A STUDY ON AGRICULTURAL GROWTH DURING 1950-1963 IN INDIA

AMIYAMOY CHATTERJI

Indian Statistical Institute, Calcutta

INTRODUCTION

1.0 A study of agricultural growth based on acreage and production data published by the Ministry of Food and Agriculture is the aim of this paper.

1.1 Agricultural production includes production of vegetables and livestock products besides cereals, pulses and other non-food crops like cotton, jute, etc. But as the statistics of the former items on a national basis are scanty and unreliable, the analysis of agricultural growth has been confined to three items of study, *viz.*, area under crop, production and productivity of important cereals and pulses—rice, wheat, jowar, bajra, maize, barley, gram and other pulses—and two primary non-food crops—jute and cotton.

MATERIAL AND METHODS

2.0 Since our interest is more in the relative growth than absolute, the index numbers of area under crop, production and productivity have been used with 1949-50 as the base year instead of the actual figures. The period covered for the study was 1950-51 to 1962-63. Each year considered was an agricultural year (July to June). The period was so chosen as to see the impact of the two Five-Year Plans on agricultural growth. The year 1949-50 was selected as the base as it was the most normal year with respect to production and price.

2.1 Among the various known methods of measuring growth, the method of trend-fitting was considered to be most suitable as it would remove any effect due to seasonal and cyclical factors. The trend is given by the equation,

$$Y = a + bX$$

where Y is the trend value depending on X which represents a particular year. By suitably selecting the origin, *viz.*, the mid-year 1956-57 as zero, and by assigning values of remaining years in such a way that the sum is zero the constants a and b of the trend equation are given by,

$$a = \frac{\Sigma Y}{N} \qquad \text{and} \qquad b = \frac{\Sigma XY}{\Sigma X^2}$$

where N is the number of years, considered.

2.2 Now if F_t and F_0 are the values in t th and initial year, *i.e.*, the base year respectively, then the comparative growth measured between the base year and t th year denoted by G_{t-0} is defined as :

$$G_{t-0} = \frac{F_t - F_0}{F_0} = I_t - 1$$

when $$I_t = \frac{F_t}{F_0}$$

And 'growth' between t th and t' th years, denoted by :

$G_{t-t'}$ is given by,

$$G_{t-t'} = \frac{F_t - F_{t'}}{F_{t'}} = \frac{I_t - I_{t'}}{I_{t'}}$$

$$= \frac{Y_t - Y_{t'}}{Y_{t'}} = \frac{b(t-t')}{Y_{t'}}$$

where Y_t and $Y_{t'}$ are the trend values of I in t th and t' th years respectively. Thus $G_{t-t'}$ will be an 'indicator' of growth.

RESULTS

(a) *The Trend of Agricultural Growth*

3.0 The trend of agricultural growth has been studied with respect to three factors, *viz.*, area under crop, production and productivity. Straight lines were fitted to the index numbers of the characteristics mentioned above, with 1949-50 as the base year.

3.1 Table I which showed the trend values of index numbers of area under crop from 1950-51 to 1962-63, revealed that the acreage under wheat and maize increased to a greater extent than other cereals and pulses in general. There was very little expansion in the acreage under barley; on the contrary, the area under it tended to decline. The area under cotton and jute did not increase to any appreciable extent.

3.2 The trend of index number of production, as shown in Table II, suggested that among all food crops, wheat reported the highest gross yield followed closely by maize while the remaining cereals and 'other pulses' had a small increase in output. The yield of gram, an important food crop, was found to be declining. Of the two cash crops, production of cotton increased considerably but that of jute remained almost unchanged since 1950-51.

3.3 Table III showing the trend values of index number of productivity indicated that output per acre of all items of food crops had increased at a slow pace, excepting that of gram which had a higher rate of increase in productivity as compared to that of 1949-50. Among the two cash crops, while cotton showed some improvement in productivity, jute had little.

