

FOURTH CONFERENCE
OF
AGRICULTURAL RESEARCH STATISTICIANS
(25th to 27th June, 1979)

ABSTRACTS OF CONTRIBUTED PAPERS
&
PROCEEDINGS



INDIAN AGRICULTURAL STATISTICS RESEARCH INSTITUTE
(I. C. A. R.)
LIBRARY AVENUE, NEW DELHI-110012

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&
PROCEEDINGS

Compiled & Prepared

By

R. K. KHOSLA

R. S. KHATRI and D. S. ANEJA



INDIAN AGRICULTURAL RESEARCH INSTITUTE
(I. A. R. I.)
LIBRARY AVENUE, NEW DELHI

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P R E F A C E

The First and Second Conferences of Agricultural Research Statisticians were held in 1974 and 1976 respectively with the objective of mutually discussing the problems by them on Design and Analysis of Experiments, Sample Surveys, Use of Computer in Agriculture and Animal Sciences Research, Statistical Techniques in Plant and Animal Breeding, Teaching of Statistics in Agricultural Institutes and Universities; and Research and Training Facilities and Personal Policies in six different technical sessions. These sessions were started with the speeches delivered by the invited speaker on the above-mentioned topics.

The Third Conference was held from 24th to 26th April, 1978 and unlike the earlier two conferences, the pattern of the sessions was changed so that the participants discussed the main topic, i.e., the role of agricultural statistics research in Sixth Five Year Plan with a special reference to integrated rural development with respect to agriculture, forestry, livestock and fisheries. This was done because one of the main policy objectives in the next Five Year Plan is the Agricultural and Rural Development which would play a great role in the growth of social justice, employment in rural areas and removal of the poverty.

In the plenary session, the recommendations made in the earlier sessions, were discussed and finalised during each of those conferences for taking action thereon by the concerned Agricultural University/Institute/Department and were reviewed in the subsequent conference.

The Fourth Conference of Agricultural Research Statisticians was held at H.P.K.V.V., Palampur from 25th to 27th June, 1979. In this conference, 78 participants from various agricultural universities, I.C.A.R. institutes and other organisations were present. Besides, 13 scientists from I.A.S.R.I. and 23 officers of H.P.K.V.V., Palampur also participated in the conference. A total number of 114 Agricultural Statisticians, representing Agricultural Universities, I.C.A.R. Institutes, State and Central Departments of Agriculture/Animal Husbandry/Forestry/Fisheries, engaged in research, participated (Appendix-I).

The various sessions in the fourth conference held at Palampur (H.P.) were divided into five technical sessions besides plenary session in the forenoon of 27th June, 1979. The sessions broadly related to (i) Agriculture and Forestry, (ii) Livestock and Fisheries and (iii) Quality of Data.

The inaugural address was delivered by Shri Shiv Kumar, Minister of Education, H.P. on 25th June, 1979. The welcome address was given by Dr. H.R. Kalia, Vice-Chancellor, H.P. K.V.V., Palampur. The vote of thanks was given by Dr. D. Singh, Director, I.A.S.R.I., New Delhi.

Session-I was held in the fore-noon of 25th June, 1979 and was devoted to a discussion on action taken on the recommendations made in the last conference.

Session-II held in the after-noon of 25th June, 1979 was devoted to Agricultural Statistics in Crop Sciences and Forestry. Session-III held in the fore-noon of 26th June, 1979 was devoted to Agricultural Statistics in Animal Sciences and Fisheries. This session was divided into two sub-sessions III(A) and III(B). Sub-session-III (A) was devoted to Agricultural Statistics in Animal Sciences and sub-session-III(B) was devoted to Agricultural Statistics in Fisheries. Session-IV held in the after-noon of 26th June, 1979 was devoted to Quality of Data. The Plenary Session held in fore-noon of the last day (27th June, 1979) was devoted to the presentation of reports by the Chairman of the various sessions.

Dr. G. R. Seth, Ex-Director, I.A.S.R.I., New Delhi and Dr. P. K. Bose, Centenary Professor, University College of Science, Calcutta were special invitees at the conference.

The summary of recommendations, made during the above-said conference were prepared and distributed separately to all the Agricultural Universities ICAR Institutes, Central and State Departments of Agriculture, Animal Husbandry, Forestry, Fisheries and also to the participants for taking necessary action thereon.

I express my gratitude to the Chairman and the Rapporteurs of various technical and other sessions, the contributors of the papers and other participants who have so kindly spared their valuable time for making the conference successful. I would like to express my appreciation of the hard work put in by the officers of the Institute in particular, Shri R. N. Bakshi, CAO and Sh. R.K. Khosla, Statistician and Sh. R S. Khatri, Sh. D.S. Aneja and other members of the staff of the Institute. These Officers worked day and night to make the conference a great success. I am also grateful to Prof. H.R. Kalia, Vice-Chancellor, H.P.K.V.V., Palampur for being the host and Dr. O. P. Awasthi, Dean and Sh. B. L. Kaistha, Asstt. Prof of Statistics of the same University who took great pains in providing facilities to the participants.

DAROGA SINGH

Director

Indian Agricultural Statistics Research Institute,
Library Avenue, New Delhi-110012.

INAUGURATION

25th June (Monday), 1979

10.00 A.M.

Presided by :

Shri Shiv Kumar,
Minister of Education,
Himachal Pradesh.

Welcome Address :

Dr. H. R. Kalia,
Vice-Chancellor,
H.P.K.V.V., Palampur (H.P.).

Inaugural Address :

Shri Shiv Kumar,
Minister of Education,
Himachal Pradesh.

Vote of Thanks :

Dr. Daroga Singh,
Director,
I.A.S.R.I., New Delhi.

WELCOME ADDRESS

By

Dr. H. R. Kalia,

Vice-Chancellor, Himachal Pradesh Krishi Vishva Vidyalaya, Palampur.

The Vice-Chancellor welcomed the delegates. He gave a brief outline of the organisation, the set up and the programme of work in the Himachal Pradesh Krishi Vishva Vidyalaya. In this context, he made a special mention of two international projects, viz., (1) Indo-Newzealand Livestock Improvement Project and (2) UNDP Centre of Excellence for Temperate Horticulture. He also said that Mushroom cultivation research of Himachal Pradesh has got special appreciation of Indian Council of Agricultural Research and the Government of India. He elaborated the specialities of the State in respect of its agriculture, horticulture and animal husbandry potentials.

The Vice-Chancellor emphasised the role of agricultural statistics in planned development of the nation. He talked of the utility of computer in analysis of data and said that alleged fear of some people that computers may dwarfen human minds was baseless as computer are created by the man. He, however, hinted towards the possible danger of man's becoming too indifferent to use his brain even for ordinary mathematical computations. He further said that many persons are afraid of statistics and the reason for this was not the mathematical nature of the subject but the way statistical problems are presented by experts. He said that with proper precaution and involvement the subject can be made very interesting.

The Vice-Chancellor thanked two ministers for their presence on the occasion. He said that their presence exhibited their keen interest in the academic activities of the Institution and was a matter of inspiration to the staff of the University and delegates of the Workshop.

He further expressed that the Himachal Pradesh Krishi Vishva Vidyalaya was still in its infancy and hence inconvenience, if any, to the delegates of the workshop would be excused. He thanked the local organiser for good arrangement and Dr. Doroga Singh, Director, Indian Agricultural Statistics Research Institute, for selecting Palampur as the venue of the 4th Conference.

INAUGURAL ADDRESS

By

Sh. Shiv Kumar,

Minister of Education, Himachal Pradesh at the Inauguration of the Fourth Conference of the Agricultural Research Statisticians at H.P.K.V.V., Palampur on 25th June, 1979.

Dr. Kalia, Dr. Daroga Singh, distinguished Agricultural Research Statisticians, Ladies and Gentlemen :

It gives me a great pleasure to be in your midst today to inaugurate the Fourth Annual Conference of Agricultural Research Statisticians. I am not a Statistician but I do believe that statistics provide an important tool in the process of policy making and formulation and execution of development plans. The theme of this Conference is the role of agricultural statistics in the planning of agricultural schemes which is an important ingredient of the overall strategy for rural development. Agriculture plays the most dominant role in the nation's economy providing food, raw materials for various industries and employment to a very large percentage of population both directly and indirectly. The main aim of agriculture in rural development as adopted in our plan is growth with social justice to ensure the welfare of the vast multitude of population living in rural areas. Realisation of self sufficiency in food grains, pulses and oil seeds even in a bad agricultural year, creation of export surpluses, diversification of agriculture, achievement of full employment and removal of poverty within a specific period are among the main objectives of our plan for agricultural and rural development. It hardly requires to be emphasised that for their development programmes, adequate and reliable statistical data base is absolutely essential.

Great strides have been made in the collection of agricultural statistics in the recent past and contributions of the Statistical Institute in that direction are unammendable. However, as the development programmes progress fresh data are required for assessment, evaluation and formulation of programmes and policies as also for tiding over operational difficulties. There is also a continuing need for improving the range, quality and content of the data. Time

losses in the availability of data assumes added importance. The following are the suggestions for the improvement of current status of agricultural statistics.

The coverage of land utilisation and crop statistics should be extended to the entire geographical area of the country. Refresher training should be imparted to the Patwaris and Kanoongos in the methods of collection of agricultural statistics at periodic intervals.

Standard forms should be adopted by different states to ensure collection of land use and crop area statistics according to standard classification and uniform concepts and definitions. Presently the land use data give the distribution of land according to its actual use and not its potential use, while data on potential use are more essential for planning. It is suggested that the periodic survey of potential land utilisation in different areas be undertaken. The sampling design for crop cutting surveys should be reviewed with a view to introducing stratification according to irrigated and rainfed areas and according to high yielding and local varieties of crops. Qualitative reports on crop and weather conditions on the basis of reports from primary unit should be prepared which could be later developed in to advance estimates of crop production.

Situation and outlook reports covering area, production, prices, market intervals, internal and external trade, stock etc. should be prepared and issued in respect of principal crops.

Adequate arrangements should be made for collection of statistics of area under important fruit and vegetables and the data collection techniques for estimating cost of cultivation and also the causes and extent of losses before reaching markets needs to be standardised. Source-wise classification of irrigated area should be amplified to give separate figures for major medium and minor sources and from surface and ground water sources.

Suitable procedure should be devised to frame estimates of unrecorded production through sample surveys or otherwise at least, once in five years. The possibility of collecting data on timber and fuelwood and other forest products as also on animals and fisheries through the periodical agricultural census should be examined. Data on consumption of fertilizers by crops and by size classes of holdings, etc. should be collected through the comprehensive scheme for cost of cultivation of crops or through special surveys.

Data on quantities of pesticides produced, distributed and applied to different crops should be collected systematically. The new series of index numbers of harvest (producers) prices as recommended by the Technical Committee on index numbers should be estimated as early as possible. For rationalization of agro-economic research priority areas of research have broadly been spelt out. Institution having field level staff like the agro-economic research centres, etc. can be entrusted with the type of studies which need collection of information from micro level units.

Studies based on secondary data could preferably be arranged at post-graduate centres of research.

These are, in brief, my views on some of the areas which might engage the attention of agricultural statistician from different institutions. The new tasks are no doubt challenging in their nature to some extent, but I am sure their fulfilment would impart greater reliability and accuracy to the planning at micro and macro levels.

The statistician can no longer afford to remain content with compiling description statistics but has to work in close association with experts in other disciplines. He has to evolve new methodologies that would suit the changing requirements.

With these words, I am happy to inaugurate this Fourth Annual Conference of Agricultural Research Statisticians and wish the deliberations a great success.

VOTE OF THANKS

By

Dr. Daroga Singh,

Director, Indian Agricultural Statistics Research Institute,
New Delhi.

Let me take this opportunity of thanking the organisers of this conference at this beautiful campus. In fact this place of Palampur is attracting a large number of statisticians, not only to participate in the conference but also to see its beautiful site. It was a great relief for many of us the moment we got into this beautiful place at Palampur. Although this is somewhat small town but it is certainly an attractive place. It has got its own grandeur. We are happy with the response and hospitality of the local people in the newly established University. I know the difficulty of the host especially when this University was established only a year ago and is still developing the infra-structure to host the conference of this type. However, inspite of all limitations I must say the local organisers have done their best and I found that every delegate was happy with the arrangements. Therefore, I very heartily thank the organisers for what they have done in organising this conference.

As a matter of introduction, as mentioned by the chief guest as well as by Dr. Kalia that this is the Fourth Agricultural Research Statisticians Conference. The Indian Council Agricultural Research had set up an Audit and Achievement Committee for the Indian Agricultural Statistics Research Institute about 5 years ago. That committee recommended that there should be an interaction between the Research Statisticians and the Statisticians working in Central and State Departments of Agriculture, Animal Husbandry, Forestry and Fisheries, Agricultural Universities and Agricultural Research Institutes, etc. As a consequence of that recommendation we have been trying out best to hold this conference every year where agricultural research statisticians could meet together and exchange their views discuss their problems and try to implement the recommendations as far as possible.

Sir, every statistician has to play a great role in the present contest of rural planning. Actually, the planning had to so oriented that there is always immediate mobilising of national resources and developing the measures to exploit the resources for the benefit of the society. To assess the agriculture resources, the statisticians have to play a great role. Their expertise can be used to optimise the plan for the use of land, water and human labour. In spite of all efforts, although we have developed a very sound statistical system, but still land use planning in this country is not as good as it should be. Particularly due to the limiting sources of land, every piece of land should be used to get maximum output and return.

I had a chance for a few minutes ago to talk with the Health Minister of H.P. He had mentioned about the development of forestry to meet the requirements of the State Government and those of people. The forest products are used in many ways. Forests are also important in conservation of water and soil. What is the total area and how can it be used, are the problems of great significance and worth investigating. When I talk of suitability I always mean a comparative study of area, use of available water and all that concerning the land. An optimum planning of use of land can be made by critically examining the land and water resources data. Topography and climate of H.P. is such that it can be considered most suitable for horticulture development. With proper production and marketing planning, H.P. can produce temperate fruits to meet the need of the entire country. But it is not done because of several reasons. One of the reasons is limited knowledge. The other major reasons may be economic and marketing constraints. An average farmer cultivates what he needs-rice, wheat pulses. He is not guided by the suitability of the land and its economics. The Statisticians/Economists have to find out the solutions of such problems faced by the farmers.

Since the Health Minister is also in-charge of the programmes to improve the health of the people, he would be interested in knowing food production and other related items. He might be interested to know, how the nutritional standard of the people can be raised. The Statisticians can assist the Health Minister in Measuring the nutritional standard at any time. It is believed that the national income has gone up and the standard of living may also have gone up but not necessarily the nutritional standard. In a country like ours where more than 50 per cent of population is below the poverty line and undernourished, we have to think about raising of their nutritional standard. Sir, for your information, we have statistics departments in almost all the States so there

could be complete co-ordination between Statisticians and nutritional experts. In case of State agricultural departments, there is a good statistical system but I am not sure whether any such system exists in the health departments also.

Now one more point, I would like to say before ending my observation, i.e., utilisation of statistics in coming years. No doubt, the use of statistics by planners, administrators, etc. has recently increased. I feel that they must use statistics more than what they have been doing. The Statistician's role is of course, to produce right type of statistics of quality in time. We would be discussing regarding quality of data in a separate session.

Dr. Kalia did mention that the computer might completely replace man. The computer is a powerful tool. It can be used by the society to its great advantages. Many calculations which were physically not possible can be easily done now. Storage of information in the memory of the computer has increased the capacity of the man to do much complicated research. Reaching of man to the moon is an example.

We spend a lot of resources in collection of data but only a part of the data is actually used for analysis. The rest remains in the file. After every 10 years, population census are conducted by the Registrar General of India but hardly any research organisation took advantage of the data collected in these censuses. Similarly we conduct census in agriculture, reports are prepared, and even Himachal Pradesh has brought out a very good report on agriculture census. It contains lot of data for planning. But I do not think it has been used at all. Similarly very important data are being collected in many research organisations like Agricultural Universities by their Scientists. The Statisticians have to play a great role by making use of that data and helping the planners for the development of rural areas.

It is indeed very fortunate that the distinguished Ministers are present amongst us. It will be beartening for us that some of the findings which will be discussed here and recommendations made will be passed on to the States so that they may be able to see that action is taken on those recommendations and I hops they will help us in carrying out our programmes in the fields. With these observations, I thank the State Ministers, Prof. Kalia, my colleagues and friends and all the delegates at the Conference from various parts of the country.

TECHNICAL SESSION—I**Action Taken on the Recommendations Made in Last Conference****25th June (Monday), 1979**

12.15 P.M.

Chairman :

**Dr. Daroga Singh,
Director,
I.A.S.R.I, New Delhi.**

Rapporteur :

Shri R.K. Khosla

Action taken on the recommendations made during the last Conference as per statement enclosed (Appendix-II) were discussed in detail and on the basis of the discussions held during the Session, further recommendations were made as follows :-

1. With the increased emphasis on newly emerging cropping systems like multiple cropping, multi-level cropping, etc., research for developing appropriate designs for indentifying judicious combinations of crops and their management is necessary.

(Action : IASRI/Other I.C.A.R. Institutes/ Agril. Universities)

The recommendations made in such conferences should continue for review till the action is completed, mentioning the conference (s) in which those were recommended.

2. The need for more uniformity trials on different field and horticultural crops was felt. The role of soil parameters in interpreting data from such trials also needs study. It was recommended that suitable trials for this purpose may be organised for various crops.

(Action : IASRI and Project Coordinators of ICAR Crop Projects)

Since there are post-graduate programmes in several Agricultural Universities, a student or staff can be entrusted such type of research work.

3. It was observed that the losses at the pre-harvest stage were mainly due to pests and diseases. Work of estimation of such losses has been done only on paddy, wheat and maize. There is need to extend this work to other crops also.

(Action : IASRI)

Statistical methodology for estimation of losses due to floods/draught/hail storm, etc., should also be developed.

4. Regarding losses at harvest stage it was pointed out that relatively the losses due to employment of manual labour were much less as compared with the losses incurred with the use of mechanised harvesters. This observation needs to be further probed.

(Action : IASRI, NSSO, and Dte. of E & S etc.)

Agricultural Universities and other research Institutes should also undertake this type of work.

5. Regarding losses in storage, it was pointed out that the work has been initiated to quantify the extent of losses. It was observed that the precise estimates of the losses are not available and they are sometimes placed in the range of 5 to 50%. It was felt necessary that studies should be undertaken to determine the extent of loss objectively at the various stages of disposal through which the harvested produce passes. This should include crop losses due to hail storm, excess of rain, and failure of rain. Such studies would help in reducing such losses in future.

(Action : IASRI)

Study regarding losses of foodgrains in various types of storage systems should be given high priority because of its importance.

6. Studies on forecasting of crops are being carried out by the IASRI on a few selected crops in few selected centres. It was pointed out that some biometric characters account for nearly 60% of the variation in crop yield. It was felt that such studies and also others for determination of crop weather relationship should be taken up in a number of homogenous agro-climatic zones. In addition it was mentioned that an integrated approach should be adopted whereby, the biometric observations, weather parameters and also the effects of pests and diseases could be simultaneously studied. For this, various disciplines and Institutes, should collaborate.

(Action : IASRI and other ICAR institutes and I.M.D.)

A manual should be prepared by the IASRI for circulation for providing guidance for similar studies.

7. It was felt that the studies on determination of the various constraints in the transmission of technology should be undertaken in diverse conditions including the tribal areas and also the small farmers. This may help to provide suggestions for remedial measures to be taken in future. Such studies should be undertaken in collaboration with the extension agencies.

(Action : IASRI/Extension Division, IARI and Extension Deptts. of Agril. Universities)

Agril. Uni., Concerned Deptts. of other Universities and other research institutes should also take up this work, at least, at micro level if not at macro level.

8. The cultivation practices relating to perennial crops in Assam namely arecanut and coconut on the one hand and pineapple, orange and banana on the other were rather typical in so far as area under these crops was substantial but scattered over large tracts both in the hills and in valleys. No reliable statistics on the extent of cultivation or the yield of fruits was available in the state. It was recommended that pilot surveys to develop suitable sampling methodology for estimation of extent of cultivation and production of fruits under such conditions may be taken up.

(Action : IASRI and Deptt. of Agriculture, Assam.)

Not only, the IASRI but other research institutes and agricultural universities should also formulate the schemes and submit to ICAR panel for Economics and Statistics. Assam Agricultural University should formulate a scheme and submit to Economics and Statistics Panel of ICAR keeping in view the regional problems.

(Action : ICAR Institutes, Assam Agril. University, Assam and other Agril. Universities).

9. The performance of half bred animals under field conditions in some areas are found to be much lower than the corresponding animals under well managed farm conditions. Such differences in the performance could be referred to as resources-cum-extension-cum-managementgap in regard to the cross breeding programme. A constraints analysis may be made in such areas to isolate the management and other factors which are coming in the way of realising the genetic potential of cross-bred animals under the field conditions.

(Action : Deptt. of A.H., Panjab).

Since this is a research scheme, it may be carried out at some research farms.

(Action ; Research Institutes & Agricultural Universities)

10. Bench-mark surveys under the guidance of IASRI, should be carried out in areas where special livestock development programme involving small and marginal farmers have been initiated recently or proposed to be initiated so that objective assessment of such development measures may be possible

(Action : A.H. Division of Ministry of Agri. & Irrigation, Govt. of India and State Department of A.H.)

All state Government should create adequate facilities and allot some funds for undertaking such studies for the part of projects.

(Action : State Depts : of A.H.)

11. To assess the potential of inland fisheries, it is necessary to have reliable data for area under water. For this purpose, it was recommended that a census of fisheries may be conducted at two points of time, viz., monsoon and lean seasons.

(Action : Fisheries Division of Min. of Agri. and Irrigation)

In the absence of a representative from Fisheries Department, this matter may be taken up with the Fisheries Department.

(Action : Fisheries Division of Min. of Agri. and Irrigation.)

12. A workshop on "Fisheries Statistics" may be convened to discuss problems which are of interest in both marine and inland fisheries.

(Action : IASRI)

Directorate of Economics & Statistics/Fishery Division of Department of Agriculture should arrange for a Workshop/Symposium exclusively for "Fisheries Statistics".

(Action : Dte of E & S/ Fishery Division of Min. of Agri. and Irrigation)

13. The ICAR may be approached to appoint a Committee to look into the need and requirement of statistical staff in different agricultural universities. The members of the Committee may go round those Universities and give recommendations regarding the creation/strengthening of the departments of Statistics as per their needs.

(Action : ICAR)

The ICAR should vigorously pursue the matter in implementing the recommendation.

(Action : IASRI)

TECHNICAL SECTION—II

Agricultural Statistics in Crop Sciences and Forestry

25th June (Monday), 1979.

02.30 P.M.

- Chairman : Dr. G. R. Seth,
Ex-Director,
I.A.S.R.I., New Delhi.
- Rapporteur : Shri K. S. Krishnan, I.A.S.R.I.
- Invited Speakers :
- i) Sh. K. S. Krishnan, I.A.S.R.I.
 - ii) Sh. S. K. Raheja, I.A.S.R.I.
 - iii) Dr. Daroga Singh/ Sh. R. K. Khosla, I.A.S.R.I.
- Others :
- iv) Sh. G. Narasimhayya/Dr. G.V.S.R. Krishna, Dte. of Oil seeds, Hyderabad.
 - v) Sh. G. Krishna Kant/Dr. G. N. Rao, A. P. A. U., Hyderabad.
 - vi) Sh. P. R. Waghmare/Sh. B. L. Bawle, M.A.U., Maharashtra.
 - vii) Sh. K. R. Satyamurthi, F.R.I., Dehradun.
 - viii) Sh. S. D. Bokil/Sh. H. Singh, I.A.S.R.I.

2.1 Scope and Steps Needed for Improving the Efficiency of Crop Experiments

By

Shri K. S. Krishnan, I.A.S.R.I, New Delhi

At the time the country achieved independence, field experiments on crops were being carried out mostly by the research stations under the control of State Departments of Agriculture. A small percentage of the total number of such experiments were conducted at the Central Institutes. The number of experiment carried out per annum on all crops put together was of the order of 1500. During the past three decades, a number of Agricultural Universities have been established. A number of research institutes have also been functioning under the I.C.A.R. The research activities in most of the states have been transferred from the State Departments of Agriculture to the newly created Agricultural Universities. There has also been a phenomenal step-up in the number of crop experiments as well as an increase in the complexity of such experiments. The magnitude of experimentation at research stations in the country is of the order of 4000 per annum. Besides these, around 8000 simple experiments on crop responses to fertilizer application and related items are also being conducted annually on various field crops, the need for following appropriate statistical principles in the designing of field experiments and in the analysis of data collected has been well recognised by the agricultural scientific community in India. The availability of manpower resources relating to statistics has also been substantially increased. In most of the Agricultural Universities and research institutes, qualified statisticians are available for assistance to the experimental scientist.

Notwithstanding the above facts, effective contributions by statisticians in improving the efficiency of field experiments are far from satisfactory. The following are the broad reasons :-

- (i) Reluctance of the experimental scientist to ensure statistical requirements relating to number of replications plot size, etc.
- (ii) Inadequate acquaintance of statisticians to the practical problems faced by an experimental scientist.

- (iii) Resource limitations particularly land.
- (iv) Vagaries of weather, attack of pests and diseases, etc.
- (v) High coefficient of variation.

More active collaboration is needed between the experimental scientist and the statistical personnel located in the universities and the research stations in order to bring about optimum utilisation of land and other resources.

Intensive utilisation of ancillary information including soil parameters at the time of analysis may help to achieve high precision.

A large number of uniformity trials on various crops will provide location specific recommendations in addition to broad overall inferences.

Statistical research in the design of experiments should also be oriented towards specific problems faced by the field experimentalists in the country.

2.2 Investigations in Sampling Methodology for Surveys in Agriculture.

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1. The need of conducting sample surveys for obtaining objective and reliable data on scientific lines for planning, policy formulation, research etc. is well recognized. Apart from cost considerations, sample surveys require much less time compared to complete enumeration and generally provide more reliable information than the latter. Further, the results from sample surveys are much more comprehensive and also provide means to judge the reliability of the estimates for practical use.

1.1 In the field of agriculture, which constitutes the main component of Indian economy and contributes the maximum to its Gross National Product, sample surveys serve as a very useful and handy tool for obtaining estimates of area, production, average yield, resource availability etc. in respect of different agricultural commodities like field crops, forestry, horticulture, fishery, animal products etc. The Indian Agricultural Statistics Research Institute has done pioneering work in the development of sample survey methodology appropriate for collecting agricultural statistics in different fields during the past 50 years.

1.2 The salient features and results of the survey on some of the important aspects like estimation of area and yield of field crops, extent of cultivation of fruits and vegetables, numbers of livestock, livestock product and study of their attendant practices, cost of production studies etc. have been provided in a comprehensive paper presented at the last Conference of Agricultural Research Statisticians held in 1978. In this paper, the progress of projects not reported earlier as well as salient results obtained under the different projects are described.

2. Sampling Investigations into High Yielding Varieties Programme.

2.1. Sample surveys for assessment and evaluation of the high yielding varieties programme were carried out by the Indian Agricultural Statistics Research Institute during the Fourth Five Year Plan in 88 selected districts covering 15 States of the country. The main objectives of the survey were to determine (i) the yield rates of high yielding varieties of five major cereals viz; rice, maize, jowar, bajra and wheat and comparable estimates of local varieties (ii) the area brought under high yielding varieties and (iii) the extent and inten-

sity of adoption of improved agricultural practices recommended for high yielding varieties under cultivators' conditions. The sampling plan adopted was stratified multi-stage with community development blocks or groups thereof as the strata. Villages, cultivators, fields and plots of specified shape and size constituted the sampling units at different stages.

2.2 These surveys provided valuable data on the yield rates, spread etc. of high yielding varieties which helped in policy formulation and planning future programmes on scientific lines. However, with new varieties of important cereals and cash crops being developed and introduced rapidly in different regions of the country an acute need was felt for undertaking methodological investigations to enable objective evaluation of the impact of high yielding varieties programme in terms of changes in area, productivity etc. from year to year as also to identify and isolate limiting factors. With these objectives sample surveys for methodological investigations into high yielding varieties programme were initiated from 1974-75 in 38 districts spread over 15 States of the country. The sampling plan adopted was the same as during the Fourth Five Year Plan. However, to study the changes in area, productivity and adoption of agricultural practices under field conditions, a part of the sample selected each year was retained for the next year also for estimating the change in area, productivity etc. as well as for building up the current estimate, with increased precision. The crops covered were the five major cereals cited above and two important cash crops namely groundnut and cotton.

2.3. The salient findings of the assessment surveys undertaken during the Fourth Five Year Plan project and those of the first two years of the project on methodological investigations into HYVP undertaken in the Fifth Five Year Plan project were presented at the Third Conference of Agricultural Research Statisticians held at this Institute during April, 1978. In this paper, the average yield performance of high yielding varieties of the crops covered during the period 1974-75 to 1977-78 is discussed. The results are presented in tables 1 to 3 and are briefly discussed below.

2.4 KHARIF

2.4.1 Rice

Yield estimation surveys on kharif rice were conducted in 12 out of the 15 States covered under the project, the exceptions being Gujarat, Maharashtra and Rajasthan. In all 24 districts were covered in these 12 States. The average yield of high yielding varieties of rice varied considerably from year to year, State to State as also between districts within a State. Yield rates of 20Q/ha or more were obtained in about 67 per cent of the districts in 1974-75.

This proportion declined to 60 per cent in 1975-76 and to 50 per cent in 1976-77. However, in 1977-78 it improved to 56 per cent. This fact is also borne out from a study of the distribution of districts recording increase/decrease in the average yield of HYV rice in a year over the previous year. In 1975-76, about 36 per cent of the districts recorded a fall in the average yield of HYV rice over that of 1974-75. This figure shot up to 80 in 1976-77. However, in 1977-78 this figure registered a substantial improvement, the proportion of such districts being about 23 per cent only. The increase in the average yield of HYV rice during 1975-76 compared to 1974-75 was between 5 and 50 per cent in 50 per cent of the districts. Compared to this an increase of similar order was observed in only 16 per cent of the districts in 1976-77 while in 1977-78 the proportion of such districts registered a phenomenal increase to 63 per cent.

The average yield of HYV rice was one and a half times or more compared to that of local varieties in about 46-53 percent of the districts in the different years.

2.4.2 Maize

Yield estimation on surveys on maize were conducted in 5 States. In all 8 districts were covered in these States. The average yield varied widely from year to year, State to State as well as between districts within a State. Yield rates of 15Q/ha or more were obtained in nearly 67 per cent of the districts in 1974-75, 63 percent in each 1975-76 and 1977-78 and 83 percent in 1976-77. The average yield of HYV maize was higher than the average yield of local varieties by about 50 percent or more in about 33 per cent of the districts in the first two years, 25 per cent of the districts in 1976-77 while in 1977-78 this figure registered a substantial increase to around 50 percent.

2.4.3 Jowar

Yield estimation surveys on jowar were conducted in the four districts of Dharwar, Shimoga (Karnataka), Mandsaur (Madhya Pradesh) and Akola (Maharashtra). The average yield did not show any specific trend over the four year in any of the four districts. It was the highest in Shimoga during 1974-75 and 1975-76 being around 21 and 17Q/ha as against 13 Q/ha in the other three districts in each year. However, in 1976-77 the average yield of HYV jowar registered a substantial fall in all the districts except Akola where it was higher than that obtained in the previous two years. In 1977-78, the average yield improved substantially in Dharwar and Shimoga. The average yield of HYV jowar was higher than the average yield of local varieties by 50 per cent or more in all the districts almost every year.

2.4.4 Bajra

Yield estimation surveys on HYV bajra were conducted in 6 States covering 9 districts. The average yield of HYV bajra varied very considerably from 1.2 Q/ha to 25.2 Q/ha in the different districts over the four years. Yield rates of 10 Q/ha or more were obtained in about 25 per cent of the districts in 1974-75 and 1975-76 and in about 45 per cent of the districts in the later two years. The average yield of HYV bajra was higher by 50 per cent or more than the average yield of local varieties in about 25 per cent of the districts in both 1974-75 & 1975-76. This figure went up to 67 per cent in the next year. However, during 1977-78 the proportion of such districts registered a fall being around 50 per cent.

2.4.5 Groundnut

Yield estimation surveys on HYV groundnut were conducted in 7 States covering 11 districts. The average yield of HYV groundnut varied from about 5 Q/ha to 13 Q/ha in the different districts over the different years except 1976-77. During 1976-77, compared to the previous two years, there was a fall in the average yield of HYV groundnut in almost all the districts and its range narrowed down to 2-9 Q/ha. Yield rates of 10 Q/ha or more were obtained in nearly 60 per cent of the districts in the first two years. In the next year none of the districts reported such yield rates. However, in 1977-78 the proportion of such districts was around 40 per cent. The average yield of HYV groundnut was higher than the average yield of local varieties by 25 per cent or more in 75 per cent of the districts during 1974-75. This figure showed a consistent fall during the next three years being around 60, 28 and 20 in the respective years.

2.4.6 Cotton

Yield estimation surveys on cotton were conducted in 7 States covering 9 districts. The average yield of HYV cotton (lint) varied between 0.3 and 7.7 Q/ha in the different districts over the four years. High yield rates of 5 Q/ha or more were obtained in 50 per cent of the districts in 1974-75. This figure declined in the next three years being around 12 per cent in 1975-76 and 1977-78 and 25 per cent in 1976-77. The average yield of HYV cotton was higher than the average yield of local varieties by 50 per cent or more in all the districts in 1974-75. The proportion of such districts declined to 86 per cent in 1975-76 and to 72 per cent in each of the two later years.

2.5 RABI

2.5.1 Wheat

Yield estimation surveys on wheat were conducted in 11 out of the 15 States covered under the project, the exceptions being Andhra Pradesh, Tamil

Nadu, Kerala and Orissa. In all 24 districts were covered in these 11 States. The average yield of HYV wheat varied considerably from year to year, State to State as well as between districts within a State. Yield rates of 25 Q/ha or more were obtained in about 35% of the districts during the first two years and in 38 and 42 per cent of the districts in the next two years respectively. In 1975-76 about 28 per cent of the districts recorded a fall in the average yield of HYV wheat over that of 1974-75. There was a spurt in the proportion of such districts during 1976-77 being around 64 per cent. However, in 1977-78 this figure was almost of the same order as during 1975-76. It may, however, be mentioned that the magnitude of the fall in the average yield of HYV wheat in different years over the preceding year was generally 25 per cent or less.

The average yield of HYV wheat was higher than of the local varieties by 75 per cent or more in 25 per cent of the districts during 1974-75. This figure came down to 18 per cent in 1975-76 and to around 15 per cent in the next two years.

2.5.2 Rice

Yield estimation surveys on rabi rice were conducted in 6 States. In all 12 districts (13 crop districts) were covered in these States. The variation in the yield rates of HYV rice in the different districts over the years was of a much lower order compared to that observed in the Kharif season. Almost all the districts recorded yield rates of 15 Q/ha or more in each of the four years. High yield rates of 25 Q/ha or more were registered in about 40 per cent of the districts during 1974-75. This figure increased to about 58 per cent in the next two years while in 1977-78 this proportion registered a slight fall being around 50 per cent. In 1975-76 and 1976-77 about 40 per cent of the districts recorded a fall in the average yield of HYV rice over that of the previous year, while in 1977-78 the corresponding figure was 33 per cent.

The average yield of HYV rice was one and a half times or more in 22-29 per cent of the districts during the first three years and in 42 per cent of the districts in 1977-78.

3. Surveys on Fruits and Vegetables

3.1 With the objective of estimating the extent of cultivation and production of fresh fruit crops, the Institute has conducted a series of pilot sample surveys during 1958 to 1973. These surveys were conducted in three phases. In the first phase surveys, single fruit crop was covered in a district. In the second phase surveys, several fruit crops were taken and the coverage was increased from a district to a wide compact region. In the third phase surveys, all the important fruit crops in a State were covered (The details of these surveys

have already been reported at the Third Conference of Agricultural Research Statisticians held in April, 1978). On the basis of these surveys, a suitable sampling methodology has been finalized for estimating the extent of cultivation and production of fresh fruit crops.

3.2 For the estimation of area and production of vegetables three pilot sample surveys were conducted by the Institute in Delhi (1964-67), Poona and Nasik (1966-69) and Bangalore (1971-74) (The results of these surveys have also been reported earlier). For the estimation of losses taking place in the marketing of vegetables and to study their price spread, a survey was conducted in Delhi during 1976-77. The results indicate that keeping in view that growers have to incur entire expenditure on cost of production of vegetables, their share in the consumer's rupee spent is very meagre. The grower's share for different vegetables lies between 30 to 40 paise per rupee which is of the same order as that of retailer's share the losses which are mainly at retailer's level are very small (less than 2%).

3.3 In order to study as to how far the vegetable cultivation is remunerative to the cultivators cost of cultivation studies have been taken up in Delhi and Ahmedabad since 1978. The field work of these surveys is in progress.

4. Surveys on Cost of Cultivation of Perennial Crops

With the objective of developing statistical methodology for cost of cultivation of perennial crops, a pilot survey was undertaken on apple in the Himalayan region of U.P. The data collected from this survey have since been processed and the results provided useful guidance for conduct of similar surveys in future. The main points of methodological nature emerging from the survey are presented below briefly.

4.1 Cost of Raising the Orchard

It was observed that apple cultivation was spreading to new areas and is no longer confined to the traditional areas possibly on account of new and improved varieties being developed. Since the orchards in these areas may not yet be of bearing age, it would be essential to allocate the sample after suitably forming the strata to ensure adequate and appropriate representation of different types of orchards. Since the number of young trees would be large in these orchards the cost of raising of such orchards may be comparatively higher and would thus receive a greater weightage.

To secure information on distribution of young (non-bearing) and bearing trees in different areas it is advisable that a survey for estimating extent of cultivation, production and disposal of the crop precedes a cost of cultivation survey in any region to provide information required for efficient allocation of the sample.

4.2 Cost per hectares per Tree and per Kg.

An examination of the costs for different orchards indicates that operational costs are more closely correlated with number of trees than with area of orchards. However, to evaluate the contribution of land input to the cost of cultivation the area of the orchard has necessarily to be taken into account. The cost of cultivation should therefore be worked out both on per hectare and per tree basis for non-bearing orchards. From the sample of bearing orchards cost per kilogram of the produce should also be worked out.

4.3 Precision of Estimates

With a sample of 17 clusters (p.s.u's) and about 100 orchards the operational cost per 100 trees was estimated with a sampling error of 10.1 per cent in the first year and 15.9 per cent in the second year. Yield per tree was also estimated with precision of the same order in the two years. The precision is rather low and efforts to increase the precision without substantial increase in sample size will have to be made. One possible approach for achieving this objective is to link the cost of production survey with general survey for estimating production of crop. Such surveys being based on much larger samples would provide estimates of yield with much greater precision. The use of these estimates for calculating the cost for per kilogram would improve the precision of these estimates.

Surveys for Estimation of Livestock Products

5.1 During the second and third five year plan periods, the Institute carried out a number of pilot sample surveys for developing a suitable sampling methodology for estimation of annual output of principal livestock products, viz. milk, eggs, wool and meat. These techniques are now being adopted by all the States under a centrally co-ordinated scheme. One of the limitations of the techniques developed was that the changes in the annual output of these products during the plan period could not be estimated unless sample surveys were repeated every year on each of the products which is costly. Therefore, a need was felt to develop an integrated sampling technique for simultaneous

estimation of these products through one single survey conducted each year. With this object in view, two pilot sample surveys one in Northern Region during 1969-72 and the other in Andhra Pradesh in Southern region during 1971-74 were carried out. The design adopted was one of stratified multi-stage random sampling where a fraction of the primary sampling units in the sample was matched overall the 9 seasons in three consecutive years. These surveys demonstrated the feasibility of collecting data and estimating simultaneously the production of all the four principal livestock products through a single survey. The reports on estimation of the individual products along with the estimation procedures and the results on animal husbandry practices have already been published. The estimates of the number of animals/birds and production of milk, eggs, wool and meat were obtained with a fairly high degree of precision in both the regions. The sample size required for obtaining estimates of various livestock products with given precision are being worked out. Subsequently the scope of the pilot sample surveys on livestock products was extended to the (i) estimation of production of hides and skins and (ii) estimation of number of pigs slaughtered in rural areas and to study the attendant swine practices and socio-economic conditions of farmers rearing pigs.

5.2 In order to evolve a suitable sample technique for estimation of production of hides and skins, a pilot sample survey was conducted in the districts of Amritsar, Jullundur, Ludhiana and Ferozepur of Punjab State during 1974-76. The sampling design adopted was one of stratified two stage random sampling. The estimates of number of hides and skins were obtained with a high degree of precision. However, before finalizing the appropriate sampling technique, it is proposed to carry out similar investigations in a few more important districts in different animal husbandry regions of the country during the sixth plan period.

5.3 For evolving a suitable sampling technique for estimation of number of pigs slaughtered, a pilot sample survey was carried out in the districts of Ali-garh and Allahabad of Uttar Pradesh. The analysis of the data is in progress. In the light of the experience gained in this survey, it is proposed to modify the sampling technique and test its efficacy by conducting similar sampling enquiries in one district in each of the States of Assam, Bihar and Karnataka during the sixth plan period.

5.4 Since it is more convenient to obtain data on milk production by enquiry than that by actual weighing, a pilot sample survey to study the relative

merits of the two approaches has been initiated recently in the districts of Barabanki (U.P.) and Rohtak (Haryana). The object of the survey is to examine the possibility of replacing the method of weighment by that of enquiry either partly or wholly without affecting the reliability of the data and precision of the estimate of production.

5.5 The sampling techniques available for estimation of live-stock products are suitable for collecting data with the help of wholetime staff, but the most important requirement of any statistical methodology to be used on regular basis is that it should be possible to collect the basic data utilising the existing field agency of the department concerned. In order to modify the existing sampling technique to meet this requirement pilot sample surveys are proposed to be undertaken in a few selected districts during the Sixth Plan for estimation of livestock products on the basis of the data collected as a part of the normal duties of the field agency of animal husbandry departments of different States.

6. The salient results of some of the projects undertaken by the Institute during the 5th Five Year Plan period have been discussed above. Keeping in view the needs of information and data on a number of other important aspects and to provide a sound statistical base for planning of agricultural development programmes, a number of research projects have been formulated and are proposed to be undertaken during the 6th Five Year Plan period. Some of the new projects are mentioned below :

1. Sample surveys for the study of constraints in the transfer of technology for increased agricultural production.
2. Pilot sample survey for developing sampling methodology for estimating the area and yield rates of high yielding varieties of potatoes and extent of adoption of improved practices.
3. Pilot sample survey for estimation of post-harvest food-grains losses.
4. Pilot sample survey for study of cost of cultivation of pulses.
5. Pilot sample survey for the estimation of cost of cultivation of oilseed crops.
6. Pilot sample survey for study of feasibility and comparative economics of grape cultivation in Punjab, Haryana and Rajasthan.

These and other research projects will be taken up in collaboration with other I.C.A.R. Institutes, Agricultural Universities or State Departments.

Table 1 : Percentage distribution of districts according to yield rate of high yielding varieties.

Season	Crop	Class interval (Q/ha)	1974-75	1975-76	1976-77	1977-78
1	2	3	4	5	6	7
Kharif	Rice	Less than 5	—	—	4	—
		5-10	7	—	—	—
		10-15	13	12	12	18
		15-20	13	28	34	26
		20-25	33	20	23	4
		25-30	34	16	23	37
		30-35	—	24	4	15
		Number of districts	15	25	26	27
	Maize	5-10	—	12	—	12
		10-15	33	25	12	25
15-20		34	38	75	25	
20-25		33	25	13	38	
		Number of districts	3	8	8	8
Jowar	5-10	—	—	75	25	
	10-15	75	75	—	25	
	15-20	—	25	25	25	
	20-25	25	—	—	—	
		Number of districts	4	4	4	4
Bajra	Less than 5	25	45	11	22	
	5-10	50	33	45	33	
	10-15	25	—	22	34	
	15-20	—	11	22	11	
	20-25	—	—	—	—	
	25 & above	—	11	—	—	
		Number of districts	4	9	9	9

1	2	3	4	5	6	7
	Ground-nut	less than 2.5	—	—	10	—
		2.5-5.0	20	—	20	20
		5.0-7.5	—	40	40	20
		7.5-10.0	20	—	30	20
		10.0-12.5	40	50	—	30
		12.5-15.0	20	10	—	10
		Number of districts	5	10	10	10
	Cotton	less than 1	—	—	12	—
		1-2	—	12	—	12
		2-3	50	50	50	38
		3-4	—	13	13	38
		4-5	—	12	—	12
		5 and above	50	13	25	—
		Number of districts	4	8	8	8
Rabi	Wheat	less than 5	—	—	—	—
		5-10	4	—	—	4
		10-15	—	—	12	12
		15-20	43	15	15	17
		20-25	19	50	35	25
		25-30	23	31	31	38
		30-31	7	—	7	4
		35 and above	4	4	—	—
		Number of districts	26	26	26	24
	Rice	less than 5	—	—	—	—
		5-10	—	—	—	—
		10-15	—	—	8	—
		15-20	30	17	8	30
		20-25	30	25	25	20
		25-30	20	33	33	30
		30-35	20	17	17	20
		35 and above	—	8	9	—
		Number of districts	10	12	12	10

Table 2 : Percentage distribution of districts showing increase (+)/decrease (—) in average yield of HYV over the previous year.

