Vol XXV
No. 2

ISSN 0019-5014

APRIL-
JUNE
1970

INDIAN JOURNAL OF AGRICULTURAL ECONOMICS

INDIAN SOCIETY OF
AGRICULTURAL ECONOMICS,
BOMBAY

The marginal value product of land shows that an increase of one acre of land will bring an additional yield of Rs. 528.47, keeping the other input constant at the geometric mean level.

CONCLUSIONS

(1) The marginal productivity of land in the cultivation of hybrid maize is far higher than that of paddy and it appears to be more profitable to bring more land under hybrid maize.

(2) Regarding fertilizers it is found that the application of a rupee worth of fertilizers would yield an additional output worth Re. 0.15 only in the case of paddy, and Rs. 2.38 in the case of hybrid maize. This shows that the application of fertilizers is beyond the optimum level in the case of paddy cultivation. Application of more fertilizer to the maize crop would yield more output.

(3) In paddy cultivation, multicollinearity is found to exist between land and labour and hence the latter does not find a place in the function considered. In the case of maize cultivation, the marginal productivity of labour is Rs. 1.25 as against the prevailing wage rate of one rupee only, indicating its utilization below the optimum level.

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ADJUSTMENT OF MEASURE OF INEQUALITY IN RURAL LAND OWNERSHIP FOR LANDLESS CATEGORIES

I

INTRODUCTION

Analyses of inequality in rural land ownership proceed usually along the lines of calculating a measure of inequality such as concentration ratio and comparing the measure-values cross-sectionally or over time. The need for and the problems in accommodating the rural landless population in such analyses seem to have evoked no discussion in the relevant literature. This is rather surprising since the need for including *some* of the rural landless categories in the analysis of inequality seems pretty obvious. For example, where a community is believed to have undergone increase in concentration in land ownership over a period of time partly through some holdings becoming smaller and partly through a section of erstwhile landowners becoming entirely landless, the inclusion of the latter in the analysis is obviously necessary to judge correctly the extent of increase in concentration. As a second example, let us suppose that a researcher desires to assess the inequality prevailing in a community in the context of a redistribution programme for reducing the prevailing inequality. If the objective of the programme is not merely to enlarge the currently small holdings but also, as is often the case, to confer ownership on currently landless classes like those of tenants and labourers, the researcher may reasonably require that the measure of prevailing

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inequality used by him should take into account the existence of such landless categories deemed eligible to receive land in the redistribution programme. Thus, even on very cursory considerations, a researcher in the area of distribution of land ownership should frequently encounter a need to include in his analysis *selected* landless categories.

It is easy enough to see that the need for being selective in choosing the landless categories for analysis would raise the problem of criteria for selection as also that of devising practicable approximations to these criteria in the field in the light of availability of data. This note, however, is not concerned with these problems of concepts and data. Its purpose is a limited one of drawing the researchers' attention to the fact that the commonly used measure of inequality in a distribution, *viz.*, the concentration ratio, can be easily adjusted to take into account the landless categories. More specifically, if a researcher has already computed the concentration ratio for a community of landowners and if, at a later point in the analysis, he needs the concentration ratio for an enlarged community obtained by combining the landowners with landless categories, the latter ratio can be obtained from the former with a single calculation without having to do the computations of concentration ratio all over again. In what follows, the concentration ratio for landowners is referred to as the unadjusted concentration ratio and that relating to the enlarged community as the adjusted concentration ratio. The next section gives the formula for adjustment along with its derivation. Section III comments on the difference between the two ratios, firstly, in the light of the formula derived and, then, with the help of some field data in hand.

II

THE FORMULA FOR ADJUSTMENT[1]

Notation

Let N_1 = Number of landowners.

N_2 = Number of landless persons (selected for inclusion in the analysis).

$N = N_1 + N_2$, *i.e.*, total number of persons in the enlarged community.

$R = N/N_1$, *i.e.*, the ratio of total number to number of landowners.

$r = N_2/N = (R-1)/R$, *i.e.*, the proportion of landless persons in the enlarged community.

C_u = Unadjusted concentration ratio.

C_a = Adjusted concentration ratio.

1. The situation considered here is a particular variant of the more general case of the relationship between the concentration ratio for a population and the ratios pertaining to two or more constituent sub-populations. The general case is considered in the author's "Two Decompositions of Concentration Ratio," *Journal of Royal Statistical Society*, Series A, Vol. 132, Part 3, 1969, pp. 418-425.

Let us assume that C_u has been worked out from a distribution of landowners into K size of holding classes with P_i and L_i (i=1,.....k) being, respectively, the cumulative proportions of landowners and of land over these classes.

