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RETURNS TO SCALE IN INDIAN AGRICULTURE*

A. M. KHUSRO

THE emergence of fairly comprehensive Farm Management statistics during the 1950s has made it possible for the first time to generalize about the relationships between inputs and outputs in Indian farming. Of particular interest are some generalizations about the relations between farm-size and farm-efficiency which are based upon a remarkable repetitiveness of some phenomena almost everywhere among the areas studied, despite very substantial dissimilarities in cropping patterns, resource availabilities and socio-cultural conditions. These generalizations also reflect upon some basic characteristics of underdevelopment which are not visible, so to speak, to the naked eye.

I

Alternative Measures of Farm-Size and Farm-Efficiency

Farm-size can be defined either in terms of a single input, say, *acreage*, or in terms of *output*; and farm-efficiency either in terms of *output per unit of a single input, acreage* or as *output per unit of cost of all inputs.* There are serious limitations in both sets of definitions while there are substantial merits too in either set.

Acreage as a measure of size has the merit that it is there for everyone to see and cannot be concealed. Though one among many inputs, it is deemed to be a

* The author is grateful to Dr. C. H. Hanumantha Rao for several useful discussions of this subject and to Shri N. Krishnaji and Shri J. R. Rao for tirelessly devoting themselves to many a tedious calculation and to Mrs. Santosh Goyal for drawing the diagrams.

critical and crucial input. That it is often a limitational factor seems to qualify it for use as an epitome of all inputs, that is to say, of farm-size or the whole scale of operation. It is relatively free from substantial annual fluctuations and changes in composition. But, on the other hand, acreage consists of good and bad and dry and wet, etc., acreage and hence requires standardization, a process which is not entirely free from arbitrariness. In any case, acreage is a single input and often not even the preponderant input; and hence the criticism of its use as a satisfactory measure of farm-size.[1]

Output, on the other hand, is no doubt a more general measure of size than acreage and hence there is great temptation to use it. The simplest measure of output may appear to be in physical weight or volume. But this is, too obviously, an unsatisfactory measure as it equates high-income-yielding and low-income-yielding crops as well as varieties of crops and takes no account of their differential value. If, then, output is measured in value terms, a whole host of problems emerge. To begin with, inter-temporal comparisons of output become difficult and the celebrated index number problem arises owing to year-to-year price changes—a difficulty which gets enlarged when farmers of different sizes grow a different variety of crops. Secondly, under conditions of under-development when a substantial part of the output is retained by farmers for self-consumption, value has to be imputed to the retained output. There is a strong presumption that almost every mode of imputation of value to retained output under-or over-estimates value and does so in different proportions for large and small farms. The mere under-or over-estimation of value may not in itself be a serious matter provided the degree of deviation from the actual value was uniform for all farms. But it happens that the ratio of retained output to sold output changes with the size of farm uni-directionally so that the error of imputation gets enhanced as we move from large to small farms. Thus incomparability between farms increases if size were to be measured in terms of value of output. And, finally, output can be concealed and evaded and this is a practical consideration which, under certain circumstances, weighs against its use as a measure of farm-size.

There is thus no single satisfactory measure of farm-size and hence the present study uses both measures in turn.

As for measures of farm-efficiency, yield per acre suffers from very similar disadvantages, as it has output in its numerator—and we have already seen some limitations of the measurement of output. Moreover, yield per acre is a crude return only to a single input, land. And finally, as will be shown presently, there is no reason why farmers should be interested in maximizing gross output per acre—a return which does not wholly accrue to them—rather than some other measure of returns such as farm business income per acre.

An alternative measure of efficiency is cost per unit of output, C/O. This concept has been blessed by economic theory and has excellent support as an indicator of what producers (farmers) will seek to minimize. But under conditions of under-development when much of the output is retained for self-consump-

1. See Raj Krishna, "The Optimum Firm and the Optimum Farm," *The Economic Weekly*, October 6 and 13, 1962. See also C.H. Hanumantha Rao, "The Optimum Firm and the Optimum Farm : A Comment," *The Economic Weekly*, November 10, 1962.

