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Holding Size, Productivity, and Some Related Aspects of Indian Agriculture

G R Saini

The inverse relationship between farm size and productivity is a confirmed phenomenon in Indian agriculture and its statistical validity, the author argues, is adequately established by an analysis of disaggregated farm management data.

Indian agriculture is ruled in general by 'constant returns to scale'.

The inverse relationship between size and productivity is perfectly consistent with the three phases of the returns to scale and can be explained simply in terms of the law of variable proportions.

The analysis presented here strongly suggests that the explanation for the unremunerativeness of Indian agriculture, as shown by the reported loss in some size-classes of farms, lies not in the valuation of family labour at the ruling wage rate, but in the imputation of a value to owned land. This, along with positive figures of profit observed even in the smallest size-group of holdings, provides ample justification for the valuation of family labour at the ruling wage rate.

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THE existence of some economic relationships in the field of Indian agriculture, revealed by recent studies in Economics of Farm Management [1], have been provoking economists to attempt alternative explanations of the observed phenomenon.[1] The main issues raised by these studies are summed up in the following observations made by Amartya Sen:[2]

(1) "When family labour employed in agriculture is given an 'imputed value' in terms of the ruling wage rate, much of Indian agriculture seems unremunerative".

(2) "By and large, the profitability of agriculture increases with the size of holding, 'profitability' being measured by the surplus (or deficit) of output over costs including the imputed value of labour."

(3) "By and large productivity per acre decreases with the size of holding."

Inverse Relationship between Farm Size and Productivity

Sen [16] had expressed doubts about the statistical basis of the observations around which the discussion on farm size and productivity has been taking place. Rudra [12] subjected the Farm Management data to statistical analysis, to confirm the doubts raised by Sen. He observed: "As the aggregate farm management data are claimed to reveal an inverse relationship, maybe one should examine whether there is something in the aggregation process that has given rise to a spurious statistical relationship. On proceeding to undertake that task (i e, of studying the disaggregated data of the Farm Management surveys and comparing them with the aggregated tables published in the reports) we have received a very rude shock. What we find is that there is no need to look beyond or below the farm management data; these very data do not permit of the generalised conclusions that have been drawn, the inferences having been made without adequate examination of tables themselves."[3] Rudra's analysis was an important turning point in the 'size and productivity' controversy. But it did not bring the discussion to a conclusive stage. Rudra himself reported 15 out of the 17 rank correlation co-efficients between farm size and productivity per acre to have a negative sign, and 9 of these to have a negative co-efficient statistically significant too. Moreover, Rudra used in his analysis [12] farm class averages[4] as against the disaggre-

Table 1 : Statistics Relating to "Inverse Relationship"

State	Year	N	Constant log C	β (Co-efficient)	S E of	T-Value of Deviation of β from Unity	R^2	F-Vaule
Andhra Pradesh	1957-58	104	2.59	.90	.05	2.11	.78	367.10
Andhra Pradesh	1958-59	97	2.60	.80	.06	3.25	.65	179.24
Andhra Pradesh	1959-60	84	2.60	.85	.10	1.49*	.48	74.56
Bihar	1958-59	98	2.55	.71	.08	3.77	.46	83.32
Madras	1954-55	198	2.08	.69	.10	3.14	.21	51.14
Madras	1955-56	181	2.22	.63	.09	4.24	.23	52.81
Maharashtra	1955-56	160	2.06	.70	.07	4.31	.39	102.74
Maharashtra	1956-57	160	2.15	.66	.07	5.10	.38	98.35
Madhya Pradesh	1955-56	159	1.71	1.03	.05	0.51*	.70	372.25
Madhya Pradesh	1956-57	159	2.12	.86	.04	3.37	.74	443.75
Orissa	1957-58	98	2.15	.96	.06	0.72*	.76	303.15
Orissa	1958-59	100	2.12	.92	.03	2.35	.88	748.89
Orissa	1959-60	99	2.05	.90	.04	2.53	.83	485.52
Punjab	1955-56	200	2.28	.90	.04	2.28	.70	451.58
Punjab	1956-57	200	2.45	.85	.04	3.88	.69	448.22
UP	1955-56	147	2.55	.78	.05	5.05	.68	304.26
UP	1956-57	196	2.52	.85	.04	3.38	.66	381.20
West Bengal	1955-56	190	2.13	1.08	.08	0.99*	.50	184.93
West Bengal	1956-57	192	2.33	1.10	.06	1.79*	.67	382.32
UP (Muzaffar Nagar)	1955-56	97	2.56	.76	.05	4.85	.71	228.54
UP (Muzaffar Nagar)	1956-57	96	2.57	.82	.05	3.44	.71	232.23
UP (Muzaffar Nagar)	1966-67	150	3.55	.84	.04	3.69	.71	367.73
Punjab (Ferozepore)	1955-56	100	2.19	.95	.06	0.81*	.70	228.99
Punjab (Ferozepore)	1956-57	100	2.45	.84	.06	2.66	.65	180.92
Punjab (Ferozepore)	1967-68	150	3.28	.94	.08	0.73	.49	143.48

