2. Green manuring is not done and in fact, when tried, was a failure; this is because, no rains are received at all during summer, when cracks develop in the soil, making it unfit for crop growth; the soil again gets soaked only with the receipt of rains in May.

3. He was inclined to think that if not the *settoon*, at least the Burmese harrow could be used with advantage on our soils.

4. The size of fields varied from 20 cents to 5 acres depending on distance from channels.

5. The labour population, not only for agricultural but for other purposes, is mostly supplied by emmigrants from Vizagapatam, who regularly sail over to Burma in batches, during the season; this is because Burmese labour is poor.

6. The cost of production of rice per acre, which 3 years ago was about Rs. 15 now ranges from Rs. 20 to 22]

POPULATION AND PRODUCTION IN INDIA, 1920–32.[1]

By P. J. THOMAS, *Professor, Madras University.*

The increase of 10·5 per cent. in the population of India between 1920 and 1930 has created considerable uneasiness in many quarters. The author of the Census Report, 1931, views it with alarm and this is shared by a large number of publicists. Mr. R. W. Brock, formerly the Editor of *Capital*, made the following statement at a meeting of the East India Association in 1932:—'So far as the official figures indicate there has certainly not been any increase in India's agricultural and industrial production, in any way proportionate to the increase of her population, and the only possible inference appears to be that there has been a fall in the average income and therefore the average standard of living.'[2] This startling statement challenges a statistical examination of the problem.

There is one serious difficulty in accurately estimating production in India. Not less than 70 per cent. of the people are dependent on agriculture, but the available statistics of agricultural production are hardly reliable, as they are based on a very imperfect system of crop forecasts. The forecasts of crop outturn in India are based on (1) area under cultivation; (2) the standard of normal outturn per acre; and (3) the condition factor or the annavari estimate. The figures of area are supplied by the Revenue Department, and are fairly reliable except in the permanently settled tracts of Bengal, Bihar and Orissa, and parts of the United Provinces. The standard outturn is 'the average yield on average soil in a year of average character'. The outturn figures are deduced from crop-cutting experiments, but in most provinces such experiments have not been systematically carried out, and in some they have not been undertaken since 1919; and although in the meantime considerable increase in the area under improved varieties of crops has taken place, the figures adopted in 1919 are still used for estimating crop yields. The worst link in the chain is the annavari estimate which is submitted by the village patwari. The annavari represents the relation of the crop reported on to the normal crop per acre, but it is based on guess-work.

The result is that year after year, the crop forecasts made have proved either an under-estimate or an over-estimate, generally the former. In the case of two crops—cotton and jute—it is possible to test the forecasts by a post-mortem examination. Such a test showed that in both cases the forecasts had been under-estimated. In the case of cotton, the difference is 17 per cent. and in the

1. I am grateful to Dr. A. L. Bowley and Mr. Sundararama Sastri for help in regard to the method and the tables.

2. *Asiatic Quarterly*, 1932, p. 440.

case of jute, 18·6 per cent. The annual average production of cotton for ten years, was 5.380,000 bales, but the post-mortem examination showed that it was 838,000 bales less than the actual crop of those years. In the case of jute, the divergence has been even wider. In a single year (1922) the difference came to 52 per cent. (The forecast was 47·37 million bales; but the actuals came to 64·36 million bales). The area under improved crops has been increasing at a rapid pace during the decade 1920–30; from 2,507 acres in 1920–21, it rose to 12,016 acres in 1930–31. It is true that such under-estimation has made the statistics rather defective as commercial information, but the error is 'systematic', and as we are here dealing with only 'relatives', it does not affect the result tangibly.

The position in respect of industrial production is slightly better, because although there are no recorded statistics of production in unorganized industries, the statistics of production in the organized industries are fairly accurate, within certain limits. In the case of textiles (cotton and jute), we have statistics for a fairly long period, and for iron and steel, sugar, coal, paper, etc., we have complete statistics for the last decade. The publication, from September 1933, of the *Monthly Survey of Business Conditions* has greatly improved our knowledge of production in the chief organized industries, but we have still only a hazy knowledge of unorganized industries, which employ the great majority of our industrial population. Hence the need for a comprehensive economic survey, as recommended by Dr. Bowley and Mr. Robertson.

