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INDEX NUMBERS OF AGRICULTURAL PRODUCTION IN INDIA

V. G. Panse

and

V. S. Menon

The stoppage of imports from Burma during the Second World War and the Bengal famine brought out forcefully the weaknesses of statistics of agricultural production, particularly of foodgrains production, in the country. These weaknesses arose from large gaps in the coverage and faulty methods of estimating area and yield. For instance, an estimated area of 13.7 million acres under cereals and gram, that is about 8 to 9 per cent of the reporting area under these crops, was non-reporting. Even among reporting areas, estimates of crop acreage were based on reports of village chowkidars in the absence of proper land records and a village revenue agency in the permanently settled areas, including West Bengal, Bihar, Orissa and several Indian States. Estimates of yield were defective everywhere as these were calculated from the concept of a normal yield and seasonal condition factor and were highly subjective.

In order to remedy these defects, the Ministry of Food and Agriculture initiated vigorous action to extend the coverage of reporting area as speedily as possible. In 1945-46, *ad hoc* estimates of area and production were secured in respect of non-reporting areas. From 1947-48 such *ad hoc* estimates were included regularly in all-India crop estimates. Efforts were also made year after year to improve the reliability of these estimates by extending to non-reporting areas the method of detailed enumeration of crop acreages through a primary reporting agency similar to that employed in the reporting areas. As a consequence, complete enumeration of area was started in Bihar in 1948-49, while sample surveys were adopted for this purpose in West Bengal and Kerala by 1949-50. Non-reporting pockets in several States, *e.g.*, Bombay, Madhya Pradesh, Mysore, etc., were made reporting also from 1949-50. Jammu and Kashmir State and other hilly areas continued to supply *ad hoc* estimates, but a sample survey for enumerating crop acreages in the hilly areas of Uttar Pradesh has been taken up recently.

Side by side, the Indian Council of Agricultural Research which had been asked to develop a scientific method of estimating yield made rapid progress in its investigations. The method evolved by the Council was entirely objective and consisted of harvesting a representative sample of the crop by a random location of plots for this purpose. Crop yields could be estimated through such random sampling crop cutting surveys with the desired degree of precision. Moreover, the large size of plot recommended for crop cutting and other operational features of the method were such that it could be easily fitted into the administrative set-up without much additional cost and was therefore highly acceptable to the States, whose primary responsibility it is to collect agricultural statistics. After satisfying themselves of the feasibility of the method on a large scale, the States have shifted to it gradually, commencing from 1949-50, for providing official statistics of crop yields in place of the traditional method. The Indian Statistical Institute, Calcutta had also been experimenting independently with objective estimation of crop

yields with the help of very small plots marked by a special apparatus and crop estimation surveys in West Bengal are being conducted according to the technique developed by the Institute. Estimates of rice yield obtained by this method have been adopted officially in West Bengal from the year 1947-48 and for other crops from subsequent years.

The progress made in the adoption of the crop cutting sample survey for providing official statistics of production for the principal crops in the country can be seen from Table I.

TABLE I—PROPORTION (%) OF OFFICIAL STATISTICS OF ALL-INDIA PRODUCTION OF INDIVIDUAL CROPS BASED ON CROP-CUTTING SAMPLE SURVEYS BY 1958-59

Foodgrains		*Oilseeds*		*Other Crops*	
Rice	90.5	Groundnut	46.9	Sugarcane	26.3
Jowar	99.9	Sesamum	39.7	Pepper	0.0
Bajra	99.4	Rapeseed and Mustard	29.7	Tobacco	19.5
Maize	78.2	Linseed	39.4	Potatoes	27.1
Ragi	77.4	Castorseed	0.0	Ginger	0.0
Small Millets	16.9	All Oilseeds	42.5	Chillies	0.0
Wheat	98.9	*Fibres*			
Barley	98.7	Cotton	64.1		
Gram	99.3	Jute	94.0		
Tur	76.0	Mesta	0.0		
Other Pulses	36.3				
All Foodgrains	87.9				

Except in small millets and other pulses the crop cutting method has almost completely replaced the traditional method of estimating production in the foodgrains group, but in other groups considerable extension of this method is still necessary in order to improve the reliability of yields. In plantation crops, tea, coffee and rubber, the total production is known with a high degree of accuracy.

The steady progress with regard to improvement in coverage and methods of collection of annual statistics of crop production has itself led to the complication that these statistics have lost strict comparability from year to year. An extreme example is provided by the *tur* crop (*Cajanus Cajan*). For the year 1949-50, the all-India production estimate for this crop stood at 1.00 million tons. From the year 1950-51, Orissa, Assam and Mysore States, which did not provide any production figures for this crop in the past, began to supply estimates. In Madhya Pradesh and Uttar Pradesh States, which are large producers of *tur*, the crop sampling method replaced the traditional method of estimating yield from the same year.

The result of these changes was that the all-India production estimate of *tur* shot up to 1.69 million tons in 1950-51 and has maintained that approximate level since. Such differences, which are statistical in nature, vitiate the annual production series, as they stand, for any comparative studies. On the other hand, for planning, for national income estimation and other purposes, strictly comparable production series for crops, reflecting physical changes in production from year to year, are a vital necessity. The Ministry of Food and Agriculture has recognised the problem created by the lack of comparability in the annual production data. It has tried to deal with this problem by publishing each year, along with production estimates of different crops for that year, a second set of estimates strictly comparable, both in coverage and in the method of collecting data, with the production estimates of the preceding year. Continuing the example of the *tur* crop, side by side with the official production figure of 1.69 million tons for 1950-51, the Ministry of Food and Agriculture has given another estimate of 0.92 million tons for the same year, which is strictly comparable with the production estimate of 1.00 million tons for the previous year, both in coverage that is, excluding production from Orissa, Assam and Mysore States and in method, that is, incorporating production estimates for Uttar Pradesh and Madhya Pradesh based on yield determined by the traditional method and not by crop cutting. Such comparable estimates for two successive years are generally available for all crops. Further, the Ministry of Food and Agriculture has developed an annual index of agricultural production which provides a strictly comparable series. It has been publishing this index since 1954.[1]

In constructing an annual index of agricultural production, two problems have to be solved. The first is to obtain a truly comparable series of annual production estimates for individual crops by removing statistical discrepancies referred to above from the annual figures and the second is to combine the production data for different crops on a suitable common scale, which is the usual index numbers problem. Even apart from the index of agricultural production, the first problem has its own importance because of the need for providing a strictly comparable time series for production of individual crops.