tion and much of the inputs are provided by farmers themselves, some difficulties of concept as well as of measurement arise. The costs of farm-produced inputs—family labour, owned land and farm-produced capital—are imputed costs and there is some doubt about the correct price for imputation as that depends upon the opportunity costs of these inputs. In any case, farmers are not interested in minimizing these imputed costs, hereafter called retained costs, C_r. They are interested only in minimizing costs which they pay out, hereafter called paid-out costs, C_p. It is, therefore, not C/O that farmers will minimize but C_p/O and this latter could be a measure of efficiency. But C_p/O has in its denominator the same output which yield per acre, O/A, has in its numerator and output is subject, in any case, to the difficulty of measurement. Moreover, each time the efficiency of two farmers, two groups of farmers, two crops or two regions has to be compared, if one has to go through the process of estimating paid-out costs and deducting them from output, the concept, though sound in itself, sheds its simplicity and becomes too tedious to estimate.

To say that farmers minimize paid-out costs C_p, is the same thing as saying that they wish to maximize not gross output but that output from which paid-out costs have been deducted ; that is, they will maximize $(O—C_p)=Y$ or farm business income. But, in order to arrive at Y, if C_p has to be estimated with all the accompanying difficulties, one might as well use C_p/O or average paid-out cost per unit of output as a measure of farm-efficiency.

It is thus clear that it is not as though in measuring farm-size the balance of advantage lies entirely with acreage or with output and in judging farm-efficiency an over-whelming superiority can be claimed either for yield per acre or for paid-out cost per unit of output. Either set of measures has its limitations and advantages and hence the present work uses in turn both definitions of size and efficiency. In sections II and III farm-size is defined by acreage and efficiency by returns per acre while in section IV size is indicated by output and efficiency is taken to mean the behaviour of paid-out cost per unit of output.

This study of size-efficiency relationships is based on the following definitions of costs and returns.

Total cost (C) = paid-out cost (C_p) *plus* retained cost (C_r) ;

Gross output (O) *minus* paid-out cost (C_p) (inclusive of depreciation)
= net farm business income (Y) ;

Net farm business income (Y) *minus* retained cost (C_r)
= net profit (P).

The data for the analysis have been obtained from the Studies in the Economics of Farm Management conducted under the auspices of the Government of India in two districts of each of the seven selected States. Only the data based on the accounting method and not on the survey method have been utilized. The data for each State for the three successive years (generally, 1954-55, 1955-56 and

1956-57)[2] have been averaged out in the hope that in farm statistics a three-year average may have greater reliability than one-year figures.

The definitions of costs and returns used in the Farm Management Studies are similar[3] to those in the present work. Nevertheless what is termed cost C in those Studies is identical with our total cost C and what is defined as cost A_2 is, for all practical purposes, the same thing as our paid-out cost C_p.[4]

II

Variations in Returns per Acre with Changes in Acreage

In this section we observe and explain the changes in returns per acre (efficiency) with changes in acreage (size). Table I shows the per farm as well as per acre returns where returns themselves are of three types : (*i*) gross output; (*ii*) net farm business income ; and (*iii*) net profits. A close examination of Part A of Table I reveals that as acreage expands per farm gross output, farm business income and net profits all increase in every State. The interesting question, however, is not whether *per farm* returns increase by size but whether *per acre* returns do so. Table I (Part B) and Diagram 1 lend themselves to the following generalizations :

(*i*) As farm-size (acreage) expands, gross output per acre declines;

(*ii*) As farm-size (acreage) expands, farm business income per acre declines ; and

(*iii*) As farm size (acreage) expands, net profits per acre increases.

It is perhaps important to observe these behaviours in some detail.

Gross Output per Acre

In Diagram 1 the top curves O in each State reveal a generally declining gross output per acre with the expansion of farm-size. There is no exception to this phenomenon in any of the seven States. In order to bring out this decreasing relationship more firmly, least square regression lines were fitted to the data of Table I and Diagram 1, and the results are presented in Statement I. It is clear that all the regression lines fitted to the data of gross output per acre and acreage are downward-sloping, the sign for the regression coefficient 'b' being invariably negative. It is this consistently recurring phenomenon of declining slopes in all the seven States without exception that lends itself to the generalization that in Indian farming of the 1950s gross output per acre declines with an increase in farm-size. We shall, of course, seek an explanation of this exciting phenomenon a little later in this section.

