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NOTES

CHANGES IN LAND-USE PATTERN IN PUNJAB*

The purpose of this paper is to attempt an analysis of recent changes in land-use pattern in the different districts of the composite Punjab State as it existed before its bifurcation in November, 1966 between the present States of Punjab and Haryana and the Union Territories of Himachal Pradesh and Chandigarh. The study extends over the years 1950-51 to 1964-65, and covers all the districts of the State except Simla which has been excluded for want of complete and comparable time-series data. The hilly districts of Lahaul-Spiti, and Kulu which were formed out of Kangra district in 1960-61 and 1963-64 respectively, have been treated as if they remained included in the Kangra district.

Districtwise index numbers of area under broad five land-use classes and of gross and multiple sown areas have been constructed with 1950-51 as the base, after making adjustment in the published area figures for the changes arising out of territorial transfers between districts, extension of reporting area, and changes in concepts and definitions and in methods of reporting. From these indices have been computed the growth rate of area under each category. The methods employed for adjustment in the published data, construction of index numbers, and computation of growth rates are the same as adopted in earlier studies.[1]

The indices of the areas under the different categories for the State and its 17 districts included are given in the Appendix. The actual area figures for the last year of the series, 1964-65 are also given there so as to enable generation of comparable area figures for the previous years also. The growth rates of the areas under the different categories, along with their statistical significance, are given in Table I. The net area sown as percentage of total arable land[2] and the degree of multiple cropping[3] during the initial triennium of the study period, 1950-53 are also given for each district and the State in this table.

Shift in Areas between Different Land-Uses

Table I shows that during 1950-51 to 1964-65, the net area sown in the State as a whole increased at the rate of 1.15 per cent per annum. The districts revealed a wide range of variation in their growth rates of net area sown which ranged from negative rate of 0.47 per cent in Gurdaspur and nominal rates of 0.08 per cent and below in Kangra, Hoshiarpur, Rohtak and Amritsar to lower than the all-State rate in Mahendragarh, Ambala, Gurgaon, Ferozepore, Jullundur, Ludhiana, Bhatinda and Sangrur and sufficiently higher than the all-State rate in Hissar, Karnal, Patiala and Kapurthala.

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1. Changes in Land-Use Pattern in India, *Indian Journal of Agricultural Economics*, Vol. XXI, No. 3, July-September, 1966; and Changes in Land-Use Pattern in Madras State, *Agricultural Situation in India*, Vol. XXII, No. 12, March, 1968.

2. Here arable land is defined to include total land minus forests and land not available for cultivation.

3. Degree of multiple cropping is defined as the ratio of gross sown area to net sown area.

TABLE I—GROWTH RATES OF AREAS UNDER FIVE BROAD LAND-USE CLASSES, GROSS AND MULTIPLE SOWN AREAS, AND NET, GROSS AND MULTIPLE SOWN AREA IRRIGATED DURING 1950-51 TO 1964-65 AND INITIAL LEVELS OF EXPLOITATION OF ARABLE LAND FOR CULTIVATION AND OF DEGREE OF MULTIPLE CROPPING IN PUNJAB AND ITS 17 DISTRICTS

District	Growth rate, per cent per annum							Net sown area as % of total arable land during 1950-53	Degree of multiple cropping during 1950-53
	Forest	Area not available for cultivation	Other un-cultivated land excluding fallows	Fallows	Net sown area	Gross sown area	Multiple sown area		
1	2	3	4	5	6	7	8	9	10
1. Bhatinda	0·00	0·66	— 4·68**	—14·54**	0·99	1·51	4·86**	83·7	1·12
2. Patiala	0·57	0·71	— 6·56**	—10·21**	3·47**	4·01**	6·38***	54·7	1·19
3. Hissar	—10·60**	1·82*	— 9·89**	— 9·90**	2·07*	3·39**	14·99**	67·2	1·06
4. Karnal ..	16·56**	—0·61	— 8·13**	—12·43**	3·45**	4·14**	6·45**	57·4	1·24
5. Mahendragarh	0·00	0·48	— 1·17*	— 4·20*	0·40	2·04*	9·86**	83·5	1·13
6. Ludhiana	16·86**	0·87	— 2·63**	—10·71**	0·98*	1·47**	3·39**	78·8	1·22
7. Jullundur	0·00	2·71**	—30·96**	— 3·74**	0·83*	1·48*	4·75**	79·6	1·16
8. Sangrur	0·00	—0·11	— 4·45**	— 9·48**	1·09*	1·94*	5·21**	79·0	1·20
9. Ferozepore	0·00	2·07**	1·07	— 8·40**	0·80*	1·39*	6·89*	79·4	1·09
10. Hoshiarpur	0·00	0·73*	— 4·82**	— 3·16**	0·02	1·44*	18·64**	79·5	1·14
11. Rohtak	— 0·38	1·25**	— 1·97**	0·64	0·05	1·10	4·51**	82·1	1·25
12. Ambala	0·24	—0·07	— 2·31**	— 2·76**	0·57*	1·85**	7·62**	79·6	1·17
13. Gurgaon	0·15	0·86	— 7·39**	— 8·95**	0·62	1·37*	6·95**	86·0	1·10
14. Amritsar	1·30*	1·09*	— 0·65	— 1·89	0·08	0·72	2·26*	77·1	1·34
15. Kapurthala	16·56**	0·20	1·22	—15·47**	3·60**	3·80**	4·53**	53·0	1·23
16. Kangra	— 0·03	0·00	— 0·28	0·91	0·02	0·14	0·31	63·5	1·67
17. Gurdaspur	0·65	3·10**	—11·30**	2·69	—0·47	0·58	4·41*	81·7	1·21
State	0·05	1·51**	— 4·25**	— 7·64**	1·15*	1·99**	5·65**	74·2	1·18

*Significance at 5 per cent level.　　** Significance at 1 per cent level.

The increases ·in net area sown were mainly contributed by fallows which declined significantly in all the districts except Rohtak, Kangra and Gurdaspur. Much of the 'other uncultivated land' was also brought under cultivation in varying degrees in the different districts.

Afforestation was carried out on "other uncultivated land" in seven out of the eight districts in which forest area increased. The eighth one is Gurdaspur in which forests seem to have been extended to fallows. Some deforestation, however, occurred in Hissar partly as a result of extension of cultivation and partly on account of construction of canals, etc.

The only districts where the uncultivated area expanded were Ferozepore and Kapurthala where some old fallows were turned into pastures; otherwise the "other uncultivated land," along with fallows, contributed to increase in the area of land not available for cultivation in several districts, and this increase was large in the districts of Gurdaspur, Jullundur, Hissar and Hoshiarpur. While a detailed study including field inquiries would be helpful in locating the causes for expansion in this area, one plausible reason seems to be loss of arable land owing to the construction of buildings and roads, canals and other irrigation sources, factories, etc. The other reason is perhaps extensive water-logging in canal irrigated areas which has turned sizable portions of areas already under cultivation, fallows and "other uncultivated land" into barren and unculturable land.

Growth in Net Sown Area and the Growth Potential

The rate of growth in net area sown may be evaluated in relation to the potential for growth which may be defined in terms of the extent of arable land already sown at the beginning of the study period. Assuming that all arable land, whether put to any economic use or not, are diverted to crop cultivation generally for higher economic gains, the lower ratio of net area sown to total arable land at the beginning of the study period would broadly indicate higher potential for extension of cultivation and vice versa.

Graph I shows the position of each district in relation to the proportion of its arable land sown during the initial triennium, 1950-51 to 1952-53 and its achieved growth rate of net area sown. The extent of exploitation of arable land for crop cultivation was the lowest in Kapurthala, and quite expectedly it recorded the highest growth in net area sown. The arable land was already cultivated to the largest extent in Gurgaon, and yet the rate of growth in net area sown in this district was higher than in several other districts. The straight line passing through Kapurthala and Gurgaon in the graph may be taken to represent extension of cultivation in tune with the availability of arable land for such expansion. Thus, the known potentials for extension of cultivation appear to have been exploited to a fuller extent in Kapurthala, Patiala, Karnal, Hissar, Sangrur, Bhatinda, Ludhiana, Jullundur, Ferozepore, Gurgaon and Mahendragarh. The exploitation of the growth potential in Gurdaspur, Kangra, Hoshiarpur, Amritsar, Rohtak and Ambala which lie sufficiently below the straight line was low. In none of these districts "other uncultivated land" which also includes pasture and miscellaneous tree crop land, increased; and the forest area increased to some extent in Amritsar, Gurdaspur and Ambala only. Apparently, the potential for economic utilization

INITIAL LEVELS OF EXTENT OF ARABLE LAND SOWN AND GROWTH RATES OF NET AREA SOWN IN PUNJAB DISTRICTS
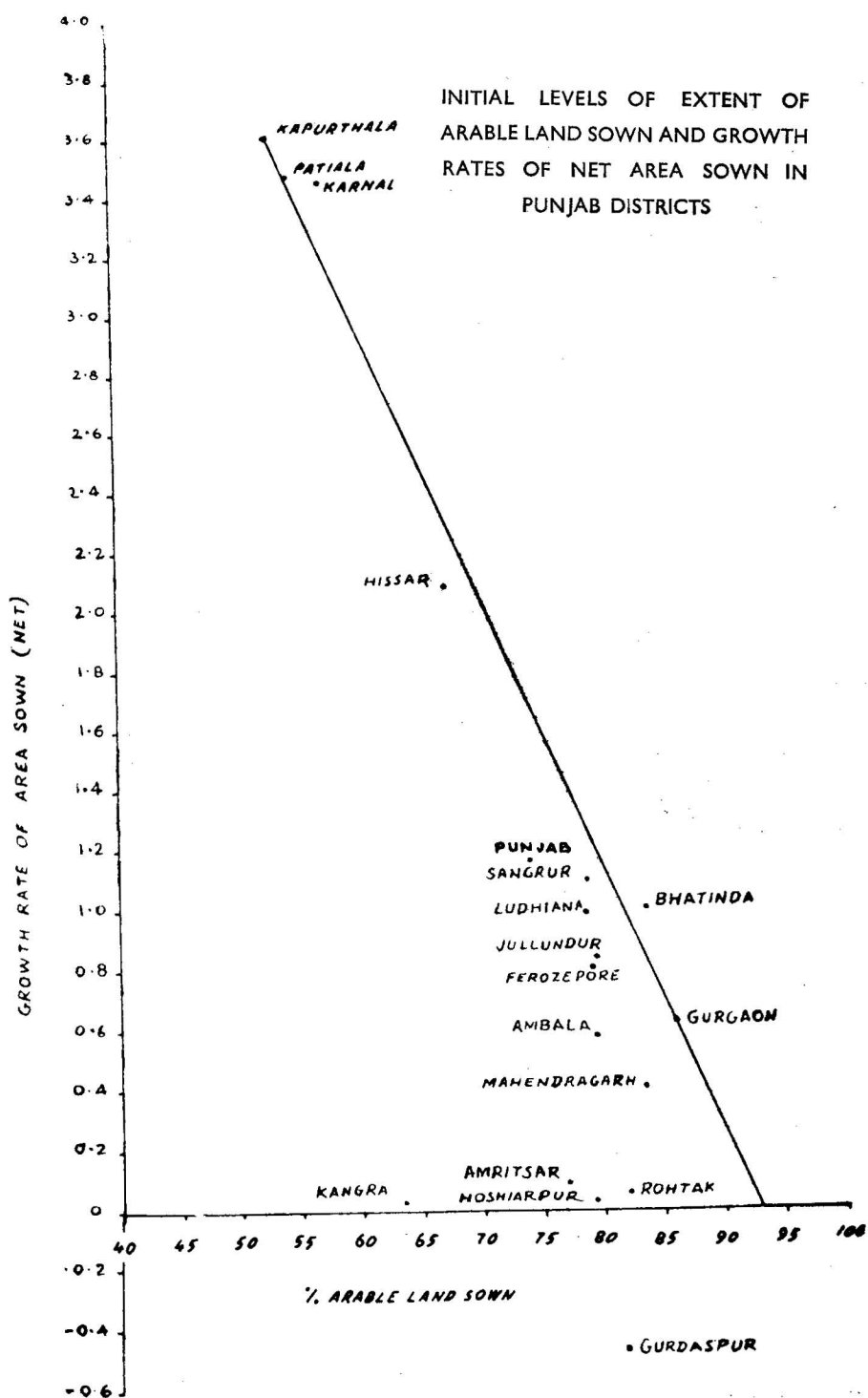
of the arable land was not fully exploited in these districts either for extension of cultivation or for growth of forest or pasture or miscellaneous tree crops.