The fact that each year's production estimate for a crop can be linked with the preceding year's estimate through a second estimate strictly comparable with the latter, makes it possible to construct a time series of adjusted production estimates comparable with one another over the entire series. The method of adjustment, which is a chain method, is illustrated with two crops, rice and *tur*, in Tables II and III respectively.

In calculating adjusted production in row 3 of Table II, unadjusted figures of production for the earlier years in the series have been brought in line with more complete and more scientifically determined recent figures. For example, the unadjusted figure of 27,122 thousand tons for the year 1955-56 was adjusted to 27,106 thousand tons, through the relationship $\frac{28,578 \times 27,122}{28,595}$ to represent the production for the year 1955-56, had the coverage been as complete as and the method of

1. *Agricultural Situation in India*, Vol. 9, No. 4, July 1954, Vol. 10, No. 6, September 1955, Vol. 11, No. 5, August 1956, Vol. 12, No. 5, August 1957, Vol. 13, No. 5, August 1958, Vol. 14, No. 5, August 1959 and Vol. 15, No. 5, August 1960.

TABLE II—ANNUAL PRODUCTION ESTIMATES FOR RICE, UNADJUSTED AND ADJUSTED AND CORRESPONDING PRODUCTION RELATIVES, 1949-50 TO 1958-59

	1949-50	1950-51	1951-52	1952-53	1953-54	1954-55	1955-56	1956-57	1957-58*	1958-59*
1. Unadjusted production ('000 tons)	23,170	20,251	20,964	22,537	27,769	24,821	27,122	28,578	24,885	30,354
2. Production comparable with preceding year in coverage and method ('000 tons)	..	20,366	20,758	22,523	27,613	24,771	26,792	28,595	24,875	30,299
3. Adjusted production ('000 tons)	23,736	20,864	21,386	22,976	28,151	25,112	27,106	28,578	24,875	30,287
4. Production relatives based on unadjusted production	100.0	87.4	90.5	97.3	119.8	107.1	117.1	123.3	107.4	131.0
5. Production relatives based on adjusted production	100.0	87.9	90.1	96.8	118.6	105.8	114.2	120.4	104.8	127.6

* Subject to further slight adjustment as fully revised production figures become available. A final estimate of production is issued by the Ministry of Food and Agriculture within one or two months after the end of the harvesting season of a crop on the basis of data supplied by the States. But States are able to complete their accounts of area and yield much later and with the help of these accounts the all-India production figure is revised in about a year's time. Partially revised figures may be used in the intervening period. With continuing effort on the part of the Ministry of Food and Agriculture, the gap between final and revised estimates of production has been narrowed down steadily.

collection of data identical with those employed in 1956-57.[2] The difference between the figures for the two years was that from 1956-57 Manipur started reporting data both for valley and hill portions while upto 1955-56 data were available for valley portions only. Again in Bombay 1956-57 data were entirely based on the results of crop-cutting surveys while in 1955-56 data for pre-reorganised Bombay State and Chanda and Bhandara districts of Vidharbha region only were based on the results of these surveys. Similarly, the unadjusted figure of 24,821 thousand tons for the year 1954-55 was adjusted to 25,112 thousand tons, through the relationship $\frac{27,106 \times 24,821}{26,792}$ to represent the production for the year 1954-55 had the coverage been as complete as and methods of collection of data identical with those employed in 1956-57. The difference between 1954-55 and 1955-56 was that Madhya Bharat and Madras States switched over to the crop sampling method for estimating yield of rice in 1955-56 from the traditional method based on normal yield and seasonal condition factor which had been followed in these States upto 1954-55. With the help of the adjusted figure of 25,112 thousand tons for 1954-55, the unadjusted production of 27,769 thousand tons for the year 1953-54 was adjusted through the relationship $\frac{25,112 \times 27,769}{24,771}$ to 28,151 thousand tons to bring it in line with the adjusted figures for 1954-55 and 1955-56. The difference between 1953-54 and 1954-55 was that rice production estimates for certain areas in Mysore State which had been non-reporting upto 1953-54 were included in the all-India production figures for 1954-55 for the first time. In this manner the adjustments were carried backward through all years, beginning with the year 1956-57 for which fully revised figures were available. In normal practice adjustment should be undertaken when all production figures in the series are revised estimates, which should be possible within two years from the most recent year of the series. This will avoid any necessity for further correction. It will be observed that the adjusted production figures in Table II do not differ from their unadjusted counterparts by any large amounts, since major improvements in coverage and in the method of enumerating rice acreage had been implemented before 1949-50. Improvements during the period covered by the table were confined mostly to introduction of crop-cutting surveys for measuring yield in several States. Orissa, an important rice growing State, continued to remain unaffected by improvements of any kind.

These adjustments could also have been made forward, that is, figures for later years could have been brought down in line with the earlier figures on the assumption that the coverage and methods of data collection had remained unchanged from what they had been in the earliest year of the series. For example, the unadjusted production figure of 20,251 thousand tons in 1950-51 could have been replaced by 20,366 thousand tons as being strictly comparable with the production in 1949-50 in coverage and method of collection of data. The unadjusted figure of 20,964 thousand tons for 1951-52 could have been adjusted to 20,876

2. Symbolically, if y_n and y_{n-1} are estimates of production for any particular year, n, and the preceding year, n-1, respectively, then if another production estimate y'_n for the year, n, is also available for the same coverage and same methods of estimation as in the year, n-1, then

$$y''_{n-1} = \frac{y_{n-1} \times y_n}{y'_n}$$

represents the adjusted estimate of production for the year, n-1, strictly comparable to the estimate y_n for the year, n, both in coverage and methods of estimation.