2. With the exception of the State of Andhra Pradesh where the years chosen were 1956-57, 1957-58 and 1958-59.

3. In the Farm Management Studies cost A represents expenditures actually incurred by farmers on raw-material purchased, capital borrowed, bullocks hired, non-family labour employed ; cost A_2 adds to A the rent paid by tenant-farmers and is very close to our definition of paid-out cost, C_p. By adding to cost A_2 the (imputed) rental value of farmers' owned land and interest on owned capital what is called cost B is obtained. And finally, the addition to cost B of the imputed value of family labour gives what has been termed cost C which is equal to our total cost C $(=C_p + C_f)$. We note, however, that as between the various Farm Management Studies themselves there are small differences of definitions.

4. In Farm Management Studies cost A_2 includes and A_1 excludes rent paid on land leased-in. Since we are dealing with tenant farmers as well as owner farmers we have preferred to define paid-out cost as inclusive of rents paid by tenants.

TABLE I—RETURNS AND COSTS BY SIZE OF FARMS (ACRES)

A B (Rs.)

Size-group (Acres)	Mean Size of Holding	Per Farm Returns and Costs					Per Acre Returns and Costs				
		Gross Output	Paid-out Cost	Farm Business Income Col. (3-4)	Retained Cost	Net Profit Col. 3—(4+6)	Gross Output	Paid-out Cost	Farm Business Income Col. (8—9)	Retained Cost	Net Profit Col. 8—(9+11)
1	2	3	4	5	6	7	8	9	10	11	12
					Andhra Pradesh						
Below 1·25	0·72	338·6	176·3	162·3	159·3	3·0	472·9	239·5	233·4	229·4	4·0
1·26 — 2·50	1·81	783·8	539·5	244·3	298·0	— 53·7	441·9	306·9	135·0	164·6	— 29·6
2·51 — 5·00	3·54	1332·4	839·8	492·6	514·5	— 21·9	387·9	248·7	139·2	144·9	— 5·7
5·01 — 7·50	6·15	1890·5	1244·4	646·1	817·6	—171·5	294·5	189·4	105·1	133·6	— 28·5
7·51 — 10·00	8·97	2927·6	2117·6	810·0	1193·9	—383·9	345·7	255·4	90·3	133·0	— 42·7
10·01 — 15·00	12·33	4675·7	3375·0	1300·7	1508·2	—207·5	368·6	263·1	105·5	122·3	— 16·8
15·01 — 20·00	17·01	6813·0	4833·7	1979·3	2073·5	— 94·2	417·9	301·6	116·3	121·0	— 4·7
Above 20·00	31·82	10635·9	5736·5	4899·4	4898·8	0·6	327·2	173·2	154·0	154·1	— 0·6
Overall	8·19	3008·2	1991·7	1016·5	1127·5	—111·0	368·5	244·4	124·1	137·7	— 13·6
					Bombay						
Below 5	2·8	338·0	223·8	114·2	187·6	— 73·4	102·1	61·3	40·8	67·0	— 26·2
5 — 10	7·7	919·9	459·4	460·5	458·6	1·9	110·2	50·4	59·8	59·6	0·2
10 — 15	12·1	790·2	459·9	330·3	404·5	— 74·1	61·8	34·5	27·3	33·6	— 6·3
15 — 20	17·0	1447·8	1024·5	423·3	292·1	131·2	94·9	70·0	24·9	17·2	7·7
20 — 25	22·3	1141·7	541·8	599·9	578·9	21·0	46·1	19·2	26·9	26·0	0·9
25 — 30	27·6	1671·4	730·2	941·2	631·8	309·4	56·3	22·2	34·1	23·1	11·0
30 — 50	37·3	2524·6	1648·0	876·6	650·5	226·1	70·3	46·8	23·5	17·1	6·4
50 & above	66·4	2781·5	1433·6	1347·9	1035·4	312·5	36·3	16·0	20·3	15·6	4·7
Overall	19·6	1239·3	712·0	525·3	465·3	65·0	72·3	45·5	26·8	23·5	3·3

(*Contd.*)

TABLE I—RETURNS AND COSTS BY SIZE OF FARMS (ACRES) (CONTD.)

(Rs.)

