GROWTH AND INSTABILITY IN INDIAN AGRICULTURE*

By S. R. Sen

I am grateful to the Council of the Indian Society of Agricultural Statistics for kindly inviting me to deliver the Technical Address at the inaugural meeting of this Conference at which they are celebrating the twentieth anniversary of the Society. I do not have that technical competence in statistics which would justify this honour being done to me. I presume the Council expects from me not a technical address on the science of statistics itself, but an address on some technical problems in the context of our national plan of development to which the attention of the statisticians assembled here could be drawn.

2. My first impulse was to speak on the statistical requirements of the planner. I recalled, however, that eight years back at the twelfth Annual Conference of the Society, I had given a discourse on "Statistical Priorities for Agricultural Planning". Although eight years have passed since then, I find that I have little to add to what I said at that time. There has been, no doubt, some progress over these years, a few of the suggestions that I made have been implemented, and some of the gaps which I complained of have been partially filled, but the main problems and the main priorities broadly continue to be the same. All that I can now urge upon the members of the Society is to take a second look at that discourse and consider how best they can correct the deficiencies that still exist.

3. I turned my attention, therefore, to a new area and decided to make the general problem of "Growth and Instability in Indian Agriculture" the main theme of my present Address. A scientific treatment of the subject is possible only if comparable agricultural and meteorological data are available for a sufficiently long period. Unfortunately, such data are lacking in this country. So far as the nineteenth century is concerned, comparable agricultural data for

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the country as a whole cannot be even pieced together for more than a few years. Some rainfall data are, no doubt, available for certain parts of the country for a somewhat longer period, but for the country as a whole, they are available only for the last quarter of the century.

4. All that we know is that severe and widespread droughts resulting in famines took place in almost every quinquennium in the Western and Deccan regions of the country in the first four decades of that century. Then there was a respite for about three quinquennia after which such droughts and famines recurred throughout the rest of the century. So far as the Eastern part of the country is concerned, it was relatively free from such droughts and famines during the first five decades of the century but after that droughts and famines were as frequent in Bihar, Orissa and Bengal as in the Western and Deccan regions (*see* Annexure I). Although rain storms and floods were frequent and caused heavy damage to crops in the affected areas, their extent was rather limited and their effect on the overall food production in the country was relatively small. Moreover flood in one season often resulted in a good crop in the next season. It was severe and widespread drought which usually led to a sharp fall in food production for the country as a whole and gave rise to famine conditions. The adverse effects of a severe drought often tended to inhibit production in the next season also. Severe droughts in two consecutive years, although infrequent, invariably proved calamitous whenever that occurred.

5. Before the development of railways, famines resulted in very heavy mortality, especially in areas where rainfall was usually medium to good but liable to failure from time to time and people tended to be unprepared for severe droughts. After the development of railways, the effect of famines could be mitigated, to a large extent, partly through moving grains frome one part of the country to another and partly through imports from abroad on trade as well as government account. Famines or near famine conditions resulting from droughts continued to recur once in every quinquennium or so until 1923-24. After 1924, the recurrence tended to become somewhat less frequent and the extent and severity also was relatively less. Crop failures comparable in severity and extent to those which were often experienced until 1924 have now occurred only after four decades. The decline of as much as 19 per cent in foodgrains production in one year which we experienced in 1965-66 is much greater than any shortfall in the intervening years and is

comparable only to the decline of 24 per cent in 1920-21 and 17 per cent in 1923-24. The notorious Bengal famine of 1943 was caused by transport difficulties and failures of government and the trade and not by drought. Food production had actually gone up by about 1·5 per cent between 1942-43 and 1943-44 for the country as a whole.

6. It is not easy to collect comparable statistics for earlier years. But on the basis of certain studies made by the Directorate of Economics and Statistics of the Ministry of Food, C.D , Co-operation and Agriculture and the Agro-economic Research Centre, Delhi University, it has been possible to compile reasonably comparable data for foodgrains production as well as index numbers of agricultural production for undivided India for 48 years from 1900-01 to 1947-48 and for Indian Union for 30 years from 1936-37 to 1965-66. These data are presented in Annexure II and the two accompanying Charts (Series I and II).

7. A study of these data shows that during the first 24 years of the century foodgrains production increased at an average annual rate of 0·3 per cent. While the peak points reached showed a rising trend of 0·81 per cent. per annum on the average, the trough points showed a declining trend of 0·14 per cent per annum on the average and there was a growing divergence. Thus, while foodgrains production showed a rising trend, the instability was also on the increase. This was further highlighted by the fact that out of a total of 24 years, on as many as seven occasions, (*i.e.* in 1 out of every 3·4 years) there was a decline from the peak reached. The minimum decline per annum was 2·8 per cent and the maximum 24 per cent. On as many as five occasions, the decline was more than 7 per cent per annum.

8. The next 24 years, however, presented a completely different picture. During this period, foodgrains production showed a declining trend of 0 02 per cent per annum on the average, in spite of the fact that droughts turned out to be relatively moderate and less frequent. In contrast with the previous period, while the peak points reached showed a declining trend of 0·04 per cent, the trough points recorded a rising trend of 0.10 per cent per annum on the average and the two were converging. There were declines from the peak reached on five occasions (*i e.* in 1 out of every 5 years). On only one occasion, the decline was more than 5 per cent per annum. Thus Indian agriculture had become stagnant but less unstable.

9. The index numbers of agricultural production also recorded similar trends but the fluctuations were somewhat less for the obvious reason that they were spread over a larger number of crops.

10. An analysis of the data for the Indian Union for the 30 year period, 1936-37 and 1965-66, also reveals similar but even more striking trends. During the first 15 years, food production declined at the rate of 0.68 per cent per annum while in the next 15 years, it increased at the rate of 2·75 per cent per annum.

11. During the first 15 years (1936-37 to 1950-51) both the peak points and the trough points showed declining trends respectively of 0·51 and 0·50 per cent per annum on the average and continued to converge. Over this period of 15 years, although there were declines from the peak on five occasions (*i e.* in 1 out of every 3 years), the minimum percentage decline per annum was 2·9 and the maximum was 9·5. On only one occasion it was more than 5 per cent. Foodgrains production was thus fairly stable while the general trend was one of stagnation.