thousand tons through the relationship, $\frac{20,758 \times 20,366}{20,251}$ to bring it on par with 1949-50. By similarly adjusting figures for subsequent years to scale them to the level of 1949-50, a strictly comparable time series could have been formed. The magnitude of production relatives would also be unaffected whether the annual production figures are brought in line with the most recent year of the series, as has been done in Table II, or whether they were scaled down to the level of the earliest year, 1949-50. The latter procedure would, however, defeat an important purpose of adjustment, namely, provision of a series of *absolute* production figure with maximum reliability, as being based on maximum coverage and on most improved methods of collection of area and yield data attained during the period of the series. In spite of the convenience that the series once established by adjusting production of each year to the level of the first year of the series would continue undisturbed in future, this procedure must be rejected as resulting in absolute production figures which are patently based on faulty methods and are unreliable. The procedure adopted in Table II and recommended by us suffers from the drawback that the resulting series of absolute production figures is not permanent, since apart from extension of coverage, improvement in techniques of collecting data is a continuous process, and increase in reliability attained by future production estimates must be incorporated in the whole series, which would require a revision of the series periodically, may be every five or ten years. It is such revision, in fact, that will guarantee that strict comparability of the series is maintained at the highest level of accuracy attained during any period.

The last two rows of Table II give production relatives calculated from unadjusted and adjusted production estimates shown in rows 1 and 3 of the table.

Note that production figures in rows 1 and 2 of Table III are identical for the years 1951-52 to 1957-58 as there was no change of coverage or method of collecting data during those years. The result of adjustment is brought out forcefully in the year 1949-50 when the adjusted production figure was over 80 per cent higher than the unadjusted figure, which as explained earlier, suffered from lesser coverage and traditional estimates of yield for large areas under this crop. Once this adjustment is made, the entire series runs smoothly without any trend, the annual production fluctuating around the decennial average of 1,741 thousand tons.

Annual production figures adjusted by the chain method illustrated above for rice and *tur* are shown for the period 1949-50 to 1958-59 in Table IV for 28 crops which are components of the index numbers of agricultural production being constructed by the Ministry of Food and Agriculture. The corresponding unadjusted production figures as published by the Ministry are shown in Table V for comparison. In Table VI are given production relatives calculated from adjusted production figures, taking 1956-57 as base year.

The most drastic change through adjustment occurred in respect of the *tur* crop in the first year of the series. Other noticeable cases of upward revision as a result of adjustment are those of jowar, bajra, maize, wheat, gram and linseed, in the earlier two or three years of the series. But generally speaking, the adjustment has not brought about any appreciable change in the original unadjusted data for most crops. It is obvious that improvements initiated in the late forties

TABLE III—ANNUAL PRODUCTION ESTIMATES OF TUR (*Cajanus Cajan*) UNADJUSTED AND ADJUSTED AND CORRESPONDING PRODUCTION RELATIVES, 1949-50 TO 1958-59

	1949-50	1950-51	1951-52	1952-53	1953-54	1954-55	1955-56	1956-57	1957-58*	1958-59*
1. Unadjusted production ('000 tons)	1,000	1,692	1,801	1,675	1,834	1,692	1,832	1,958	1,412	1,671
2. Production comparable with preceding year in coverage and method ('000 tons)	—	918	1,801	1,675	1,834	1,692	1,832	1,958	1,412	1,675
3. Adjusted production ('000 tons)	1,842	1,691	1,800	1,674	1,833	1,691	1,831	1,958	1,412	1,676
4. Production relatives based on unadjusted production	100.0	169.2	180.1	167.5	183.4	169.2	183.2	195.8	141.2	167.1
5. Production relatives based on adjusted production ..	100.0	91.8	97.7	90.9	99.5	91.8	99.4	106.2	76.6	90.9

*Please see footnote to Table II.

were not pursued with equal vigour during the decade under study. We need not go into the reasons here. For these reasons reference may be made to the article entitled "National Sample Survey, Agricultural Statistics and Planning in India" by V. G. Panse in *Changing India*, Asia Publishing House, 1961.

Tables IV and VI provide the most reliable series so far of annual production estimates, both absolute and relative, for all principal crops. The data cover the entire country including Jammu and Kashmir State and Andaman and Nicobar Islands but possibly excluding some cultivated pockets in the North East Frontier Administration area whose contribution to total production would be negligible.

It is from these data that the index number of agricultural production of the Ministry of Food and Agriculture is compiled. This index number is a fixed base quantity index of the Laspeyre's type. It is based on the gross production of 28 crops shown in Table IV without any further allowances being made in these figures for wastage, seed, feed, etc. The weights employed are farm harvest prices prevalent during the year 1949-50. In a very few cases such as for rubber, ginger and chillies, where these prices were not available, wholesale prices during the harvest season of that year were used after appropriate deductions to make them equivalent to farm prices. Weighting by prices converts production into money value and these values are added over all commodities each year. The total annual value of agricultural production at base year prices expressed as a percentage of value for a given (base) year shows the index number of agricultural production.

The year 1949-50 was chosen as the base for the weights, as it was regarded an agriculturally normal year. Although a change in the weighting system within reasonable limits, that is as long as the weights refer to a recent period and the relative production of major commodities included in the index had not been upset by any abnormal circumstances during the period on which the weights are based, is not likely to affect the index number perceptibly, the question of the most suitable period for the weights might be looked into. It is difficult to single out any particular year as being normal for all commodities entering the index number, and averages of prices prevailing in 3 to 5 consecutive years, omitting any year characterised by gross abnormality before averaging, are to be preferred as representing the average price level to which these commodities are subject. The year 1949-50 has been taken by the Ministry of Food and Agriculture as the base period for the index number of agricultural production; but since for calculating adjusted production relatives for individual commodities the base taken is 1956-57 (Table VI), it is logical to shift the base for the index number of agricultural production also to that year. The index numbers calculated for the period 1949-50 to 1958-59 with 1949-50 as the base and also with 1956-57 as the base are shown in Table VII. The prices for 1949-50 used as weights in the calculation are shown in Table VIII.

The present index is a very considerable improvement over an earlier series of index numbers compiled for 19 crops and covering only a part of the country, namely the previous British India and some of the Indian States to which regular statistics of crop acreages and yields had been confined in the past.[3]

3. *Agricultural Situation in India*, Vol. 3, No. 10, January, 1949.