* Deviation not significant at the 5 per cent level.

gated farm level observations. Again, Rudra's result [12] are based on productivity per unit of gross cropped area. Even if one gets a constant productivity relationship on the basis of gross cropped area, the results will still be consistent with an inverse relationship between farm size and productivity[5] — 'productivity' being defined in terms of acreage under the operational holding. We feel that the latter (productivity per acre of operational holding) is basic to the issues involved in the controversy. For these reasons, too, Rudra's results, based on productivity per unit of gross cropped area, are not conclusive to the controversy. We feel that there still remains the need for testing the statistical validity of the relationship between farm size and productivity[6] and some explanation of the observed phenomenon.

We proceed, therefore, to present an analysis of the *disaggregated* farm management data and examine the statistical validity of the relationship between farm size and productivity. We have fitted the following function by the method of ordinary least squares to the farm level observations pertaining to 25 sets of data obtained for 9 States of India.

$$\text{Log } Q = \log C + \beta \log A$$

where

Q = Gross value of output of crops

A = Size of the operational holding.

The estimated parameters and related statistics are shown in Table 1. For the existence of an inverse relationship between farm size and productivity, it is necessary that the β co-efficient for A should be less than unity. We observe it to be so in 22 out of the 25 cases. For this phenomenon to be valid on the basis of statistical significance too, it is necessary that the β co-efficient should be significantly less than unity. On testing the significance of deviation of the β co-efficient from unity, we find that inverse relationship between farm size and productivity strongly holds in 18 out of 25 cases. In only three cases (*viz*, Madhya Pradesh in 1955-56 and West Bengal in 1955-56 and 1956-57) we find that the β co-efficient turns out to be greater than unity, though not statistically significantly different from unity. In terms of confidence limits, these cases also do not exclude the possibility of the existence of inverse relationship between farm size and productivity. Thus, by and large, the inverse relationship between farm size and pro-

TABLE 2 : RETURNS TO SCALE IN INDIAN AGRICULTURE

State	Year	Sum of Regional Co-efficients	Deviation from Unity	Standard Error	T-Value	R^2	F-Value	Returns to Scale Indicated by T-Value
Andhra Pradesh	1957-58	1.03	.03	.04	.85	.90	181.66	C
Andhra Pradesh	1958-59	.99	—.01	.05	.17	.86	111.52	C
Andhra Pradesh	1959-60	1.18	.18	.06	2.96	.87	102.32	I
Bihar	1958-59	.94	—.06	.05	1.09	.88	163.87	C
Madras	1954-55	1.12	.12	.07	1.60	.60	67.93	C
Madras	1955-56	1.07	.07	.05	1.32	.77	147.81	C
Maharashtra	1955-56	1.11	.11	.05	2.40	.81	163.48	I
Maharashtra	1956-57	1.12	.12	.05	2.57	.81	161.73	I
Madhya Pradesh	1955-56	1.16	.16	.05	3.33	.79	147.23	I
Madhya Pradesh	1956-57	.89	.11	.09	2.91	.78	137.45	D
Orissa	1957-58	.97	—.03	.04	.80	.89	183.54	C
Orissa	1958-59	.97	—.03	.02	1.25	.95	414.46	C
Orissa	1959-60	.95	—.05	.04	1.33	.89	188.42	C
Punjab	1955-56	1.06	.06	.04	1.65	.83	188.01	C
Punjab	1956-57	1.05	.05	.04	1.33	.80	154.46	C
UP	1955-56	.96	—.04	.04	1.16	.83	140.85	C
UP	1956-57	.99	—.01	.04	.30	.78	132.08	C
West Bengal	1955-56	.92	—.08	.11	.77	.87	243.55	C
West Bengal	1956-57	11.9	.19	.14	1.32	.72	93.70	C
UP (Muzaffar Nagar)	1955-56	.88	—.12	.05	2.58	.83	90.93	D
UP (Muzaffar Nagar)	1956-57	.91	—.09	.09	1.77	.81	77.33	C
UP (Muzaffar Nagar)	1966-67	.95	—.05	.05	1.15	.78	103.49	C
Punjab (Ferozepore)	1955-56	1.09	—.09	.06	1.47	.83	90.06	C
Punjab (Ferozepore)	1956-57	1.00	—.00	.06	.06	.78	66.11	C
Punjab (Ferozepore)	1967-68	.99	—.01	.09	.10	.59	42.01	C