12. On the other hand, during the last 15 years (1951-52 to 1965-66) which coincided with the era of planned development, there was an unprecedented rate of growth, which seems to be a difference not merely of degree but almost of kind. Those who tend to denigrate India's agricultural effort during the last 15 years have only to look at the Chart (Series II) to see the contrast between the previous period and this 15 year period in spite of the fact that the latter ended with the worst drought in 40 years. But a most disturbing fact was that the instability tended to increase with the rate of growth. While the peak points reached rose at the rate of 2·76 per cent per annum, the trough points increased by 2·20 per cent per annum, and there was again a diverging trend. Over this 15 year period, there were five occasions when there were declines from the peak points (*i.e.* in 1 out of every 3 years)—the range varying between 2 per cent and 19 per cent—and on as many as three occasions, it was more than 7 per cent.

13. During these 30 years also, the index numbers of agricultural production revealed similar trends but again the fluctuations were somewhat less for the same reason mentioned earlier.

14. The questions that arise now are several:

(*i*) What are the reasons for growth between 1900-01 and 1923-24 and again between 1951-52 and 1965-66 and stagnancy during the period 1924-25 to 1950-51?

(*ii*) Why was there greater instability during the two periods of growth and less instability during the period of stagnancy mentioned above? Is it a change relationship or is there any deeper significance in this relationship?

(*iii*) Is there any qualitative difference between the growth and instability experienced between 1900-01 and 1923-24 and those between 1951-52 and 1965-66?

(*iv*) How much of this difference is ascribable to man-made factors and how much to weather conditions?

(*v*) Is there any significance in the fact that in the 1860's the frequency and severity of droughts increased after a fairly long period of relative stability and the same phenomenon seems to be repeating in the 1960's?

(*vi*) Is any periodicity discernible in rainfall variations and is any forecast of the droughts possible, at least for particular quinquennium, so that planning of food production and food distribution for five year periods can take note of such possible weather hazards?

(*vii*) Is it possible to demarcate areas within each State and, if possible, within each district, where droughts are likely to be frequent and severe and where the planning for agricultural development has, therefore, to be different?

(*viii*) What steps can be taken so as to minimise the man-made factors which tend to increase the instability as the rate of growth increases?

(*ix*) Is it possible to forecast severe droughts sufficiently ahead of sowing time every year so that the seeds and varieties can be selected, release of water from irrigation storages adjusted and supply of mobile pumpsets arranged well in time with a view to minimising its effect on foodgrains production?

(*x*) Is it possible to formulate rough monthly forecasts of overall production of foodgrains, state-wise, on the basis of current data regarding rainfall and run of dry days and correlation between past data on rainfall, run of dry days, weekly reports of crop condition and final figures of crop production with a view to assisting the food administration?

15. It is not possible for me to attempt an answer to all these questions in this present Address. In fact, I do not think that any simple or off-hand answer is possible for most of them. Sustained

and painstaking inter-disciplinary studies by a team of experts in the fields of statistics, meteorology, agronomy and irrigation will be necessary before any definitive answer to these questions can be found. Even some of the seemingly obvious answers cannot be confirmed without such study.

16. The main purpose of my present Address is to draw the attention of the members of the Society to these questions and stimulate their interest in research in these fields in close collaboration with meteorologists, agronomists and irrigation experts. For, I have now come to the conclusion that it is not enough for us merely to plan for increasing the rate of growth of food production as we have done over the last fifteen years. It is equally important for us to plan for the minimisation of the instability that often accompanies such growth.

17. It is obvious that a certain amount of fluctuation is unavoidable in foodgrains production because of weather hazards. But if these fluctuations can be kept within certain narrow limits, the problem of food management becomes relatively easy. For instance, if the difference between the peak reached and the subsequent trough of foodgrains production for the country as a whole is not more than 5 per cent (or, say 3 or 4 million tonnes), there is a reasonable chance of meeting it partly by buffer stocks and partly by imports based on our own foreign exchange earnings. On the other hand, if the difference between the peak and the subsequent trough is as much as 19 per cent (or 17 million tonnes) as happened in 1965-66, it is impossible to meet that through a buffer stock policy or through such imports as we could conceivably finance through our own foreign exchange earnings. If such sharp declines occur in future, our helpless dependence on foreign aid will have to continue unless we are prepared to take draconian measures to ensure an equitable distribution of whatever foodgrains we may produce. The difficulty of the latter alternative is that while it may ensure equity in distribution and minimise mortality from starvation, it is also likely to inhibit production in the long run and prolong the precariousness of the situation. Whatever be the short term expedient in regard to distribution, the only long term solution to the problem lies in taking measures which will promote both growth and stability.

18. Although correct answers to the questions that I have asked can be found and the measures for ensuring growth with stability can be devised only after the studies mentioned by me have

been completed, I would like to take this opportunity to share with the members of the Society some of my tentative speculations on the subject, certainly not to provide answers, but only to provoke discussion among those who are better equipped than me to find the answers.

19. My first point is that there should ordinarily be a tendency for an increase in the rate of growth to be accompanied by an increase in instability, especially if the growth comes about mainly as a result of extension of acreage and increase of inputs like fertilisers rather than improvement in skills, unless sufficient corrective action is taken simultaneously. As acrease extends, relatively marginal land tends to be put under crops and such land is prone to be more adversely affected by weather hazards like drought. Again, when more intensive doses of inputs like fertilisers are used, the risk of loss from factors like drought tends to increase considerably.