Season	Crop	Class interval (%)	In 1975-76 over 1974-75		In 1976-77 over 1975-76		In 1977-78 over 1976-77			
			(+)	(—)	(+)	(—)	(+)	(—)		
1	2	3	4		5		6			
Kharif	Rice	Less than 5	—	—	4	8	4	4		
		5-25	14	29	16	60	42	15		
		25-50	36	7	—	8	23	4		
		50-75	7	—	—	4	4	—		
		75-100	7	—	—	—	—	—		
		100 & above	—	—	—	—	4	—		
		Number of districts		9	5	5	20	20	6	
		Maize	Less than 5	—	33	—	—	—	—	
				5-25	—	—	38	38	50	13
				25-50	67	—	12	—	—	25
50-75	—			—	—	—	—	12		
75-100	—			—	—	—	—	—		
100 & above	—			—	12	—	—	—		
Number of districts				2	1	5	3	4	4	
Jowar	Less than 5			34	33	—	—	—	—	
				5-25	—	33	—	—	25	25
				25-50	—	—	25	25	—	—
		50-75	—	—	—	50	25	—		
		75-100	—	—	—	—	—	—		
		100 & above	—	—	—	—	25	—		
		Number of districts		1	2	1	3	3	1	
		Bajra	Less than 5	—	—	—	—	—	12	
				5-25	25	25	11	—	25	—
				25-50	—	25	22	22	12	13
50-75	—			25	11	—	—	25		
75-100	—			—	—	—	13	—		
100 & above	—			—	34	—	—	—		
Number of districts				1	3	7	2	4	4	

1	2	3	(+)	4 (-)	(+)	5 (-)	(+)	6 (-)
	Groundnut	5-25	25	—	—	10	25	—
		25-50	25	25	—	80	50	—
		50-75	25	—	—	10	13	—
		75-100	—	—	—	—	—	—
		100 & above	—	—	—	—	12	—
		Number of districts		3	1	—	10	8
	Cotton	Less than						
		5	—	—	12	12	—	29
		5-25	25	50	13	13	14	14
		25-50	—	25	38	—	14	14
		50-75	—	—	—	—	—	—
		75-100	—	—	—	12	—	—
	100 & above	—	—	—	—	15	—	
	Number of districts		1	3	5	3	3	4
Rabi	Wheat	Less than						
		5	16	12	16	12	21	12
		5-25	36	16	16	36	42	17
		25-50	12	—	4	12	4	4
		50-75	4	—	—	—	—	—
		75-100	4	—	—	—	—	—
	Number of districts		18	7	9	16	16	8
	Rice	Less than						
		5	—	10	25	17	22	11
		5-25	40	30	33	17	34	22
		25-50	20	—	—	8	11	—
	Number of districts		6	4	7	5	6	3

Table 3 : Percentage distribution of districts according to increase in average yield of HYV over local

Season	Crop	Class interval (%)	1974-75	1975-76	1976-77	1977-78
1	2	3	4	5	6	7
Kharif	Rice	less than 25	20	20	12	8
		25-50	27	28	42	42
		50-75	40	32	23	42
		75-100	13	8	19	4
		100 & above	—	12	4	4
		Number of districts	15	25	26	26
	Maize	Less than 25	33	—	—	12
		25-50	33	63	75	38
		50-75	34	12	—	12
		75-100	—	—	12	13
		100 & above	—	25	13	25
		Number of districts	3	8	8	8
	Jowar	Less than 25	25	—	—	25
		25-50	—	—	—	—
		50-75	50	25	33	25
		75-100	—	—	—	—
		100 & above	25	75	67	50
		Number of districts	4	4	3	4
	Bajra	Less than 25	50	43	—	—
		25-50	25	29	33	50
		50-75	—	28	56	25
		75-100	25	—	11	13
		100 & above	—	—	—	12
		Number of districts	4	7	7	8

1	2	3	4	5	6	7
	Groundnut	Less than 25	25	50	72	80
		25-50	75	38	—	—
		50-75	—	12	14	20
		75-100	—	—	14	—
		Number of districts	4	8	7	5
	Cotton	25-50	—	14	28	29
		50-75	67	29	14	—
		75-100	—	—	29	14
		100 & above	33	57	29	57
		Number of districts	3	7	7	7
Rabi	Wheat	Less than 25	4	4	9	14
		25-50	50	43	48	38
		50-75	21	35	30	33
		75-100	8	9	—	10
		100 & above	17	9	13	5
		Number of districts	24	23	23	21
	Rice	Less than 25	14	45	27	29
		25-50	57	33	46	29
		50-75	29	11	9	42
		75-100	—	11	9	—
		100 & above	—	—	9	—
		Number of districts	7	9	11	7

2.3 Assessment of Foodgrain Losses

By

D. Singh and R.K. Khosla,

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New Delhi

1. The efforts such as introduction of high yielding varieties, increasing use of fertilizers, extension of irrigation facilities, adoption of improved cultural practices etc. are being made to produce more foodgrains to meet the needs of the growing population of the country. The problem is, however, not solved by merely producing more foodgrains unless food produced are protected and preserved properly in consumable form. It is well known that there are appreciable pre-harvest crop losses due to pests and diseases, and post-harvest foodgrain losses at different stages of handling, such as harvesting, threshing, cleaning, storage, transportation, processing, etc. If such losses are avoided there is no doubt, the gap between the supply and demand of food can be reduced considerably. The protection measures will depend upon the causes of losses and the quantities affected thereby. It thus seems necessary to objectively study the causes of grain losses and the quantities thereof.

Pre-Harvest Losses

2.1 For obtaining the reliable and objective estimates of pre-harvest foodgrain losses due to pest and diseases, the Institute initiated a pilot sample survey in Cuttack district during 1959-62 with the objective of evolving suitable sampling and measurement techniques for estimating the incidence of pests and diseases on paddy crop and assessment of consequent loss in yield. Thereafter, with a view to verifying the suitability of the techniques which were developed on the basis of the Cuttack survey, in a different agro-climatic conditions, the study was extended to Thanjavur district in 1962 and to W. Godavary districts in 1963. The surveys in these two districts were carried out for four years. A similar survey with the objective of evolving a suitable sampling and measurement techniques for the estimation of incidence of pests and diseases on wheat and maize crops and assessment of consequent losses in yield was also carried out in Aligarh district during 1963-67.

2.2 On the basis of the above mentioned studies, the methodology for estimation of the incidence of pests and diseases on paddy, wheat and maize crops and, by making use of the yield data of the affected crop, the assessment of crop losses was evolved. The results obtained by

making studies on different angles were printed in various publications. The review of some of the important publications is presented below in brief :—

2.3 Abraham and Khosla (1965) studied to reduce the number of variables and to form a single index of the level of incidence of pests and diseases in rice crop in cultivators' fields. The techniques of component analysis has been used for this purpose. It was found that about 33 to 39 per cent of the total variation was accounted for by this index in different years. Alternative indices based on (i) ranking methods, (ii) method suggested by Elston and (iii) standardized values were also worked out.

2.4 Abraham and Khosla (1967) demonstrated the sampling and measurement techniques for the estimation of incidence of pests and diseases and consequent loss in the yield of rice crop based on the data collected from cultivators' fields in the Cuttack district of Orissa State for three years (1959-62). About 11 to 17 per cent losses were estimated for different years. The maximum loss was due to helminthosporiose (*Helminthosporium oryzae*) consistently in all the years. It was also found that for every one per cent increase in white earheads due to Borers (*Tryporyza incertulas*), the yield decreased by 0.6 per cent.

2.5 Abraham, Khosla and Kathuria (1969) examined the use of successive sampling in pest and diseases survey on rice crop for obtaining better estimates of (i) the incidence in the second year of the survey, (ii) the change in their occurrence from one year to the next year and (iii) the overall mean incidence over the two years. They discussed the relative efficiencies of various estimates based on matched sample.

2.6 Singh *et al* (1971) studied the incidence of pests and diseases of maize crop and consequent loss in the yield of Aligarh district of Uttar Pradesh during 1963-67. The percentage of plants damaged by major pests, viz; stemborer (*Chilo partellus* Swinhoe) gujia weevil (*Tanymecus indicus* Faust) and leaf-roller (*Marasmia trapezalis* Gianee) were 11.38, 34.38 and 7.9 respectively for early maize during 1964-67 and were 14.73, 32.61 and 15.59 for late maize during 1964-66. The significant decrease in yield due to infestation of gujia weevil and leaf-roller in the early maize was 12 and 3 per cent respectively. The average avoidable loss in yield in the district was 1.93 and 1.81 q/ha in the early and late maize respectively by applying plant protection schedule as per recommendations of Department of Agriculture of the State Government.

2.7 Sardana, Khosla and Rao (1971) studied the sample size required

at various stages of stratified multi-stage random sampling on the basis of the pilot sample surveys carried out in the districts each in the paddy growing States of Orissa, Andhra-Pradesh and Tamil Nadu for 3-4 years. It was observed that at district level it may be possible to estimate the incidence of major pests and diseases with standard error not more than 10 per cent by taking a sample of 100 villages, 4 fields per selected village and 2 plots of 1 sq. metre each per selected field.

2.8 Kishen *et al* (1972) studied the sampling and measurement techniques for estimation of incidence of pests and diseases on wheat crop and consequent loss in the yield in Aligarh district of Uttar Pradesh during 1963-67. They observed that gujia weevil (*Tanymecus indicus* Fst.) and termites (*Microtermes obesi* Holmgs) were the major pests. The peak period of their infestation was the second fortnight from the date of sowing. Gujia weevil damaged 14.42 ± 0.65 per cent and termites 2.08 ± 0.43 per cent of the clumps. Brown rust (*Puccinia triticina* Erikss) and black rust (*Puccinia graminis tritici* Pers.) (Erikss. & P. Henn.) were the major diseases and their maximum incidence was in the 11th fortnight. The percentage infection of brown rust in the peak period was 14.57 ± 0.44 and the black rust 4.49 ± 0.25 . Infestation of termites caused a significant loss in the yield of crop.

2.9 Seth *et al* (1971) presented the report of the pilot sample surveys conducted in rice crop in three districts during 1959-67. The various aspects of sampling and measurement techniques were dealt with and reported the results obtained. The average percentage losses due to incidence of all the major pests and diseases over all the years in Cuttack district were found to be 13.00 ± 2.63 , 7.13 ± 6.32 and 11.38 ± 5.72 for long duration varieties of *Sarad* crop, short duration varieties of *Dalua* crop and medium duration varieties of *Dalua* crop respectively. The overall average percentage losses due to incidence of all the major pests and diseases in Thanjavur district were 4.39 ± 1.03 , 3.25 ± 0.33 , 10.46 ± 1.65 and 3.96 ± 4.15 for short duration varieties of *Kuruvai* crop and long duration varieties of *Kuruvai* crop and long duration varieties of *Samba* and *Thaladi* crops respectively. In the W. Godavari survey, the average percentage loss due to incidence of all the major pests and diseases pooled over the years was 10.57 ± 2.06 and 14.43 ± 2.95 during *Khari* season (long duration varieties) and *Rabi* (medium duration varieties) season respectively. The major pests and diseases were Stemborer (*Tryporyza incertulas*), gall fly (*Pachydiplosis oryzae*) Helminthosporiose (*Helminthosporium oryzae*) and Blast (*Piricularia oryzae*).

2.10 Singh *et al* (1973) reported, adopting paired fields (sprayed and

unsprayed) technique in stratified multistage random sampling, that the average avoidable loss in the yield of paddy in *Samba* season in Thanjavur district (1962-66), *Kharif* and *Rabi* seasons in W. Godavari district (1963-66) were 411 ± 32 kg/ha 76 ± 27 kg/ha and 204 ± 32 kg/ha respectively. The estimates of Average avoidable loss in the yield of early and late maize in Aligarh district (1963-67) were found to be 193 ± 63 kg/ha and 181 ± 58 kg/ha respectively. The avoidable loss in the yield of wheat in Aligarh district (1963-67) was estimated to be 185 kg/ha.

2.11 Khosla (1977) suggested three methods for the assessment of crop losses caused by pests and diseases :

- (i) using the multiple regression technique involving the actual incidences of major pests and diseases in crop as independent variables and yield as the dependent variable;
- (ii) forming an index based on the incidences of major pests and disease on crop by component analysis technique then reducing it to a linear regression of yield on an index thus formed, and
- (iii) adopting chemical plant protection measures to control the incidences of pests and diseases in one of the paired selected fields. The formulae were simplified as far as possible and demonstrated its application to the data of the pilot sample survey carried out in one of the paddy growing districts. The estimated percentage losses by methods of regression study and that of index formation were 19.21 and 20.35 respectively with standard errors of 9.58 and 5.36. The percentage of avoidable loss in yield by adopting plant protection measures was 4.68 with standard error of 1.17.

2.12 The sampling and measurement techniques evolved at this Institute for the estimation of incidence of pests and diseases and consequent crop losses by relating the incidences with the yields, on the basis of pilot sample surveys carried out on paddy, wheat and maize crop during 1959-67, could be applied on other crops on similar lines. Similar studies on high yielding varieties of paddy and wheat crops in the districts of S. Arcot in Tamil Nadu and Gorakhpur in Uttar Pradesh respectively have recently been planned.

2.13 Some of the important work done on tea crop in India is also reviewed in brief as follows :—

2.14 Sen and Chakrabarty (1964) estimated the loss in tea crop due to pests and diseases in the tea estates of North-East India on the basis of sample

surveys. A stratified multistage sampling design was adopted, with partial replacement of sampling units in the successive years. For mature tea, the overall loss due to major pests and diseases during 1959 in Assam Valley was estimated to be about 1 maund per acre under actual conditions, when using normal control measures. This was 5.6 per cent of the disease free crop.

2.15 Sen *et al* (1966) described sampling techniques for estimating the degree of infestation of pests in tea estates, with particular reference to Red Spider Mite in North-East India. Systematic sampling of bushes from a section of an estate has been shown to be at least as efficient as any alternative sampling scheme, for the same sample size. They discussed possible gain due to double sampling, using combination of eye estimation of incidence in a section with scoring (objective) technique as a sub-sample of sections.

2.16 Sen and Chakrabarty (1967) estimated loss in tea due to Red Spider Mite with incidence index of 16.2 per cent as 139 ± 34 , 141 ± 59 and 124 ± 49 kg/ha by using the methods of least squares, Wald and Bartlett respectively.

3. Post-Harvest Losses

3.1 A review in brief of losses at different stages of harvesting, threshing cleaning, storage, transportation, processing etc. is as follows :—

3.2 The Government of India appointed a Committee in Sixties to make studies of the crop losses. The estimates of losses of important crops, viz., wheat, rice, jowar, bajra, gram, millets and pulses, made by the Committee of different stages, viz., threshing yards, transport and storage are given in Table-1, averaged over the three years 1962-63, 1963-64 and 1964-65.

Table—1. Estimates of Food Grain Losses at Different Stages in Important Crops (in percentage)

State at which the loss occurred	Wheat	Rice	Jowar	Bajra	Maize	Gram	Millets	Pulses (excepting gram)	Total
Threshing yard	1.0	2.5	2.0	0.5	0.5	0.5	1.0	0.5	1.68
Transport	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.15
Processing Storage	—	2.0	—	—	—	—	—	—	0.92
(i) Rodents	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.50
(ii) Birds	0.5	1.0	1.0	1.0	0.5	0.5	2.0	0.5	0.85
(iii) Insects	3.0	2.0	2.0	1.0	3.0	5.0	0.5	5.0	2.55
(iv) Moisture	0.5	0.5	2.0	0.5	0.5	0.5	0.5	0.5	0.68
Total									9.33

N. B. : Losses have been worked out on the basis of loss to food value only. Driage which causes loss in weight but not loss in food value, spillage, loss in weight on account of theft, loss on account of conversion where some quantity may be lost for human consumption but is available for animal consumption, have not been considered as loss.

Krishnamurthy (1968) reported that the losses of foodgrains suffered annually by the Government during storage of 7 to 10 million tonnes was less than 0.2 per cent. The co-operative organisations (2 to 6 months of storage) and warehousing corporations (upto 8 months of storage) suffered losses of 1 to 2 per cent and 1 per cent, respectively. In the rural storage under farmer's condition the losses due to insects in the wheat stored upto 8 months varied from 2.03 to 9.52 per cent.

The Committee on Post-harvest Losses of Foodgrains in India (1971) indicated the losses of foodgrains of wheat, paddy, jowar, bajra, maize, etc.

on various stages of post-harvest. The storage losses during the period from 1963-64 to 1968-69 held in storage were as given in Table 2.

Table—2. Losses of Foodgrains in Storage

Year	Quantity stored (in tonnes)	Loss % in relation to quantity stored
1963-64	59,34,351	0.20
1964-65	60,92,374	0.26
1965-66	47,12,823	0.13
1966-67	43,30,063	0.14
1967-68	27,73,576	0.10
1968-69	20,22,386	0.074

The percentage of losses during transportation for the period 1962 to 1967 in respect of wheat were as given in Table 3.

Table—3. Losses of Wheat Grains in Transportation

Year	Loss as percentage of the quantity transported
1962-63	0.75
1963-64	0.59
1964-65	0.31
1965-66	0.29
1966-67	0.17

Prof. B. R. Seshachar, President, Indian National Science Academy, told in his address during the seminar on Post-harvest Technology of Foodgrains held at New Delhi in December, 1972, that about 10 million tonnes of foodgrains were lost annually during the process of drying, transportation, storage and distribution.

Srivastava *et al* (1973) reported weight loss due to insects in villages to the extent of 9.7 percent kernel damage to the tune of 30.1 percent.

Girish *et al* (1974) estimated the losses of wheat in farm storage in different regions of Uttar Pradesh ranging from 0.6 to 9.7 percent.

The Committee on Cost of Handling of Foodgrains set up by the Food Corporation of India (1974) reported the transit and storage losses in Food Corporation of India from 1969-70 to 1972-73 as given in Table—4.

Table 4 Foodgrain Losses in Transit and Storage

Year	Rs. (in crores)	Quantity (in lakh tonnes)	Percentage of transit and storage losses on purchase and sale value
1969-70	15.29	2.06	1.03
1970-71	15.00	1.76	1.06
1971-72	18.36	2.12	1.09
1972-73	21.47	2.33	1.08

Krishnamurthy (1975) reported that the losses of foodgrains in rail transit were estimated by the Food Corporation of India at about one percent during 1979-71. He also assessed the loss in commercial storage of foodgrains as 3 to 5 percent when storage was for 8 months and around one percent when the storage was up-to 4 months. In underground structures, the loss was 6 to 10 percent. He also observed that a loss of 3 percent was due to use of hooks, 0.1 to 0.2 percent due to spillage, and 0.5 percent due to loss of moisture in general during storage.

Girish *et al* (1975) estimated the average loss of wheat due to insect damage as 2.0, 0.85 and 0.95 percent after seven months of storage in grain markets of Western U.P., Punjab and Haryana, respectively.

Padua (1977) gave the losses of rice at different stages of post-harvest operations as follows:-

Table—5 Losses of Rice at Different Stages of Post-harvest

Stage	Range of Loss in percentages
Harvesting	1 to 3
Handling	2 to 7
Threshing	2 to 6
Drying	1 to 5
Storage	2 to 6
Milling	2 to 10
Total range of loss	10 to 37

The Indian Agricultural Statistics Research Institute estimated, on the basis of the tentative report on the pilot study conducted in Aligarh district during 1973-74, the percentage loss in storage as 2.0 and 5.2 during the years 1972-73 and 1973-74 respectively.

The estimates of post-harvest losses given above are mostly based on intelligent guesses by the experts. Even where objective methods have been used, it is based on limited field experiments. The need of statistical methodology for assessment of such loss has been felt not only in India but also elsewhere. Keeping in view the importance of the problem, research studies for evolving appropriate methodology for the assessment of Post-harvest losses of foodgrains at different stages seem to be necessary.

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2.4 Theoretical Constraints in Layingout the Multilocational Trials and Processing the Resulting Data-A Non-Parametric Approach.

By

G. Narasimhayya and G.V.S. Ramakrishna,
Directorate of Oilseeds Research, Rajendranagar,
Hyderabad (A.P.).

Abstract

1. Procedures for fixing optimum plot size in the Co-ordinated Trials to be conducted at various locations were not available in the literature. Some alternative rough methods to fix the plot size were suggested for such cases.

2. Theoretical constraints in analysing the multi-way non-orthogonal data with heterogenous error variances were mentioned. A non-parametric procedure of analysing the data under the above constraints was given. The procedure was illustrated by working on some actual data of two-way classification of the Directorate of Oilseeds Research, Hyderabad, which can be extended to multi-way non-orthogonal data without loss of generality.

2.5 Projection of Area Under Groundnut in Andhra Pradesh.

By

G. Krishnan Kanth and G. Nageshwara Rao,
Andhra Pradesh Agricultural University, Rajendranagar,
Hyderabad (A.P.).

Abstract

Bal and Raghava Rao (1973) has used different short run and long run models for estimating the area under wheat in Punjab State. In this paper an attempt has been made for estimating short-run projection of area under groundnut in Andhra Pradesh by district-wise taking the time series data from 1955 to 1974. The different projection models have been used for estimating the area under the said crop. Also, the long-run projection has been made for the state as a whole for this crop, by fitting the orthogonal polynomials with the help of variate difference methods. The groundnut crop has been selected as it is one of the important commercial crops in Andhra Pradesh and also due to prevailing scarcity of edible oils in the country as a whole.

2.6 Production Functions and Economic Optima in Nitrogen Use for Some Cotton Varieties at Different Spacings at Parbhani and Nanded.

By

P.R. Waghmare and B.L. Bawle, M.A.U.,
Parbhani (Maharashtra).

Abstract

Cotton is important cash-crop in Maharashtra. The production of cotton mostly depends upon the Nitrogen and plant population per hectare.

In the present paper an attempt has been made to study the cotton yield—Nitrogen relationship by fitting (1) Cobb Druglas (2) Quadratic and (3) Squart production functions at different spacing at two location for the data of two years' experimental trials conducted at Cotton Research Station.

The analysis revealed that Quadratic function was the most suitable production function to estimate the relationship between yield and Nitrogen use

Similarly, the figures of economic optima differed for different varieties H-4, L-147, ACH-2 and DHY-286, at Parbahani and Nanded, when the spacings were changed. The information so obtained is of impetus use for cultivators, as the economic optima differs from place to place and also depends upon the plant population.

2.7 Sampling With a Rope—a Useful Method for Forest Surveys.

By

K.R. Satyamurthi,

Forest Research Institute, and Colleges, Dehradun (U.P.).

Abstract

“The basal area of a forest, which can be understood by immagining all cut trees (at one meter height from the ground) when viewed from a helicopter will have wooden portion whose total area is basal area, when multiplied by average trunk height gives the volume of the useable timber in the forest. Hence the basal area is an important statistics for forest management. To enumerate this we have a novel method which is introduced by Bitterlich. A useful modification done by the author in this method is to be discussed in the paper.”

2.8 A Note on Bufferstock Policy with Reference to Foodgrains.

By

S.D. Bokil and H. Singh,

Indian Society of Agricultural Statistics, New Delhi.

The main objective of bufferstock policy is to even out fluctuations in supplies of foodgrains resulting from fluctuations in domestic production. It can take care only of the random fluctuation and not of any long term problems resulting from divergent trends in demand and supply. To answer the question of size of bufferstock, various efforts have been made. We have adopted here the approach made by Simaika, J.B. (1974) to calculate the probability of meeting the deficit in a continuous period of say 5 or 10 years. On the basis of the recurrence relations between the probability of success for N and N-1 year, calculation for the initial stock required to ensure 90% probability of success in bufferstock operations is worked out for 5 years and 10 years period. The results obtained are presented in the paper in tabular form.

Based on the discussions held during the session, the recommendations made were as follows :—

1. It was noted that the Govt. of India has given high priority to rural development programmes under the Sixth Five Year Plan. It is necessary to develop a proper statistical frame for monitoring the rural development projects particularly those for the benefit of small farmers and landless labourers. The conference stressed the need for the creation of a suitable and adequate machinery for proper assessment and evaluation of these programmes as was followed for Rinderpest Eradication, IADP and State part of I.C.D.P.

(Action : IASRI, Ministry of Agriculture and Irrigation, State Departments concerned and Agricultural Universities)

2. The programmes of experiments in cultivators' fields taken up so far have covered largely crop response to fertilizer application. Other problems like plant protection inter-cropping, etc. suitable for study in different areas should be identified. As experiments in cultivators' fields are in the nature of adoptive research, State Departments of Agriculture may be involved in the execution of such investigation.

(Action : ICAR, State Departments of Agriculture and Agricultural Universities)

3. Estimates of post-harvest crop losses currently available are based on guesses and limited field experiments. In view of the importance of the problem, research studies for evolving appropriate methodology for the assessment of post-harvest losses of foodgrains at different stages and due to various causes should be taken up on a priority basis. In such studies provision may also be made to collect information on types of storage in use and their relative efficiency under field conditions.

(Action : IASRI, ICAR, Department of Food, Ministry of Agriculture and Irrigation)

4. Statistical methodology for estimation of crop losses due to floods/ draught/hailstorm, etc. should be developed.

(Action : IASRI and Agricultural Universities)

5. Considerable variability had been observed in the performance of high yielding varieties of major cereals and cash crops even in a

compact region like a district. The performance of the HYV was also not very consistent from year to year. The extent of adoption of improved practices also varied widely from cultivator to cultivator. It was recommended that intensive investigations to study the constraints in the adoption of technology for increased agricultural production may be taken up in typical districts in different States under the VI Plan.

(Action : IASRI)

6. For determining yield rates of crops like cotton and those vegetables involving multiple pickings component sampling approach with independent sample of fields at different pickings with a large number of fields for the first and second pickings and a smaller number of fields for the remaining pickings have been found to be convenient and efficient. However, investigations for studying the efficiency of alternative sampling procedure may be conducted in other areas to test and standardise these procedures.

(Action : IASRI and State Departments/Agricultural Universities)

7. In view of the value of straw as cattle feed there is need to estimate the availability of all types of straw which can be used as feed. Straw to grain ratio for HYV is likely to be different from similar ratio for conventional varieties. Efforts should be made to estimate straw to grain ratio for such varieties.

(Action : IASRI and other ICAR Institutes, State Departments/Agricultural Universities)

8. The need for initiating appropriate surveys and other studies for bringing about improvement in Forestry Statistics was reiterated. It was felt that not much headway has been made in this regard though a similar recommendation was made at the last conference. It was suggested that the Director, IASRI and the President, Forest Research Institute may jointly examine the problems as early as possible with a view to remove the impediments for the follow up action expeditiously.

(Action : IASRI and F.R.I., Dehradun)

9. A useful modification to Bitterlick's method for determining basal area of trees and from it the volume of the useable timber in a forest has been developed by the Forest Research Institute, Dehradun.

The modified method may be tried in different topographical forest areas and in various regions of the country. Its applicability for enumerating crop area may also be tested on a pilot scale.

(Action : FRI, State Departments of Agriculture and IASRI)

10. In order to protect the interest of the producers and for the purpose of price fixation it was recommended that the cost of production data should be collected on a wider scale.

(Action : IASRI, Agricultural Universities and State Departments of Agriculture)

11. It was recommended that prices of inputs like fertilizers, irrigation, human labour, bullock labour etc. may be collected from a fixed set of villages on a priority basis in order to study trend in prices.

(Action : Ministry of Agriculture and NSSO)

TECHNICAL SESSION—III(A)
Agricultural Statistics in Animal Sciences

26th June (Tuesday), 1979.

09.00 A.M.

- Chairman : Dr. P.N. Saxena,
Assistant Director General,
I.C.A.R., New Delhi.
- Repporteur : Dr. K.C. Raut
- Invited Speakers : i) Dr. K.C. Raut, I.A.S.R.I.
ii) Dr. P. Narain/Sh. J.C. Malhotra, I.A.S.R.I.
- Others : iii) Sh. G.S. Tiwari, Dte. of Vety. Services,
Madhya Pradesh
iv) Sh. N.Y. Palimkar, M.A.U., Maharashtra.
v) Sh. Dharamendra Kumar/Dr. P. Narain,
Dte. of A.H., Lucknow and I.A.S.R.I.
vi) Sh. U.G. Nadkarni, I.A.S.R.I.
vii) Dr. H.P. Singh/Sh. B.C. Saxena, I.A.S.R.I.
viii) Sh. Dharmendra Kumar, Dte. of A.H.,
Lucknow.

3(a).1. Status of Statistical Methodology for Animal Sciences Research and Development

By

K. C. Raut,

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Application of statistical research to animal sciences received some attention only recently. Methodological investigations carried out in the past or being carried out can be discussed broadly under the following heads :

- (i) Methodology evolved and adopted by various organisations;
- (ii) Methodology evolved but needs to be adopted by organisations concerned;
- (iii) Methodological investigations in progress; and
- (iv) Research Investigations proposed to be undertaken.

In addition, there are other areas in which methodological investigations need to be undertaken. These aspects are being discussed in brief in the sections which follow.

1. Methodology Evolved and Adopted :

There is considerable gap in the availability and requirements of data in the field of animal husbandry, dairying and poultry. The Indian Agricultural Statistics Research Institute (IASRI) initiated pilot investigations on a few items and was successful in evolving suitable methodologies for the purpose. The methodologies evolved have been successfully adopted by various organisations. In some cases the working procedures were modified to suit the conditions prevailing in the area or for organisational convenience. These investigations include estimation of intercensal estimates of number of livestock; estimation of livestock products. The sampling plan devised on livestock numbers is not only suitable for providing rationalised supervision over the work of primary enumerating staff during census operations so that independent estimates of livestock numbers can be obtained much more quickly than the census data but also for estimation of livestock numbers in intercensal years. More recently the Institute has developed an integrated plan for estimating annual output of one principal livestock product every year with sufficient precision and simultaneously estimating on the basis of smaller samples the indices of changes of production in respect of other principal

livestock products. These have been successfully implemented by State Departments of Animal Husbandry. The details on these studies are discussed in a separate article. A satisfactory technique has also been developed for estimating the cost of production of milk in a compact area and this has been adopted by some of the organisations in dairy sector. The operational feasibility of the plan for systematic sampling of milk records to estimate the milk production was studied and tried successfully in Key Village Blocks. This has also been adopted by some State Departments for assessing improvement in terms of milk production brought about by cattle development schemes. A satisfactory technique was evolved to grade the wools on the basis of quality, as judged from the fibre characteristics which effects the ultimate manufacturing products. Based on these studies definite standards were formulated and adopted.

A modest but interesting example of operational research in the field of animal husbandary was provided by the efforts that were made to improve the operational efficiency of the Rinderpest Eradication Campaign which was executed on a national scale in India. While assessing the progress of the rinderpest eradication campaign, the operational efficiency was critically examined which resulted in estimating the optimum team size required for vaccination of animals in the village in order to have maximum outturn and number of ampoules containing the vaccine with the object of reducing wastage. These findings were fruitfully utilised in different States. Statistical techniques developed in the field of statistical genetics and breeding have also been successfully utilised for getting better knowledge of genetic composition of the herd and in selection for improvement of the stock. These aspects are being dealt in a separate article.

2. Methodology Evolved but Needs to be Adopted :

The IASRI, after undertaking a series of investigations in various aspects, have evolved techniques for adoption in the field of animal sciences. These studies include : an integrated approach for estimation of availability and cost of production of milk and preparation of its index ; study of impact of milk supply schemes on rural economy in milk collection areas ; Estimation of cost of production of poultry and eggs under commercial management conditions; Study of economics of sheep rearing in relation to wool production under migratory and stationary types of management ; Standardization of methods for estimating solids-not-fat (SNF) in milk by calculation. An efficient method of sampling wool from fleece and commercial bulk was evolved for the assessment of wool quality.

Analysing large body of data collected from the survey of bacteriological quality of milk, acceptable standards of milk were fixed so as to improve the keeping quality and to ensure the supply of good quality milk. These standards were prescribed considering bacteriological quality (organoleptic, alcohol, methylene blue reduction time (MBR), bacteria count acidity percentage etc.) of milk. Through another study dealing with chemical analysis of milk samples, standards were prescribed for market milk on the basis of percentage of butter fat, solids-not-fat (SNF) and specific gravity of milk.

The procedure of estimating objectively the amount of milk sucked by the calf through periodical weighing of the calf before and after sucking on a systematic sample of the days of lactation of the cow was standardised so as to work out correctly the milk production of a cow. Separate papers have been prepared dealing with some of these topics.

It is for the organisations, responsible for the development of livestock, to see that efforts are made by adopting the methods already evolved to collect various statistics. Adoption of these methodologies would ultimately help in sound planning in future.

3. Methodological Investigations in Progress :

Considering the importance of some of the studies, the IASRI is engaged in various studies which would be of use in livestock sector. These investigations include estimation of birth and death rates in bovines; economics of pig rearing; cost of production of poultry under small scale poultry farming conditions; estimation of area of grazing land and its utilisation; economics of rearing calves etc. Estimation of specific fertility and mortality rates of animals according to age, breed etc. would be useful in life tables and scientifically projecting livestock population. Study of economics of pig production will help in providing guidelines for improving the economic status of the weaker section of the population who generally maintains pigs. Estimation of herbage taken by animals through grazing will be useful to work out nutritional status of livestock. Study of economics calf rearing particularly crossbred ones will help in suggesting ways and means of reducing the cost on rearing. After working out the methodologies, these will be tried in various areas to test their suitability for adoption and thereafter various organisation can adopt for the purpose intended for.

4. Research Investigations proposed to be undertaken :

Within the resources available, the IASRI has planned to undertake a

few research investigations during the current Plan period. One of the impact studies proposed to be taken up is to evolve a suitable methodology for estimating the incidence of diseases and pests in bovines, the loss in production due to disability and death and the losses that could be avoided through control measures. Another project is to estimate the cost of cultivation of fodder crops. The study will be useful in working out cost of production of livestock products in a more realistic manner. Study of economics of mixed farming involving crop, livestock, fishery and poultry will be useful in assessing the performance of different systems of farming and labour intensification in these systems, and thereby suggesting efficient farming practices. The possibilities of recording reliable data directly by the respondents are being explored in order to obtain estimates of various livestock population characteristics and to compare the efficiency of the procedure with those in vogue. If found successful, it will create awareness among the householders for maintaining proper records and thereby knowing the quantitative aspect of their enterprise.

5. Studies Required to be Undertaken :

Although there is a considerable gap between the requirements and availability of data in livestock, dairy and poultry, this gap can be bridged to some extent only if efforts would be made by all concerned in carrying out research investigations in these fields. Due to perhaps non-availability of resources as well as trained manpower, the methodological investigations in some areas have not been taken up so far. Some of the areas in which the studies need to be carried out are : Performance characteristics of cross-bred cows in different generations maintained under village conditions; estimation of various vital characteristics of different species of livestock; estimation of feed intake by animals both through stall feeding and grazing at a point of time and the nutritional status of livestock; estimation of feed stock at a point of time; index of cost of sheep rearing; availability and requirements of bullock energy; distribution of various categories of livestock as well as net return accrued according to size of holding; estimation of demands for various livestock products etc. No satisfactory yardstick is available for measuring the working capacity of bullocks particularly crossbred ones. Considering the utility of these studies, efforts should be made to carry out the investigations.

6. Before undertaking further studies in any field, it is desirable that one should have the information about the work done in the past. Towards this end, attempts have been made by the IASRI to prepare compendia on the animal experiments carried out in the country and these compendia cover the experiments on animal nutrition, physiology, breeding etc. Experiments covered

under other disciplines are proposed to be covered under this project. The preparation of these compendia will enable the research worker engaged in the work connected with animal sciences to utilise the results of past experiments for further advancement of research. It will also facilitate the co-ordination and review of research work as well as help in scientific planning.

7. Utilisation of Secondary Data :

Sample surveys and experimental investigations are carried out with some specific objectives. After meeting these objectives, generally these data are not utilised further to make some deeper studies. It is not possible nor desirable to conduct experiments or surveys for every item of study. If the data available from other studies can be fully utilised, of course pinpointing the limitations of the studies, then the results obtained can form some basis for future work and also for future planning & development. The IASRI have emphasized the utilisation of secondary data for other studies. Some of these studies include target for milk production, feed requirements of bovines, trends in growth of bovines and ovines, nutritional requirements for milk production, seasonal variation in milk production, seasonality of calving and its effect on milk yield, milk production function and optimum feeding schedules, investment in commercial production of milk, breed variation in cost of milk production, productivity of different systems of farming, price of milk and feed cost as factors influencing increased milk production, cost of production of mutton & wool, classification and productivity of milch stock, livestock morbidity studies, per capita availability of milk, regional imbalance in livestock and its products, extent of utilisation of bullock power, extent of labour utilisation in livestock keeping, production and utilisation of milk in different categories of producers and their economy. References of those studies for which results have been published are appended.

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3 (a). 2 Data Analysis in Animal Breeding

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Introduction

It is now well recognised that the low productivity of animals can be improved by developing efficient techniques in animal breeding. However, these techniques depend to a great extent on the science of statistics. For instance, if statistical considerations demand that twenty progenies are needed for the progeny test of a sire, it is not desirable for a breeder to be content with two or three progenies per sire. It is therefore necessary for animal breeders to take into account statistical considerations while conducting breeding experiments.

Investigations on the application of statistics to animal breeding problems are carried out through critical examination of large body of breeding data available at various livestock and poultry farms and other institutions in the country. This involves large-scale data processing and subsequent data analysis on a computer. This leads to evolution of suitable statistical techniques for animal breeding problems. The feasibility for their adoption can then be tested. In the course of investigations conducted at the I.A.S.R.I., N. Delhi in the field of statistical genetics, some techniques based on data analysis in various species of livestock and poultry were developed and others are currently under examination. Such techniques are described below species-wise with the ultimate object of their possible adoption by the concerned statisticians who have gathered in this Conference.

I. Cattle

(a) Genetic Changes in Economic Characters in a Closed Herd

The problem of measurement of genetic gain which results from the breeding policy carried out at a cattle farm over a number of generations has been tackled by developing a suitable statistical technique for measuring the actual genetic changes per year in the various economic characters with the help of cattle breeding data spread over a period of about 25 years of five herds of Indian breeds viz. Red Sindhi herds at Hosur & Bangalore, Kangayam, Tharparkar and Kankrej (Narain and Garg, 1972). The average genetic

change in an economic character can be estimated as twice the pooled intra-sire, intra generation regression coefficient of the weighted difference between the herd and the individual sire means on the years. This separates out the genetic from the environmental trends in a closed herd where a sire has daughters spread over several years. The technique so developed has been recommended to all the State Departments of Animal Husbandry for undertaking the analysis of data at their farms to ascertain whether the changes over years in the average milk production of the respective herds actually observed are at the genetic level or due to environmental factors. Some states have already started adopting this technique with modifications to suit their specific requirements.

(b) Phenotypic Index

Genetic improvement in a quantitative trait in a population is usually achieved by adopting selective breeding on the basis of the phenotypic values of a trait. The rate of this improvement can, however, be increased if the variation in this trait due to auxiliary traits, particularly at the environmental level are minimised as far as possible. In such a case selection could be made on the basis of a 'phenotypic index' expressed as deviation of the phenotypic value of the trait from its expected value predicted with the help of the auxiliary traits. Such an approach was used by Narain and Mishra (1975), who showed that the genetic improvement expected on the basis of such a selection procedure could be substantial over the direct selection procedure if the phenotypic and genetic correlations between the main and the auxiliary characters are of opposite signs. Unlike the case of selection index, a knowledge of the estimates of genetic parameters is not necessary for constructing the phenotypic index and as such it is easier to adopt this procedure. With the help of data analysis on cattle, it would found in the above mentioned study, that the genetic gain in first lactation milk yield could be increased by about 3% if the age of first calving is used as an auxiliary character.

(c) A new Sire Index for Milk Production Corrected for an Auxiliary Trait

In a programme for the genetic improvement of dairy cattle, a major problem is to assess the breeding value of a sire. The average performance of n daughters of a sire gives the most efficient procedure for judging this breeding value, since the correlation between this value and the average performance of sires' daughters tends to one as n increased indefinitely. In order to take into account the unequal production levels of the dams mated to a sire, the daughters average for a character is usually corrected on the basis of the

regression of daughters performance on those of dams for this character. Recently, Narain (1979) has given a new sire index in which we correct the corrected daughter average index for the given character (y) with the help of an auxiliary character (x) by using the averages of daughters, dams and herd in terms of the 'phenotypic index' $I = P_y - b P_x$ as discussed above. The heritability of a character is also replaced by the heritability of the phenotypic index which depends on the heritability of the main character, phenotypic correlation between main character and auxiliary character and C, which equals the product of the genetic correlation between the two traits and the square-root of the ratio of the heritabilities of the auxiliary and the main character respectively. The index is given by

$$S_1 = A_1 + \frac{2nW}{n+a_y} [D - \frac{1}{2} h_1^2 (\bar{M}_1 - A_1 - A_1)]$$

It has been shown that this sire index is more efficient than the previous index in a large number of cases which were examined with the help of data on dairy cattle.

(d) Effect of Inbreeding on Economic Characters

Inbreeding is a mating system in which progeny are produced by parents more closely related than are random members of the population from which they come. In a closed herd, however, it is inevitable because of limited population size. Kumar and Narain (1977) studied the impact of inbreeding on economic characters like birth weight and weight at first calving, lactation yield, lactation period and inter-calving period in a closed Sahiwal herd by grouping the animals according to inbreeding percentage and comparing the performance of the inbred cows with those of their dams. To predict the extent of decrease in various economic characters due to inbreeding, parabolic regression equations were fitted taking inbreeding coefficient as an independent variable and values of various economic characters of the inbred cows as a dependent variable. Significant cumulative adverse effect of inbreeding was noticed after 4% inbreeding coefficient.

(e) Data Analysis in Cross-bred Cattle

It is now well recognised that an efficient and more quick way to increase the milk productivity in India is to improve the Indian cow genetically by adopting cross-breeding of indigenous cattle with exotic breeds such as Holstein-Friesian, Jersey, Red Danes, etc. We can achieve by cross-breeding

in about 5 years as much as we would achieve in 80 years by selection within indigenous breed. Several attempts have been made in the past to improve productivity by cross-breeding. The most significant attempt in this direction has been the cross-breeding policy adopted in military dairy farms where now a large number of animals belonging to various genetic grades and maintained under good managerial practices are available. For studying the comparative performance of different grades of cross-bred cows, Amble and Jain (1967) analysed the data from nine military dairy farms in respect of different characteristics related to production and adaptability. The method of analysis of variance by fitting constants was employed to adjust the grade differences for the possible period to period variation due to changes in environmental factors for each farm separately. However, no attempt was made to quantify the increase or decrease in the character studied due to increase in the level of exotic inheritance. This was subsequently attempted by Narain and Garg (1979). To quantify the amount of increase in milk production as well as the number of days by which calving interval increases due to a unit increase in the level of exotic inheritance, the data relating to 516 cows of different Friesian-Sahiwal grades from nine military farms with lactation records mostly from 1930 to 1955 were analysed. The data were adjusted for grade differences, farm to farm variation as well as differences due to changes in environmental factors over time by fitting a least square model. The results showed significant differences due to grades for first lactation yield and calving interval. Weighted regressions between square constants for grades and exotic level of inheritance were therefore fitted, the weights being the inverse of the variances of the estimates of least square constants. It was found that lactation yield increases with increase in the percentage of exotic level upto about 60 to 65% and decreases thereafter. On the other hand, calving interval decreases with the increase in the level of exotic blood upto about 25% but increases thereafter. It was concluded that for cross-breeding programme in cattle, level of exotic inheritance should be between 50% to 75%.

(f) Lactation Performance Index in Dairy Animals :

In dairy animals, economic considerations suggest that apart from higher lactation yield, the animals should also have optimum lactation length, smaller calving interval, smaller dry and service periods. This calls for devising some index wherein these characteristics can be combined in an optimum manner. A dairy cow or buffalo repeats her lactation a number of times in her life. But there is usually some curvilinear relationship between repeated lactations of the same animal. Sanders Correction factors are therefore

worked out to bring the lactation records of different orders of an animal to her first lactation basis. Such corrected records of an animal provide with repeat performance which could be used to develop a discrimination function for lactation performance based on several characteristics. Such a procedure was developed by Narain and Lal Chand (1979) with the help of data on Sahiwal and Haryana Cattle maintained at Meerut and Agra Military dairy farms respectively. Four characters viz. lactation yield (x_1), lactation length (x_2), calving interval (x_3) dry period (x_4) were considered. The discriminant function was fitted by maximising the variation for the index between animals relative to variation within animals after converting the data to first lactation basis by Sanders' method. The fitted indices were

$$\text{Sahiwal : } y = x_1 - 6.08x_2 + 7.43x_3 - 7.33x_4$$

$$\text{Haryana : } y = x_1 - 1.92x_2 + 2.47x_3 - 2.00x_4$$

The repeatabilities of the indices were estimated for Sahiwal as 0.51 with 95% limits as 0.45 to 0.58 and for Haryana as 0.48 with 95% limits as 0.38 to 0.57.

(g) Relationship between the survival of a cow to culling and its milk yield in first lactation.

From the breeding data maintained at several livestock farms of the Central and the State Governments, it is found that the maximum number of lactations of a cow upto which the data are recorded is of the order of about 15. However, the management practices in the herds are such that a cow is culled as soon as she becomes unproductive. Such culling has to be undertaken in order to allow for their replacement by heifers. As such, if a particular cow continues to give milk upto a certain order of lactation say k-th, then she can be said to have survived (k-1) cullings i.e. during (k-1) preceding lactations she was not removed from the herd for reasons of poor performance, on the assumption that the disposal of a cow for reasons unconnected with its productive performance is not very frequent. As such, a high yielder cow is likely to survive several cullings and can therefore have a longer productive life in the herd. A measure of this productive period can therefore be taken as the proportion of cows in the first lactation which survive cullings to various orders of lactation. Narain and Bhatia (1979) studied the relationship between the productive life of a cow and its milk yield in the first lactation. In order to relate the probability of survival of a cow to cullings with its performance in the first lactation in regard to milk yield a progeny test of each sire is worked out by taking the deviation of the daughters' average

yied (\bar{D}) from the herd average (A). The square of the genetic correlation between milk yield in first lactation and survival to culling upto a given order of lactation was estimated as the proportion of excess x^2 removed by the fitting of the regression of survival on initial milk yield.