The progress of industrial production has been rapid since the War. The advance has been phenomenal in sugar and large in cement and in iron and steel. The value of organized industrial production today may be between one-third and one-half of that of primary products. The progress has been even more rapid since 1929.

Four statements are given below to illustrate them. The first two deal with agricultural production (chief crops) and the next two deal with industrial production (chief industries). The period taken for the analysis is the 12 years from 1920–21 to 1931–32. The average of the estimated production (both agricultural and industrial) during the years 1920–21 and 1921–22 is taken as the base. On this basis the relatives of the several commodities for the successive biennial periods are calculated. The general or composite index number of production for each biennial period is a weighted average of the relatives, the weights being proportional to the values of the several commodities. Throughout, the price per unit of the commodity is taken as constant. For all agricultural commodities the average wholesale prices in the years 1920–21 and 1921–22 (base period) are taken as the prices per unit. As prices for all the industrial products for the base period are not available, those of the prices which are given in the *Indian Trade Journal* (cotton yarn, piecegoods, jute bags and gunny cloth, and sugar) are taken for that period, and the rest are standard prices recommended by the Tariff Board. These prices are only a means to get the weights, and slight variations in weights do not alter the composite index number to any material extent.

In Tables I and III average estimated production and value of each commodity are given; and in Tables II and IV, the relatives with the respective weights assigned to each commodity are given. The formulae used in calculating the composite index number are:—

1. Weighted arithmetic mean.

$$100 \times \frac{\Sigma p_0 q_1 \times \frac{q_1}{q_0}}{\Sigma p_0 q_1}$$

p_0 price per unit of the commodity in the base year.
q_0 production of the commodity in the base year.
q_1 production of the commodity in the given year.

TABLE I

Agricultural Production (Quantity and Values)

(Average of two years).

Commodity.	Average Price per Unit in 1920–21 and 1921–22 (base period).	1922–23 and 1923–24		1924–25 and 1925–26		1926 27 and 1927–28		1928–29 and 1929–30		1930–31 and 1931–32	
		Quantity.	Value (Crores of Rs.)	Quantity.	Value (Crores of Rs.)	Quantity.	Value (Crores of Rs.)	Quantity.	Value (Crores of Rs.)	Quantity.	Value (Crores of Rs.)
Rice (millions of tons) ...	Rs. 9 per cwt.	31	558	30·9	556	29	504	31·5	567	32 6	587
Wheat (millions of tons) ...	Rs. 9—1—0 per cwt.	9·9	179	8·8	159	8 4	152	9·5	172	9·2	167
Sugar cane (millions of tons)	Rs. 55 per 500 lbs.	3·2	79	2 8	69	3·3	81	2·7	67	3·6	89
Tea (million lbs.)	Rs. 0—9—3 per lb.	343	20	369	21	392	23	418	25	392·6	23
Cotton (million bales) ...	Rs. 50—9—0 per cwt.	5·2	94	6·2	112	5·5	100	5·5	100	4 6	83
Jute (million bales)	Rs. 300—6—0 per ton	8·3	45	10·5	57	10·1	55	10·7	58	5·7	31
Linseed (thousand tons) ...	Rs. 12—6—0 per cwt.	568	14	551	14	377	9	351	8	394	10
Rapeseed (thousand tons) ...	Rs. 11—6—0 per cwt.	1179	28	1065	26	922	22	1002	23	1014	24
Sesam (thousand tons) ...	Rs. 15—4—0 per cwt.	463	14	467	14	479	14	430	13	495	15
Groundnuts: nuts in shell (millions of tons)	Rs. 13—4—0 per cwt.	1·2	24	1·8	36	2·4	48	2·9	58	2·9	58
Indigo (thousand cwt.) ...	Rs. 41 -9—0 per cwt.	44	2	25	1	15	1	14·5	1	12	1
Coffee (million lbs)	Rs. 59—3—0 per cwt.	22	2	26	3	35	4	33·5	4	33	4
Rubber (million lbs.)	Rs. 78—0—0 per cwt.	13	1	18	2	25	3	27·5	3	22	2
Jowar (millions of tons) ...	Rs. 6 per md.	5·8	95	5·6	91	5·9	96	6·3	103	6·6	108
Bajra (millions of tons) ...	Rs. 6—5—0 per md.	2·3	41	2·1	37	2·5	44	2 0	36	2·7	48
Maize (millions of tons) ...	Rs. 5 per md.	2·1	29	1·8	25	2·1	29	2 2	30	2·35	33
Gram (millions of tons) ...	Rs. 7 per md.	4 9	94	4·1	78	3·6	69	2 9	58	3·6	69
Barley (millions of tons) ...	Rs. 10—4—0 per cwt.	3·0	62	2·6	54	2·4	50	2·4	48	2·4	48