Growth in Multiple Sown Area and the Growth Potential

Intensive use of the same land to raise two or more crops in successive seasons in the year is another way, besides extension of cultivation, to increase area under crops. Given the necessary conditions, the districts with lower/higher degree of multiple cropping at the beginning of the study period should have larger/ smaller scope for improving the multiple cropping by increasing the area sown more than once. Graph II shows the positions of the different districts in regard to their degree of multiple cropping during the initial triennium, 1950-51 to 1952-53, of the study period and their achieved rates of growth in the area sown more than once. The lowest multiple cropping of 1.06 during the initial triennium was observed in Hissar, and the rate of growth in the multiple sown area achieved in this district was next only to that in Hoshiarpur. The performance of Hoshiarpur in increasing the multiple cropping may be rated as very high inasmuch as it excelled in this regard several other districts, namely, Hissar, Ferozepore, Gurgaon, Bhatinda and Mahendragarh, which, given the necessary conditions, had larger scope for such growth. Hoshiarpur excluded, Hissar may be taken to represent the rate of growth in area sown more than once as could be expected from the prevalent low level of multiple cropping.

The highest multiple cropping of 1.67 during the initial triennium was practised in Kangra; and next in order was Amritsar which had a multiple cropping of 1.34. If Kangra, the sub-montane district where the agricultural conditions are distinctly different from those in the plains districts is excluded, Amritsar may be taken to represent the possible rate of growth in multiple sown area from an already high level of multiple cropping.

The rates of growth in area sown more than once achieved in Hissar and Amritsar and the other districts falling around the straight line passing through these districts in Graph II, namely, Mahendragarh, Ambala, Karnal, Sangrur Rohtak and Kapurthala, conformed to the possibilities of growth. The growth in area sown more than once in other districts which fall much below this line, *viz.*, Ferozepore, Gurgaon, Patiala, Bhatinda, Jullundur, Gurdaspur and Ludhiana was thus much lower than what was achieved in several other districts.

The known potentials for growth were thus exploited to fuller extent in respect of both extension of cultivation and intensive cropping in Hissar, Karnal, Mahendragarh, Sangrur and Kapurthala districts. Generally where cultivation was extended to new areas in a large measure as in Bhatinda, Patiala, Ludhiana, Jullundur, Ferozepore and Gurgaon, the increase in multiple cropping was low. On the other hand, large increase in multiple cropping occurred in the districts like Hoshiarpur, Rohtak, Ambala, Amritsar and Kangra where cultivation to new area was extended to a much lower extent.

Associated Factors

What factors have been in operation singly or in various combinations to enable exploitation of known potentials for expansion of cultivation and/or

Graph II
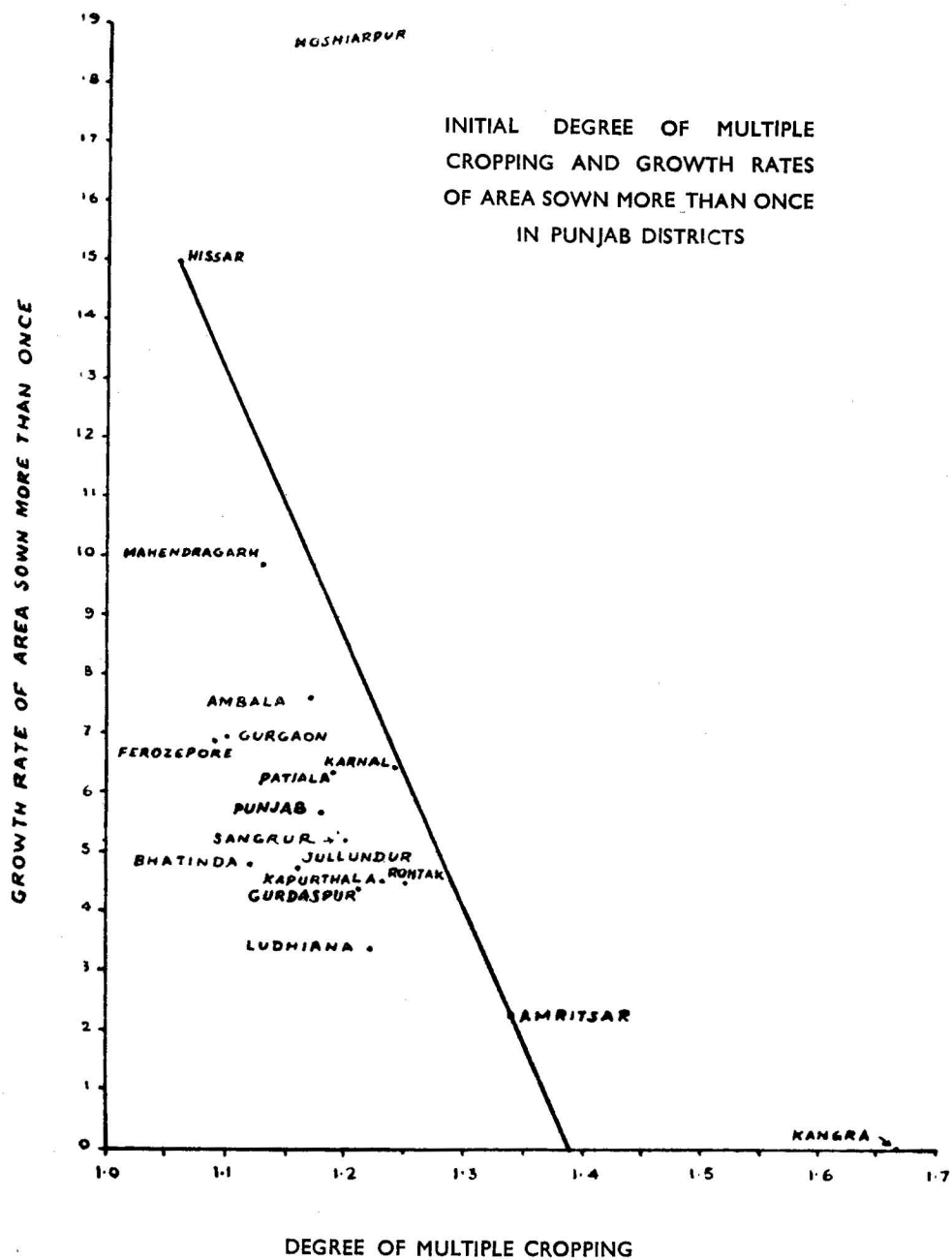
intensification of cropping in some districts; and what have been the impediments to such growths in others? For lack of adequate time-series data, an answer to this question is attempted only in regard to two factors : rural population and irrigation.

The density of rural population per acre of arable land increased by 20 to 45 per cent in 1961 over 1951 in all the districts except Amritsar, Kapurthala and Kangra; and in several districts this increase was recorded from an already high level of density (Table II)

TABLE II—GROWTH IN DENSITY OF RURAL POPULATION PER ACRE OF ARABLE LAND IN PUNJAB AND ITS 17 DISTRICTS

District	Rural Population per acre of net arable land		
	1951	1961	Per cent increase in 1961 over 1951
1	2	3	4
1. Bhatinda	0·393	0·513	30·5
2. Patiala	0·495	0·715	44·4
3. Hissar	0·268	0·421	57·1
4. Karnal	0·509	0·715	40·5
5. Mahendragarh	0·512	0·634	23·8
6. Ludhiana	0·783	0·945	20·7
7. Jullundur	1·010	1·222	21·0
8. Sangrur	0·491	0·660	34·4
9. Ferozepore	0·451	0·564	25·1
10. Hoshiarpur	0·942	1·358	44·2
11. Rohtak	0·704	0·910	29·3
12. Ambala	0·760	0·960	26·3
13. Gurgaon	0·657	0·845	28·6
14. Amritsar	0·885	0·997	12·7
15. Kapurthala	0·653	0·756	15·8
16. Kangra	1·182	1·301	10·1
17. Gurdaspur	0·980	1·262	28·8
State	0·595	0·765	28·6

The rising pressure of population may be one motivating force for bringing more areas under plough and/or intensifying cultivation. However, there seem to have been serious impediments to the growth in area under crops either through extension of cultivation or intensive cropping in Gurdaspur where the area under crops expanded little despite rapidly rising pressure of rural population on arable land, and also in spite of some increase in irrigation as we shall see presently.

The level of irrigation has been quite high in several Punjab districts, but the increase in the extent of net sown area irrigated was notable only in Hissar from a low level and in Jullundur from a high level (Table III).