The analysis of data on five Indian herds of cattle spread over about 25 years indicated that the cows of Tharparkar herd tend to remain in the herd longer than the other herds. The cows with higher initial milk yield tend to have a longer productive life in the herd. The average yield in the first lactation, as judged by ($\bar{D} - A$), significantly affects the chances of survival of a cow to the culling in the first few orders of lactation. The maximum survival to culling was, by and large, noticed in the third lactation. The genetic correlation coefficient between milk yield in the first lactation and the proportion surviving to 2nd lactation was estimated to be 0.4.

II. SHEEP

(a) Use of Discriminant Function in a Cross-breeding Programme

In a sheep breeding programme aimed at evolving crossbreds suitable for major sheep breeding regions, one of the problems is to have a sound technique for comparing the performance of the different grades of sheep in terms of the economic characters. A grade adjudged best on the basis of greasy fleece weight need not necessarily be the best on the basis of fibre diameter and fibre length or both. For treating this problem Narain and Garg (1975) used the technique of fitting a linear discriminant function which combines the several characters in a optional manner with the help of data collected in a cross-breeding experiment at the Sheep Breeding Farm, Banihal-Reasi, Jammu & Kashmir. It was found that a comparison of the different grades of sheep can be best made by the following linear discriminant function :

$$y = 7.57x_1 - 1.00x_2 - 1.49x_3 + 2.08x_4$$

which combines greasy fleece weight (x_1), fibre diameter (x_2), fibre length (x_3) and fleece density (x_4) in an optimum manner. The discriminating power of this function was found to be much higher than those based on the individual characters. On this basis, half-breds and three-fourths do not differ substantially and the optimum level of exotic blood for stabilizing a new breed could be taken as 50%.

The above procedure assumes the equality of variance-covariance matrices of the two grades under test. However, within grades variance-

covariance matrices are not likely to be equal due to segregation and other factors. In such a case the above procedure cannot be used for the comparison of various grades based on the scores derived with the help of linear discriminant function. Using the same data on sheep, the variance-covariance matrices of pure local and pure Rambouillet breeds were therefore tested for equality and were found to be heterogenous. To deal with this case, when the condition for equality of matrices is not satisfied, Narain and Malhotra (1979) have used an alternative linear procedure which minimises the probabilities of mis-classification and is a minimax procedure. In such a procedure, first of all eigen-roots of $S_1 S_2^{-1}$ where S_1 and S_2 are the two dispersion matrices are estimated from the data. A value lying between the maximum and minimum roots is then chosen and used to evaluate 't' between 0 and 1. This 't' is substituted in the normal equation

$$[t S_1 + (1-t) S_2] b = d$$

where d is the vector of differences between two means. The coefficient vector b is then solved and substituted in the quadratic form

$$b' [t^2 S_1 - (1-t)^2 S_2] b$$

to test whether it becomes practically zero. If it is so, we have the discriminant function $b' x$. If not, another value between maximum and minimum root is chosen and the whole procedure is repeated, till the quadratic form becomes zero. The discriminating power is given by

$$D_p = 2 \left(\frac{b' d}{\sqrt{b' S_1 b} + \sqrt{b' S_2 b}} \right)$$

This reduces to the square-root of D^2 -statistic when S_1 is taken same as S_2 .

(b) Relationship Between the Retention of a Sheep in the Flock and its Wool Yield in the Initial Clip.

Since a sheep giving initially a high wool yield is likely to be retained longer in the flock, it is necessary to study the relationship between the longevity in the flock and the wool yield in the initial clip. With this end in view, the probability of retention of a sheep upto a given order of clip and its relation to the yield in the initial clip were investigated in respect of various grades of ewes bred at the Sheep Breeding Farm at Banihal-Reasi in J&K State by Bhatia and Narain (1973). The proportion of ewes retained to various orders of clips continued to decrease with the increase in the order of clips for both the indigenous and cross-bred ewes. However, the rates of decline were different in the two cases. The greasy fleece weight of the 2nd

clip of ewes retained to various orders of clips showed an almost increasing trend with the increase in the order of clip. The regression coefficients of the proportion retained to a particular order of clip on the average wool yield in the initial clip were calculated in each of the grades including local ewes. This gave a series of regression coefficients corresponding to retention to different clips but each relating to the given initial clip. To compare these regression coefficients, it was considered necessary to divide them by the corresponding overall proportion retained (\bar{q}) to give the relative retention coefficient R which is obviously independent of any units. For the local type and three-fourths, in the initial 4 clips, these coefficients were found to be negative indicating that the ewes were not probably culled on the basis of wool yield. For these grades, beyond the 7th clip, however, the coefficients were found to be positive and showed an increasing trend with the increase in the order of clip. In the case of half-breds, no definite conclusions could be drawn.

III. POULTRY

(a) Statistical methodology for developing efficient selection procedures in poultry breeding.

A series of coordinated Poultry Breeding Programmes for improvement of egg production are currently being undertaken in the country by various State Governments at the instance of the Government of India. One such programme was initiated by Madhya Pradesh State Government at their Regional Poultry Farm at Bhopal with a view to evolve a strain of poultry with high level of egg production by selecting, birds on the basis of Osbornes' Index based on combining the performance of the individual bird with the average performances of the sire and dam families to which the bird belongs. The Government of Madhya Pradesh approached IASRI for providing them with the selection scores of the birds based on this index for rate of lay for the selection programme on a regular basis. Accordingly, a project entitled "Statistical methodology for developing efficient selection procedures in poultry breeding" was initiated with a view to evaluate the selection procedure adopted and suggest alternatives. The project has since been completed and a report thereon is under publication (Narain *et al* (1979)).

The results of the analysis of data collected indicated that the average rate of lay (egg production upto 240 days of age divided by 241 minus the age at first egg) improved by 7% in the course of three generations. However, the average egg weight decreased by about 4 gms during the same period. The

heritability of rate of lay also decreased consistently from 0.129 to 0.002. It appeared therefore that although the method of selection based on the index is effective in improving rate of lay, it results in a correlated decline in the egg weight. To cope with this difficulty, a new index was developed which includes the individual performance for another character in addition to combining the information about main character on the individual bird with those of its full-sibs and half-sibs. It has been observed that the efficiency of the new index is always increased when the genetic and phenotypic correlations are of opposite signs. Another important feature of the index is that it could be useful even for higher values of heritability of trait under improvement provided the correlations are of higher magnitude and are of opposite signs.

(b) Effect of non-normality on response to selection

Very rarely realised selection responses agree with those expected. One of the causes could be the assumption of normality of criterion of selection when in effect it follows a non-normal distribution. For fixed values of accuracy of selection and genetic standard deviation, this amounts to studying the relative magnitude of intensities of selection, corresponding to a given proportion of individuals served, on the assumption of normality vis-a-vis actual distribution. (Rao and Jain (1979)). From the empirical studies, it is seen that Pearsonian Types I and III provide adequate representation to many types of data in the field of poultry. In a few cases, exponential and lognormal distributions are also found to fit well. Beta and gamma distributions for parametric values characterizing common situations can be approximated to normal distribution for moderately heavy and low cullings without any serious error. However, the use of normal approximation for exponential and lognormal distributions is not warranted as the discrepancy in response to selection for almost all values of the proportion of individuals is too serious to be ignored.

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3(a).3 Agricultural Statistics in Animal Sciences

Ry

G. S. Tiwari,

Directorate of Veterinary Services, Madhya Pradesh.

Abstract

The Animal Husbandry Programmes broadly aim (i) the development of better quality livestock, poultry for increasing their productivity by improving their productives efficiency (ii) provide efficient draught animal for crop production and transport and (iii) enable the small and marginal farmers, agricultural labour to undertake Animal Husbandry as a subsidiary occupation for improving their economic condition and social status. Animal Husbandry Sector has a very important role in the Nation's economy but the importance of the application of statistics in animal science has not received the due attention so far. The attempts however have been made to collect, collate, analyse, interpret and evaluate some Animal Husbandary Programmes in recent years. The yield rates, estimated number and annual production of livestock and poultry at State level are available but the livestock statistics often required for planning at regional district, block and other level are hardly available and no attention is also being paid in this context. Planning of livestock development on realistic lines more data are needed in respect of various aspects of livestock husbandry at different levels.

A few of them are indicated below :-

1. Livestock population according to holding.
2. Livestock population possessed by non-cultivators.
3. Availability of motive power for agriculture and rural transport.
4. Cost of producing a crossbred heifers.
5. Extent of losses in productivity and reproductivity due to diseases.
6. Extent of un-avoidable losses through protective measures.
7. Feed and fodder requirement and availability.
8. Extent of economic gains through Animal Husbandary Programmes and their investment pattern.

The above topics are suggestive and not exhaustive.

An integral and vital part of any developmental programme is a proper and timely assessment of the changes that are produced through development. Planning should not confine now only on preparing and implementing the developmental programmes and achieving the physical targets. At the initial stage of planning itself mode and ways for proper assessment and evaluation of the impact of the programme simultaneously and continuously in order to take mid-course corrective action wherever necessary should be decided.

3(a).4 **Veterinarians and Statistical Tools**

By

N. Y. Palimkar, M. A. U., Prabhani (Maharashtra).

Abstract

The importance of statistics is never denied by any research worker. But its use in their sciences is done according to their conveniences, and veterinarians are not an exception.

To ascertain the use of statistical tools by veterinarians at Agricultural University, Parbhani, an attempt is made by the author, to find out to what extent statistics is used in different disciplines of veterinary.

Out of 125 observations from 13 departments it is observed that the methods are used to 65 per cent, sampling 18 per cent and designs 17 per cent.

Moreover, the reasons for not using statistics, on large scale were asked, and it is concluded that due to complications in the statistical tools and lack of trained personnels in their colleges is the main cause of it.

3(a).5 **Different Methods of Sire Evaluation**

By

Dharamendra Kumar and Prem Narain,

Directorate of Animal Husbandry, Uttar Pradesh and I. A. S. R. I.,
New Delhi.

Abstract

Five different methods have been used to evaluate 14 sires in respect of milk yield, using the data of Sahi wal Cows of Chak-ganjaria farms at Lucknow. One of the methods use only daughters production, whereas in two of the me-

thods records of dams production are also utilised. Out of the remaining two in one of them information on daughters and contemporaries are used whereas in the other information on both the dam and daughters alongwith their contemporaries are used. One of the indices is, however, different from the other four indices in the sense that it utilises information on a correlated auxiliary character such as either age at first calving or first calving interval. It has been found that the index with calving interval as the auxiliary character is more efficient than the others. It has been recommended that for increasing the efficiency of sire evaluation for milk production, it may be necessary to utilise information on one or more auxiliary characters which are correlated with milk yield.

3 (a).6 Cost of Production of Poultry and Eggs

By

U. G. Nadkarni,

Indian Agricultural Statistics Research Institute, New Delhi

Abstract

Two pilot surveys for the estimation of cost of production of poultry and eggs at the commercial farms, the first in Dasuys and Tanda regions of Hoshiarpur districts of Punjab state during the years 1967-69 and the second in the Union Territory of Delhi during the years 1969-71 were carried out by IASRI.

The objectives of both these surveys were (i) to evolve suitable methodology for the estimation of cost of poultry and egg production under commercial management conditions which will evolve estimates of cost of production of tables and hatching type eggs and cost of rearing of birds upto various ages from day-old to adult stage and cost of maintenance of layers and cocks together with estimates of various components of cost and their variation both in monetary terms and in terms of physical quantities ; (ii) to secure information for lowering the cost and on price spread. For the purpose of these surveys, a commercial poultry farm was taken as one which had at least 50 layers, and habitually sold eggs and/or birds. In this paper, the cost-structure for the production of birds and eggs was presented, and the variation in these over the four farm categories were studied. The four farm categories were (i) urban with membership of co-operative society, (ii) urban individuals, (iii) rural with membership of Cooperative Society, (iv) rural individual.

These comparisons showed that (i) farms in the rural sector in both the States in general incurred higher cost of maintenance of birds and production of eggs than the farms in urban sector; (ii) individual farming units had incurred higher cost of maintenance of birds than the co-opting farming units. The possible reasons for this may be that the inputs were obtained at higher rates in rural sector than in urban area and the technology adopted might have been efficient in rural sector.

3 (a).7 Impact of Milk Supply Schemes on Rural Economy in Milk Collection Areas

By

H.P. Singh and B.C. Saxena,

Indian Agricultural Statistics Research Institute, New Delhi.

Abstract

The milk supply schemes in urban areas draw upon their milk requirements from the neighbouring villages. As a consequence of which the milk producers supplying milk to these schemes are assured of market and a guaranteed price of milk. This leads to a certain impact on the milk production potential as well as economy of the milk producers in the rural areas. With a view to develop a suitable sampling technique for estimating the changes in the rural economy that are taking place in the milk shed areas of milk supply schemes, large scale sample surveys were carried out by I.A.S.R.I. at two points of time in the milk shed areas of four major milk supply schemes, namely Delhi Milk Supply Scheme, Delhi; Duthsagar Dairy, Mehsana; Madhavaram Milk Supply Scheme, Madras and Greater Calcutta Milk Supply Scheme, Calcutta.

The design adopted in these surveys was a stratified two stage random sampling with clusters of villages as first stage units and households as second stage units. In order to assess correctly, the impact of milk supply schemes, the changes were simultaneously studied in the supplying area as well as control area (villages agro-biologically similar to supplying one but not supplying milk to any organised milk agency). The comparative picture of changes in the supplying area and the control area will thus provide a measure of the impact of milk supply schemes. The response indicators studied include changes in the number of breed of milch animals, milk production and its mode of utilisation, feeding status of animals, cropping and employment pattern, gross annual income etc.

The results on the socio-economic status of the rural milk producers in the milk shed areas of four major dairy plans indicated their pre-dominant contribution in developing India's Dairy Industries. The findings of these investigations lead us to the conclusion that a dairy plant could be effective in improving socio-economic status of the rural milk producers. It is very necessary to provide simultaneously with the setting up of dairy plant, the necessary in-fra-structure for the milk producers in terms of their own milk collection cum marketing unions in addition to provide them liberal loans for purchase of high yielding milch animals, cattle feed and improved fodder seeds at subsidised rates as well as necessary facilities for veterinary aid. To improve the structure of the organised sector of India's Dairy Industries, rural milk producers have therefore to be involved to the fullest extent. The linkage between the rural milk producers and dairy plants which draw upon their milk from them should be straightforward and direct. Intermediate milk collection agency such as middleman should have no hand in transporting the rurally milk produced to the dairy. It is therefore necessary, that milk producers should be knit together in the form of Producer's Cooperatives which need to be handled by themselves at all levels.

3 (a). 8 Methodology for Studying Growth Rate of Milk in Plan Period

By

Dharmendra Kumar,

Directorate of Animal Husbandry, Lucknow (U.P.)

Abstract

For studying growth rate of milk in a plan period, the inputs provided up to fourth plan as well as proposed to be provided during fifth plan period were used. The milk production during fifth plan will increase due to (i) increase in the no. of graded cows and buffaloes (ii) increase in the no. of cross-bred cows (iii) impact of additional inputs in existing I.C.D. projects in the fifth plan and (iv) impact of additional acreage under high yielding and nutritious varieties of fodder. The total increase in milk production due to above mentioned 4 inputs would be 5.96 lakh metric tonnes comprising of 5.06 lakh metric tonnes from graded cows and buffaloes, 0.35 lakh metric tonnes from the progeny of exotic and cross-bred bulls, 0.51 lakh metric tonnes from the impact of I.C.D. projects and 0.04 lakh metric tonnes from increase in acreage of green fodder, taking 48.55 lakh tonnes of milk at the end of 1973-74, the growth rate of milk for the Vth plan period would be 12.28%. giving compound annual growth rate of 2.34%.

Based on the discussions held during the session, the recommendations made were as follows :-

1. It was pointed out that based on the scientific investigations in the field of animal sciences, certain statistical methodologies have been evolved but these need to be adopted more widely by the organisations concerned. It was, therefore, recommended that IASRI may prepare a list of all such studies made at various Institutes and Agricultural Universities and circulate to various organisations for their adoption.

(Action : IASRI, Other Institutes, Agril. Universities, State Departments of A.H. and Ministry of Agriculture).

2. It was felt that there may be a number of constraints for adopting the techniques already evolved. It was, therefore, recommended that these constraints may be examined in detail and necessary modifications made in the methodology. IASRI may initiate action in this regard.

(Action : IASRI, State Departments of A. H. and Ministry of Agriculture).

3. For a proper dissemination of various results obtained in statistical research as applied to animal sciences and for wider applications of methodologies, it was recommended that a Workshop/Summer Institute might be organised at the IASRI. This will also provide desired forum for mutual discussions and formulation of appropriate programmes for adoption.

(Action : IASRI)

4. While adopting the methodology on the integrated plan for estimating the annual output of principal livestock products, some states expressed certain difficulties, both in respect of sampling designs as well as in their implementation. It was recommended that these aspects might be discussed by the concerned agencies with the coordinating agency and the IASRI to arrive at a suitable plan of work.

(Action : Division of Animal Husbandry, Department of Agriculture).

5. In order to examine the operational feasibility and possibility of improving the sampling techniques and reduction in cost by collecting data by enquiry, it was recommended that data may be collected simultaneously by enquiry and observation while carrying out pilot investigations. (Action : IASRI and State Departments)
6. As there is a need for working out projection of milk production and other livestock products in the near and distant future, it was recommended that suitable methodologies may be evolved for such projections, as also the demand projections. (Action : IASRI)
7. Although data collected in livestock farms are analysed to study the performance of a herd, it was felt that more efforts may be made to collect data on animals maintained under village conditions to judge their performance.

(Action : IASRI, State Deptts., Agricultural Universities and other Institutes)
8. A large body of data are collected during surveys and experimental investigations in animal husbandry and dairy fields with some specific objectives. It was recommended that these secondary data may be critically examined for making further useful studies.

(Action : IASRI, other Institutes, State Departments, Agricultural Universities and Ministry of Agriculture).
9. The possibility of using discriminant function approach and other multivariate techniques for improvement in analysis of breeding data on cattle may be explored.

(Action : IASRI, other Institutes, Agricultural Universities).
10. Studies may be made to examine the various methods evolved so far for working out sire indices in respect of their efficiency, stability, etc.

(Action : IASRI, other Institutes, Agricultural Universities, State Departments)

11. There is an urgent need for knowing the number of cattle and buffaloes under different breeds as well as crossbred ones in the country. It was recommended that in the first instance the number of crossbred animals may be obtained during quinquennial livestock census.

(Action : Ministry of Agriculture and State Deptts.)

TECHNICAL SESSION—III (B)

Agricultural Statistics in Fisheries

26th June (Tuesday), 1979

11.15 A.M.

Chairman :

Dr. Daroga Singh,
Director,
I.A.S.R.I., New Delhi.

Rapporteur :

Sh. K. K. Ghosh

Invited Speakers :

(i) Sh. K.K. Ghosh, C. I. F. R. I.,
Barrackpore.

(ii) Sh. T. Jacob/Dr. K. Alagaraja,
C.M.F.R.I., Cochin.

Others :

(iii) Sh. V. Ramamoorthy, Dte. of
Fisheries, Madras.

(iv) Sh. A.K. Sen, Dte. of Fisheries,
Calcutta.

3 (b).1 Inland Fisheries Research Statistics in India

By

K. K. Ghosh,

Central Inland Fisheries Research Institute, Barrackpore, West Bengal

Scope of Fisheries Research Statistics

Fisheries Research Statistics broadly encompass (i) biological statistics on fish and their populations, other aquatic biota of importance in relation to their ecologies (ii) statistics on catch, fish producing effort, their structure in quality and quantity over space and time in capture fisheries (iii) statistics on production in relation to various inputs biotic and biotic variables affecting growth and survival in aquaculture. Fisheries research statistics bears the same linkage with fisheries statistics as agricultural or animal husbandry research statistics, bears with agricultural animal husbandry statistics.

The prime objective of inland fisheries research being elucidation of sound strategies for management and optimum utilisation of inland aquatic resources, the statistical data and quantitative analytical technique development are basically resource oriented. In order to appreciate the requirements of fisheries research statistics, it is therefore, necessary to have an overview of inland fisheries resource identification.

Inland Fisheries Resources Identification

Inland fisheries resources refer to aquatic resources on land forms sustaining or capable of sustaining fishery wealth. This is distinct from marine fisheries resources, which are of oceans, seas and their arms. Landbased aquatic resources are broadly classified as (i) capture fisheries resources and (ii) culture fisheries resources. Their distinction is fundamental in approach. In capture fisheries, the resources managed by man are the fish populations, so that they utilise optimally the available ecological productive capacity of the aquatic system and yield fishery produce around a sustained optimum (or maximum). The real resources exploited and managed by man in such cases are fish populations in the aquatic systems.

Aquaculture attempts the opposite by altering the ecological opportunities in a culture medium through management means to suit optimally the organisms under culture, whether fed extraneously or left to draw their food from culture environment. Thus in such cases the resources are the culture compartments

available for management control. So we call the land areas under water as culture fisheries resources. Such management objectives necessitates the formulation and evaluation of measures of optimization. Formulations come through research. Research statistics provide the basic data and quantitative analytical tools of statistics are utilised for assessment of natural productivity of resources and formulation of management measures.

Requirements of Research Statistics in Fisheries

The fisheries research statistics need can be broadly classified as.

1. Capture Fisheries

- (i) Biological data of populations : Identification of populations, their, abundance and basic biologies, such as growth, reproduction, mortality-age-structure, spatial and temporal distributions etc.
- (ii) Exploitation structure : Quality and quantity of effort expended at capture, age-size structure of catches in time and space by different gear.
- (iii) Statistical techniques, basically for fitting mathematical or statistical models to research data (stochastic models in fisheries science have attempted very recently by more advanced countries only in very specific cases).

2. Culture Fisheries

Culture fisheries research statistics needs are an amalgam of the needs of agricultural and of animal sciences research statistics. These data related to

- (i) Identification of suitable organism for culture in different aquatic closed manageable systems based on quantitatively assessed quality characteristics. The age old experience dominates in choice of organisms as in agricultural or animal husbandry, depending on ecology preference of organisms.
- (ii) Identification of nutritioa requirements and ecological tolerances of different species for formulation of high conversion efficiency diet schedules. This is similar to that of animal husbandry.
- (iii) Reproductive biology studies including research on genetics for evolving desirable strains of cultivable species. Again a close similarity exists with genetic research as on animals, with the added advantage of following plant genetic research quantitative approach because of highly fecund nature of fishes, which are capable of producing thousands or lakhs in one breeding.

- (iv) Pest and pollution control research similar to both agricultural as well as animal husbandry research.

Status of Indian Inland Fisheries Research Statistics

Indian experience in inland fisheries research, though about a century old, is largely of the past fifty years. Organised attempt is of still recent origin, practically, emanating from the birth of Central Inland Fisheries Research Institute in 1947 and taking shape in the last 25 years.

In capture fisheries research, the major inland aquatic fisheries resources of the country have been studied in varying details employing various tools of data collection and analysis.

The Ganga fisheries have been studied through capture fishery based methods to identify the fauristic structure of different stretches of the river system. Basic biological statistics on age, growth, fecundity, reproduction and yield have been estimated through sampling techniques, for selected fishes. Studies on abundance, mortality rates, effort structure and catch structure by effort pattern is not fully available. Organised fishery being absent, effort statistics are different to compile, still more difficult to caleberate and utilise. Most of the statistical tools of abundance and mortality studies are based on effort data. Techniques based on age and growth relationship coupled with age structure of catches, under broad assumptions, have been attempted to identify the mortality levels. Two or three paremateric simple statistical models have been applied, heavily banking on regression approach for estimation and analysis, in studies of growth, age and mortality estimation of fish populations.

In the case of Hooghly—Matlah estuarine system, catch and effort statistics have been estimated by employing stratified multistage sampling and yield estimates have been built up. Biological statistics on age, growth, fecundity, mortality and population characteristics have been built up for some important fisheries. Abundance and potential yield based on dynamics on population models have not been estimated for the entire multispecies fisheries, although for some species it has been done with fair degree of success.

Capture fisheries resources of Chilka Lake, Pulicat Lake, sections of Godavari and Narmada rivers ; have been also similarly assessed, though the depth of analytical approach is somewhat limited except in case of Chilka Lake.

Organised collection of inland capture fisheries statistics under any objective programme being absent in the country, it has not been possible to go further than what has been done with the limited fisheries at CIFRI.

Alongside the study of catch, effort, biological parameters of fish, exploitation pattern and fish abundances of different resources, the ecology of different systems have been studied employing various statistical sampling and estimation tools to assess the production potential of the systems.

The quality and detailed data require to calibrate effort, estimate accurately fluctuations in age class strengths, requirement, exploitation structure of catch and effort are lacking. Thus dynamic population model approach for estimating potential yields and identifying optimal levels of exploitation have not been possible. The modern approach of non-fishery based methods, such as productivity estimation through various trophic levels of energy transfer to estimate potential capacities of productions that can be profitably exploited by man, has not yet been applied in sizeable measure in inland fisheries research except in case of some reservoirs. Thus these research statistics are lacking.

In the case of some selected reservoirs of India, however, ecological parameters have been studied at some depth and basic research statistics on the ecological variable are available. The building of indices of productive potential has been attempted, based on these basic research statistics. The research data on effort, catch and their structure is available for such investigated reservoirs. Among these may be mentioned the D.V.C., Rihand, Getalsud, Nagargunsaagar, Bhavanisagar, Ukei and Govindsagar Reservoirs.

Culture Fisheries

The situation in culture fisheries is relatively more bleak. The basic research statistics for identifying dosage levels of various inputs in aquaculture such as seeding rate, size at seeding, optimum combinations in polyculture, fertilizer requirements, supplementary feeding schedules, exploitation optimum, etc. generated through a series of isolated experimentations. The trial and error method has led to the development of high yielding technologies of different fish culture systems. Planned experimental designs, involving use of statistical principles, have practically not been adopted so far for want of basic research facilities. Trend approach has been adopted to estimate input levels in culture fisheries operations.

Research statistics on nutrition requirements and ecological tolerances of selected indigenous species of fish and prawns are mostly lacking. Feed formu-

lations are largely empirical. Statistical evaluation of feed formulations have been done only, in story cases for certain young stages in laboratory conditions.

Genetic data for line identifications of indigenous fish stocks of India are almost wholly absent. Applied research on development of hybrids have been done, but hybrid quality, heritability coefficients, genetic advance, etc. have not been studied.

Estimation of Resources and Fish Catch Data

The inland capture fisheries resources of the country are some what understood. Fisheries resources have been identified for the more important capture fisheries waters. Their trends have been analysed in some cases. But potentials or regenerative productive capacities have not been well assessed in most cases. Data on extent of riverine resources are available in comparatively greater detail for the Ganga, the Yamuna, the Godavari the estuaries of Hooghly and others in Sunderbans, Mahanadi, Godavari, brackishwater lagoons, Enilka lake, Pulicat Lake, and Kerala Backwaters. Resource data on some selected reservoirs and fish catches therefore, are known.

The coldwater high altitude fisheries in streams and lakes of upland are poorly developed and less known. Very little data exists on these resources.

The total extent of area under storage reservoirs is not available. Water resource statistics or irrigation statistics provide, the total storage capacity according to drainages or streams. The number of such storage reservoirs is not readily known.

The situation in culture fisheries is much more bleak. This resource portion is not well understood or known. Estimates of aggregated area of ponds at tanks, swamps, reservoirs and brackishwater area, released from time to time by the fisheries division of the Central Ministry of Agriculture, etc. are highly divergent, incoherent and of little value. The fish catch from such resources are not collected through any objective methodology. The figures of fish catch released by fisheries division of the Central Ministry of Agriculture are highly unsatisfactory since they are subjectively built up. The quality of catch or production data of different States can be very well assessed by the fact that the annual achievements have been exactly equal to plan targets in most of the States (Table 1).

Utilisation of Inland Fisheries Resource

Capture fisheries resources and their utilisation data is presented in Table 2 to provide a glimpse of available knowledge on productivity of some of the

investigated resources. A similar figure can not be given for culture fisheries resources since they are not available. Resource data released by the fisheries division of the Government of India from time to time and other source speak for themselves about their quality. These are shown in Tables 3 and 4.

Need for Improvement and Possible Approach

It is necessary to provide a bench mark to inland fisheries data base of India, to assess the impact and benefit of developmental planning. A quinquennial fisheries Census in the country, similar to the decennial agricultural census or quinquennial livestock census is a must to provide such a bench mark. For requirements of quickly building up data on basic resources and their utilisation, it is necessary to recognise a few basic facts and adopt the procedures listed below.

- (i) The water resources of the country especially the surface waters flowing through streams and rivers and managed through run-of the river or storage projects for irrigation and power generation are of paramount importance for inland fisheries also and need to be viewed as the basic resources for development of inland fisheries
- (ii) The Land Utilisation Survey (LUS), which at present is directed towards estimating agricultural utilisation, can be suitably enlarged to meet the need of inland fisheries. The subhead, lands under non-agricultural use, at present accounts for all water areas such as rivers, canals, ponds, tanks in addition to houses, roads, buildings, parks, etc. It is possible to enlarge the schedule by introducing a broad-head 'under water'. Further sub-heads for perennial/seasonal area, utilisation under various systems of fish culture exploitation, number of crops per year, etc. could provide the much needed data on resource and its utilisation. Similar enlargement of irrigation statistics schedules would help further in assessing resources and their utilisation.
- (iii) The CIFRI, being technically best equipped to interpret inland fisheries data, may be charged to be a major depository of inland fisheries statistics relating to various technologies, their results, resource and utilisation etc.

The statistics Division of CIFRI can be asked to formulate schedules of data requirements. The States fisheries departments and other agencies can help to collect possible statistics so that a proper

perspective be developed of existing data base of inland fisheries.

- (iv) The CIFRI in collaboration with IASRI are already involved in development of objective methodologies for estimation of inland fisheries resources and catch. A coordinated programme, involving the active participation of State Fisheries Departments, may be developed so that pilot scheme surveys are extended to all areas quickly and completed in all States India to meet the needs of methodologies,

Table-1 : The striking coincidence of targets and achievements in inland fish production of some States in 1975-1976.

States	Fish production ('000' tonnes)		Spawn production (in millions)		Fry & Fingerlines production (in millions)	
	Target	Achivement	Target	Achievement	Target	Achievement
Andhra Pradesh	100.00	100.00	50.00	47.00	46.00	46.00
Bihar	73.00	68.00	260.00	280.00	70.00	57.50
Haryana	1.25	1.25	3.65	3.65	0.70	0.70
Himachal Pradesh	0.95	0.95	—	—	2.00	2.00
Kerala	24.00	24.00	6.00	6.00	3.00	3.00
Madhya Pradesh	9.50	9.50	250.00	250.00	40.00	40.00
Maharashtra	19.40	19.30	90.00	90.00	65.00	65.00
Manipur	1.80	1.80	12.00	8.00	2.00	2.00
Meghalaya	1.85	1.85	0.60	0.60	0.36	0.36
Karnataka	75.00	75.00	100.00	80.00	25.00	27.00
Nagaland	0.16	0.16	0.09	0.09	0.60	0.85
Orissa	25.00	25.00	400.00	400.00	48.00	48.00
Punjab	2.10	2.10	6.00	6.00	1.20	1.20
Uttar Pradesh	26.50	26.50	250.00	191.00	27.00	22.00
Rajasthan	9.50	9.50	80.00	70.00	20.00	18.00
Tamil Nadu	175.00	175.00	—	—	45.00	64.00
West Bengal	250.00	260.00	600.00	600.00	50.00	120.00

Based of Statistical Supplement (1976), Fisheries Division, Ministry of Agriculture, etc., Govt. of India.

Table-2 : A synoptic account of studies of capture fisheries resources and their utilisation.

System	Area or length	Commercially productive area or length	Length or area covered for estimation	Estimated reference years	Yield rates (Kg/ha/yr yield rate)	Catch estimation techniques	Resource utilisation
1	2	3	4	5	6	7	8
RIVERS							
R. Ganga	—	C. 1600 km	} 14800 ha	1958-61	56	Two stage sampling for estimation of marketed quantity at selected points.	Irrational, exploitation resulting in lowering of carp populations.
R. Yamuna.	—	C. 850 km		1961-69	50.3	Provides lower bund of estimates of catch, ring subsistence factor about 8-10%.	Hilsa fishery disappeared in post 1973 period above Farakka Barrage.
Ganga system	—	Carp spawn yield	U.P.	1967-70 1972-75	160-170 million/yr 49-61.6 million/yr	State collection, enumeration data.	18-23 productive centres (more than 1 million/yr) in 1967-70. 6-9 such centres in 1972-75. Water management and abstraction affected spawn yield.

1	2	3	4	5	6	7	8
			Bihar	Pre 1964	3000	Estimation technique	Fall after 1964 attrib-
				1960-64	2010	not known. Mostly	ted to North Bihar
				1973	2037	through lessee retu-	flood control embank-
					mllion/yr	rns, railway book-	ment project.
			West Bengal	Per 1964	1200	Estimation Technique	Fall in yield in post-
				1971-75	530	not known.	1973 period attributed
					million/yr		to Farraka Barrage.
Godavari	1440 km	Not available	189 km	1963-64	9.24	Statistical three stage	The area between
				1965-69	6.75	cluster sampling. Ration	Dummugudam and
						estimate of total. Stan-	Dowlaiswaran anicuts
						dard errors not known.	show lowered yield due
						Gearwise, species-wise	to irrational exploita-
						catches and efforts avai-	tion.
						lable.	
R. Narbada	1280 km	Not available	48 km	1958-66	8.9	Market arrivals at two	Resources not assessed,
						enumerated points.	
						Lower bounds of estim-	
						ate.	

1	2	3	4	5	6	7	8
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ESTUARIES

Hooghly- Matlah system	0.4 milli- on ha	<u>C.</u> 26,500 ha	<u>C.</u> 26,500 ha	1966-71 1974-75	306.7 484.2	Total species-wise, gear Catch of marine species wise catch estimated by rising with higher effort, a three stage cluster sam- higher CPUE. Post- pling. Ratio estimates 1973 lowered salinity margin of erro estimated affecting abundance of 3-10%. Coefficient of vari- marine species. ation of annual estimates 6-10%.	
		Additional sizable quantities of prawn, bhetki, Mullet seed collected. Quantity not estimated.					
Godavari Mahanadi	<u>C.</u> 30,000	<u>C.</u> 30,000 ha	30,000 ha	1961-64	19.00	Two stage maket sampl- Yield pattern show ing of dry fish marketing. under exploitation. Raising factor used for dry to fresh conversion. Fresh fish landing enum- erated. Sampling estimat- ed having error variance of 14.03%.	
Godavari	<u>C.</u> 18,000	<u>C.</u> 18,000 ha	18,000 ha	1963-64	196	Estimation technique not Resource assessment known. not available.	

1	2	3	4	5	6	7	8
Adyar	6.4 km	<u>C.</u> 100 ha	100 ha	1963-64	144	Estimation techniques not known,	In recent years the pollutional load of Madres City discharge has affected yields.
Kazubeli	<u>C.</u> 782 ha	782 ha	782 ha	1969-70	92		
Ponnaiyar	<u>C.</u> 43 ha	43 ha	43 ha	„	302		
Godilam	<u>C.</u> 346 ha	346 ha	346 ha	„	52	Estimation techniques	Resource assessment
Parvanan						} not known.	not known-
Vellai	<u>C.</u> 262 ha	262 ha	262 ha	„	111		
Killar	<u>C.</u> 1685 ha	1685 ha	1685 ha	„	82		
Coleroon	<u>C.</u> 809 ha	809 ha	809 ha	„	111		

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WARMWATER RESERVOIRS

1. Tilaiya	6475	(FRL+DSL)/2	1962-68	6.5	State owned waters. Under exploited under Fishery controlled. Total managed. Potential yields known through yield 100 kg/ha/yr. enumeration.	
2. Maithon	11492	—do—	„	1.9	—do—	—do—
3. Konar	2792	—do—	„	6.4	—do—	—do—
4. Panchet	7511	—do—	„	2.7	—do—	—do—

1	2	3	4	5	6	7	8
5. Stanley	14690	—do—		1968-69	62.9	—do—	Showing increased yields now.
6. Bhavanisagar	7875	—do—		1968-69	27.8	—do—	Potential of Bhavanisagar 118 kg/ha/yr. At present under exploited.
		—do—		1976-77	80.0	—do—	—do—
7. Sathanur	1255	(FRL+DSL)/2		1976-77	77.0	State owned waters. Weel exploited. Fishery controlled. Total oped reservoir yields known through enumeration.	Devel
8. Krishnagiri	1250	—do—			20.5	—do—	—do—
9. Amravati	850	—do—			160.0	—do—	—do—
10. Rihand	46620	—do—		1964-69	9.7	—do—	Under exploited. Potential yield 40 kg//yr ha
				1970-71	2.26		
11. Tungabhadra	37814	—do—		1961-65	6.20	—do—	
12. Gobindsagar	11000	—do—		1976-77	50.0		Under exploited. Potential yield 276 kg/ha/yr.
13. Nagarjun-sagar	18429	—do—		1976-77	6.00	—do—	Potential yield 88 kg/ha/yr.
14. Ukai	60095	—do—		„	5.60	—do—	Potential yield 220 kg/ha/yr.

1	2	3	4	5	6	7	8
15. Harsi	2560	965	FRL/4+DSL	1963-67	52.8	—do—	Harsi, Pagara are not developed still.
16. Pagara	1441	480	„	„	55.9	—do—	
17. Madansagar	444	200	„	„	120.4	—od—	Madansagar, Gwaisagar, Yeshwantsagar are developed.
18. Gwaisagar	280	212	„	„	203.1	—do—	
19. Yeshwantsagar	1025	460	„	„	51.1	—do—	
20. Maniari	2400	800	„	„	45.3	—do—	Maniari and Gandhisagar are being developed.
21. Gandhisagar	64750	34000	„	„	6.6	—do—	
22. Hirakud	72592	(FRL+DSL)/2		1968-69	0.21	Not known	Under exploited.

BRACKISHWATER LAGOONS

Chilka Lake	116 000 ha	C. 100 000 ha	C. 100 000 ha	1954-55	47.00	Sampling technique at assembly points. Total catch estimates of overexploitation. reliable.	Resources irrationally exploited, suggestive of overexploitation.
				1964-65	30.00		
				1970-71	27.40		
Pulicat Lake	77 700 ha	37 000	37 000	1965-70	26.6	—do—	Production potential not fully assessed.
Kerala Backwaters	50 000 ha	50 000 ha	50 000 ha	NA	Fish & Prawn 280-340 Clams-1760	Not available Data reliability not known.	Catches decline in recent years. Overexploitation suggested.

Table-3: Comparative data on area (thousand hectares) of impounded water resources of India according to different sources.

States Union Territories	Ponds and Tanks				Reservoirs		Total		Remarks
	New Delhi (1976)	Fish Shed Committee (1966)	New Delhi (1976)	Fish Seed Committee (1966)	New Delhi (1976)	Jhingran (1975)	Fish Seed Committee (1966)	Silas (1978)	
1	2	3	4	5	6	7	8	9	10
1. Andhra Pradesh	91.05	...	111.29	...	202.34	133.97	42.10	177.10	
2. Assam	185.0	...	—	...	18.50	NR	4.36*	19070.00	*Includes Meghalaya, Mizoram, Arunachal Pradesh.
3. Bihar	80.00	...	20.00	...	100.00	37.25	150.00	485.50	Does not include DVC Reservoirs.
4. Gujarat	48.00	6.50	99.00	0.80	147.00	82.94	7.32	331.00	
5. Haryana	1.20	**	0.03	**	1.23	**	**	380.00	**Included in Punjab
6. Himachal Pradesh	—	0.20	0.04	12.00	13.00	**	0.04	NR	
7. Jammu Kashmir	—	NR	0.40	NR	0.40	00.10	NR	89.40	
8. Karnataka	272.00	...	126.00	...	398.00	152.77	240.20	749.00	
9. Kerala	3.30	3.18	6.50	6.23	9.80	19.43	9.41	94.80	
10. Madhya Pradesh	39.07	20.80	300.03	100.00	340.00	152.05	120.80	526.90	
11. Maharashtra	123.00	10.70*	95.00	49.51*	218.00	151.11	60.21*	263.40	*Only cultiva- ble waters in 1964.

1	2	3	4	5	6	7	8	9	10
12. Manipur	0.80	0.86	8.10	8.10	8.90	NR	8.96	29.10	
13. Maghalaya	1.70	**	0.95	**	2.65	NR	**	1.00	**Included in Assam
14. Nagaland	0.10	...	—	...	0.10	NR	0.22	40.70	
15. Orissa	22.00	...	256.00	...	278.00	79.87	116.33	409.60	
16. Punjab	3.10	5.06*	0.10	8.53*	3.20	43.37+	13.59*	420.90	*Includes Haryana +Includes Haryana and Himachal Praderh.
17. Rajasthan	...	54.00	...	18.80	121.40	43.92	72.80	202.30	
18. Tamil Nadu	255.12	...	48.96	...	304.08	49.88	240.00	418.80	
19. Tripura	4.12	6.12	2.20	1.08	6.32	NR	7.20	27.50	
20. Uttar Pradesh	162.00	19.97	—	10.10	162.00	125.73	30.70	849.80	
21. West Bengal	323.70	23.57	320.00	566.50	
22. Delhi	0.11	0.12	—	—	0.11	NR	0.12	5.30	
23. Arunachal Pradesh	0.12	0.06	—	—	0.12	NR	0.06	40.90	
24. Goa	0.10	NR	—	NR	0.10	NR	NR	NR	
25. Pondicherry	0.51	0.12	—	0.84	0.51	NR	0.96	1.00	
26. DVC Reservoirs	—	—	—	30.00	—	—	30.00	—	
27. Tungabhadra Reservoirs	—	—	—	37.38	—	—	37.38	—	

Notes : ...Classified data not reported.
NR-Data not reported.

Table-4

Total area (thousand hectares) under ponds, tanks and reservoirs according to various sources.

Source	Ponds & tanks	Reservoirs	Total	Remarks
Fish Seed Committee				
(1966) Classified	127.69	284.17	412.86	
Un-classified	—	—	1200.90	
Total :			1613.76	
New Delhi (1976)	1425.9	1074.60	2659.79	
Silas (1978)			25380.60	
National Commission of Agriculture Report (1976)				
Less than 10 ha	400.00			
More than 10 ha	1100.00			
Total :	1500.00	3000.00	4500.00	

Table-5 : Comparison of brackishwater area (million hectore) in maritime States based on different sources.

State	Total Brackishwater area in M ha according to				Remarks
	Cochin (1972)	Silas (1978)	National Commission of Agriculture	New Delhi (1976)	
Gujarat	.376	0.4189	0.376	0.375	Silas (1978 provides the 'brackishwater area', presumably including estuaries.
Maharashtra	.081	0.1214	0.080	—	
Karnataka	.008	0.1092	0.080	0.007	Cochin (1978) provides data of brackishwater and estuarine area.
Kerala	0.243	0.3399	0.200	0.203	Suitable for brackishwater aquaculture.
Tamil Nadu	.080	0.1457	0.080	0.047*	*Inclusive of estuaries.
Andhra Pradesh	0.200	0.5665	0.200	0.121**	**Inclusive of Lakes and estuaries,
Orissa	0.299	0.4128	0.008	0.008	Exclusive of Chilka Lake.
West Bangal	0.405	0.8175	0.400	0.404	
Others	.020				
Total	1.712	2.9319	1.424	1.165	

3(b).2 Application of Statistical Methods in Fisheries Research and Development

By

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Total annual catch of fish from India is about 2.4 million tonnes, the contribution from marine sector being about 1.4 million tonnes. Fish and fish products earn over 2,000 million rupees every year in foreign change. Added to that it is a common man's protein-rich food. As such fisheries sector needs special attention both from research and development angles. Moreover since it is a renewable resource, detailed data on various aspects of dynamics of fisheries, are required for proper management of this resource. Quantitative analysis in fisheries science demand of the application of statistical tools, as in any other field. However the units under study in fisheries are not within the visual horizon as compared to those in crop and livestock fields. Hence development of appropriate techniques to study fish population is a must. Some of the important methods used at present are briefly discussed in this paper.

Sampling Techniques

Fish landings take place throughout day and night overtime and landing centres are widely scattered over space. Complete enumeration of catch is almost impossible. Hence sample survey techniques suited to the fishing conditions have been developed for estimation of fish landings in India.

Estimation of Marine Fish Landings

On the basis of pilot surveys conducted by C. M. F. R. I. in 1948- 49, fisheries data were collected on regular and systematic basis from 1950 by dividing the entire coastal line of India into 12 survey zones, each zone manned by a well trained field staff for the collection of catch statistics. From 1957 the coverage was further increased by increasing the zones from 12 to 20 and collection of additional data on fishing effort was also initiated from that year. Since the zones were too big containing many landing centres to be covered on the bases of random sampling procedure, a purposive sampling scheme was adopted

collecting data from fixed landing centres. During 1950-56 the Indian Council of Agricultural Research initiated a number of pilot surveys of various designs in different regions of the country, with a view to evolving a suitable sampling design for the estimation of marine fish landings in India. On the basis of above studies and the vast experience gained by the Central Marine Fisheries Research Institute (C.M.F.R.I.) since 1948 in the collection of marine fish catch statistics, the Institute has developed and introduced a stratified multistage random sampling design suited to our conditions involving space-time stratification where a number of geographically contiguous landing centres from space stratum and a ten days period of a month the time stratum. This design was first put into operation in the Kerala State in the middle of 1969 and was progressively extended to other states of India culminating in the formation of 57 zones on all India level, covering about 1300 landing centres.