TABLE II

Agricultural Production—(Index Numbers)

Base: Average of 1920–21 and 1921–22 = 100.

Commodity.	Average of 1922–23 and 1923–24		Average of 1924–25 and 1925–26		Average of 1926–27 and 1927–28		Average of 1928–29 and 1929–30		Average of 1930–31 and 1931–32	
	Index.	Weight.	Index.	Weight.	Index.	Weight.	Index.	Weight.	Index.	Weight.
Rice	102	40	101	41	95	37	103	42	107	42
Wheat	121	13	107	12	102	12	116	13	112	12
Sugar-cane	128	6	112	5	132	6	108	5	142	6
Tea	111	1	119	1	127	2	135	2	127	2
Cotton	130	7	155	8	138	8	137	7	115	6
Jute	177	3	223	4	215	4	228	4	121	2
Linseed	161	1	153	1	107	1	99	1	115	1
Rapeseed	117	2	105	2	91	2	99	2	100	2
Sesam	103	1	104	1	106	1	96	1	110	1
Groundnuts	120	2	180	3	240	4	290	4	290	4
Indigo	80	...	45	...	28	...	26	...	22	...
Coffee	105	...	124	...	167	...	160	...	157	...
Rubber	118	...	164	...	228	...	250	...	200	...
Jowar	89	7	86	7	91	7	97	8	102	8
Bajra	100	3	91	3	109	3	87	3	117	3·5
Maize	91	2	78	2	91	2	96	2	102	2·5
Gram	111	7	93	6	82	5	66	3	82	5
Barley	107	5	92	4	86	4	86	3	86	3
Composite Index Numbers										
Weighted Arithmetic Mean ...	**111**		**112**		**113**		**111**		**116**	
Aggregative type	**109**		**107·4**		**106**		**102**		**112**	
Median	**100**		**106**		**108**		**101**		**115**	

Weighted Arithmetic Mean ...	111	112	113	111	116
Aggregative type	109	107·4	106	102	112
Median	100	106	108	101	115

TABLE III

Industrial Production (*Average of two years*).

Commodity.	Average price in base period.	1920–21 and 1921–22	1922–23 and 1923–24		1924–25 and 1925–26		1926 27 and 1927–28		1928–29 and 1929–30		1930–31 and 1931–32	
		Quantity.	Quantity.	Value (Crores of Rs.)	Quantity.	Value (Crores of Rs.)	Quantity.	Value (Crores of Rs.)	Quantity.	Value (Crores of Rs.)	Quantity.	Value (Crores of Rs)
*Cotton yarn (millions of lbs.)	Re. 1—8—0 per lb.	677	661·5	74·55	790·3	88·91	808	90·9	741	83·36	916·5	103·11
Cotton cloth (millions of yds.)	Rs. 0·4 per yard	165·6	1713·5	68·54	1962·0	78·48	2324	92·96	2116·5	84·66	2651·5	106·06
Jute bags (millions)	Rs. 0·46 per bag	438·3	365·5	16·81	419·4	19 29	437	20·06	480·4	22·10	478·2	22·00
Jute cloth (millions of yds)...	Rs. 0·2 per yard	1314	1187·5	23·75	1402·5	28·05	1482	29·64	1560·5	31·21	1461	29·22
Sugar (thousands of tons) ...	Rs. 470 per ton	74·3	84·4	3·97	79·4	3·74	120·4	5·62	105·0	4·94	189·9	8·93
Coal (millions of tons) ...	Rs. 9 per ton	186·5	19·4	17·46	21·1	18·99	21·7	19·53	23·0	20·70	22·8	20·52
Cement (thousands of tons).	Rs. 53 per ton	112	193·0	1 03	321·0	1·71	512	2·71	555	2·95	555	2·95
Paper (Do.).	Rs. 464 per ton	29	25·0	1·16	27·1	1·26	33·0	1·53	39·1	1·82	39·1	1·82
Pig Iron (Do.).	Rs. 34·5 per ton	339·6	454·0	1·57	876·3	3·02	1021·3	3·52	1116·5	3·85	1085·5	3·75
Steel (Do.).	Rs. 180 per ton	119·2	131·3	2·36	284·0	5·11	394·5	7·11	344·0	6·19	442·0	7·96