20. Secondly, there is a marked difference in the situation obtaining in 1951-52 to 1965-66 and that obtaining in the two earlier periods. The growth between 1900-01 to 1923-24 was very slow and it occurred mainly due to extension of areas. Droughts were quite frequent and severe and had relatively greater impact on marginal lands. Between 1924-25 and 1950-51, there was a general stagnancy in production, droughts were relatively less frequent and less severe and the extension of irrigation in certain areas of the country was also having a somewhat stabilising effect. There was hardly any increase in the use of inputs like fertilisers and the risk from this factor was absent. In the period 1951-52 to 1965-66, there was not only an unprecedented increase in the rate of growth but there was also a sharp increase in both acreage and use of inputs like fertilisers. There was, no doubt, an appreciable increase in irrigation also, but it was neither sufficient in volume nor utilised with sufficient care and economy so as to compensate for the destabilising effect of the first two factors. So when a wide-spread and severe drought struck the country in 1965, there was a sharp decline of as much as 17 million tonnes in foodgrains production, an order of decline which the country had not seen for over 40 years.

21. Thirdly, although the meteorologists have not yet been able to find any conclusive evidence on the point, there is a feeling in some quarters that there is a certain kind of periodicity, however irregular, so far as the long-term as well as the short-term incidence of droughts is concerned. The similarity between the relative respite

from severe droughts from the fourth to the sixth decade of the nineteeth century and again from the third to the seventh decade of the present century and the recurrence of severe drought at the end of this period of respite is too striking to be brushed aside without further investigation. And certain old records lead one also to believe that there was possibly a period of similar relative respite ending with a severe drought and famine around 1770. The question is whether we are now going to face a period of frequent and severe droughts as we did about 100 years back. If there is even a small chance of that, the whole question of recurrence of droughts and the steps to be taken to meet them, requires much more serious consideration at both experts and policy levels than has been the case in the recent past. In this context, I cannot help remembering that, seven years back, a noted foreign expert on agricultural statistics and meteorology told me that he had analysed a long series of Indian meteorological data and had come to the conclusion that India was likely to face a spell of severe droughts at least during the 1960's, if not in the following decades. He said that it was only a cursory analysis but he felt, nevertheless, that the results were sufficiently indicative to warrant a thorough study by a team of experts. When I mentioned this observation to some of my colleagues in the administrative and technical fields, they all said that on the basis of whatever data for the last 80 or 90 years that they had studied, no such forecast was warranted. I then left the matter at that. But now that we know that two consecutive years in 1960's have actually experienced widespread droughts, I wonder whether the time has not come when we should pay somewhat greater attention to the suggestions that this foreign expert had made. With the unprecedented facilities for analysis which modern electronic computers offer, is it possible to subject all the data, regarding rainfall, run of dry days, crop conditions and crop output that are available for different regions and districts of the country for the last 90 years or so and the information about the current world atmospheric conditions which the weather satellites and other aids to scientific meteorology are making available now, to an imaginative programme of cooperative research by statisticians, meteorologists and agronomists, which may throw some light on this question ? But even in the absence of such an intensive research, it seems possible to make certain tentative observations based on the studies which the Meteorological Department has already undertaken. On the basis of a rather narrow and obviously unsatisfactory definition of a drought,

namely, "deficiency in rainfall numerically equal to or greater than 25 per cent of the normal" and the available data for the South West Monsoon which accounts for 70 per cent of the rainfall in the country, the number of years of droughts in the country has been tabulated in Annexure III. A rough inference from this table seems to be that the country should be prepared for such conditions of droughts over large areas once in four to five years. It can be as bad as once in three years in the Telangana region of Andhra Pradesh, Madras, Gujarat, East Rajasthan, Kashmir and Uttar Pradesh. The worst is West Rajasthan where it may be once in $2\frac{1}{2}$ years (*see* Annexure IV). The data given in Annexures III and IV are, however, of a rather limited value because they do not give information either about the severity of the drought or the timing and duration of dry spells. A season when the extent of the drought may be limited but the deficiency of rainfall exceeds numerically, say, 50 per cent is likely to cause much greater damage to crops than a drought whose coverage may be, somewhat, greater but the departure from normal rainfall does not exceed, say, 27 per cent or so. The frequency of a severe drought of the first type is fortunately much less (for instance, rainfall deficiency of 50 per cent and more is found to occur on the average only once in twenty years in Telengana) ; but for that very reason whenever it comes it tends to catch people unawares and causes very great distress. Some idea of the deviations from the normal during the last two S W. Monsoon seasons may be obtained from Annexure V. The timing and duration of dry spells are also very important. A drought in June adversely affects kharif sowings, in September/October kharif crop yields and in December/January rabi production. Droughts of equal severity in other parts of the years may not have equally damaging effect on crop production. Further the nature of the area covered by the drought is also very important from the stand-point of the country's over-all foodgrains production. A drought in high production areas like Bihar, Orissa, U.P., Madhya Pradesh, and coastal Andhra Pradesh or Madras may have a much greater effect on the over-all foodgrains production than a drought of equal severity and extent in areas like Gujarat, Rajasthan, Rayalaseema or Telangana.

22. My fifth point follows from the fourth. I feel that it is important to demarcate different areas in each State, and if possible even in each district, in accordance with their susceptibility to drought. If more detailed classification seems difficult for the

present, it should suffice if different areas in each State are classified into the following categories :

(A) Areas where there is an assured water supply both in volume and in spread either from assured rainfall or from sources of irrigation (*e g.* tubewells, deep bore wells, canals from snow-fed rivers or storage dams) which are not unduly dependent on the vagaries of the monsoon ;

(B) Areas where supply of water from rainfall or sources of irrigation largely dependent on the monsoon (*e.g.* tanks, ordinary wells, run of the river canals depending entirely on the monsoon) is subject to large fluctuations in terms of volume or spread. These areas may again be divided into two broad sub-groups :

(B_1) those where droughts are relatively less frequent; and

(B_2) those where droughts are relatively more frequent;

(C) Areas where there is no dependable irrigation and where rainfall is scanty and precarious.

23. Once this is done, it should be possible and desirable to prescribe quite different agricultural and irrigation policies and programmes for these three different types of areas.

