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NOTES

ESTIMATION OF ACREAGE RESPONSE TO PRICE OF SELECTED CROPS IN PUNJAB STATE

To facilitate the formulation of an appropriate agricultural price policy for growth and stability, an understanding of the long run price elasticities is essential The whole fabric of our past and present price support programme could not be adequately judged without finding clear-cut answers to the problem of response of production to prices. Therefore, the present study was conducted to gauge the impact of price changes on the farmer's decision to allocate land to different crops.

For this purpose, two crops, *viz.*, wheat and gram were selected. The estimating equation is of the type :

$X_t = a_0 + a_1 P_{t-1} + a_2 P_{Ct-1} + a_3 Y_{t-1} + a_4 (I_{At-1} \text{ or } W_t)$ where,

X_t is the acreage of the crop in time t,

P_{t-1} is the harvest price of the crop lagged,

P_{Ct-1} is the harvest price of the competing crop lagged,

Y_{t-1} is the yield per acre lagged,

I_{At-1} is the percentage of area irrigated to total cropped area lagged,

and W_t is the total rainfall for three months preceding the sowing time.

The study covered six districts, *viz.*, Hoshiarpur, Amritsar, Ludhiana, Jullundur, Ferozepur and Gurdaspur and reorganized Punjab State as a whole. Rest of the five districts were not included because of non-availability of reliable time-series data. For four districts, namely, Jullundur, Ludhiana, Ferozepur and Amritsar, where more than 50 per cent of the area was irrigated, I_{At-1} was considered. For Hoshiarpur and Gurdaspur, which are mostly rain-fed, W_t was considered. To get the elasticities directly, the analysis was carried out with the logarithm of the variables instead of the actual values. The analysis covered a period of 15 years from 1951-52 to 1965-66. Cropwise discussion of these crops is as follows :

Wheat

$$X_t = \underset{}{2.1298} + \underset{(0.2854)}{0.8982^*} P_{Wt-1} - \underset{(0.1356)}{0.1254} P_{Gt-1} - \underset{(0.0391)}{0.0017} Y_{t-1} + \underset{(0.0271)}{0.0602^*} W_t$$

$$R^2 = 0.5776$$

For the State as a whole, the response of wheat acreage to price was significant at 5 per cent level with an elasticity of 0.898 and standard error 0.285. The effect of price of gram on wheat acreage was insignificant with an elasticity of

—0.125. For the analysis of Punjab State, rainfall prior to sowing season (W_t) was also significant at 5 per cent level with an elasticity of 0.060. These results clearly indicated that with favourable weather conditions and given the suitable price incentive, the farmer would allocate more land to wheat.

These results confirm the findings of Kahlon, *et. al.*[1] who found that the coefficient of wheat price was significant at 1 per cent level with the magnitude of 3.4250 and standard error 0.8697. They also found the coefficient of gram price to be negatively significant at 5 per cent level, whereas in the present study cross elasticity of gram price was found to be insignificant. They included time as an independent variable but they excluded rainfall. In the present study, the effect of rainfall was found to be positively significant. Gram was usually grown on unirrigated land and hence the acreage under gram was affected by rainfall. When rainfall was adequate, the farmer planted wheat in preference to gram. Hence when rainfall was not considered, its effect was incorporated in gram acreage and indirectly in gram price.

Districtwise Analysis

Districtwise analysis gave interesting results. The districts were both irrigated and rain-fed. The results obtained are presented in Table I.

TABLE I—PRICE ELASTICITIES OF SUPPLY, THEIR STANDARD ERRORS AND COEFFICIENT OF MULTIPLE DETERMINATION FOR WHEAT CROP (DISTRICTWISE ESTIMATES)

Districts	a	Elasticities of supply and their standard errors				R^2
		P_{t-1}	P_{ct-1}	Y_{t-1}	I_{At-1}	
Hoshiarpur ..	3.0685	—0.0975 (0.2196)	0.0472 (0.1387)	—0.2058 (0.1218)	0.0274 (0.0149)	0.4225
Amritsar ..	4.0336	2.2856 (0.2024)	—0.0488 (0.1053)	0.1677 (0.1046)	—1.2094* (0.5481)	0.6241*
Ludhiana ..	0.1574	0.8457** (0.2295)	—0.0986 (0.1304)	0.1646 (0.1783)	0.3305 (0.6436)	0.7569**
Jullundur ..	0.8567	0.7389* (0.3212)	—0.1803 (0.2064)	0.1371 (0.1809)	0.1570 (0.3584)	0.5625
Ferozepur ..	—0.4696	0.2911 (0.2949)		0.3552 (0.3935)	0.9931 (0.9597)	0.2153
Gurdaspur ..	0.3487	0.8727* (0.3923)	—0.1668 (0.2170)	0.3161 (0.1463)	0.0113 (0.0293)	0.6400**

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

Of the irrigated districts, Ludhiana and Jullundur showed significant response to price with elasticities of 0.845 and 0.739 which were significant at 1 per cent and 5 per cent level respectively. Of the rain-fed districts, Gurdaspur showed significant response to price at 5 per cent level.

1. A. S. Kahlon, S. S. Johl and H. N. Dwivedi, "Structure of Farm Prices in the Punjab," *Indian Journal of Agricultural Economics*, Vol. XX, No. 1, January-March, 1965, pp. 35-40.

In Ferozpur, normally no crop competed with wheat which was usually cultivated on fallow land. Hence no cross price elasticity was computed for this crop. For Hoshiarpur district, the price coefficient was negative. The decline in wheat acreage from 278 thousand acres in 1950-51 to 261.2 thousand acres in 1965-66 could not be attributed to prices. This decline was due to the fall in total cropped area in Hoshiarpur district from 876 thousand acres in 1950-51 to 763.5 thousand acres in 1965-66, because of the appropriation of agricultural land for non-agricultural purposes.

The cross price elasticity of gram (competing crop) relative to wheat acreage ranged from —0.180 to 0.047. This was not found to be significant in any district. Prices of both wheat and gram have been increasing over the years. But the price of wheat was generally higher than the price of gram. Also, with the extension of irrigation facilities, farmers tend to put more land under wheat. Therefore, the price of gram did not affect acreage allocation under wheat.

In Amritsar district, the coefficient of percentage of area irrigated was found to be significant at the 5 per cent level.

These findings indicate that the acreage allocation under wheat was affected considerably by wheat price. It is also affected to some extent by the irrigated area or rainfall. But, apparently the price of gram had no effect in allocating acreage under wheat.

