

REPORT OF THE RESEARCH ACTIVITIES OF THE SOCIETY

The Research Unit of the Indian Society of Agricultural Statistics was set up in 1966-67 with the objective of undertaking investigations on problems of national importance in the field of Agricultural Statistics. It has carried out a number of important studies under the technical guidance of the Research Direction Committee set up by the Council of the Society. Some of the problems on which the research work was carried out are mentioned, in brief, as follows in addition to current and future programme of work.

Past Work :

1. *Trends in Growth of Livestock and Poultry Population*

All the *quinquennial* livestock census data available from 1920 to 1961 were utilised to determine the growth trends in various categories of animals. The available census data were not comparable due to differences in coverage, concepts and changes in State boundary. The data were critically examined and adjusted before undertaking the desired study. With appropriate adjustment, trends were worked out and projection of livestock numbers obtained. The limitations of the estimates obtained from census data were brought out. The role of Sample Surveys in this connection was discussed. Suggestions were also made for improvement in the collection of such data. The results obtained from the studies can be seen from the specific papers prepared and published such as; (i) 'On trends in the bovine population in India' (1968). (ii) 'On the selection of districts from different States for studies of trends over time' (1969). (iii) 'Trends in growth of ovines, other livestock and poultry population in India' (1970). (iv) 'Intercensal estimates of livestock numbers' (1971).

2. *Studies on Current Yield Rates and Response to Inputs of Various Crops*

With the objective of estimating the availability of feeds and fodder,

requirements and possibilities of improving them, a number of studies were undertaken. Since foodgrains in themselves to a small extent and by-products of agricultural commodities such as bran, husks, oilcakes etc. contributed to the total availability of livestock feeds, it was necessary to obtain the total production of foodgrains, oilseeds, cottonseeds etc. This in turn required realistic estimates of potential yield rates of different crops. The studies carried out were on yield rates and responses to different fertiliser doses of various newly introduced high yielding dwarf/hybrid/exotic varieties of cereal crops and the indigenous varieties of cereal and other crops and also on cultivated fodders. The findings were brought out in the article 'Study on the yield rates of High Yielding Varieties of major cereal crops' (1970).

3. *Conversion Factor for Estimation of Availability of Concentrates and Dry Fodder*

Feeds for livestock consist of (a) concentrates which include oilcake, bran, husk (b) dry fodder such as Paddy straw, wheat bhusa etc. (c) cultivated and uncultivated green fodders. The estimates of first two i.e. concentrates and dry fodders can be estimated at any point of time from the corresponding production of agricultural commodities provided the necessary conversion factors are available. Straw to grain ratio, percentage of bran and husk accruing from paddy and wheat, extraction rates of cake from oilseeds, percentage of allowances for seeds, feed and wastage, etc., are required in working out the contribution of agricultural commodities for livestock feeds. A review of available information on various conversion factors was made and inadequacies were highlighted with suggestion for remedial measures for obtaining more reliable estimates.

4. *Requirements of Milk for the Indian Population*

Efforts were made to assess milk needs of the population following two approaches namely, from the point of view of nutrition and through demand analysis. These estimates were obtained from 1969 and 1974 following both the approaches.

5. *Feed Balance-sheet for Livestock and Prospects of Enhancing Milk Production*

To what extent milk production in the country can be increased within the available feed resources involves several components studies. These comprised estimation of the requirements and availability of feeds and fodder, estimation of yield of livestock, determination of feasibility alterna-

tives, if any, which facilitate enhancing production of nutritious fodder without affecting the supply of foodgrains for human consumption etc. Investigations were made on these problems.

6. *Long Range Perspective of Feeds and Milk*

These were undertaken to find out ways and means for meeting not only current requirements of livestock products but its requirements over time for the next two decades. Projection of availability of feeds were worked out over a period of two decades commencing from 1981 and position of milk supply in relation to the requirements was examined. Alternative cropping pattern, stabilisation of the cultivation of most promising high yielding varieties of foodgrain crops including Soyabean, optimum use of fertilisers and increased production of cultivated fodders were examined.

7. *Prospects of Mechanical Cultivation in India*

An attempt was made to study the prospects for mechanisation of agricultural operations and its impact on the working stock. It was observed that a judicious rationalisation of bullock power and introduction of mechanical cultivation would be necessary so that the feed requirements for working stock should be reduced and availability of feeds for the milch animals should be increased.