TABLE 3 : PROFIT (OR LOSS) AND RENTAL VALUE (OR INTEREST) OF LAND ACCORDING TO SIZE-GROUPS

ANDHRA PRADESH (Rs per unit of land)

Farm Size-Group	1957-58		1958-59		1959-60	
	A	B	A	B	A	B
I	—5.48	171.79	13.55	164.89	8.89	166.94
II	—20.59	136.47	—38.67	146.73	12.30	153.26
III	—23.60	119.22	12.31	117.05	28.48	127.60
IV	—13.08	92.39	—43.39	114.11	—19.27	75.07
V	—39.16	137.16	—46.27	79.31	—72.58	134.17
VI	20.72	95.45	—54.28	110.18	41.11	87.32
VII	—33.65	121.48	22.09	94.07	0.20	64.75
VIII	17.37	123.76	—18.73	148.99	16.50	149.48
IX	—4.36	117.23	—22.51	122.39	9.35	123.11

BIHAR (1958-59)

Farm Size Group	North Monghyr		Central Monghyr		South Monghyr	
	A	B	A	B	A	B
I	218.68		—32.45		—58.66	
II	274.54		61.30		37.89	
III	211.91		—37.32		—17.13	
IV	160.31		87.53		—3.25	
V			—24.09		—13.58	
VI	150.78		208.85		33.42	
VII	152.01		60.38		18.56	
VIII						
IX	190.19		53.80		16.78	

Note : Size classification differs from State to State. Data are reported for as many size groups as are given in Farm Management reports. The last row in each case gives the average figures for the sample of farms. For Punjab and Madras figures under column B are rent or/and rental value of owned land.

A = Profit (or Loss) B = Rental Value of Owned Land

(Continued)

TABLE 3: CONTINUED

MADRAS

Farm Size-Group	1954-55		1955-56		1956-57	
	A	B	A	B	A	B
I	—61.5	44.3	—65.8	49.3	—23.2	50.4
II	—30.4	39.9	22.3	44.9	64.8	55.4
III	—10.5	33.5	10.6	33.9	48.2	44.8
IV	—6.3	37.0	—2.6	36.3	83.5	49.3
V	—38.1	36.7	—16.9	23.9	49.1	30.3
VI	—6.4	20.5	—4.7	20.4	—3.7	21.1
VII	—14.7	10.0	12.6	19.9	—3.1	39.5
VIII	14.4	24.7	21.2	17.0	17.2	13.4
IX	2.2	29.1	4.0	28.5	36.8	36.6

AHMEDNAGAR

Farm Size-Group	1955-56		1956-57	
	A	B	A	B
I	—9.5	14.6	—35.74	15.48
II	17.5	7.5	—14.22	9.84
III	2.6	11.7	—14.40	12.34
IV	54.8	11.1	—3.63	9.33
V	7.1	5.2	—9.15	7.17
VI	21.4	3.8	—4.38	5.32
VII	13.4	6.0	2.77	6.03
VIII	9.1	3.0	1.65	3.56
IX	13.4	6.2	—3.90	6.90

PUNJAB

Farm Size Group	1954-55		1955-56		1956-57	
	A	B	A	B	A	B
I	—52.0	72.00	—42.91	71.00	—23.08	76.00
II	—19.0	63.00	—10.85	59.00	—21.11	79.00
III	—9.0	51.00	—8.72	59.00	—4.27	68.00
IV	—9.0	48.00	4.62	54.00	4.31	63.00
V	1.0	45.00	28.56	53.00	18.55	49.00
VI						
VII						
VIII						
IX	—8.0	50.00	0.28	56.00	—0.11	65.00