TABLE III—GROWTH IN IRRIGATION IN NET, GROSS AND MULTIPLE SOWN AREA IN PUNJAB AND ITS 17 DISTRICTS

District			Percentage of area irrigated in					
			Net sown area		Multiple sown area		Gross sown area	
			1950-53	1962-65	1950-53	1962-65	1950-53	1962-65
1			2	3	4	5	6	7
1. Bhatinda	..	..	51·0	49·9	55·6	83·6	51·5	55·4
2. Patiala	..	..	45·4	37·6	23·9	79·6	42·0	46·6
3. Hissar	..	..	18·2	47·5	43·9	0·0	19·7	38·6
4. Karnal	..	..	47·2	37·5	24·5	40·6	42·9	38·3
5. Mahendragarh	..	..	5·2	8·7	0·6	0·0	4·7	6·3
6. Ludhiana	..	..	56·9	52·8	65·4	95·6	58·4	63·4
7. Jullundur	..	..	58·1	67·4	77·2	57·4	60·7	65·2
8. Sangrur	..	..	51·9	48·4	68·9	77·2	54·8	55·8
9. Ferozepore	..	..	67·6	65·2	9·4	76·6	62·6	67·1
10. Hoshiarpur	..	..	11·9	14·3	16·0	8·1	12·4	12·7
11. Rohtak	..	..	38·7	38·8	36·5	17·7	38·3	32·1
12. Ambala	..	..	8·4	13·3	7·1	2·0	8·2	10·6
13. Gurgaon	..	..	16·9	15·4	10·9	0·9	16·4	13·0
14. Amritsar	..	..	89·0	86·2	83·3	91·1	87·6	87·8
15. Kapurthala	..	..	61·6	67·8	64·8	90·4	62·2	73·1
16. Kangra	..	..	25·3	22·2	17·8	22·7	22·3	22·4
17. Gurdaspur	..	..	49·5	50·0	4·7	24·9	41·7	42·9
State		..	41·1	44·0	38·3	42·7	40·7	43·7

Even the extent of irrigation in multiple sown area increased substantially only in some districts, *viz.*, in Patiala, Karnal, Ferozepore and Gurdaspur from a low level and in Bhatinda, Ludhiana and Sangrur from an already high level. The impact of irrigation on increase in crop area through extensive and/or intensive cultivation seems obvious in all these districts except Gurdaspur. Large increase took place in both net sown area and in area sown more than once in Hissar, Karnal and Sangrur; and in net area sown in all the remaining districts except Gurdaspur.

Increases in multiple cropping in Hoshiarpur, Rohtak, Ambala and Kangra where neither the level of irrigation nor rise in that level was significant, seem to have been achieved through other measures like suitable crop rotation and cropping pattern, such land developments as help retention of moisture in the soil for the raising of the second crop, etc. During the Third Plan period alone, land reclamation and land development were carried out in an area of 8.82 lakh acres against a target of 2.40 lakh acres; and soil conservation was completed in 1.23 lakh acres against the target of 0.46 lakh acres.[4]

The serious problem of expansion of water-logging (as in Gurdaspur, Ferozepore, Jullundur, Ludhiana, Amritsar and Rohtak), poor soils (as in Kangra) and inadequate irrigation (as in Hoshiarpur, Ambala and Gurgaon) have combined with other adverse factors or among themselves to impede fuller realization of potentials for extension of cultivation or intensification of cropping or both.[5] The specific causes for slow growth of crop area in different parts of these districts need to be identified and remedial measures taken.

R. GIRI[*]

4. Based on figures compiled by the Directorate of Economics and Statistics, Ministry of Food, Agriculture, Community Development and Co-operation, from the State Annual Plans and Check Lists on Agricultural Production Programmes for 1966-67.

5. Also see Regional Differences in Crop Output Growth in Punjab, Directorate of Economics and Statistics, Ministry of Food, Agriculture, Community Development and Co-operation, Government of India, November, 1967, pp. 18-24.

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APPENDIX

Index Numbers of Areas under Five Broad Land-Use Classes, Gross and Multiple Sown Areas, and Net, Gross and Multiple Irrigated Areas in Punjab State and Its 17 Districts during 1950-51 to 1964-65

(published area figures for 1964-65 in thousand acres)

Year	Forest (F)	Area not available for cultivation (NAC)	Other uncultivated land excluding fallows (UNC)	Fallows (FL)	Net area sown (S)	Gross sown area (GS)	Multiple sown area (MS)	Net sown area irrigated (NI)	Gross sown area irrigated (GI)	Multiple sown area irrigated (MI)
1	2	3	4	5	6	7	8	9	10	11

1·0 Punjab State

Year	F	NAC	UNC	FL	S	GS	MS	NI	GI	MI
1950-51 ..	100·0	100·0	100·0	100·0	100·0	100·0	100·0	100·0	100·0	100·0
1951-52 ..	100·0	100·1	100·5	134·7	95·4	93·8	85·2	102·9	106·7	130·9
1952-53 ..	99·3	99·9	99·6	129·2	96·4	95·8	92·4	112·5	109·5	91·4
1953-54 ..	99·1	100·5	93·2	97·3	101·5	102·4	106·9	118·1	112·9	81·2
1954-55 ..	99·1	100·7	90·2	77·7	104·5	112·3	154·1	128·1	121·6	81·4
1955-56 ..	99·1	100·8	86·8	65·2	106·7	119·2	185·7	127·1	122·8	96·5
1956-57 ..	98·1	101·3	81·1	57·0	108·6	120·6	185·5	117·6	124·2	166·0
1957-58 ..	98·1	114·1	80·0	60·5	108·4	119·9	182·0	116·5	124·2	172·8
1958-59 ..	99·7	115·6	71·8	47·2	110·9	124·3	197·3	116·0	129·2	212·2
1959-60 ..	99·7	117·0	68·2	48·6	110·7	121·4	180·1	116·6	129·6	211·4
1960-61 ..	99·8	117·1	67·7	54·4	109·8	121·6	186·0	120·1	130·1	193·2
1961-62 ..	99·5	116·5	64·9	48·4	111·3	121·6	177·6	124·7	133·9	191·3
1962-63 ..	99·5	116·5	61·8	45·4	112·1	125·5	196·8	126·9	141·8	234·9
1963-64 ..	98·9	116·7	59·3	45·9	112·3	121·6	171·8	131·6	144·8	227·1
1964-65 ..	101·9	116·1	59·0	42·9	112·9	126·2	198·8	131·3	150·3	269·1
Published area figures for 1964-65 ..	1,115·1	7,968·8	1,240·9	1,119·8	18,900·0	25,010·1	6,110·1	8,364·6	11,106·1	2,741·5

1·1 Bhatinda District

Year	F	NAC	UNC	FL	S	GS	MS	NI	GI	MI
1950-51 ..	100·0	100·0	100·0	100·0	100·0	100·0	100·0	100·0	100·0	100·0
1951-52 ..	100·0	100·0	100·0	396·3	87·4	86·1	76·3	102·5	97·8	77·8
1952-53 ..	100·0	100·0	100·0	556·4	80·6	80·7	82·4	121·7	99·4	4·2
1953-54 ..	100·0	98·7	98·6	40·6	102·8	102·6	101·0	130·5	105·7	0·0
1954-55 ..	100·0	98·7	98·6	40·6	102·8	102·6	100·7	135·9	110·0	0·0
1955-56 ..	100·0	98·9	91·6	11·1	105·1	111·0	158·5	145·4	117·7	0·0
1956-57 ..	100·0	104·4	104·2	12·1	104·4	116·3	212·7	109·8	122·9	196·0
1957-58 ..	100·0	104·4	93·1	12·1	104·8	109·1	144·4	109·9	115·9	155·2
1958-59 ..	100·0	106·5	86·8	10·0	105·1	112·5	172·7	111·9	123·8	191·4
1959-60 ..	100·0	106·5	86·8	10·0	105·1	106·7	120·0	126·1	124·3	127·7
1960-61 ..	100·0	106·5	86·8	52·3	100·1	104·7	141·5	112·7	125·0	194·1
1961-62 ..	100·0	106·5	52·8	18·4	105·1	111·8	165·0	116·6	134·1	228·1
1962-63 ..	100·0	106·5	52·8	24·3	104·4	112·5	177·0	119·7	136·4	226·5
1963-64 ..	100·0	106·5	58·1	17·9	105·1	107·0	122·0	123·3	122·1	127·3
1964-65 ..	100·0	106·5	58·1	19·2	105·0	114·3	188·4	129·8	141·9	210·7
Published area figures for 1964-65 ..	16·1	87·0	9·9	21·6	1,567·1	1,919·4	352·3	815·9	1,100·4	284·5

(Contd.)

APPENDIX (*Contd.*)

Year	(F)	(NAC)	(UNC)	(FL)	(S)	(GS)	(MS)	(NI)	(GI)	(MI)
1	2	3	4	5	6	7	8	9	10	11

1·2 Patiala District

Year	(F)	(NAC)	(UNC)	(FL)	(S)	(GS)	(MS)	(NI)	(GI)	(MI)
1950-51 ..	100·0	100·0	100·0	100·0	100·0	100·0	100·0	100·0	100·0	100·0
1951-52 ..	99·5	100·1	96·3	100·0	102·5	100·2	88·4	100·4	113·3	2204·8
1952-53 ..	99·5	100·1	96·3	124·7	98·0	97·6	95·1	102·1	116·8	2504·7
1953-54 ..	99·5	100·1	96·3	144·3	94·4	93·4	88·3	96·1	103·6	1335·0
1954-55 ..	99·5	100·1	94·3	144·3	95·7	100·4	124·0	100·8	112·3	1981·1
1955-56 ..	99·5	99·7	91·0	103·9	106·3	107·9	116·1	107·4	117·5	1763·2
1956-57 ..	77·3	106·2	86·5	52·7	119·9	124·4	147·2	96·1	130·5	5712·8
1957-58 ..	77·3	106·4	81·5	29·2	127·5	133·5	164·1	102·3	144·7	7026·7
1958-59 ..	94·2	108·1	52·0	29·2	141·7	144·2	157·0	107·1	157·7	8354·7
1959-60 ..	94·2	108·1	52·0	29·2	141·7	140·2	132·7	118·8	157·2	6399·7
1960-61 ..	96·0	109·7	50·5	46·0	138·7	157·9	254·5	121·9	169·1	7839·6
1961-62 ..	94·2	110·0	48·3	32·8	141·8	143·8	154·2	119·1	177·0	9595·7
1962-63 ..	94·2	110·0	48·5	30·0	142·4	153·0	207·6	115·6	182·1	10996·7
1963-64 ..	94·2	110·0	48·5	47·9	138·8	143·5	167·9	116·8	177·9	10128·0
1964-65 ..	141·3	101·6	47·6	41·7	140·5	150·2	200·1	118·8	187·7	11414·3
Published area figures for 1964-65 ..	23·4	103·9	27·5	66·1	924·5	1,185·0	260·5	353·4	563·0	209·6