24. For instance, in area 'A', irrigation policy should be intensive and productivity oriented, rather than extensive and protection oriented, and agricultural policies and programmes should aim primarily at maximising the yield of crops per unit of land, which is the most scarce factor in such regions. Intensive water use may necessitate the re-demarcation of command areas of irrigation works and undertaking of supplementary irrigation works within command areas. The aim should be to grow 2 or more crops so as to secure the highest possible intensity of cultivation in these areas. Seeds should be evolved which can give very high yields with intensive use of water, fertiliser and pesticides. Crop insurance should be provided in these areas against pests and diseases as well as weather hazards like hail-storms (but not droughts) to induce the farmers to take the risks which such intensive agriculture involves. The I.A.D.P. and H.Y.V.P. approach, with certain improvements and adjustments, would appear to be appropriate for this area.

25. In area 'B', the policy of irrigation should be mainly 'protective'. Special research should be undertaken to evolve seeds

which would aim more at security (*i.e.*, resistance against droughts) rather than mere maximisation of yield per acre, especially in areas of 'B_2' type. With this object in view, appropriate safe doses of fertiliser and economic doses of water should be also determined. Arrangements should be made so that adequate number of mobile pumps can be promptly supplied in times of unusual dry spells. Artificial rain making is likely to prove of considerable help in such areas, if it can induce even limited precipitation at the critical time. Crop insurance against drought is, obviously, too hazardous a proposition and should be ruled out in such areas. It is through timely warning of droughts, introduction of drought resisting varieties and practices and provision of protective irrigation that necessary security should be provided to the farmers.

26. In area 'C', concentrated effort should be put on contour bunding and contour cropping, dry farming practices, enclosures and controlled grazing. Most economic use should be made of whatever water is available and sprinkler irrigation should be encouraged in this area. The objective should be to adopt those forms of agriculture as would give an optimum and stable economic return per unit of water, which is the most scarce factor in such regions. Emphasis should be put on developing and introducing not merely drought-resisting varieties of foodgrains but also other drought-resisting crops and, if necessary, even on changing the pattern of agriculture from crop production to animal husbandry based on grass land development or plantation of drought-resisting trees, *i.e.*, to farming practices which are most suited for arid and semi-arid conditions.

27. In all the three areas greater attention than hitherto should be paid to scientific methods of water use and moisture conservation adapted to the nature of the volume and spread of precipitation. As irrigation works get built up, these areas should be appropriately redemarcated periodically and upgraded from 'C' to 'B' and from 'B' to 'A'. It will be useful if the agricultural departments and research institutes in the country have separate divisions specialising in the problems of these three types of areas. Not only research work but also extension services will have to be specially designed to deal effectively with the problems of each of these areas. No blanket prescription is likely to meet the needs of the situation.

28. From the stand-point, however, of reducing overall instability in foodgrains production of the country, it is area 'B'

which needs to be paid relatively greater attention than the other two. In area 'A', production is high and instability relatively little. In area 'C' instability may be high but production is relatively low. But it is area 'B' where both production and instability are high, which is the main culprit for the large fluctuations that occur in the national production of foodgrains.

29. In the map at Annexure VI, an attempt has been made on the basis of some readily available data on volume and variation of rainfall, irrigation and crop yields to demarcate these different types of areas in a somewhat rough manner just to give a general idea of their possible location and extent. This map is, however, too rough to be of much use for policy formulation or operational purposes. Within each district tentatively shown in one category, there are areas belonging to other categories which require sorting out. Moreover, data available about some of the districts were inadequate or inaccurate and a re-classification may be necessary after further enquiry. It is obvious that each district will have to be carefully studied from the meteorological, agronomic and irrigation stand-point before a realistic classification can be made. An approximate idea of the share of these different areas in the total acreage and production of foodgrains in the country may, however, be obtained from the table at Annexure VII. It appears that about 37 per cent of the total foodgrains production is contributed by area 'A', 42 per cent by area 'B' and only 21 per cent by area 'C'. To the extent, irrigation can be extended to areas 'B' and 'C', it will, of course, help reduce the instability. But it has been estimated that even after the fullest use is made of all potential irrigation resources in the country—and that is likely to take several decades —over half the sown area will still remain without irrigation. In any case bulk of the areas in categories 'B' and 'C' is likely to remain without dependable irrigation in the foreseeable future. It is worth noting that a very large part of such areas lie within the triangle formed by the Eastern and Western Ghats and the ranges of mountains and hills south of the Indo-Gangetic plain. It is this triangle with its precarious rainfall and large tracts of relatively poor soil that has brought down India's average yield rates and made her record compare unfavourably with that of some of the neighbouring countries, which are more fortunately placed.

30. It is in this area that the meteorologists, agronomists and statisticians can render a very important service by helping to

determine the policies and programmes which will minimise the instability. One aspect in which the meteorologists can help most is by undertaking intensive research in regard to the forecasting of the run of dry days in different regions and districts. As has been mentioned earlier, with greater knowledge of variations in world atmospheric conditions which are now becoming available as a result of modern meteorological techniques, if the on-set of the monsoon and its course during the season can be forecast, even a few days ahead with some accuracy, the agronomists should be able to advise the agriculturists well in time as to what type of seeds to sow, what fertiliser and moisture conservation practices to follow and what precautionary measures to take against the possible onset of drought. But to do this, there will be need for intensive research, on the one hand, on different types of crops from the stand-point of their resistance to drought and, on the other, on water requirements of different crops and soil moisture conditions in different areas. The statisticians could help these two groups of scientists in their design of experiments and help them in the techniques of programming and forecasting. Development of techniques of forecasting droughts and crop outputs in particular is an aspect to which statisticians and meteorologists should pay much greater attention than they have done in the past. To be forewarned is to be forearmed. Both food production and food distribution programmes would benefit considerably from better forecasting services. Intensive research for the application of modern science and technology to this end deserves, therefore, very high priority.