Earlier, as there was no demand for district—wise estimates, zones were formed without taking this aspect into consideration. Now-a-days district level planning is gaining momentum and there is a great demand from all spheres of economic activity for district-level estimates. Hence zones are being regrouped to accommodate this aspect. Taking into account the developments in the fisheries sector the sampling procedure is periodically modified to suit the prevailing fishing conditions.

As stated earlier C.M.F.R.I. is following a stratified multistage random sampling procedure for estimating marine fish landings in India. For this purpose, each maritime state is divided into zones taking into consideration the intensity of fishing, type of fishing etc., each zone consisting of about 20-30 landing centres. A month is divided into 3 groups of about 10 consecutive days each. From the first ten-day group three clusters of 2 days each are selected for observations at the selected landing centres. From each of the other two groups of ten days, three clusters of two days are selected systematically. On the selected day of observation the landings are sampled for detailed observations on catch, effort, etc. A sub sample of the selected units is taken for biological observations.

Some of the States like Maharashtra are also collecting catch statistics employing probability sampling procedures. As per the recommendation on the National Commission on Agriculture an integrated methodology is being evolved so that the CMFRI and the State Departments may be able to combine their efforts so as to arrive at more precise estimates. In case of States where no system for collection of catch statistics exists, CMFRI is giving the necessary technical help.

Estimation of Inland Fish Production

The total catch of fish from inland resources are not available beyond the rough estimates provided by the Reports on the Marketing of Fish in the Indian Union (1948, 1951 and 1961) and estimates of annual marketable surplus furnished by the States. Collection of fish statistics from inland waters is beset with additional problems, such as, highly dispersed and isolated nature of fishing and the innumerable landing places.

The Central Inland Fisheries Research Institute(CIFRI) has conducted surveys for the estimation of inland fish production from selected freshwater riverine stretches of the Ganga, the Narmada and the Godavari; from selected estuarine areas of the Hoogly Matlah, the Mahanadi and the Godavari river systems and from a few brackishwater lakes viz. the Chilka, the Pulicat and the Vembanad.

However to arrive at an overall estimate of inland fish production in the country on a sound sampling basis, an attempt was made during 1955-59 by the I.C.A.R. for collection of statistics of fish production in 2 districts of the erstwhile States of Hyderabad but without much success. At that juncture in pursuance of a Government decision, the work relating to the sample surveys for the estimation of fish catches from inland waters was transferred from the ICAR to the Directorate of the National Sample Survey. In September, 1958, the Directorate of the National Sample Survey took up the survey work in Orissa to evolve a suitable sampling technique for estimation of fish production. By the end of 1958, certain basic information such as various resources of inland fisheries and their relative importance, availability of sampling frame, fishing practices and availability of suitable agency for field work was collected, which later formed the basis of the pilot survey in Orissa during 1962-63. A two-stage stratified sampling design was followed for the pilot survey. Later this programme was extended to the districts of Murshidabad (West Bengal) and Madurai (Tamil Nadu). The catch data were recorded in respect of each pond, tank and swamp in the selected villages. Besides these the Indian Statistical Institute made attempts in 1960-61 to find out some suitable sampling techniques for inland fish production in West Bengal. This study gave only some acquaintance with the field problems and furnished broad indications of the variability of the character under study in different stages of sampling. Now an inter Institutional project has been taken up by I.A.S.R.I. and C.I.F.R.I. to develop a suitable sampling procedure.

Census

For sampling developmental programmes it is essential to have village-wise data on number of fisherfolk, craft and tackle, available infrastructure, etc. Such information is gathered through quinquennial census. This also helps in updating the frame of fish landing centres and assessing the progress if any, made during the period.

During the pilot survey conducted by the CMFRI in 1948-49, village-wise data on the total fisherman population, number of active fishermen, fishing units of different types and varieties of fish caught in different fishing seasons were collected. With the expansion of the fishery resource survey scheme during the successive plan periods periodic censuses of fishing village were undertaken during 1957-58 and 1961-62. The censuses conducted during later years brought additional information such as number of fish landing centres, approach to fishing villages and landing centres, jetty facilities available for the landings of mechanised fishing boats and other infrastructure facilities available, such as number of cold storages, freezing plants, canning plants etc. at important landing centres. A similar census was organised during 1973 to collect information on the number of mechanised boats, different category of indigenous fishing crafts and gears etc. in each marine as well as the inland fishing was collected in a limited scale along with livestock census. Due to the inadequate coverage, these surveys required intensification. Accordingly some of the State Governments such as Maharashtra and Gujarat have introduced new performance to have better coverage in this field.

Dynamics of Fish Populations

Being a renewable resource, for proper exploitation and use of this resource, the dynamics of fish populations are to be studied. This study required information on vital statistics such as growth, mortality and recruitment rates. Several models, such as graham Beventon and Holt, are used for the same. Capture-recapture techniques, production assessment methods etc, are also employed for stock assessment studies.

For growth studies, determination of age of fish is not that easy in tropical waters though it is not that difficult in temperate waters. To overcome this difficulty, size frequency studies are extensively used involving dissection of multimodal curves into unimodal ones by Peterson's graphical method, probability paper method, etc. Apart from this method tagging experiments are also conducted to study growth. Other vital statistics such as mortality etc., are also evaluated using similar methods.

There are two types of models to study the dynamics of fish populations. One is micro analytic model involving many parameters to be evaluated. Beverton and Holt model is one of micro analytic model. In micro analytic models few parameters are involved for example, estimates of catch, effort etc. Schaffer's model is one of the micro analytic models. For detailed study of growth curve such as non-Bertalaffey, Logistic, Gompertz etc. are used extensively. In the exploitation of fishery resources, stock assessment studies based on the above are essential in order to get maximum sustainable yield without affecting the stocks. This in turn helps in the proper management of these renewable resources.

Apart from these methods, acoustic surveys using echo sounding system and sonar equipments are also used to assess the fish stocks. Aerial surveys are also conducted for the same purpose. In culture fisheries, production assessment involved estimation of numbers and the growth. Capture-recapture methods are used to assess the number and the growth rate and to study the productivity of water bodies. These data are statistically analysed and the estimates are obtained with their corresponding variances for comparisons.

Design of Experiments

In capture fisheries, fish catches cannot be increased beyond certain limit. To meet the growing demand of fish, more attention is now being paid towards culture aspects. Experiments have shown that fish production can be increased manifold by proper utilisation of water resources. To maximise the yield and increase the carrying capacity of the water bodies, suitable experimental designs are used in aquaculture experiments. In mariculture, for spat settlement studies and other culture experiments appropriate designs are formulated. Polyculture experiments are being conducted in both inland and marine waters.

In investigating for obtaining a comprehensive idea on the carrying capacity of a water body, factors to be studied are innumerable such as shape, depth etc. of water bodies, treatment of water bodies involving different types of chemicals at different levels and combinations, size of stocks to be introduced, density of stocks, ratio of their combination etc. The totality of all these aspects in different combinations involve a large number of factors for experimental studies. The inherent variability of water bodies even when they are adjacent is well known in pisciculture experiments. As such, existing designs may not be quite suitable to give the required information. Hence appropriate system analysis and simulation process methods are being tried.

Multi Variate Analysis

Fish stocks in general are influenced by various factors-hydrological and biological. To associate these factors with the availability fish stocks for exploitation, multivariate analysis is being attempted. This method is also employed in discriminating fish stocks under different races according to their morphometric and maristic characters.

Bio-assay Studies

Eco-systems are being affected by the effluents from the factories. To find the lethal level beyond which fish populations cannot survive and to suggest the industries accordingly, bioassay studies are taken up. In addition, in culture fisheries the adaptability of important species in different habitats is also studied through these methods.

Economic and Econometric Analysis

In spite of considerable increase in the contribution of fisheries sector to the national income, the economic condition of fisherfolk continues to be poor. To find out the reasons for the same, socio-economic surveys are being conducted adopting suitable sampling techniques. Bench mark and assessment surveys are also used in studying the impact of introduction of integrated rural development programmes among fishermen families.

Increased use of synthetic materials in the production of crafts and gears, introduction of mechanisation in fishing activities, improvement in the infrastructure facilities and marketing are fast influencing the fishing industry. The impact of these on the economic viability of fishing operations are studied through cost-benefit analysis, demand supply analysis and other econometric methods.

In addition to the above, there are many more fields where statistical methods are being applied. To mention a few, in a sample surveys for estimation of fish catches, to reduce non-sampling errors, checks at tabulation stage are being made using quality control techniques. In culture operations there is vast scope for the application of statistical genetics for the improvement of fish stocks. Methods in time series analysis form another important set of tools. Investigations are on way to study seasonal fluctuations cyclical variations and overall trend in landings, efforts etc. Attempts are also being made to develop suitable forecasting procedure.

3 (b). 3 **The Importance of Fisheries Statistics and its Improvement
in Development of Fisheries**

By

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Abstract

Reliable statistics are a pre-requisite for any developmental programme. The role of Fisheries Statistics in the development of Fisheries has been understood only very recently and the position of the Fisheries Statistics now available in the country is not so satisfactory.

In the present paper, the importance of Fisheries Statistics in "Inland" and "Marines" development is discussed and various improvements to the present mode of collection of Fisheries Statistics are suggested.

3(b). 4 Agricultural Statistics in Fisheries in West Bengal

By

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Abstract

- (i) There is urgent need for building up fishery resources data, particularly of impounded water units and also of annual fish catch/production estimates separately for inland and marine areas. West Bengal has made considerable progress in this regard.
- (ii) Developing estimates of fish eaters, per capita consumption of fish/egg/meat and milk say every 5th year is also equally important and the state maintains such data regularly.
- (iii) Districtwise sample survey on pond's soil is also vital at the moment in view of the present trend of changing ecology and topography. State has made a beginning on this front.
- (iv) Monitoring and evaluation of major schemes viz. composite fish culture etc. in inland sector and mechanized fishing in marine sector etc. are of crying need of the hour.
- (v) Determination of productivity in brackish and sewage water fisheries, in particular, in connection with fixation of optimum economical managing units is also necessary at the moment. The state has taken up some programme on this work.
- (vi) Regular maintenance of market intelligence statistics viz. retail/wholesale price of fish, meat, egg etc. and their indices and other trade mechanism are also very vital. The state has made a considerable progress in this regard.
- (vii) Case study/survey on fishery co-operative sector is also necessary to assess the fisherman's social and upliftment of the socio-economic conditions of the fisherman.
- (viii) Biological and manural studies are being done by C.I.F.R.I., Barrackpore, and a no. of co-ordinating projects have been taken up.
- (ix) Developing of suitable methodology on ponds/estuaries ecology, environmental science, fish seed resources, ground water resources, water pollution in riverine fisheries etc. are also vital at the moment.
- (x) Complete census of crafts and gears both in inland and marine sector are equally very important.

Based on the discussions held during the Session, the recommendations made were as follows :—

1. The joint research project of CIFRI and IASRI for development of methodology for estimation of inland fishery resources and catches therefrom is operating in a comparatively small area in West Bengal. In order to provide an enlarged scope to the project, the Conference recommends that the Fisheries Directorates/Agricultural Universities/State Departments may provide necessary qualified manpower support to enlarge the scope of the survey to different states so that an objective method is evolved quickly.

(Action : CIFRI/IASRI/Dir. of Fisheries (All States)/ BCKVV, West Bengal/OUAT, Orissa/GBPAU, U.P./ RAU, Bihar/TNAU)

2. Considering the fact that inland fish seed production and fish production from larger water bodies is largely a state activity in public sector, the conference recognises that the available data at various state level organisations can be properly processed and made available for the benefit of various users. In order to achieve this objective it recommends that a small group of 3 or 4, consisting of experienced inland fisheries statisticians be constituted to design standard proformae, for collection of data at state level, for the entire country. The State Fisheries Directorates may be required to fill the same to identify gaps and availability of inland fisheries data. This may be completed by Nov., 1979, so that a background is available for the symposium of inland fisheries statistics, where background papers of each State may be invited.

(Action : IASRI)

3. It is recognised that some of the objectives of developing a sound data base of inland fisheries can be met through a proper enlargement of the schedules of the existing national level data collection system. It recommends that the following be done :

- (i) Enlargement of the land utilisation survey schedule so that water areas, now going under "land not available for agriculture" are removed from there and placed under a new broad-head "under Water" with sub-heads to identify ponds, tanks, reservoirs, rivers, seasonal, perennial, stocked with fish seed not stocked.

(Action : Dte. of E&S)

- (ii) Enlargement of the Irrigation Statistics schedules so that the maximum and minimum surface area of storage reservoirs/tanks in every year is available in addition to water capacity—

(Action : Dte. of E&S)

4. In order to obtain a basic data base at district level, required by the new planning process recommended by NCA, and Village/Panchyat level, required by institutional financiers and banks on items such as water areas, classified as perennial/seasonal, under stocking/no-stocking, commercial/non-commercial exploitation, active fishermen/their operation zones, crafts and implementation etc., it is necessary to have a Quinquennial Fisheries Census. It has been recognised as a basic need and recommended by NCA for implementation.

The Conference recommends that this be done urgently for which a working group be constituted to prepare the schedules and suggest an operative mechanism for the census.

(Action : Deptt of Agri. Dte. of E&S)

5. The Statistics and Resources Division of CIFRI being experienced and well equipped to analyse the inland fisheries data, the Conference recommends that this expertise may be used by the States for collection and interpretation of inland.

(Action : State Dirs. of Fisheries/CIFRI)

6. The State Fisheries Directorates, which are the organisation now involved in fisheries data collection and dissemination, need to have well organised statistics section headed by a senior level statistician with experience in fisheries. The conference recommends that this be done expeditiously.

(Action : State Fisheries Departments.)

7. The committee recommends that "A Summer School or Seminar of 2-3 weeks on "Quantitative methodology in inland fisheries research" be organised jointly by CIFRI and IASRI.

(Action : CIFRI/IASRI)

8. Multi-disciplinary studies may be taken up for detailed micro-level data analysis in integrated use of water, especially for multiuse water so that optimum water utility can be worked out. Such investiga-

tions may be taken in some selected reservoirs or tanks involving Irrigation/Agriculture/Fisheries/Power, Scientists representing different interests.

Action : CIFRI/IASRI/Project Co-ordinator (Reservoir Fisheries)

9. Considering the fact that the data base for inland fisheries resources itself is highly unsatisfactory, the conference recommends that the census of water areas initiated in different state as a result of NSSO recommendations be completed urgently.

Action : Dir. of Fisheries (All States).

TECHNICAL SESSION—IV
QUALITY OF DATA

26th June (Tuesday), 1979

02.00 P.M.

Chairman

Prof. P.K. Bose,
Centenary Professor,
University College of Science,
Calcutta.

Rapporteur

Sh. S.K. Raheja

Invited Speakers

- (i) Dr. K.C. Seal/Sh.M.G. Sardana, C.S.O.
- (ii) Dr. K.C. Seal/Sh.M.G. Sardana/Sh. M.S. Ahluwalia, C.S.O.
- (iii) Dr. B.N. Tyagi, Dte. of Agriculture, Lucknow.
- (iv) Sh. S.K. Raheja, I.A.S.R.I.
- (v) Dr. K.C. Raut, I.A.S.R.I.
- (vi) Sh. H.L. Chawla/Sh. R. Raghunathan/Sh. T.N. Khushu/Sh. P.P. Singh, Dte. of E&S, New Delhi.
- (vii) Dr. S.N. Sen, Dte. of Statistics & Economics, Patna.
- (viii) Sh. P.N. Bhargava/Sh. P.K. Batra, I.A.S.R.I.
- (ix) Sh. N.K. Sonavane/Dr. M.N. Das, C.W.C.
- (x) Dr. M. Padmanabhan, N.S.S.O.
- (xi) Sh. G.S. Tiwari, Dte. of Vety. Sciences, M.P.
- (xii) Sh. Randhir Singh, I.A.S.R.I.
- (xiii) Sh. Dharamendra Kumar, Dte. of A.H., Lucknow.

Others

4.1. Quality of Data in the Agricultural Sector

By

K.C. Seal and M.G. Sardana

Central Statistical Organisation,
New Delhi.

Introduction :

Quality of data is the basis of all our statistical activities. The last three decades have witnessed not only rapid advance in statistical theory but also the development in statistical system in India to meet the requirements for planning and policy making. But, all these advanced tools have ultimately to operate on data, which are the basis of all statistical analysis. Data are the input of all statistical analysis. No statistical tool, however, powerful, can hope to compensate for the short-comings in the basic raw material. It is, therefore, absolutely necessary to closely examine the raw data or to be more precise, the accuracy of data. A general discussion about the statistical measures of quality of data with particular reference to work done in India is presented in Part I, while Part II attempts to present the quality of data in agriculture sector in our country.

I. Quality of Data

2. An error in observational data is defined as the inevitable deviation of the actually observed value from the true value. The true value is defined as that value which would be observed if the prescribed concepts, definitions and procedures are followed in data collection and a faithful response is evoked from the subject under observation.

3. Obviously, the observed value will often differ from the true value. In natural sciences where the experiment can be repeated under almost identical conditions, the variability of the repeated observations provides a measure of the margin of error. The situation is entirely different in social and economic fields where the repetition of observations under identical conditions is rather difficult if not impossible. Errors in data collected often arise due to the subjective element in the observer, the observed and the interaction between these. Intensive training and strict supervision would generally lead to control the errors due to first and last sources but the response bias of the observed is much more difficult to control.

4. Whatever the difficulties it is absolutely necessary to give some idea of the margin of error while presenting data. If possible, the margin of error may be given explicitly, and in case it is not possible, the shortcomings in the

observational data may be mentioned. Error consciousness needs to be cultivated not only among the producers but also among the users of data. It must be impressed upon the users that all data suffer from inaccuracy and no data are free from it. The producers of data should take all possible steps to minimise the inaccuracy and the users should take into account the degree of inaccuracy indicated by the producers while drawing inferences or in policy formulations.

5. Deming (1944) was one of the first research workers who had probed into the problem of quality of data and had listed different factors which affect the ultimate usefulness of the data collected in a survey. Following this, valuable work has been done by several research workers concerning procedures of selection, tools of collecting data, missing data or non-response, enumeration bias, errors in data processing etc. A detailed discussion of the researches is beyond the scope of this paper. However, we will briefly mention about the work done in this direction in India.

6. Researchers at the Indian Statistical Institute and Institute of Agricultural Research Statistics (now called Indian Agricultural Statistics Research Institute) have done pioneering work relating to non-sampling errors. The salient results are briefly described.

Integration of Errors

7. It is difficult to identify individual sources of errors as the contributions of individual sources of errors are pooled together and the component parts are generally indistinguishable. Das Gupta and Mitra (1958) provide an example of the procedure to assess the relative contribution of various sources of errors based on 'age data' collected in the NSS.

Out-dated Frames

8. Seal (1962) had considered the problem of error creeping in on account of using frames which are not upto-date with particular reference to Annual Survey of Industries and surveys of Labour conditions. Simple methods based on reasonable births and death process were suggested which could be easily worked out in most of the practical situations.

Memory Error

9. The accuracy of data depends to a large extent upon how correctly past events are remembered. The error in data that appear as a result of memory lapses is termed as 'memory error'.

10. Mahalanobis and Gupta (1954) demonstrated with the help of the data on the sex ratio of children from different marriage cohorts by limiting only to the case of children to the fourth birth, that a definite relationship exists between the distance in time of the events under study and the ability to recall these events. The birth of a male child is better remembered because it is considered to be much more important. Later in 1955, Das Gupta *et al* attempted to formulate the relationship between the time lapse and completeness in reporting of the events with the help of the data collected in the fourth round of NSS. In the seventh round of NSS a study made on memory lapses in reporting births and death cases revealed decreasing percentage of births reported in the year preceding the survey as the time lapse increases.

Reference Period

11. The problem of the period of reference has two aspects. The first concerns its length while the second deals with the location in time of the period selected. For instance, if a day has been selected as the period of reference, it can be the day of the survey, the preceding day, etc. In a survey dealing with characteristics which occur with more or less regular cycles, the period of reference should not be less than a cycle. The length of the reference period should be decided keeping in view not only the natural cycles of the characteristics under study but also the memory error. It is best to base the decision on experimental evidences. Mahalanobis and Sen (1954) have reported the result of one of such experiments. In the first round of NSS, a reference period of one year was used. Later, in the fourth round using interpenetrating samples, data on expenditure of some items were collected using a week and a month as reference periods. The results revealed that expenditures obtained with a week as a period of reference were higher than the corresponding estimates obtained with a month as the reference period. The answer to the question as to which of these two periods lead to more accurate data was sought through another experiment where data were collected in a set of two interpenetrating sample households through actual weighing and through verbal enquiry. The results of this experiment led to the conclusion that for food items more accurate data would be available with a period of reference of one month.

12. Ghosh (1953) considered a day, a week and a year as the reference period for collection of data on expenditure on food items and concluded that most accurate data were available with a year as the reference period and one day reference period led to most inaccurate data.

13. The period of reference may either fall between two specified dates (fixed reference period) or may just precede the day of collection of data (moving reference period). Although data collected with a moving reference period do not relate to the same period, this is not likely to introduce any bias if the characteristics under study vary randomly from one day to another. On the other hand, with moving reference period the end effect is negligible and can be considered as nil at the nearer cut off point. Som *et al* (1961) have discussed this issue based on NSS data.

Missing Data

14. The term 'missing data' is used as a common name for all cases where it has not been possible to get the data from selected unit (s) irrespective of the reason for enumerator's failure or respondent not-at-home. The name 'non-response' or 'incomplete samples' is used by some authors.

15. Consequences of missing data are well known. In India, where by and large the data in sample survey are collected by enquiry through trained personnel, the missing data arises on account of the selected unit (s) being not available or the refusal of the unit to provide the answers to the questions. The long experience of NSS has shown that by rigorous training of field staff, rational supervision, adequate publicity and approaching the respondents with all the necessaries background details etc., the non-response can be reduced to a large extent.

Enumerator's Effect

16. It is accepted that use of trained enumerators make it possible to reduce the non-sampling errors but they also become an additional source of errors in data. Changes introduced into data by enumerator is termed as enumerator effect. Mahalanobis (1954) was the first to use statistical tools for assessing enumerator effect. The general theory to deal with the problem of enumerator effect was developed independently by Hausen *et al* (1951), and Sukhatme and Seth (1952). The theory is based on the assumption of allotment of sampling units at random to the enumerators which would mean that each enumerator is supposed to travel over the whole area. To overcome this problem Sukhatme proposed stratification of the population and use of the general theory separately in each stratum.

Interpenetrating Sub-Samples

17. Mahalanobis (1944) was the first statistician to suggest use of interpenetrating sub-samples method to get an overall measure of errors in

the collected data in a pilot survey conducted in 1937 for estimating the area under jute in Bengal. This technique has become a novel feature of the NSS over a long period. With this technique not only each of the interpenetrating sub-samples provides an equally valid estimates of the parameter being estimated but also it is possible to derive a simple estimates of the standard error of the estimators. This property of interpenetrating sub-samples has been primarily responsible for its popularity amongst survey statisticians. Another equally important advantage of this technique is the fact that suitably designed interpenetrating sub-samples enable the statistician to study the contribution of the enumerator effect towards the variance of the estimator.

18. The technique of interpenetrating sub-samples can be used as a check of the quality of the work of the field staff. If m sub samples are used and the field staff are grouped into m parties so that each party is assigned a sub-sample, the variability amongst the sub-samples can be tested for significance. Sukhatma (1954) pointed out that such tests may be sensitive for larger areas, like a country and further these sub-samples do not help in identifying the sources of discrepancies. Mere agreement amongst the estimates of interpenetrating sub-samples does not indicate absence of enumerator bias as the bias of each enumerator may be equal and in the same direction.

19. Another interesting use of interpenetrating sub-samples is the Fractile graphic analysis developed by Mahalanobis (1960). The technique of Fractile graphical analysis was applied to the data of consumer expenditure on food collected under the NSS.

20. Interpenetrating samples do increase the cost, but Mahalanobis (1950) pointed out that the increase in the cost of the survey may not exceed 10 per cent. It could also sometimes give rise to some false sense of accuracy of the estimates, although it may not reveal the true picture.

Quality of Processing :

21. Errors could also creep in the processing stage. Data processing with conventional punch card equipment involves different stages like coding, punching, verification, tabulation and error correcting. Sampling techniques can be used to check the quality of work at various stages. Mahalanobis (1946) advocated deliberate introduction of errors in the material to be processed as one of the means of obtaining an idea about the quality of work at various stages of processing. After the processing, the proportion of deliberately introduced error which remain undetected can be considered as a measure of the quality of work. The deliberate introduction of errors brings about extra rigorous control and interest in work which ultimately results in improv-

ing the quality of work. The scrutiny programmes developed for checking internal consistency of data play a very important role in improving the quality of processed results.

Errors in Crop Estimation Surveys :

22. The problem of estimation of crop yields has been studied more systematically in India than in any other country. It should, therefore, be appropriate to discuss the types of errors that generally creep in to distort the estimates.

23. Sukhatme and Panse had done pioneering work in developing an objective method of estimation of crop yields under Indian conditions. This technique is commonly called 'Crop Cutting Experiments'. In spite of it being an objective procedure, biases can creep into the results unless adequate preventive measures are taken. Broadly, the biases and errors can creep in on account of selection of sample fields, size and shape of sample plots, location of sample plots, missing data, harvesting and thrashing procedures etc.

Selection of Fields

24. The principle of random selection if strictly followed will ensure that no bias is introduced on this account at the stage of selection of fields. It is only when some simplification or deviation from strictly random selection is adopted, there are avenues for errors to creep in. Examples of this are cited Sukhatme (1954).

Location of Plots

25. The location of sample plots in fields with regular shape does not create any bias. However, in irregular fields, the selection procedure may not yield unbiased sample plots. If the yield along the border of such fields is different from that of the remaining fields the usual procedure of location of sample plots will introduce bias which is called "border bias". Sen Gupta (1964) demonstrated that border bias diminishes with decrease in the size of the plot.

26. It is also known that the usual procedure of locating the sample plots with the help of random coordinates does not strictly give equal probability to all the areas in the field. The areas located along the borders of the field have a lower probability of selection than the areas inside the field. Thus, if the yield is borders areas in different from the yield inside the field, bias will be introduced. Panse and Sukhatme (1948) found no indication or border

biases in India whereas Mahalanobis (1944) reported differential yield rates of jute at different distances from the edge of the selected fields.

Plot Size and Shape

27. The problem of appropriate pilot size for crop estimation surveys has been studied at the ICAR under the leadership of Sukhatme and at the ISI under the guidance of Mahalanobis. Serious overestimation with small plots was the main conclusion of several experiments reported by Mahalanobis and Sen Gupta (1951) Sukhatme (1947) also found tendency of overestimation with small plots. It is believed that this bias is a kind of psychological bias on the part of the enumerator to include unduly some of the bordering plants or tillers inside. Panse (1963) provided some results which support the use of large plots. On the other hand Sengupta (1964) concluded that with trained field staff it would be appropriate to use circular cuts of a radius 4 ft. Anyway, this had been a controversial issue for quite some time which did not permit any definite generalisation of results.

28. In taking a decision about the size and shape of plot, attention needs to be given to the method of cultivation. If the crop is cultivated in rows, it is rather not difficult to ascertain whether any plant belongs to the plot or not. However, if the crop is sown by broadcasting, plants will be spread all round and the border plants do create problems. For crops sown in rows, the selection may be a set of rows and a few plants within each row thereby doing away with the idea of size and shape of plots. Thus the type of crop and the procedure of sowing also play an important role in making a decision about size and shape of plots.

29. Mahalanobis and Sengupta (1951) have dealt with the problem whether the shape of the cut (circular, square, triangular) has any effect on the estimates of crop yields and found that triangular cuts had tendency to overestimate as compared to circular or square cuts.

Missing Data

30. The experience in regard to the missing data in crop estimation surveys has not been very unhappy. It has been possible to attain high level of response mainly on account of training of field staff and keeping in touch with the cultivators of the selected plots about the probable date of harvesting. Missing data or normally connected with fields with an early harvest. Unless the yield rates of early and late harvests are widely different, the problem is not a serious one. In cases where the early and late harvests yields widely differ, the practical solution to overcome this problem would be to

ensure that the field staff maintain a good liaison with the selected cultivators of the selected fields so that missing data are reduced to the extent possible.

Mixed Crops

31. The procedure of recording area under each of the constituents of mixed crops is an important matter and deserves mention in the paper. In cases where the mixed crops are sown in rows, the area under the mixed crops can be divided under each crop in the ratio of number of rows under each. In other cases, where the mixed crops are broadcast, in spite of considerable deliberations on this issue by various Committees since fifties, no uniform procedure appears to have been adopted by States. However, the recommended procedure in this regard is to apportion the area at the Tehsil or District level on the basis of standardized seed rates which need to be updated periodically on the basis of crop cutting experiments. This procedure needs to be implemented uniformly by all the States.

Harvesting and Threshing

32. In regard to the procedure of harvesting and threshing, the philosophy of the crop cutting experiments technique has been to make sure that the procedures adopted are as close as possible to the one adopted by the cultivators in general. These efforts have resulted in reducing the errors on account of the said sources.

33. The crop cutting experiments appear to be a simple technique but the foregoing paragraphs have demonstrated the complexity of the procedure many elements of which are subject to error. Efforts through a number of plan schemes like 'Timely Reporting', 'Improvement of Crop Statistics' and 'Establishment of an Agency for Reporting Crop Statistics in permanently settled States' are underway to improve the quality of crop estimation in India.

II. Agricultural Statistics

34. Our country being predominantly agricultural in character the improvement of agricultural statistics has been receiving priority. During the last two decades considerable headway has been made in making available increasingly reliable, comparable and comprehensive agricultural statistics to meet the requirements for planning and policy making. In spite of all these there are still some gaps: the coverage is not complete, comparability is lacking and in certain cases there are serious time-lags. Timeliness in avail-

ability of data for planning has assumed greater importance in view of the recent emphasis on rolling plans.

Committees/Working Groups

35. A Working Group set-up in 1963 undertook a critical review of the system of collection and compilation of agricultural statistics and formulated several short-term and long-term proposals for filling-up the gaps as also for collection of new types of data. Data Improvement Committee set-up in 1969 also made several recommendations for effecting improvements in the field of agricultural statistics. Reduction in time-lag, improvement in the reliability of the estimates, systematic collection of prices data were the priority areas identified by the Committee. The National Commission on Agriculture (NCA) also considered in depth the question of improvements in data collection and analysis in the field of agricultural statistics. Recommendations of the Commission concern various segments of agricultural statistics like land utilisation, statistics of fruits and vegetables, irrigation, livestock, fisheries, forestry and agricultural inputs.

36. The present status of availability of statistics in the various segments of agricultural statistics except for plantation crops are briefly described below along with the improvements needed in the light of the several recommendations made by the aforementioned Committees. A separate paper dealing with the quality of data of plantation crops is being also presented by CSO.

Area Statistics

37. Broadly, there are three different systems for collection of area statistics—(i) by complete enumeration from land records (ii) on the basis of sample surveys, and (iii) using conventional methods. The system of land records is followed in the States of Andhra Pradesh, Assam (excepting two hill districts of North Cachar and Karbi Anglong), Bihar, Gujarat, Haryana, Himachal Pradesh, Jammu & Kashmir, Karnataka, Madhya Pradesh, Maharashtra, Punjab, Rajasthan, Tamil Nadu and Uttar Pradesh as also in the Union Territories of Chandigarh, Delhi, Dadra and Nagar Haveli, Pondicherry and the Andaman district of Andaman and Nicobar Islands. In these States which cover about 75 per cent of the cultivable area, there exists a primary reporting agency commonly called Patwari to carry out field to field crop inspection in each crop season of the year. The agency belongs to the Revenue Land Records Department and attends to this work along with the collection of land revenue and other duties.

38. Until recently, the States of Kerala, Orissa and West Bengal which account for about 8 per cent of the cultivable area, had no established village agency to maintain regular land records. For the collection of agricultural statistics these States were organising sample surveys for estimation of area and yield through full-time statistical staff. For obvious reasons, these surveys served only a limited objective of providing estimates of area and yields for some of the important crops at Divisional levels or at State level. Steps have been taken recently to establish a primary reporting agency in the permanently settled States of Orissa, West Bengal and Kerala to provide land utilization statistics on a complete enumeration basis in a sufficiently large sample of villages.

39. There are tracts covering about 8 per cent of the cultivable areas of the country in respect of which a satisfactory system of collection of area statistics is yet to be developed. These include portions of Manipur, Meghalaya, Nagaland, Sikkim, Nicobar district of Andamad & Nicobar Islands, Arunachal Pradesh and Mizoram. Some hilly tracts in the States of Andhra Pradesh, Assam and Madhya Pradesh which are not cadastrally surveyed, also come under this category. Further, in the cadastrally surveyed areas like plain areas in Manipur, Tripura, Sikkim, Goa, Daman & Diu and Lakshadweep, there is no satisfactory system of collection of agricultural statistics. As such, agricultural statistics in these areas are mainly compiled by conventional methods.

40. In order to reduce the time-lag and improve the quality of agricultural statistics, two schemes—the Timely Reporting Scheme (TRS) and the Scheme for Improvement of Crop Statistics (ICS) are in operation since the Fifth Plan. The basic theme of the TRS is to have areas enumeration completed on a priority basis in a random sample of 20 per cent of the villages during each crop season in the States. All the villages in a State are selected in the form of five independent non-overlapping sets, the intention being to canvas one set in a year and thereby cover the entire States in a period of five years. The scheme which is in operation in 13 major States is thus able to provide timely and reliable estimates of area immediately after crop sowings are completed and of production, immediately after harvest. The companion scheme viz., ICS is also in operation since the Fifth Plan. The main objective of this scheme is to locate through the joint efforts of Central and State authorities, deficiencies in the system of collection of crop statistics and suggest remedial measures. The programme envisages overseeing the work of area enumeration in a sample of 10,000 villages and of crop cutting experiments of harvest in a sample of 30,000 fields spread over principal crops.

The scheme is reported to have brought about a general consciousness among the Patwaris to improve the accuracy of reporting crop areas and land utilisation statistics.

Yield Estimation

41. Crop estimation surveys are being conducted in all the land records States, the permanently settled States of Kerala, Orissa and West Bengal as also in some of the Union Territories. At the All-India level, 96 per cent of the production of cereals and 71 per cent of the production of pulses are based on the results of crop cutting experiments. Further, 76-95 per cent of production of important commercial crops ground-nut, cotton, jute and sugarcane is based on crop cutting experiments. The number of crops for which All-India estimates are issued has been considerably increased from 24 in early fifties to 38 at present. Proposals are under way to bring black gram in Madhya Pradesh and Maharashtra, green gram in Maharashtra, masur in Madhya Pradesh and potato in Uttar Pradesh, under the crop cutting experiments scheme for estimation of production.

42. All the States except, Haryana, Maharashtra, Punjab and Uttar Pradesh calculate the sampling error of the estimates of average yield of forecast crops. Normally, the yield rates at State level of major crops have standard error of the order of 2-3 per cent and of other crops of about 5 per cent. However, there are some crops in some States for which the standard errors are fairly high. Examples of such cases include jowar, bajra, ragi, wheat, gram and tobacco in Gujarat, bajra, maize, onion, chillies and rape and mustard in Madhya Pradesh, green gram, masur, peas, tur and linseed in West Bengal, potato, linseed and rape and mustard in Jammu and Kashmir.

43. The design for crop estimation surveys is generally a composite one without any stratification according to inputs such as irrigation and seed. The yield rates are, however, worked out on a post-stratification basis using the ancillary data regarding inputs collected during the course of the crop cutting experiments. The NCA had recommended that the sampling design for crop cutting experiments should be modified with a view to introducing stratification according to irrigated and rain-fed areas and also high yielding and local varieties. The position with regard to stratification according to irrigation is satisfactory as the basic forms of area enumeration now have a provision for recording irrigation particulars which makes it possible to allocate samples among the basic strata. The position in regard to varieties is not, however, satisfactory in view of practical difficulties in attempting stratification.

Agricultural Census

44. The size distribution and other related characteristics of holdings are important for planning purposes. Data on operational holdings were collected by the NSSO in the 8th, 16th, 17th and 26th rounds which provided estimates at the all-India and State levels. Realising the need to provide such data at lower levels for effective planning, an agricultural census was taken in 1971-72 with 1970-71 as the reference year. The data were collected on complete enumeration basis in States having basic revenue records and through sample surveys in States where land records are not maintained. The second Agricultural Census was carried out with 1976-77 as the reference year. It is proposed to organise the next Census during 1981-82 with 1980-81 as the reference year.

45. One of the lacuna of the agricultural censuses has been that these could provide information on open tenancies only, since concealed tenancies are not mentioned in the land records and it was the method of retabulation from land records which was adopted in the censuses. Thus, it was not possible to get correct information in regard to operational holdings. Unless the tenancies are regulated and, in particular the rights of all the crop sharers are correctly recorded, it will be very difficult to improve the present situation.

Irrigation Statistics

46. Irrigation statistics are available mainly through land utilisation statistics, annual administrative reports of State Irrigation Departments and periodical reports prepared by Ministry of Agriculture and Irrigation, Planning Commission, Central Water Commission, etc. There are serious discrepancies between the data based on land utilisation statistics and those derived from the progress reports. The main reason for this is the lack of uniformity in concepts and definitions. In many cases there are serious time-lags in the availability of statistics.

47. The NCA has suggested standard concepts and definitions of items and a revised classification of sources of irrigation which when adopted would make the two series comparable. Reconciliation of the two sets of figures at the district level has also been recommended by NCA. Steps taken recently to create special cells for collection and compilation of irrigation statistics in major States will improve the quality of statistics.

Fruits and Vegetables

48. The statistics of area under fresh fruits-mangoes, citrus, banana, grapes, pome are now available at all-India level. However, reliable estimates

of the production of fruits except banana are lacking. The production estimates are mostly based on ad-hoc surveys carried out by IASRI and some marketing surveys carried out by the Directorate of Marketing and Inspection. Crop cutting surveys for estimation of production of banana are being conducted in the important growing areas of Maharashtra, Madhya Pradesh and Karnataka.

49. In regard to vegetables, separate figures of area are available for potato, tapioca, sweet potato, onion and all other fresh vegetables taken together. Production estimates of tapioca and potato are based on crop cutting experiments in some important States, while the estimates of production of other vegetables are purely based on ad-hoc considerations.

50. In order to improve the quality of available statistics of fruits and vegetables, steps need to be taken to implement three important recommendations of NCA, viz., making arrangements for regular collection of area under important fruits and vegetables, undertaking sample surveys for estimation of production of fruits based on the methodology developed by IASRI and initiating pilot investigations for estimation of production of vegetables.

Livestock Statistics

51. Census of livestock organised quinquennially provide data on the size and composition of livestock. Some of the censuses in the past were not taken uniformly in all the States at the same point of time. It is necessary that not only the censuses should be undertaken simultaneously in all the States but also the practice of having a post-enumeration check by an independent agency should be revived.

52. The position with regard to the availability of statistics of livestock products such as milk, milk products, meat, eggs, wool, hides and skins is not satisfactory. Likewise, no reliable estimates of cost of production of these products which are a pre-requisite for assessing the economic viability of livestock developed projects are available. Since some of the livestock products like milk and egg are obtained almost everyday and in case of milk at different times in the day, certain methodological problems not faced in case of crop estimation surveys are posed in organising sample surveys for estimation of livestock products. As a result of a number of pilot projects undertaken by IASRI, the sampling methodology for collecting data on production, management and feeding practices of livestock have been evolved and some of the States had formulated schemes for undertaking integrated sample surveys for this purpose during the Fourth Plan. However, much headway

has not been made in this direction in most of the States. The NSSO have also collected information on the quantity and value of livestock products in some of the rounds. The estimates thrown up by these surveys are considered to be of limited utility as the information had been collected by verbal enquiry. Unless the State Governments give the due priority for organising integrated sample surveys for obtaining reliable estimates of livestock products the quality of statistics is not likely to improve.

Fisheries Statistics

53. For marine fisheries all-India estimates of production with their State-wise break up are issued by the Central Marine Fisheries Research Institute (CMERI) on the basis of sample surveys. However, no reliable estimates of annual catches of inland fish are available. During 1973-75 NSSO conducted pilot surveys in three districts of Madurai (Tamil Nadu), Karimnagar (Andhra Pradesh) and Murshidabad (West Bengal), covering both impounded water areas as well as riverine areas. The result of these pilot surveys indicated that it was feasible to collect satisfactory data on catch of fish from impounded water areas adopting interview technique. Further, the catch of fish from inundated water area was very small as compared to the total inland water area. The collection of accurate data from riverine area/as posed several practical problems which led to the conclusion that the usual technique of selection of villages is not likely to yield data which are not subject to gross ascertainment errors. This aspect needs further careful investigation

54. The CMFRI obtained data every month regarding total landlings of marine fish by mechanised and non-mechanised boats and their variety-wise composition for each maritime State, the total number of man-hours spent, the number of units operated and the size composition of the landings in respect of selected species. The standard error of the estimate of production based on these surveys is as high as four to five percent even at the all-India level. Further, the estimates worked out by the CMFRI differ considerably from the estimates worked out by States on the basis of independent sample surveys. There is a need for reconciliation of the differences between the two sets of figures. The real solution lies in undertaking an integrated sample survey like the one organised by NSSO which has both the Central and State samples. Such an effort is likely to yield all-India estimates with standard errors of the order of 2 per cent.

Forestry Statistics

55. The principal forest statistics relate to area under forests, volume of standing timber and fire-wood, quantity and value of out-turn of timber,

firewood and minor forest produce, employment in forestry and of forest based industries, area afforested and deforested, classification of forests by management and status, out-turn of logs and sleepers, etc. These data are collected through the State Departments of Forests. The time-lag in the availability of statistics in some of the cases is as high as three years. The land use statistics also provide data on area under forests. There is a large discrepancy between the area under forests as available from the State Forest Departments and through the land utilisation statistics. The discrepancies are mainly on account of the differences in the concepts and definitions used. Reconciliation has to be attempted at the district level between the Divisional Forest Officers and Officers incharge of Agricultural Statistics at the district level so that one set of figures becomes available for planning and policy purposes. In order to succeed in this mission it is absolutely necessary that the statistical units in the Divisional Forest Offices and Chief Conservators of Forests in different States are properly equipped with adequately qualified and competent statistical staff.

Cost of Cultivation of Crops

56. A comprehensive scheme of the Ministry of Agriculture and Irrigation for studying the cost of cultivation of principal crops is in operation in different States since 1970-71. Some pioneering work in this direction had also been undertaken under the guidance of Panse in the erstwhile Committees of Sugarcane, Cotton, etc. However, there are still several controversial issues which need to be resolved. A Committee under the Chairmanship of S R. Sen has been recently set-up to look into the various aspects. The deliberations of this Committee are likely to indicate the ways and means to overcome the various problems connected with the enquiries relating to cost of cultivation of crops.

Input Statistics

57. Three important type of input statistics are required for planning and policy purposes. The first relates to production and distribution of input, like fertilizers, seeds, pesticides, insecticides and agricultural machinery. It should be possible to compile most of these data with the co-operation of the concerned manufacturing companies and distribution agencies. Consumption of input crop-wise and according to holding size and other characteristics of the holding like irrigation etc. are the second type of the data required. These data are lacking at present. A Standing Committee set up under the Chairmanship of the Member, Planning Commission to evolve co-ordinated and

intergrated approach for improving the data base is sized of this problem. The last category of input data deal with the yardstick of production in relation to fertilizers, seed rates, irrigation, pesticides, and insecticides etc. This information can be obtained by undertaking appropriate statistical analysis of the data collected under the experiments conducted on cultivators' fields following well planned sampling procedure as also the controlled experiments conducted at agriculture research stations.

Market Intelligence

58. The existing arrangement for collection of wholesale prices are quite satisfactory both in terms of coverage and timeliness of reporting, Market intelligence for pulses, edible oils, important fruits and vegetables, minor oilseeds, condiments and spices needs to be organised on lines similar to those adopted for cereals and fibres.

59. Reliable information relating to prices of inputs like fertilizer, irrigation, human labour, bullock labour, pesticides and insecticides etc. paid by the cultivators is generally lacking. To a limited extent these data are available through the scheme on cost of cultivation of crops of Ministry of Agriculture and Irrigation. Since the cluster of villages selected in the Scheme do not remain fixed over years, the data on prices of inputs collected do not permit a study of trend in prices. However, efforts are being made by the NSSO to overcome this limitation by collecting data from a set of villages which will be kept fixed for a number of years.

60. In regard to stocks, reliable data relating to stocks of foodgrain held by the Government including Food Corporation of India in their own godowns are available. In case of certain cash crops like cotton and jute data on stocks held by the traders are also available. It is necessary to take steps to collect data on stock with farmers, consumers, wholesalers, retailers, etc.

Publications and Dissemination

61. Statistical publications generally become available with a certain time-lag due to which their utility gets considerably impaired. The time-lag is both due to delay in transmission of the information to the concerned coordinating authority and the delay in printing. The delay in publication to large extent can be remedied by either providing small size printing presses to important statistical organisations or by assigning priority to statistical publications as is being done in some of the States like Haryana and Punjab where the Statistical Abstract is regarded as a budget document and is brought out every year without any delay.