Gram

This multi-purpose crop is mostly grown on unirrigated land. Hence for this crop instead of irrigated area, the rainfall just prior to the sowing season was taken as one of the factors affecting the acreage under gram.

$$X_t = \underset{}{1.9193} + \underset{(0.4177)}{0.0220}\ P_{Gt-1} - \underset{(0.2206)}{0.4601}\ P_{Wt-1} + \underset{(0.2699)}{0.7039^*}\ Y_{t-1} + \underset{(0.0334)}{0.0389}\ W_t$$

$$R^2 = 0.7921^{**}$$

For the State as a whole, the coefficient of yield per acre was significant at 5 per cent level. The coefficient of price of the competing crop was negative, indicating that as the price of wheat (competing crop) increased, the acreage under gram declined.

Districtwise Analysis

The results of districtwise analysis in Table II showed that for Hoshiarpur, Ludhiana and Jullundur districts, the price elasticity was positive, ranging from 0.622 to 3.785. The price elasticity for Jullundur was significant at 5 per cent level. Amritsar, Ferozepur and Gurdaspur districts gave negative price elasticity ranging from —0.884 to —0.279. This is contrary to economic reasoning. These results do not, however, disprove economic theory; they only indicate that the fall in gram acreage could be attributed to factors other than price. For example, Amritsar and Gurdaspur districts have been affected by waterlogging in recent years. This rendered the soil unfit for gram cultivation. Hence in spite of a

rise in prices, the acreage under gram in these districts came down from 13.02 per cent and 6.5 per cent in 1950-51 to 6.07 per cent and 2.9 per cent in 1965-66. In Ferozepur, because of extensive irrigation and fertility of soil, gram was cultivated on marginal land only. Therefore, over the years from 1950-51 to 1965-66, acreage under gram went down from 26.1 per cent to 14.2 per cent of total cropped area in spite of a rise in prices. The negative price elasticity could not be attributed to price fluctuations because gram prices showed a continuous rising trend.

TABLE II—PRICE ELASTICITIES OF SUPPLY, THEIR STANDARD ERRORS AND COEFFICIENT OF MULTIPLE DETERMINATION FOR GRAM CROP (DISTRICTWISE ESTIMATES)

Districts	a	Elasticities of supply and their standard errors				R^2
		P_{t-1}	P_{ct-1}	Y_{t-1}	W_t	
Hoshiarpur ..	—0.7144	1.1656 (0.8344)	0.5842 (0.5932)	—0.0656 (0.1006)	0.0982 (0.0452)	0.5041
Amritsar ..	4.3907	—0.8843 (0.5212)	—0.1389 (0.3105)	—0.2268 (0.2575)	0.0279 (0.0292)	0.7921**
Ludhiana ..	4.7573	0.6225 (0.5979)	—0.9611* (0.3169)	—0.7493* (0.3368)	—0.0080 (0.0313)	0.6889**
Jullundur ..	—0.7285	3.7854* (1.5873)	—2.7989* (0.0876)	0.1106 (0.5535)	0.1971 (0.0992)	0.6724**
Ferozepur ..	3·6028	—0.5702 (0.4146)	—0.2432 (0.1732)	0.1175 (0.1526)	0.0147 (0.0171)	0·7744**
Gurdaspur ..	5.2275	—0.2799 (0.9590)	—0.6421 (0.5056)	—0.6623 (0.4486)	—0.0868 (0.0704)	0.4489

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

The cross price elasticities of wheat for Jullundur and Ludhiana districts were significant at 1 per cent and 5 per cent levels respectively. For Ludhiana district, yield was negatively significant at 5 per cent level. This supports the conclusions drawn from the analysis on wheat crops. In Jullundur and Ludhiana districts, the acreage under wheat was significantly affected by the rise in wheat prices. Since wheat and gram are competing crops, relatively higher wheat prices are bound to increase the acreage under wheat and decrease the acreage under gram.

The analysis on gram indicates that the acreage under gram, a multi-purpose crop was affected significantly by wheat prices, but insignificantly by gram prices.

In order to make a relative comparison of the price elasticities obtained, we present Table III along with the estimates obtained by Raj Krishna[2] and Kaul.[3]

2. Raj Krishna, "Farm Supply Response in India-Pakistan : A Case Study of the Punjab Region," *The Economic Journal*, Vol. LXXIII, No. 291, September, 1963, pp. 477-487.

3. J. L. Kaul, "A Study of Supply Response to Price of Punjab Crops," *Indian Journal of Economics*, Vol. 48, No. 188, July, 1967, pp. 25-29.

TABLE III

Crops (acreages)	Raj Krishna Punjab (undivided) elasticities (1913-14 to 1945-46)	Kaul Punjab (India) elasticities (1950-51 to 1963-64)	Authors Punjab (divided) elasticities (1951-52 to 1965-66)
Wheat	0.14	0.09	0.90
Gram	—0.33	—0.65	0.02

There does not seem to be any marked difference between the results obtained by Raj Krishna and Kaul. But these estimates are lower than the estimates obtained by the authors. Both Raj Krishna and Kaul used Nerlove's model where lagged acreage was one of the variables affecting acreage. The deletion of lagged acreage as one of the independent variables in this study resulted in higher estimates of price elasticities as compared with Raj Krishna and Kaul.

Raj Krishna included rainfall and found it to be positively significant for wheat unirrigated and gram. In fact, he included annual rainfall which had nothing to do with acreage decision of farmers. Kaul included rainfall for the months preceding the sowing season and found its effect to be significant in rainfed districts which is confirmed by the findings of the present study.

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AND
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CHANGES IN LAND-USE PATTERN IN ORISSA†

Study of changes in land-use pattern in Orissa is made difficult for want of complete and comparable time-series data. In the recent past, the figures of area under different land-uses reported in the years 1950-51, 1955-56 and 1960-61 have been almost invariably repeated in the subsequent four years in all the districts. It is thus meaningless to attempt any analysis of changes in land-use pattern in Orissa on the basis of rates of growth in areas under different land utilizations as has been done in similar studies[1] on Madras and Punjab in which the land utilizations with positive rates of growth were interpreted to have gained at the cost of those which had negative rates of growth.

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† The author wishes to thank Shri S. N. Khare for his assistance in preparing this paper. The views expressed are, however, entirely his own and do not reflect necessarily the views of the Organization he belongs to.