31. A final point that I wish to stress is that in India, on account of pressure of population, the production of foodgrains has been extended to sub-marginal lands which are unsuitable for food production either because of poor quality of the soil or lack of moisture, and which should have never been put under foodgrains. As a result, whenever there is any drought, there are large declines in foodgrains production of the type we have faced during the last two years. The rather thoughtless policy which has ignored, until recently, the importance of geographical specialisation and has encouraged extension of foodgrains production to all kinds of lands in all parts of the country has tended to add to our food difficulties. In areas 'C', in particular, the ecological balance is being seriously upset with grave consequences for the future. A time has come when the agricultural statisticians should make a very careful analysis of this problem and indicate to the country the correct policies

that should be followed. The lay policy maker unfortunately is often too preoccupied with the present to pay adequate attention to what is really in the long run interest of the country. It is here where the scientist has a duty. He has to analyse all the available data, bring out the dangers of short-sighted policies and indicate to the farmer the lessons which science has to offer and help him in formulating such balanced policies and programmes as will yield the optimum results from the long as well as short term point of view.*

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ANNEXURE 1

FAMINES IN INDIA
(1801 to 1900)

Year	*Parts of the country affected*
1799-1801 to 1802-04	N.W. Provinces, Bombay, Central India and Rajputana
1806-07	Widespread, especially Deccan
1812	Bombay, Agra and Madras
1819-20	N.W. Provinces, Rajputana, Deccan and Broach
1820	Upper Sind
1822	Upper Sind
1824-25	Bombay (Deccan). Also in Deccan Districts of Madras
1832-33	Sholapur (Bombay) and Northern Madras
1833-34	Gujarat, Khandesh, Deccan and parts of N.W.P.
1837-38	N.W.P., Punjab and Rajputana
1853-55	Madras, Bombay and Rajputana
1860-61	N.W.P., Punjab, Rajputana and Kutch
1862	Deccan
1866-67	Orissa, Bengal and Bihar
1868-69	N.W.P., Punjab and Rajputana
1873-74	Bengal, Bihar and Bundelkhand
1876-78	Madras, Bombay, Mysore and Hyderabad
1877-78	N.W.P., Kashmir and Punjab
1879-80	Deccan
1880	N.W.P.
1884-85	Bengal
1886-87	Central Provinces
1888-89	Ganjam (Madras), Orissa
1890-92	Garhwal, Bengal and Bihar, Madras and Ajmer Marwara
1894	Central Provinces
1896-97	N.W.P. & Oudh, Bengal, Madras, Central Provinces, Bombay, Punjab and several Indian States
1899-1900	Central Provinces, Berar, Bombay, Punjab and Ajmer

ANNEXURE II

SERIES I

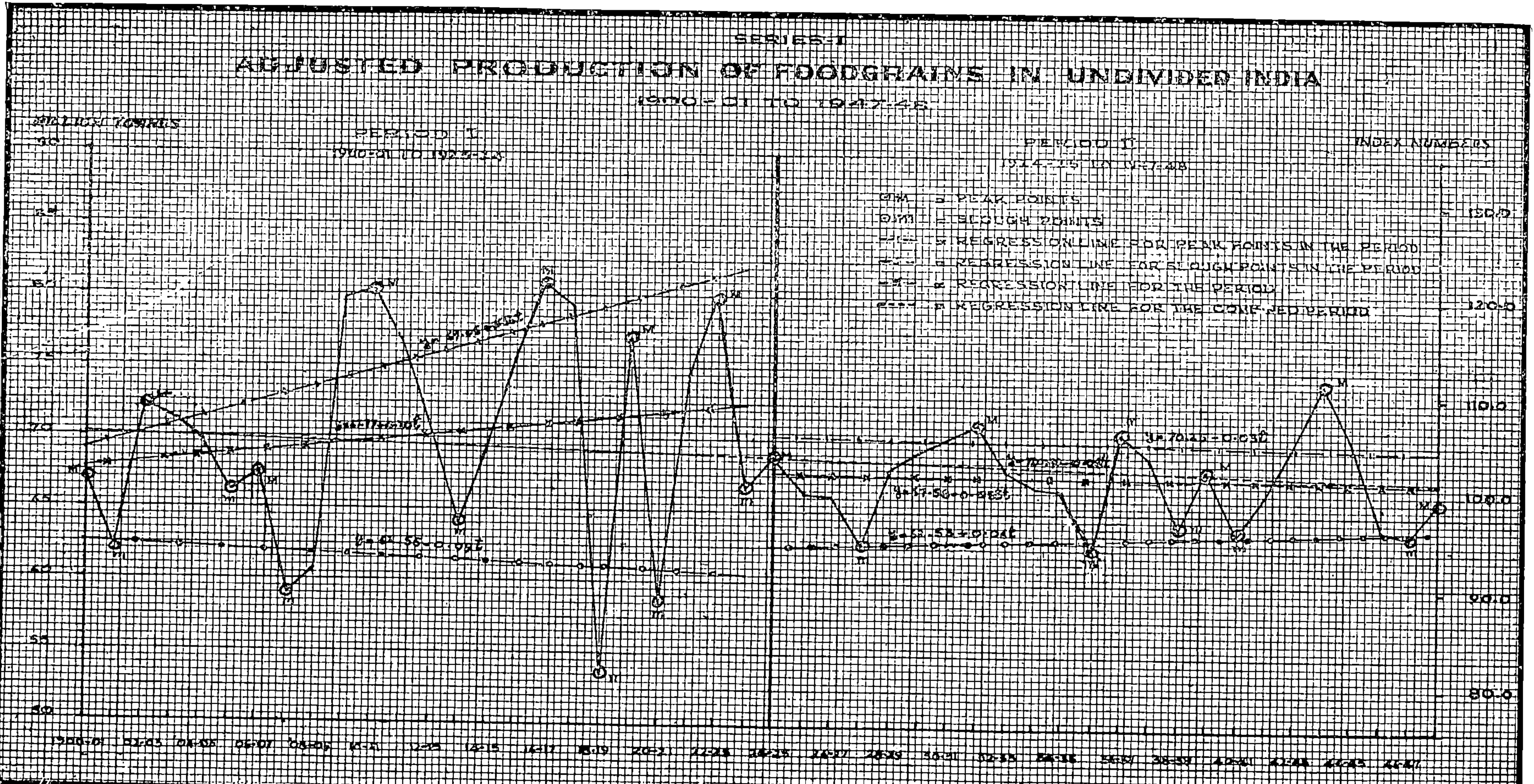
Adjusted Production of Foodgrains in Undivided India