Including the landless persons in the analysis amounts to adding a new class to the above distribution. Let it be indicated by i = 0 since it precedes the previous smallest size class, i = 1. Let P_i^* and L_i^* (i = 0, i, ...k) stand, respectively, for the cumulative proportions of persons and land over the set of k+1 classes.

Derivation

Step 1 Let us first see the relation between P_i^* and P_i and that between L_i^* and L_i.

$P_o^* = r$, *i.e.*, the proportion of the landless persons in the enlarged community.

$P_i^* = (P_i/R) + r$ .....i = 1,.....K

i.e., each P_i is deflated by R due to enlargement of the community and P_o^* gets added to each succeeding proportion in the process of cumulation.

Defining $P_o = 0$, P_o^* can be expressed in the same notation, *viz.*, $P_o^* = (P_o/R) + r$

As regards L_i^* and L_i,

$L_o^* = 0$

and, therefore, defining $L_o = 0$,

$L_i^* = L_i$.... i = 0, 1,.....k

Step 2 $C_a = \sum_{i=0}^{k-1} (P_i^* L_{i+1}^* - P_{i+1}^* L_i^*)$

$$= \sum_{i=0}^{k-1} \left[\left\{ (P_i/R) + r \right\} L_{i+1} - \left\{ (P_{i+1}/R) + r \right\} L_i \right]$$

..... by substituting for P_i^* and L_i^* in terms of P_i and L_i, respectively

$$= 1/R \sum_{i=0}^{k-1} (P_i L_{i+1} - P_{i+1} L_i) + r \sum_{i=0}^{k-1} (L_{i+1} - L_i)$$

$$= (1/R) \; C_u + r \quad \text{Since} \sum_{i=0}^{k-1} (L_{i+1} - L_i) = 1$$

and, given $P_o = 0$, $L_o = 0$,

$$\sum_{i=0}^{k-1} (P_i L_{i+1} - P_{i+1} L_i) = C_u$$

$$\therefore C_a = (1/R) C_u + r = (1-r) C_u + r \ldots\ldots\ldots \text{since } 1/R = 1-r.$$

III

COMMENTS ON THE DIFFERENCE BETWEEN THE ADJUSTED AND UNADJUSTED CONCENTRATION RATIOS

Let us at the outset take a note of some properties of the difference implicit in the formula for adjustment.

(*i*) The difference between the two ratios, *viz.*, $(C_a - C_u)$, which equals $r(1 - C_u)$, is positive, barring the extreme situations of $r = 0$ and/or $C_u = 1$, *i.e.*, in realistic situations the adjusted ratio would show higher concentration than the unadjusted ratio.

(*ii*) The difference varies directly with r and inversely with C_u and, hence, the need for adjustment would be more in situations where modest inequality among the landowners coexists with widespread landlessness and less in the opposite case.

(*iii*) This would be even more true of the difference in the relative form, *viz.*, $(C_a - C_u)/C_u = r(1 - C_u)/C_u$, *i.e.*, ratio of the difference to the value of the unadjusted concentration ratio.

(*iv*) While comparing inequality among a number of situations—cross-sectional or temporal —, the need for adjustment would be more if r and C_u have a large range of variation over the situations being compared.

The points noted above are in the nature of logical implications of the formula for adjustment and they, by themselves, provide no indication about the order of differences likely to be encountered in practice. Tables I to III may be of help to researchers in judging the latter. The tables are based on the land ownership data of 36 villages in Maharashtra and Gujarat covered in a recent research project of the Department of Economics, University of Bombay to study the implementation and impact of the "Tiller's Day" Amendment (1955) to the Bombay Tenancy and Agricultural Lands Act. Six villages each were selected from six talukas located in three districts—Satara and Kolaba in Maharashtra and Kaira in Gujarat; their regional spread should make the results based on their data of particular interest for the topic of this note. The data used here relate to 1956-57, the year prior to the implementation of the amendment. The unadjusted and adjusted concentration ratios were calculated villagewise for each of the 36 villages. The landless category taken into account for this purpose is that of landless tenants which is quite usually regarded as the category most eligible to receive land in a

redistribution programme. Tables I and II provide a summary of the results obtained. Table I presents, talukawise, the range of variation among the selected villages in the unadjusted ratio (C_u), ratio of landless tenants to total of land-owners and landless tenants (r) and the difference between the adjusted and un-adjusted ratios (C_a—C_u). The ranges are seen to be appreciably wide even *within* some of the talukas and are decidedly so for the region as a whole; the latter ranges are from 0.22 to 0.66 for the unadjusted ratio, from 0 to nearly 0.92 for r and from 0 to nearly 0.60 for the difference between the two ratios. In the light of these ranges, the importance of the adjustment for landless categories in any cross-sectional investigation of land ownership in the region seems obvious.