Concluding Remarks

62. Estimates of area and production are the most important agricultural statistics required for planning and policy making. Fortunately, at present we are not in an unhappy situation as far as the quality of statistics of area and production are concerned. The three schemes—Timely Reporting, Improvement of Crop Statistics, and Establishment of a Field Agency in the permanently settled States of Orissa, Kerala and West Bengal—are the backbone of our effort for further improving the quality of statistics of area and production. Every effort needs to be made to ensure that these schemes are successfully implemented.

63. In order to meet the data needs in the various segments of agricultural statistics referred to in different sections, the best approach as recommended by the NCA is to devise an integrated system of agricultural surveys covering both the annual crop surveys and periodic agricultural and livestock censuses. The integration demands combining surveys with common sampling units and having both Central and matching State sample like the NSS. This effort is likely to result not only in economy on financial resources by rational deployment of the field staff but also in reducing the burden on the respondents in providing the requisite data. The NCA has suggested integration in the form of national agricultural surveys with four broad types of surveys depending upon whether the sampling unit is a field or an agricultural holding or a livestock holding or dealing with cost of production enquiries. The proposal, if properly implemented should result not only in improvement of quality of data but also in filling some of the important gaps. The Agricultural Statistics Wing of the Field Operations Division of NSSO, which is already doing pioneering work for improving the quality of agricultural statistics would be the right type of agency to carry out such national agricultural surveys.

64. Priority needs to be given to the proposal of collecting regularly prices of important inputs in a set of fixed villages through the NSSO so as to fill in an important gap.

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4.2 Availability of Statistics of Plantation Crops

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Introduction :

Plantation crops are important both for export transactions and for internal consumption. The most important among the plantation crops grown in the country are tea, coffee, rubber, cardamom, coconut, black pepper, arecanut and cashewnut. Regular estimates of area and production are being issued by the Directorate of Economics and Statistics, Ministry of Agriculture and Irrigation (DES-Ag) on the basis of the reports received from the States in respect of black pepper, coconut, arecanut and cardamom from 1951-52, 1965-66, 1966-67 and 1969-70 respectively. All-India Boards of Tea, Coffee and Rubber, Collect data on various aspects of the respective crops and publish the same in the statistical reports exclusively devoted to these crops. The publications giving data on area and production of plantation crops are indicated in Annex. This paper describes briefly the quality of the estimates of area and production pertaining to these crops.

Tea

2. Tea is grown in Northern and North-Eastern States of Assam, Tripura, West Bengal, Bihar, Uttar Pradesh, Himachal Pradesh and in the States of Kerala, Tamil Nadu and Karnataka in South India. Assam and West Bengal account for 76 per cent of area and 78 per cent of production in the country.

3. The Tea Board, constituted under the Tea Act 1953, compiles and disseminates data on various aspects of tea. Data on area, production and yield per hectare are issued district-wise for Assam, West Bengal, Kerala, Tamil Nadu and Karnataka and for the State as a whole for Tripura, Uttar Pradesh, Bihar and Himachal Pradesh. The area under the crop is also compiled by age groups of bushes. Area and production are also classified according to the size of the estates. The data on number of tea estates and area relate to 31 March while the production figures relate to calendar years.

4. The registration of tea estates with the Tea Board is not compulsory. According to the Tea Act permission is to be obtained for planting on new

areas. In case there was an estate before the enactment of Tea Act and that estate did not undertake new planting operation by way of extension of tea area, such an estate would not be required legally to be registered with the Tea Board. Since all the larger estates undertake extension of plantings at one time or the other, almost all such estates are registered with the Tea Board. There are, however, thousands of small growers who are not registered with the Board.

5. The area figures are obtained by the Tea Board from the large registered tea estates (more than 10 hectares) in the form of an annual return. Similar annual returns are not available from the small growers (less than 10 hectares). The figures relating to small growers, therefore, are incomplete because a large number of small growers are still not registered with the Board and even in respect of the registered small growers there is no system of annual up-dating of data. To this extent the figures relating to the small growers would be incomplete, besides being inaccurate. In the absence of either a census of tea growers or a well-planned sample survey, it is not possible to indicate definitely the share of small growers in the total area.

6. The production figures relate to manufactured tea. Most of the large estates have their own factories where tea is manufactured. The small growers as also some slightly bigger gardens cannot afford to have a factory of their own. Such growers sell their green leaves either to Cooperative Tea Factories or to 'Bought Leaf Factories' set up in the Private Sector. All the tea factories are registered with the Central Excise Authorities, and these factories are sending monthly returns to them indicating the quantity of tea manufactured (or the production) in the factory every month. A copy of this return is also sent to the Tea Board by factories. In regard to non-responding gardens the production figures are estimated based on the percentage increase or decrease in production recorded in the case of the reporting gardens. The procedure of compilation of statistics of manufactured tea appears to be satisfactory. However, it would be desirable to collect the information from Cooperative Tea Factories and 'Bought Leaf Factories' about the contribution of small growers to the total production so that the correspondence between the area and production figures could be studied separately for large estates and small estates.

Coffee

7. Coffee is grown in the States of Kerala, Tamil Nadu and Karnataka which together account for about 99 per cent of its area in the country. The Coffee Board, constituted under the Coffee Act, 1942, compiles and disseminates data on various aspects of coffee industry.

8. Data on number of registered and unregistered estates, area planted with coffee, production and yield per hectare of coffee are compiled by the Coffee Board, based on the reports of its field staff. A census carried out by the Coffee Board during 1972-75 has revealed that the information based on the reports of the field staff did not have complete coverage. According to the census, the number of unregistered units on 31 March 1976 was 35253 as against 9639 unregistered units on 31 March 1975 reported by the field staff. As a result, the area under the crop rose from 156138 hectare in March 1975 to 171535 hectares in March 1976.

9. The data are collected on the basis of complete enumeration in the case of all coffee estates of size 2 hectares and above in the statutory returns. In the case of estates below 2 hectares, a random sample of 10 per cent of the estates is selected in each range for visit by the field staff for collection of the statutory returns. The data so collected are projected to the total number of estates under 2 hectares in the range and added to the range total of the estates of 2 hectares and above compiled on complete enumeration basis.

10. Under the Coffee Act, 1942, all the coffee produced by the registered owners should be delivered to the Coffee Pool administered by the Coffee Board except a small quantity retained by the growers for their domestic use and seed purposes. The Pool Agents, who receive the coffee on behalf of the Board, cure it to the prescribed standards and arrange to deliver it to the parties to whom the Board has sold. Actual crop production for the season is compiled on the basis of the quantities actually cured and despatched as made available by these pool agents in their final monthly returns. Quantities of coffee retained by growers for their domestic use and seed purposes, as furnished by the Divisional Assistant Coffee Marketing Officers, are added to the cured figures to arrive at the production of coffee for the season. Production of coffee in respect of non-traditional coffee growing areas like Assam, Maharashtra, Orissa, Mizoram, Madhya Pradesh, Andaman and Nicobar etc., which are exempted from delivering coffee to the Pool are also taken into account while arriving at the total season's crop for the country. For small estates (less than 2 hectares) area and production are also estimated based on a random sample of 10 per cent of the estate selected every year. It is necessary that the format of the returns furnished by the Pool agents is suitably modified so as to make available figures separately for the small estates which could then be cross-checked with the estimates based on sample surveys.

Rubber

11. Kerala is the principal rubber producing state accounting for over 93 per cent of the production. Tamil Nadu and Karnataka are the other States where rubber is grown. All research and development activities regarding natural rubber in the country are controlled and regulated by the Rubber Board constituted under the Rubber Act, 1937.

12. The Rubber Board makes available data on total area, tappable area, production and yield per hectare. The data are given separately for Kerala, Tamil Nadu and Karnataka and Andaman & Nicobar and others taken together. The information on 'area new planted' and replanted for ordinary and high yielding varieties is also given. Besides, the classification of holdiags and estates according to size is also provided.

13. The Rubber Board compiles data on area under rubber from the registration records on annual basis. Under the Rubber Act, any person desiring to plant or replant rubber is required to take out a licence from the Board. However, a number of units have been detected to be unregistered.

14. Under the Rubber Act, rubber traders and consumers of rubber, are required to take out licence, renewable every year, from the Rubber Board. The estates of above 20 hectares, traders producers and consumers are statutorily bound to submit monthly returns to the Board in the prescribed forms. The returns prescribed for the estates provide gradewise details of rubber produced, sold and stock held at the end of the month. Returns of traders cover gradewise details of rubber acquired, sold, stock held etc. at the end of each month. The returns submitted by consumers cover the stock held at the end of the month. These returns provide monthly figures of estates, consumption in the country and stocks held by estates, traders and consumers. Production is then estimated by the following indirect method :

$$\text{Production} = \text{Consumption} + \text{export} - \text{import} + \text{adjustment for stock difference.}$$

15. The figure of production of rubber, estimated as above, is cross checked with the estimates based on the inter-State movement of rubber. Under the Rubber Rules, when rubber is transported from one State to another, a declaration from which *inter alia* gives the quantity transported, value of rubber transported etc. should accompany the consignment. The total quantity of rubber transported from Kerala (which accounts for over 93 per cent of rubber produced), is compiled based on the forms. This figure when adjusted against consumption in these State and stock differences gives an idea about the quantity produced in the State.

16. In order to study the production trend of small holdings (less than 20 hectares) which account for two-thirds of the rubber produced in the country, the Board introduced a sample survey from 1978. Under this survey, a 1 per cent stratified random sample of small holdings is selected to collect the information about production of rubber. The sample size of 1 per cent of small holdings does not appear to be adequate for estimating the production of rubber for the small holdings.

Black Pepper

17. Only 20 per cent of the production is consumed within the country the rest being exported. Kerala holds the monopoly with about 97 per cent of the country's area and production.

18. The regular forecasts of area and production of black pepper are being issued by the DES-Ag since 1951-52. The estimates of area under the crop for Kerala are based on the sample surveys for land utilisation. The per hectare yield of pepper used for estimating production was till recently obtained on the basis of pilot studies conducted by Indian Agricultural Statistics Research Institute (IASRI) earlier during 1954-55 and later during 1966-68 adjusted on the basis of forecast reports to take note of annual changes. The position has, however, improved with the establishment of an agency for collection of agricultural statistics through complete enumeration in a sample of 20 per cent of villages. Estimates of area and per hectare yield of pepper become available on an annual basis through the scheme which has been in progress since 1975-76.

19. In Karnataka and Tamil Nadu, while the estimates of area under the crop are based on complete enumeration, the production is estimated on ad hoc basis. The estimation of yield rate of black pepper through sample surveys has been included as a part of the Centrally sponsored scheme for extension of crop estimation surveys to fruits, vegetables and minor crops. With the implementation of this scheme, the production of pepper in these two States would also be based on an objective procedure.

Cardamom

20. The crop is concentrated in three States of Kerala, Karnataka and Tamil Nadu. Regular all-India estimates of the crop based on forecast reports received from the cardamom growing States are being issued by the DES-Ag since 1969-70. However, adhoc estimates of area and production of the crop are available from 1955-56.

21. In Karnataka and Tamil Nadu, estimates of area under the crop are being formulated on the basis of complete enumeration, while in Kerala

these are based on land use sample surveys. Random sampling technique of crop estimation surveys for estimating the production of cardamom has not so far been introduced in any of these States. However, the Karnataka Government has agreed to extend the technique to this crop under the Centrally sponsored scheme for extension of crop cutting surveys to fruits, vegetables and minor crops. DES-Ag has taken up with the Government of Kerala to include cardamom also as one of the crops for which crop estimation surveys would be organised for estimating yield rate.

Coconut

22. The main coconut producing States are Kerala, Karnataka, Tamil Nadu and Andhra Pradesh, which together account for nearly 93 per cent of area and 94 per cent of production in the country. Coconut is also cultivated in the States of Assam, Maharashtra, Orissa, West Bengal and the Union Territories of Andaman & Nicobar Islands, Goa, Daman & Diu, Lakshadweep and Pondicherry.

23. Regular all-India estimates based on the forecast reports from the coconut growing States are being issued by the DES-Ag since 1965-66. Figures for the earlier years available since 1949-50 were based on ad-hoc estimates.

24. Area under coconut is based on complete enumeration in the States of Andhra Pradesh, Assam, Karnataka, Maharashtra, Tamil Nadu and Pondicherry. Kerala State which accounts for nearly 70 per cent of the All-India area under coconut, used to base its estimates of area till recently on the sample surveys for land utilisation. Since 1975-76, an agency for collection of agricultural statistics through complete enumeration has been set up under a Centrally sponsored scheme. By 1978-79 it has covered 20 per cent of the villages and by 1982-83 all the villages in the State are expected to be covered by this Agency. A similar scheme is being implemented in Orissa and has been sanctioned for West Bengal, though for the present, adoption of complete enumeration approach for coconut statistics is not envisaged in these States.

25. The yield rate of coconut was obtained till recently on the basis of objective procedure of random sampling under the scheme sponsored by the erstwhile Indian Coconut Development Committee. However, such surveys have been discontinued in all States except in Maharashtra and Tamil Nadu. The main coconut producing States of Kerala, Karnataka, Tamil Nadu and Andhra Pradesh, need be persuaded to revive the scheme of conducting sample surveys for providing objective estimates of production.

Arecanut

26. Assam, Karnataka and Kerala are the three important States growing the crop. These States account for nearly 91 per cent and 94 per cent respectively of the total area and production of the crop in the country.

27. While estimates of area and production of arecanut are available from 1964-65 onwards, regular all-India estimates based on the forecast reports received from arecanut growing States are being issued by DES-Ag from 1966-67. In Assam and Karnataka, the area under the crop is estimated by the regular revenue agencies on the basis of complete field-to-field enumeration. However, in Kerala, in the absence of a regular reporting agency, the area under the crop is estimated on the basis of sample surveys.

28. In so far as the production estimates are concerned, these were uptill 1960 based on the results of sample surveys organised for the estimation of area and production of arecanut but these were discontinued thereafter. At the instance of the DES-Ag, the Government of Assam have once again initiated these surveys since 1975-76. The Government of Karnataka propose to take up such surveys under the Centrally sponsored scheme for extension of crop estimation surveys to fruit, vegetables and minor crops. In Kerala, as part of the scheme for establishing an agency for collection of agricultural statistics through complete enumeration it has been possible to revive the attempt at framing reliable estimates of area and production of arecanut. This need be pursued vigorously with the States so that the objective estimates of production become available over time.

Cashewnut

29. Cashewnut is grown mainly in the States of Andhra Pradesh, Kerala, Karnataka, Maharashtra, Orissa, Tamil Nadu and Goa, Daman and Diu.

30. The question of issue of regular all-India estimates on cashewnut crop has been engaging the attention of the DES-Ag for quite some time past. However, information received from the State Governments is neither adequate nor of requisite reliability. As at present, complete information is being received by the DES-Ag only from 4 States, namely, Andhra Pradesh, Karnataka, Kerala and Tamil Nadu.

31. A review of the status of availability of statistics of area and production of cashewnut was undertaken at a meeting convened by DES-Ag in May 1976. Pursuant to the decisions taken in the meeting, the State Governments have been requested by the DES-Ag to organise a special supervisory

check in respect of cashewnut in the revenue areas. Pilot studies for the estimation of area and production of cashewnut in areas administered by Forest Departments have also been undertaken in the States of Andhra Pradesh, Karnataka, Tamil Nadu, Orissa and Maharashtra. The State Governments have been given 100 per cent financial assistance for the conduct of these studies. Kerala has reported that there is very little cultivation of cashewnut in forest administered areas. It is necessary that the system of collection of data on area and production of cashewnut evolved makes available data on area under bearing and non-bearing trees and production of raw kernal separately for forest and other areas.

Concluding Remarks

32. The statistics of area and production of plantation crops presently available need considerable improvement. The coverage is incomplete in respect of Tea, Coffee and Rubber estates. It is necessary to conduct periodically, say once in five years, a census of estates growing these crops to identify the unregistered estates and thereafter efforts may be made to register such units for collection of data. Further, analytical studies may be undertaken to work out the appropriate sampling methodology for estimating the production of these crops.

33. Kerala is an important State growing other plantation crops, viz., Black Pepper, Cardamom, Coconut, Arecanut and Cashewnut. The quality of statistics of area of these crops is likely to improve by 1982-83 when agricultural statistics will be collected in all the villages of Kerala through complete enumeration with the help of an agency set up in 1975-76. Further, while collecting the area under these crops, a record of bearing and non-bearing trees may also be obtained. If reliable estimates of bearing and non-bearing trees are available for each of these crops, the estimates of total production can be worked out by providing estimates of yield rates per bearing tree. For this purpose, suitable sample surveys would need to be organised in each of the States growing these crops based on the pilot sample surveys conducted by IASRI during 1960-70.

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ANNEXURE

Publications Giving Data on Area and Production of Plantation Crops**1. Indian Agricultural Statistics (Annual)**

This publication of DES-Ag is issued in two volumes which give area under coconut, black pepper, cardamom, tea, coffee and rubber at State and district level respectively.

2. Estimates of Area and Production of Principal Crops in India (Annual)

This publication of DES-Ag provides data on area, production and yield per hectare of Arecanut, coconut, black pepper, cardamom, tea, coffee and Rubber. Data in respect of arecanut, coconut, black pepper and cardamom are available State-wise. For tea, coffee and rubber only All-India figures based on data furnished by the respective Boards are given.

3. Indian Agriculture in Brief (Annual)

This publication of DES-Ag gives All-India figures of area, production and yield per hectare in respect of tea, coffee, rubber, black pepper and cardamom.

4. Bulletin on Commercial Crop Statistics (Biennial)

This publication of DES-Ag provides figures of area, production and yield per hectare of coconut, arecanut, black pepper and cardamom.

5. Tea Statistics (Annual)

Issued by the Tea Board, it gives All-India and State-wise data on number of estates, area, production and yield rates. District-wise details are available for major tea producing States. Area figures are also given by age group of bushes. Area and production are also classified according to the size of the estate.

6. Coffee Statistics (Annual)

Issued by the Coffee Board, the publication gives data on number of registered/unregistered estates, area planted with coffee, production and yield per hectare of coffee separately for Arabica and Robusta Coffee. The information is also available according to States and size of holdings. District-wise details are given for major coffee producing States.

7. Indian Rubber Statistics (Annual)

Issued by the Rubber Board, the publication provides data on number of units, area under rubber, tappable area, production and yield per hectare. The information is presented separately for major rubber producing States. Taluk-wise details are available for Kerala and district-wise for Tamil Nadu and Karnataka. The information on area new planted and re-planted for ordinary and high yielding varieties is also given. The classification of holdings and estates by size is also provided. The figures of production are also available separately for natural and synthetic rubber.

8. Rubber Statistical News (Monthly)

This publication of the Rubber Board gives monthly data on production of natural and synthetic rubber.

9. Cardamom Statistics (Annual)

Issued by the Cardamom Board, the publication gives data on number of registered estates and area, State-wise and according to size of holdings. These are also given Taluk-wise for Kerala and District-wise for other States. The data given relate to 'Elettaria Cardamomum.'

4.3 Quality of Data

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1. Introduction

Census and sample survey methods are being extensively used to collect data on numerous items, important for economic, social, political point of views. No method of census or surveys is, however, free from error. The consequences of these errors may vary over a very large range of possibilities. The modern users of these data are quite aware of these errors and these users demand detailed information about the quality of data. The user asks for the evidences both internal and external in support of the data supplied to him. He wants to be reasonably sure that he has got the data he wanted. If no, to what extent the data supplied to him can be substituted for the data demanded by him and with what possible consequences. All such relevant questions have to be answered.

In this paper, we will discuss various aspects of quality of data, viz., sources of errors, techniques for checking quality of data and quality of data processing with special references to the problems in the field of statistics.

2. Some Basic Concepts

(i) *True Value* : It is the real value of the characteristic which is sought to be collected through a survey. In a very large number of cases, true values can be exactly defined. In the case of a census of holdings, the true value of the total area of a holding is the sum of true values of the area of individual fields. Let us define the true value of the i th unit of the population by the symbol x_i and the survey value by Z_i .

(ii) *Error* : As individual true values are not always achieved in survey practice for all the units, the difference between the survey value and the corresponding true value, viz.,

$$d_i = z_i - x_i \quad (1)$$

is called the individual error.

3. Types of Error

There are three broad groups of error :

- (A) Errors resulting from inadequate preparations,
- (B) Errors committed in the stage of data collecting, and
- (C) Processing errors.

The errors of group A may occur due to the adoption of biased procedures of measurement selection and estimation and biased tools consisting of tables of random numbers, questionnaires (including proformae and various types of forms), frames and instructions for collecting the requisite data.

The errors of Group B may be broken down into

- (A) Listing errors,
- (B) Missing data, and
- (C) Response or observational error.

Errors due to incomplete listing or faulty listing and missing data needs no elaboration. The response or observational errors refer to the difference between the individual true value and corresponding survey value. For example if a holder gives the information that he has applied urea @ 200 kg. per hectare, while he has actually used ammonium sulphate at this rate, the answer given by the holder contains a response error.

The errors of Group C can arise due to deficiencies in editing, coding, punching, tabulation, etc.

4. Sources of Error

As the concept of quality of data is closely associated with the concept of error, it will be useful if the errors are discussed in a little more details. The errors of Type A arise out of inadequate preparation. For carrying out any sample surveys or censuses, it is essential to ensure that the procedures adopted and tool utilized are unbiased. A biased procedure is one whose repeated application results in biased data. A procedure can be biased either because it was conceived and formulated as such or because its implementation was defective. There are three groups of biased procedures, namely (a) Measurement procedure, (b) Procedure of selecting the sample, and (c) Estimation procedures. These need separate discussion.

(A) Biased Procedure

(a) Measurement Procedure

The first measurement procedure, I would like to discuss is the weighing which is often used in agricultural statistics for purpose of production measurement. If the field workers are using the local weights which in certain areas

are made of stones have lost a portion of their weights due to constant use. The results based on this sort of measurement would be biased. Similarly, if the area of the fields are measured through pacing, the measurement of area would not be accurate. Another example of such biased measurement procedure is the use of the jute or other non-metallic spring for marking the experimental plots in crop-cutting surveys.

(b) Selection Procedure :

The aim of the selection procedure is to obtain a sample that has to know probability structure. Otherwise no rigorous use of statistical theory can be made. The procedure of selection is normally planned and formulated together with the estimation procedure because they represent two aspects of the same probability model adopted in the design of the survey. If the selection procedure fails to achieve its aim, the estimation procedure of the types planned may not be worthwhile. The bias resulting from the former would be carried over automatically and the final estimates could be biased unless some means are found to remove the bias in selection of sample. As an illustration of the biased procedure of the selection, I would like to refer to the sample surveys for estimating the yield of crop in India. For this purpose, a sample of villages is selected. Within the selected villages all the fields under the crop are listed and the samples are, thus, selected according to their survey numbers. The instructions issued for the selections are as follows.

“Against the names of each selected villages are shown two random number smaller than the highest survey numbers in the village. Select the survey numbers corresponding to the given random numbers for experiments. If the selected numbers does not grow the specified crop, select the next higher survey number growing the specified crop in its place”.

What is the result of this selection procedure ?

If the total of survey numbers in a village amounts to 290, the random numbers are 18 and 189 and the fields under the specified crops are 49 to 88 and 189 to 290, it is obvious that the field 49 is selected with the probability of $49/290$ and the field 189 with a probability of $1/290$. Clearly, the selection of fields is not according to the sample plan which results in biased selection. This bias could be avoided if the field personel are trained to use the tables of random numbers. Instead of using the pre-selected numbers, they would read three digit numbers from the table of random number and reject all these which fall on field growing crops other than the specified crop.

(c) Estimation Procedure :

Having collected the data on sample basis, appropriate estimation procedure have to be used to provide estimate of the population value. Now if $E(x)=X$, where x is computed as the sample estimate of X , then such an estimation procedure is said to be unbiased. Unbiased estimation procedure are generally preferred but if biased procedure lead to considerable reduction in the mean square error, they are also used. The ratio method of estimation may be used because it has a lower mean square error than some alternative unbiased estimates. In the case of biased estimation procedures, the important factor is convenience of the methods used, the simplicity of instructions, the cost of computation, etc. For example, computation of variances may be replaced by some approximate method based on the use of data from past surveys. In other words, the justification of the procedures used lie in increased speed, more convenient work, etc.

However, when a biased procedure is used, it is necessary to know the mathematical expressions for the magnitude of the bias so that it can be established whether the bias should be a cause for concern, on what quantities it primarily depends and what steps may be useful to reduce or to eliminate it altogether. A variety of steps are possible for reducing or eliminating the bias. Let us consider the case of ratio method of estimation in sample surveys. A lot of work has been done by Sukhatme, Cochran, Koop etc. These studies show the conditions under which the ratio method may be considered as the best method of linear unbiased estimates. Another useful approach might consist in a study of the empirical evidence with the aim of establishing the magnitude of the biases due to ratio estimates in the past surveys. This type of work was undertaken by Kish, Namboodiri and Pillai.

Another approach consists in defining and adopting a selection procedure that eliminates the bias in the estimated ratio, as proposed by Lahiri.

(B) Biased Tools.

Apart from biased procedures, biased tools also lead to considerable errors in the data collection. In Sample Surveys or Census, the following three types of tools are frequently used ;—

- (a) Tables of random numbers,
- (b) Questionnaires or schedules, and
- (c) Instructions to the field workers.

(a) **Tables of Random Numbers.**

Before using the tables of random numbers, it is essential to test these tables for randomness. Various tests have been developed for the purpose. It is not only essential to submit such tables to rigorous tests of randomness but also each usable part of the tables should be separately tested.

(b) **Questionnaires or Schedules.**

In most of the statistical work, questionnaires are most widely used. Designing of questionnaires to get the needed information requires very careful study, experimentation and testing of alternative drafts under different conditions. Questions may be presented in the questionnaires are dichotomous, multiple choice or open questions. The most important source of errors in questionnaires is improper wording of question. The errors appear here for a number of reasons. Very often, the person responsible for designing the questionnaire is not sure himself of the meaning of the various definitions and concepts used in the survey. Designers of questionnaires often assume that the respondents know everything about the survey and its aims. Sometimes allowances are not made for the fact that the respondents belong to a very different social categories may not be always able follow a proper connotation to the vocabulary used for various purposes in statistics. Obviously these factors open the way for errors.

While preparing the questionnaire, it is important to make a thorough study of the interpretations that might be given to various questions. In some cases, misinterpretation appears where one hardly expects. For example, the question "How many persons live in this household?" seems to have a clear meaning. But, in fact, this is far from being the case. Census experiences show that the answer to this question may also include people who used to live in the household, those who will live there some time in the future, those who are only present from time to time, etc. It is a very well known fact that the babies are often excluded. When the enumerator points out the baby, he receives the answer "Oh, no. That is the baby. In other words, for statistical purposes, a baby is a person and for many respondents, a baby is a baby and not a person.

Many other problems have to be kept in mind while designing the questionnaire. One of them is the number of questions, that is the length of the questionnaire. It is a well-known fact that a long questionnaire provokes a gradual decrease in interest on the part of the respondent. As a result less attention is paid to the accompanying instructions: the meaning of the questions

is less well understood; the respondent's desire to answer the questions adequately declines and the quality of the information decreases. Moreover, a long questionnaire is a source of discouragement to respondents. Willingness to co-operate with enumerators has its limits; there are not many people who are ready to spare a long time interviews or questionnaires. Refusals to co-operate are often the outcome of a long questionnaire.

No definite rule governs the problem of the permissible length of the questionnaire. A great deal depends upon circumstances. In a country where surveys have been a routine and the general education of the people is sufficiently high to allow quick reading and understanding of a properly prepared questionnaire, even a relatively long questionnaire may not present any serious difficulty. Other factors come into play. If the subject matter is interesting, respondents may be prepared to accept a long questionnaire and try to answer all its questions. The technical appearance of the questionnaire, the layout of the material, the size of the paper, and other aesthetic factors also play a considerable role. An unwieldy questionnaire where it is difficult to find the different instructions is not popular with respondents.

The problem of the sponsor is no less important. In many countries there is a widespread opinion that surveys sponsored or made by the government concern problems of common importance. It is also believed that data obtained in such surveys will be useful for the promotion of national goals and interests. In this situation one may, in principle, have a larger number of questions than in surveys sponsored by private bodies or business firms. Therefore in the latter case considerable attention is again necessary for all details in the preparation of the questionnaire.

(c) Instructions

Instructions prepared for collecting information are equally important. Instructions should be as clear as possible. They should be complete. In order to improve the quality of data, the instructions must correspond adequately to the purpose they are supposed to serve. The drafting of instructions requires a perfect knowledge of the subject matter of the survey involved of the machinery that is to be used in achieving the survey aims, of the characteristics of the population to be dealt with, of the psychology of both the respondent and the enumerators.

(B) Inadequate Frames, Missing Data and Response Error

(a) Inadequate Frame

One of the most important source of error is the inadequate frame which

is called as listing error. When the frame is incomplete some units are omitted from listing. Sometimes it also happens that some units are listed several times and even non-existent units are listed. These types of errors constitute listing errors. Listing errors are also caused due to misclassification. For example, an agricultural holding may be classified as joint holding on the basis of ownership of more than one person of the holding, whereas actually, all operations of the holdings are being managed by one single person.

(b) Missing Data

Missing data represent special types of errors encountered primarily in sample surveys. In some cases even in complete censuses some units are omitted for various reasons from being listed. However, in sample surveys, the problem of missing data is much more serious and frequent. In the field of agriculture, the common example of missing data occurs when some fields selected for crop-cutting experiments are harvested before the enumerator reaches there. The information for such fields is treated as missing. In socio-economic or other surveys based on enquiry method, refusal to give information represents a special case of missing data. Missing data are usually dealt with in statistical literature under the name of non-response in incomplete survey. A lot of work has been done in this direction and interested persons can look into that work for more details.

(c) Response Error

The response for observational errors refers to the difference between the individual true and the corresponding sample value. If the holder gives the information that the total production of wheat in his holding was 20 quintals while actually his product was 25 quintals, the answer given by the holder contains a response error. Generally response error may be positive and negative and those, on an average, are self balancing. However, if they occur in a systematic way, the total or averages based on such observations would be biased.

(d) Processing Error

The errors committed in processing data are those of adding, coding, punching, tabulation, etc. We are all well aware of the processing errors. All necessary care should be taken to ensure that, after having collected the data, no error enters into the results at the processing stage. Such errors can easily be controlled because processing is generally centralized and it is much more easier to eliminate errors at the processing stage than otherwise.

5. Checking the Quality of Data

As pointed out earlier, no survey or census is free from errors. During the operation of various phases of the survey, it is also very difficult to locate the possible errors, their frequency and effect on the ultimate results. For obtaining the information on these points, the following two techniques for quality checking or evaluation or appraisal are adopted :—

- (a) Post hoc techniques, and
- (b) Sampling method.

(B) Post Hoc Techniques

There are various techniques used for checking the quality of data collected through sample surveys or censuses. Some of the most frequently used post hoc techniques are discussed below :—

1. Comparison of Survey or Census Data with Data from Independent Sources

In many situations repeat surveys from censuses are carried out. Even if the repeat surveys or censuses are not carried out, there are other sources from which similar information is available. The survey results should be compared with those results. As an illustration of such comparison, we take the example of crop-estimation survey on apple crop in U.P. during the year 1972-73. The estimated production of apple Crop during 1972-73 was 15.37 thousand tonnes. The apple crop is mostly exported from the hilly portion of U.P. to other parts of the country through four exit points. At those exit points, a record is available in regard to the number of trucks loaded with fruits and vegetables which pass through these exit points. On the basis of this information an alternative estimates of production of apples worked out to be about 12.5 thousand tonnes also. Considering that about 10 to 15 per cent of the apple production is consumed in the area, a comparison between these two estimates indicated that the survey estimates were quite in agreement with the external evidence and can be used with confidence.

In many other examples the use of this type of comparison is not fully justified. For example, data obtained in an expenditure survey on expenditures on tobacco in a given period of time may be compared with sales data available from tobacco manufacturers. This comparison is valid if the figures cover the same reference period. This is, however, not easy to achieve as the manufacturers' data may include quantities sold or to be sold in retail business at some time outside the reference period.

2. Consistency Studies

Consistency studies are also undertaken for checking the quality of the data. By consistency studies we mean that the data given by sample surveys or censuses follow some expected norms. For example, the following relationship could be used as valid in most cases of the data on crop-cutting experiments on certain crops :—

- (i) The proportion of irrigated field selected under the crop-cutting experiments should almost be equal to the proportion of area irrigated under the crop.
- (ii) The proportion of fields selected under the crop-cutting experiments under different varieties would be the same as that in the total area.
- (iii) The yield rates of the irrigated crop should normally be higher than the yield rates of unirrigated crop.

However, comparison of yield rates does not lead to entirely valid evidence because a number of factors of production interact with each other. For example, sugarcane is generally shown under irrigated condition. However, in *tarai* area, it is shown under unirrigated conditions also. As, however, in *tarai* areas, there is enough moisture, irrigation is not required. Hence, the yield rates in irrigated and unirrigated areas in such cases may not be very much different.

3. Drawback of Post Hoc Technique

The post hoc technique has some common characteristics that to be borne in mind while planning their use. They are :

- (i) Every comparison implies the existence of data collected previously on the same topic. It restricts the use of all such techniques to situations with a considerable tradition in statistical work and with several surveys on the same topic.
- (ii) The application of post hoc techniques provides impressions on quality rather than its numerical measures.
- (iii) As the post hoc techniques refer to final survey results, such as totals, averages, proportions, etc., any information on individual errors and circumstances under which they appear is, thus, lost and the evaluation of data does not furnish any guidance on what has to be changed in the techniques of collecting data in order

to achieve better results. Accordingly, the above techniques have little to offer for the improvement of the quality of data in subsequent surveys.

4. Sampling Methods

Another technique of checking of quality of data is the use of sampling method both in sample surveys as well as in censuses. With sampling methods, the results of a check are based on the sample of units obtained through the highly professionalised agency. The advantage of adopting this technique is that the quality checking of survey data is possible independently of whether similar surveys have ever been made before. This makes the use of sampling methods suitable for quality studies in all situations. An illustration of these sampling methods for quality checks is the sample surveys are being carried out under the scheme of Improvement of crop statistics in the country. Under this scheme, for checking the quality of the figures of the area under important crops reported by State agencies and the estimates of yield rates, a very small sub-sample is randomly selected and the statistical supervisors are required to record the area under various crops grown in the selected survey numbers in the selected villages and get the crop-cutting experiments conducted in their presence. This technique not only gives the quantitative measures of the data but also provides the information how the data are being collected and how these can be improved upon in subsequent censuses or sample surveys.

6. Summary and Concluding Remarks

No survey or census is free from errors. Errors arise from three sources :—

- (i) Inadequate preparation
- (ii) Incomplete frame, non-response, etc. and
- (iii) Faulty processing of data

These errors cannot perhaps be altogether eliminated but with careful planning and meaningful efforts, these can be minimised. Modern users are very conscious of the quality of data and before use they wish to be sufficiently assured that they are using the data they needed. This places a great obligation on the data collecting agencies. This becomes much more important where one sees that in most of the cases data collecting agencies use public resources. They, therefore, have a public function and the responsibility to produce the best possible data with the resources available. This implies that the design of the survey or census of such a built in system of qua-

lity checking of the data it is going to produce. Here design of the survey does not mean only sampling plan but covers all such items as sample, questionnaires, selection and training of the field personnel, the supervisory staff the techniques of data collection.

Thus, the data collecting agency must submit their data to the severest test of quality checking before releasing these for use. Unfortunately, sometimes this care is not taken which creates so much confusion in the mind of the users that they start equating even very reliable and precise data to lies. One has to see that this sort of situation does not arise.

4.4 Qualitative Aspects of Data of Agricultural Field Surveys

By

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As a basic requirement and a pre-requisite for drawing valid inferences, the need for quality data cannot be over-emphasised. If the data collected lack in quality there is no known procedure or statistical tool which can help in eliminating or improving this deficiency. It, therefore, becomes imperative for us to direct maximum possible efforts to ensure that the data collected are free from gaps and errors as far as possible.

In the case of field surveys, there are three major stages of work, viz., (i) planning, (ii) data collection, and (iii) processing and summarisation of data. The different types of errors that are likely to be committed at the various stages of the survey can be broadly classified as :

- (i) data specification being inadequate and inconsistent with respect to the objectives of the survey,
- (ii) omission or duplication of units due to imprecise definition of sampling units, incomplete or wrong identification particulars of units,
- (iii) Incomplete sample/gaps in coverage,
- (iv) inadequate or ambiguous schedules, concepts and definitions or instructions,
- (v) inaccurate or inappropriate methods of observation or measurement,
- (vi) investigator's bias,
- (vii) Lack of trained and experienced investigators,
- (viii) incomplete response/errors due to memory lapse of the respondents,
- (ix) errors in data processing operations such as coding, punching, verification, compilation, etc.,
- (x) errors committed during tabulation and presentation of results and printing of reports, etc.

Although the errors listed above are not exhaustive yet they provide a fairly good idea of the possible sources of errors. Errors can also arise due to defective frame and faulty selection of sampling units. The above sources and

types of errors were examined with regard to the data collected under some of the important projects carried out by the Institute and are discussed below :

1. (i) **Sample surveys for assessment of high yielding varieties programme,** and (ii) **Sample surveys for methodological investigations into high yielding varieties programme.**

The first surveys were in operation in 88 districts spread over 15 States of the country during the 4th Five Year Plan and while surveys at (ii) are in operation in 38 selected districts spread over 15 States of the country since 1974-75. The various types of errors observed in these two surveys were as follows :

(a) **Incomplete Sample/Caps in Coverage**

This type of error has occurred on account of transfer of staff in the course of the survey, State Govt. employees strike, State general elections, etc. The number of cultivators that could not be canvassed and the number of crop-cutting experiments that could not be conducted on account of these reasons in different years are given in the Table-1. As will be observed from this table during rabi 1977-78 in Aurangabad district (Maharashtra) no crop-cutting experiments could be conducted owing to strike by State Govt. employees and State general elections. On the other hand, only 9 per cent of the experiments could be conducted during kharif 1972-73 in Anantapur district (Andhra Pradesh) and 20 per cent of the experiments during kharif 1976-77 in Gonda district (U.P.) due to strike by the N.G.O.'s and due to transfer of staff in the middle of the season. The percentage of loss of data of crop-cutting experiments in different districts due to various reasons varied between 23 to 100. Similarly for the area estimation and agronomic and agro-economic enquiries, a substantial number of cultivators (about 20 to 50 per cent) could not be canvassed due to transfer of staff as can be seen from the table.

Likewise in the conduct of crop-cutting experiments due to non-intimation of the harvesting date by the cultivator to the Statistical Inspector about 6-8 per cent of the experiments planned were lost in Kolar district of Karnataka State during 1977-78.

(b) **Incomplete Response**

In the area estimation enquiry schedule there is a provision for recording the cultivator's reasons for not adopting/partially adopting HYV seeds of the

crops covered in their fields. A few cases are given in Table-2. As can be seen from the table, the percentage of cultivators who did not report any reason for not growing HYV seed of the various crops varied between 10 to 72 in the different districts. Also in the agronomic and agro-economic enquiry the information regarding the difficulties experienced by the cultivators in getting loan was not available since the specific reasons were not recorded by the Statistical Inspectors in almost all the cases.

(c) Inaccurate Observation

In the area estimation enquiry schedule, the investigator is required to record the total area under a particular crop in a holding by enquiry from the cultivator as also the fieldwise details of such area by enquiry/observation in the same schedule. It was observed that in 3-5 per cent of the cases the fieldwise area under a crop did not add up to the total area under that crop.

(d) Investigator's Bias

For case of data processing and summarisation on electric computer, yield data are recorded at multiple places in the same schedule to be available for punching for each card design. In some of the schedules it was noticed that the pilot yield was recorded as 10.50 kg when the same was either 10 kg and 500 gms or 10 kg and 50 gms. Another instance of wrong reporting was observed in the basic information consisting of total number of villages growing a crop in a block, number of cultivators growing the crop in a village area under the crop, etc. supplied by the Statistical Inspectors for working out the estimates of area under HYV of the crops studied e.g. in some cases the number of villages/cultivators growing the crop under study exceeded the population of villages/cultivators in a particular block.

(e) Errors Committed at the Processing Stage

Errors were noted in the parameter cards prepared for obtaining the estimates of area under high yielding varieties or yield rates of a crop with the help of electronic computer. In some cases the conversion factor applied for working out the yield of paddy in terms of dry rice (husked) from the green produce harvested was found not to contain the conversion ratio from paddy to rice with the result that the yield was reported in terms of dry rice (husked) although the same was actually in terms of paddy. This error arose on account of the relevant information not being recorded in the schedule.

2. Cost of Cultivation of Fruits

The Institute has in the recent years conducted a number of surveys on cost of cultivation of fruit crops based on the cost accounting method. In these surveys one fieldman is posted in each primary sampling unit, usually a cluster of 2 or 3 villages. The different types of errors observed were as followed :

(i) Incomplete Sample

Due to late appointment of the field staff only 17 fieldmen could be appointed instead of 20 and that too not simultaneously with the result that some information had to be collected by enquiry. This affected the quality of data so collected.

(ii) Incomplete Response

Information regarding the pruning operation was not reported in 2 out of 17 clusters. This gap was noticed only at the data processing stage. To avoid and minimize such occurrences, it would be desirable to provide the fieldmen with a calendar of operations to ensure that they are watchful and do not miss any operation. Also wage rates in case of casual hired labour were not recorded by the fieldmen. The prevailing wage rates in the villages, therefore, had to be employed for working out the hired as well as the family labour which affected the quality of such data.

(iii) Differences in the Estimates of Production

Estimates of yield and production are of vital importance for obtaining estimate of cost per unit output. Estimates of production are obtained in these surveys by enquiry from the sampled holdings as well as by crop-cutting experiments in selected orchards. The estimates obtained by enquiry from cultivators were usually lower than those of crop-cutting experiments. This difference in the two sets of estimates may be on account of (a) downward bias in the enquiry estimates, (b) upward bias in the crop-cutting estimates, (c) combination of both. Extreme care is thus essential to achieve reasonable agreement between the two sets of estimates. In the surveys on cost of cultivation of fruits, the yield per tree estimated from the two approaches is given in the following table :

District	Yield in Kg/tree	
	By crop-cutting experiments	By enquiry
Nainital	18.1	8.8
Almora	7.8	1.8
Tehri	9.3	11.1
Uttarkashi	12.4	6.9

It may be observed from this table that large differences existed in the two estimates. This could be partly due to the sampling errors arising from small size of the sample. However, there is reason to believe that the production was under reported by the orchardists. Possibly, the production figures reported by them were based on the quantities actually sold or retained by them. Apart from deliberate under reporting, they would not take into account the spoilage, pilferage and other damage and losses. Such factors have to be kept in view to ensure better quality of data on production.

(iii) Surveys on Area and Production of Fruits and Vegetables

The Institute has carried out a number of surveys on different fruit and vegetable crops in typical different regions of the country since 1958. The data collected in these surveys are mainly of three types (i) data regarding extent of cultivation, (ii) data regarding cultivation practices and (iii) data regarding yield and production. The data regarding extent of cultivation and yield are collected by actual observations while those on cultivation practices are obtained by enquiry. For fruits, the extent of cultivation includes the number of orchards, number of trees (both young and bearing), area under orchards, etc. Since orchards are completely enumerated in sampled villages, the quality of data regarding this aspect is quite satisfactory. Regarding the yield of fruit crops, selected trees are observed for the entire period of harvest. Some difficulties are observed when several fruits are covered in a single survey. The problem becomes all the more serious since the picking of fruits is required to be done in the presence of the field staff. Population help is of critical importance in this context. As an incentive, cash honorarium is paid to the cultivator to compensate for additional labour required and this has led to a

great improvement in the situation. Another important measure to ensure good quality of data is intensive supervision of field work and accordingly, quotas of supervision has to be assigned to officers from the States as well as from the Centre to ensure regular check as also to provide opportunity to field staff for removal of their day to day problems.

In vegetable surveys, since several vegetables are under study simultaneously and on account of multiple pickings of vegetables, the problem of collection of yield data by actual observation becomes still more acute. In order to elicit better co-operation from the cultivators, in addition to cash incentive etc., care was also taken to restrict the jurisdiction of the enumerator within 5 to 6 kilometers.

Another problem faced in observing the yield of vegetables was the location of random plot for crop-cutting experiments. Since several cultural operations are regularly undertaken in the vegetable fields, the pegs used for locating the plot were sometime found missing. However, these cases were not frequent.

The quality of data collected in the surveys conducted by the Institute is by and large fairly reliable. The main reason for this is that whole time field staff has been appointed under these projects. The field staff is adequately trained not only in the beginning of the survey but also during the progress of data collection work which helps in removal of doubts and solution of problems faced in actual field work. Intensive and frequent supervision is also undertaken and thus a number of problems are solved on the spot. Separately, the technical aspects like objectives, sampling designs and sample size, method of selection of sampling units, etc. concepts and definitions of various items, time schedule for collection of data on different aspects, procedure for measurement and observation of different units, the proforma for collection of data, the instructions for filling up the schedules and other relevant details are all brought out in the form of Hand-book of Instructions and supplied to each field assistant and supervisor to serve as ready reference for constant guidance as also for solving field problems. This has greatly helped in improving the quality of data and thus the gaps and discrepancies on technical ground are almost nil or negligible in the surveys carried out by the Institute. The main sources of error are incompleteness on account of insufficient field staff, frequent transfers during the course of survey work, assignment of other work and duties in addition to the survey work and sometime indifference or non-response on the part of respondents. The errors on this account can also be minimised by greater cooperation and understanding between the various agencies involved.