(b) *Comparative Study of Growth Rates*

3.4 The regression coefficient calculated to fit the trend of index numbers of the three characters would be an estimate of growth rate. These growth

TABLE I—TREND VALUES OF INDEX NUMBER OF AREA UNDER CROP IN INDIA FROM 1950-51 TO 1962-63

(Base year : 1949-50)

Crops	Agricultural years												
	1950-51	1951-52	1952-53	1953-54	1954-55	1955-56	1956-57	1957-58	1958-59	1959-60	1960-61	1961-62	1962-63
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)
1. Food crops													
Rice	97.4	98.7	100.0	101.3	102.6	103.9	105.2	106.5	107.8	109.1	110.4	111.7	113.0
Wheat	91.4	96.4	101.5	106.6	111.7	116.8	121.9	126.9	132.0	137.1	142.2	147.3	152.3
Jowar	106.0	106.8	107.6	108.4	109.1	109.9	110.6	111.4	112.4	112.3	113.7	114.4	115.2
Bajra	111.9	112.8	113.8	114.7	115.6	116.5	117.5	118.4	119.3	120.2	121.2	122.1	123.0
Maize	99.9	103.3	106.7	110.1	113.5	116.7	120.3	123.7	127.1	130.5	133.9	137.3	140.7
Barley	103.8	103.8	103.8	103.7	103.7	103.7	103.7	103.6	103.6	103.6	103.5	103.5	103.5
All cereals	101.5	104.2	106.8	109.5	112.2	114.9	117.6	120.2	122.9	125.6	128.3	131.0	133.7
Gram	91.6	94.3	96.9	99.6	102.3	104.9	107.6	110.3	112.9	115.6	118.3	120.9	123.6
Other pulses	100.6	102.8	104.9	107.0	109.2	111.3	113.4	115.6	117.7	119.8	121.9	124.1	126.2
All food crops	101.1	102.6	104.2	105.7	107.3	108.8	110.3	111.9	113.4	115.0	116.5	118.1	119.1
2. Non-food crops													
Jute	128.3	131.6	134.9	138.2	141.5	144.9	148.2	151.5	154.8	158.2	161.5	164.8	168.1
Cotton	132.9	135.8	138.6	141.4	144.2	147.0	149.8	152.7	155.5	158.3	161.1	163.9	166.7

TABLE II—TREND VALUES OF INDEX NUMBER OF AGRICULTURAL PRODUCTION IN INDIA FROM 1950-51 TO 1962-63

(Base year : 1949-50)

Crops	Agricultural years												
	1950-51	1951-52	1952-53	1953-54	1954-55	1955-56	1956-57	1957-58	1958-59	1959-60	1960-61	1961-62	1962-63
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)
1. Food crops													
Rice	92.0	95.9	99.7	103.6	107.4	111.3	115.1	119.0	122.8	126.7	130.5	134.3	138.2
Wheat	98.6	104.7	110.9	117.0	123.1	129.2	135.4	141.5	147.6	153.7	159.9	165.0	172.1
Jowar	99.2	101.9	104.6	107.4	110.1	112.8	115.5	118.2	120.9	123.6	126.3	129.1	131.8
Bajra	93.1	95.2	97.3	99.4	101.5	103.5	105.6	107.7	109.8	111.9	114.0	116.1	118.2
Maize	100.5	105.4	110.3	115.2	120.1	125.0	129.9	134.8	139.7	144.5	149.5	154.4	159.2
Barley	112.4	112.8	113.3	113.7	114.2	114.6	115.0	115.5	115.9	116.3	116.8	117.2	117.7
All cereals	94.9	98.8	102.6	106.4	110.2	114.0	117.8	121.6	125.4	129.2	133.0	136.8	140.7
Gram	98.5	97.3	96.1	94.9	93.6	92.4	91.2	90.0	88.8	87.5	86.3	85.1	83.9
Other pulses	90.0	91.5	92.9	94.3	95.7	97.1	98.5	100.0	101.4	102.8	104.2	105.6	107.0
All food crops	95.3	99.0	102.7	106.3	110.0	113.7	117.3	121.0	124.6	128.3	132.0	136.0	139.3
2. Non-food crops													
Jute	134.2	134.8	135.3	135.8	136.3	136.9	137.4	137.9	138.4	138.9	139.5	140.0	140.5
Cotton	121.9	128.1	134.2	140.3	146.4	152.5	158.6	164.8	170.9	177.0	183.1	189.2	195.4

TABLE III—TREND VALUES OF INDEX NUMBER OF AGRICULTURAL PRODUCTIVITY IN INDIA FROM 1950-51 TO 1962-63

(*Base year: 1949-50*)