(1900-01 to 1947-48)

Year	*Adjusted estimate of production of foodgrains (million tonnes)*	*Difference between a peak and subsequent trough (million tonnes)*	*No. of years over which the difference in col. 3 relates to*	*Percentage difference per annum*
1	2	3	4	5
1900-01	67·0	5·1	1	7·6
1901-02	61 9			
1902-03	72·3	6·0	3	2·8
1903-04	71·2			
1904-05	69·7			
1905-06	66·3			
1906-07	67·7	8·7	1	12 9
1907-08	59·0			
1908-09	60·8			
1909-10	79·7			
1910-11	80·4	16·4	3	6·8
1911-12	76·7			
1912-13	70 9			
1913-14	64·0			
1914-15	69·2			
1915-16	75·7			
1916-17	80·9	27·3	2	16·9
1917-18	79·2			
1918-19	53·6			
1919-20	77·1	18·5	1	24·0
1920-21	58 6			

Year	*Adjusted estimate of production of foodgrains (million tonnes)*	*Difference between a peak and subsequent trough (million tonnes)*	*No. of years over which the difference in col. 3 relates to*	*Percentage difference per annum*
1	2	3	4	5
1921-22	74·5			
1922-23	79 9	13·3		
1923-24	66·6		1	16·6
1924-25	68·8			
1925-26	66·3	6·1	3	3·0
1926-27	66·1			
1927-28	62·7			
1928-29	68·1			
1929-30	69·3			
1930-31	70·2			
1931-32	71·2			
1932-33	68·1	8·5	4	3·0
1933-34	66·8			
1934-35	66·7			
1935-36	62·7			
1936-37	70·7			
1937-38	69·0	6·7	2	4·7
1938-39	64·0			
1939-40	68·2	4·5	1	6·6
1940-41	63·7			
1941-42	66·6			
1942-43	70·1			
1943-44	75·2			
1944-45	70·1	10·5	3	4·7
1945-46	64·1			
1946-47	63·7			
1947-48	66 0			

Note : Adjusted figures have been computed by taking the actual total production of foodgrains in undivided India for the year 1944-45 as the 'base' and relating it to the Index Number for the same year.


SERIES-I
ADJUSTED PRODUCTION OF FOODGRAINS IN UNDIVIDED INDIA
1900-01 TO 1947-48
MILLION TONNES
PERIOD I
PERIOD II
INDEX NUMBERS
= PEAK POINTS
= SLOUGH POINTS
= REGRESSION LINE FOR PEAK POINTS IN THE PERIOD
= REGRESSION LINE FOR SLOUGH POINTS IN THE PERIOD
= REGRESSION LINE FOR THE PERIOD
= REGRESSION LINE FOR THE COMBINED PERIOD
120.0
110.0
100.0
90.0
80.0
1900-01
02-03
04-05
06-07
14-15
16-17
20-21
24-25
26-27
28-29
30-31
32-33
36-37
38-39
40-41

ANNEXURE II

SERIES II

Adjusted Production of Foodgrains in the Indian Union

(1936-37 to 1965-66)

1	2	3	4	5
1936-37	64·7			
1937-38	63·4	5·8	2	4·5
1938-39	58·9			
1939-40	61·0			
1940-41	58·9	3·5	2	2·9
1941-42	57·5			
1942-43	64·2			
1943-44	65·1			
1944-45	63·1	8·1	3	4·2
1945-46	57·6			
1946-47	57·0			
1947-48	58·7	1·7	1	2·9
1948-49	57·0			
1949-50	59·8	5·7	1	9·5
1950-51	54·1			
1951-52	54·5			
1952-53	60·5			
1953-54	71·2	2·4	1	3·4
1954-55	69·8			
1955-56	69·0			
1956-57	72·3	7·0	1	9·7
1957-58	65·3			
1958-59	78·1	1·6	1	2·0
1959-60	76·5			

1	2	3	4	5
1960 61	82·0			
1961-62	83 9	5·9	1	7·0
1962 63	78·0			
1963-64	81·3			
1964-65	89·9	17 3	1	19·2
1965-66	72·6			

Note : Adjusted figures have been computed by taking the actual total production of foodgrains in India for the year 1960-61 as the 'base' and relating it to the Index Number for the same year.

SERIES II

ADJUSTED PRODUCTION OF FOODGRAINS IN INDIA

1936-37 TO 1965-66

MILLION TONNES

INDEX NUMBERS

PERIOD I
1936-37 TO 1950-51

PERIOD II
1951-52 TO 1965-66

P. M. = PEAK POINTS

S. M. = SLOUGH POINTS

=1= REGRESSION LINE FOR PEAK POINTS IN THE PERIOD

=S= REGRESSION LINE FOR SLOUGH POINTS IN THE PERIOD

=X= REGRESSION LINE FOR THE PERIOD

=+= REGRESSION LINE FOR THE COMBINED PERIOD

1936-37 38-39 40-41 42-43 44-45 46-47 48-49 50-51 52-53 54-55 56-57 58-59 60-61 62-63 64-65

ANNEXURE III

Number of Years of Drought (25% and lower)
(SUB-DIVISION-WISE—S.W. Monsoon only)