TABLE IV —ADJUSTED ANNUAL PRODUCTION ESTIMATES FOR PRINCIPAL CROPS, 1949-50 TO 1958-59

(Thousand tons unless otherwise stated)

Crop/Group	1949-50	1950-51	1951-52	1952-53	1953-54	1954-55	1955-56	1956-57	1957-58*	1958-59*
1	2	3	4	5	6	7	8	9	10	11
I. *Foodgrains*										
(a) *Kharif Cereals*										
Rice	23,736	20,864	21,386	22,976	28,151	25,112	27,106	28,578	24,875	30,287
Jowar	6,848	6,150	6,602	7,300	8,012	9,060	6,622	7,211	8,245	8,711
Bajra	3,139	2,630	2,379	2,975	4,237	3,384	3,399	2,828	3,522	3,788
Maize	2,279	1,924	2,309	2,810	2,968	2,906	2,560	3,029	3,036	3,063
Ragi	1,519	1,331	1,221	1,245	1,747	1,650	1,818	1,765	1,665	1,878
Small Millets	1,937	1,722	1,886	1,896	2,438	2,456	2,035	1,900	1,704	2,102
Total Kharif Cereals	39,458	34,621	35,783	39,202	47,553	44,568	43,540	45,311	43,047	49,829
(b) *Rabi Cereals*										
Wheat	6,563	6,645	6,171	7,407	7,887	8,899	8,630	9,254	7,662	9,675
Barley	2,339	2,470	2,339	2,862	2,881	2,909	2,771	2,818	2,224	2,654
Total Rabi Cereals	8,902	9,115	8,510	10,269	10,768	11,808	11,401	12,072	9,886	12,329
Total Cereals	48,360	43,736	44,293	49,471	58,321	56,376	54,941	57,383	52,933	62,158
(c) *Pulses*										
Gram	3,840	3,764	3,387	4,194	4,816	5,603	5,334	6,133	4,978	6,874
Tur	1,842	1,691	1,800	1,674	1,833	1,691	1,831	1,958	1,412	1,676
Other Pulses	3,571	3,057	3,221	3,246	3,664	3,557	3,710	3,278	3,117	3,756
Total Pulses	9,253	8,512	8,408	9,114	10,313	10,851	10,875	11,369	9,507	12,306
Total Foodgrains	57,613	52,248	52,701	58,585	68,634	67,227	65,816	68,752	62,440	74,464

1	2	3	4	5	6	7	8	9	10	11
II. *Non-Foodgrains*										
(*a*) *Oilseeds*										
Groundnut	3,381	3,428	3,144	2,884	3,391	4,178	3,800	4,300	4,445	4,824
Sesamum	439	446	453	469	560	593	460	431	377	545
Rapeseed and Mustard	800	757	928	844	858	1,021	846	1,026	923	1,025
Linseed	425	373	328	366	379	384	413	384	249	447
Castorseed	128	103	106	102	103	122	123	122	89	112
Total Oilseeds	5,173	5,107	4,959	4,665	5,291	6,298	5,642	6,263	6,083	6,953
(*b*) *Fibres*										
Cotton ('000 bales of 392 lbs. each)	2,598	2,876	3,096	3,143	3,943	4,250	3,998	4,707	4,668	4,624
Jute ('000 bales of 400 lbs. each)	3,092	3,287	4,682	4,595	3,092	2,932	4,199	4,289	4,051	4,904
Mesta ('000 bales of 400 lbs. each)	664	664	696	686	654	906	1,160	1,471	1,291	1,488
(*c*) *Plantation Crops*										
Tea ('000 lbs.)	5,85,556	6,07,807	6,41,769	6,75,731	5,89,069	6,46,453	6,27,716	6,36,499	6,84,515	7,19,648
Coffee ('000 lbs.)	38,638	43,390	43,545	48,645	56,605	58,652	75,769	78,860	88,790	93,195
Rubber ('000 lbs.)	33,906	31,804	32,007	35,974	44,688	43,264	49,536	48,621	47,502	48,621
(*d*) *Other Crops*										
Sugarcane (Gur)	4,991	5,674	6,128	5,070	4,467	5,784	5,979	6,847	6,722	6,957
Tobacco	264	257	206	241	268	251	298	300	237	263
Potato	1,521	1,633	1,685	1,960	1,924	1,735	1,829	1,697	1,914	2,258
Pepper (Black)	21	20	22	21	23	26	27	27	26	25
Chillies (Dry)	289	345	342	283	303	381	355	349	362	326
Ginger (Dry)	15	14	14	13	13	14	15	15	15	12

* Based on partially revised estimates of production and therefore subject to revision.

TABLE V—UNADJUSTED ANNUAL PRODUCTION ESTIMATES FOR PRINCIPAL CROPS, 1949-50 TO 1958-59

(Thousand tons unless otherwise stated)

Crop/Group	1949-50	1950-51	1951-52	1952-53	1953-54	1954-55	1955-56	1956-57	1957-58*	1958-59*
1	2	3	4	5	6	7	8	9	10	11
I. *Foodgrains*										
(a) *Kharif Cereals*										
Rice	23,170	20,251	20,964	22,537	27,769	24,821	27,122	28,578	24,885	30,354
Jowar	5,777	5,408	5,981	7,243	7,954	9,056	6,619	7,211	8,246	8,714
Bajra	2,790	2,554	2,309	3,142	4,475	3,463	3,374	2,828	3,522	3,789
Maize	2,014	1,702	2,043	2,825	2,991	2,928	2,561	3,029	3,036	3,381
Ragi	1,520	1,407	1,291	1,316	1,846	1,627	1,817	1,765	1,665	1,877
Small Millets	2,242	1,722	1,885	1,895	2,438	2,455	2,037	1,900	1,671	2,072
Total Kharif Cereals	37,513	33,044	34,473	38,958	47,473	44,350	43,530	45,311	43,025	50,187
(b) *Rabi Cereals*										
Wheat	6,290	6,360	6,085	7,382	7,890	8,900	8,622	9,254	7,741	9,772
Barley	2,215	2,340	2,330	2,882	2,905	2,933	2,771	2,818	2,238	2,672
Total Rabi Cereals	8,505	8,700	8,415	10,264	10,795	11,833	11,393	12,072	9,979	12,444
Total Cereals	46,018	41,744	42,888	49,222	58,268	56,183	54,923	57,383	53,004	62,631
(c) *Pulses*										
Gram	3,667	3,593	3,334	4,142	4,756	5,532	5,332	6,133	4,979	6,881
Tur	1,000	1,692	1,801	1,675	1,834	1,692	1,832	1,958	1,412	1,671
Other Pulses	3,363	2,993	3,152	3,227	3,860	3,553	3,707	3,278	3,116	4,320
Total Pulses	8,030	8,278	8,287	9,044	10,450	10,777	10,871	11,369	9,507	12,872
Total Foodgrains	54,048	50,022	51,175	58,266	68,718	66,960	65,794	68,752	62,511	75,503