Crops	Agricultural years												
	1950-51	1951-52	1952-53	1953-54	1954-55	1955-56	1956-57	1957-58	1958-59	1959-60	1960-61	1961-62	1962-63
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)
1. Food crops													
Rice	95.0	97.3	99.7	102.0	104.3	106.7	109.0	111.3	113.6	116.0	118.3	120.6	123.0
Wheat	100.4	102.1	103.8	105.5	107.1	108.8	110.5	112.2	113.9	115.5	117.2	118.9	120.6
Jowar	93.5	95.3	97.1	98.8	100.6	102.4	104.2	106.0	107.7	109.5	111.3	113.1	114.9
Bajra	77.2	78.4	79.6	80.8	82.0	83.2	84.4	85.6	86.8	88.0	89.2	90.3	91.5
Maize	100.7	101.8	103.0	104.1	105.2	106.3	107.4	108.6	109.7	110.8	111.9	113.1	114.2
Barley	108.2	108.6	109.1	109.5	110.0	110.4	110.9	111.3	111.8	112.2	112.7	113.1	113.6
All cereals	95.5	97.7	99.9	102.1	104.3	106.5	108.7	110.9	113.1	115.3	117.5	119.7	121.9
Gram	37.8	55.5	73.2	90.8	108.5	126.1	143.8	161.4	180.1	196.7	214.4	232.0	249.7
Other pulses	91.1	89.6	89.1	88.6	88.1	87.6	87.1	86.6	86.1	85.6	85.1	84.6	84.1
All food crops	94.6	96.5	98.4	100.2	102.1	104.0	105.9	107.8	109.7	111.6	113.4	115.3	117.2
2. Non-food crops													
Jute	82.0	82.4	82.8	83.3	83.7	84.1	85.0	85.4	85.8	86.2	86.7	87.1	87.5
Cotton	92.1	94.3	96.5	98.7	100.9	103.0	105.2	107.4	109.6	111.7	114.0	116.1	118.3

rates of different food crops and cash crops under study with respect to the factors, *viz.*, area under crop, production and productivity, are shown in Table IV.

TABLE IV—ANNUAL GROWTH RATES OF AREA UNDER CROP, PRODUCTION AND PRODUCTIVITY DURING 1950-1963

Crops	Annual growth rates of index numbers of		
	Area under crop	Production	Productivity
(1)	(2)	(3)	(4)
Rice	1.30	3.85	2.33
Wheat	5.08	6.13	1.68
Jowar	0.76	2.71	1.78
Bajra	0.93	2.10	1.20
Maize	3.40	4.90	1.12
Barley	—0.03	0.44	0.45
All cereals	2.68	3.81	2.20
Gram	2.67	—1.22	17.65
Other pulses	2.13	1.42	—0.50
All food crops	1.55	3.66	1.89
Jute	3.32	0.52	0.42
Cotton	2.82	6.12	2.18

Annual increase in per acre of output of all food items, excepting that of gram which had a higher rate of increment, was small in comparison to those in the base year.

3.5 The ratios between any two regression coefficients or growth rates shown in Table IV were used as 'indicators' for a comparative study of the growth rates of different factors, *viz.*, area under crop, production and productivity. The 'indicators' β_1, β_2 and β_3 were thus given by following relationships:

$$\beta_1 = \frac{b_P}{b_A}; \quad \beta_2 = \frac{b_P}{b_R}; \quad \beta_3 = \frac{b_R}{b_A}$$

where b_A, b_P and b_R are the regression coefficients of the index numbers of area under crop, production and productivity respectively.

3.6 Values of these indicators shown in Table V showed that β_1 was negative for barley and gram and ranged between 3.6 and 0.7 for remaining food crops and varied between 2.2 and 1.6 for cash crops. β_2 was estimated to be positive, ranging between 4.4 and 1.0 for all cereals and to be negative for gram and other pulses. The variation was wide (between 2.8 and 1.3) among the two cash crops. β_3 was found to be negative for barley and other pulses, and it varied from 6.6 to 0.3 for other food crops. The variation was very little (0.6 to 0.2) among the cash crops.

TABLE V—VALUES OF β_1, β_2 AND β_3

Crops	β_1	β_2	β_3
(1)	(2)	(3)	(4)
Rice	2.96	1.65	1.79
Wheat	1.20	3.65	0.33
Jowar	3.56	1.53	2.34
Bajra	2.26	1.75	1.29
Maize	1.44	4.36	3.30
Barley	—16.97	0.97	—17.42
All cereals	1.42	1.73	0.82
Gram	—0.46	—0.07	6.62
Other pulses	0.66	—2.34	—0.23
All food crops	2.37	1.94	1.22
Jute	1.58	1.26	0.78
Cotton	2.17	2.80	0.77

3.7 Table VI shows the growth of area under crop, production and productivity of each crop in relation to the year 1950-51. The growth was found to be negative for barley when area under crop was considered. Similarly, it was negative in case of gram with respect to production and productivity respectively.