1·3 Hissar District

Year	(F)	(NAC)	(UNC)	(FL)	(S)	(GS)	(MS)	(NI)	(GI)	(MI)
1950-51 ..	100·0	100·0	100·0	100·0	100·0	100·0	100·0	100·0	100·0	100·0
1951-52 ..	100·0	100·7	113·7	220·5	78·5	76·5	43·3	103·5	93·3	62·1
1952-53 ..	67·2	102·7	113·7	203·3	81·7	83·6	114·7	165·7	124·9	0·3
1953-54 ..	33·6	109·8	94·0	121·6	97·4	97·2	93·4	172·5	129·9	0·1
1954-55 ..	33·6	115·2	94·0	72·1	105·3	117·5	319·9	230·8	173·8	0·1
1955-56 ..	33·6	121·8	83·7	47·4	110·4	131·0	473·1	292·2	220·0	0·1
1956-57 ..	20·2	129·2	66·5	34·9	114·4	130·2	393·1	282·3	212·5	0·2
1957-58 ..	20·2	130·2	66·2	59·4	110·4	128·4	428·5	308·3	232·1	0·0
1958-59 ..	20·2	130·6	64·3	30·4	115·6	140·5	555·8	379·5	285·7	0·0
1959-60 ..	20·2	134·0	65·9	24·9	116·2	136·7	480·2	356·0	268·0	0·1
1960-61 ..	20·2	134·0	65·9	41·5	113·4	137·4	539·7	342·8	257·8	0·0
1961-62 ..	20·2	125·4	39·1	41·3	114·5	132·6	437·7	362·7	272·8	0·0
1962-63 ..	20·2	122·1	44·1	41·0	114·8	134·1	457·8	405·5	305·0	0·0
1963-64 ..	20·2	128·0	26·8	53·5	112·2	129·3	416·1	427·8	321·8	0·2
1964-65 ..	20·2	124·9	21·8	47·0	113·7	132·0	438·2	427·8	321·8	0·0
Published area figures for 1964-65 ..	19·4	306·7	3·9	213·6	2,900·9	3,576·3	675·4	1,401·1	1,401·1	0·0

(Contd.)

APPENDIX *(Contd.)*

Year	(F)	(NAC)	(UNC)	(FL)	(S)	(GS)	(MS)	(NI)	(GI)	(MI)
1	2	3	4	5	6	7	8	9	10	11

1·4 Karnal District

Year	(F)	(NAC)	(UNC)	(FL)	(S)	(GS)	(MS)	(NI)	(GI)	(MI)
1950-51 ..	100·0	100·0	100·0	100·0	100·0	100·0	100·0	100·0	100·0	100·0
1951-52 ..	100·0	99·6	100·0	100·0	100·1	95·3	77·1	110·0	122·6	368·3
1952-53 ..	335·7	88·3	98·0	79·7	108·5	106·5	98·8	110·7	120·4	309·7
1953-54 ..	278·6	89·3	94·4	79·7	110·3	117·2	142·4	113·5	118·1	207·8
1954-55 ..	278·6	89·4	83·8	47·2	124·0	123·6	121·8	118·0	138·2	531·6
1955-56 ..	278·6	89·2	80·0	42·1	127·3	139·7	185·7	116·3	137·5	530·7
1956-57 ..	278·6	89·2	70·8	41·6	132·3	144·3	188·9	121·5	128·6	264·3
1957-58 ..	278·6	89·2	69·5	37·5	134·0	149·1	204·8	116·0	134·6	495·3
1958-59 ..	828·6	89·2	66·4	30·7	136·4	154·5	221·4	118·9	127·9	302·1
1959-60 ..	828·6	89·2	57·8	30·7	140·9	155·1	207·0	119·1	144·5	638·6
1960-61 ..	828·6	89·2	54·6	30·7	142·6	157·3	210·7	120·1	144·5	620·1
1961-62 ..	828·6	89·3	48·9	30·3	145·6	157·9	202·5	119·1	159·0	936·4
1962-63 ..	828·6	87·8	37·1	19·9	154·9	171·6	232·9	124·9	163·6	919·5
1963-64 ..	828·6	87·8	33·4	13·1	158·8	161·5	170·5	126·6	170·8	1034·4
1964-65 ..	828·6	87·8	33·4	18·2	157·4	167·6	205·3	136·2	172·7	884·4
Published area figures for 1964-65 ..	25·0	229·8	145·5	52·9	1,525·1	2,057·3	532·2	601·2	800·6	199·4

1·5 Mahendragarh District

Year	(F)	(NAC)	(UNC)	(FL)	(S)	(GS)	(MS)	(NI)	(GI)	(MI)
1950-51 ..	100·0	100·0	100·0	100·0	100·0	100·0	100·0	100·0	100·0	100·0
1951-52 ..	100·0	98·6	97·9	56·0	107·3	100·2	65·7	130·4	123·8	0·0
1952-53 ..	100·0	98·6	97·9	37·5	110·2	96·3	28·4	110·6	105·0	0·0
1953-54 ..	100·0	98·6	97·9	40·8	109·6	105·0	81·8	111·9	106·3	0·0
1954-55 ..	100·0	98·6	99·7	17·5	113·2	138·7	261·7	100·4	95·4	0·0
1955-56 ..	100·0	98·6	99·7	15·9	113·4	147·7	313·5	84·5	80·3	0·0
1956-57 ..	100·0	100·0	96·8	14·2	113·7	155·2	356·1	103·9	98·8	0·0
1957-58 ..	100·7	100·7	96·0	14·4	113·7	146·2	303·8	83·1	79·0	0·0
1958-59 ..	100·0	101·3	95·7	38·6	110·3	150·0	342·7	101·2	112·3	318·8
1959-60 ..	100·0	101·4	95·7	18·1	113·2	129·8	209·7	135·2	156·9	562·7
1960-61 ..	100·0	104·2	89·6	15·0	113·9	151·5	333·4	55·4	140·9	1756·7
1961-62 ..	100·0	104·2	89·6	52·1	108·7	134·5	259·4	91·7	167·2	1593·3
1962-63 ..	100·0	104·2	85·8	37·8	111·1	132·6	236·6	178·8	170·0	0·0
1963-64 ..	100·0	104·2	85·8	31·1	112·1	131·4	224·5	194·7	185·1	0·0
1964-65 ..	100·0	104·2	85·8	23·0	113·0	123·4	173·5	229·9	218·6	0·0
Published area figures for 1964-65 ..	6·4	81·3	49·1	11·2	704·8	926·7	221·9	69·7	69·7	0·0

(Contd.)

APPENDIX *(Contd.)*

Year	(F)	(NAC)	(UNC)	(FL)	(S)	(GS)	(MS)	(NI)	(GI)	(MI)
1	2	3	4	5	6	7	8	9	10	11

1·6 Ludhiana District

1950-51 ..	100·0	100·0	100·0	100·0	100·0	100·0	100·0	100·0	100·0	100·0
1951-52 ..	100·0	100·1	98·7	98·6	100·4	97·3	84·8	74·6	114·0	6236·0
1952-53 ..1650·0		115·6	86·3	104·8	98·5	96·1	87·0	89·8	114·8	3991·0
1953-54 ..1650·0		119·5	82·2	75·8	102·8	102·1	99·7	102·2	120·9	3017·2
1954-55 ..1650·0		117·1	81·6	77·9	102·9	108·3	131·7	124·6	130·6	1056·0
1955-56 ..1650·0		101·5	86·0	76·3	104·6	109·9	132·6	123·2	122·9	64·4
1956-57 ..1650·0		104·7	86·0	126·7	96·8	111·8	175·0	76·8	134·7	9201·2
1957-58 ..1650·0		107·9	91·8	56·9	105·9	115·5	156·3	69·7	129·2	9431·2
1958-59 ..1650·0		114·7	88·3	39·6	107·9	114·9	144·6	81·8	125·8	6988·5
1959-60 ..1650·0		118·6	84·2	33·3	108·8	112·6	129·1	77·1	121·5	7058·4
1960-61 ..1650·0		118·4	84·5	31·8	109·0	109·7	113·1	89·5	124·8	5625·5
1961-62 ..1650·0		112·6	70·0	27·7	112·2	113·6	120·6	95·9	133·3	5957·4
1962-63 ..1650·0		119·9	65·8	31·6	111·2	113·9	126·6	85·3	136·2	8090·1
1963-64 ..1650·0		117·1	62·8	23·4	113·1	119·0	145·2	98·9	144·1	7208·3
1964-65 ..4600·2		117·2	66·6	34·0	110·4	123·9	181·4	89·7	153·6	10127·7
Published area figures for										
1964-65 ..	9·2	93·5	49·5	29·5	744·1	1,037·8	293·7	389·4	669·9	280·5

1·7 Jullundur District

1950-51 ..	100·0	100·0	100·0	100·0	100·0	100·0	100·0	100·0	100·0	100·0
1951-52 ..	100·0	105·2	94·1	162·9	93·5	95·5	109·7	102·0	120·1	368·3
1952-53 ..	100·0	95·7	94·1	124·8	98·9	101·1	116·7	102·0	122·5	404·0
1953-54 ..	100·0	103·8	94·1	133·8	96·8	98·8	112·3	106·6	120·8	316·3
1954-55 ..	100·0	103·6	93·8	131·7	97·1	104·7	158·5	138·9	129·9	6·0
1955-56 ..	100·0	105·4	89·3	119·8	98·2	113·2	220·0	142·2	133·5	14·4
1956-57 ..	100·0	105·4	80·4	92·4	101·5	115·1	212·3	138·5	132·4	48·8
1957-58 ..	100·0	97·3	80·4	92·4	103·6	112·7	177·3	138·5	129·4	2·0
1958-59 ..	100·0	114·5	37·1	83·1	105·1	112·2	163·1	127·8	126·8	112·8
1959-60 ..	100·0	129·8	2·1	83·5	105·1	115·2	187·9	130·7	126·3	64·4
1960-61 ..	100·0	128·2	2·1	77·2	106·2	113·5	166·7	133·2	138·6	210·8
1961-62 ..	100·0	128·2	2·1	83·8	105·4	111·5	156·4	139·3	130·1	0·0
1962-63 ..	100·0	137·6	2·1	59·7	106·8	118·4	202·7	136·2	140·0	187·6
1963-64 ..	100·0	137·6	2·1	130·9	103·5	111·1	166·4	122·4	141·3	396·8
1964-65 ..	100·0	134·4	2·1	82·1	108·1	127·3	265·2	124·0	162·4	685·7
Published area figures for										
1964-65 ..	6·5	140·1	0·7	42·0	669·5	901·0	231·5	430·7	602·1	171·4

(Contd.)