UTTAR PRADESH

Farm Size-Group	1954-55		1955-56		1956-57	
	A	B	A	B	A	B
I	—30.63		18.0		3.0	
II	47.82		31.0		38.0	
III	49.91		19.0		43.0	
IV	66.93		27.0		64.0	
V	100.78		60.0		92.0	
VI						
VII						
VIII						
IX	60.14		35.0		55.0	

WEST BENGAL

Farm Size-Group	1954-55		1955-56		1956-57	
	A	B	A	B	A	B
I	—7.38		15.4		2.94	
II	15.25		13.7		38.66	
III	7.82		—2.1		62.15	
IV	8.51		34.2		13.06	
V	21.43		31.7		70.24	
VI	57.21		35.8		74.33	
VII	4.79		50.9		19.90	
VIII	36.21		25.6		40.38	
IX	18.18		26.8		44.49	

(Continued)

ductivity is a confirmed phenomenon in Indian agriculture and its statistical validity is adequately established by an analysis of the disaggregated data.

Under the impact of the 'green revolution', one would expect the inverse relationship to undergo a change and to cease to be true at least in the areas which have experienced the 'green revolution'. The data relating to Punjab (Ferozepore) and Uttar Pradesh (Muzaffarnagar), however, do not provide any evidence of such a change. It is, perhaps, too early to expect a change in the first two or three years of the setting in of the 'green revolution'. We will have to wait for some time more before we can make any definite observations on the impact of the 'green revolution' in this context.

RETURNS TO SCALE IN INDIAN AGRICULTURE

Before we proceed to examine the first of the three observations made by Amartya Sen, it is pertinent to estimate the returns to scale in Indian agriculture and distinguish them from the phenomenon of 'inverse relationship' which clearly is a matter of relationship between output (output per acre) and a single input (acreage) without holding other inputs constant. For this, we are confronted with the choice of the algebraic form of the function which reflects the postulated production relationship. We feel that a multiplicative model seems to be logically quite appropriate and adequate for the purpose. We, therefore, choose the function stated in the following equation:

$$Q = CA^{b_1} L^{b_2} B^{b_3} F^{b_4} I^{b_5}$$

We use the long linear transformation of this production function and state it as:

$$\text{Log } Q = \log C + b_1 \log A + b_2 \log L + b_3 \log B + b_4 \log F + b_5 \log I$$

where

Q = Gross value of output of crops (Rs)
A = Land (gross cropped area)
L = Human labour (adult man-days)
B = Bullock labour (pair-days)
F = Farm manures and fertilisers (Rs)
I = Irrigation expenditure (Rs)

We have estimated the equation by the method of ordinary least squares for each of the 25 sets of *disaggregated* Farm Management data. The value of R^2 turns out to be quite high in all but two cases. The included variables explain between 59 and 95 per cent of

the variations in the logarithm of the gross value of output (see Table 2).

The regression co-efficients in our production function are the production elasticities and their sum, S indicates the returns to scale.

$$S = \sum_{i=1}^{n} b_i$$

Returns to scale are increasing, constant or decreasing, according as S is greater than, equal to, or less than unity. Table 3 gives the sum of regression co-efficients for each of the sets of Farm Management data. The sums of regression co-efficients were tested for their deviation from unity. The t-test indicated constant returns to scale in 19 out of 25 cases. Of the remaining six cases, four indicated increasing while two indicated diminishing returns to scale. These cases demand a closer scrutiny. In the case of Andhra Pradesh we encounter constant returns in two out of three years. Increasing returns in the third year in Andhra Pradesh could as well have occurred by chance. This is true also of UP (Muzaffarnagar). The evidence in Madhya Pradesh is not conclusive in either direction. Taking an overall view, we can safely infer that, in general, constant returns to scale rule the scene of Indian agriculture.

Explanation of the Inverse Relationship

Our estimates of the returns to scale are of considerable interest in the context of our discussion on an inverse relationship between farm size and productivity. We find that the 'inverse relationship' — which clearly is a matter of relationship between output (output per acre) and only a single input (acreage) without holding other inputs constant — is consistent with all the three phases of the returns to scale, *viz*, increasing, constant, and decreasing. It is now clear that the inverse relationship has to be explained in terms of the operation of the law of variable proportions only.