1. See "Changes in Land-Use Pattern in Madras State," *Agricultural Situation in India*, Vol. XXII, No. 12, March, 1968; and "Changes in Land-Use Pattern in Punjab," *Indian Journal of Agricultural Economics*, Vol. XXIV, No. 2, April-June, 1969.

A cruder method based on Kendall's and Spearman's rank correlations has to be adopted in the present paper to examine if the changes in land-use pattern in the different districts of the State have been so pronounced as to change their ranks in 1955-56 and in 1960-61 from those in 1950-51. Abrupt increase or decrease in the area under any land-use class in 1955-56 and 1960-61 in comparison to the preceding four years will arise not only from a fuller accounting of the annual changes just at the end of every fifth year synchronizing with the pre-Plan year and the end of the First and Second Plans, but also partly from the changes in the method and extent of "reporting area" and changes in concepts and definitions. The changes arising from refinement in statistics would not ordinarily be so large as to cause by themselves much alterations in the ranks of different land-use classes. However, unless these changes are separated, they might confound the effect of real changes on the land-use pattern. On the other hand, errors of judgment in adjusting the published figures for changes arising from statistical improvements might also jeopardise the analysis. Therefore, the analysis in this paper has been based on rank correlations calculated from both the published area figures and the area figures adjusted for changes originating from improvements in statistics.

Adjustments for Changes arising out of Statistical Refinements

While making adjustments for changes arising from statistical refinements, the following assumptions have been made.

(1) Increase in "reporting area" is assumed to have been contributed by only those land-use categories which themselves recorded increase, and their contributions to this increase are taken in proportion to their own increases.

(2) Similarly, decrease in "reporting area" is assumed to be contributed by only those categories which themselves recorded decrease, in proportion to their own decreases.

(3) There being little ambiguity in identifying "net area sown," the recorded variation in this category is generally taken as real, the first claimant on this variation being "fallow."

(4) All increases in "fallow," unless explained by decreases in "net area sown" are taken as statistical.

(5) Shift of area from "forest" to "other uncultivated land" is generally statistical.

(6) Shift from "land not available for cultivation" to other categories except "net area sown" is generally taken as statistical.

(7) All other shifts in area from one category to another are taken either real or statistical, their exact nature being determined on the basis of some general considerations.

(8) Besides the above general considerations, large, abrupt shift in area from one category to another, particularly when it was found to have been reversed in a subsequent year, has been taken as arising from statistical improvements.

For different land-use categories in each district, year-to-year progressive totals of changes arising from statistical refinements have been made, and adjusted figures for 1955-56 and 1960-61 have been obtained by deducting these totals from the land-use classes which had swelled up because of these changes and by adding these totals to the classes which had correspondingly shrunk.

Methodology

For each of the years 1950-51, 1955-56 and 1960-61 the ranks of different land-use classes in each district have been determined both for their published and adjusted area figures, in relation to their shares in the total "reporting area" of the district (Appendix). Thereafter, Spearman's and Kendall's rank correlation coefficients (r and r') have been worked out between the rankings of different land-use categories for 1950-51 and 1955-56, and for 1950-51 and 1960-61. For n (total number of ranks) as small as five, both r and r' do not follow normal law and hence for test of significance, their actual distributions are taken into consideration.[2] By the very nature of the formulae, to test the significance of r and r' we have to take 8 per cent and 2 per cent levels of significance and not the conventional 5 per cent and 1 per cent levels of significance. If the correlation coefficient is statistically significant, it means that land-use pattern has not changed significantly. On the contrary, if it is not significant, it means that land-use pattern has changed significantly.

The correlation coefficients between rankings of 1950-51 and 1955-56, and between 1950-51 and 1960-61 show how far the land-use pattern changed by 1955-56, and by 1960-61 respectively from that in 1950-51. An idea of the total change over the period 1950-51 to 1960-61 can be had by examining whether land-use patterns in 1950-51, 1955-56 and 1960-61 were in general different from each other or not, with the help of the concordance coefficient, W. If the value of W is significant, we can say that land-use pattern has not changed significantly from quinquennium to quinquennium and if it is not significant it means that land-use pattern has changed significantly.

Results : Extent and Nature of Changes

Table I gives for Orissa and its 13 districts (*a*) Kendall's and Spearman's rank correlation coefficients between the rankings of different land-use categories for 1950-51 and 1955-56, and for 1950-51 and 1960-61, (*b*) concordance coefficient to measure total change in ranks in 1950-51, 1955-56 and 1960-61, and (*c*) the significance of all these coefficients.

All the rank correlation coefficients based on adjusted data, except those between 1950-51 and 1960-61 for Cuttack and Mayurbhanj districts, are statistically significant, indicating that significant changes in land-use pattern took place in these two districts only by 1960-61 over 1950-51.

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2. For details of methodology, please see M. G. Kendall : Rank Correlation Methods Second Edition, Charles Griffin & Co., London, 1955.

TABLE I—KENDALL'S AND SPEARMAN'S RANK CORRELATION COEFFICIENTS BETWEEN THE RANKINGS OF DIFFERENT LAND-USE CATEGORIES FOR 1950-51 AND 1955-56 AND FOR 1950-51 AND 1960-61, AND OVERALL CONCORDANCE COEFFICIENTS AND THEIR SIGNIFICANCE