1	2	3	4	5	6	7	8	9	10	11
II. Non-Foodgrains										
(*a*) *Oilseeds*										
Groundnut	3,379	3,426	3,142	2,883	3,391	4,178	3,801	4,300	4,436	4,812
Sesamum	431	438	445	464	554	593	460	431	354	511
Rapeseed and Mustard ..	793	750	928	844	858	1,021	846	1,026	923	1,025
Linseed	411	361	328	366	379	384	413	384	249	447
Castorseed	128	101	106	102	103	122	123	122	89	112
Total Oilseeds	5,142	5,076	4,949	4,659	5,285	6,298	5,643	6,263	6,051	6,907
(*b*) *Fibres*										
Cotton ('000 bales of 392 lbs. each)	2,628	2,910	3,133	3,194	3,944	4,250	3,998	4,707	4,739	4,686
Jute ('000 bales of 400 lbs. each)	3,089	3,283	4,678	4,592	3,091	2,929	4,198	4,289	4,052	5,158
Mesta ('000 bales of 400 lbs. each)	N.A.	N.A.	N.A.	682	650	901	1,153	1,471	1,291	1,488
(*c*) *Plantation Crops*										
Tea ('000 lbs.)	5,85,030	6,07,318	6,41,079	6,75,270	5,88,733	6,46,384	6,27,669	6,36,499	6,84,738	N.A.
Coffee ('000 lbs.)	48,362	54,322	54,538	48,505	56,613	58,654	75,784	78,860	88,769	N.A.
Rubber ('000 lbs.)	33,941	31,829	32,033	35,996	44,702	43,267	49,550	48,621	N.A.	N.A.
(*d*) *Other Crops*										
Sugarcane (Gur)	4,938	5,615	6,066	5,019	4,423	5,782	5,979	6,847	6,871	7,113
Tobacco	264	257	206	241	268	251	298	300	237	263
Potato	1,519	1,634	1,685	1,961	1,925	1,736	1,830	1,697	1,966	2,319
Pepper (Black)..	21	21	23	23	24	26	28	27	27	26
Chillies (Dry)	289	345	342	283	303	381	355	349	362	326
Ginger (Dry)	23	14	14	19	14	14	16	15	15	12

* Partially revised estimates of production and therefore subject to revision.
N.A.: Not Available

TABLE VI—PRODUCTION RELATIVES CALCULATED FROM ADJUSTED PRODUCTION ESTIMATES FOR PRINCIPAL CROPS, 1949-50 TO 1958-59
(BASE YEAR—1956-57)

Crop/Group	1949-50	1950-51	1951-52	1952-53	1953-54	1954-55	1955-56	1956-57	1957-58	1958-59
1	2	3	4	5	6	7	8	9	10	11
I. *Foodgrains*										
(*a*) *Kharif Cereals*										
Rice	83.1	73.0	74.8	80.4	98.5	87.9	94.9	100.0	87.0	106.0
Jowar	95.0	85.3	91.5	101.2	111.1	125.6	91.8	100.0	114.3	120.8
Bajra	111.0	93.0	84.1	105.2	149.8	119.6	120.2	100.0	124.5	133.9
Maize	75.3	63.6	76.3	92.8	98.0	96.0	84.6	100.0	100.2	101.1
Ragi	84.2	73.8	67.7	69.1	96.9	91.5	100.8	100.0	94.4	106.4
Small Millets	102.0	90.7	99.4	99.9	128.5	129.4	107.2	100.0	89.7	110.6
Total Kharif Cereals	85.5	75.0	77.3	84.3	102.7	94.4	95.6	100.0	92.1	108.5
(*b*) *Rabi Cereals*										
Wheat	71.1	71.9	66.7	80.1	85.3	96.2	93.3	100.0	82.8	104.5
Barley	83.0	87.6	83.0	101.6	102.2	103.2	98.3	100.0	78.9	94.2
Total Rabi Cereals	73.0	74.5	69.5	83.6	88.1	97.4	94.2	100.0	82.1	102.8
Total Cereals	83.2	74.9	75.7	84.1	99.7	95.0	95.4	100.0	90.0	107.3
(*c*) *Pulses*										
Gram	62.6	61.3	55.2	68.3	78.5	91.3	86.9	100.0	81.2	112.1
Tur	94.2	86.4	92.0	85.6	93.7	86.4	93.6	100.0	72.1	85.6
Other Pulses	108.8	93.1	98.1	98.9	111.6	108.4	113.1	100.0	95.1	114.6
Total Pulses	81.4	74.6	73.5	80.4	91.1	96.4	96.3	100.0	84.8	110.0
Total Foodgrains	82.8	74.9	75.4	83.7	98.6	95.2	95.4	100.0	89.3	107.7