8. *A Study of Bufferstock Policy With Reference to Foodgrains*

The rules governing addition to and releases from the stocks, the estimate of size of bufferstock necessary for the success of various bufferstock policies were examined. The policies considered envisaged full or partial adjustment for surplus/deficit for different growth rates of demand and supply of foodgrains and for periods of 3, 5 and 10 years. The results of the study are brought out in the article 'A statistical study of bufferstock policy' (1981).

9. *Trend of Production of Wheat and Rice in pre-HYV and post-HYV Period*

Available data on area, production and yield per hectare of Wheat and Rice for period 1954-55 to 1977-78 were examined in most important wheat and rice producing States as well as for India as a whole to study the trend of growth of two important cereal crops in respect of these characters. The findings of the studies were brought out in the articles' (i) "Trend of production of Wheat in pre-HYV and post-HYV periods"

(1980) and (ii) "Growth of Rice production in India—progress and prospects" (1981).

10. *Studies on the Production of Pulses and Oilseeds*

It was considered desirable to review the trend of production of these economically important crops to see whether there were any differences in production trend in states and in particular whether productivity is showing any encouraging trend or otherwise. For this purpose, the study was undertaken for the pulses like Gram, Arhar, Moong and for oilseeds like Groundnut, Rapeseed, Mustard, Safflower, Sessamum and Niger seed.

11. *Study of Measurement of Growth and Instability in Sugar Production*

The figures of production of sugar and sugarcane for the 14 years 1967-68 to 1980-81 were examined for 8 States contributing significantly to the production of the commodity and for India as a whole. With such a small time series, it was hardly possible to isolate and measure seasonal and cyclical variation.

12. *Projection of Production and Productivity Levels of Foodgrains*

A study was undertaken to examine future production and productivity levels in the country in respect of foodgrains such as Rice, Wheat, Jowar, Maize, Bajra and pulses. For projecting supply of foodgrains, crop-wise production functions relating to the productivity of a crop with the proportion of irrigated area divided to that crop, proportion of area under HYV to total cultivated area under the crop and total consumption of nutrients per unit gross or under the crop were fitted. Such production functions enable projection of the yield rates, crop by crop at a future date by first projecting the corresponding inputs themselves on the basis of their growth rates and then substituting them in the production function. With the help of the growth rates and area for different crops, one can also project the crop-wise areas expected at a future date. Using projected yield rates and areas, one can obtain the crop-wise projected production and hence by summation over crops the total foodgrains production. Using these technologies the desired results obtained were published in the articles, "Perspective plan for foodgrains" (1982), "Perspective for foodgrains production in 2000 A.D." (1984) and "On foodgrains production projections" (1985).

These studies have shown that foodgrain production would reach levels of 179 million tonnes and 225 million tonnes by 1990 and 2000 A.D. respectively if the selected inputs would grow at their current levels of

growth. However, to meet the revised demand of food grains of the order of 250 million tonnes by the end of this century, the selected inputs use-levels have got to be raised by about 20 per cent above their predicted use-levels in 2000 A.D. The inputs needed for this purpose would be 142 million hectares of gross cropped area, 9.7 million tonnes of nutrients, 97.2 million hectares of area under HYV and 60.4 million hectares of irrigated land.

Current Programme

13. *Methodological Investigations Relating to Comprehensive Crop Insurance*

On request from the General Insurance Corporation of India (GIC), the Society has undertaken studies for working out the threshold yield and actuarial premium based on 5 years annual yield data for the period ending 1985-86, for important cereals, pulses and oilseeds crops in most of the participating States. The data based on crop-cutting experiments are sent to the Society by these States on instruction from G.I.C. The studies include determination of premium rates following normal curve technique and Dandekar's procedure. The effect of coefficient of variation and indemnifiable limits on premium rates was also examined. The Talukwise/Blockwise premium and indemnity tables were prepared separately for Rabi and Kharif crops in different States for the year 1985-86. The updating of P & I tables utilising current data is in progress. A methodological paper was prepared dealing with various aspects and presented at the symposium on 'Crop Insurance'. A detailed summary on the paper 'Statistical Aspects of Comprehensive Crop Insurance Scheme', (1986) has been published.