District	Kendall's rank correlation coefficient				Spearman's rank correlation coefficient				Concordance coefficient W between 1950-51, 1955-56 and 1960-61	
	For unadjusted data		For adjusted data		For unadjusted data		For adjusted data			
	Between 1950-51 and 1955-56	Between 1950-51 and 1960-61	Between 1950-51 and 1955-56	Between 1950-51 and 1960-61	Between 1950-51 and 1955-56	Between 1950-51 and 1960-61	Between 1950-51 and 1955-56	Between 1950-51 and 1960-61	For unadjusted data	For adjusted data
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
1. Balasore	0.80*	0.60	0.80*	0.80*	0.90*	0.70	0.90*	0.90*	0.89**	0.96**
2. Bolangir	0.80*	0.60	1.00**	0.80*	0.90*	0.80	1.00**	0.90*	0.91**	0.96**
3. Cuttack	0.80*	0.00	1.00**	0.40	0.90*	0.10	1.00**	0.60	0.62	0.82*
4. Dhenkanal	0.80*	0.60	0.80*	0.80*	0.90*	0.80	0.90*	0.90*	0.91**	0.96**
5. Ganjam	0.60	1.00**	1.00**	0.80*	0.70	1.00**	1.00**	0.90*	0.87**	0.96**
6. Kalahandi	0.80*	—0.20	0.80*	0.80*	0.90*	—0.30	0.90*	0.90*	0.44	0.96**
7. Keonjhar	0.20	0.20	1.00**	1.00**	0.30	0.30	1.00**	1.00**	0.69	1.00**
8. Koraput	0.80*	1.00**	1.00**	1.00**	0.90*	1.00**	1.00**	1.00**	0.96**	1.00**
9. Mayurbhanj	0.80*	0.60	0.80*	0.60	0.90*	0.70	0.90*	0.70	0.89**	0.89**
10. Baudh Phulbani	0.00	0.40	1.00**	1.00**	0.10	0.40	1.00**	1.00**	0.60	1.00**
11. Puri	1.00**	1.00**	1.00**	1.00**	1.00**	1.00**	1.00**	1.00**	1.00**	1.00**
12. Sambalpur	0.80*	0.40	0.80*	1.00**	0.90*	0.60	0.90*	0.90*	0.82*	0.96**
13. Sundargarh	0.60	0.80*	1.00**	0.80*	0.80	0.90*	1.00**	1.00**	0.91*	0.96**
Orissa	0.40	0.60	1.00**	0.80*	0.60	0.70	1.00**	0.90*	0.82*	0.96**

* Significant at 8 per cent level.
** Significant at 2 per cent level.

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

From the rank correlations and concordance coefficient based on unadjusted data also, one would suspect significant changes in land-use pattern in the following cases only :

(*i*) In both 1955-56 and 1960-61 over 1950-51 in Keonjhar and Phulbani districts and in the State as a whole;

(*ii*) In 1955-56 over 1950-51 in Ganjam and Sundargarh districts; and

(*iii*) In 1960-61 over 1950-51 in Balasore, Bolangir, Cuttack, Dhenkanal, Kalahandi, Mayurbanj and Sambalpur districts.

The rank correlations in all the above cases except those under (*i*) and those relating to Cuttack and Kalahandi under (*iii*) above, were, however, high. Only in the case of these exceptions, the concordance coefficient was also not significant. This would imply that significant changes in land-use pattern took place in these cases only. A closer scrutiny of the unadjusted published land-use data for Keonjhar district would, however, show that large and abrupt shifts in area between forests and land not available for cultivation were almost wholly due to statistical improvement, and in reality no significant change took place in land-use pattern in this district also. Thus, significant changes in land-use pattern occurred in Cuttack, Kalahandi and Phulbani districts only. This conclusion in respect of Cuttack district is supported by the analysis based on adjusted data also.

Sources of Change in Net Area Sown

Rank correlations indicate whether changes in land-use pattern have taken place or not; and that too very broadly; for shares of different land-use categories may substantially change, yet their ranks may not be significantly disturbed. At least one would be interested to know how far changes in land-use pattern have contributed to expansion of cultivation. A broad idea of this can be had from Table II which gives for the State and for each district (*a*) the average net area sown during the initial as well as the end triennium and the percentage change in it during the intervening period, (*b*) the extent to which this change is purely due to variation in Reporting Area, and (*c*) the extent to which this change has been contributed by "forests" and "land not available for cultivation" and by "arable land not previously sown," *i.e.*, "other uncultivated land."

Table II shows that, during the study period, the net sown area increased in 10 districts, but the increase was large only in three: Mayurbhanj, Sambalpur and Dhenkanal. The increases in net area sown originated mainly from extension of cultivation to arable land. Some cultivation was also extended to forests and lands classified as barren and unculturable in Balasore, Kalahandi, Dhenkanal, Koraput and Mayurbhanj, chiefly in the latter three.

In four districts, namely, Bolangir, Ganjam, Keonjhar and Puri, some parts of net sown area, despite increase in it, were diverted to forests or were lost to cultivation. Such transfers of sown area also took place in Phulbani and Sundargarh where the net sown area declined. A substantial fall in net sown area was recorded in Koraput also chiefly as a result of its diversion to "other uncultivated land."

TABLE II—SOURCES OF CHANGE IN NET AREA SOWN IN ORISSA AND ITS 13 DISTRICTS DURING 1950-53 TO 1962-65

District	Net area sown during the triennium (thousand acres)		Percentage change in net area sown			Percentage contribution to net area sown from	
	1962-65	1950-53	Total	Due to variation in Reporting Area	Real	Forests and land not available for cultivation	Other uncultivated land
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
1. Balasore ..	1,101.0	1,034.8	6.4	0.9	5.5	1.4	4.1
2. Bolangir ..	1,148.6	988.0	16.3	8.4	7.9	—0.4	8.3
3. Cuttack ..	1,662.0	1,530.1	8.6	—	8.6	—	8.6
4. Dhenkanal ..	970.7	804.5	20.7	—	20.7	7.6	13.1
5. Ganjam ..	1,019.0	930.0	9.6	—1.1	10.7	—5.7	16.4
6. Kalahandi ..	892.7	1,001.1	—10.8	—13.7	2.9	0.3	2.6
7. Keonjhar ..	690.6	646.5	6.8	—	6.8	—1.3	8.1
8. Koraput ..	2,125.7	2,383.8	—10.8	4.3	—15.1	5.9	—21.0
9. Mayurbhanj	1,027.0	790.0	30.0	—	30.0	5.2	24.8
10. Phulbani ..	480.7	759.0	—36.7	—1.6	—35.1	—26.4	—8.7
11. Puri ..	1,073.7	1,057.6	1.5	—	1.5	—0.8	2.3
12. Sambalpur ..	1,767.3	1,402.2	26.0	0.1	25.9	—	25.9
13. Sundargarh ..	714.3	726.9	—1.7	—	—1.7	—	—1.7
Orissa ..	14,673.3	14,054.5	4.4	0.2	4.2	—0.1	4.3

In the State as a whole, the sown area increased to a very small extent, and, on the balance, this increase was entirely due to extension of cultivation to arable land. A negligible fraction of area already under crops was lost to cultivation because of afforestation, unprofitable cultivation or increase in non-agricultural uses.