Table-1 : Number of cultivators/crop cuts which could not be canvassed/ conducted in different districts in different years due to various reasons.

Year & season	State	District	Type of enquiry	Crop covered	Proposed sample size	Actual sample size achieved	Reason for short-fall
1972-73 Kharif	Andhra Pradesh	Guntur	CCE	Rice	80	47	Strike by N.G.-O.'s
" "	"	"	"	Bajra	80	20	"
" "	"	Anantapur	"	Rice	80	7	"
" Rabi	"	"	"	Rice	80	17	"
1975-76 Kharif	Maharashtra	Aurangabad	AEE	—	600	387	Due to transfer of one Stat. Inspector
" "	"	"	AAE	—	288	147	"
" "	"	"	CCE	Bajra	48	37	"
" "	"	"	"	Groundnut	48	37	"
1975-76 Rabi	"	"	AAE	—	600	487	"
" "	"	"	AAE	—	288	230	"
" "	"	"	CCE	Wheat	48	37	"
1976-77 Kharif	U.P.	Gonda	AEE	—	600	280	Due to transfer of 2 Stat. Inspectors

”	”	”	”	AAE	—	288	118	”
”	”	”	”	CCE	Ricc	48	12	”
”	”	”	”	CCE	Maize	48	7	”
1977-78 Rabi	Mhara- shtra	Auran- gabad		CCE	Wheat	48	Nil	State Govt. employ- ees strike & State General elections

Note : CCE crop-cutting experiments

AEE area estimation enquiry

AAE agronomic and agro-economic enquiry.

Table - 2 : Percentage of cultivators not specifying any reason for not growing high yielding varieties seed of the crop during 1974-75.

State	District	Crop	Sample size proposed (No. of cultivators)	Percentage of the cultivators not specifying any reason for not growing HYV seed of the crop
Andhra Pradesh	Guntur	Kharif rice	600	37
	Chittor	"	"	25
	Karimnagar	"	"	32
Assam	Sibnagar	Winter rice	"	55
Haryana	Ambala	Rice	"	24
Karnataka	Raichur	Rice	"	72
Kerala	Trichur	Rice (Autumn)	"	21
Gujarat	Mehsana	Wheat	"	10
Haryana	Hissar	"	"	44
	Ambala	"	"	49
Karnataka	Dharwar	"	"	17
	Raichur	"	"	50
Maharashtra	Akola	"	"	42
Rajasthan	Chittorgarh	"	"	47
	Jaipur	"	"	23

4.5 Quality of Data for Livestock and Allied Studies

by

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Development of statistical system relating to livestock has been very slow in India. Moreover, the application of statistical methods to animal sciences is of comparatively recent origin. Administrators and planners had not given in the past the same serious thinking to the planning of livestock developments as they had given to the crop production. However, as a result of the establishment of the I.C.A.R., considerable progress has been achieved in this direction but wider application of statistical methods is considerably handicapped by the paucity of data.

Data are generally collected by interview method where an investigator contacts a respondent and records what he listens and notes down what he observes. He is supposed to elicit information according to a schedule packed with questions. Those who have some field experience are aware how the quality of information so collected varies depending on the honesty and ability of the investigator and also on the co-operation and memory of the respondent. Statistical methods can reveal what may not be obvious in a mass of figures but cannot create new information. If the data are poor or faked and misleading in content the results and conclusions suffer to that extent. It is always necessary and desirable to have a closer look at the type of raw data collected to consider in general the problems of the accuracy of data and their improvement. The quality of data will very much depend on to what extent the investigator had followed strictly the prescribed concepts, definitions and procedures prescribed for collection of data and to what extent he evoked a faithful response from the respondent about the phenomena under observation. Data are collected with certain objectives. These data may be considered as satisfactory considering the objective for which these were collected but these may not be satisfactory for other studies.

Research workers have now started probing into the quality of data to detect and discuss the various sources of errors and to attempt to quantify their magnitude. There was a Data Improvement Committee (DIC) headed by Dr. B.S. Minhas. A Steering Committee was also set up to continuously review and suggest improvements in collection of agricultural statistics. Perhaps due attention has not been given even by these committees for

collection and improvement of livestock statistics. The quality of data can be discussed under each of the three heads namely, livestock number ; livestock maintenance ; and livestock products.

While collecting information about status i.e. actual position regarding the number of livestock maintained, acreage under fodder crops etc., the data may be accurate but when it comes to recalling the events in the past viz. production of milk, sale and purchase of animals ; and feeds and fodders etc. data may not be very accurate. Generally, data on these aspects are supplied reluctantly, wrongly or completely concealed from the investigator. It was found from the sample surveys conducted by IASRI (1951-56) that livestock census which is carried out once in five years, gives reliable information for broad category of livestock at the district level. According to independent sample check on 1956 Livestock Census conducted by the Directorate of N.S.S., the percentage difference observed in All-India Survey figures for cattle and buffaloes over the corresponding census figures varied 4 to 5 per cent. This shows that the census figures may not be appropriate for use for compact areas.

While collecting information on quantum of feed given to animals, the householder reports the quantity in the form of bundles (for green and dry fodder) or baskets. Sometimes he weighs one bundle and multiplies by the number of bundles fed, presuming that bundles are of equal weight. Similarly, the quantum of farm-yard-manure utilised in fields is generally reported in cart-loads. The investigator generally converts to standard units utilizing his own intelligence. Once the data are recorded in standard units the user feels that the quantity recorded is accurate and he uses sophisticated statistical models for analysis.

For weighing of milk, feed, etc. the enumerators are provided with herd recorders, spring balances, etc. After using these balances for sometime, generally, the springs in these balances become loose and give wrong weighing figures. Although the instructions given are to check the balances at regular intervals, these are hardly carried out. As such the data recorded do not give the correct picture.

When the data are collected by enquiry, the householder sometimes gives the figures in local units, for example, the milk yield of animals in the rural area of Tamil Nadu are supplied in Padi and Ollocks and feed quantities in Viss. Unless the investigator is well conversant with the conversion figures, the data are not likely to be reliable.

Data on input of labour are recorded by investigators by enquiry from the householder. The quantum of labour is generally recorded in the schedule. But it is obvious that the investigator does not record the quantum of labour strictly on the basis of the actual time taken for each item and moreover, the householder also would not be reporting the quantum of labour correctly. Utilization of such data for more sophisticated analysis may not be desirable.

In some of the surveys where cost accounting approach is followed the enumerator is supposed to visit the householder at regular intervals and record data on the basis of his actual observation and careful enquiry. Sometimes he misses some of the visits due to some reason or the other and these data are recorded by enquiry in subsequent visits. Such cases are not taken care of while analysing the data.

After receipt of data these are scrutinised and discrepancies, if any, are reported for clarifications. Sometimes, it is observed that the discrepancies are such that it would not be possible to get the correct information after certain lapse of days. For example, if the price of an animal at the time of sale and purchase is not recorded and the information is asked after a pretty long time, the householder either gives wrong figures or regrets to provide the information because of his inability to recall. In such situations, the investigator records some rough figure which is carried forward in analysis.

Recently, to expedite the processing of data, electronic calculators are being used. Data collected from the field are coded either by the field staff or by the staff at the headquarters, and thereafter these are processed through computer. It is sometimes observed that the data are wrongly coded and errors are not detected during the process of analysis. Even if the coding is done correctly, mistakes occur in the punching and verification stage.

It is, therefore, essential that efforts be made to see that the collection of data is improved so as to improve the status of livestock statistics. It is very often quoted "if we adulterate country liquor we kill only hundred persons but if we produce adulterated statistics we will be subjecting millions of people to poverty, hunger and slow death". No Plan for progress can be efficiently formulated unless more basic and reliable data are made available ; and the data cannot be collected satisfactorily unless there is a plan for it. For improving the quality of data the following may be ensured :—

- (i) The producers and users of data must have close communication between themselves. The user must know about the manner in which the data are collected.

- (ii) **Compilation of statistics must not be left to those who are indifferent to the quality of data.**
- (iii) **Research workers in Universities and Institutes must take keen interest in finding out how the basic data are collected and compiled. They must give a heed in improving the process of collection and compilation.**
- (iv) **Statistical organisations engaged in collection of data should establish a Cell for constant review and appraisal of data collecting technique. It should be their job to suggest internal and external checks to ensure the accuracy of data collected, to design suitable schedules and in general, to constantly have all improvement in data collection.**

4.6 Quality of data in Agricultural Statistics

By

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Introduction

Comprehensive and reliable statistics constitute an important infrastructure for sound planning. India's economy is predominantly agricultural and in this economy the importance of timely, reliable, comparable and comprehensive agricultural statistics needs no reiteration. Agricultural Statistics in India have no doubt a long tradition but in the past the collection of these statistics was merely incidental to the collection of land revenue which formed the principal source of finance to State Governments. The Statistics of crop production were needed by the commercial and trade interests but data collected were too defective to serve this purpose adequately. After independence, importance of the role of agricultural statistics for planning agricultural development, food policy and administration, import and export policies, price support, internal trade etc. had been gradually realised. With the formulation of each Plan, the economy became more complex calling for detailed and comprehensive data. As such a number of measures were taken to improve the quality and content of agricultural statistics to meet the growing needs of the policy makers, administrators and research workers. In the present article the scope of the quality of data in agricultural statistics has been restricted to the basic statistics of area and production of crops.

In 1948-49, land use and crop area statistics were available only for 47% of the total area of the country; conventional estimates were available for another 22% of the area and no statistics at all were reported for nearly one-third of the country. As a result of the sustained efforts by the Central and State Governments during the last three decades, the coverage of land use statistics has improved considerably and their reliability enhanced. Cadastral surveys were conducted in unsurveyed tracts and reporting agencies established where these did not exist. As a result, out of a total geographical area of 328 million hectares land use statistics are currently available for 306 million hectares, i.e. 93% of the area. The bulk of the non-reporting area was in the hill tracts of Jammu and Kashmir and Arunachal Pradesh where among other things, due to the nature of the terrain, the collection of these statistics is very difficult as well as costly. There is very little cultivation in these areas and as

such the quality of crop production statistics for the country as a whole is not impaired.

Agency and Methods Employed

As in the case of any other statistics, the quality of data in agricultural statistics depends to a large extent on the agency and the method employed for its collection. Except in the States of Kerala, Orissa and West Bengal and some north-eastern States and UTs, statistics of land use and area under crops become available as a bye-product of the revenue administration. There exists in these States a primary agency, commonly known as Patwari, incharge of a village or group of villages to carry out season-wise crop inspection and collection of crop area/land utilisation statistics. The patwari is responsible for the collection of these primary data on the basis of complete field to field inspection during prescribed periods. Normally, there are two crop area enumerations during an agricultural year, one during the kharif season and the second during the rabi season. In some states like Assam, Bihar, Karnataka, Gujarat, Maharashtra, Uttar Pradesh etc. where summer crops are being cultivated on an enlarged scale, there is a provision for three crop enumerations, an additional one during the summer season. After each crop inspection, patwari is required to submit to his superior officer an abstract statement showing total area under specified crops in each season in standard forms prescribed for the purpose. The superior officer called 'kanungo' or 'revenue inspector' who is incharge of a revenue circle varying in size from 30 to 100 villages, besides supervising the work of the village officials is required to consolidate statistics for his jurisdiction and pass on the statements to Tehsildar. Similar consolidation is attempted at tehsil, district and State levels. This system of collection of agricultural statistics is prevalent in the temporarily settled areas of the country where the system of maintenance of land records has been placed on a sound footing. The National Commission on Agriculture in its Final Report after reviewing in detail the different systems of collection of agricultural statistics has considered this system to be the best. In the States of Kerala, Orissa and West Bengal, where no such village revenue agency exists, the land utilisation and crop area statistics are based on sample surveys. In the third category of areas, which are neither cadastrally surveyed nor possess the requisite revenue agency, statistics reported are in the nature of eye estimates based on the personal knowledge of the revenue officers as in the absence of cadastral surveys and village officials complete enumeration and sample surveys cannot be conducted.

Quality of Area Statistics

As already mentioned, land use statistics are at present available for nearly 93% or 306 million hectares out of a total geographical area of 328 million hectares in the country. The area for which land use statistics are not available, comprises mostly the areas under illegal occupation of Pakistan and China in the States of Jammu and Kashmir as also some hill tracts in north-western States. Pending cadastral surveys and the establishment of regular reporting agencies in these non-reporting areas, a beginning has been made in the States of Arunachal Pradesh and Nagaland to explore the feasibility of building up land use statistics on the basis of aerial photographs available with the Surveyor General of India. Out of the 306 million hectares for which land use statistics are available, statistics for 82% of the area are based on complete enumeration, for 9% of the area on sample surveys and for another 9% on conventional methods.

As a system, collection of area statistics based on land records is the best provided the basic records are maintained properly. Also the patwari who is the most knowledgeable person in the field, is considered to be the best agency available to collect area statistics. However, in practice it has been found that due to a number of reasons, the patwari is unable to devote adequate time and attention needed for collection of agricultural statistics. This is due to the fact that his jurisdiction is quite large and he is burdened with multifarious duties connected with development programmes. This disrupts his normal schedule of work and results in delay in the submission of returns of agricultural statistics and more importantly affects the reliability of data.

Keeping in view the genuine need for estimates of area under crops immediately after the crops are sown as also of production immediately after the crops are harvested, a scheme for timely reporting of estimates of area and production of principal crops is being implemented since 1969-70 in a phased manner. At present, the scheme is in operation in 14 States of Andhra Pradesh, Assam, Bihar, Gujarat, Haryana, Himachal Pradesh, Jammu and Kashmir, Karnataka, Madhya Pradesh, Maharashtra, Punjab, Rajasthan, Tamil Nadu and U.P. and in the Union Territory of Pondicherry. During the current year, it is proposed to extend this scheme to Sikkim and the UT of Delhi also. In essence, the scheme provides for obtaining area estimates on the basis of priority enumeration in a sample of 20% of the villages selected at random. It also provides for intensive supervision both by departmental and by statistical staff for ensuring timeliness and accuracy. There is also a

provision for estimates of area under irrigated and un-irrigated categories of important crops as also under high yielding and traditional varieties. Since there is considerable timelag in the receipt of agricultural statistics returns from the State Governments, efforts are underway to explore the possibility of building up land use statistics also on the basis of priority enumeration in the selected sample of villages. The experience of implementing the scheme during the last 6-7 years has shown that the scheme has been able to meet its objective of obtaining estimates of area under crops by the due dates. Provision of statistical supervision by wholetime staff has had a salutary effect in improving the timeliness and accuracy. The scheme has also been able to meet the needs of current data on irrigated area under the crops as also on area under high yielding varieties. Some of the States have also started building up land use statistics on the basis of priority enumeration.

The inaccuracies which creep into the crop enumeration are (i) missing of the crop actually sown in the field, i.e., showing no crop when it is sown, (ii) reporting of a crop when it is not grown in the field, (iii) incorrect assessment of area under crop sown in the field, and (iv) totalling errors. Even earlier, steps were taken to minimise these errors by rationalised supervision of the patwaris' work by the superior officers, such as, kanungos, tehsildars, etc. Besides, supervision of area enumeration work was also entrusted to the statistical staff of agriculture and other departments. However, taking note of the persistent criticism levelled against the reliability of area estimates, a scheme for improvement of crop statistics was taken up for implementation during the Fifth Plan period. The scheme essentially provides for supervision of area enumeration by wholetime statistical staff in a sample of 10,000 villages. It also provides that the work would be equally shared by the N.S.S.O. and the States. During 1977-78 supervision of area enumeration was conducted in more than 5,200 villages all over the country. Under this scheme the occurrence or otherwise of the types of errors mentioned above is assessed by a comparison of the entries made by the supervisory staff for the sub-sample of survey/sub-survey numbers chosen within supervision villages with the corresponding record made by the primary workers. As a measure of incidence of these inaccuracies in the crop enumeration done by the latter simple proportion of survey/sub-survey numbers where these types of discrepancies were observed for all the specified crops to the total number of survey sub-survey numbers in the sample growing the specified crops are calculated. These provide the correction factors for correcting the area estimates of specified crops. The inaccuracies noticed are also brought to the notice of the primary workers at the time of imparting training so as to minimise their

occurrence in future. As mentioned earlier, estimates for 9% of the total reporting area are based on sample surveys. These comprise mainly the States of Kerala, Orissa and West Bengal, where no revenue agency exists for maintenance of detailed land records. The basic inadequacies in the estimates based on sample surveys are that such estimates become available only at district level and do not provide data at lower levels such as a village or a taluk. Also these estimates do not give data about area sown to minor crops. In the absence of such data it becomes difficult to formulate realistic programmes for agricultural development at lower geographical levels. The sample survey estimates also do not provide complete land use statistics and area under irrigated crops for which there is a pressing demand to meet the requirements for effective agricultural planning. To overcome this difficulty it was considered necessary to establish regular reporting agencies in these States also for the collection of agricultural statistics on complete enumeration basis. Accordingly a scheme for establishment of an agency for the collection of agricultural statistics on complete enumeration basis in Kerala, Orissa and West Bengal was included in the Fifth Five Year Plan. The objective of the scheme was to establish regular reporting agencies in these States in a phased manner so as to cover 20% of the villages in each of these States by the end of the Fifth Five Year Plan period. Till now, regular reporting agencies have been established in 20% of the villages in Kerala and 15% of the villages in Orissa. The West Bengal Government has not been able to take up this scheme for implementation so far.

It has also been mentioned earlier that estimates for nearly 9% of the reporting area are based on conventional methods, i.e., impressionistic estimates by village headman, chowkidars and superior revenue officers. Such estimates mainly relate to the States of Manipur, Tripura, Nagaland, Arunachal Pradesh and other Territories in the eastern region. In Manipur and Tripura even during the Fourth Plan period schemes for setting up regular reporting agencies for the collection of agricultural statistics were sanctioned. But these agencies were not entrusted with the work of collection of agricultural statistics for which they were appointed. It is only recently that both Manipur and Tripura have agreed to put the system of collection of agricultural statistics in their respective States on a sound footing by entrusting the work to the regular reporting agencies. In Sikkim also a scheme for improvement of agricultural statistics has been formulated. The scheme is being taken up for implementation during the current year as a part of the timely reporting scheme. In Nagaland, efforts are underway to set up regular reporting agencies for the collection of agricultural statistics on complete enumeration basis.

Quality of Production Statistics

In early 1950 production estimates for almost all the principal crops were based on the subjective method of eye estimation. The estimates were arrived at by the primary reporting agencies on the basis of normal yields fixed longtime ago and the condition of the crop during the current year, expressed in terms of annas, a fixed number annas representing the normal. This system of estimating the production of crops had been gradually replaced by the objective method of crops estimation surveys by random sampling technique. Under this procedure, a pre-determined number of villages is selected at random for such crop and in each selected village, two fields are selected at random and in each field a plot of defined size (5 m × 5 m) located at random. The produce from the plots is harvested, processed and weighed. In a small percentage of cases, further processing of the crop is also done to determine the ratio of the crop in the marketed form to the crop on the date of harvesting. At present at the All-India level approximately 2 lakh experiments are planned annually on principal food and commercial crops. The surveys are designed, organised and conducted either by the State Bureau of Economics and Statistics or the Department of Agriculture/Land Records under the overall technical direction of the N.S.S.O. in the Ministry of Planning. The field work is generally entrusted to the staff of Revenue/Land Records/Agriculture/Development departments. At present at the all-India level, 95% of the production of cereals and 72% of production of pulses is based on crop estimation surveys. The percentage in respect of rice and wheat are 95 and 98 respectively. Among commercial crops, the percentage production based on crop estimation surveys is 91 for groundnut, 78 for cotton, 99 for jute and 95 for sugarcane.

The possible inaccuracies which affect the results of general crop estimation surveys are (i) non-response, and (ii) departures from the prescribed procedure for the conduct of the crop cutting experiments especially relating to marking of experimental plots, harvesting of the crop in the plots and weighing of the produce. These inaccuracies in the crop estimation surveys are also sought to be rectified through the scheme for improvement of crop statistics which provides for supervision of crop cutting experiments in 30,000 experiments spread over various food and commercial crops. During 1971-78, such supervision was carried out in experimental plots by the statistical staff of the National Sample Survey Organisation and the State Governments, appointed under the scheme. Since the supervisory staff are not expected to carry out crop cutting experiments but present themselves at the time when the

primary workers conduct the experiment, the numbers of experiments lost by the latter for various reasons indicates the extent of non-response. For getting an idea regarding the frequency of occurrence of the various departures made by the primary workers on the prescribed procedures as noted by the supervisory staff, simple proportions of occurrence of such cases in the sample canvassed are calculated. Estimates of yield rates of crops based on supervised results are computed since these are expected to be free from errors which the supervisory staff are supposed to rectify while the primary workers conduct the experiments. A comparison of these estimates with GCES estimates gives an idea of the magnitude of errors present in the GCES estimates. Yet another lacuna in the estimates based on GCES is that these do not provide separate data regarding irrigated and un-irrigated yields as also yields of high yielding and local varieties. However, a beginning has already been made to estimate the irrigated and un-irrigated yields of crops based on these surveys by suitable stratification of the sample. The question of estimating yields of high yielding and local varieties will be considered as soon as reliable data regarding area, sown to high yielding varieties under different crops become available.

Gaps in Area and Production Statistics

Another factor which affects the quality of current statistics on agriculture is the non-availability of reliable estimates of area and production of certain crops like fruits, vegetables and minor crops. Statistics of area under different fruits are at present available for mangoes, citrus, papaya, grapes and pome under fresh fruits and cashewnut among dry fruits. In addition estimates of area and production of papaya and banana are also published by the Directorate of Economics and Statistics. In so far as vegetables are concerned separate estimates of area are available for potato, tapioca, sweet-potato and onions. Estimates of production are available for potato, sweet potato and tapioca. In order to fill the gap in the availability of statistics for these crops as also for other minor crops a scheme for crop estimates surveys on fruits, vegetables and minor crops was included in the Fifth Five Year Plan. The scheme comprises of two parts, namely, (i) recording of area under important fruits, vegetables and minor crops in the basic khasra forms in the States, and (ii) conduct of crop estimation surveys for estimating the production of these crops on the methodology laid down by IASRI. The scheme could not be implemented so far due to the delay in the receipt of proposals from the State Governments. However, proposals received from 11 States have now been processed and forwarded for consideration by the Planning Commission and

the Ministry of Finance. It is hoped that with the implementation of this scheme by the various State Governments considerable improvements will be made in the availability of regular estimates of area and production of these crops also. It may be relevant to mention here that proposals have already been finalised for the issue of regular All-India estimates of area and production of onion crop from the year 1979-80 and it is proposed to cover sunflower crop also in the crop forecasting fold from the year 1980-81. In the case of cashewnut, pilot studies are already in progress for estimation of area and production of cashewnut grown in forest areas in the States of Andhra Pradesh, Karnataka, Tamil Nadu, Orissa and Maharashtra. The objective of the studies is to evolve a suitable methodology for the estimation of area and production of cashewnut in the forest areas.

Future Programme

While the last three decades have witnessed considerable improvements in the scope, coverage and content of agricultural statistics, the demands made on the system for new and varied types of data are seen to be on the increase—particularly in the context of planned development of our economy and building up of a sound data base for policy and planning purposes. It will be relevant to mention in this connection that recently the National Commission on Agriculture in its Final Report has reviewed in detail the present position regarding the availability of timely and reliable statistics in the various fields of agriculture and has made a number of important recommendations on improvements in land use statistics, area statistics, statistics of crop production, fruits and vegetables statistics, irrigation statistics, inputs statistics, market intelligence, agricultural census, agricultural surveys, research statistics, derived statistics and livestock, fisheries and forestry statistics. The Commission has recommended that the Committee on Improvement of Agricultural Statistics should be activated to consider new proposals for improvement of agricultural statistics and to review from time to time action taken on its recommendations. It has also recommended that the scope of the Committee should also be widened to cover live stock, fisheries and forestry statistics also.

Future improvements in the system of collection of agricultural statistics are, therefore, sought to be made in pursuance of the recommendations made by the National Commission on Agriculture as also by the Committee on Improvement of Agricultural Statistics (which has now been reconstituted to cover animal husbandry, forestry and fisheries statistics also) from time to time. The main directions in which further improvements in the field of area and production statistics will be made are as under :—

- (i) To extend the coverage of land utilisation and crop statistics to the entire geographic area of the country.
- (ii) To review the existing jurisdiction of the primary and supervisory agencies responsible for the collection of agricultural statistics and to strengthen these agencies wherever necessary.
- (iii) To ensure that arrangements are made by the State Govts. to impart refresher training to the primary and supervisory agencies in the collection of agricultural statistics.
- (iv) To ensure that uniform concepts and definitions are used in the collection of crop area statistics such as recording of area under mixed crops and long duration crops.
- (v) To review the sampling design for crop cutting surveys with a view to introducing stratification according to the irrigated and rainfed areas and according to the high yielding and local varieties of the crops.
- (vi) Adoption of revised classification of irrigation sources recommended by the National Commission agriculture so as to make available data on area irrigated according to surface and ground water resources as also major, medium and minor sources of irrigation.
- (vii) Collection of reliable area and production statistics of crops like sunflower, soyabean and other important fruit, vegetable and minor crops for which these data are not available at present.

Implementation of the recommendations made by the NCA on improvements in agricultural statistics has been taken up with the State Governments and they have been requested to formulate suitable proposals and include them as Plan schemes in the State Plan.

4.7 Improvement in Quality of Survey Data

By

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1. Improvement of the quality of data depends on the system of collection of statistics, the type of field agency responsible for collection, planning and designing the frame of field work, the methods and quantum of supervision, scrutiny of filled-in schedules and administration of field staff. Along with the quality of data, the following problems are intimately associated :—

- (i) Lack of timely submission of statistics from the primary reporting agencies ;
- (ii) deteriorating situation in the quality of data collected from fields and consequent loss of reliability and precision, and
- (iii) lack of availability of prescribed amount of data based on sampling for getting efficient estimates due to non-responses etc.

Apart from the above three deficiencies, the existing system of collection also involves an appreciable amount of non-sampling error, which cannot, otherwise, be estimable or eliminated. Sampling error is estimable, as this obeys the law of probability. Non-sampling error occurs either due to incomplete or faulty definition, non-responses by the reporting agencies or incomplete nature of replies. The statistics collected in the fields of agriculture, industry, prices, income estimation, etc. are not free from these deficiencies.

2. For reliability of the quality of data collected through survey or enquiries, at the planning of the survey or the intimation of the projects study, the design of the sample frame should be properly evolved. The amount of information to be collected from the field and the time taken for collecting these information should be assessed through a pilot study prior to undertaking any large scale survey. The size of the sample should be adequate such that at least the desired precision is attended. In allocation of work to the field staff, the previous performances and the quality of work attended should also be considered so that the work could be completed duly and timely. It is being suggested to set up operational control charts for the field staff to note his earlier performances so that his average performance and the nature of variability may be assessed. At the time of allocation of work, the relative ability should be judged as far as possible. During the time of execution of the programme, periodic review of the progress and making necessary and adequate adjustments for completing field work by targetted

date should be done. Periodical meetings, fortnightly or at least once a month, should also be held. It has also been noted that due to various difficulties, particularly primary reporting agency being not under the direct control of the agency responsible for the study, the timeliness of the receipt of the schedules within the prescribed date is not ensured. This is a serious problem affecting the very objectives of the scheme. Hence it may be examined whether a separate supplementary sample may be augmented through alternative agency on a small scale to meet such situations so that by pulling the two samples or by any other sampling technique it is possible to give valid estimates within the prescribed period.

3. The quality of data depends on the methods of collection, incomplete coverage, lack of prior knowledge of the field under investigations, lack of adequate training of the primary field agency etc. In the collection of data sometimes it is observed that the frame prescribed is incomplete, (e.g. the decadestrally surveyed and depopulated areas, particularly in hilly and terrain areas), the selection of a sample of the desired number of clusters under improvements of crop statistics scheme could not be done due to the lack of cadastral survey maps and identification of plots also becomes difficult. Sampling should be done separately for such areas. Wrong selection creates difficulties for an investigating officer who, not being a local person, fails to procure a cadastral survey map for proper identification. Specific instruction should be issued that the investigating supervisors should contact the primary reporting agency by intimating his programme well ahead or at time of attending the fortnightly meeting with the primary reporting agency. This will guard against wrong selection or failure in contacting the primary reporting agency at the time of supervision. Due to incomplete or lack of adequate instructions, decisions in filling up the proforma becomes difficult. Perhaps, the investigator may be asked to fill up the proforma as best as possible and give a note wherever there exist divergences from the given instructions. Although uniformity in the collection of data should be aimed at, but to tackle such situations, the matter where work could not be undertaken according to instructions, should be separately mentioned and survey should be completed. Such schedules should be examined properly and information should be restored as far as possible. For ensuring operational efficiency, all the instructions should be sent timely and the field personnel should maintain a file and sign in such instructions. The supervising officer at the time of field checking should also ensure that these instructions are properly understood by him and carried in practice. Along with the field instructions, the difficulties experienced at the field level should also be discussed at the perio-

dical meetings. Whatever difficulties are being confronted at the field level at any area, should be intimated on to the higher officer so that a general instruction is given to all concerned. The problems of re-allocation, imputation, bifurcation or substitution should be done only with the knowledge of the higher officer at the field level. Substitution may be allowed, but the list of such substituted sample should be prepared beforehand particularly for agricultural statistical work. With respect to crops having low intensity of cropping, such list of substitution or imputation should be supplied prior to the survey along with detailed instructions. The sampling frame, it is needless to mention, should be flexible, but there should not be deviation from the main objective. In case of agricultural survey, the informant fatigueness, is not the problem, but in the socio-economic and motivation surveys, the problem of informant fatigueness should be avoided by repeated visits or by supply of a suitable broad spectrum of answers where from the needed one could be chosen.

4. For collection of efficient and precise data from the field, it is essential there should be realistic plan of supervision or spot verification which should be worked out in such a manner that along with pre planned supervision, random supervision should also be made. Sometimes, concurrence in the beginning of the survey season where advices and instructions are more necessary rather than mere detection of mistakes. Rationalised supervision is being done at present by both technical and administrative officers at different hierarchal levels which has its own psychologic importance. Whenever any administrative officer like District Magistrate or Sub Divisional Officer visits the field along with the technical officer, this adds importance and the primary reporters, whenever they are under the control of other Deptt. act in a more responsive and responsible manner.

A detailed chart of supervision should be prepared earlier and circulated to all the supervising officers only. The supervision will be of 3 types viz. current supervision, pre-planned supervision and random supervision. All the three will be necessary in each survey season. The size of supervision sample should be fixed in such a way that this also forms basis for assessment of the correction factor and also for direct estimation from a small sample. The control chart for each supervisor may be prepared indicating the extent of divergences from the primary workers and the type of mistakes. This will help in knowing the level and type of differences between the primary reporting agency and the supervising agency. During the time of inspection, the instructions should be given afresh on the spot and at the time the mistakes should be corrected. Whatever schedules will be completed prior to the time

of supervision, should be handed over to the inspecting officer for his scrutiny and feed back.

5. The scrutiny sheets indicate inconsistencies in filling up the schedules or wrong coding or divergences from the supervised schedules. After the receipt of the filled-in schedules, the scrutiny notes are sent back after scrutiny to the field staff for re-checking at the spot. This takes unnecessary long time. Perhaps supervisors may be utilized for scrutiny of the records and checking at the field level and quickly passing it on the headquarters after scrutiny. The mistakes may be the following categories :—

- (a) Primary Reporting Agency (PRA) not doing the survey and reporting,
- (b) PRA undertaking the survey but not completed timely for want of time or other reasons.
- (c) PRA reporting information which deviates from the reality,
- (d) PRA reporting other things or crops but not the real ones one which is detected later by the supervisor,
- (e) PRA reporting nil, which afterwards has been reported to be existing,

Each of the above five cases should be tackled in the proper way. A few will lead to incompleteness, a few lead to wrong information and the rest to under-estimation or over-estimation.

Intra-Block and inter-block consistency-check within each filled-in schedule should be carried out, immediately after receipt of the schedules. The nature of mistakes committed by different reporters may be compared for enlightening whether these are due to the inadequacy in instructions. Inter-reporter variability should also be assessed during scrutiny. Identification of of sampling or non-sampling errors should be attempted and non-sampling errors should be categorised as far as possible. The scrutiny thus should be undertaken from the very beginning of the season after the receipt of the first batch of the schedules. A timely action may eliminate many of the non-sampling errors that may likely crop up in the remaining parts of the season.

6. Prior to the commencement of the survey, training programme should be arranged and if possible, another also for a very short duration in the middle of the survey based on the experiences of current field work and

after scrutiny of far completed. The duration of the first training will be a longer one, but the mid-term training will be only for a day or two. After the survey is over and the results are scrutinised, assessment training should be undertaken for future references, which will really be the review of the performances of the field staff. This will help in assessing the ability and levels of performances of the primary workers and ranking them accordingly. Once the primary and supervisory staff are posted they should not usually be transferred within a period of three years or so, unless, of course, adverse actions necessate the urgency of transferring them. In posting the field staff, it should invariably be kept in view that he knows the local language properly. Immediately after his posting, he should gather thorough on the area and give a note accordingly to his superior officers regarding the area of his work, transportation facilities, the local persons who can be of any help to him in his work, and other such vital information. For optimum utilisation of staff, the priority of work entrusted to the primary reporting agency, supervising officers, etc. should be fixed up. Job satisfaction is one of the important criteria for giving incentives to the staff towards increasing their efficiency. During on the collection of correct data and timely submission, the staff may be given incentives in the form of grant of ad-hoc increments based on the performance of goods work for successive 3 seasons.

4.8 Quality of Experimental Data

By

P.N. Bhargava & P.K. Batra,

I.A.S.R.I., New Delhi

Abstract

The quality of agricultural experimental data very much depend upon the type of agency involved for the collection of data and the agency under whom experimental programme is being executed and the type of statistical design adopted for the investigations. In the country there are different agencies involved, for the conduct of experiments, namely agricultural research stations, universities, agricultural university students. All India Crop Improvement Projects and experiments on cultivators' fields. The quality of data collected by each of these agencies differs considerably because of number of factors like the level of education of the agency involved in the collection of data, type of experimental design adopted in each case, which differs very much keeping in view the type of facilities available as well as the requirement of the experimental programme. In addition, to this, the objectives for which the experiments are planned have also much role to play in effecting the quality of data.

The experiments planned at agricultural research stations are more or less conducted under controlled conditions where the facilities for the supervision and the basic requirements for the conduct of experiments are available. At these research stations, the sites selected are generally of uniform nature and all the agricultural operations practices which are to be adopted in the conduct of an experiment are ensured to be uniform. Apart from this, the supervision which can be exercised over these experiments are of a high quality nature which also ensure the quality data. The experiments planned at these research stations lack in optimum utilisation of the resources available at their end. The type of designs adopted some time do not meet the basic requirement of the statistical design because of the limited resources available at the research stations while otherwise is also observed i.e. resources are sometimes wasted because of non-proper planning of the experiment.

The experiments planned on cultivators' fields which are in large number and have to be left in the hands of Field Assistants whose level of education and the appreciation of data is very much different than that of a scientist who is involved in this programme. Another limitation of this type of experimental programme is the proper type of available site, namely a uniform filed from where the treatment comparisons are least effected due to uncontrolled varia-

tions but by the variations which are introduced due to the non-uniformity in the site. This very often happens in this type of programme which definitely affects to a large extent the quality of data. Another source of error in this type of experiments is the carelessness of the Field Assistant which is psychologically true as he has to handle a large number of experiments in the same area. As such, the recording of observations right from the beginning to the end are very often effected. Additionally, the experimental plot is though generally large and the field agency sometime commit error in inclusion or exclusion of the border plant which ultimately affects the accuracy of the yield.

Under the National Index of Agricultural Field Experiments Scheme, a large body of data is being collected annually on the experiments planned all over the country. The attempt was therefore made to examine the quality of data for different crops as well as their variation with regard to the objectives for which these experiments were planned. For the purpose of examination, co-efficients of variation were worked out. This is one of the most important statistical parameters which determines the precision of the estimates obtained from the experimental designs. This is effected due designs adopted, field operations done for the conduct of the experiments and other factors which are explainable otherwise. It was observed that the percentage of experiments falling in different classes of coefficients of various important crops obtained from field experiments conducted in the country differs under different agro-climatic conditions and with different designs. On the whole, the results obtained indicate that different crops behave inconsistently in respect of coefficients of variation. Among the cereals and millet crops, about two-third of paddy, wheat and barely experiments have coefficient of variation upto 20 while over 60% of the experiments conducted on maize and ragi fall in this range whereas about 20% experiments on these crops fall in the interval 20 to 30. For perennial and vegetable crops the coefficient and variation was comparatively large in large number of cases, it was mainly due to the variability in material, not because of positional variation.

However, it is observed that the experiments planned at agricultural research stations, the coefficient of variation is of low order which definitely suggests the maintenance of high quality data at these research stations. But when we examine the data with regard to the objectives of the experments for which it is planned, it seems that there are large number of experiments planned to investigate the effect of plant protection measures. There is a large amount of variation observed in these experiments. It seems that not only there is a need for development of suitable designs to study this aspect but the plot size which is to be adopted in these type of investigations are also to be standardised.

4.9 Some Impediments of Data Quality and Possible Remedy

By

N.K. Sonavane and M.N. Dass, Directorate of Statistics, C.W.C.,
New Delhi.

Abstract

Maintenance of quality of data is of great importance for ensuring validity and precision of inference from them. In many situations maintenance of data quality is very difficult. Recording of water flow data is one such example. As direct measurement of water flow discharge is difficult against the hindrances of strong current, variable depths, lack of proper equipments etc. It is desirable to take help of some correlated variables which are relatively easier to observe ensuring sufficient accuracy. Some work in this direction has been done in the Directorate of Statistics, C.W.C.

Other impediments while processing large body of data mechanically are the likely mistakes that might occur while punching the data to cards, transferring them to tapes and also for writing programmes for their analysis. Such mistakes may occur due to faulty punching, mis-placement of cards, repetition or omission of cards, faulty programmers etc., While careful checking is necessary to reduce such mistakes it is desirable further to conduct suitable test studies on these data for detection of mistakes. The actual test study depends on the type of data. For example, for daily discharge and water level data programme for plotting both level and discharge data against each date of a year may indicate all major mistakes is data transfer, as it is known that there is a relation between the above two variables such that both of them move in unison. Similarly another programme may be run for printing out all observations which are outside given limiting values. The limits can be fixed such that usually all observations for a particular site remain within them. Suitable update and sort programmes are also useful to maintain data quality.

4.10 Quality of Crop Statistics-Role of National Sample Survey Organisation.

By

M. Padmanabhan, N.S.S.O. (F.O.D.), Central Govt. Offices Building, Block-II, N.H.IV, Faridabad (Haryana).

Abstract

In the field of Agricultural Statistics, the National Sample Survey Organisation (NSSO) has the overall responsibility of examining the quality of crop statistics collected by the States and suggesting lines of its improvement. It seeks to fulfil these by a two fold approach-(i) through sample checks under the scheme for Improvement of Crop Statistics (ICS) on the primary field work done in the States and (ii) Coordination of the General Crop Estimation Surveys (GCES) of the States. In addition, it undertakes special studies on different aspects of data collection with a view to improving the quality of statistics collected.

2. The ICS scheme has the objective of locating, through the joint efforts of Central and State authorities, deficiencies in the system of collection of crop statistics and suggesting remedial measures. Under the scheme, sample checks are carried out by both the authorities on the primary field work done in the States in respect of area enumeration cover a total of 10,000 villages and on yield estimation over 30,000 crop cutting experiments. Apart from the field work in respect of the Central sample, the NSSO undertakes for both the samples the planning of the survey, drawing up of schedules and instructions, analysis of the data collected and preparation of survey reports. The scheme, which is in implementation since 1973-74, has brought to light the situation existing in different States on such aspects as timeliness in completion of area enumeration and submission of crop abstract statements, errors in recording of and crop areas and their impacts, accuracy of the totals in the village registers, departures in the conduct of crop cutting experiments from the procedures prescribed and collection of ancillary data. The findings under the scheme are brought out in the State-wise and All India reports on the "Status of Estimation of Agricultural Production in India". The findings are also considered by the High Level Coordination Committees on Agricultural Statistics set up in the various States and suitable measures to improve the system of collection of statistics formulate. The NSSO is also convening Zonal meetings of State Agricultural Statistics Authorities in which technical

and administrative problems connected with agricultural statistics are considered and recommendations made.

3. The coordination of the GCES of the States by NSSO involves the examination of the design and plan for conduct of crop cutting experiments on various crops, participation in the training programmes organised for field staff, as also examination of the response and results of the surveys. In the light of the examination, suggestions on different aspects such as the design of the survey, adequacy of sample size, improvement of response, validity of the estimates and collection of ancillary data are made to the States. A report giving the "Consolidated Results of Crop Estimation Surveys on Principal Crops" is also brought out annually.

4. Among the ad-hoc studies on specific aspects of collection of agricultural statistics being currently undertaken by NSSO, mention may be made of the studies on the extension of GCES of individual States to additional crops, the procedures adopted in different States for preparation of visual estimates of yield rates, feasibility of stratified planning of experiments under GCES according to in put use and the pilot study on aggregation of area figures at levels higher than the village.

4.11 Quality of Data

By

G.S. Tiwari

Directorate of Veterinary Services, Madhya Pradesh

Abstract

Modern age is the age of planning and according to Prof. A.L. Robins :
 "Planning is the solution of all problems of modern age". Quality of data is essential pre-requisite for any successful planning. The fast changing economic situation and the importance of the livestock in the Nation's economy necessitates the collection of authentic, reliable and comprehensive data in respect of livestock husbandry sector. No doubt, the need for data for planning purposes has fully been recognised and the scattered efforts are also being made to collect certain important data in this sector as and when required, but no serious thought is still being given to collect the quality data, which may be required for preparing the reliable development plant schemes & their timely assessment & evaluation. It can very well be imagined when would be the future of the plan schemes and how the aimed targets would be achieved the schemes themselves have not been prepared on reliable data. The qualified statisticians in such circumstances become very controversial as he is aware of the danger. According to the Prof. R.A. Fisher :- "The statistician is no longer an alchemist expected to produce gold from any worthless material offered him. He is more like a chemist capable of assaying exactly how much of value it contains, and capable also of extracting this amount, and no more. In these circumstances, it would be foolish to commend a statistician because his results are precise or to reprove because they are not. If he is competent in his craft, the value of the result follows solely from the value of the material given him. It contains so much information and no more. His job is only to produce what it contains".

The data awareness is however healthy sign which may ultimately lead to a better arrangements for collecting quality data, but till data consciousness comes it would always be a question mark whether the rosy picture aimed in the plan schemes would ever be achieved.

The quality of data is mostly depends on the following points :—

1. Nature & extent of the data.
2. Method of observation & Interview.
3. Equipment used for measurement.

4. The type of investigators.
5. The educational & social condition of the informants.

The statisticians being fully aware of importance of the quality of data are trying hard to eliminate the difficulties faced therein, but the most important aspect for improving the quality of data is the behaviour of the investigator and attitude and co-operation of the informants. The investigator's sincerity and behaviour has a great bearing in collecting the quality of data. The informants has a vital role for improving the quality of data. It is well known that the informants are mostly backward and uneducated and have always many doubts in providing correct data. Sometimes their ignorance also create difficulties. If the informants are educated in respect of importance of the quality of data for improving their economic conditions then they will make their own efforts for providing the correct data to the best of their knowledge. It would then be a landmark in improving quality of the data.

4.12 On the use of Incomplete Frames in Sample Surveys

By

Randhir Singh, I.A.S.R.I., Library Avenue, New Delhi.

Abstract

The existence of a frame is the pre-requisite for designing any sampling inquiry or census. The quality of frame not only provides a basis for choosing the appropriate sampling design but also affects the ultimate results obtained. However, the existence of an accurate frame is very rare and generally all the frames are subject to various shortcomings. The incompleteness of the frame is one of the most common defects of almost all frames mainly due to the dynamic nature of the populations. Seal (1962), Hartley (1962), Hansen, Hurwitz and Zabine (1964) have suggested various procedures to deal with the problem of incomplete frames. In the present investigation improvements have been proposed in the procedure suggested by Hansen, Hurwitz and Zabine (1962).

4.13 Quality of Data

By

Dharamendra Kumar, A.H. Deptt., Lucknow

Abstract

Data collected through various types of returns of different periodicity for assessing the progress of various development schemes, data collected through large scale sample surveys, ad hoc surveys, type and operational studies, data collected through quential livestock census and data collected on performance of cows and buffaloes in Animal Husbandry department were discussed for making improvement in their quality. It was recommended that continuous monitoring of data collected through various returns should be done by the monitoring division to be provided in the department and it should be independent from data collecting agencies. Similar action is necessary for data maintained at livestock farms. For improving the quality of census data, some independent system of monitoring should be developed in addition to rationalised supervision and post census sample survey. In this connection help of Pradhan of Gram Panchayat will be useful. For improving quality of the data collected under various type of surveys it is necessary that spot checking of 20% of the selected villages where field work is going on should be done by the supervisory officers by making surprise visits. Checking and rechecking of the data at compilation and tabulation stage is essential for the improvement of the quality of the secondary data. In the end it was emphasised that the improvement of the quality of the data is a continuing effort. The errors and biases continue to change in intensity and direction over time. Thus continuous watch is to be kept for their control and assessment.