1	2	3	4	5	6	7	8	9	10	11
II. *Non-Foodgrains*										
(*a*) *Oilseeds*										
Groundnut	78.6	79.7	73.1	67.1	78.9	97.2	88.4	100.0	103.4	112.2
Sesamum	101.8	103.5	105.1	108.9	129.9	137.6	106.7	100.0	87.5	126.5
Rapeseed and Mustard ..	77.9	73.7	90.4	82.2	83.6	99.5	82.5	100.0	89.9	99.9
Linseed	110.7	97.2	85.4	95.2	98.7	100.0	107.5	100.0	64.9	116.5
Castorseed	104.9	84.5	86.9	83.6	84.5	100.1	100.8	100.0	72.9	91.8
Total Oilseeds	83.1	81.9	81.0	76.4	86.2	101.9	90.3	100.0	96.1	110.9
(*b*) *Fibres*										
Cotton	55.2	61.1	65.8	66.8	83.8	90.3	84.9	100.0	99.2	98.2
Jute	72.1	76.6	109.2	107.1	72.1	68.3	97.9	100.0	94.4	114.3
Mesta	45.1	45.1	47.3	46.6	44.5	61.6	78.9	100.0	87.8	101.2
Total Fibres	58.6	63.6	75.2	75.2	77.4	82.2	87.7	100.0	97.0	102.5
(*c*) *Plantation Crops*										
Tea	92.0	95.5	100.8	106.2	92.5	101.6	98.6	100.0	107.5	113.1*
Coffee	49.0	55.0	55.2	61.7	71.8	74.4	96.1	100.0	112.6	118.2*
Rubber	69.7	65.4	65.8	74.0	91.9	89.0	101.9	100.0	97.7	100.0*
Total Plantation Crops ..	87.0	90.4	95.1	100.6	90.4	98.4	98.4	100.0	107.7	113.0
(*d*) *Other Crops*										
Sugarcane	72.9	82.9	89.5	74.1	65.2	84.5	87.3	100.0	98.2	101.6
Tobacco	88.0	85.6	68.6	80.3	89.3	83.6	99.3	100.0	79.0	87.7†
Potato	89.6	96.2	99.3	115.5	113.4	102.2	107.8	100.0	112.8	133.1†
Pepper (Black)	76.0	73.9	81.7	78.1	86.1	96.7	100.8	100.0	97.4	93.4
Chillies (Dry)	82.8	98.8	98.0	81.1	86.8	109.2	101.7	100.0	103.7	93.4
Ginger (Dry)	97.8	92.3	93.8	87.6	88.9	92.2	103.3	100.0	100.0	80.9
Total Other Crops ..	77.4	85.4	88.2	78.6	75.4	89.6	93.0	100.0	97.6	99.8
Non-Foodgrains	76.6	81.1	84.6	79.5	80.2	92.6	91.8	100.0	98.1	104.7
All Commodities	80.6	77.1	78.6	82.3	92.2	94.4	94.2	100.0	92.4	106.7

*Based on provisional estimates. † Based on final estimates.

Note—The indices for 1957-58 and 1958-59 are generally based on partially revised estimates. The indices for these years are, therefore, subject to revision.

Even so, the index numbers now prepared will need to be augmented by inclusion of animal products like milk, eggs, meat, etc., before it can be truly termed the index of agricultural production. This will need arrangements for systematic collection of reliable statistics of animal products which the country lacks today. Setting up these arrangements through appropriate departments in the States will thus constitute a major contribution to the improvement of agricultural statistics. In the meanwhile, it is suggested that the present index may be called the index numbers of crop production to describe its scope correctly and also to serve as a reminder of its limitation and need to enlarge its scope to cover animal husbandry.

In an article entitled 'India's Elusive Agricultural Output Figures,'[4] Dr. Daniel Thorner stressed the need of adjustment of original production data crop by crop, year by year and region by region, whenever subsequent results obtained through improved methods of estimation showed that earlier figures stood in need of correction. The series of adjusted annual production figures for individual crops prepared by the Ministry of Food and Agriculture (Table IV) and the index numbers of agricultural production based on these series (Table VII) represent precisely such an attempt, although not region by region. Surprisingly enough, Thorner criticises these adjusted production data and the production relatives calculated from them, while arguing, in effect, in favour of the original unadjusted annual figures! This is obviously due to a lack of appreciation of the position that the production relatives, the so-called index numbers for individual crops, are merely the adjusted production figures in a percentage form. It is hoped that the explanation provided in the present paper of the technique of calculating the production relatives will remove this misunderstanding.

While the present effort is in the right direction, much additional work is needed in order to further increase the reliability of all-India series of production figures for individual crops and of the index number of agricultural production. The first step would be for the different States to adjust their production data and construct index numbers of agricultural production by methods explained above, so that these form the basis of the corresponding all-India series, instead of the latter being calculated directly from all-India production data as at present. The component series of adjusted area and yield per acre of individual crops should also be established for each State and for India as a whole, the method of adjustment being similar to that employed for adjusting production. Another step required urgently is for the Ministry of Food and Agriculture to issue a comprehensive memorandum on each year's production statistics, setting out clearly the coverage and methodology in respect of each crop and bringing uptodate the various series of adjusted production estimates and index numbers. Such a memorandum will furnish the desired authoritative information on the quality and limitations of annual production statistics and will lead to a wider and more scientific use of these data by various users. Lastly, the most important advance needed is the improvement in the quality of primary data by making their coverage complete and by speedy extension of scientific methods of measuring area and yield and livestock products in the States, so that the necessity of adjustment of production figures is reduced to a minimum in the future and a comprehensive index of agricultural production becomes available. The quality

4. *Economic Weekly*, Annual Number, January, 1960.