In the discussion that followed the publication of Amartya Sen's analysis, economists ascribed size-productivity differences to the differences in the level of different inputs which can be listed as ranging from the directly quantifiable inputs like human labour to factors like soil fertility and management which are rather difficult to measure. There appears to be a good deal of weight, however, in Dipak Mazumdar's observation that "higher output per acre in smaller farms is really a function of higher input of labour per acre — the other factors varying more or less in the same proportion as labour".[7] As we had pointed out earlier [13], the observed intensity of cultivation on the smaller farms is generally higher than on the larger farms. Larger inputs of labour on these (small) farms is, thus, expended not on one crop alone but on more than one crop grown during the period of production on the same piece of land. This may further explain the higher productivity on smaller farms, productivity being defined in terms of acreage under the operational holding.

Table 3: Concluded

Nasik

Farm Size-Group	1955-56		1956-57	
	A	B	A	B
I	1.29	13.62	—75.2	21.9
II	13.58	12.41	—10.0	11.1
III	—7.92	8.96	—7.4	7.5
IV	2.14	10.22	—8.1	14.4
V	6.57	5.26	—2.7	4.8
VI	15.56	5.36	8.7	6.8
VII	—2.39	4.57	9.9	5.9
VIII	8.38	3.96	—1.5	4.1
IX	4.33	6.82	—1.4	7.6

Madhya Pradesh

Farm Size-Group	1955-56		1956-57	
	A	B	A	B
I	—9.34	17.76	43.43	29.55
II	—7.97	15.48	27.34	21.58
III	3.08	14.22	32.61	17.37
IV	5.10	11.65	22.03	20.00
V	4.56	12.16	35.50	19.82
VI	6.91	14.04	30.97	24.28
VII	32.57	15.00	16.71	27.83
VIII	13.97	15.65	29.48	24.18
IX	11.01	14.41	29.22	22.84

Orissa

Farm Size-Group	1957-58		1958-59		1959-60	
	A	B	A	B	A	B
I	44.45	18.29	2.31	17.56	—8.41	17.47
II	34.28	16.38	12.53	16.34	—0.30	16.61
III	41.22	15.50	11.09	14.17	—14.75	16.36
IV	48.21	10.57	—8.18	10.75	2.32	10.35
V	30.43	20.17	41.73	16.15	10.25	17.06
VI						
VII						
VIII						
IX	37.45	16.73	16.61	14.94	—2.01	16.08

Labour Productivity Wage Rates and Farm Profitability

On the basis of an *a priori* reasoning, Amartya Sen offered a general explanation for the observed phenomenon in terms of low opportunity cost of (family) labour in a labour surplus economy and the resultant variations in the input of human labour over different size-classes of farms which range from essentially family-labour based small farms to large farms employing a relatively greater proportion of wage-paid labour — the proportion of family labour to hired labour generally falling with an increase in the farm size.[8] Sen's analysis implies a marginal product of labour below the wage rate for some classes of farms (usually small farms) which have a relative abundance of family labour. Analysing the Farm Management data for Uttar Pradesh and Punjab, we [14] had earlier reported that the marginal value product of labour was not only positive but was also higher than the labour cost — though in some cases, the two were not statistically significantly different from each other. An analysis based on the classification of farms according to (a) size and (b) the extent of their dependence on family labour corroborated these findings.[9]

Thus, there appeared ample justification for the valuation of family labour at the ruling wage rate. The explanation for 'unremunerative' character of Indian agriculture must, therefore, lie elsewhere. Our analysis had also shown that the implicit earnings

of bullock labour, an input factor characterised by specificity and indivisibility, fell much short of its actual cost to the farms. This suggested that the explanation for the observed behaviour of net revenue lay, not in the valuation of family labour at the ruling wage rate, but, perhaps, in the value productivity of bullock labour (and variations therein over different size-classes of farms) coupled with its excess capacity maintained on the farms (which the Farm Management Studies clearly bring out).