Size-group (Acres)	A: Mean Size of Holding	A: Per Farm Returns and Costs					B: Per Acre Returns and Costs				
		Gross Output	Paid-out Cost	Farm Business Income Col. (3-4)	Retained Cost	Net Profit Col. 3—(4+6)	Gross Output	Paid-out Cost	Farm Business Income Col. (8—9)	Retained Cost	Net Profit Col. 8—(9+11)
1	2	3	4	5	6	7	8	9	10	11	12
Madhya Pradesh											
Below 5	2·95	299·5	133·0	166·5	117·5	49·0	105·0	46·5	58·5	41·5	17·0
5 — 10	7·35	642·0	314·5	327·5	256·5	71·0	89·5	42·5	46·0	37·5	8·5
10 — 15	12·45	1110·5	544·0	566·5	357·5	209·0	93·5	45·5	48·0	30·0	18·0
15 — 20	17·05	1365·0	650·5	714·5	523·5	191·0	81·5	39·0	42·5	29·0	13·5
20 — 30	24·25	1915·5	895·0	1020·5	574·0	446·5	84·0	39·0	45·0	25·0	20·0
30 — 40	34·65	2817·0	1256·5	1560·5	938·5	622·0	84·5	37·5	47·0	28·0	19·0
40 — 50	44·25	3997·5	1892·5	2105·0	1050·0	1055·0	97·0	46·0	51·0	26·5	24·5
50 & above	85·40	7352·0	3680·0	3672·0	1913·0	1759·0	91·5	46·0	45·5	24·0	21·5
Overall	21·95	1878·5	900·5	978·0	561·5	417·5	86·5	41·5	47·0	27·0	20·0
Madras											
Below 2·5	1·54	393·0	243·2	149·8	220·8	— 71·0	256·5	199·8	56·7	101·2	—44·5
2·5 — 5·0	3·59	814·9	345·4	469·5	314·9	154·6	222·0	100·9	121·1	77·6	43·5
5·0 — 7·5	5·93	1174·4	505·2	669·2	492·1	177·1	194·7	95·2	99·5	70·1	29·4
7·5 — 10·0	8·66	1672·4	661·6	1010·8	657·2	353·2	190·9	92·8	108·1	67·7	40·4
10·0 — 15·0	11·64	1459·4	615·8	843·6	696·0	147·6	121·4	64·8	57·6	41·5	16·1
15·0 — 20·0	16·93	1243·9	631·5	612·4	685·9	— 73·5	71·6	40·7	30·9	35·0	— 4·1
20·0 — 25·0	22·07	1994·3	790·1	1204·2	1291·4	— 87·2	88·2	47·2	41·0	44·7	— 3·7
25 & above	46·24	3129·6	1447·3	1682·3	887·8	794·5	76·3	32·3	44·0	24·8	19·2
Overall	7·39	1114·9	461·0	653·9	503·8	150·1	145·5	72·2	73·3	52·9	20·4