TABLE VII—INDEX NUMBERS OF AGRICULTURAL PRODUCTION, 1949-50 TO 1958-59

1	1949-50	1950-51	1951-52	1952-53	1953-54	1954-55	1955-56	1956-57	1957-58*	1958- 59*
	2	3	4	5	6	7	8	9	10	11
I. Foodgrains										
(a) Kharif Cereals										
Rice										
With 1949-50 as base	100.0	87.9	90.1	96.8	118.6	105.8	114.2	120.4	104.8	127.6
With 1956-57 as base	83.1	73.0	74.8	80.4	98.5	87.9	94.9	100.0	87.0	106.0
Jowar										
With 1949-50 as base	100.0	89.8	96.4	106.6	117.0	132.3	96.7	105.3	120.4	127.2
With 1956-57 as base	95.0	85.3	91.5	101.2	111.1	125.6	91.8	100.0	114.3	120.8
Bajra										
With 1949-50 as base	100.0	83.8	75.8	94.8	135.0	107.8	108.3	90.1	112.2	120.7
With 1956-57 as base	111.0	93.0	84.1	105.2	149.8	119.6	120.2	100.0	124.5	133.9
Maize										
With 1949-50 as base	100.0	84.4	101.3	123.3	130.2	127.5	112.3	132.8	133.1	134.3
With 1956-57 as base	75.3	63.6	76.3	92.8	98.0	96.0	84.6	100.0	100.2	101.1
Ragi										
With 1949-50 as base	100.0	87.6	80.4	82.0	115.0	108.6	119.7	118.7	112.0	126.3
With 1956-57 as base	84.2	73.8	67.7	69.1	96.9	91.5	100.8	100.0	94.4	106.4
Small Millets										
With 1949-50 as base	100.0	88.9	97.4	97.9	125.9	126.8	105.1	98.0	87.9	108.4
With 1956-57 as base	102.0	90.7	99.4	99.9	128.5	129.4	107.2	100.0	89.7	110.6
Total Kharif Cereals										
With 1949-50 as base	100.0	87.7	90.4	98.5	120.0	110.4	111.8	116.9	107.7	126.8
With 1956-57 as base	85.5	75.0	77.3	84.3	102.7	94.4	95.6	100.0	92.1	108.5
(b) Rabi Cereals										
Wheat										
With 1949-50 as base	100.0	101.1	93.9	112.7	120.0	135.4	131.3	140.7	116.5	147.1
With 1956-57 as base	71.1	71.9	66.7	80.1	85.3	96.2	93.3	100.0	82.8	104.5
Barley										
With 1949-50 as base	100.0	105.6	100.0	122.4	123.2	124.4	118.5	120.5	95.1	113.5
With 1956-57 as base	83.0	87.6	83.0	101.6	102.2	103.2	98.3	100.0	78.9	94.2
Total Rabi Cereals										
With 1949-50 as base	100.0	102.0	95.1	114.5	120.6	133.3	128.9	136.9	112.4	140.7
With 1956-57 as base	73.0	74.5	69.5	83.6	88.1	97.4	94.2	100.0	82.1	102.8
Total Cereals										
With 1949-50 as base	100.0	90.3	91.2	101.4	120.1	114.5	114.9	120.5	108.5	129.3
With 1956-57 as base	83.2	74.9	75.7	84.1	99.7	95.0	95.4	100.0	90.0	107.3
(c) Pulses										
Gram										
With 1949-50 as base	100.0	98.0	88.2	109.2	125.4	145.9	138.9	159.8	129.7	179.1
With 1956-57 as base	62.6	61.3	55.2	68.3	78.5	91.3	86.9	100.0	81.2	112.1
Tur										
With 1949-50 as base	100.0	91.8	97.7	90.9	99.5	91.8	99.4	106.2	76.6	90.9
With 1956-57 as base	94.2	86.4	92.0	85.6	93.7	86.4	93.6	100.0	72.1	85.6

(Contd.)

TABLE VII—INDEX NUMBERS OF AGRICULTURAL PRODUCTION, 1949-50 to 1958-59—(*Contd.*)

1	2	3	4	5	6	7	8	9	10	11
				Other Pulses						
With 1949-50 as base	100.0	85.6	90.2	90.9	102.6	99.6	103.9	91.9	87.4	105.3
With 1956-57 as base	108.8	93.1	98.1	98.9	111.6	108.4	113.1	100.0	95.1	114.6
				Total Pulses						
With 1949-50 as base	100.0	91.7	90.3	98.8	112.0	118.5	118.4	122.9	104.2	135.2
With 1956-57 as base	81.4	74.6	73.5	80.4	91.1	96.4	96.3	100.0	84.8	110.0
				Total Foodgrains						
With 1949-50 as base	100.0	90.5	91.1	101.1	119.1	115.0	115.3	120.8	107.9	130.1
With 1956-57 as base	82.8	74.9	75.4	83.7	98.6	95.2	95.4	100.0	89.3	107.7
				II. Non-Foodgrains						
				(a) Oilseeds						
				Groundnut						
With 1949-50 as base	100.0	101.4	93.0	85.3	100.3	123.6	112.4	127.2	131.5	142.7
With 1956-57 as base	78.6	79.7	73.1	67.1	78.9	97.2	88.4	100.0	103.4	112.2
				Sesamum						
With 1949-50 as base	100.0	101.6	103.2	106.9	127.6	135.1	104.8	98.2	85.9	124.2
With 1956-57 as base	101.8	103.5	105.1	108.9	129.9	137.6	106.7	100.0	87.5	126.5
				Rapeseed and Mustard						
With 1949-50 as base	100.0	94.6	116.0	105.5	107.3	127.7	105.8	128.3	115.4	128.2
With 1956-57 as base	77.9	78.7	90.4	82.2	83.6	99.5	82.5	100.0	89.9	99.9
				Linseed						
With 1949-50 as base	100.0	87.8	77.1	86.0	89.1	90.3	97.1	90.3	58.6	105.2
With 1956-57 as base	110.7	97.2	85.4	95.2	98.7	100.0	107.5	100.0	64.9	116.5
				Castorseed						
With 1949-50 as base	100.0	80.5	82.8	79.7	80.5	95.4	96.1	95.3	69.5	87.5
With 1956-57 as base	104.9	84.5	86.9	83.6	84.5	100.1	100.8	100.0	72.9	91.8
				Total Oilseeds						
With 1949-50 as base	100.0	98.5	97.4	91.9	103.7	122.6	108.6	120.3	115.6	133.4
With 1956-57 as base	83.1	81.9	81.0	76.4	86.2	101.9	90.3	100.0	96.1	110.9
				(b) Fibres						
				Cotton						
With 1949-50 as base	100.0	110.7	119.2	121.0	151.8	163.6	153.9	181.2	179.7	178.0
With 1956-57 as base	55.2	61.1	65.8	66.8	83.8	90.3	84.9	100.0	99.2	98.2
				Jute						
With 1949-50 as base	100.0	106.3	151.4	148.6	100.0	94.8	135.8	138.7	131.0	158.6
With 1956-57 as base	72.1	76.6	109.2	107.1	72.1	68.3	97.9	100.0	94.4	114.3
				Mesta						
With 1949-50 as base	100.0	100.0	104.8	103.3	98.5	136.5	174.7	221.5	194.4	224.1
With 1956-57 as base	45.1	45.1	47.3	46.6	44.5	61.6	78.9	100.0	87.8	101.2
				Total Fibres						
With 1949-50 as base	100.0	108.6	128.3	128.4	132.1	140.4	149.7	170.7	165.5	175.0
With 1956-57 as base	58.6	63.6	75.2	75.2	77.4	82.2	87.7	100.0	97.0	102.5