APPENDIX (*Contd.*)

Year	(F)	(NAC)	(UNC)	(FL)	(S)	(GS)	(MS)	(NI)	(GI)	(MI)
1	2	3	4	5	6	7	8	9	10	11

1·8 Sangrur District

1950-51 ..	100·0	100·0	100·0	100·0	100·0	100·0	100·0	100·0	100·0	100·0
1951-52 ..	100·0	100·0	100·0	156·4	92·3	85·4	56·8	99·4	89·9	69·4
1952-53 ..	100·0	100·0	93·2	68·0	105·6	103·6	95·3	118·5	85·6	14·9
1953-54 ..	100·0	99·0	78·9	58·7	108·6	108·0	105·3	135·3	92·3	0·0
1954-55 ..	100·0	99·0	78·9	58·7	108·6	115·1	142·0	151·7	103·5	0·0
1955-56 ..	100·0	99·0	77·2	46·3	110·3	119·4	156·6	100·1	99·9	92·4
1956-57 ..	100·0	99·0	73·2	39·9	111·5	125·8	184·8	103·3	104·2	98·4
1957-58 ..	100·0	95·0	68·4	39·9	112·3	122·2	162·8	103·3	97·4	104·9
1958-59 ..	100·0	98·6	68·4	39·9	112·0	125·0	178·6	98·2	98·2	117·4
1959-60 ..	100·0	98·6	61·8	38·7	112·8	121·8	158·6	98·2	100·9	126·0
1960-61 ..	100·0	98·6	58·4	33·4	113·7	125·2	172·4	109·4	102·4	108·5
1961-62 ..	100·0	98·6	58·4	33·7	113·7	121·3	152·6	111·7	103·8	108·5
1962-63 ..	100·0	98·6	58·4	31·7	114·0	129·3	192·4	113·4	110·4	126·7
1963-64 ..	100·0	98·6	55·9	26·8	114·8	118·7	134·1	114·0	111·1	127·5
1964-65 ..	100·0	98·5	54·0	26·8	114·9	124·9	164·9	115·0	110·1	122·0
Published area figures for 1964-65 ..	29·1	127·2	51·6	53·5	1,683·3	2,265·2	581·9	819·4	1,253·5	434·1

1·9 Ferozepore District

1950-51 ..	100·0	100·0	100·0	100·0	100·0	100·0	100·0	100·0	100·0	100·0
1951-52 ..	100·0	100·0	101·2	92·7	101·1	98·8	82·5	100·4	100·3	96·1
1952-53 ..	100·0	101·7	99·5	121·5	96·6	87·2	20·3	103·1	101·2	3·6
1953-54 ..	100·0	101·7	101·7	114·5	97·6	96·4	89·3	110·0	108·0	5·6
1954-55 ..	100·0	107·0	98·8	101·3	99·6	106·8	160·9	114·6	112·4	2·0
1955-56 ..	100·0	109·5	100·7	80·6	102·7	109·9	164·4	120·6	118·2	5·6
1956-57 ..	100·0	112·2	97·9	80·6	102·7	113·7	196·3	102·3	118·9	997·2
1957-58 ..	100·0	112·2	97·9	95·8	100·1	109·6	181·4	96·1	117·5	1247·5
1958-59 ..	100·0	112·2	106·4	52·5	107·2	115·1	174·7	87·9	124·3	2034·7
1959-60 ..	100·0	126·8	101·2	55·1	105·8	115·7	189·5	83·8	120·2	2028·6
1960-61 ..	100·0	126·8	116·6	49·9	105·8	107·7	123·4	100·5	120·3	1168·5
1961-62 ..	100·0	126·8	116·6	51·0	105·6	110·4	147·5	103·5	122·7	1141·6
1962-63 ..	100·0	126·3	116·4	45·9	106·8	111·2	145·1	112·1	123·2	727·2
1963-64 ..	100·0	126·3	111·7	36·5	109·0	114·2	153·7	108·7	131·0	1310·4
1964-65 ..	100·0	125·2	106·7	33·9	110·0	116·9	169·7	100·2	132·4	1825·4
Published area figures for 1964-65 ..	19·8	169·7	113·2	135·2	2,057·2	2,494·7	437·5	1,240·5	1,677·6	437·1

(*Contd.*)

APPENDIX (*Contd.*)

Year	(F)	(NAC)	(UNC)	(FL)	(S)	(GS)	(MS)	(NI)	(GI)	(MI)
1	2	3	4	5	6	7	8	9	10	11

1·10 Hoshiarpur District

Year	(F)	(NAC)	(UNC)	(FL)	(S)	(GS)	(MS)	(NI)	(GI)	(MI)
1950-51 ..	100·0	100·0	100·0	100·0	100·0	100·0	100·0	100·0	100·0	100·0
1951-52 ..	100·0	100·0	100·0	100·0	100·0	125·0	19981·8	121·7	158·2	3200·0
1952-53 ..	100·0	100·0	98·5	100·0	100·5	119·9	15525·9	121·6	148·4	2384·0
1953-54 ..	100·0	100·6	96·2	100·7	100·2	123·5	18677·7	121·8	151·4	2608·1
1954-55 ..	100·0	101·0	90·9	98·5	100·6	125·7	20115·9	125·0	156·1	2730·7
1955-56 ..	100·0	101·7	85·6	109·6	99·8	127·3	22047·0	122·6	135·2	1163·3
1956-57 ..	100·0	101·9	83·7	109·6	99·9	127·7	22289·5	143·7	143·7	123·3
1957-58 ..	100·0	102·1	80·4	85·8	101·9	129·6	22200·3	129·5	136·8	728·6
1958-59 ..	100·0	107·4	62·1	96·1	98·8	139·3	32345·8	125·4	135·4	963·9
1959-60 ..	100·0	107·4	62·1	94·9	98·9	135·3	29078·9	87·0	133·9	4046.5
1960-61 ..	100·0	107·4	61·2	91·6	99·2	128·5	23437·6	126·7	182·2	4819·4
1961-62 ..	100·0	108·2	58·4	71·5	100·4	131·2	24656·4	130·6	139·4	872·3
1962-63 ..	100·0	108·2	58·4	69·3	100·6	136·6	28848·0	133·9	162·0	2505·2
1963-64 ..	100·0	108·1	58·4	69·3	100·7	137·1	29223·0	136·8	165·6	2560·3
1964-65 ..	103·1	108·1	57·6	65·5	101·0	138·6	30275·0	142·1	165·4	2102·0
Published area figures for										
1964-65 ..	41.5	569·4	57·5	35·6	717·4	988.0	270.6	106·0	124.8	18.8

1·11 Rohtak District

Year	(F)	(NAC)	(UNC)	(FL)	(S)	(GS)	(MS)	(NI)	(GI)	(MI)
1950-51 ..	100·0	100·0	100·0	100·0	100·0	100·0	100·0	100·0	100·0	100·0
1951-52 ..	111·1	99·5	100·0	164·3	96·3	84·5	46·5	100·3	118·9	317·1
1952-53 ..	105·4	101·2	98·4	113·2	99·4	98·3	94·6	98·6	119·5	342·2
1953-54 ..	105·4	101·2	98·8	113·3	99·3	96·1	85·8	104·2	123·4	327·8
1954-55 ..	102·1	102·1	94·6	61·4	102·9	113·1	145·8	108·3	140·6	484·2
1955-56 ..	102·1	102·2	91·8	60·4	103·3	122·7	185·0	117·6	126·8	225·2
1956-57 ..	102·1	105·6	89·6	64·1	103·1	121·0	178·5	115·4	128·6	270·2
1957-58 ..	102·1	105·6	87·8	57·1	103·8	115·4	152·6	116·1	126·9	243·5
1958-59 ..	102·1	106·1	87·3	70·0	103·0	115·2	154·3	116·0	113·1	84·0
1959-60 ..	100·5	114·5	85·6	91·8	100·9	104·3	115·1	119·7	121·0	136·8
1960-61 ..	100·5	114·5	85·6	101·0	100·3	105·6	122·1	89·5	102·5	242·0
1961-62 ..	100·5	114·5	85·6	106·9	99·9	106·9	128·8	120·9	110·6	2·7
1962-63 ..	100·5	114·5	82·1	105·5	100·4	109·8	139·5	80·4	109·5	420·5
1963-64 ..	100·5	114·5	75·6	105·5	101·2	108·7	132·4	114·2	116·7	146·3
1964-65 ..	100·5	114·5	75·6	145·4	98·5	118·0	180·6	109·4	110·5	124·1
Published area figures for										
1964-65 ..	20·1	124·0	102.2	114.6	1,131.7	1,776·3	644.6	481.4	532.7	51.3

(*Contd.*)

APPENDIX (*Contd.*)

Year	(F)	(NAC)	(UNC)	(FL)	(S)	(GS)	(MS)	(NI)	(GI)	(MI)
1	2	3	4	5	6	7	8	9	10	11

1·12 Ambala District

Year	(F)	(NAC)	(UNC)	(FL)	(S)	(GS)	(MS)	(NI)	(GI)	(MI)
1950-51 ..	100·0	100·0	100·0	100·0	100·0	100·0	100·0	100·0	100·0	100·0
1951-52 ..	100·0	100·0	99·2	92·1	100·8	104·5	127·7	99·3	128·3	800·0
1952-53 ..	100·0	100·0	104·1	110·4	98·4	97·5	91·6	133·0	134·7	175·2
1953-54 ..	100·0	100·0	95·7	91·1	101·5	97·7	73·2	116·5	125·0	321·1
1954-55 ..	100·0	100·0	104·5	90·8	100·3	101·4	108·6	133·9	128·5	4·2
1955-56 ..	100·0	100·0	91·0	89·4	102·4	111·3	169·2	123·6	121·6	75·1
1956-57 ..	102·8	100·0	89·7	67·9	104·2	114·9	183·6	123·2	135·0	404·7
1957-58 ..	102·8	100·0	86·7	83·4	103·3	112·8	174·1	122·0	127·4	250·5
1958-59 ..	102·8	100·0	85·1	83·0	103·5	113·8	180·0	129·6	124·5	4·3
1959-60 ..	102·8	100·0	85·1	83·0	103·5	126·9	276·7	153·4	147·2	0·0
1960-61 ..	102·9	100·0	83·5	71·0	104·9	117·0	193·7	184·7	177·2	0·0
1961-62 ..	102·8	99·1	83·5	71·0	105·3	126·1	259·2	165·7	158·9	0·0
1962-63 ..	102·8	99·1	83·9	71·0	105·3	125·2	253·2	190·7	182·9	0·0
1963-64 ..	102·2	99·1	72·9	71·0	108·0	120·2	199·0	196·4	188·4	0·0
1964-65 ..	102·3	99·1	72·8	71·0	108·0	121·2	205·8	175·0	193·7	694·1
Published area figures for 1964-652 ..	161·2	256·2	135·0	65·0	863·9	1,120·3	256·4	106·3	122·6	16·3