TABLE I—MINIMUM AND MAXIMUM VALUES OF C_u, r AND (C_a—C_u) AMONG THE SELECTED VILLAGES IN EACH TALUKA

District	Taluka	No. of selected villages	C_u		r		C_a—C_u	
			Minimum	Maximum	Minimum	Maximum	Minimum	Maximum
Kaira	Matar	6	0·41	0·63	0·08	0·17	0·04	0·07
	Nadiad	6	0·40	0·58	0·01	0·18	0·01	0·09
Satara	Satara	6	0·39	0·53	0·00	0·14	0·00	0·07
	Wai	6	0·37	0·52	0·00	0·10	0·00	0·05
Kolaba	Karjat	6	0·43	0·65	0·10	0·47	0·06	0·23
	Panvel	6	0·22	0·66	0·07	0·92	0·04	0·58

Table II gives for each taluka the simple averages of the villagewise adjusted and unadjusted ratios and their difference. While what difference seems significant to a researcher would depend on his judgment and purpose, many might regard as noteworthy the difference observed in the case of Matar, Karjat and Panvel. It is also necessary to remember that the difference would increase if the landless category taken into account includes labourers along with tenants. This larger category could not be used in this note since information on landless labourers is not available for all the villages. Matar taluka, where this information is available for 5 out of the 6 selected villages, showed that the difference would nearly double with the inclusion of the landless labourers.

TABLE II—AVERAGES OF VILLAGEWISE C_a, C_u AND (C_a—C_u) FOR EACH TALUKA

District	Taluka	No. of selected villages	Simple average of		
			C_u	C_a	(C_a—C_u)
Kaira	Matar	6	0·50	0·56	0·06
	Nadiad	6	0·49	0·52	0·03
Satara	Satara	6	0·45	0·47	0·02
	Wai	6	0·45	0·46	0·01
Kolaba	Karjat	6	0·57	0·69	0·12
	Panvel	6	0·49	0·74	0·25

Note : C_a = Adjusted concentration ratio.
C_u = Unadjusted concentration ratio.
r = Ratio of landless tenants to total of land owning persons and landless tenants.

A convenient feature of the function — $C_a = (1 - r) C_u + r$ — is that all the variables entering in it are, by definition, constrained to be between 0 and 1. This feature of restricted domain and range of the function facilitates a second way to visualize the difference between the adjusted and unadjusted ratios, *viz.*, by mapping the function for alternative combinations of C_u and r values. Table III provides an illustration of this approach. Alternative C_u values are placed along

TABLE III—C_a VALUES FOR ALTERNATIVE COMBINATIONS OF C_u AND r VALUES

C_u \ r	0·05	0·10	0·15	0·20	0·25	0·30	0·35	0·40	0·45	0·50
0·20	0·24	0·28	0·32	0·36	0·40	0·44	0·48	0·52	0·56	0·60
0·25	0·29	0·33	0·36	0·40	0·44	0·47	0·51	0·55	0·59	0·63
0·30	0·34	0·37	0·41	0·44	0·48	0·51	0·54	0·58	0·61	0·65
0·35	0·38	0·42	0·45	0·48	0·51	0·54	0·58	0·61	0·64	0·68
0·40	0·43	0·46	0·49	0·52	0·55	0·58	0·61	0·64	0·67	0·70
0·45	0·48	0·51	0·53	0·56	0·59	0·61	0·64	0·67	0·70	0·73
0·50	0·53	0·55	0·58	0·60	0·63	0·65	0·67	0·70	0·72	0·75
0·55	0·57	0·60	0·62	0·64	0·66	0·68	0·71	0·73	0·75	0·78
0·60	0·62	0·64	0·66	0·68	0·70	0·72	0·74	0·76	0·78	0·80
0·65	0·67	0·69	0·71	0·72	0·74	0·75	0·77	0·79	0·80	0·83
0·70	0·72	0·73	0·75	0·76	0·78	0·79	0·80	0·82	0·83	0·85
0·75	0·76	0·78	0·79	0·80	0·81	0·82	0·84	0·85	0·86	0·88

Note : C_a = Adjusted concentration ratio.
C_u = Unadjusted concentration ratio.
r = Ratio of landless persons to total of land owning and landless persons.

the rows of the table and alternative r values along the columns and each cell in the table shows the C_a value corresponding to the specified combination of C_u and r values. Such a table can help analysis in the same way as graphing of function does. It may prove particularly handy in seeing the implications for C_a of alternative time-profiles of change in C_u and r.

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