Scrutiny of profit and loss figures (see Table 3) for different size-classes of farms in different regions, however, demands a fresh look at Sen's first of the three observations cited above. On the basis of an examination of these figures, we wish to make the following observations :

(a) The number of cases (11 out of 27) in which even the smallest size-group shows positive profit, is not insignificant.
(b) Losses are not only observed in smaller size-groups of holdings but also in bigger size-groups of farms.
(c) Size-classes reporting losses in one year quite frequently report profit in other year.

Our first reaction is that, even when family labour is given an imputed value at the ruling wage rate, a sizeable proportion of our agriculture does not turn out to be unremunerative. What explains then the negative figures of profit reported in a large number of cases? We wish to seek the answer not in the valuation of family labour at the ruling wage rate, but in the imputation of a value to owned land either in terms of rental value or in terms of interest on the value of owned land. We wish to assert that imputation of a value to owned land (which is almost invariably inherited by farmers from their forefathers) is highly arbitrary and usually does not enter into a farmer's calculations and decision-making. (To some extent, interest on fixed capital also tends to fall in the same category.)

If we deduct the rental value of owned land from cost C[10] and then compute the figures of profit[11] we find that the negative figures turn into positive ones in the case of Andhra Pradesh, Madhya Pradesh, Orissa and Punjab. The problem does not seem to exist in Uttar Pradesh and West Bengal. In the case of Maharashtra (Ahmednagar and Nasik districts) the losses are completely wiped out in one year and reduced to insignificant levels in the other. In Madras, rent and rental value of owned land, together with interest on fixed capital,[12] take care of the reported losses. The evidence strongly suggests that the observed remunerative character of Indian agriculture can be traced to and explained in terms of imputation of a value to owned land rather than the valuation of family labour at the ruling wage rate. In arriving at this conclusion, we are particularly strengthened by our findings on the marginal value product of labour and the existence of positive figures of profit (as computed on the basis of cost C) even in the smallest size-groups of holdings. If we hold the uneconomic nature of bullock-labour maintained on the farms (particularly on the smaller farms where it remains highly underutilised) responsible for losses on the farms, the implicit earnings of land appear to be sufficient to wipe out such losses. In any case, the valuation of family labour at the ruling market-wage rate need not be held responsible for the observed losses.

In the end we wish to sum up the observations made by us in the foregoing analysis :

(1) We have found that, by and large, the inverse relationship between farm size and productivity is a confirmed phenomenon in Indian agriculture and that its statistical validity is adequately established by an analysis of the *disaggregated* Farm Management data.

(2) We also found that the scene of Indian agriculture is ruled in general by 'constant returns to scale'.

(3) The inverse relationship is perfectly consistent with the three phases of the returns to scale, *viz*, increasing, constant and decreasing, and can be explained simply in terms of the law of variable proportions.

(4) Our analysis strongly suggests that the explanation for unremunerativeness of Indian agriculture as shown by the reported losses in some size-classes of farms, lies not in the valuation of family labour at the ruling wage rate but in the imputation of a value to owned land. This, along with positive figures of profit observed even in the smallest size-groups of holdings, provides ample justification for the valuation of family labour at the ruling wage rate.

References

[1] Government of India: "Studies in the Economics of Farm Management". These studies, initiated in 1954-55, were conducted in the States of Uttar Pradesh, Punjab, Bombay, Madras, West Bengal and Madhya Pradesh. The studies were later extended to other States (see [2]).

[2] Government of India: "Farm Management in India: A Study Based on Recent Investigations", April 1966.

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Notes

1 See Amartya Sen [15, 16] Morton Paglan [7], Dipak Mazumdar [5, 6], A M Khusro [4] C H Hanumantha Rao [9, 10], A P Rao [8], Ashok Rudra [11, 12], G R Saini [13], T N Srinivasan, [17]. For an excellent summary and critical observations see J Bhagwati and S Chakravarty [3].
2 Amartya Sen [15], p 243.
3 Ashok Rudra [12], p A-33.
4 These averages are based on three

years' data. Because of the reported changes in the sample of holdings in some cases, the averages may not be entirely free from some bias.

5 Farm Management Studies show that intensity of cultivation declines with an increase in the farm size.

6 In a Seminar held in the University of Delhi as late as January 1971, and attended by almost the entire galaxy of top economists who contributed to the discussion on farm size and productivity from time to time, doubts about the statistical basis of the relationship still echoed.