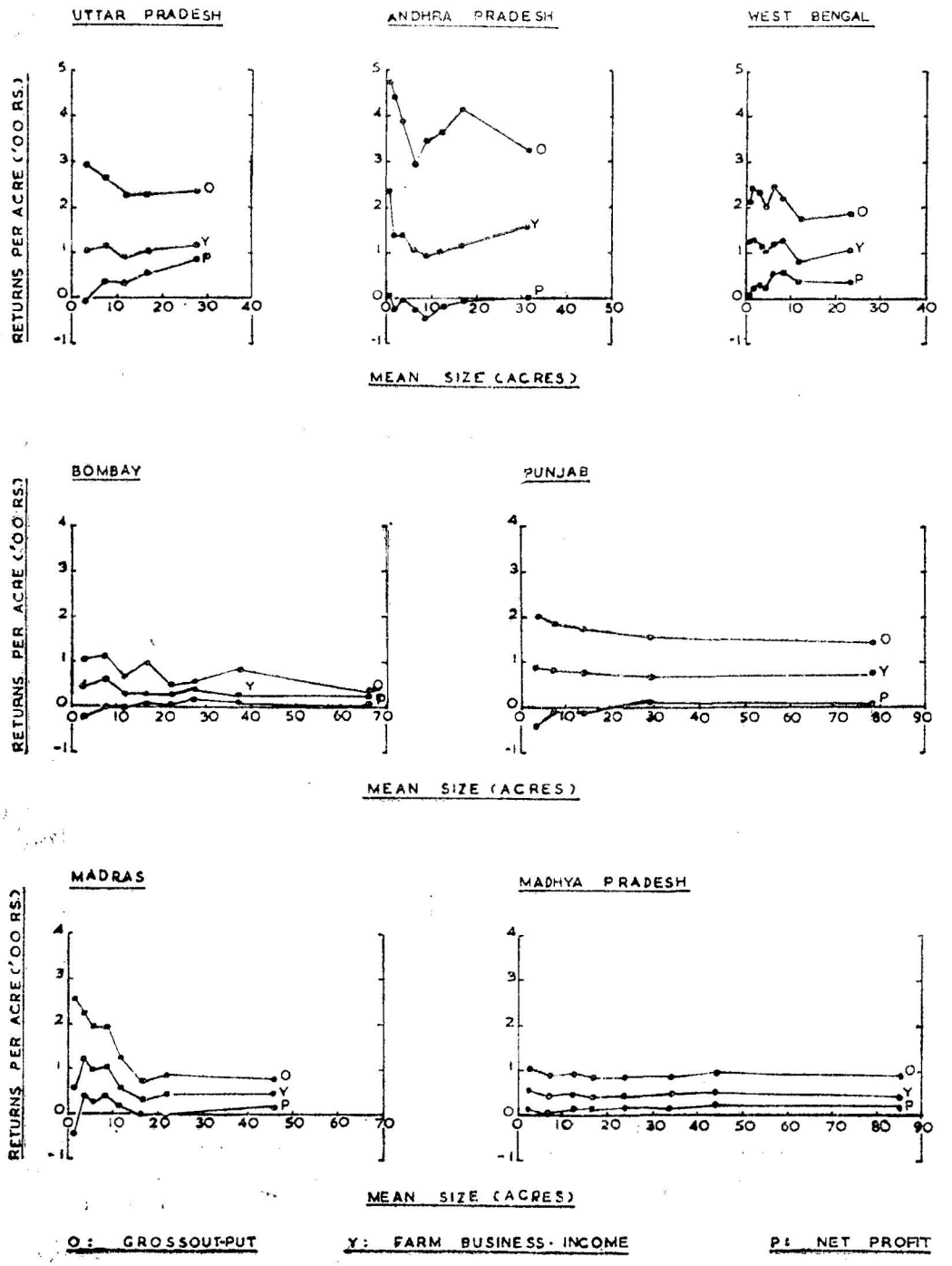
(*Contd.*)

1	2	3	4	5	6	7	8	9	10	11	12
					Punjab						
Below 5	3·76	753·1	419·6	333·5	480·8	—147·3	200·3	111·6	88·7	129·7	—41·0
5 — 10	7·40	1373·4	764·4	609·0	734·7	—125·7	185·6	103·3	82·3	94·3	—12·0
10 — 20	14·35	2482·5	1363·2	1119·3	1224·3	—105·0	173·0	95·0	78·0	91·0	—13·0
20 — 50	29·09	4497·3	2461·0	2036·3	2038·0	— 1·7	154·6	84·6	70·0	62·3	7·7
50 & above	78·76	11207·5	5513·2	5694·4	4403·6	1290·7	142·3	70·0	72·3	63·6	8·7
Overall	17·56	2855·3	1543·5	1311·8	1358·8	— 47·0	162·6	88·9	74·7	76·4	1·7
					Uttar Pradesh						
Below 5	3·3	962·0	626·7	335·3	346·6	— 11·3	292·0	190·3	101·7	105·0	— 3·3
5 — 10	7·6	2025·3	1176·3	849·0	548·3	300·7	266·3	154·3	112·0	73·0	39·0
10 — 15	12·1	2632·0	1602·7	1029·3	585·3	444·0	227·3	141·0	86·3	49·0	37·3
15 — 20	16·9	3839·7	2152·4	1687·3	795·6	891·7	228·0	127·7	100·3	47·3	53·0
20 & above	27·6	6440·7	3197·7	3243·0	932·7	2310·3	234·3	116·3	118·0	34·0	84·0
Overall	10·3	2500·7	1416·4	1084·3	566·6	517·7	244·0	138·3	105·7	55·7	50·0
					West Bengal						
Below 1·25	0·66	153·1	69·7	83·4	77·5	5·9	213·1	86·7	126·4	117·3	9·1
1·26 — 2·50	1·81	436·8	205·4	231·4	170·1	61·3	240·9	113·1	127·8	101·6	26·2
2·51 — 3·75	3·10	720·6	364·1	356·5	263·4	93·1	233·4	118·4	115·0	85·0	30·0
3·76 — 5·00	4·35	877·7	398·8	478·9	431·1	47·8	202·5	93·7	108·8	85·2	23·6
5·01 — 7·50	6·23	1479·8	738·7	741·1	469·2	271·9	246·9	128·0	118·9	68·0	50·9
7·51 — 10·00	8·36	1869·1	793·9	1075·2	619·7	455·5	220·5	91·9	128·6	73·6	55·0
10·01 — 15·00	12·13	2121·1	1192·7	928·4	505·4	423·0	172·7	96·2	76·5	41·1	35·4
Above 15·00	23·23	4389·4	1924·2	2465·2	1812·9	652·3	189·0	82·9	106·1	73·1	33·0
Overall	3·04	666·5	318·2	348·3	237·8	110·5	221·6	107·0	114·6	79·0	35·6