Extent of Exploitations of Arable Land for Cultivation

The net area sown formed less than 50 per cent of the total arable land in the initial triennium, 1950-53 in Sambalpur, Ganjam and Phulbani and 65 per cent and below in six more districts : Mayurbhanj, Bolangir, Keonjhar, Kalahandi,

Koraput and Sundargarh (Table III : columns 2 and 3). By the end triennium 1962-65, these proportions of sown area to total arable area increased in four of the above-mentioned districts. The performance of the other five districts, Phulbani, Keonjhar, Kalahandi, Koraput and Sundargarh where the extent of cultivation of arable land declined, may be said to be disappointing in comparison to what was achieved in districts with similar potentials or even in districts with lower potentials like Cuttack. In these five districts as well as in Ganjam, the extent of arable land being cropped was low during 1962-65. The factors responsible for shrinkage in cultivation or impeding extension of cultivation in these six districts need to be identified and measures taken to create and promote favourable factors.

TABLE III—NET AREA SOWN AS PERCENTAGE OF TOTAL ARABLE LAND AND CROPPING INTENSITIES IN ORISSA AND ITS 13 DISTRICTS DURING 1950-53 AND 1962-65

District	Percentage of arable land sown in the triennium		Cropping intensity during the triennium	
	1950-53	1962-65	1950-53	1962-65
(1)	(2)	(3)	(4)	(5)
1. Balasore	82.2	82.2	1.01	1.10
2. Bolangir	58.6	71.2	1.05	1.24
3. Cuttack	68.9	78.5	1.27	1.46
4. Dhenkanal	66.3	66.9	1.03	1.19
5. Ganjam	46.1	53.5	1.01	1.43
6. Kalahandi	58.6	52.5	1.02	1.14
7. Keonjhar	56.0	54.1	1.01	1.11
8. Koraput	65.0	57.5	1.00	1.09
9. Mayurbhanj ..	53.4	67.3	1.01	1.09
10. Phulbani	47.0	45.0	1.04	1.17
11. Puri	69.2	71.1	1.21	1.40
12. Sambalpur	47.9	66.1	1.06	1.17
13. Sundargarh	65.1	51.0	1.04	1.07
Orissa	59.6	63.0	1.07	1.21

Cropping Intensity

A redeeming feature in all the above-mentioned six districts except Sundargarh was sizable increase in cropping intensity almost from the level of a-crop-a-year (Table III : columns 4 and 5). The increase in Ganjam was particularly spectacular. The cropping intensity increased in the remaining seven districts also where new areas were also brought under cultivation.

The only districts in Orissa having cropping intensities comparable to those in several Punjab and Madras districts are the coastal districts of Ganjam, Cuttack and Puri and cropping intensities have further improved sizably. Considering what has been achieved in these three districts, once the favourable conditions are created, all other districts in Orissa could be enabled to improve substantially their cropping intensities which are still low.

Factors Associated with Change in Crop Area

For want of comprehensive time-series data, it is difficult to have a proper analysis of the factors responsible for growth or otherwise of cropped area in Orissa. The available data on water supply could, however, be examined to see how for the growth of cropped area in Orissa has been associated with adequacy or otherwise of water supply. All the Orissa districts receive high precipitation of 1150 millimetres or above a year. The level of irrigation, however, differs from district to district (Table IV). It is fairly high in Cuttack, Ganjam, Puri,

TABLE IV—EXTENT OF IRRIGATED AREA IN THE STATE OF ORISSA AND ITS 13 DISTRICTS DURING 1950-52 TO 1963-65

District	Percentage of area irrigated in			
	Net sown area		Gross sown area	
	1950-52	1963-65	1950-52	1963-65
(1)	(2)	(3)	(4)	(5)
1. Balasore	9.0	11.3	8.9	15.5
2. Bolangir	24.1	20.1	24.5	18.1
3. Cuttack	22.0	34.3	17.8	36.1
4. Dhenkanal	23.7	22.7	23.3	25.9
5. Ganjam	28.1	39.6	27.9	32.4
6. Kalahandi	5.7	10.7	5.7	10.3
7. Keonjhar	2.0	11.7	2.0	19.1
8. Koraput	2.4	7.9	2.4	9.1
9. Mayurbhanj ..	7.4	12.3	7.3	16.5
10. Phulbani	17.8	7.7	16.6	16.3
11. Puri	23.6	33.9	19.8	29.6
12. Sambalpur	22.0	38.2	20.1	45.9
13. Sundargarh	N.A.	3.1	N.A.	4.9
Orissa	18.0	21.2	17.0	24.0

N. A. = Not available.

Sambalpur, Bolangir and Dhenkanal and it further improved in the first four of these districts. The intensity of cropping improved in all these six districts and the cultivation was also extended to new areas in all of them except Puri and Dhenkanal. With improvement in irrigation from a low level, the cropping intensity increased in Balasore, Kalahandi, Keonjhar and Mayurbhanj, in the last one of which cultivation was also extended to new areas. The level of irrigation continued to be low in Koraput and Sundargarh and it declined in Phulbani, and all these districts had a retarded growth in cropped area.

R. GIRI*

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APPENDIX

PUBLISHED AND ADJUSTED FIGURES OF AREAS UNDER DIFFERENT LAND-USE CATEGORIES IN ORISSA AND ITS 13 DISTRICTS DURING 1950-51, 1955-56 AND 1960-61

(area figures in thousand acres)