The Comprehensive Crop Insurance Scheme, as already introduced from Kharif 1985, is compulsory for all crop-loanee farmers and is at present limited to the five crops-Paddy, wheat, millets, oilseeds and pulses. The scheme is based on *homogeneous area approach* notified for each crop in each State by the Union Ministry of Agriculture through GIC. The actual average yield per hectare of the insured crop in the notified area is determined on the basis of an adequate number of crop-cutting experiments. The premium rates are fixed uniformly at 2% for paddy, wheat and millets and 1% for pulses and oilseeds. The indemnity is calculated on the basis of the shortfall in the actual yield from the threshold yield per hectare of the insured crop. This threshold yield of a crop for the defined area is fixed at 80% of the average yield per hectare of the crop during the last five years based on the crop-cutting experiments. The criterion of fixing this threshold yield at 80% is, however, being debated. Some of

the participating States suggest that the indemnifiable limit be raised from 80% to 90% or even to 100% for a State like Punjab with assured irrigation facilities.

Assuming that crop yields follow normal distribution with mean m and standard deviation s , the premium rate, defined as the average indemnity expressed as percentage of threshold yield, is given by

$$\text{Premium rate} = \frac{-(qA)}{p} 100 + \frac{d}{p} (CV)$$

where p, q are fractions with $p + q = 1$, $C = pm$, being the threshold yield, A is area of normal probability curve corresponding to ordinate at C , d is the ordinate of this curve at C and $CV = s/m \times 100$, the coefficient of variation in percentage.

Based on the above formula, the Table below gives the premium rates at a given indemnifiable limit for CV ranging from 5 to 40 per cent and at a given CV for indemnifiable limits ranging from 65 to 100 per cent.

PREMIUM RATES (PER CENT) AT VARIOUS LEVELS OF C.V. AND INDEMNIFIABLE LIMITS BASED ON NORMAL DISTRIBUTION

Coefficient of Variation (percentage)	Indemnifiable limits (percentage)							
	100	95	90	85	80	75	70	65
5	1.99	0.44	0.05	0.00	0.00	0.00	0.00	0.00
10	3.99	2.01	0.93	0.35	0.11	0.00	0.00	0.00
15	5.98	4.01	2.52	1.47	0.79	0.26	0.00	0.00
20	7.98	6.03	4.40	3.14	2.08	1.35	0.84	0.45
25	9.97	8.08	6.40	4.95	3.76	2.78	2.00	1.40
30	11.97	10.13	8.47	6.98	5.67	4.53	3.57	2.77
35	13.96	12.22	10.59	9.33	7.73	6.47	5.43	4.48
40	15.96	14.19	12.73	11.24	9.88	8.63	7.50	6.46

It can be seen that the premium rates depend characteristically on CV and indemnifiable limits. The rates increase with increase in variation in yield and decrease with decrease in indemnifiable limit. The results indicate that raising of the threshold yield to 100% would match the flat rate of premium fixed at 2% only if the CV in the crops (paddy, wheat and millets) is as low as 5%. This is clearly not possible as 5 per cent CV in the crops is hardly obtainable in a large number of crop strata. The

Table is therefore a ready reckoner for deciding on the indemnifiable limits to be fixed separately for notified areas once the observed *CV*, after correcting for trend, if any, is available for the area. One has to choose that indemnifiable limit for which the premium rate just matches the flat rate of 2% or 1% in the column pertaining to the observed *CV*.

14. *Statistical Basis for Studying Instability in Foodgrains Production During pre-and-post Green Revolution Periods*

Several workers pointed out that food stability in India has declined in the sense that there is greater variability in the production and yield of some of the major food crops with the introduction of the new high yielding technology. A recent study however indicated that introduction of the new agricultural technology is now reaching a stage where increased production is combined with greater stability of production with exception of pearl millets and wheat. In the case of Wheat, it is argued that it will begin to have greater stability as the limits of yield increase are reached. These diverse claims appear to stem from the assumption that level of development is uniform within the State. There are various limitations in the studies carried out so far. What is needed is therefore to disaggregate these results obtained and concentrate on the aspects of the instability according to the levels of development related to poverty ratio. The problem of instability needs to be examined from this angle. For this purpose, the districts in each State need to be classified according to their degree of development in regard to adoption of new technology and within each region district-wise time series data are to be built up. This will help in examining the intra-crop variability over the periods as well as co-variability between crops within the same region or between regions for the same crop. In-depth studies in different regions with a view to identify the sources and extent of instability in foodgrain production in relation to level of development are being undertaken.

Future Programme

15. *Concept, Methodology and Data on Rural Employment in Agriculture*

Based on the discussion held during the Symposium on 'Planning for Employment in Agriculture' organised at the 40th Annual Conference of the Society at Varanasi, it has been decided that the above project need to be undertaken considering its importance both on national and State level. The details of the project are being formulated.

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