Source : Studies in the Economics of Farm Management, Ministry of Food and Agriculture.

DIAGRAM: 1

RETURNS PER ACRE BY SIZE OF FARM (ACREAGE)



O: GROSS OUT-PUT Y: FARM BUSINESS-INCOME P: NET PROFIT

STATEMENT I—EQUATIONS FOR LEAST SQUARE REGRESSION LINES FITTED TO BEHAVIOUR OF RETURNS PER ACRE BY SIZE OF FARM (ACREAGE)

State	Regression Coefficient	Standard Error of Regression Coefficient
	A	
Gross Output per Acre (O/A) *and Farm Size in Acres* (A)		
Andhra Pradesh	O/A = 409·46 — 2·66 A	2·13
Bombay	O/A = 96·01 — 0·98 A	0·37*
Madhya Pradesh	O/A = 91·63 — 0·03 A	0·12
Madras	O/A = 209·10 — 3·87 A	1·27*
Punjab	O/A = 189·24 — 0·68 A	0·20*
Uttar Pradesh	O/A = 279·91 — 2·25 A	1·19
West Bengal	O/A = 230·96 — 2·15 A	1·13
	B	
Net Farm Business Income per Acre (Y/A) *and Farm Size in Acres* (A)		
Andhra Pradesh	Y/A = 142·69 — 0·76 A	5·24
Bombay	Y/A = 41·59 — 0·39 A	0·20
Madhya Pradesh	Y/A = 49·37 — 0·05 A	0·07
Madras	Y/A = 89·29 — 1·33 A	0·80
Punjab	Y/A = 82·82 — 0·17 A	0·10
Uttar Pradesh	Y/A = 96·52 + 0·53 A	0·68
West Bengal	Y/A = 122·23 — 1·17 A	0·83
	C	
Net Profit per Acre (P/A) *and Farm Size in Acres* (A)		
Andhra Pradesh	P/A = —20·41 + 0·47 A	0·63
Bombay	P/A = —11·33 + 0·40 A	0·17
Madhya Pradesh	P/A = 14·47 + 0·12 A	0·06
Madras	P/A = 10·74 + 0·09 A	0·81
Punjab	P/A = —19·28 + 0·35 A	0·30
Uttar Pradesh	P/A = —0·12 + 3·12 A	0·61
West Bengal	P/A = 27·93 + 0·66 A	0·77

* denotes significant.

Farm Business Income per Acre

Meanwhile, farm business income per acre is seen to decline consistently in six out of the seven States with an expansion of farm-size. To make doubly sure of this phenomenon, regression lines have been fitted to the data and in all but one of the seven States the signs for regression coefficients (slopes of the regression lines) are seen to be negative in Statement I-B.

Net Profits per Acre

The behaviour of net profits per acre stands in sharp contrast with that of the other two returns. For one thing, net profits per acre *increase* with farm-size in all the seven States as witness the positive signs of all the regression coefficients in Statement I-C. For another, in several States, net profits per acre are found to be negative in the farms of very small size.