1·13 Gurgaon District

Year	(F)	(NAC)	(UNC)	(FL)	(S)	(GS)	(MS)	(NI)	(GI)	(MI)
1950-51 ..	100·0	100·0	100·0	100·0	100·0	100·0	100·0	100·0	100·0	100·0
1951-52 ..	100·0	100·0	100·0	112·8	99·1	101·1	119·3	135·7	133·3	104·2
1952-53 ..	100·0	102·8	92·8	117·8	98·7	94·7	58·6	153·2	149·2	100·9
1953-54 ..	100·0	116·4	49·0	96·2	101·1	99·4	85·8	153·2	142·3	11·8
1954-55 ..	100·0	117·8	38·7	40·3	106·1	115·7	205·7	128·8	120·0	13·5
1955-56 ..	100·0	117·8	38·7	59·1	109·6	119·1	253·0	105·4	97·3	0·0
1956-57 ..	101·3	116·2	38·6	27·7	107·4	105·2	86·5	97·4	95·2	68·3
1957-58 ..	101·3	116·2	38·6	35·3	106·8	121·1	253·3	88·8	83·8	23·6
1958-59 ..	101·3	116·2	38·6	61·2	104·3	124·6	311·3	78·3	73·2	11·0
1959-60 ..	101·6	117·8	34·6	71·4	103·3	111·6	190·2	117·5	109·5	12·7
1960-61 ..	101·6	121·6	34·5	53·7	104·4	119·4	259·8	117·9	109·7	11·8
1961-62 ..	101·6	114·3	34·7	23·6	108·9	121·3	239·0	101·7	95·1	16·0
1962-63 ..	101·6	115·0	33·1	26·0	108·7	117·8	205·3	120·6	113·4	26·1
1963-64 ..	101·6	115·0	33·1	42·4	107·0	113·1	173·1	126·8	117·9	11·8
1964-65 ..	101·6	115·0	33·0	26·7	108·8	117·3	198·9	136·9	127·2	11·8
Published area figures for 1964-65 ..	34·6	229·2	25·5	32·4	1,186·5	1,425·0	238·5	194·2	195·6	1·4

(*Contd.*)

APPENDIX (*Contd.*)

Year	(F)	(NAC)	(UNC)	(FL)	(S)	(GS)	(MS)	(NI)	(GI)	(MI)
1	2	3	4	5	6	7	8	9	10	11

1·14 Amritsar District

Year	(F)	(NAC)	(UNC)	(FL)	(S)	(GS)	(MS)	(NI)	(GI)	(MI)
1950-51 ..	100·0	100·0	100·0	100·0	100·0	100·0	100·0	100·0	100·0	100·0
1951-52 ..	100·0	100·0	105·2	89·2	100·5	101·3	103·8	110·5	106·9	96·3
1952-53 ..	100·0	100·0	105·2	92·5	100·1	100·1	100·1	110·6	110·1	108·8
1953-54 ..	100·0	100·0	105·6	89·9	100·4	108·7	133·4	111·7	116·6	131·6
1954-55 ..	100·0	100·1	104·0	84·9	101·3	110·7	138·7	112·3	116·7	130·4
1955-56 ..	100·0	100·2	103·8	75·5	102·5	108·8	127·5	108·0	110·5	118·7
1956-57 ..	100·0	104·7	98·9	63·2	104·0	106·7	114·8	119·3	108·4	76·3
1957-58 ..	100·0	104·7	98·9	79·4	102·0	103·6	108·4	119·7	104·9	61·3
1958-59 ..	111·1	111·7	96·4	71·7	102·0	110·5	135·7	105·0	110·9	129·3
1959-60 ..	111·1	111·7	96·4	87·0	100·1	105·1	120·1	102·1	105·1	115·3
1960-61 ..	111·1	111·7	96·4	123·0	95·5	98·3	106·6	103·7	102·6	100·5
1961-62 ..	111·1	111·7	96·4	65·3	102·9	107·1	119·6	107·8	109·6	116·2
1962-63 ..	111·1	111·7	96·4	63·9	103·1	117·5	160·4	103·8	120·3	170·8
1963-64 ..	111·1	111·7	97·6	73·2	101·7	111·2	139·2	107·4	119·1	154·9
1964-65 ..	122·2	111·7	97·6	69·5	102·2	117·0	160·6	106·2	124·1	178·4
Published area figures for 1964-65 ..	16·6	166·0	141·8	76·8	856·4	1,308·8	452·4	742·3	1,160·2	417·9

1·15 Kapurthala District

Year	(F)	(NAC)	(UNC)	(FL)	(S)	(GS)	(MS)	(NI)	(GI)	(MI)
1950-51 ..	100·0	100·0	100·0	100·0	100·0	100·0	100·0	100·0	100·0	100·0
1951-52 ..	100·0	100·0	95·5	98·7	102·7	96·5	75·6	98·0	114·6	277·8
1952-53 ..	100·0	100·0	87·8	91·0	110·2	100·1	66·3	101·8	124·0	342·0
1953-54 ..	100·0	98·8	72·9	82·5	121·6	108·2	63·3	103·0	127·8	372·1
1954-55 ..	100·0	98·8	71·1	78·0	124·6	112·9	73·6	112·7	130·5	305·5
1955-56 ..	100·0	99·3	66·9	76·1	127·3	122·8	107·5	115·4	136·0	338·8
1956-57 ..	100·0	99·3	57·1	76·1	131·8	125·6	104·9	116·0	141·2	389·3
1957-58 ..	100·0	99·3	83·1	46·0	142·2	128·7	83·7	116·0	140·9	386·6
1958-59 ..	100·0	105·1	88·7	36·1	144·8	134·7	101·6	116·5	151·0	492·5
1959-60 ..	100·0	105·1	88·5	31·7	147·6	133·4	86·7	125·1	158·9	492·5
1960-61 ..	400·0	105·4	85·2	21·7	154·4	134·7	69·7	136·9	153·3	316·2
1961-62 ..	400·0	105·4	86·7	16·5	157·2	137·8	74·0	139·1	156·1	324·7
1962-63 ..	400·0	105·4	86·7	26·1	151·2	153·1	160·7	161·5	216·7	653·0
1963-64 ..	400·0	105·5	107·5	11·5	160·0	159·4	158·3	167·8	216·2	695·4
1964-65 ..	1300·0	91·2	107·5	11·5	167·2	166·7	165·9	175·4	219·9	660·6
Published area figures or 1964-65 ..	2·6	82·7	2·4	19·6	299·5	388·5	89·0	201·9	279·2	77·3

(*Contd.*)

APPENDIX   (*Concld.*)

Year	(F)	(NAC)	(UNC)	(FL)	(S)	(GS)	(MS)	(NI)	(GI)	(MI)
1	2	3	4	5	6	7	8	9	10	11

1·16 Kangra District

Year	(F)	(NAC)	(UNC)	(FL)	(S)	(GS)	(MS)	(NI)	(GI)	(MI)
1950-51 ..	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
1951-52 ..	100.0	100.0	100.0	106.2	99.1	102.0	107.0	81.8	100.9	171.2
1952-53 ..	100.0	100.0	107.7	124.1	93.6	104.8	123.6	81.8	103.9	185.4
1953-54 ..	100.0	100.0	98.4	108.1	99.9	101.1	103.3	81.8	104.9	190.4
1954-55 ..	100.0	100.0	97.7	107.5	100.5	102.2	105.3	81.8	103.3	183.0
1955-56 ..	100.0	100.0	97.7	108.0	100.4	102.9	107.4	81.8	98.5	160.7
1956-57 ..	100.0	100.0	97.7	108.0	100.4	102.0	104.9	81.8	99.5	165.2
1957-58 ..	100.0	100.0	97.8	113.5	99.4	102.1	106.7	127.2	99.8	0.0
1958-59 ..	100.0	100.0	97.8	122.8	97.9	99.8	102.9	78.4	100.5	182.9
1959-60 ..	100.0	100.0	97.8	122.9	97.9	103.5	112.8	79.4	102.5	188.6
1960-61 ..	100.0	100.0	97.8	123.3	97.8	102.1	109.0	83.7	101.6	168.6
1961-62 ..	100.0	100.0	97.8	121.7	98.1	102.7	110.2	82.9	99.9	163.7
1962-63 ..	100.0	100.0	97.8	114.0	99.3	103.1	109.3	82.9	105.5	189.9
1963-64 ..	99.3	100.0	97.8	113.2	100.3	103.9	109.7	74.4	100.9	199.2
1964-65 ..	99.4	100.0	97.8	120.6	99.0	104.5	113.4	79.5	105.1	200.2
Published area figures for										
1964-65 ..	605.9	4,989.5	225.4	93.2	482.6	812.0	329.4	108.7	183.3	74.6

1.17 Gurdaspur District

Year	(F)	(NAC)	(UNC)	(FL)	(S)	(GS)	(MS)	(NI)	(GI)	(MI)
1950-51 ..	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
1951-52 ..	100.0	100.0	89.9	50.6	108.8	93.9	50.8	112.6	106.2	2.5
1952-53 ..	102.2	99.9	104.3	79.2	103.0	97.8	79.9	117.8	111.1	3.1
1953-54 ..	100.1	99.6	104.3	74.7	103.8	98.2	78.9	113.3	106.9	3.1
1954-55 ..	100.1	99.6	102.9	74.6	104.0	104.0	104.5	114.3	107.9	3.8
1955-56 ..	100.1	102.3	104.9	90.9	100.6	104.4	118.5	106.5	100.5	1.9
1956-57 ..	100.1	102.4	104.8	70.7	103.6	92.4	53.8	99.9	94.3	1.3
1957-58 ..	100.1	102.4	104.8	131.4	94.4	94.3	95.0	69.0	92.5	467.9
1958-59 ..	100.1	115.0	43.5	67.0	108.3	88.6	20.6	70.7	89.3	385.1
1959-60 ..	100.1	137.3	29.7	111.0	97.4	104.6	131.9	75.3	100.7	506.0
1960-61 ..	100.1	137.3	29.7	118.4	96.2	100.7	118.4	103.9	113.8	269.2
1961-62 ..	100.1	137.2	29.7	118.2	96.3	99.1	110.6	92.8	96.4	149.7
1962-63 ..	100.1	136.9	29.7	118.2	96.4	104.6	135.3	96.4	106.3	261.1
1963-64 ..	100.1	137.2	29.7	108.0	97.9	105.9	135.6	106.5	120.0	332.9
1964-65 ..	131.5	135.3	29.7	68.1	102.9	111.7	144.5	114.7	133.1	423.4
Published area figures for										
1964-65 ..	38.1	197.1	0.0	57.0	562.5	788.1	225.6	293.6	360.9	67.3

BIDDING FOR CATTLE FEED SOURCES

The Problem

A question was posed by the General Manager of a leading cattle feed factory whether it would be possible to find out the cost of the nutritional element in the cattle feed so that one could devise the pricing policy on the basis of one or more of these elements in the raw material. For example, as milk pricing was based on fat content, could the cattle feed price be based either on protein or fat contents of the raw material!