7 Dipak Mazumdar [6]. Mazumdar's observation could be interpreted as assuming a technology under which inputs are combined in a fixed proportion. This is not quite borne out by the data. It would be more appropriate to state that higher output per acre in smaller farms is really a function of higher input of labour per acre — the other factors varying in the same *direction* as labour, rather than in the same *proportion*.

8 See Amartya Sen [15, 16]. Dipak Mazumdar's explanation based on the 'supply price of labour' appears basically similar to the one offered by Sen. See Dipak Mazumdar [5, 6].

9 A similar analysis for other regions is in progress and shall be reported in the near future.

10 For definition of costs, see Government of India [1].

11 Comparative figures of profit (or loss) and rental value are given in Table 3. Since figures of rental value were not directly available for Bihar in the published sources, no comments are offered in this case.

12 Not reported here in the Tables.

Size of Farm and Productivity

Usha Rani

This paper seeks to investigate the relationship between size of farm and yield per acre. Like other efforts in this direction so far, it uses data from the Farm Management Studies. But whereas the earlier studies have used aggregated data for different size-groups of farms, the present exercise uses data for individual farms.

Further, in order to study the relationship between productivity and size of farms in the context of the new trends developing in Indian agriculture, the study is confined to IADP districts.

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THE Farm Management data has often been utilised to study the relationship between size of farm and yield per acre. Several such studies — for instance, those of Khusro,[1] Hanumantha Rao,[2] and the Directorate[3] itself — have tried to show an inverse relationship between size of holding and yield per acre. All of them have utilised the size-class data of the Farm Management Surveys. On the other hand, Rudra[4] and A P Rao[5] have, on the basis of their studies based on the disaggregated data of 'Continuous Village Surveys' conducted by the Agricultural Economics Research Centre, questioned the validity of this widely accepted formulation of an inverse relationship between size of farm and yield per acre. Both of them have found that, yield per acre remains constant irrespective of differences in size of farms. Theoretical explanations have been given in support of both types of observations.

The objective of this paper is to find out the relationship between size of farm and yield per acre based on the use of individual holdings data of Farm Management Surveys (i e, disaggregated), and to test some of the hypothetical explanations offered from both sides. Thus the present study of size of farm and productivity is also based on the data of Farm Management Surveys conducted by the Directorate of Economics and Statistics. But whereas all the earlier studies have utilised the aggregated data of the different size groups of farms of Farm Management Surveys, the present exercise is based on the data about individual farms rather than on data about the size groups. Secondly, in order to study the relationship between productivity and size of farms in the context of the new trends developing in Indian agriculture, the study is confined to the IADP districts. All the IADP districts for which the FMS data is available have been covered. The period and the districts covered in the study are as follows: Pali (Rajasthan) 1962-65, West Godavari (Andhra Pradesh) 1957-60, Sambalpur (Orissa) 1957-60, Raipur (Madhya Pradesh) 1962-65, and Alleppey (Kerala) 1962-65. The data on each of the three years of surveys has been taken up separately for all the five districts and, therefore, in all, there are 15 series of data. The total number of observations are 1431.

Method of Analysis

To study the relationship between size of farm and yield per acre, an exponential function of the form Y is equal to AX^b (which is the same as log Y is equal to log A plus b log X, in the linear form), where Y and X are dependent and independent variables respectively, has been utilised. The regression co-efficient 'b' would have a negative sign if output per acre declines along with an increase in the size of farm. The results are as shown in Chart A.

In Chart A equations, Y stands for yield per acre (i e, gross value of output divided by the size of farm) and X stands for the size of farm. The regression co-efficient in 14 out of the 15 cases is negative. Hence, in consideration of the sign of regression of the sign of regression co-efficient, it could be concluded as Khusro did,[1] that yield per acre has a tendency to decrease along with an increase in the size of farm. But if the 't' test is applied for testing the significance of regression co-efficient, then the conclusion varies considerably according to the level of significance at which the test is applied. A test at 10 per cent level of significance reflects that, in 9 out of 15 cases, the regression co-efficient is significant and hence the formulation of inverse relationship between yield per acre and size of farm is found still valid. But if the 't' test is applied at the 5 per cent level of significance, then the regression co-efficient is found significant only in 7 out of 15 cases, and hence no generalisation regarding the relationship can be made. Further, if the test at 1 per cent level of significance is applied, the regression co-efficient is found significant