Before Re-organisation | After Re-organisation

Meteorological Sub-divisions	*1901 to 1910*	*1911 to 1920*	*1921 to 1930*	*1931 to 1940*	*1941 to 1946*	*1947 to 1956*	*1957 to 1966*	*Meteorological Sub-divisions*
Assam	0	1	1	0	0	0	0	Assam
Bengal	3	1	2	2	1	—	0	West Bengal
Orissa	3	2	2	1	0	4	3	Orissa
Chota Nagpur	2	4	0	3	1	4	2	Bihar (plateau)
Bihar	3	1	3	2	1	1	3	Bihar (plains)
U.P. (East)	4	4	2	3	2	1	4	U.P. (East)
U.P. (West)	3	5	3	3	2	1	1	U.P. (West)
Punjab (East & North)	5	5	4	6	2	—	—	Himachal Pradesh
Punjab (South & West)	4	6	1	5	0	—	1	Panjab (India)
Kashmir	4	6	6	7	1	1	3	Jummu & Kashmir
Rajputana (West)	5	5	6	2	1	5	5	Rajasthan (West)
Rajputana (East)	3	5	4	2	1	4	2	Rajasthan (East)
Gujarat	3	4	3	4	0	3	4	Gujarat
Central India (West)	3	5	4	0	1	—	—	——
Central India (East)	4	3	3	4	2	—	—	——
Berar	4	5	3	1	2	2	1	Vidarbha
Central Province (West)	4	3	0	0	1	*x*	2	Madhya Pradesh (W)
Central Province (East)	3	2	2	0	1	3	2	Madhya Pradesh (E)
Konkan	3	4	2	0	1	*x*	1	Konkan
Bombay Deccan	4	3	4	1	0	2	0	Madhya Maharashtra
Hyderabad (North)	4	6	8	3	1	0	0	Marathwada
Hyderabad (South)	5	5	6	4	3	1	0	Telangana
Mysore	4	3	3	2	2	*x*	0	Interior Mysore
Malabar	1	2	2	2	2	*x*	0	Kerala (South)
Madras (South & East)	3	4	7	3	2	*x*	0	Madras
Madras Deccan	3	4	6	5	3	2	0	Rayalaseema
Madras Coast (North)	2	2	1	2	1	3	0	Coastal Andhra Pradesh
						x	2	Saurashtra & Kutch
						x	0	Coastal Mysore
						x	0	Interior Mysore

x Due to re-organisation, data are not available for full period.

ANNEXURE IV

APPROXIMATE PROBABILITY OF DROUGHT

(S.W. Monsoon—25% or less)

State	*Recurrence period of drought*
Assam	rather rare—once in 15 years.
West Bengal	Once in 5 years.
Madhya Pradeah	
Konkan	
Andhra Pradesh (Coastal)	
Madhya Maharashtra	
Kerala	
Bihar	
Orissa	
Interior Mysore South	Once in 4 years.
Uttar Pradesh West	
Vidharbha	
Gujarat	Once in 3 years.
Rajasthan East	
Uttar Pradesh West	
Madras	
Kashmir	
Rayalaseema	
Telangana (Andhra Pradesh)	
Rajasthan West	Once in 2·5 years.

ANNEXURE V

SOUTHWEST MONSOON—DEVIATION FROM NORMAL RAINFALL

	1964	*1965*	*1966*
Assam North	6	—24	—10
Assam South	6	— 7	—13
Sub-Himalayan West Bengal	18	10	— 5
Gangetic West Bengal	—13	—10	—29
Orissa	— 1	—35	—31
Bihar Plateau	— 7	—31	—38
Bihar Plains	— 1	—17	—50
Uttar Pradesh East	— 3	—41	—41
Uttar Pradesh West	15	—32	0
Punjab (India)	50	—46	3
Himachal Pradesh	—15	—61	— 7
Jammu and Kashmir	4	—64	24
Rajasthan West	30	—42	—21
Rajasthan East	1	—30	—36
Madhya Pradesh West	— 8	—46	—30
Madhya Pradesh East	7	—37	—31
Gujarat Region	8	—45	—31
Saurashtra and Cutch	13	—33	—40
Konkan	0	—20	—30

	1964	*1965*	*1966*
Madhya Maharashtra	22	— 8	—13
Marathwada	— 7	— 5	— 4
Vidharbha	2	—32	—11
Coastal Andhra Pradesh	37	—10	— 5
Telangana	10	—7	— 4
Rayalaseema	71	—4	17
Madras	30	—1	48
Coastal Mysore	— 3	—19	—22
Interior Mysore North	52	9	— 3
Interior Mysore South	45	—18	9
Kerala	5	—24	— 8

WEST BENGAL

1. Cooch Behar
2. Jalpaiguri
3. Darjeeling
4. West Dinajpur
5. Malda
6. Murshidabad
7. Birbhum
8. Burdwan
9. Nadia
10. 24-Parganas
11. Hooghly
12. Howrah
13. Midnapore
14. Bankura
15. Purulia
16. Calcutta

PUNJAB

1. Kangra
2. Gurdaspur
3. Hoshiarpur
4. Kapurthala
5. Amritsar
6. Ferozepore
7. Bhatinda
8. Sangrur
9. Jullundur
10. Ludhiana
11. Simla
12. Patiala
13. Ambala
14. Karnal
15. Rohtak
16. Hissar
17. Mahendragarh
18. Gurgaon
19. Lahul & Spiti

ANDHRA PRADESH

1. Adilabad
2. Nizamabad
3. Karimnagar
4. Madak
5. Hyderabad
6. Nalgonda
7. Warangal
8. Khamman
9. East Godavari
10. Visakapatnam
11. Srikakulam
12. West Godavari
13. Krishna
14. Guntur
15. Mahabubnagar
16. Kurnool
17. Nellor
18. Cuddapah
19. Anantpur
20. Chittoor

MAHARASHTRA

1. Dhulia
2. Jalgaon
3. Buldana
4. Akola
5. Amraoti
6. Wardha
7. Nagpur
8. Bhandara
9. Chanda
10. Nander
11. Yeotmal
12. Parwani
13. Aurangabad
14. Nasik
15. Sawai Madhopur
16. Kolaba
17. Poona
18. Ahmadnagar
19. Bir
20. Osmanabad
21. Sholapur
22. South Satara
23. Ratnagiri
24. North Satara
25. Kolhapur
26. Bombay Suburban

RAJASTHAN

1. Ganganagar
2. Bikaner
3. Churu
4. Jhunjhunu
5. Sikar
6. Nagour
7. Jodhpur
8. Jaisalmer

9. Barmer
10. Pali
11. Ajmer
12. Jaipur
13. Alwar
14. Bharatpur
15. Sawai Madhopur
16. Tonk
17. Kota
18. Jhalawara
19. Bundi
20. Bhilwara
21. Chittorgarh
22. Banswara
23. Dungarpur
24. Udaipur
25. Sirohi
26. Jalor