Fortunately, it is possible to find out the marginal value of each of the nutritional elements in the cattle feed through the linear programming technique. These values mean that if we want to increase or decrease one per cent of the nutritional element in the cattle feed mix, the cost of the cattle feed mix will increase or decrease by the amount shown as the marginal value of the element. However, if the raw materials which are mixed to get the cattle feed mix with the least cost provide more than the specified requirement of the nutritional element in the cattle feed mix, it is obvious that adding or removing one per cent of the nutritional element to the least cost solution will not affect it and hence the marginal value of this one per cent is zero.

Thus the marginal value or the shadow price of each element in the cattle feed mix varies with the specific conditions under which the optimal cattle feed mix is prepared. However, the knowledge of this value is important for deciding whether a raw material whose market price was more than its intrinsic value arrived at by pricing the nutritional elements at the shadow prices should be purchased.

An Example

The cattle feed factory had on its list about 19 raw materials from which a cattle feed mix was to be prepared such that it should satisfy the nutritional requirements of protein and fat and also should not exceed the tolerance limits of fibre and silica. There were availability restrictions on five out of 19 raw materials. Restrictions regarding the composition of the feed and the nutrition requirements for summer period and for monsoon period were separately specified. With the help of linear programming technique the least cost combinations of the cattle feed mix with these specifications and also under two different sets of prices, *viz.*, (*a*) ex-factory prices, and (*b*) the market prices were worked out as follows:

    I.   Summer period requirements   — ex-factory price.

    II. Summer period requirements   — market price.

    III. Monsoon period requirements   — ex-factory price.

    IV. Monsoon period requirements   — market price.

LEAST COST COMBINATIONS

	Prices			
	I	II	III	IV
	Ex-factory	Market	Ex-factory	Market
Cost per ton of cattle feed (Rs.) ..	310.92	335.01	281.58	303.25
Maize	.4000	.4000	.4000	.4000
Mineral	.0200	.0200	.0200	.0200
Groundnut cake II	.1200	.1200	.0361	.0038
Deoiled groundnut cake I	.0382	—	.0038	—
Deoiled groundnut cake II	.0665	.0389	—	—
Water melon seed cake	.0551	.0020	.1200	.1200
Maize husk	.0850	.0161	.0630	.0291
*Kodara kushki** (husk and bran mixture)	.0500	.0500	—	.0500
Deoiled rice bran	.1200	.1000	.1000	.1000
Rice polish grade III	.0450	.0500	—	—
Kodara husk	—	.0802	.1200	.1200
Maize gluten	—	.1200	—	.0361
Rice husk	—	.0028	.0169	.0008
Groundnut cake I	—	—	.1200	.1200
Total (metric ton)	1.0000	1.0000	1.0000	1.0000

Kodara is a kind of millet.

These solutions satisfy the following nutritional requirements:

Protein percentage	18.00	18.00	14.2	14.3
Fat percentage	4.4	4.4	4.4	4.4
Fibre percentage	7.0	7.0	13.3	12.7
Silica percentage	2.4	2.5	2.5	2.5
The minimum protein requirement percentage	18.0	18.0	14.0	14.0
Minimum fat requirement percentage ..	4.4	4.4	4.4	4.4
Maximum fibre tolerance percentage ..	7	7	14	14
Maximum silica tolerance percentage ..	2.5	2.5	2.5	2.5

For the four specific conditions for which we have obtained the optimum solutions, the shadow prices of the nutritional elements were worked out. They are as follows:

SHADOW PRICES OF NUTRITIONAL ELEMENTS

(in rupees per one per cent)

Nutritional elements					I	II	III	IV
					Ex-factory	Market	Ex-factory	Market
Protein	..	..	..	..	..	2.4	4.9	0	0
Fat	..	..	..	..	..	10.2	14.6	3.1	2.0
Fibre	..	..	..	..	..	—4.7	—4.0	0	0
Silica	..	..	..	..	..	0	—1.7	—2.5	—4.0

The negative prices denote the penalty per one per cent of fibre and silica that have been allowed in the solution. For instance, in summer period (ex-factory price) the cost of cattle feed mix would decrease by Rs. 4.7 if one per cent additional fibre is tolerated.

Value of Nutritional Elements in the Total Cost

If we price the nutritional elements in the cattle feed mix at their shadow prices, the cost of the cattle feed mix can be broken down as follows:

(in rupees)

				I	II	III	IV
				Ex-factory	Market	Ex-factory	Market
Total cost	..	..	..	310·92	335·01	281·58	303·25
Protein	..	..	..	43·20	88·20	0	0
Fat	..	..	..	44·88	64·24	13·64	8·80
Fibre	..	..	..	—32·90	—28·00	0	0
Silica	..	..	..	0	— 4·25	— 6·75	—10·00
Carbohydrates and other nutrients				255·74	214.82	274·19	304·45

It is obvious from the above figures that the major cost in the cattle feed mix is that of carbohydrates and other nutrients and not of protein and fat as is generally believed.

Specification for Carbohydrates

To arrive at the optimal solution, should the specifications be in terms of only protein and fat (with the tolerance for fibre and silica specified) or should they also contain the Energy Equivalent or T.D.N. (Total Digestible Nutrients) Units? In our economy the structure of pricing of raw materials seems to be carbohydrate-based rather than protein-based. This could partly be due to the high cereal-

oriented agricultural market where maize, *kodara* and the like as cattle feed compete with the demand for human consumption. In such a situation, could the cost of carbohydrates be minimized by specifying its requirement and then searching for the cheapest source of carbohydrates?

Considering the limiting constraint of fibre and silica tolerance, should attempts be not made to find cheaper substitutes for the carbohydrate resources which would not contain fibre in any significant quantities and use more economic sources of proteins of vegetable-origin or otherwise?

D. K. DESAI‡

GROWTH OF FOODGRAIN PRODUCTION IN BIHAR*

This paper attempts to study the growth in the production of foodgrain crops in Bihar during the period 1950-51 to 1965-66. Both simple and compound rates of growth have been calculated and statistical tests of significance have been applied to the time-series data on acreage and production.

Although this period covers all the three Five-Year Plans, for a detailed analysis of the impact of the three Plans the whole period was divided into two overlapping segments of series. The first series extends up to 1960-61 and covers the first two Plans, while the period of 1955-56 to 1965-66 constitutes the second series and embodies Second and Third Plans. Such a pair of short-term trends exhibits the changes occurring in the rates of growth during the entire period. These changes would otherwise remain concealed since within the trend fitted to the whole period, the trend in a given segment is necessarily affected by data of other years.

Data

The cropwise data on acreage and production used in this analysis were taken from Season and Crop Reports published annually by the Directorate of Statistics and Evaluation, Government of Bihar. Needless to say that the validity of our conclusion is contingent upon the accuracy of these data. The classification of crops will be evident from the accompanying tables. Different items of cereals and of pulses have been placed in order of their importance. For example, rice being the most important cereal is placed first while all the least important cereals and millets like *shama, kauni, cheena, kodo,* etc., have been combined to form the last class labelled as 'Other cereals and millets.' Similar is the case with pulses where less important and inferior pulses like *masoor, khesari,* peas, etc., have been put in the class of 'Other pulses.'

Some adjustments had to be made before the data could be used. First, to maintain the same geographical coverage, the data were suitably adjusted for territorial changes made in the State under 'Bihar and West Bengal Transfer of

Territories Act 1956.' Secondly, the production figures for 'Other cereals and millets' and 'Other pulses' of a few years were not available separately, rather both had been shown under the class 'Other foodgrains and pulses.' The production figures of some important constituents of 'Other pulses,' namely, *khesari, masoor* and peas were, however, separately available. Therefore, to make the production data comparable with those of acreage, the total production of *khesari, masoor* and peas was subtracted from those of 'Other foodgrains and pulses' and the remainder was labelled as 'Other cereals and millets.' This is necessarily an approximation to the extent that production of a few minor pulses like *urid, kulthi,* etc., remained entangled with 'Other cereals and millets.' But in view of very small contribution of these minor pulses to 'Other pulses,' the error involved would not be serious.

Methodology

As we would be more interested in relative growth rates rather than the absolute ones, the data were converted into indices of acreage and production with 1950-51 as base year. Then to smooth out the seasonal fluctuations, linear trends of the type $y = a + bt$ were fitted to these index numbers of individual crops. The simple (or linear) growth rate was measured by b in terms of percentages of base year value.

The compound (or geometric) rate of growth r′ is given by the well-known compound interest formula.

$$y_T = y_o (1 + r')^T \qquad .. \qquad .. \qquad .. \qquad .. \qquad .. \qquad .. \quad (1)$$

where y_o and y_T are the values in the initial and final year respectively and r′ is the compound rate of growth in terms of per cent increase over previous year. In actual practice, however, one may prefer to fit the following curve to the data.

$$y = a \beta^t \qquad .. \qquad .. \qquad .. \qquad .. \qquad .. \qquad .. \quad (2)$$

where a is the value of y at $t = 0$ and $\beta = 1 + r'$. The second approach is superior to the first in that it utilizes the information contained in the data of *all* years instead of just two terminal years. However, the curve (2) can approximately be represented by a simpler curve

$$y = a e^{rt} \qquad .. \qquad .. \qquad .. \qquad .. \qquad .. \qquad .. \quad (3)$$

The exponential curve has the advantage of being easily manipulated algebraically. It should be noted that the exponential rate of growth r as given in (3) is only approximately equal to r′. For small values of r this approximation is quite good. A comparison of (3) with (2) gives an idea about the discrepancy between the two rates of growth.

From (2) and (3), we obtain

$$\beta = e^r$$
$$i.e., 1 + r' = e^r$$
$$or, \quad r' = e^r - 1$$

Expanding e^r in a series of powers of r, we get

$$r' = r + \frac{r^2}{2!} + \frac{r^3}{3!} + \cdots\cdots$$

When r is small its powers converge rapidly and terms involving second and higher powers of r can be neglected. Thus r becomes approximately equal to r', the compound rate of growth in (2).

Minhas[1] has shown that the ratio of linear rate of growth to the harmonic mean can be used as an estimator of r. Therefore, one advantage in using r instead of r' is the economy of computational labour which would otherwise be required to fit a logarithmic or exponential curve.

In the present study we shall use Minhas's estimator, $\frac{b}{H}$, for the compound growth rate. It should, however, be remembered that it is an estimator of r and not of r' unless, of course, r is very small.

The methodology adopted for analysing the overlapping Series I and II is essentially same as described above. For a better assessment of Plan results the data of Series I have been converted into index numbers by using 1950-51, *i.e.*, the pre-Plan year as base. Similarly, in the case of Series II 1955-56, *i.e.*, the year just preceding the Second Plan was used as base.