Based on the discussions held during the Session, the recommendations made were as follows :—

1. All data should be subjected to appropriate quality checks before being released for general use.

(Action : All concerned organisations)

2. Efforts should be made to combine the elements of a Rational Survey Design, viz., the sampling design, the questionnaire, the selection and training of field personnel, the supervisory staff, the techniques of data collection, publicity etc., in such a way that they result in the best possible quality of data under the given general conditions of work.

(Action : IASRI, Agril. Univ./ICAR Instts.)

3. Pilot surveys may be planned to obtain the facts to build a rational survey design.

(Action : IASRI, Agril. Univ./ICAR Instts.)

4. In order to protect the interests of the producers and for the purpose of price fixation, it was recommended that the cost of production data should be collected on a wider scale.

(Action : IASRI, Agril. Univ. and State Deptts. of Agri.)

5. Keeping in view the importance of agricultural statistics it was recommended that all efforts should be made to educate the officials and other workers engaged in data collection as well as the respondents.

(Action : All agencies concerned)

6. In order to meet the data needs as also to fill in some of the important gaps, the conference reiterated the recommendation of the National Commission on Agriculture to devise an integrated system of agricultural surveys and periodic agricultural and livestock censuses.

(Action : IASRI, Min. of Agri. and NSSO)

7. It was recommended that prices of inputs like fertilizers, irrigation, human labour, bullock labour etc. may be collected from a fixed

set of the villages on a priority basis in order to study trend in prices.

(Action : Min. of Agri. and NSSO)

8. For improving the quality of statistics of area production of crops it was recommended that steps may be taken to ensure that the schemes of timely reporting and improvement of crop statistics in all states and establishment of a field agency in the States of Kerala, Orissa and West Bengal are uniformly implemented.

(Action : Ministry of Agriculture, NSSO and State Departments concerned)

9. It was recommended that taking into account the commercial aspects of plantation crops particularly tea, coffee and rubber, urgent steps may be taken to improve the quality of statistics of area and production of these crops.

(Action : IASRI and State Deptts.)

10. Regarding other plantation crops, it was recommended that IASRI may examine whether the sampling methodology already developed on the basis of pilot surveys during the 2nd Plan for estimating the area and production of plantation crops like coconut, arecanut, pepper, etc. need any modification in view of the changes in cultivation practices, etc.

(Action : IASRI)

11. It was observed that one of the main reasons for non-response and incomplete sample was the administrative problems like transfer of field staff in the middle of data collection work, late appointment of field staff, or sometimes keeping the posts vacant, assignment of other duties, etc. It was, therefore, recommended that the field staff employed for a survey should be completely made available for the field work and their transfer avoided throughout the period of the survey. This will also ensure collection of data on a uniform basis.

(Action : State Deptts. concerned)

12. It was recommended that in addition to organising a detailed training programme for the field staff before commencement of data collection, regular training of the field staff should be arranged at the

beginning of each season/round and the proforma and instructions compiled in detail in the light of experience gained.

(Action : IASRI, Agril. Univ. and State Deptts.)

13. It was recommended that intensive and frequent supervision of field work, both pre-planned and surprise, may be undertaken to solve the field problems and remove conceptual as well as operational difficulties in data collection. It will be useful to provide the field staff with a Hand-book of Instructions giving details of sampling design, procedure of selection of units, proforma, instructions for filling of proforma, time schedule of collection of different items of data, procedure of measurement and observation of units, etc.

(Action : All agencies concerned)

14. It was recommended that for an effective sample check on the quality of data collected, a sub-sample of the ultimate sampling units may be canvassed by Supervisory Officers and the data of the supervised sample may be separately processed for judging and assessing the overall quality of data collected.

(Action : All agencies concerned)

15. It was recommended that close scrutiny of schedules may be done and the gaps and discrepancies observed referred to the field agency involved in the data collection without much time lag to minimize errors on account of memory lapse and investigators' bias.

(Action : IASRI, NSSO and State Deptts.)

16. Since, data are generally processed on Electronic Computer, it was recommended that suitable scrutiny and error detection programmes may be prepared not only to eliminate errors introduced due to computerisation of data analysis like coding, punching of cards, tabulation, etc. but also other errors and inconsistencies in the body of data. Other methods for detection of these errors like the use of statistical relationships between various factors, range of a parameter, observed trends etc., may also be employed to detect and eliminate errors.

(Action : IASRI and other concerned agencies)

17. Realising the need for making available the data of agricultural field experiments conducted at different Research Stations to scientists

and research workers all over the country, it was recommended that a standardised proforma may be developed for recording data of these experiments on a uniform basis. The data could be suitably stored in National Agricultural Research Information System at the IASRI which will enable instant availability of data of experiments to any user.

(Action : Agril. Univ./ICAR Institutes)

18. It was observed that sometimes the administrators and planners wanted data which were either not readily available or incomplete or were not of good quality. Data from ancillary or other related sources were therefore used for the purpose. It was recommended that limitations of data supplied may be clearly made known to planners and margins of errors specified. The methodology of tackling incomplete data may also be investigated.

(Action : IASRI and other agencies concerned)

19. It was recommended that robustness of various survey designs in use at present which were less prone to non-sampling errors should be investigated to determine the effect of deviations and disturbances on the estimates of parameters being studied.

(Action : IASRI, other ICAR Institutes and Agril. Univ.)

20. It was recommended that efforts should be made to provide inbuilt system for quality check in each and every project to ensure constant assessment of quality of data collected.

(Action : IASRI and other agencies concerned)

21. It was recommended that once a technique has been developed with the help of pilot surveys undertaken by IASRI and passed on to the States for adoption on a regular basis, the Institute should actively collaborate and cooperate with the concerned agencies in the States in proper implementation of design as also in other technical aspects like training of field staff, supervision of field work etc. This will not only ensure good quality of data but also serve as feed back for further research to bring about improvements in the methodology already developed.

(Action : IASRI)

22. For improving the data base for agricultural planning in India, it was recommended that the coverage of land use and crop statistics may be extended to the entire country.

(Action : Min. of Agri. & State Deptts.)

23. Realising the need for data of crop cutting experiments for irrigated/unirrigated areas and also for indigenous/high yielding varieties, it was recommended that the sampling design of the surveys conducted under the State series may be modified to introduce stratification on these parameters. This will greatly improve the precision of estimation of crop yields in different categories.

(Action : NSSO)

24. It was recommended that the Statistical organisations engaged in data collection should establish a Cell for constant review and appraisal of data collection techniques. The Cell should devise suitable checks, both internal and external, to ensure accuracy and quality of data. Preparation of suitable schedules for data collection should also be the responsibility of these organisations. As a first step in this direction, a monitoring Cell or unit may be established at IASRI to develop guidelines to assess and monitor quality of data.

(Action : All agencies concerned).

PLENARY SESSION**Presentation of Reports by the Chairman of the Various Sessions**

27th June (Wednesday), 1979

09.00 A.M.

Chairman

Dr. Daroga Singh,

Director,

I.A.S.R.I., New Delhi.

Rapporteur

Sh. R.K. Khosla

The Chairman thanked the participants for presenting various papers during different technical sessions of the Conference. He then, requested the Chairman of various sessions to present their reports. The reports of the five technical sessions were read out by the Chairman of the sessions. The Chairman then declared these reports open for discussion and after a long discussion on each of the reports the recommendations made were summarised as below :—

**Summary of Recommendations made during the Fourth Conference
of Agricultural Research Statisticians held from 25th to 27th
June, 1979 at H.P.K.V.V., Palampur (H.P.).**

S.No.	Recommendations	Conf. No. and Year when it was made/and or reviewed.
1	2	3

A. Crop Sciences

- | | |
|--|------------------|
| <p>1. The need for more uniformity trials on different fields and horticultural crops was felt. The role of soil parameters in interpreting data from such trials also needs study. It was recommended that suitable trials for this purpose may be organised for various crops.</p> | <p>3rd, 1978</p> |
|--|------------------|

(Action : IASRI and Project Co-ordinators of Crop Projects)

- | | |
|---|------------------|
| <p>Since there are post-graduate programmes in several agricultural universities, a student or staff can be entrusted such type of research work.</p> | <p>4th, 1979</p> |
|---|------------------|

(Action : IASRI and Agricultural Universities)

- | | |
|--|------------------|
| <p>2. It was observed that the losses at the pre-harvest stage were mainly due to pests and diseases. Work of estimation of such losses has been done only on paddy, wheat and maize. There is need to extend this work to other crops also.</p> | <p>3rd, 1978</p> |
|--|------------------|

(Action : IASRI)

Statistical methodology for estimation of losses due to floods/drough/hailstorm, etc. should be developed.

4th, 197

(Action : IASRI and other Concerned Agencies)

3. Regarding losses at the harvest stage it was pointed out that relatively the losses due to employment of manual labour were much less as compared with the losses incurred with the use of mechanised harvestors. This observation needs to be further probed.

3rd, 1978

(Action : IASRI, NSSO and Dte. of E&S).

Agricultural Universities and other research institutes should also undertake this type of work.

4th, 1979

(Action : ICAR Institutes and Agricultural Universities).

4. Estimates of post-harvest crop losses currently available are based on guesses and limited field experiments. In view of the importance of the problem, research studies for evolving appropriate methodology for the assessment of post-harvest losses of foodgrains at different stages and due to various causes should be taken up on a priority basis. In such studies provision may also be made to collect information on types of storage in use and their relative efficiency under field conditions.

4th, 1979

(Action : IASRI, ICAR, Deptt. of Food, Ministry of Agriculture and Irrigation).

5. Studies on forecasting of crops are being carried out by the IASRI on a few selected centres. It was pointed out that some biometric characters account for nearly 60% of the variation in crop yield. It was felt that such studies and also others for determina-

3rd, 1978

tion of crop weather relationship should be taken up in a number of homogenous agro-climatic zones. In addition, it was mentioned that an integrated approach should be adopted where by, the biometric observations, weather parameters and also the affects of pests and diseases could be simultaneously studied. For this, various disciplines, and Institutes, should collaborate.

(Action : IASRI, other ICAR Institutes and I.M.D.).

A manual should be prepared by the IASRI for circulation for providing guidance for similar studies.

4th, 1979

(Action : IASRI).

6. The cultivation practices relating to perennial crops in Assam namely arecanut and coconut on the one hand and pineapple, orange and banana on the other were rather typical in so far as area under these crops was substantial but scattered over large tracts both in the hills and in valleys. No. reliable statistics on the extent of cultivation or the yield of fruits was available in the State. It was recommended that pilot surveys to develop suitable sampling methodology for estimation of extent of cultivation and production of fruits under such conditions may be taken up.

3rd, 1978

(Action : IASRI and Department of Agriculture, Assam).

Not only the IASRI but other research institutes and agricultural universities should also formulate the scheme and submit to ICAR Panel for Economics and Statistics. Assam Agricultural University should also formulate a scheme and submit to Economics & Statistics Panel of ICAR keeping in view the regional problems.

4th, 1979

(Action : ICAR Institutes, Assam Agricultural University and other Agricultural Universities).

7. The programmes of experiments in cultivators' fields taken up so far have covered largely crop response to fertilizer application. Other problems like plant protection intercropping, etc. suitable for study in different areas should be identified. As experiments in cultivators' fields are in the nature of adoptive research, State Departments of Agriculture may be involved in the execution of such investigations.

4th, 1979

(Action : ICAR, State Departments of Agriculture and Agricultural Universities).

8. Considerable variability had been observed in the performance of high yielding varieties of major cereals and cash crops even in a compact region like a district. The performance of the HYV was also not very consistent from year to year. The extent of adoption of improved practices also varied widely from cultivator to cultivator. It was recommended that intensive investigations to study the constraints in the adoption of technology for increased agricultural production may be taken up in typical districts in different states under the VI Plan.

4th, 1979

(Action : IASRI).

9. For determining yield rates of crops like cotton and those vegetables involving multiple pickings, component sampling approach with independent sample of fields at different pickings with a larger number of fields for the first and second pickings and a smaller number of fields for the remaining pickings have been found to be convenient and efficient. However, investigations for studying the efficiency of alternative sampling procedure may be conducted in other areas to test and standardise these procedures.

4th, 1979

(Action : IASRI and State Departments of Agriculture/Agricultural Universities).

10. In view of the value of straw as cattle feed there is need to estimate the availability of all types of straw which can be used as feed. Straw to grain ratio for HYV is likely to be different from similar ratio for conventional varieties. Efforts should be made to estimate straw to grain ratio for such varieties. 4th, 1979

(Action : IASRI, other ICAR Institutes, State Departments of Agriculture and Agricultural Universities).

11. In order to protect the interests of the procedures and for the purpose of price fixations it was recommended that the cost of production data should be collected on a wider scale 4th, 1979

(Action : IASRI, Agricultural Universities and State Departments of Agriculture).

12. It was recommended that prices of inputs like fertilizers, irrigation, human labour, bullock labour etc. may be collected from and a fixed set of villages on a priority basis in order to study trend in prices. 4th, 1979

(Action ; Ministry of Agriculture/NSSO).

13. For improving the quality of statistics of area production of crops it was recommended that steps may be taken to ensure that the schemes of timely reporting and improvement of crop statistics in all states and establishment of a field agency in the states of Kerala, Orissa and West Bengal are uniformly implemented. 4th, 1979

(Action : Ministry of Agriculture, NSSO, State Departments Concerned).

1	2	3
14.	It was recommended that taking into account the commercial aspects of plantation crops particularly tea, coffee and rubber, urgent steps may be taken to improve the quality of statistics of area and production of these crops. (Action : IASRI and State Departments of Agriculture).	4th, 1979
15.	Regarding other plantation crops, it was recommended that IASRI may examine whether the sampling methodology already developed on the basis of pilot surveys during the 2nd and 3rd Plans for estimating the area and production of plantation crops like coconut, arecanut, pepper etc. need any modification in view of the changes in cultivation practices, etc. (Action : IASRI).	4th, 1979
16.	For improving the data base for agricultural planning in India, it was recommended that the coverage of land use and crop statistics may be extended to the entire country. (Action : Ministry of Agriculture and State Departments).	4th, 1979
17.	Realising the need for data of crop-cutting experiments for irrigated /unirrigated areas and also for indigenous/high yielding varieties, it was recommended that the sampling design of the surveys conducted may be under the state series modified to introduce stratification on these parameters. This will greatly improve the precision of estimates of crop yields in different categories, (Action : NSSO)	4th, 1979

B. Forestry

18. It was observed that even the bare statistics of forest resources like different types of wood and other forestry products were not available with any degree of reliability. Some data in this regard were being collected by Forestry Department. These data however, need to be put on sound statistical basis by developing appropriate sampling techniques.

3rd, 1978

(Action : IASRI and States)

The need for initiating appropriate surveys and other studies for bringing about improvement in Forestry Statistics was reiterated. It was felt that not much headway has been made in this regard though a similar recommendation was made at the last Conference. It was suggested that the Director, IASRI and the President, Forestry Research Institute may jointly examine the problems as early as possible with a view to remove the impediments for the follow up action expeditiously.

4th, 1979

(Action : IASRI and F.R.I. Dehradun),

19. A useful modification to Bitterlick's method for determining basal area of trees and from it the volume of the useable timber in a forest has been developed by the Forest Research Institute, Dehradun. The modified method may be tried in different topographical forest areas and in various regions of the country. Its applicability for enumerating crop areas may also be tested on a pilot scale.

4th, 1979

(Action : F.R.I., Dehradun, State Departments of Agriculture and IASRI).

C. Animal Sciences

20. The performance of half/bred animals under field conditions in some areas is found to be much lower than the corresponding animals under well/managed farm conditions. Such differences in the performance could be referred to as resources-cum-extension-cum-management-gap in regard to the cross-breeding programme. A constraints analysis may be made in such areas to isolate the management and other factors which are coming in the way of realising the genetic potential of cross-bred animals under field conditions.
- (Action : Department of A.H., Punjab)
- Since this is a research scheme, it may be carried out at some research farms,
- (Action : Research Institutes and Agricultural Universities)
21. Bench-mark surveys under the guidance of IASRI should be carried out in areas where special livestock development programmes involving small and marginal farmers have been initiated recently or proposed to be initiated soon so that objective assessment of such developmental measures may be possible.
- (Action : A.H. Division of Ministry of Agriculture & Irrigation and State Department of A.H.)
- All State Governments should create adequate facilities and allot some funds for undertaking such studies as the part of projects.
- (Action : State Departments of A.H.)
22. It was pointed out that based on the scientific investigations in the field of animal sciences, certain statistical methodologies have been evolved but these need to be adopted

3rd, 1978

4th, 1979

3rd, 1978

4th, 1979

4th, 1979

more widely by the organisations concerned. It was, therefore, recommended that IASRI may prepare a list of all such studies made at various Institutes and Agricultural Universities and circulate to various organisations for their adoption.

(*Actcon* : IASRI, other Institutes, Agricultural Universities, State Departments of A.H. and Ministry of Agriculture).

23. It was felt that there may be a number of constraints for adopting the techniques already evolved. It was, therefore, recommended that these constraints may be examined in detail and necessary modifications made in the methodology, IASRI may initiate action in this regard. 4th, 1979

(*Action* : IASRI, State Departments of A H. and Ministry of Agriculture).

24. For a proper dissemination of various results obtained in statistical research as applied to animal sciences and for wider application of methodologies, it was recommended that a Workshop/Summer Institute might be organised at the IASRI. This will also provide desired forum for mutual discussions and formulation of appropriate programmes for adoption. 4th, 1979

(*Action* : IASRI).

25. While adopting the methodology on the integrated plan for estimating the annual output of principal livestock products, some States expressed certain difficulties, both in respect of sampling designs as well as in its implementation. It was recommended that these aspects might be discussed by the concerned agencies with recommended that these 4th, 1979

aspects might be the co/ordinating agency and the IASRI to arrive at a suitable plan of work.

(Action : Division of Animal Husbandry, Department of Agriculture, Ministry of Agriculture).

26. As there is a need for working out projection of milk production and other livestock products in the near and distant future, it was recommended that suitable methodologies may be evolved for such projections, as also the demand projections. 4th, 1979

(Action : IASRI)

27. Although data collected in livestock farms are analysed to study the performance of a herd, it was felt that more efforts may be made to collect data on animals maintained under village conditions to judge their performance. 4th, 1979

(Action : IASRI, State Departments of A.H., Agricultural Universities and other Institutes).

28. A large body of data are collected during surveys and experimental investigations in animal husbandry and dairy fields with some specific objectives. It was recommended that these secondary data may be critically examined for making further useful studies. 4th, 1979

(Action : IASRI, other Institutes, State Departments of A.H., Agricultural Universities and Ministry of Agriculture).

29. The possibility of using discriminant function approach and other multivariate techniques for improvement in analysis of breeding data on cattle may be explored. 4th, 1979

(Action : IASRI, other Institutes and Agricultural Universities)

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2

3

30. Studies may be made to examine the various methods evolved so far for working out sire indices in respect of their efficiency, stability, etc. 4th, 1979

(Action : IASRI, other Institutes, Agricultural Universities and State Department of A.H.)

31. There is an urgent need for knowing the number of cattle and buffaloes under different breeds as well as crossbred ones in the country. It was recommended that in the first instance the number of crossbred animals may be obtained during quinquennial livestock census. 4th, 1979

(Action : Ministry of Agriculture and State Department of A.H.)

D. Fisheries

32. To assess the potential of inland fisheries, it is necessary to have reliable data for area under water. For this purpose, it was recommended that a census of fisheries may be conducted at two points of time, viz., monsoon and lean seasons. 3rd, 1978

(Action : Fisheries Division of Ministry of Agriculture and Irrigation).

In the absence of representative from Fisheries Department, this matter may be taken up with the Fisheries Department. 4th, 1979

(Action : Fisheries Division of Ministry of Agriculture & Irrigation)

33. A Workshop on "Fisheries Statistics" may be convened to discuss problems which are of interest in both marine and inland fisheries. 3rd, 1978

(Action : IASRI)

Directorate of Economics & Statistics/Fishery Division, Ministry of Agriculture & Irrigation should arrange for a Workshop/Symposium exclusively for 'Fisheries Statistics'.

4th, 1979

(Action : Dte. of E & S/ Fishery Division Ministry of Agriculture & Irrigation)

34. The joint research project of CIFRI and IASRI for development of methodology for estimation of inland fishery resources and catches therefrom is operating in a comparatively small area in West Bengal. In order to provide an enlarged scope to the project, the Conference recommends that the Fisheries Directorates/Agricultural Universities/State Departments may provide necessary qualified manpower support to enlarge the scope of the survey to different states so that an objective method is evolved quickly.

4th, 1979

(Action : CIFRI/IASRI/Dte. of Fisheries (All States)/BCKVV, West Bengal/OUAT, Orissa/GBPAU, U.P./R. A.U., Bihar/TNAU).

35. Considering the fact that inland fish seed production and fish production from larger water bodies is largely a state activity in public sector, the conference recognises that the available data at various state level organisations can be properly processed and made available for the benefit of various users. In order to achieve this objective it recommends that a small group of 3 or 4, consisting of experienced inland fisheries statisticians be constituted to design standard proformae, for collection of data at state level, for the entire country. The State Fisheries Directorates may be required to file the same to identify gaps and availabilities of inland fisheries data. This may be completed by Nov., 1979, so that a background is available for the symposium of inland statistics, where background papers of each State may be invited.

4th, 1979

(Action : IASRI)

1.	2	3
36.	It was recommended that Shri K.K. Ghosh might prepare a note for onward transmission to Dte. of E & S regarding inclusion of item, i.e., area under water with sub-heads to identify ponds, tanks, reservoirs, rivers, seasonal, perennial, stocked with fish seed, not stocked under their land utilisation schedule for taking necessary action.	4th, 1979
37.	In order to obtain a basic data base at district level, required by the new planning process recommended by NCA, and village/panchayat level, required by institutional financiers and banks on items such as water areas, classified as perennial/seasonal. under stockings/no-stockings, commercial/non-commercial exploitation, active fishermen/their operation zones, crafts and implementation etc., it is necessary to have a Quinquennial Fisheries Census. It has been recognised as a basic need for and recommended by NCA for implementation. The Conference recommended that this be done urgently for which a working group be constituted to prepare the schedules and suggest an operative mechanism for the census. <i>(Action : Deptt. of Agriculture/Dte. of E & S).</i>	4th, 1979
38.	The Statistics and Resources Division of CIFRI being experienced and well equipped to analyse the inland fisheries data, the Conference recommended that this expertise may be used by the States for collection and interpretation of inland fisheries data. <i>(Action : State Directorates of Fisheries/CIFRI).</i>	4th, 1979
39.	The State Fisheries Directorates, which are the organisations now involved in fisheries data collection and dissemination, need to have well organised statistics section headed by a senior level statistician with experience in fishery statistics. The conference recommended that this be done expeditiously. <i>(Action : State Fishery Departments).</i>	4th, 1979

1	2	3
40.	The conference recommended that a Summer School or Seminar of 2—3 weeks on “Quantitative methodology in inland fisheries research” be organised jointly by CIFRI and IASRI. (Action : CIFRI and IASRI)	4th, 1979
41.	Multi-disciplinary studies may be taken up for detailed micro-level data analysis in integrated use of water, especially for multi-use water so that optimum water utility can be worked out. Such investigations may be taken in some selected reservoirs or tanks involving irrigation Agriculture/Fisheries/Power, Scientists representing different interests. (Action : CIFRI/IASRI/ Project Co-ordinator (Reservoir Fisheries)).	4th, 1979
42.	Considering the fact that data base for inland fisheries resources itself is highly unsatisfactory, the conference recommends that the census of water areas initiated in different states as a result of NSSO recommendations be completed urgently. (Action : Department of Fishery, Ministry of Agriculture and Irrigation and State Fisheries Department.).	4th, 1979
E. General		
43.	With the increased emphasis on newly emerging cropping systems like multiple cropping, multi-level cropping etc., research for developing appropriate designs for identifying judicious combinations of crops and their management is necessary. (Action : IASRI, other ICAR Institutes and Agricultural Universities),	3rd, 1978

1	2	3
The recommendations made in such conferences should continue for review till the action is completed mentioning the conference (s) in which those were recommended.		4th, 1979
	<i>(Action : IASRI)</i>	
44. It was felt that the studies on determination of the various constraints in the transmission of technology should be undertaken in diverse conditions including the tribal areas and also the small farmers. This may help to provide suggestions for remedial measures to be taken in future. Such studies should be undertaken in collaboration with the extension agencies.		3rd, 1978
	<i>(Action : IASRI, Extension Division of IARI and Extension Department of Agricultural Universities).</i>	
Agricultural Universities, concerned departments of other universities and other research institutes should also take up this work, at least, at micro level if not at macro level.		4th, 1979
	<i>(Action : Research Institutes, Agricultural Universities and Concerned Departments of other Universities).</i>	
45. The ICAR may be approached to appoint a committee to look into the need and requirement of statistical staff in different agricultural universities. The members of the committee may go round those universities and give recommendation regarding the creation/strengthening of the department of statistics as per their needs.		3rd, 1978
	<i>(Action : ICAR).</i>	
The IASRI should vigorously pursue the matter with implementing the recommendation.		4th, 1979
	<i>(Action : IASRI/ICAR)</i>	

1	2	3
46.	<p>It was noted that the Govt. of India has given high priority to rural development programmes under the Sixth Five Year Plan. It is necessary to develop a proper statistical frame for monitoring the rural development projects, particularly those for the benefit of small farmers and landless labourer. The conference stressed the need for the creation of a suitable and adequate machinery for proper assessment and evaluation of these programmes as was followed for Rinderpest Eradication, IADP and State part of I.C.D.P.</p> <p>(Action : IASRI, Ministry of Agriculture and Irrigation/Concerned Departments of Agricultural Universities).</p>	4th, 1979
47.	<p>In order to examine the operational feasibility and possibility of improving the sampling techniques and reduction in cost by collecting data by enquiry, it was recommended that data may be collected simultaneously by enquiry and observation while carrying out pilot investigations.</p> <p>(Action : IASRI and State Departments).</p>	4th, 1979
48.	<p>All data should be subjected to appropriate quality checks before being released for general use.</p> <p>(Action : All Concerned Organisations).</p>	4th, 1979
49.	<p>Keeping in view the importance of agricultural statistics it was recommended that all efforts should be made to educate the officials and other workers engaged in data collection as well as the respondents,</p> <p>(Action : All Agencies Concerned),</p>	4th, 1979

1	2	3
50.	<p>In order to meet the data needs as also to fill in some of the important gaps, the conference reiterated the recommendation of the National Commission on Agriculture to devise an integrated system of agricultural surveys and periodic agricultural and livestock censuses.</p> <p>(Action : IASRI, Ministry of Agriculture and NSSO).</p>	4th, 1979
51.	<p>It was observed that one of the main reasons for non-response and incomplete sample was the administrative problems like transfer of field staff in the middle of data collection work, late appointment of field staff, or sometimes keeping the posts vacant, assignment of other duties, etc. It was, therefore, recommended that the field staff employed for a survey should be completely made available for the field work and their transfer avoided throughout the period of the survey. This will also ensure collection of data on a uniform basis.</p> <p>(Action : State Departments Concerned).</p>	4th, 1979
52.	<p>It was recommended that in addition to organising a detailed training programme for the field staff before commencement of data collection, regular training of the field staff should be arranged at the beginning of each season/round and the proforma and instructions explained in detail in the light of experience gained.</p> <p>(Action : IASRI, Agricultural Universities and State Departments.)</p>	4th, 1979
53.	<p>It was recommended that intensive and frequent supervision of field work, both pre-planned and surprise may be undertaken to solve the field problems and remove conceptual</p>	4th, 1979

as operational difficulties in data collection. It will be useful to provide the field staff with a Handbook of Instructions giving details of sampling design, procedure of selection of units, proforma, Instructions for filling of proforma; time schedule of collection of different items of data, procedure of measurement and observation of units etc.

(Action : All Agencies Concerned).

54. It was recommended that for an effective sample check on the quality of data collected, a sub-sample of the ultimate sampling units may be canvassed by Supervisory Officers and the data of supervised sample may be separately processed for judging and assessing the overall quality of data collected. 4th, 1979

(Action : All Agencies Concerned).

55. It was recommended that close scrutiny of schedules may be done and the gaps and discrepancies observed referred to the field agency involved in the data collection without much time lag to minimize errors on account of memory lapse and investigator's bias. 4th, 1979

(Action : IASRI, NSSO and State Departments.)

56. Since data are generally processed on Electronic Computer, it was recommended that suitable scrutiny and error detection programmes may be prepared not only to eliminate errors introduced due to computerisation of data analysis like coding, punching of cards, tabulation, etc. but also other errors and inconsistencies in the body of data. Other methods for detection of these errors like the use of statistical relationships between various 4th, 1979

factors, range of a parameter, observed trends etc., may also be employed to detect and eliminate errors.

(Action : IASRI and Other Concerned Agencies).

57. Realising the need for making available the data of agricultural field experiments conducted at different Research Stations to scientists and research workers all over the country, it was recommended that a standardised proforma may be developed for recording data of these experiments on a uniform basis. These data could be suitably stored in Agricultural Research Information System at the IASRI which will enable instant availability of data of experiments to any user. 4th, 1979

(Action : Agricultural Universities/ICAR Institutes).

58. It was observed that sometimes the administrators and planners wanted data which were either not readily available or incomplete or were not of good quality. Data from ancillary or other related sources were therefore used for the purpose. It was recommended that limitations of data supplied may be clearly made known to planners and margins of errors specified. The methodology of tackling incomplete data may also be investigated. 4th, 1979

(Action : IASRI and other Agencies Concerned).

59. It was recommended that robustness of various survey designs in use at present which were less prone to non-sampling errors should be investigated to determine the effect of deviations and disturbances on the estimates of parameters being studied. 4th, 1979

(Action : IASRI, other ICAR Institutes and Agricultural Universities).

60. It was recommended that efforts should be made to provide inbuilt system for quality check in each and every project to ensure constant assessment of quality of data collected.

4th, 1979

(Action : IASRI and other Agencies Concerned).

61. It was recommended that once a technique has been developed with the help of pilot sample surveys undertaken by IASRI and passed on to the States for adoption on regular basis, the Institute should actively collaborate and co-operate with the concerned agencies in the States in proper implementation of design as also in other technical aspects like training of field staff, supervision of field work, etc. This will not only ensure good quality of data but also serve as feed back for further research to bring about improvements in the methodology already developed.

4th, 1979

(Action : IASRI).

62. It was recommended that the Statistical Organisations engaged in data collection should establish cell for constant review and appraisal of data collection techniques. The cell should devise suitable checks, both internal and external, to ensure accuracy and quality of data. Preparation of suitable schedules for data collection should also be the responsibility of these organisations. As a first step in this direction a monitoring cell or unit may be established at IASRI to develop guidelines to assess and monitor quality of data.

(Action : All Concerned Agencies).

APPENDIX—I

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APPENDIX-II

The statement showing the action taken on the recommendations made during the 3rd Conference of Agricultural Research Statisticians by some of the ICAR Institutes Agricultural Universities/State Departments of Agriculture, Animal Husbandry, Forestry and Fisheries.

Sl. No.	Recommendations	Name of the Institutes/ Agricultural Universities/ State Deptts. etc.	Action taken
1	2	3	4
1.	The results of past experiments on crops indicate wide variation in varietal performance and input response not only from region to region but also within the same region and quite often within the same research centre. In this connection, it was recommended that greater use of data on soil fertility parameters should be made in the interpretation of experimental results.	<ul style="list-style-type: none"> i) I.A.S.R.I. (ICAR), New Delhi ii) K.A.U., Mannuthy. 	<ul style="list-style-type: none"> i) Some work on the lines is also being attempted with the data of All India Co-ordinated Agronomic Research project. ii) This is being followed.
2.	It was noted that in a number of varietal trials the check/local varieties are not uniform. Appropriate method of	<ul style="list-style-type: none"> i) I.A.S.R.I. (ICAR), New Delhi. 	<ul style="list-style-type: none"> i) The problem is proposed to be allotted to a student of post-graduate Diploma in Agril. Statistics.

Sl. No.	Recommendations	Name of the Institutes/ Agricultural Universities/ State Depts. etc.	Action taken
	analysis need to be developed for combining the results of such trials over different locations and years.	ii) K.A.U., Mannuthy.	ii) A scheme is being drawn up to implement the recommendation.
3.	With the increased emphasis on newly emerging cropping systems like multiple cropping, multi-level cropping etc., research for developing appropriate designs for identifying judicious combinations of crops and their management is necessary.	i) I.A.S.R.I. (ICAR), New Delhi. ii) A.I.C.R.P. for Dryland Agri., 2-2-58/60, Amber- pet, Hyderabad.	i) The problem has been brought to the notice of all the Scientists in the Division of Crop Sciences and Training and Basic Research of the IASRI. ii) We have successfully tried quite complex multiple cropping systems in "strip strip plot" designs and sometimes in "strip-split plot" designs. These designs accommodate ratios of crops/cropping patterns such as uniform versus paired row cropping.
		iii) J.N.K.V.V., Jabalpur (M P.).	iii) The Director of Research Services, J.N.K.V.V., Jabalpur requested the Depts. of Agronomy, Soil Science, Plant Breeding, Extension, Agril. Economics and Statistics to take action on the recommendation.

Sl. No.	Recommendations	Name of the Institutes/ Agricultural Universities/ State Deptts. etc.	Action taken
4.	Attention was drawn to the large number of pot-culture and other laboratory experiments that are being conducted under controlled conditions in the various research institutes. It was recommended that critical reviews on the nature of these experiments, the designs adopted, scope for improvement in their designing, magnitudes of various components of variation etc. may be undertaken.	I.A.S.R.I. (ICAR), New Delhi	A project on the topic has been formulated in the Division of Crop Sciences of IASRI which has been approved by the Divisional Research Committee and the staff Research Council. It will be put up to the Management Committee of the IASRI (ICAR) at its next meeting.
5.	Considerable work that has been done on supplemented block and other related designs was noted. It was recommended that a suitable publication in the form of monograph on supplemented block designs should be prepared on a priority basis.	I.A.S.R.I. (ICAR), New Delhi	A project has been initiated at IASRI for preparing a monograph on supplemented block designs.
6.	The need for more uniformity trials on different field and horticultural crops was felt. The role of soil parameters	i) I.A.S.R.I., (ICAR), New Delhi.	i) Some of the Agricultural Universities/ State Departments of Agriculture have been contacted to lay out uniformity

Sl. No.	Recommendations	Name of the Institutes/ Agricultural Universities/ State Deptts, etc.	Action taken
	<p>in soil parameters in interpreting data from such trials also needs study. It was recommended that suitable trials for this purpose may be organised for various crops.</p>		<p>trials on field and horticultural crops. When these trials are laid out, data on soil parameters will also be collected.</p>
		<p>ii) A.I.C.R.P. for Dryland Agri., 2-2-58/60, Amberpet Hyderabad.</p>	<p>ii) Uniformity trials, one each with sorghum and pearl millet have been laid out by us under dryland conditions at Hayat Nagar Research Farm during the present kharif season. We will continue the trials during two more <i>kharif</i> seasons before concluding.</p>
7.	<p>Statistical projects for studying the economics of Soil Conservation and Water Management Schemes being implemented in various parts of the country should be made with a view to optimising the use of Soil and Water Resources in different areas.</p>	<p>i) K.A.U., Mannuthy. ii) J.N.K.V.V., Jabalpur.</p>	<p>i) A project for implementing this recommendation will be drawn up soon. ii) The Director of Research Services, J.N.K.V.V., Jabalpur requested the Deptts. of Agronomy, Soil Science, Plant Breeding, Extension, Agril. Economics and Statistics to take action on this recommendation.</p>

Sl. No.	Recommendations	Name of the Institutes/ Agricultural Universities/ State Deptts. etc.	Action taken
8.	It was observed that the losses at the pre-harvest stage were mainly due to pests and diseases. Work of estimation of such losses has been done only on paddy, wheat, and maize. There is need to extend this work to other crops also.	I.A.S.R.I. (ICAR), New Delhi.	Earlier work on estimation of crop losses due to pests and diseases on paddy, wheat and maize covered only traditional varieties of these crops. Subsequently work on such loss estimation was taken up on high yielding varieties of paddy and wheat in districts South Arcot (T.N.) in 1976 and district Gorakhpur (U.P.) in 1977 respectively where it is currently in progress. Further work on this aspect is proposed to be initiated by Tamil Nadu Government., in collaboration with IASRI on cotton and groundnut crops shortly.
9.	Regarding losses at the harvest stage it was pointed out that relatively the losses due to employment of manual labour were much less as compared with the losses incurred with the use of mechanised harvestors. This observation needs to be further probed.	I.A.S.R.I. (ICAR), New Delhi.	A survey to study post-harvest foodgrain losses had been formulated and included in the Sixth Plan projects. Approval of the ICAR is awaited.

Sl. No.	Recommendations	Name of the Institutes/ Agricultural Universities/ State Deptts. etc.	Action taken
10.	Regarding losses in storage, it was pointed out that the work has been initiated to quantify the extent of losses. It was observed that the precies estimates of the losses are not available and they are sometimes placed in the range of 5 to 50%. It was felt necessary that studies should be undertaken to determine the extent of loss objectively at the various stages of disposal through which the harvested produce passes. This should include crop losses due to hailstorm, excess of rain, and failure of rain. Such studies would help in reducing such lossess in future.	I.A.S.R.I. (ICAR), New Delhi.	A survey to study post harvest foodgrain losses had been formulatad and included in the Sixth Plan projects. Approval of ICAR is awaited.
11.	Studies on forecasting of crops are being carried out by the IASRI on a few selected crops in few selected centres. It was pointed out that some	I.A.S.R.I. (ICAR), New Delhi.	Studies were initiated during the Fourth Five Year Plan period with a view to developing a suitable statistical methodology for preharvest forecasting of crop yield on the basis

Sl. No.	Recommendations	Name of the Institutes/ Agricultural Universities/ State Deptts. etc.	Action taken
	<p>biometric characters account for nearly 60% of the variation in crop yield. It was felt that such studies and also others for determination of crop weather relationship should be taken up in a number of homogenous agro-climatic zones. In addition, it was mentioned that an integrated approach should be adopted whereby, the biometric observations weather parameters and also the effects of pests and diseases could be simultaneously studied. For this, various disciplines and institutes, should collaborate.</p>		<p>of observations on biometrical character recorded during different stages of crop growth. The crops covered were paddy, wheat, cotton, and jute on farmer's fields in major crop growing areas of the country. These studied were further extended to sugarcane, tobacco and jowar during the fifth five year plan period and work thereon is proposed to be continued during the sixth five year plan period also.</p> <p>Investigation were undertaken recently to develop a suitable yield productions model for paddy crop on the basis of weather parameters. An attempt is now being made to evolve an overall weather Index to be used either alone or in conjunction with other variables such as biometrical characters and agricultural inputs as explanatory variables. Work has also now been taken up to develop a crop yield forecasting model thro-</p>

Sl. No.	Recommendations	Name of the Institutes/ Agricultural Universities/ State Deptts. etc.	Action taken
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ugh an integrated approach involving the use of variables like biometrical characters, weather parameters and incidence of pests and diseases as simultaneous explanatory variables in the model.

Co-ordinated programme involving inter-institutional and inter-disciplinary collaboration are being formulated for implementation during sixth five year plan period. The programme will cover major cereals, oil seeds, pulses and fruit crops in the major crop growing areas of the country. Appropriate data on biometrical characters, weather parameters incidence of pests and diseases and other important variables affecting crop yield are proposed to be collected.

ii) Indian Meteorological Deptt., Lodhi Road, New Delhl.

ii) I.M.D. has carried out a number of investigations in crop weather relationship studies. Work has been done in

Sl. No.	Recommendations	Name of the Institutes/ Agricultural Universities/ State Deptts. etc.	Action taken
12.	It was pointed out further that some econometric models have been developed for optimisation of the resources on individual crops. It was felt that such studies should be extended to groups of crops so that in future it should be possible to evolve models	I.A.S.R.I. (ICAR) New Delhi.	IASRI has initiated a project on the supply response of pulses using macro data. The results would provide guide lines for allocation of acreage under various crops of macro level, However, the work on optimum crop pattern for the villages, blocks etc. have not been initiated so far.
		iii) C.P.R.I. (ICAR) Simla.	iii) We have formulated a project for forecasting the yields of potato in hills and plains with the help of biometrical characters and weather parameters as per recommendation. The Institute needs help from IASRI as regards the statistical methodology for yield estimates at per-harvest stage.
			in developing statistical models to forecast the yield of important crops on sub-divisional basis. The Institute is also undertaking crop yield formulation studies.

Sl. No.	Recommendations	Name of the Institutes/ Agricultural Universities/ State Depts. etc.	Action taken
	for optimum cropping pattern for the villages, blocks, districts and also the States.		
13.	It was felt that the studies on determination of the various constraints in the transmission of technology should be undertaken in diverse conditions including the tribal areas and also the small farmers. This may help to provide suggestions for remedial measures to be taken in future. Such studies should be undertaken in collaboration with the extension agencies.	I.A.S.R.I. (ICAR), New Delhi.	i) Studies on the evaluation of various constraints in the transfer of new farm technology will be undertaken under diverse conditions specially on small farms. At present the IASRI has undertaken a project to study various constraints in rice cultivation in the districts of Raipur, Nalgonda, Puri and Cuttack. Work on the examination of constraints is also under progress in Operational Research Project, Chittor garh. Crop and Livestock integration is being examined. The Institute is also planning to undertake surveys in other areas in coming years.

Sl. No.	Recommendations	Name of the Institutes/ Agricultural Universities/ State Deptts. etc	Action taken
		ii) Div. of Agril. Extn., I.A.R.I., New Delhi.	ii) We had initiated an all India Co-ordinated Research programme in Extension Education. Through this Research project, attempts are being made to scientifically examine various farming systems and situation including tribal and small farmers areas and constraints in transmission of technology. The project is in progress and the data collection with respect to this project has been completed at eight centres located in different parts of the country. The study will be completed in the year 1979.
		iii) K.A.U., Mannuthy	iii) This is being done in the University. in the case of livestock this has been carried out in Trichur Taluk.
		iv) J.N.K.V.V., Jabalpur (M.P.)	iv) The Director of Research, J.N.K.V.V., Jabalpur, requested the Deptts. of Aronomy, Scial Science, plant Breed-

S.I No.	Recommendations	Name of the Institutes/ Agricultural Universities/ State Deptts. etc.	Action taken
14.	It was generally felt that with the spread of high yielding varieties of cereals particularly for rice, wheat and sorghum, there was a need to undertake these surveys in other important districts of the States representing different agro-ecological conditions since the results from the districts would not be directly applicable to these regions.	I.A.S.R.I. (ICAR), New Delhi.	<p>ing Extension, Agril. Economics & Statistics to take action on this recommendation.</p> <p>The project "Sample Survey for methodological investigations into HYVP" is sanctioned upto August, 1979. After the completion of this project, another scheme "Sample Survey for study of constraints in transfer of technology for increased agricultural production is proposed to be taken up in the VI Plan covering about 30 districts in the country. The scheme is proposed to cover such districts where the new technology has not made much headway and will help in identifying the local problems and limiting factors in the transfer of new technology, particularly to small and marginal farmers.</p>

Sl. No.	Recommendations	Name of the Institutes/ Agricultural Universities/ State Deptts. etc.	Action taken
15.	Other cereals which were important in some of the States like Ragi in Karnataka should also be brought under the purview of high yielding varieties programme.	i) I.A.S.R.I. (ICAR), New Delhi.	ii) Under the proposed VI plan project "Sample Surveys for study of constraints in transfer of technology for increased agricultural production" the approach is to determine the constraints in transfer of technology adopting the holding as a sampling unit and as such all the crops grown in a region will be covered.
		ii) Dte of Agriculture, Trivandrum.	ii) Paddy is the only major cereal produced in the State and as such high yielding varieties programme is vigorously pursued for rice alone.

Sl. No.	Recommendations	Name of the Institutes/ Agricultural Universities/ State Deptts. etc.	Action taken
16.	It was mentioned that consequent to development of new high yielding varieties of potato and their large scale cultivation in a number of States, no reliable statistics were available regarding extent of cultivation and yield rates of the new varieties of potato which was an important commercial crop and affected the economy of a number of States. It was recommended that sample surveys for estimation of area and yield of high yielding varieties of potato may be initiated in important States.	<ul style="list-style-type: none"> iii) Dte. of Agriculture, Bangalore. i) I.A.S.R.I. (ICAR) New Delhi. ii) Dte. of Agriculture, Gujarat State, Ahmedabad. 	<ul style="list-style-type: none"> iii) Ragi an important H.Y.V. grown in Karnataka should also be brought under purview of H.Y.V.P. with the assistance of IASRI. i) A project for developing suitable sampling methodology for estimating area and production of HYV of potatoes is being formulated in collaboration with CPRI, Simla and will be taken up as soon as it is approved by the ICAR. ii) A sample survey for estimation of composite yield rate of potato crop is undertaken on pilot basis in Gujarat State. Generally Kukari high yielding varieties of potato crop is grown in the state,

Sl. No.	Recommendations	Name of the Institutes/ Agricultural Universities/ State Deptts. etc.	Action taken
17.	It was observed that the IASRI had developed methodology for estimation of extent of cultivation and production of different fruits in a number of regions. There was an urgent need of bringing out a monograph wherein all such techniques should be brought at one place for ready reference and use in States. This may also be incorporated the latest work done in the country.	I.A.S.R.I. (ICAR), New Delhi.	The monograph has been prepared.
18.	Regarding statistics of extent of cultivation of fruits and their yield rates it was pointed out that sampling methodology was available at present envisaged whole time agency for this purpose, In many States, however, on account of limited resources or otherwise no whole time field agency was available. It was, therefore, strongly recommended that methods	i) I.A.S.R.I. (ICAR) New Delhi. ii) Dte. of Agriculture, Gujarat, Ahmedabad).	i) The project proposal is under finalisation. ii) A pilot sample survey for determining the cost of production of Important fresh fruits and studying their marketing practices is being implemented.