1	2	3	4	5	6	7	8	9	10	11
(c) Plantation Crops										
Tea										
With 1949-50 as base	100.0	103.8	109.6	115.4	100.6	110.4	107.2	108.7	116.9	122.9†
With 1956-57 as base	92.0	95.5	100.8	106.2	92.5	101.6	98.6	100.0	107.5	113.1†
Coffee										
With 1949-50 as base	100.0	112.3	112.7	125.9	146.5	151.8	196.1	204.1	229.8	241.2†
With 1956-57 as base	49.0	55.0	55.2	61.7	71.8	74.4	96.1	100.0	112.6	118.2†
Rubber										
With 1949-50 as base	100.0	93.8	94.4	106.1	131.8	127.6	146.1	143.4	140.1	143.4†
With 1956-57 as base	69.7	65.4	65.8	74.0	91.9	89.0	101.9	100.0	97.7	100.0†
Total Plantation Crops										
With 1949-50 as base	100.6	104.0	109.4	115.7	104.0	113.2	113.2	115.0	123.8	130.0
With 1956-57 as base	87.0	90.4	95.1	100.6	90.4	98.4	98.4	100.0	107.7	113.0
(d) Other Crops										
Sugarcane										
With 1949-50 as base	100.0	113.7	122.8	101.6	89.5	115.9	119.8	137.2	134.7	139.4
With 1956-57 as base	72.9	82.9	89.5	74.1	65.2	84.5	87.3	100.0	98.2	101.6
Tobacco										
With 1949-50 as base	100.0	97.3	78.0	91.3	101.5	95.1	112.9	113.7	89.8	99.7‡
With 1956-57 as base	88.0	85.6	68.6	80.3	89.3	83.6	99.3	100.0	79.0	87.7‡
Potato										
With 1949-50 as base	100.0	107.4	110.8	128.9	126.5	114.1	120.3	111.6	125.9	148.5‡
With 1956-57 as base	89.6	96.2	99.3	115.5	113.4	102.2	107.8	100.0	112.8	133.1‡
Pepper (Black)										
With 1949-50 as base	100.0	97.2	107.5	102.8	113.3	127.8	132.6	131.6	128.2	122.9
With 1956-57 as base	76.0	73.9	81.7	78.1	86.1	96.7	100.8	100.0	97.4	93.4
Chillies (Dry)										
With 1949-50 as base	100.0	119.4	118.4	98.0	104.9	131.9	122.9	120.8	125.3	112.8
With 1956-57 as base	82.8	98.8	98.0	81.1	86.8	109.2	101.7	100.0	103.7	93.4
Ginger (Dry)										
With 1949-50 as base	100.0	94.4	96.0	89.6	90.9	94.3	105.7	102.3	102.3	82.8
With 1956-57 as base	97.8	92.3	93.8	87.6	88.9	92.2	103.3	100.0	100.0	80.9
Total Other Crops										
With 1949-50 as base	100.0	110.3	114.0	101.5	97.9	115.8	120.1	129.2	126.1	129.0
With 1956-57 as base	77.4	85.4	88.2	78.6	75.4	89.6	93.0	100.0	97.6	99.8
Non-Foodgrains										
With 1949-50 as base	100.0	105.9	110.5	103.8	104.7	120.9	119.9	130.6	128.1	136.7
With 1956-57 as base	76.6	81.1	84.6	79.5	80.2	92.6	91.8	100.0	98.1	104.7
All Commodities										
With 1949-50 as base	100.0	95.6	97.5	102.0	114.3	117.0	116.8	124.0	114.6	132.3
With 1956-57 as base	80.6	77.1	78.6	82.3	92.2	94.4	94.2	100.0	92.4	106.7

* Based on partially revised estimates and therefore subject to revision. † Based on provisional estimates. ‡ Based on final estimates.

TABLE VIII—PRICES FOR INDIVIDUAL CROPS IN 1949-50 USED AS WEIGHTS IN CALCULATING INDEX NUMBERS OF AGRICULTURAL PRODUCTION

Foodgrains (*Rs. per md.*)		*Oilseeds* (*Rs. per md.*)		*Plantation Crops* (*Rs. per lb.*)	
Rice	17.86	Groundnut	19.91	Tea	1.80
Jowar	10.21	Sesamum	31.77	Coffee	1.45
Bajra	11.45	Rapeseed and Mustard	29.88	Rubber	0.83
Maize	12.06	Linseed	21.97		
Ragi	9.38	Castorseed	17.84	*Other Crops* (*Rs. per md.*)	
Small Millets	7.51	*Fibre Crops* (*Rs. per bale*)		Sugarcane	20.69
Wheat	15.78	Cotton	336.09	Tobacco	86.59
Barley	10.63	Jute	143.87	Potato	7.98
Gram	11.85	Mesta	138.54	Pepper	436.62
Tur	13.31			Chillies	79.98
Other Pulses	13.23			Ginger	169.66

of the data depends almost entirely on the efficiency of the primary reporting and supervising agencies in the States and far greater attention needs to be devoted to the strengthening of these agencies than has been done during the past decade.

SUMMARY

As a result of gradual improvement in the coverage and in the methods of collecting acreage and yield data for crops, the comparability of annual production figures is lost. A chain method for adjusting annual production estimates in order to restore comparability and bring the figures for earlier years on a level of accuracy attained by more recent data is explained in the paper. Production estimates adjusted by this method over the period 1949-50 to 1958-59 for 28 crops which are components of the index number of agricultural production compiled by the Ministry of Food and Agriculture are included in the paper. The index number of agricultural production is briefly described and suggestions have been made for its improvement and for the improvement of agricultural statistics generally.