TABLE VI—VALUE OF G_{63-61}, SHOWING GROWTH BETWEEN 1951 AND 1963

Crops	Area under crop	Production	Productivity
(1)	(2)	(3)	(4)
Rice	0.16	0.50	0.29
Wheat	0.67	0.75	0.22
Jowar	0.87	0.33	0.23
Bajra	0.99	0.27	0.19
Maize	0.41	0.59	0.13
Barley	—0.00	0.47	0.50
All cereals	0.32	0.48	0.28
Gram	0.35	—0.15	5.60
Other pulses	0.25	0.19	—0.07
All food crops	0.18	0.14	0.12
Jute	0.31	0.05	0.28
Cotton	0.25	0.61	0.07

DISCUSSION

4.0 (a) The trend of indices of area under crop, production and productivity revealed that production of foodgrains was increased during the period 1950-1963 by 39 per cent by extending the cropping area by 20 per cent over the base year. Of the food crops, production of all cereals together was raised by 40 per cent of the production over the base year by extending the cropped area to the extent of 33 per cent over the base year. Although the productivity of all foodgrains and all cereals together was raised by 17 per cent and 20 per cent over the base year respectively, the gross yield was stepped up more by extensive than intensive cultivation.

(b) As regards the two cash crops, the area under jute and cotton reported increase by nearly 68 per cent over the base year; although cotton reported an increase in yield by 95 per cent over the base year, jute yield recorded an increase of 41 per cent only. The higher yield of cotton was more due to increase in its productivity which increased by 18 per cent over the base year than due to extension of acreage. Similarly, the decline in the productivity of jute by 12 per cent caused lower increase in its gross yield. Thus in cash crops like jute and cotton, productivity factor was more responsible for affecting the output than the extension of acreage.

(c) Of the food crops, wheat, maize and rice reported an increase of yield at the rate of 6 to 4 per cent over the base year annually, jowar and bajra at the rate of 3 to 2 per cent, other pulses and barley at the rate of 1.4 per cent and 0.4 per cent respectively. Gram, however, showed a declining rate of 1.2 per cent per year. Among the cash crops although cotton reported an increase at the rate of 6 per cent over the base year per year, yield of jute increased at the rate of 0.5 per cent over the base year. Similarly, the annual rate of increase in the cropped area under wheat, maize and gram ranged between 5 and 3 per cent, that of rice, bajra, jowar and other pulses between 2 and 1 per cent, and barley reported a decline in the cropped area. The area under jute and cotton increased at the rate of about 3 per cent per year. But it is important to note that the annual rate of increase in productivity of cereals with the exception of barley ranged mostly between 1 and 2 per cent, rice reporting the highest increase (2.3 per cent). Barley reported a rate of increase in productivity of the order of only 0.4 per cent. Among the pulses group, gram reported an annual rate of increase in productivity of 17 per cent while other pulses reported a decline in productivity. Of the cash crops the productivity of cotton increased by 3 per cent as against 0.4 per cent in jute.

(d) When the growth of a particular factor under study is compared with another, it was seen that the ratio between the growth of production and the growth of area was 3 for rice and jowar, 2 for bajra and less than 1.5 for the remaining food crops. Comparing the growth of production with the growth of productivity, the ratio was seen to be 3 for wheat and maize, and between 2 and 1 for other food crops. Similarly, when the growth of productivity is compared with the growth of area under crop, the ratio was 6 for gram, 3 for maize, a little over 2 for jowar and less than 2 for all other food crops excepting other pulses and barley which showed negative ratios. Of the cash crops, cotton reported a growth of

production twice that of area, and 3 times that of productivity. The corresponding figures for jute are only 2 and 1. The ratio between the growth of productivity and area was less than 1 both for cotton and jute.

(e) Thus an analysis of time series data relating to acreage, production and productivity of food crops and non-food crops like jute and cotton reveals that (*i*) the growth of output was brought about more by the expansion of area through the extension of cultivation than by the use of productivity-raising factors. (*ii*) Among the food crops, wheat recorded highest growth of output and the major contribution to growth of production of wheat came from land. In the case of barley and gram which are substitute crops for wheat, not much effort has been made to increase their production; on the contrary, their production has tended to decline partly due to bad planning and wrong policy adopted by the government. (*iii*) As a result of a decline in the productivity of jute, its gross yield could not improve despite an expansion in the area under it.