Item	1. Balasore district			2. Bolangir district			3. Cuttack district		
	1950-51	1955-56	1960-61	1950-51	1955-56	1960-61	1950-51	1955-56	1960-61
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Reporting Area (R.A.) ..	1,524.0	1,524.0	1,600.0	2,274·2	2,041.1	2,182.0	2,694.4	2,694.4	2,690.0
F—Published area ..	97.7	95.7	96.0	342.6	303.1	403.0	156.6	220.0	320.0
Percentage to R.A. ..	6.4	6.3	6.0	15.1	14.9	18.5	5.8	8.2	11.9
Adjusted area ..	97.7	96.0	96.0	342.6	331.0	388.9	156.6	156.6	156.6
Percentage to R.A. ..	6.4	6.0	6.0	15.1	16.2	17.8	5.8	5.8	5.8
NAC—Published area ..	167.6	169.7	163.0	166.6	164.1	164.0	315.7	252.3	252.0
Percentage to R.A. ..	11.0	11.1	10.2	7·3	8.0	7.5	11.7	9.3	9.4
Adjusted area ..	167.6	169.7	163.0	166.6	182.5	182.4	315.7	315.7	315.4
Percentage to R.A. ..	11.0	11.1	10.2	7.3	8.9	8.9	11.7	11.7	11.7
UNC— Published Area ..	145.0	137.5	127.0	681.9	409.7	324.0	285.5	277.6	328.0
Percentage to R.A. ..	9.5	9.0	7.9	30.0	20.1	14.8	10.6	10.3	12.2
Adjusted area ..	145.0	137.5	131.6	681.9	376.5	332.8	285.5	277.6	328.0
Percentage to R.A. ..	9.5	9.0	8.2	30.0	18.5	15.2	10.6	10.3	12.2
FL—Published area ..	73.0	114.6	129.0	70.1	188.6	172.0	410.8	408.7	152.0
Percentage to R.A. ..	4.8	7.5	8.1	3.1	9.2	7.9	15.3	15.2	5.6
Adjusted area ..	73.0	114.6	124.4	70.1	175.5	158.9	410.8	408.7	252.0
Percentage to R.A. ..	4.8	7.5	7.8	3.1	8.6	7.3	15.3	15.2	9.4
S—Published area ..	1,040.7	1,006.5	1,085.0	1,013.0	975.6	1,119.0	1,525.8	1,535.8	1,638.0
Percentage to R.A. ..	68.3	66.1	67.8	44.5	47.8	51.3	56.6	57.0	60.9
Adjusted area ..	1,040.7	1,006.5	1,085.0	1,013.0	975.6	1,119.0	1,525.8	1,535.2	1,638.0
Percentage to R.A. ..	68.3	66.1	67.8	44.5	47.8	51.3	56.6	57.6	60.9

F = Forests; NAC = Land not available for cultivation; UNC = Other uncultivated land excluding fallows; FL = Fallows; S = Net area sown.

(Contd.)

APPENDIX (*Contd.*)

Item	4. Dhenkanal district			5. Ganjam district			6. Kalahandi district		
	1950-51	1955-56	1960-61	1950-51	1955-56	1960-61	1950-51	1955-56	1960-61
(1)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)	(19)
Reporting Area (R.A.) ..	2,704.6	2,704.6	2,698.0	3,024.0	3,024.0	3,014.0	3,236.5	3,236.5	3,227.0
F—Published area ..	1,144.0	1,232.7	836.0	457.4	516.8	517.0	438.6	315.5	1,094.0
Percentage to R.A. ..	42.3	47.4	31.0	15.1	17.1	17.1	13.5	9.7	33.9
Adjusted Area ..	1,144.0	1,144.0	1,008.1	457.4	457.4	457.6	438.6	438.6	438.6
Percentage to R.A. ..	42.3	42.3	37.3	15.1	15.1	15.2	13.5	13.5	13.6
NAC—Published area ..	350.3	254.8	409.0	548.1	535.3	594.0	1,089.8	1,309.6	255.0
Percentage to R.A. ..	12.9	9.4	15.1	18.1	17.7	19.7	33.7	40.5	7.9
Adjusted area ..	350.3	395.5	431.8	548.1	594.7	653.4	1,089.8	1,089.8	1,079.2
Percentage to R.A. ..	12.9	14.6	16.0	18.1	19.7	21.7	33.7	33.7	33.4
UNC—Published area ..	418.7	224.3	378.0	908.4	502.1	686.0	481.0	204.8	569.0
Percentage to R.A. ..	15.5	8.3	14.0	30.1	16.6	22.8	14.9	6.3	17.6
Adjusted area ..	418.7	224.3	218.8	908.4	861.1	828.8	481.0	481.0	481.0
Percentage to R.A. ..	15.5	8.3	8.1	30.1	28.5	27.5	14.9	14.9	14.9
FL—Published area ..	85.3	114.2	140.0	133.8	172.0	264.0	222.7	123.5	311.0
Percentage to R.A. ..	3.2	4.2	5.2	4.4	5.7	8.8	6.9	3.8	9.7
Adjusted area ..	85.3	114.2	104.3	133.8	172.0	264.0	222.7	132.5	132.5
Percentage to R.A. ..	3.2	4.2	3.9	4.4	5.7	8.8	6.9	4.1	4.1
S—Published area ..	706.3	828.6	935.0	976.3	1,297.8	953.0	1,004.4	1,283.0	998.0
Percentage to R.A. ..	26.1	30.7	34.7	32.3	42.9	31.6	31.0	39.7	30.9
Adjusted area ..	706.3	828.6	935.0	976.3	938.8	810.2	1,004.4	1,094.6	1,095.7
Percentage to R.A. ..	26.1	30.6	34.7	32.3	31.0	26.8	31.0	33.8	34.0

(*Contd.*)

APPENDIX (*Contd.*)

Item	7. Keonjhar district			8. Koraput district			9. Mayurbhanj district		
	1950-51	1955-56	1960-61	1950-51	1955-56	1960-61	1950-51	1955-56	1960-61
(1)	(20)	(21)	(22)	(23)	(24)	(25)	(26)	(27)	(28)
Reporting Area (R.A.) ..	2,058.5	2,058.5	2,054.0	6,320.0	6,224.0	6,311.0	2,573.5	2,573.5	2,569.0
F—Published area	101.4	619.3	431.0	778.7	779.1	1,219.0	571.1	571.2	557.0
Percentage to R.A. ..	4.9	30.1	21.0	12.3	12.5	19.3	22.2	22.2	21.7
Adjusted area	101.4	72.0	125.8	778.7	779.2	825.1	571.1	571.2	560.1
Percentage to R.A. ..	4.9	3.5	6.1	12.3	12.5	13.1	22.2	22.2	21.8
NAC—Published area ..	740.0	276.3	349.0	1,873.4	2,304.2	1,566.0	522.3	522.4	485.0
Percentage to R.A. ..	36.0	13.4	17.0	29.6	37.0	24.8	20.3	20.3	18.9
Adjusted area	740.0	740.0	740.5	1,873.4	1,938.5	1,734.4	522.3	522.4	491.4
Percentage to R.A. ..	36.0	35.9	36.1	29.6	31.1	27.5	20.3	20.3	19.1
UNC—Published area ..	500.0	416.3	353.0	819.5	1,293.0	1,388.0	140.9	140.8	310.0
Percentage to R.A. ..	24.3	20.2	17.2	13.0	20.8	22.0	5.5	5.5	12.0
Adjusted area	500.0	499.9	466.3	819.5	819.5	883.1	140.9	140.8	299.7
Percentage to R.A. ..	24.3	24.3	22.7	13.0	13.2	14.0	5.5	5.5	11.7
FL—Published area ..	44.0	60.8	287.0	464.6	60.5	175.0	532.2	433.9	244.0
Percentage to R.A. ..	2.1	3.0	14.0	7.4	1.0	2.8	20.9	18.8	9.5
Adjusted area	44.0	60.8	87.4	464.6	426.1	431.9	532.2	433.9	244.0
Percentage to R.A. ..	2.1	3.0	4.3	7.4	6.9	6.8	20.9	18.8	9.5
S—Published area	673.1	685.8	634.0	2,383.8	1,787.9	1,963.0	300.0	855.2	973.0
Percentage to R.A. ..	32.7	33.3	30.8	37.7	28.7	31.1	31.1	33.2	37.9
Adjusted area	673.1	685.8	634.0	2,383.8	2,261.4	2,436.5	300.0	855.2	973.0
Percentage to R.A. ..	32.7	33.3	30.8	37.7	36.3	38.6	31.1	33.2	37.9