Sl. No.	Recommendations	Name of the Institutes/ Agricultural Universities/ State Deptts. etc.	Action taken
	for collection of data on extent of cultivation and yield rates of fruits by the normal staff of Horticulture Deptt. or other concerned agencies in the States may be developed by IASRI for adoption on regular basis		
19.	The cultivation practices relating to reennial crops in Assam namely arecanut and coconut on the one hand and pineapple, orange and banana on the other were rather typical in so far as area under these crops was substantial but scattered over large tracts both in the hills and in valleys. No reliable statistics on the extent of cultivation on the yield of fruits was available in the State. It was recommended that pilot surveys to develop suitable sampling methodology for estimation of extent of cultivation and production of fruits under such conditions may be taken up.	I.A.S.R.I. (ICAR) New Delhi.	The project proposal is under finalisation.

Sl. No.	Recommendations	Name of the Institutes/ Agricultural Universities/ State Deptts. etc.	Action taken
20.	It was observed that plantation crops like cashewnu and coconut and fruits like mango were extensively grown in some of the forest areas but no statistics were available on their extent of cultivation or even their contribution to the total production. It was recommended that pilot surveys be initiated to develop sampling techniques for estimation of extent of cultivation and production of fruits from such areas.	<ul style="list-style-type: none"> i) I.A.S.R.I. (ICAR), New Delhi. ii) Forest Research Institute & College, P. O. New Forest, Dehra Dun. 	<ul style="list-style-type: none"> i) The project proposal is under finalisation. ii) Regarding evaluation of surveys techniques for estimating the production of fruit from the fruit-trees in forest areas already some work has been done by the Statistical Branch of Forest Research Institute. The aim was to enumerate the 'Amba' yield from the forest area of Budhaban Block in Mohand Range Siwalik Forest Division. The extent of fruit trees in an area is not difficult to estimate.
		iii) Chief Conservator of Forest (Development), Madras.	iii) (a) A pilot survey for the estimate of area and yield of cashew has been under taken by the State Commissioner of Statistics at the instance of the Govt. of India.

Sl. No.	Recommendations	Name of the Institutes/ Agricultural Universities/ State Deptts. etc.	Action taken
23.	The role of forestry in the water availability for agriculture and increased water-use efficiency was stressed and designing of suitable experiments for moisture conservation and water management in forestry are recommended.	<ul style="list-style-type: none"> ii) Dte. of Agriculture, Gujarat (Ahmedabad). i) I.A.S.R.I. (ICAR), New Delhi. ii) Forest Research Institute & Colleges, P. O. New Forest, Dehra Dun. 	<ul style="list-style-type: none"> ii) The estimate of production of cotton on the basis of survey tally with those worked out on the basis of processing returns. i) The IASRI has only advisory role to play in these investigations. The Institute would therefore be glad to provide the necessary technical guidance if a project is initiated by the forest research organisation. ii) The statistical branch alongwith Forest Influence Branches of Forest Research Institute & Colleges is trying to form calibration equations to estimate the water run-off to compare run-off when different treatments are implemented. This will go a long way towards water use management.

Sl. No.	Recommendations	Name of the Institutes/ Agricultural Universities/ State Deptts. etc	Action taken
		iii) Chief Conservator of Forest, Trivan- dram.	iii) Steps have been initiated to strengthen the Statistical Cell of the State Forest Department.
24.	It was observed that lac cultivation constitutes an important constituent of tribal economy and welfare aspects. It was common knowledge that the traders exploited the tribals and other backward classes engaged in lac cultivation. It was considered important and urgent that the cost structure of lac cultivation and marketing aspects are investigated to enable formulation of appropriate development programmes for the uplift of tribals. The Conservator of Forests from Bihar who was very keen for such surveys offered all help and agreed to provide the basic data in this regard.	i) I.A.S.R.I. (ICAR), New Delhi. ii) Chief Conservator of Forests, Tamil Nadu, (Madras).	i) A project for estimation of lac production in the important lac growing regions of India has been proposed in the Sixth Five Year Plan. The aspects relating to cost structure and marketing will also be included in the proposed survey. ii) The planting of lac hosts, trees has been discontinued in this State.

Sl. No.	Recommendations	Name of the Institutes/ Agricultural Universities/ State Deptts. etc.	Action taken
25.	It was observed that even the bare statistics of forest resources like different types of wood and other forestry products were not available with any degree of reliability. Some data in this regard were being collected by Forestry Department. These data, however, need to be put on sound statistical basis by developing appropriate sampling techniques.	<ul style="list-style-type: none"> <li>i) I.A.S.R.I. (ICAR), New Delhi. <li>ii) Office of the Chief Conservator of Forests, Madras. <li>iii) Chief Conservator of Forests, Lucknow. <li>iv) Chief Conservator of Forests, Tamil Nadu (Madras), 	<ul style="list-style-type: none"> <li>i) A proposal for having a joint project on "Forestry Statistics" with Forest Research Institute or C.S.W.C. R.T.I. is under consideration. <li>ii) The proposal to conduct sample surveys is acceptable. <li>iii) In this state, Forestry Statistics are being collected regularly. These are reasonably reliable. The inventory data are based on sampling. Besides in VI Five Year Plan Steps are also proposed to strengthen the statistical wing to improve data collection. <li>iv) The proposal to conduct sample survey is acceptable.

Sl. No.	Recommendations	Name of the Institutes/ Agricultural Universities/ State Deptts. etc.	Action taken
26.	<p>Farm forestry and social forestry were likely to play a crucial role in the economy of rural population and would, therefore, constitute an important component in integrated rural development. The demand for forestry products in the near future was another important consideration which should be taken note of while planning surveys on forestry. It was, therefore, recommended that the need for earmarking certain areas in the vicinity of villages or blocks or even bringing the waste and barren lands under forests may be investigated. Surveys should also be undertaken to study extent of availability of such areas and cultivation taken up wherever feasible. The special problems in forestry cultivation were underlines by various speakers</p>	<p>i) I.A.S.R.I. (ICAR), New Delhi.</p> <p>ii) Forest Research Institute & Colleges, P.O. New Forest, Dehra Dun.</p> <p>iii) Chief Conservator of Forests, Madras.</p> <p>iv) Chief Conservator of Forests, Lucknow.</p>	<p>i) A proposal for having a joint project on "Forestry Statistics" with Forest Research Institute or C.S.W.C.R.T.I. is under consideration.</p> <p>ii) We fully agree with the recommendation. The state department which are the implementing agencies should act on these points.</p> <p>iii) A reconnaissance survey of croded lands was conducted to ascertain the area available during the II plan. A fresh survey is necessary to determine the extent of land available (under various categories) for implementing social forestry programmes.</p> <p>iv) A project on farm forestry and social forestry has been formulated by Forest Department keeping in view its role in the economy of rural population and future demand of forestry products.</p>

Sl. No.	Recommendations	Name of the Institutes/ Agricultural Universities/ State Deptts. etc.	Action taken
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for instance the need for protection of newly cultivated trees which, if left unguarded, might be grazed or eaten up by animals. Similar other problems need to be tackled in the context of forestry cultivation.

27. In other that the livestock population projections are made on a realistic basis, it is desirable that population figures are available for finer age groups alongwith specific mortality and fertility rates. The I.A.S.R.I. may finalize the sampling technique for estimation of specific mortality and fertility rates, as early as possible, but for bovines and ovines. While such data may be collected from large scale surveys conducted for the purpose, efforts should also be made to extract as such information as possible from other livestock surveys.

i) I.A.S.R.I. (ICAR),
New Delhi.

i) Pilot studies to work out the methodology for estimation of birth and death rates in bovines at four centres would be undertaken. The work has already been taken up at three centre and the work at the fourth centre will be taken up during 1979. After completion of work suitable methodology would be evolved. Similar studies to work out the methodology on ovines is proposed to be undertaken during Sixth Five Year Plan. Data collected from other surveys are being utilized to extract relevant information.

Sl. No.	Recommendations	Name of the Institutes/ Agricultural Universities/ State Deptts. etc.	Action taken
		ii) Dte. of A.H., Orissa.	ii) Steps will be taken up after finalisation of sampling technique by the IASRI for the estimation of specific mortality and fertility rates.
		iii) Dte. of A.H., J & K.	—do—
		iv) Dte. of A.H., Maharashtra State, Pune.	iv) After the sampling technique is finalised by IASRI this would be introduced in the State.
		v) Dte. of A.H., Gujarat (Ahmedabad).	v) The suggestion will be adopted after finalisation of sampling techniques by IASRI for estimation of specific mortality and fertility rates. Related data will be collected from large scale sample surveys.
		vi) Dte. of A.H., Himachal Pradesh.	vi) An Integrated Sample Survey has already been launched for estimating major livestock products such as milk, egg, wool and meat and to study other attendant practices.

Sl. No.	Recommendations	Name of the Institutes/ Agricultural Universities/ State Deptts. etc.	Action taken
28.	The possibility of estimating feed stock available at any point of time may be explored. The basic data required for estimation may be collected from the livestock surveys being undertaken.	<ul style="list-style-type: none"> <li>i) I.A.S.R.I. (ICAR), New Delhi. <li>ii) Dte. of A.H., Orissa. <li>iii) Dte. of A.H., J. & K. <li>iv) Dte. of A.H., Gujarat (Ahmedabad). <li>v) Dte. of A.H., Himachal Pradesh. 	<ul style="list-style-type: none"> <li>i) The estimation of availability and requirement of feed and fodder for livestock are being worked out utilizing the available data. <li>ii) Steps have already been taken to implement scheme for estimation of production and availability of feeds and fodder during the Sixth Plan period. <li>iii) Action will be taken with appropriate authorities. <li>iv) This department has proposed a scheme namely estimation of area and production of feeds and fodder during the period of Sixth Five Year Plan. <li>v) An integrated sample survey has already been launched for estimating major livestock products such as milk, egg, wool and meat to study other attendant practices.

Sl. No.	Recommendations	Name of the Institutes/ Agricultural Universities/ State Deptts. etc.	Action taken
		iv) Dte. of A.H., Maharashtra State, Pune.	iv) On this point guidelines from IASRI are required.
29. Although suitable sampling techniques are available for estimation of feeds fed to animals, the estimates are worked out at present only for total greens, total dry fodder and total concentrates. It is necessary to obtain estimates of the individual constituents of feed under each of three groups. Future surveys should be planned suitably for working out estimates of different constituents of feeds. In the meantime, efforts should be made to fully utilise the available data in working out the estimates of different constituents of feeds fed to animals.		i) I.A.S.R.I. (ICAR) New Delhi.	i) Estimates of feeds given to animals constituent-wise have been worked out from the pilot surveys. Similar efforts are also being made to have such information from such survey.
		ii) Dte. of A.H., Cuttack.	ii) Data are being collected to estimate the individual constituents of feed to animals under present survey conducted in I.C.D.P.
		iii) Dte. of A H. J. & K.	iii) It will be considered.
		iv) Dte. of A.H., Gujarat (Ahmedabad)	iv) The aspect will be taken care of at the time of implementation of the scheme for estimation of area and production of feed and fodder during Sixth Five Year Plan.

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30.	The sampling technique evolved by the IASRI for estimation of availability and cost of production of milk may be adopted for conducting such surveys in milk collection areas.	<ul style="list-style-type: none"> v) Dte. of A.H., Maharashtra State, Pune. i) I.A.S.R.I. (ICAR), New Delhi. ii) Dte. A. H., Orissa. 	<ul style="list-style-type: none"> v) IASRI may give the guidlines regasding the sample size of households in the Integrate Survey Scheme as the present sample size is not adequate for estimating the constituents of individual feed and fodder fed to animals. i) A Monograph is being prepared giving details about the plan of work sampling design, method of collection of data procedure of analysis, broad findings and relevant schedules for collection of data on availability of cost of milk production. This monograph will be sent to all the departments of animal husbandry and dairying and other organisations concerned for the adoption of the technique. ii) Proposal to implement four schemes during the Sixth Plan Period and steps will be taken to work out the cost of production of livestock products.

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31.	Pilot sample surveys for evolving a technique for studying the economics of rearing crossbred calves which is undertaken by IASRI at one centre may be taken up in a few more centres representing different animal husbandry regions.	iii) Dte. of A.H., Gujarat (Ahmedabad). IASRI (ICAR), New Delhi.	ii) The sampling technique evolved by IASRI has been adopted to estimate availability, of milk in the state. For estimation of structure and indices of the cost of production of livestock products a scheme has been proposed for implementation during the sixth plan. The Institute carried out the first survey for studying economics of rearing calves in Hissar area of Haryana. The second survey to study the economics of rearing of crossbred calves is in progress in West Bengal. One more centre is proposed to be taken up for similar work during Sixth Five Year Plan.
32.	The methodology evolved by IASRI for working out the cost of production of poultry and eggs under commercial management conditions, may be adopted for undertaking similar surveys by concerned organisations.	i) I.A.S.R.I (ICAR), New Delhi.	Based on two such surveys, a monograph is being prepared giving details about the plan of work, sampling design method of collection of data alongwith specimen schedules, procedure of analysis, broad findings etc. This monograph will be sent to state depart-

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			ments of Animal Husbandry, Agricultural Universities and other concerned organisations for adoption of technique for the purpose.
		ii) K.A.U., Mannuthy.	ii) This is yet to be done.
		iii) Dte. of A.H., Orissa.	iii) Proposal to implement 4 schemes during 6th Plan period and steps would be taken to work out the cost of production of livestock.
		iv) Dte. of A.H., Gujarat (Ahmedabad).	iv) Scheme for estimation of structure indices of cost of production of livestock products is proposed in Sixth Five Year Plan.
		v) Dte. of A.H., Maharashtra State, Pune.	v) The scheme for working out cost of production of poultry and eggs under commercial management will be considered as regards the cost of production of poultry and eggs by small flock

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			owners (flock size upto 20) a pilot scheme is under consideration of the Govt. and is likely to be taken up during VI Plan.
		vi) Dte. of A.H., Maharashtra State, Pune.	vi) The scheme for working out the cost of production of poultry and eggs under commercial management will be considered. Besides, a pilot scheme is under consideration and is likely to be taken up in the VI Plan.
		vii) J.N.K.V.V., Jabalpur (M.P.).	vii) The Director of Research Services, J.N.K.V.V., Jabalpur requested the Deptt. of Agril. Economics, to make proposal with the help of Asstt. Statisticians of Cattle and Poultry Projects for the implementation of this recommendation.

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33.	Methodological investigation to study the comparative performance of mixed farming involving suitable combinations of crop, livestock, poultry and fish may be taken up.	i) I.A.S.R.I. (ICAR), New Delhi. ii) K.A.U., Mannuthy.	i) A methodological investigation for studying the comparative performance of mixed farming involving crop, livestock, poultry and fish is proposed to be taken during Sixth Five Year Plan. ii) Mixed farming is going to be taken up shortly at Kumarakam.
34.	A Breeding Policy Committee may be set up in each State consisting of Geneticist, Breeder and Statistician to decide upon the choice and level of exotic inheritance to be introduced in cross-breeding programmes in the area taking into account the local conditions as well as the availability of various essential inputs like nutrients, disease and health cover and management.	i) Dte. of A.H., Cuttack. ii) Dte. of A.H., J. & K. iii) Dte. of A.H., Gujarat (Ahmedabad)	i) Breeding Policy Committee may be set up to formulate breeding programme of the State. ii) Suggestion will be considered. iii) The state department of Animal Husbandry has evolved a breeding policy for the state in consultation with various agencies such as N.D.D.B., G.D.D.C., Gujarat Agril. University & Co-operative Dairies and Prominent Cattle Breeders.

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		iv) Dte. of A.H., Maharashtra State, Pune.	iv) The Cattle Breeding policy to be adopted in the state is decided by appointing a Committee from time to time consisting of Geneticist, Breeders and Technical Experts,
35.	The non-availability of statistical findings of various cross-breeding programmes being undertaken in the country was keenly felt. While the IASRI has taken up the analysis of data from all the Military Dairy Farms in a comprehensive way, the statistical departments of agricultural universities in different State may undertake the analysis of cross-breeding programmes in operation in their States.	i) J.N.K.V.V., Jabalpur. (M.P.) ii) K.A.U., Mannuthy,	i) At present a cross-breeding scheme is being run by the University under AICRP on Cattle. ii) This will be done alongwith the cross-breeding programme of the University.
36.	The performance of half-bred animals under field conditions in some areas are found to be much lower than the	i) Dte. of A.H., Gujarat, Ahmedabad.	i) This has been noted for implementation.

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	<p>corresponding animals under well-managed farm conditions. Such differences in the performance could be referred to as resources-cum-extension-cum-management-gap in regard to the crossbreeding programme. A constraints analysis may be made in such areas to isolate the management and other factors which are coming in the way of realising the genetic potential of cross-bred animals under field conditions.</p>		
37.	<p>A uniform system of milk recording under village conditions may be introduced in each State so that the progeny testing programmes as well as crossbreeding programmes introduced under field conditions in some of the States could be properly evaluated. The</p>	<p>i) Dte. A.H., Orissa. ii) Dte. of A.H. J. & K.</p>	<p>i) Milk recording has already been taken up in villages under key village schemes and I.C.D. project. ii) Suggestion will be considered.</p>

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	identification of animals may be undertaken and pedigree and history sheets may be maintained.	iii) Dte. of A.H., Gujarat (Ahmedabad.)	iii) Uniform system of milk recoding under village conditions has been adopted in I.C.D.P. areas. Central herd registration scheme Gir and Kankrej cattle is also in operation in the state.
		iv) Dte. of Animal Husbandry, Maharashtra. State, Pune.	iv) Milk recording in the areas covered by the I.O.D. P.'s and K.V.C.'s has been undertaken as per pattern of systematic recording evolved by I.A.S.R.I. In addition milk recording by the cross bred cattle is being introduced. The data will be utilized for sire evaluation. Identification of the cross-bred animals born by way of eartagging is adopted under each institutes doing artificial insemination work. Pedigree sheets has been maintained for this purpose.

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38.	In those States where the progeny testing programmes in cattle and buffaloes are being implemented and sires are being evaluated on the basis of an adequate number of daughters, attempts should be made to publicise the breeding worth of the bulls along with their repeatability.	i) Dte. of A.H., Orissa. ii) Dte. of A.H., Gujarat, Ahmedabad iii) Dte. of A.H., Maharashtra State, Pune.	i) Steps have been taken to execute the progeny testing programme in the State. ii) This recommendation has been noted for future action. iii) The progeny testing programme is undertaken only in cattle in Maharashtra. The breeding worth of the sires alongwith repeatability would be published in due course.
39.	It was stressed that in progeny testing programmes with cattle and buffaloes, bulls should be tested on the basis of adequate number of daughters. In case of buffaloes, in view of the higher rate of calf normally about 50 to 60 dams may normally be mated to a	i) Dte. of A.H. Gujarat, Ahmedabad ii) Dte. of A.H., Orissa.	i) Steps have been taken to execute the programme in the State. ii) This has been noted for action.

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	sire so that at least 10 to 12 daughters become available for working out a precise estimate of the breeding worth of the sire.	iii) Dte. of A.H., Maharashtra State, Pune.	iii) Progeny testing of cattle bulls is only being done in the State so far. This is being done on the basis of adequate number of animals.
40.	It was pointed out that in certain cattle and buffalo herds in some areas, the average production of the herd is decreasing over time. It was recommended that in such cases statistical methods may be used to separate out the genetic trends from the environmental ones for knowing whether decreases are at the genetic level or due to environmental factors. The methodology developed by the IASRI in this regard may be circulated to all the States for undertaking such analysis.	i) I.A.S.R.I. (ICAR), New Delhi. ii) Dte. of A.H., Orissa.	i) The methodology developed by I.A.S.R.I. for separating out genetic trends from environmental ones in cattle and buffaloes in the form of research papers were sent to the Vice Chancellors of all Agricultural Universities and Directors of State Departments of Animal Husbandry for undertaking such analysis. ii) Disease intelligence units have already been established in the State to collect timely information about the diseases of livestock.

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41.	Since authentic information about the incidence of diseases in cattle and buffaloes is not readily available in most of the States, it was recommended that a Disease Intelligence Agency may be established in each State to collect and collate timely information in this regard so that necessary prophylactic measures could be taken in advance.	i) Dte. of A.H., J. & K. ii) Dte. of A.H., Gujarat. Ahmedabad, iii) Dte. of A.H., Maharashtra, State, Pune.	i) Suggestion will be considered. ii) The State Department of Animal Husbandry has established an epidemiology unit at Lusagarh to Co-ordinate the working of the disease investigation units and to provide necessary guidance to the field officers for undertaking prophylactic measures in advance. iii) Timely action for reporting and control of Contagious disease but breaks in the animals is being taken up in the State, through disease investigation selection, monthly return regarding incidences, animals affected and died etc., is also circulates to all the districts.

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42.	A proper method for estimating the incidence of diseases in bovines under field conditions may be developed by a team of scientists working in the field of veterinary and statistics.	i) I.A.S.R.I. (ICAR), New Delhi.	i) Study to estimate the losses due to incidence of pests and diseases in bovines has been proposed to be taken up during the Sixth Plan in collaboration with IVRI.
43.	Wool Analysis Laboratories should be established in States dealing with wool production. These laboratories could be associated with the Sheep Breeding Farms in the State for providing with necessary data on the quality of wool on a sampling basis.	i) Dte. of A.H., Gujarat, Ahmedabad, ii) Dte. of A.H., Maharashtra State, Pune.	i) It has been already adopted in the State Wool Analysis Laboratory at Morvi. ii) The wool analysis laboratory has been established in the State since long and is associated with the Sheey Breeding Farms. The laboratory analysis the samples received from the different sheep breeding farms and guides the farms for selection of breeding stock.
		iii) Dte. of A.H., Himachal, Pradesh.	ii) Two wool analysis laboratories are in operation and are associated with sheep breeding farms for the purpose.

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44.	A Mini-Workshop may be arranged on the "Statistical Analysis of Animal Breeding data with special reference to standardising the procedures of analysis.	i) IASRI (ICAR), New Delhi.	i) Action regarding Mini-workshop on Statistical Analysis of breeding data is being initiated.
45.	Besides hides and skins and pigs the scope of pilot sample survey for estimation of livestock products being carried out by IASRI should be extended so as to cover other livestock products such as hair and bristles and by-products of milk and of those coming out of slaughter houses.	i) I.A.S.R.I. (ICAR), New Delhi.	i) Surveys to cover livestock products like hair and other by-products of milk etc., will be planned and taken, in the second phase after completing the work in hand/proposed during the Sixth Five Year Plan.
46.	The sampling methodology for estimation of livestock products, viz., milk, wool, eggs and meat has been developed for providing estimates of production at the State level only. In the context of integrated rural development it is necessary that methodology	i) I.A.S.R.I. (ICAR), New Delhi.	i) Implemented-Pilot sample surveys will be undertaken from May, 1979 in Barabanki district of Uttar Pradesh and Rohtak district of Haryana for the purpose of developing methodology for obtaining estimates of milk production at the district level.

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	should be developed to provide such estimates at the district and block levels.		
47.	Bench-mark surveys under the guidance of IASRI, should be carried out in areas where special livestock development programmes involving small and marginal farmers have been initiated recently or proposed to be initiated soon so that objective assessment of such developmental measures may be possible.	i) IASRI (ICAR), New Delhi. ii) Dte. of A.H., Orissa. iii) Dte. of A.H., J & K.	i) Necessary guidance for carrying out bench mark surveys in areas where special livestock development programmes are in progress/ to be initiated will be provided as and when the concerned organisations approach the Institute. ii) Such studies will be taken if some new scheme are implemented in the Sixth Plan period. The Central Ministry is being requested to evolve a model for such studies, so that it will be possible to execute in the State. iii) Bench mark survey is already being conducted in I.C.D.P. area.

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		iv) Dte. of A.H., Gujarat, Ahmeda- bad.	iv) The recommendation is accepted and needful will be done in Sixth Plan.
		v) Dte. of A.H., Maharashtra State, Pune.	v) This would be considered in the VI plan.
		vi) Dte. of A.H., Himachal Pradesh.	vi) A benchmark survey has been under- taken in the Intensive Cattle Develop- ment Project and report submiited to the Govt. and the Institute.
48. In all State Livestock Breeding Farms statistical staff should be provided adequately for collection of statistical data.		i) Dte. of A.H., Orissa.	i) Action is being taken to make provi- sion for statistical staff under the Livestock Breeding Farms.
		ii) Dte. of A.H., Gujarat, Ahmedabad.	ii) This has been noted for action in the Sixth Plan.
		iii) Dte. of A.H., Maharashtra State, Pnne.	iii) This would be considered in the VI plan.

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49.	The available sampling methodology for estimation of livestock products essentially requires collection of basic data through ad-hoc field staff. Since such methodology is to be ultimately used by the Animal Husbandry Departments in the States, it is necessary that this should fit into the day to day working of these departments and basic data obtained through their field agencies. Pilot studies should be undertaken by IASRI to modify the available methodology to meet this requirement. This requirement should also be kept in view in the future research programmes for estimation of livestock products. Such studies will also help in substantially reducing the cost of conduting sample surveys on livestock products.	<ul style="list-style-type: none"> i) I.A.S.R.I. (ICAR), New Delhi. ii) Dte. of A.H., Orissa. iii) Dte. of A.H., J & K. iv) Dte. of A.H., Gujarat, Ahmedabad. 	<ul style="list-style-type: none"> i) Implemented :— Pitol sample surveys for estimating production of livestock products by using normal departmental staff will be undertaken in the districts of Ludhiana (Punjab) and Hoshangabad (M.P.) during June, 1980-August, 1981 and in Nasik (Maharashtra) and Trichur (Kerala) districts during 1981-82. ii) Data are being collected for estimation of major livestock products under centrally sponsored scheme and the methodology adopted as secommended by Govt. of India, Min. of Agriculture and Irrigation, Deptt. of Agriculture. iii) Suggestion will be considered. iv) This has been noted for action.

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		v) Dte. of A.H., Maharashtra State, Pune.	v) The collection of data for estimation of livestock products through normal field agencies is not possible. Special agencies are necessary for collection of data on livestock products.
		vi) Dte. of A.H., Himachal Pradesh.	vi) An integrated sample survey has already been launched for estimating major livestock products such as milk, egg, wool and to study other attendants practices.
50.	To assess the potential of inland fisheries, it is necessary to have reliable data for area under water. For this purpose, it was recommended that a census of fisheries may be conducted at two points of time, viz., monsoon and lean seasons.	i) Deptt. of Agri., Min, of Agri. & Irriga- tion, Krishi Bhavan, New Delhi.	i) A pilot sample survey in collaboration with N.S.S.O. was carried out during 1973 in three districts of three States viz., Andhra Pradesh, Tamil Nadu and West Bengal which has since been completed. The methodology based on pilot sample surveys which gave estimation of inland resources was communicated to the States for implementation in 1977.

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51.	System analysis and simulation approach may be adopted for studying the overall impact of stocking size and density, feeding quality, quantity periodicity, species composition for polyculture and pond management.		No reply has been received from CMFRI & CIFRI.
52.	Studies to correlate the data on fish landings with those on meteorological, hydrological, physical and chemical observations may be undertaken by a team of scientists working in the fields of biological, statistical, meteorological, physical and chemical sciences.		No reply has been received from C.M.F.R.I.
53.	Socio-economic studies may be undertaken to study the impact of mariculture such as those of mussels, oysters, prawns etc. on the rural economy of villages in the coastal regions.		No reply has been received from C.M.F.R.I.

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54.	Experimental studies may be undertaken to determine the optimum mesh size for capture of prawns of commercial size.		No reply has been received from C.M.F.R.I.
55.	Bio-assay studies may be undertaken for fixing lethal doses for living organisms so as to control the toxicity of effluents due to pollution.		No reply has been received from C.M.F.R.I.
56.	A Workshop on "Fisheries Statistics" may be convened to discuss problems which are of interest in both marine and inland fisheries.	I.A.S.R.I. (ICAR), New Delhi.	The Indian Society of Agricultural Statistics is organising a symposium on "Inland Fishery Statistics" in its forthcoming annual conference later this year. A workshop will be convened thereafter, if necessary.
57.	The available statistics on inland fisheries in various states are highly inadequate, primarily due to lack of statistical personnel in the fisheries departments. The statistical cells in these departments should be suitably	Deptt. of Agriculture, Min. of Agri. & Irrig., Krishi Bhawan, New Delhi.	The State Fisheries Departments have very skelton staff for the collection of fisheries statistics. The matter is being pursued with the State Govts.

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	strengthened on the line suggested by NCA so that collection and compilation of statistical data on fisheries can be organised in a systematic manner to meet the research needs.		
58.	A suitable methodology should be developed at the earliest for estimating the production of inland fish. The pilot sample surveys planned for this purpose jointly by IASRI and CIFRI in West Bengal and Orissa should also be extended to other important States like Assam Bihar and Maharashtra. In this connection, the reports published by NSSO, may be taken into account.	I.A.S.R.I. (ICAR), New Delhi.	Pilot survey for estimation of resources and catch of inland fish has been initiated in four districts of West Bengal. Similar surveys in 2 more districts of West Bengal and 3 districts of Orissa will be carried out after ICAR's approval is obtained.
59.	The impact of mechanised fishing on the economy of the traditional fishing communities in the coastal areas may be studied.	I.A.S.R.I. (ICAR), New Delhi.	IASRI has proposed a project to study the relative economics of various fishing methods and impact of mechanised fishing in Calicut Area of Kerala State. The project will be undertaken in collaboration with the C.M.F.R.I. (Cochin).

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60.	<p>Studies should be undertaken to develop standard methods of estimation to evaluate total availability and requirements of feed. For working out the availability of feed, accurate estimates of production of crop by-products should be obtained. The NSSO and State Deptts. which are responsible for conducting crop estimation surveys may be requested to record weightment of crop by-products in the sample plots selected for crop cutting experiments. Such estimates should be obtained not only for different crops but also for important varieties, (separately for high yielding varieties) of a crop. It necessary, State Deptts. of Animal Husbandry may extend their help during the period of crop estimation surveys.</p>	<p>i) I.A.S.R.I. (ICAR), New Delhi.</p> <p>ii) Dte. of A.H., New Delhi.</p> <p>iii) Dte. of A.H., Gujrat (Ahmedabad)</p>	<p>i) Studies to estimate the availability and requirements of feed for animals are in progress. For working out the estimates the latest livestock census figures would be required and these are not available as yet for all the States.</p> <p>ii) The crop estimation of the State is being conducted by the Dte. of Bureau of Statistics and Economics, Orissa. Action is being taken to move the concerned Deptt. to record the crop by-products in the simple plots selected for crop-cutting experiments.</p> <p>iii) A scheme has been proposed for estimation of area and production of feed and fodder under sixth plan scheme.</p>

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61.	Sampling techniques evolved on the basis of a pilot study for estimation of area of grazing land and its utilisation need to be tested in different regions and finalised for adoption by State Departments.	<ul style="list-style-type: none"> <li>iv) Dte. of Agriculture, Gujarat (Ahmedabad). <li>i) I.A.S.R.I. (ICAR), New Delhi. <li>ii) J.N.K.V.V., Jabalpur (M.P.) <li>iii) Dte. of A.H., Orissa. 	<ul style="list-style-type: none"> <li>iv) Weight of by-products obtained from the sample plot selected for crop-cutting experiments is being recorded. <li>i) A Pilot sample survey for estimation of area of grazing land and its utilisation is in progress in Puri district. A similar survey will be taken up in Tamil Nadu subsequently. The methodology will be finalized and passed on to the states, after results of these surveys become available. <li>ii) Action is being contemplated to establish a Statistical Cell in the University Research Wing which can take up steps to implement this recommendation. <li>iii) A study for estimation of area of grazing land and its utilization has already been taken up in the State by

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			the Directorate of Bureau of Statistics and Economics, Orissa under the scheme sponsord by ICAR.
		iv) Dte. of A.H., Gujarat, Ahmedabad.	iv) It has been noted for action.
		v) Dte. of A.H., Maharashtra State, Pune.	v) This will be considered after guidance is obtained from IASRI regarding sampling techniques, etc,
		vi) Dte. of Agriculture, Gujarat, (Ahmeda- bad.	vi) Such type of pilot study can be under- taken if the staff is provided.
62. The sampling technique for estimation of production of cultivated fodders available on the basis of pilot surveys may be adopted with necessary modifications, if any, to suit local conditions.		i) J.N.K.V.V., Jabalpur (M.P.).	i) Action is being contemplated to establish a Statistical Cell in the University Research Wing which can take up steps to implement this recommendation.

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		ii) K.A.U., Mannuthy.	ii) Projects will be taken up.
		iii) Dte. of A.H., Orissa.	iii) It has been proposed to take up survey on feed and fodder in the Sixth Plan period.
		iv) Dte. of A.H., Gujarat (Ahmedabad).	iv) A scheme has been proposed for estimation of area and production of feed and fodder under Sixth Five Year Plan.
		v) Det. of A.H., Maharashtra State, Pune.	v) A scheme is being proposed by the Deptt. for estimating yield rates of cultivated fodder and naturally grown grass.
		vi) Dte. of Agriculture, Gujarat (Ahmedabad).	vi) Such type of pilot study can be undertaken if the staff is proposed.
63. The departments of Statistics of Agricultural Universities and State Departments in Animal Husbandry and Fisheries should take up research problems which are location-specific		i) J.N.K.V.V., Jabalpur (M.P.)	i) Action is being contemplated to establish a Statistical Cell in the University Research Wing which can take up steps to implement this recommendation.

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	in nature as far as Central Institutes of ICAR are concerned they should take up problems which are of nationwide interest.	ii) Dte. of A.H., Gujarat (Ahmedabad).	ii) It has been noted for appropriate action.
64.	Priorities may be given to statistical problems which are relevant to emerging farming systems such as crop-livestock farming, crop-fish farming, and sea-farming in view of the fact that such systems can lead to not only additional production but also more income and gainful employment. Attempts should be to meet the requirements of the weaker sections of the rural community, i.e., the small and marginal farmers as well as landless labourers.	i) K.A.U., Mannuthy. ii) Dte. of A.H., Gujarat (Ahmedabad).	i) Priority will be give to this recommendation. ii) It has been noted for action.
65.	The All India Co-ordinated Projects of ICAR, the Agricultural Universities and Agricultural Research Institutes	I.A.S.R.I. (ICAR), New Delhi.	Ado. letter was addressed by the Director, IASRI to the Directors of ICAR Institutes and All India Co-ordinated Projects to make

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	may be requested to make available the basic data collected under various experimental projects to the IASRI for preparing a comprehensive Agricultural Research Information System.		available the basic data collected under various experimental projects to IASRI. Favourable replies received from about six of them.
66.	The information on statistical manpower proposed, sanctioned and recruited may be collected from the Directors of Agriculture, Animal Husbandry and Statistics in various States.	<ul style="list-style-type: none"> i) Dte. of Agri., Bangalore. ii) Dte. of A.H., Orissa. iii) Dte. of A.H., Gujarat, Ahmedabad. iv) Dte. of Agriculture, Gujarat, Ahmedabad. 	<ul style="list-style-type: none"> i) Statistical manpower in the Statistical Cell of the Directorate of Agriculture Karnataka is as Dy. Director of Statistics-1, Sr. SA-2, Jr SA-2. ii) Information on Statistical manpower will be supplied as and when required. iii) Action in this direction has already been taken. iv) If any information is required in respect of manpower and if the collection of such an information is possible by existing staff, can be supplied.

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67.	Statistical assessment of the impact of all developmental projects should be taken up by the statistical cells in Agriculture and Animal Husbandary departments, if necessary by augmenting the staff strength.	<ul style="list-style-type: none"> v) Dte. of A.H., Himachal Pradesh i) I.A.S.R.I. (ICAR), New Delhi. ii) Dte. of Agriculture, Bangalore. iii) Dte. of A.H., Orissa. 	<ul style="list-style-type: none"> v) More staff on the statistical side has been demanded in the VI Plan proposal. i) The increase in statistical staff strength has been proposed in view of these projects to be taken up during the VI Plan. ii) Statistical Cell is conducting study regarding (1) Impact of soil testing on farmers (2) An evaluation study on fertilizers promotion programme and (3) Impact of Agricultural training to sons of farmers is also in hand. Proposal will be made to augment the statistical cell. iii) Statistical assessment on major developmental projects will be taken up in the Sixth Plan period after augmentation of statistical staff in the department. However, actions have already been taken to study the impact of I.C.D. Projects,

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		vi) Dte. of A.H., Gujarat, Ahmedabad.	iv) The department has proposed a scheme for monitoring and assessment of livestock development programmes in the field of A.H. Besides at present regular assessment surveys are conducted to assess the import of I.C.D.P.
		v) The Chief Conservator of Forests, Trivandrum.	v) Steps have been initiated to strengthen the Statistical Cell of the State Forest Department.
		vi) Dte. of A.H., Maharashtra State, Pune.	vi) This would be considered.
		vii) Dte. of Agriculture, Gujarat, Ahmedabad.	vii) A proposal in this regard is submitted to the State Government for necessary action.
		viii) Dte. of A.H., Himachal Pradesh.	viii) More staff on statistical side would be provided with the availability of funds in the Sixth Plan proposal.

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68.	Adequate statistical staff should be provided at the community development block level and at the district level for collection and compilation of statistics required for planning purposes, in the context of integrated planning for rural development.	<ul style="list-style-type: none"> i) Forest Research Institute & Colleges, P.O. New Forest, Dehra Dun. ii) Dte. of A.H., Gujarat, Ahmedabad. iii) Dte. of A.H., Maharashtra State, Pune. 	<ul style="list-style-type: none"> i) We fully agree with the recommendation. The State Deptt. which are the implementing agencies should act on these points. ii) For the purpose of district planning the Govt. of Gujarat has set up District Planning Boards consisting of suitable statistical staff for collection and compilation of the required data for planning purposes. It has also proposed a scheme in Sixth Five Year Plan for monitoring assessment of livestock development programme in the field of Animal Husbandry, through which it will be possible to collect basic information at district level. iii) This would be considered in the VIth Plan.

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		iv) Dte. of Agriculture, Gujarat, Ahmedabad.	iv) A proposal for creation of Statistical Cell at taluka as well as district level was submitted to the State Government but it is not sanctioned for the year 1979-80.
		v) Dte. of A.H., Himachal Pradesh.	v) More staff on statistical side would be appointed with the availability of funds in Sixth Plan proposal.
		vi) Deptt. of Agri., Min. of Agri. and Irrigation, Krishi Bhavan, New Delhi-1.	vi) Collection of data on fisheries statistics at the community development block level and at the district level not feasible with the existing statistical staff.
69. Since all the research activities in Agriculture and Animal Husbandry have been transferred to the Universities, there is need for augmenting the strength of existing statistical department or establishing statistical departments wherever they do not exist.		i) Dte. of A.H., Gujarat, Ahmedabad.	i) At the State Directorate level the statistical unit is in existence and it is proposed to be strengthened during VI Five Year Plan.

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		ii) Dte. of Agriculture, Gujarat, Ahmedabad.	ii) A proposal for strengthening the existing statistical organisation at State level was submitted to the State Government as per recommendation of N.C.A. but it is not sanctioned for the year 1979-80.
		iii) Dte. of A.H., Himachal Pradesh.	iii) More staff on the statistical side would be appointed with the availability of funds in the Sixth Plan proposals.
70.	At present there is no proper exchange of statistical information between States, Agricultural Universities and other agencies engaged in data collection. Machinery should be established to coordinate the exchange of statistical information between various agencies engaged in data collection relating to agricultural development.	i) J.N.K.V.V., Jabalpur (M.P.) ii) K.A.U., Mannuthy.	i) Action is being contemplated to establish a Statistical Cell in the University Research Wing can take up steps to implement this recommendation. ii) There is a proposal to start a Statistical Unit in the University for the purpose.

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71.	The members of the advisory committees of students, who require statistical analysis of data for preparation of their thesis. should ensure that such students underge a basis course in computer programming.	K.A.U., Mannuthy.	At present there is no facility in the University for offering basic course in Computer programmeing Shortly the University is going to appoint programme assistants then this can be implemented.
72.	Statistics Departments in Agricultural Universities should be strengthened. Each Agricultural University should have a separate department of Statistics. The strength of the department may vary according to the needs.	K A.U., Mannuthy.	Implemented.
73.	There should be an exchange programme so that scientists may visit other institutions (including universities) for short periods.		No reply has been received from I.C.A.R.
74.	The eligibility for attending courses in computer programming conducted by IASRI should be modified to include	I.A.S.R.I. (ICAR) New Delhi.	Holders of Bachelors degree with experience in data analysing shall also be included as and when courses are organised in future.

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	holders of Bachelors' degree with sufficient experience in data analysis.		
75.	The state statistical staff may be well qualified and experienced and if need, be trained at IASRI.	<ul style="list-style-type: none"> i) I.A.S.R.I., (ICAR), New Delhi. ii) K.A.U., Mannuthy iii) Dte. of A.H., Gujarat, Ahmedabad. iv) Dte. of Agriculture, Gujarat, Ahmedabad. v) Dte. of A.H., Himachal Pradesh. 	<ul style="list-style-type: none"> i) The Institute is already conducting a large number of courses for training the Statistical Staff of State Departments. ii) Implemented. iii) It has been noted for action. iv) Persons from statistical branch of this Dte. are deputed for the Junior and Senior Certificate Course in Statistics at IASRI. v) This will be done as and when necessary.
76.	Refresher training courses of senior statistical personnel in various States may be arranged periodically at IASRI	<ul style="list-style-type: none"> i) I.A.S.R.I. (ICAR), New Delhi. 	<ul style="list-style-type: none"> i) A Symposium on "Design of Experiments" is being contemplated to be organised by IASRI in late 1979.

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	to acquaint them with the latest developments and they in turn may conduct training courses in their States.		details would be circulated as soon as the arrangements are finalised.
		ii) Dte. of A.H. Gujarat State, Ahmedabad.	ii) This department will depute persons to undergo refresher training courses when arranged by IASRI.
		iii) Dte. of A.H., Maharashtra State, Pune.	iii) Suggestion is noted.
		iv) Dte. of Agriculture Gujarat, Ahmedabad.	iv) This can be done if IASRI may arrange such type of training courses at IASRI.
		v) Dte. of A.H. Himachal Pradesh.	v) This will be done as and when necessary.
77. Regarding the cost of cultivation studies of fruits, vegetables and other crops like oil seeds and pulses, it was generally felt that methodological		i) I.A.S.R.I. (ICAR), New Delhi.	i) A number of projects for studying the cost of cultivation of fruits, vegetables, oilseeds and pulses has been planned during the VIth Five Year Plan.

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	<p>studies for determining cost of cultivation should be taken up to investigate the remunerativeness of cultivation of these crops in different soil and agro-climatic regions. It was also felt that different components of costs particularly for the labour input may be worked out as precisely as possible not only for determining the total cost of cultivation but also for labour utilisation and other policies connected with employment aspect. The crops and areas to be covered may be finalised in consultation with the Economic and Statistical Advisor, Ministry of Agriculture and Irrigation, New Delhi.</p>	<p>ii) Dte. of Agriculture, Gujarat. Ahmedabad.</p>	<p>A project to study the cost of cultivation of apple has already been completed. The report has been prepared and is awaiting publication. Surveys for studying the cost of cultivation of orange in Maharashtra and mango and banana in Gujarat, are in progress. Similar surveys for studying the cost of cultivation of vegetables are also in progress in Delhi and Ahmedabad.</p> <p>Surveys to study the cost of cultivation of oilseeds and pulses are planned and would be started very soon.</p> <p>In all these surveys detailed information regarding human and animal labour utilization will be collected.</p> <p>ii) A scheme for pilot sample survey for determining the cost of production of fruits and spices and studying their market practices is being implemented in Gujarat State.</p>

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78.	<p>It was observed that there had been considerable development in different fields of statistics particularly in sample survey techniques in the recent years. A number of surveys were being conducted by IASRI in collaboration with State Departments, Agricultural Universities, etc. wherein different sampling designs were being tried to develop appropriate sampling methodology for estimation of parameters under study with desired precision. This collaboration would be more meaningful and fruitful if the statisticians in different State agencies were kept abreast of the latest developments in survey techniques. It was, therefore, recommended that IASRI may arrange refresher training or workshop or Summer Institute in sample survey techniques for the benefit of agricultural research Statisticians in different States.</p>	I.A.S.R.I. (ICAR), New Delhi.	A Summer Institute on 'Recent Advance in Application of Sample Survey Methodology in Agriculture' has been organised by the Institute from 7th May to 5th June 1979.

Sl. No.	Recommendations	Name of the Institutes/ Agricultural Universities/ State Deptts. etc.	Action taken
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79. The ICAR may be approached to appoint a committee to look into the need and requirement of statistical staff in different agricultural universities. The members of the committee may go round these Universities and give recommendation regarding the creation/strengthening of the department of statistics as per their needs.

No reply has been received from I.C.A.R.

PERIODICAL PUBLICATIONS ANNUAL REPORT

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

I.A.S.R.I STATISTICAL NEWSLETTER

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Sampling Methodology for estimation of Milk Production in Southern Region, A.P. 1971-74 (1979)—D. Singh, B.B.P.S. Goel, J.N. Garg and K B. Singh.

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