* As we are here comparing the growth of industrial activity at different periods, the question of double counting does not arise.

TABLE IV

Industrial Production: Index Numbers

Base: Average of 1920–21 and 1921–22 = 100.

Commodity.	1922–23 and 1923–24		1924–25 and 1925–26		1926–27 and 1927–28		1928–29 and 1929–30		1930–31 and 1931–32	
	Index. No.	Weight.	Index. No.	Weight.	Index. No.	Weight.	Index. No.	Weight.	Index. No.	Weight.
Cotton yarn	97·5	35	103·5	36	119·5	33	109·5	32	136	34
„ cloth	103·5	32	118·5	31	140·5	34	128·0	32·5	161	35
Jute bags	83	8	96	8	100	7	110·0	8	109	7
„ cloth	89	11	107	11	112·5	11	118·5	12	112	9
Coal	104	8	113	8	116	7	126	8	122	7
Sugar	114	2	107	1·5	162	2	141	2	256	3
Steel	110·5	1	238	2·0	331·5	3	289	2	320	1
Pig Iron	129·5	1	258	1·0	301	1	329	1·5	371	2·5
Cement	172·5	1	286·5	1·0	457·5	1	495·5	1	504	1
Paper	86	1	93·5	0·5	114·0	1	134·5	1	138	0·5
Composite Index Numbers										
Weighted Arithmetic Mean ...	**99**		**115**		**137**		**130**		**151**	
Aggregative type	**98**		**111**		**128**		**122**		**144**	
Median	**104**		**110**		**130**		**131**		**149**	

2. Aggregative type.

$$100 \times \frac{\Sigma p_0 q_1}{\Sigma p_0 q_1 \times \frac{q_0}{q_1}}$$

3. *The Median.*

The weighted arithmetic mean is the biased II type of Fisher (refer Fisher's *Making of Index Numbers*). In Appendix II, Art. 8 of the same book it is pointed out that for the arithmetic mean this is the best system of weighting, because the upward bias possessed by the average has to be counteracted by a downward bias in weighting. As for the aggregative type, it is pointed out by Fisher that the two types differ very little and hence, for the sake of convenience in calculations the given formula is chosen.

In result, we obtain the following indices of population and production during the period :—

	1920–21 to 1921–22	1922–23 to 1923–24	1924–25 to 1925–26	1926 27 to 1927–28	1928–29 to 1929–30	1939–31 to 1931–32
Population[1]	100	102	104	106	108	110·4
Production[2]						
(1) Agricultural	100	111	112	113	111	116
(2) Industrial	100	99	115	137	130	151

It may be clear from the above that agricultural production has kept pace with population, and that industrial production has increased much faster than population. In the decade 1920–30, population increased by 10·5 per cent., but this is abnormal for India, seeing that in the three previous decades, population increased only by 2·5, 7·1 and 1·2 per cent., respectively. The increase of population between the biennial periods 1920–21 to 1921–22 and 1930–31 to 1931–32 had been 10·4 per cent. but agricultural production increased by about 16 per cent. and industrial production by 51 per cent. during the same period. The slow growth of agricultural production is due largely to the declining demand for cereals, especially dry grains, which are being supplanted by rice and wheat. India formerly exported large quantities of wheat, but today most of it is consumed at home. Thus some classes at any rate have raised their standard of living. Considering the limited scope for the expansion of rice cultivation, it is likely that India will have to depend increasingly on imported rice in future.[3] However, there is a large compensating factor in the steady growth of industrial production.