(*Contd.*)

APPENDIX (*Contd.*)

Item	10. Phulbani district			11. Puri district			12. Sambalpur district		
	1950-51	1955-56	1960-61	1950-51	1955-56	1960-61	1950-51	1955-56	1960-61
(1)	(29)	(30)	(31)	(32)	(33)	(34)	(35)	(36)	(37)
Reporting Area (R.A.) ..	2,740.5	2,738.6	2,728.0	2,594.6	2,587.5	2,586.0	4,329.3	4,330.3	4,321.0
F—Published area	476.4	1,216.0	1,216.0	758.4	757.6	764.0	1,118.0	1,270.6	733.0
Percentage to R.A. ..	17.4	44.4	44.6	29.2	29.3	29.5	25.8	29.3	17.0
Adjusted area	1,216.0	1,216.0	1,216.0	758.4	751.4	757.9	1,118.0	1,118.0	814.4
Percentage to R.A. ..	44.4	44.4	44.6	29.2	29.0	29.3	25.8	25.8	18.9
NAC—Published area ..	481.0	320.3	443.0	308.7	301.6	309.0	285.3	526.0	905.0
Percentage to R.A. ..	17.6	11.7	16.2	11.9	11.6	11.9	6.7	12.2	20.9
Adjusted area	243.0	243.1	243.1	308.7	308.7	316.2	285.3	286.5	665.5
Percentage to R.A. ..	8.9	8.9	8.9	11.9	11.9	12.2	6.7	6.6	15.4
UNC—Published area ..	1,086.9	282.0	551.0	396.1	394.0	353.0	1,326.7	623.3	522.0
Percentage to R.A. ..	39.6	10.3	20.2	15.3	15.2	13.7	30.6	14.4	12.1
Adjusted area	584.3	431.9	441.1	396.1	393.0	375.0	1,326.7	1,023.1	955.9
Percentage to R.A. ..	21.3	15.7	16.2	15.3	15.2	14.5	30.6	23.7	22.1
FL—Published area ..	50.6	126.8	33.0	76.6	70.9	98.0	170.1	229.9	407.0
Percentage to R.A. ..	1.8	4.6	1.2	2.9	2.8	3.8	3.9	5.3	9.4
Adjusted area	50.6	54.1	33.0	76.6	70.9	74.9	170.1	221.9	131.2
Percentage to R.A. ..	1.8	2.0	1.2	2.9	2.8	2.9	3.9	5.1	3.0
S—Published area	646.6	793.5	485.0	1,054.8	1,063.5	1,062.0	1,429.2	1,681.0	1,754.0
Percentage to R.A. ..	23.6	29.0	17.8	40.7	41.1	41.1	33.0	38.8	40.6
Adjusted area	646.6	793.5	794.8	1,054.8	1,063.5	1,062.0	1,429.2	1,681.0	1,754.6
Percentage to R.A. ..	23.6	29.0	29.1	40.7	41.1	41.1	33.0	38.8	40.6

(*Contd.*)

APPENDIX (*Concld.*)

Item	13. Sundargarh district			Orissa State		
	1950-51	1955-56	1960-61	1950-51	1955-56	1960-61
(1)	(38)	(39)	(40)	(41)	(42)	(43)
Reporting Area (R.A.)	2,424.3	2,424.3	2,420.0	38,498.7	38,162.5	38,400.0
F—Published area	722.0	887.7	627.0	7,162.9	8,835.2	8,813.0
Percentage to R.A.	29.8	36.6	25.9	18.6	23.1	22.9
Adjusted area	722.0	722.0	619.1	7,902.5	7,353.4	7,465.0
Percentage to R.A.	29.8	29.8	25.6	20.5	20.6	19.4
NAC—Published area	585.8	286.4	386.0	7,434.6	7,223.0	6,280.0
Percentage to R.A.	24.2	11.8	16.0	19.3	18.9	16.4
Adjusted area	585.8	585.8	685.4	7,196.6	7,370.9	7,701.7
Percentage to R.A.	24.2	24.2	28.3	18.7	19.3	20.1
UNC—Published area	247.2	456.5	405.0	7,436.4	5,361.9	6,294.0
Percentage to R.A.	10.2	18.8	16.7	19.3	14.1	16.4
Adjusted area	247.2	247.2	246.5	6,935.2	5,913.4	5,988.6
Percentage to R.A.	10.2	10.2	10.2	18.0	15.5	15.6
FL—Published area	143.2	66.4	301.0	2,484.0	2,220.9	2,713.0
Percentage to R.A.	5.9	2.8	12.4	6.5	5.8	7.1
Adjusted area	143.2	142.0	168.0	2,484.0	2,577.2	2,206.5
Percentage to R.A.	5.9	5.8	6.9	6.5	6.7	5.7
S—Published area	726.1	727.3	701.0	13,980.1	14,521.5	14,300.0
Percentage to R.A.	29.9	30.0	29.0	36.3	38.1	37.2
Adjusted area	726.1	727.3	701.0	13,980.1	14,447.6	15,038.2
Percentage to R.A.	29.9	30.0	29.0	36.3	37.9	39.2

AGRICULTURAL SURPLUS, LABOUR SURPLUS AND ECONOMIC DEVELOPMENT—A THEORETICAL APPROACH: A REPLY

The following is my reply to the observations of the Group for "Theory of Economic Growth in Over-populated Countries" made at the 27th Annual Conference of the Indian Society of Agricultural Economics and subsequently published in this *Journal*[1] in regard to my paper on "Agricultural Surplus, Labour Surplus and Economic Development—A Theoretical Approach."[2]

It appeared to the Group that there was an error in my calculation of reduced output owing to withdrawal of R units of labour from the volume of labour giving optimum output. In fact, the estimate of the reduced output, *i.e.*, $\left(\frac{b^2}{4c} - bR + CR^2\right)$ as arrived at by me is correct when the calculation is made as:

$$\left(a + \frac{b^2}{4c}\right) - (a + bR - CR^2)$$

or, in words, optimum output minus the output of withdrawn labour.