The net growth over the period has been calculated by the increase in trend value of the final year over that of base year.

Results

From Table I it appears that the acreage and production of total cereals and millets have been significantly increasing over the whole period of 1950-51 to

TABLE I—ACREAGE AND PRODUCTION TRENDS OVER THE ENTIRE PERIOD 1950-51 TO 1965-66

(Base : 1950-51)

Crops	Acreage			Production		
	a	b	s.e.	a	b	s.e.
1. Autumn rice	110.23	—1.60**	.232	89.97	.66	.472
2. Winter rice	89.02	.33	.224	105.86	5.57**	1.290
3. Total rice	90.76	.17	.200	104.60	5.19**	1.205
4. Wheat	97.58	1.60**	.595	102.81	5.93**	1.711
5. Maize	106.26	2.06**	.532	69.90	12.70**	2.729
6. Barley	106.22	.09	.582	117.71	2.85*	1.489
7. *Ragi*	90.74	.45	.677	83.19	1.92*	.962
8. Other cereals and millets ..	81.75	—1.32	.768	49.11	1.69	1.134
9. Total cereals and millets ..	95.10	.36*	.161	95.75	5.36**	.963
10. Gram	109.23	.50	.473	125.67	4.10*	1.758
11. *Arhar*	113.01	—1.83	1.055	89.64	2.68	1.982
12. Other pulses	96.54	1.96**	.621	92.03	8.24**	1.787
13. Total pulses	101.39	.96	.556	101.87	6.08**	1.584
14. Total foodgrains	95.98	.51*	.230	96.56	5.46**	.986

* Significant at 5 per cent level.
** Significant at 1 per cent level.

1. See B. S. Minhas, "Rapporteur's Report on Measurement of Agricultural Growth," *Indian Journal of Agricultural Economics*, Vol. XXI, No. 4, October-December, 1966, pp. 167-168.

1965-66. Dominance of total cereals and millets, which contributes not less than three-fourths to total foodgrain acreage and production, is perceptible in the trends of the latter also. There may be three sources of the expansion in the acreage under foodgrain crops, namely, extension of area under cultivation, increase in crop intensity and a change in cropping pattern. In the context of our study, however, the first may be ruled out because on the basis of 1950-51 to 1952-53 and 1963-64 to 1965-66 averages, we see that the net area sown has been reduced by about 3 per cent. But (total) area sown more than once has increased by about 6 per cent and the share of foodgrain has also risen from 86 per cent of total cropped area in early 'fifties to 89 per cent in mid-sixties. Thus, it can reasonably be inferred that increased demographic pressure on land has resulted in an expansion of acreage under foodgrain crops through increased intensity of cropping as well as a shift in acreage from non-foodgrain to foodgrain crops.

In regard to production, it is noted that the production of rice, barley, *ragi* and gram has been increasing significantly though the trends in their acreage has shown no appreciable increase. This indicates that the increase in their production was a result of increased productivity rather than due to expansion in acreage.

As a matter of fact, a comparison of rates of growth in Table II reveals that the compound rates of production of all the crops are well above those of acreage.[2]

TABLE II—GROWTH RATE IN AGRICULTURE OVER THE ENTIRE PERIOD 1950-51 TO 1965-66

(*Base : 1950-51*) (*per cent*)

Crops	Acreage			Production		
	Linear growth rate	Compound growth rate	Net growth over 1950-51	Linear growth rate	Compound growth rate	Net growth over 1950-51
1. Autumn rice	—1.60	—1.67	—22.10	.66	.69	10.92
2. Winter rice	.33	.36	5.54	5.57	3.86	74.98
3. Total rice	.17	.19	2.80	5.19	3.68	70.91
4. Wheat	1.60	1.46	24.20	5.93	4.22	81.80
5. Maize	2.06	1.69	28.52	12.70	8.56	230.63
6. Barley	.09	.08	1.26	2.85	2.10	35.46
7. *Ragi*	.45	.48	7.40	1.92	2.01	33.84
8. Other cereals and millets	—1.32	—1.07	—24.62	1.69	3.27	49.90
9. Total cereals and millets	.36	.36	5.50	5.36	3.99	79.52
10. Gram	.50	.48	6.83	4.10	2.72	47.39
11. *Arhar*	—1.83	—1.95	—24.68	2.68	2.82	43.54
12. Other pulses	1.96	1.76	29.85	8.24	5.65	123.27
13. Total pulses	.96	.89	14.06	6.08	4.28	84.48
14. Total foodgrains	.51	.50	7.93	5.45	4.01	80.14

2. According to S. R. Sen's estimates, the annual compound rates of increase in production, cultivated area and productivity in the agricultural sector of Bihar during 1952-53 to 1961-62 period were 3.22, 1.07 and 2·07 per cent respectively. See "Population Growth and Agriculture," *Yojna*, February 20, 1966.

The productivity per acre of all the crops has, possibly, been increasing throughout.   The growth in production was most spectacular in the case of maize, which grew at a rate of 8.6 per cent and finally increased by about 230 per cent over the base year.   The acreage and production of wheat have shown a total growth of 24 per cent and 82 per cent respectively.   In the case of rice, the most important foodgrain, the growth rate and total growth of acreage have been only about .2 per cent and 2.8 per cent as against 3.7 per cent and 70.9 per cent for its production.   This again speaks of our success in increasing the productivity.   The production of total pulses has shown a higher growth than that of cereals and millets. As our diet is known to be deficient in protein, it may be a happy tendency.   But at the same time, it should be noted that this increasing trend in total pulses reflects a relatively high growth in other pulses, which contribute above 55 per cent of its production.   And roughly about 82 per cent of the production of 'Other pulses' is due to *khesari*, an inferior pulse with a low nutrient content.

A comparative study of trends in Series I and Series II is possible as shown in Table III which gives the values of a, b and s.e. of b.   So far as acreage is

TABLE III—ACREAGE AND PRODUCTION TRENDS IN SERIES I (1950-51 TO 1960-61)
AND IN SERIES II (1955-56 to 1965-66)

Crops			Acreage			Production		
			a	b	s.e.	a	b	s.e.
1. Autumn rice	I	..	106.41	.79*	.377	93.13	.08	.931
	II	..	103.11	—2.21**	.234	84.63	1.17	.845
2. Winter rice	I	..	91.58	—.20	.189	102.55	6.16*	2.695
	II	..	98.00	.94**	.224	92.96	3.90*	1.613
3. Total rice	I	..	92.80	—.24	.395	101.80	5.69*	2.526
	II	...	98.44	.65**	.178	92.43	3.74*	1.536
4. Wheat	I	...	97.17	1.60	1.218	106.35	4.85	3.215
	II	...	104.78	1.34	1.234	77.83	6.08*	2.185
5. Maize	I	—	102.83	2.64**	.932	58.50	14.44**	4.847
	II	—	106.28	2.42*	.976	126.02	17.46*	6.266
6. Barley	I	..	100.52	1.14	1.047	108.50	4.34	2.591
	II	..	110.53	—.15	1.086	92.84	1.32	1.928
7. *Ragi*	I	...	88.96	.75	1.433	81.33	2.25	2.073
	II	..	117.35	2.23	1.553	120.15	4.69*	2.124
8. Other cereals and millets	I	—	125.16	.90	1.380	53.62	.80	2.417
	II	—	99.68	—1.96*	.647	87.80	2.95*	1.215
9. Total cereals and millets	I	—	95.54	.24	.335	93.18	5.74**	1.998
	II	—	97.91	.51*	.253	93.52	4.61**	1.447
10. Gram	I	—	103.80	.55	.879	123.19	4.62	3.674
	II	...	109.73	—.57	.984	95.81	5.85*	2.158
11. *Arhar*	I	—	116.53	—2.25	2.266	111.30	—1.61	3.819
	II	—	116.09	1.44	1.784	67.88	12.23**	3.221
12. Other pulses	I	—	98.04	1.57	1.302	106.47	5.01	3.476
	II	—	97.01	3.24**	1.027	72.01	10.21**	1.947
13. Total pulses	I	—	101.32	.91	1.181	112.62	3.76	3.317
	II	—	101.65	2.13*	.993	78.68	9.13**	1.771
14. Total foodgrains	I	—	96.43	.38	.483	95.77	5.48*	2.055
	II	..	100.88	1.03*	.408	91.66	5.17**	1.451

*   Significant at 5 per cent level
**   Significant at 1 per cent level.

concerned rice, total cereals and millets and total pulses remained more or less static in Series I whereas in Series II they increased significantly. Similar is the case with total foodgrains also. On the production side, total cereals and millets as well as total foodgrains have shown significant increase in both the series. However, total pulses did not increase significantly in Series I while it was found highly significant in Series II.

A comparison of growth of production between the two series as shown in Table IV reveals that while the rate of growth of total foodgrain production is

TABLE IV—GROWTH OF PRODUCTION IN SERIES I (BASE : 1950-51)
AND IN SERIES II (BASE : 1955-56)   *(per cent)*

Crops	Linear growth rate		Compound growth rate		Net growth over base years	
	I	II	I	II	I	II
1. Autumn rice	.08	1.17	.09	1.29	.89	13.67
2. Winter rice	6.16	3.90	4.68	3.49	56.66	40.26
3. Total rice	5.69	3.74	4.41	3.38	52.94	38.89
4. Wheat	4.85	6.08	3.86	5.81	43.61	72.46
5. Maize	14.44	17.46	11.47	8.89	197.97	121.69
6. Barley	4.34	1.32	3.38	1.36	38.46	14.02
7. *Ragi*	2.25	4.69	2.50	3.26	26.92	37.58
8. Other cereals and millets	.80	2.95	1.76	2.86	1.47	32.51
9. Total cereals and millets	5.74	4.61	4.69	3.95	58.02	46.97
10. Gram	4.62	5.85	3.28	4.73	36.14	57.54
11. *Arhar*	—1.61	12.23	—1.92	10.70	—14.68	152.66
12. Other pulses	5.01	10.21	4.38	8.52	44.90	124.17
13. Total pulses	3.76	9.13	2.97	7.46	32.31	103.97
14. Total foodgrains	5.48	5.17	4.44	4.39	54.12	53.39

more or less the same in both the series, the growth rate of rice has been at a faster rate in I than in II. In the first series, rice production increased by about 53 per cent while in the second series it increased by only about 39 per cent. Similar is the case with total cereals and millets. For total pulses, however, the reverse was true. It increased at a slower rate in I than in II and the total increase in the two series was about 32 per cent and 104 per cent respectively.

In brief, it can be contended that the impact of the First and Second Plans taken together was more favourable to the production of cereals and millets, specially rice. However, in respect of total pulses (and also *ragi*), the combined effect of the Second and Third Plans was more pronounced.

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