A decade, even twelve years, is far too short a period for correlating population and production. The thirty years between 1900 and 1930 may provide better scope for such a correlation. Full statistics of industrial production for the period are not available, and therefore only cotton yarn, piecegoods, jute cloth and gunny bags, and coal are taken, but the figures for agricultural production are fairly complete. The following table gives quinquennial indices of population and agricultural production, worked out by Fisher's weighted aggregate index method.

Period.	Population	Agricultural production.	Industrial production.
1900–01—1904–05	100	100·0	100
1905–06—1909–10	104	103·0	142
1910–11—1914–15	107	123·5	187
1915–16—1919–20	103	124·5	255
1920–21—1924–25	109	120·0	251
1925–26—1929–30	113·5	129·0	289

1. It is assumed that population increased uniformly from year to year.
2. Indices worked on the Weighted Arithmetical Mean.
3. See *Madras Census Report* (1931) I, p. 47.

Population increased by 19 per cent. between the two censal years 1901 and 1931, but if we compare the first and last quinquennia, as in the case of production, the increase is only 13 5 per cent. Thus, when population increased by 13·5 per cent. production increased by 29 per cent. The index would be much higher if we take the arithmetic mean; for the production of several commodities increased enormously during the period. Groundnuts, for example, increased from 93,000 tons to 2,466,000 tons, i. e. 2,500 per cent. Industrial production has also increased rapidly; the annual production of cotton textiles increased from 500 million yards in 1900 to 2,654 million yards in 1931–32. Hardly any pig iron was made in 1900; but 1,085,000 tons of it was made in 1931–32.

Thus, whatever period we may take, there is no indication that population has outstripped production. It does not mean that India is not overpopulated. It may, or may not be; that is a different question, and I do not propose to deal with it here. All I can see from the statistical study carried out is that if India was not overpopulated in 1900—and that is the view of some—it is not overpopulated now. Production has been keeping pace with population; and in some lines—e.g., industry, commercial crops—it has increased at a much more rapid pace than population. And this progress has been kept up during the world depression—and that is a significant fact. [From the *Madras Univ. Journal* Vol. VII, No. 2, pp. 93—102 by courtesy of the Author].

ABSTRACTS

A simple apparatus for measuring the compactness of soil in the field, and some results obtained in a cultivation experiment. By O. V. S. Heath (*The Empire Jour. of Experi. Agri.* vol. ii. No. 7 pp. 205—212). The article describes a simple and easily-made apparatus, for measuring compactness in a soil, the method of working it, and the results obtained with it. Based on the principle of the stratometer, the apparatus consists of a tripod, supporting an iron rod which bears at its lower end a steel cone. A length of steel pipe surrounding the rod, serves to carry the force of impact direct to the cone, the rod only serving as a guide. The weight is lifted to a mark on a graduated scale behind and allowed to fall freely, thus driving the point into the soil. A "soil plate" placed flush with the soil, and provided with a projecting tube which prevents loose soil falling into the hole made by the steel cone, completes the apparatus.

The apparatus was used on a cultivation experiment with three treatments, which were designed to give different degrees of soil compactness, namely:—normal, grubbed and compressed soil,—and results obtained by the apparatus are very comparable and satisfactory. More than any thing else, cheapness of its construction, should appeal, to all who desire a fairly satisfactory method of comparing soil compactness in different treatments. M. R. B.

Activation of cambial growth by pure Hormones. By R. Snow (*The New Phytologist*, Vol. 34, No. 5, p. 23). An extremely interesting paper which throws light on the possible nature of the hormone present in leaves, which is responsible for cambial growth. Urine being a good and abundant source of auxin and other hormones, the ether-soluble extract of urine was tried on young sunflower seedlings, which were decapitated before applying the solution to the cut surface. The experiment was also done in the hypocotyl-region and the results show that cambial growth is activated by solutions in gelatine of synthetically prepared hetro-auxin and auxin-£—in minute concentrations. From the results, it is concluded that the normal cambial growth is promoted in plants by the same growth—hormone (perhaps auxin-£) in young leaves. M. R. B.

The non-protein nature of a fraction of soil organic Nitrogen. By A. W. J. Dyek and R. R. Mckibbin (*Can. Jour. of Res.* Vol. 13, No. 5, pp. 264—269). In the case a number of samples of organic soils, drawn from widely different locations in the