The reason for this way of calculation of the reduced output rather than simply by putting $\left(\frac{b}{2c} - R\right)$ in equation $Y = a + bL - cL^2$ which gives different result as recorded by the Group is the assumption of withdrawal of earlier rather than later units of labour from the production process of the farm. This is realistic because when there is migration of farm labour to industries it is the more productive labour units (earlier units) of the production function that are withdrawn. I should say that my calculation was not mechanistic—mathematical but realistic —mathematical.

Also, contrary to the feeling of the Group, my criticism of Ranis and Fei does not stand or fall with that portion of my mathematical analysis on which the attention of the Group was focused; most of the criticism is supported by other portions of the mathematical note specially the earlier minor part relating of Production-Consumption relationship.

Unfortunately, as I was out of India I could not be present at the Conference and the observations of the Group came to my notice rather late so as to cause a great deal of delay in my reply.

G. C. MANDAL*

AGRICULTURAL SURPLUS, LABOUR SURPLUS AND ECONOMIC DEVELOPMENT—A THEORETICAL APPROACH: FURTHER COMMENTS

In justifying his calculations of reduced output owing to the withdrawal of R units of labour from volume of labour giving optimum output, Mandal says that

1. Summary of Group Discussion on Subject II—"Theory of Economic Growth in Over-populated Countries," *Indian Journal of Agricultural Economics*, Vol. XXIII, No. 1, January-March, 1968, p. 18.

2. *Indian Journal of Agricultural Economics*, Vol. XXII, No. 4, October-December, 1967, pp. 65-79.

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his calculations are based on the "assumption of the withdrawal of earlier rather than later units of labour from the production process." Thus, his assumption is that in the production process the earlier units are more efficient and productive. If this assumption were meaningful and even somewhat realistic, then his calculations could be considered as correct. But how realistic is this assumption? Can we really distinguish between earlier units and later units of labour and allocate higher efficiency to the former than to the latter.

The decision to employ more or less labour is based on the marginal productivity analysis. Even if earlier labour units were replaced by the later units, the production cruve will not be altered to take the shape Mandal suggests. If we interpret Mandal's contention in a literal sense, it would mean that with the withdrawal of the first R units of labour from the production process (Figure 1), the part OB of the function evaporates and the later part BT of the function will be operative.

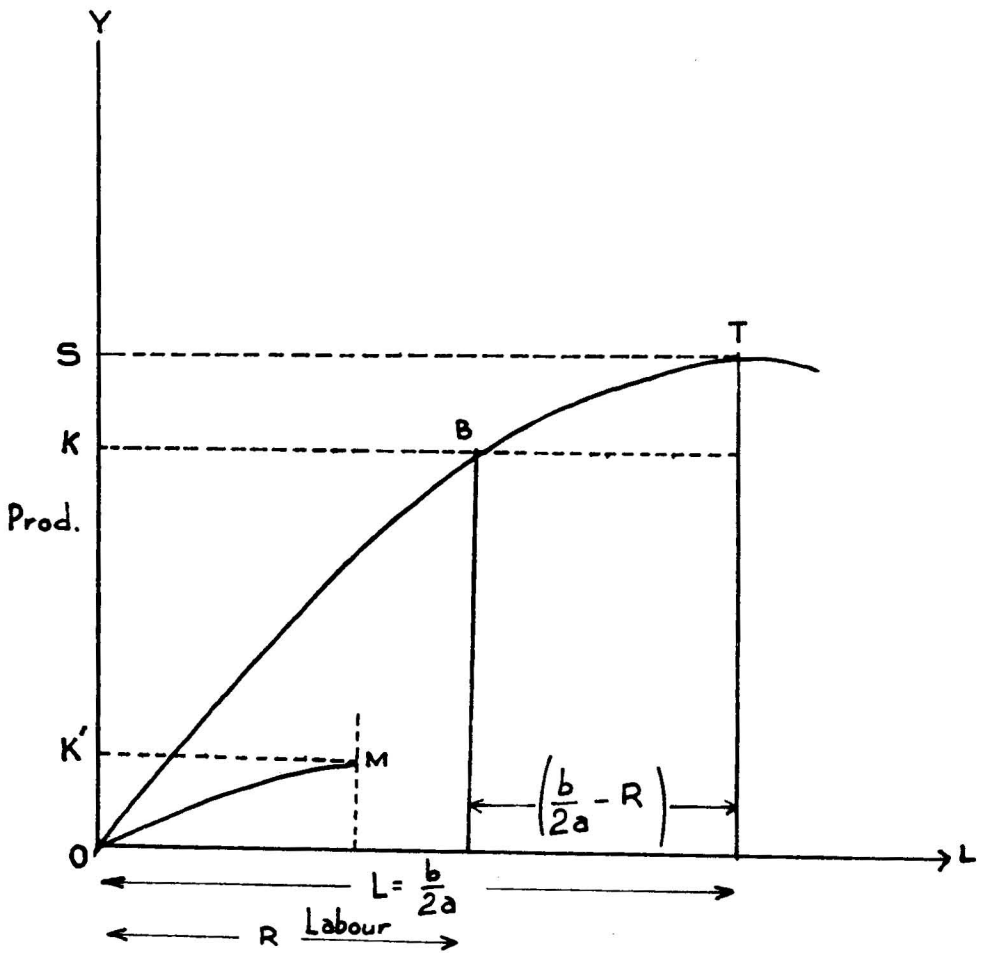

Figure 1.

It would mean that the later part of the function BT becomes disjointed to produce KS production in Figure 1. Even if this part of production function were shifted to the origin O, his assumption implies that with $\left(\frac{b}{2a} - R\right)$ units of labour, production will be $OK' = KS$ which is less than OK and the function will take the form of OM in Figure 1. This sounds rather unconvincing and it is, therefore, difficult to accept Mandal's interpretation.

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[With the publication of these comments, the correspondence on this subject is closed. (Ed.)]

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