PONDICHERRY

1. Pondicherry
2. Karaikal
3. Mahe
4. Yanam

GUJARAT

1. Kutch
2. Banas Kantha
3. Mehsana
4. Sabar Kantha
5. Panch Mahal
6. Baroda
7. Broach
8. Surat
9. Dangs
10. Bhavnagar
11. Kaira
12. Ahmedabad
13. Surendranagar
14. Rajkot
15. Jamnagar
16. Junagadh
17. Amreli

BIHAR

1. Champaran
2. Muzaffarpur
3. Darbhanga
4. Saharsa
5. Purnea
6. Santal Parganas
7. Bhagalpur
8. Monghyr
9. Patna
10. Saran
11. Shahabad
12. Gaya
13. Hazaribagh
14. Dhanbad
15. Singhbhum
16. Ranchi
17. Palamau

MYSORE

1. Bidar
2. Gulbarga
3. Bijapur
4. Belgaum
5. North Kanara
6. Dharwar
7. Raichur
8. Bellary
9. Chitradurga
10. Shimoga
11. South Kanara
12. Chikmagalur
13. Hassan
14. Coorg
15. Mysore
16. Mandya
17. Tumkur
18. Bangalore
19. Kolar

HIMACHAL PRADESH

1. Chamba
2. Mandi
3. Bilaspur
4. Mahasu
5. Kinnaur
6. Sirmur

MADHYA PRADESH

1. Morena
2. Bhind
3. Gwalior
4. Datia
5. Shivpuri
6. Guna

7. Rajgarh
8. Vidisha
9. Sagar
10. Tikamgarh
11. Chhatarpur
12. Damoh
13. Panna
14. Jabalpur
15. Satna
16. Shahdol
17. Rewa
18. Sidhi
19. Surguja
20. Raigarh
21. Bilaspur
22. Raipur
23. Bastar
24. Durg
25. Balaghat
26. Mandla
27. Seoni
28. Chhindwara
29. Narsinghpur
30. Raisen
31. Hoshangabad
32. Betul
33. East Nimar
34. Dewas
35. Sehore
36. Shajapur
37. Ujjain
38. Indore
39. West Nimar
40. Dhar
41. Jhabua
42. Ratlam
43. Mandasor

STATES NOT DIVIDED INTO DISTRICTS

Andaman and Nicobar Islands
Delhi
Laccadive, Minicoy & Amindivi Islands
Manipur
Tripura
Sikkim
Goa, Daman, Diu

ASSAM

1. Goalpara
2. Kamrup
3. Darrang
4. Lakhimpur
5. Sibsagar
6. Nowgong
7. Mikir & N.C. Hills
8. K. & J. Hills
9. Garo Hills
10. Cachar
11. Mizo Hills
    N.E.F.A.
12. Kameng Fron. Div.
13. Subansiri Fron. Div.
14. Siang Frontier Div.
15. Luhit Frontier Div:
16. Tirap Frontier Div.

ORISSA

1. Balasore
2. Mayurbhanj
3. Keonjhar
4. Sundargarh
5. Sambalpur
6. Bolangir
7. Dhenkanal
8. Cuttack
9. Puri
10. Baudh Khondmals
11. Ganjam
12. Koraput
13. Kalahandi

BHUTAN

1. Rimphu
2. Thimphu
3. Punakha
4. Tongsa
5. Wangdu Phodrang
6. Ta-Ga-Na

MADRAS

1. Madras
2. Chingleput
3. South Arcot
4. Thanjavur
5. Ramanathapuram
6. Tiruchchirappalli

7. North Arcot
8. Salem
9. Coimbatore
10. Madurai
11. Tirunelveli
12. Kanniyakumari
13. Nilgiri

JAMMU & KASHMIR

1. Gilgit
2. Kabayali Pradesh
3. Chilas
4. Gilgit Wazarat
5. Ladakh
6. Kashmir North
7. Muzaffarabad
8. Punch
9. Kashmir South
10. Udhampur
11. Riasi
12. Mirpur
13. Jammu
14. Kathua

KERALA

1. Cannanore
2. Calicut
3. Palghat
4. Trichur
5. Ernakulam
6. Kottayam
7. Alleppey
8. Quilon
9. Trivandrum

NAGALAND

1. Tuensang
2. Kohima
3. Mokokchung

U. PRADESH

1. Tehri
2. Garhwal
3. Almora
4. Dehra Dun
5. Saharanpur
6. Muzaffarnagar
7. Bijnor
8. Naini Tal
9. Meerut
10. Moradabad
11. Rampur
12. Bareilly
13. Pilibhit
14. Bulandshahr
15. Aligarh
16. Budaun
17. Shahjahanpur
18. Kheri
19. Bahraich
20. Sitapur
21. Hardoi
22. Farrukhabad
23. Etah
24. Mathura
25. Agra
26. Mainpuri
27. Etawah
28. Kanpur
29. Unnao
30. Lucknow
31. Bara Banki
32. Gonda
33. Basti
34. Gorakhpur
35. Deoria
36. Ballia
37. Azamgarh
38. Faizabad
39. Sultanpur
40. Rae-Bareli
41. Partapgarh
42. Jaunpur
43. Gazipur
44. Varanasi
45. Mirzapur
46. Allahabad
47. Fatehpur
48. Banda
49. Hamirpur
50. Jalaun
51. Jhansi
52. Uttar Kashi
53. Chamoli
54. Pithoragarh

ANNEXURE VI

Acreage and Production of A, B and C Types of Areas

Category	*No. of districts*	*Average area under foodgrains 1961-64 (million hectares)*	*Percentage to All-India of Col. 3*	*Average production of foodgrains, 1961-64 (million tonnes)*	*Percentage to All-India of Col. 5*	*Average yield per hectare (Kgs.)*
1	2	3	4	5	6	7
A	101	37 0	31	30 0	37	810
B_1	89	31·9	27	22·4	28	700
B_2	41	17·5	15	11·1	14	630
$B(B_1+B_2)$	130	49·4	42	33 5	42	680
C	99	31·2	27	17 0	21	545
All India	330	117·6	100	80·5	100	685