Meanwhile our desire to generalize for the country as a whole (or for very substantial parts thereof) suggests a rough averaging[5] of the data for the seven States in order to obtain a general behaviour curve for the whole country or for all the parts of the country studied.[6] This averaging is done through a process of linear interpolation of the values of each of the three types of returns per acre for specified sizes of holdings and the results can be seen in Diagram 1(a). Taking all the States together, gross output per acre as well as farm business income per acre is clearly seen to decline consistently as farm-size expands while net profits per acre increase with farm size. This only goes to confirm the Statewise results given earlier. The behaviour of the curves in Diagram 1(a) permits no doubt a generalized shorthand statement of the phenomenon in the country as a whole, or for all the areas studied; but the basis for generalizations, we wish to stress, is not the average behaviour but the repeated occurrence of the same relationship in all or nearly all the separate States studied.

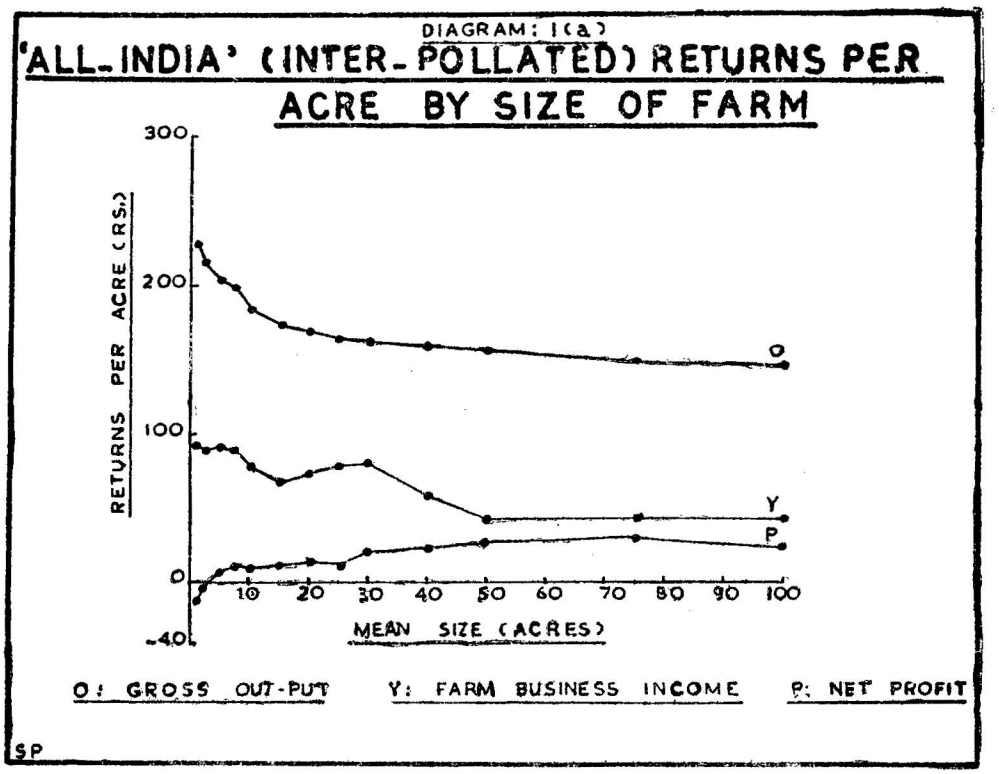
Some Explanations of the Behaviour of Returns

The tendency for gross output per acre to vary inversely and for net profit per acre to vary directly with farm-size has been noticed by many observers of under-developed economies.[7] In respect of these two tendencies the present

5. The obstacle to such averaging is that the Farm Management Studies in different States work with different size-groups of farms. Some States, for example, have zero to 2·5 acres and others zero to 1·25 acres as the first size class. There are similar differences all along the line and some States have 15 acres and above as the largest size-group while others have 20 acres and above or 25 acres and above or 50 acres and above as the highest size classification. However, it is possible to take some specified sizes of farms along the horizontal axis and read out the levels of per farm and per acre returns on the vertical axis through the graphic method or indeed, what comes to the same thing, through linear interpolations or extrapolations. We thus get for each State the values of gross output per acre, farm business income per acre and net profits per acre for given sizes of farm. Summing up for all the seven States in an unweighted manner we get for each specified size a kind of all-India average of the level of these returns.

6. The sceptical reader who refuses to accept this average as valid for the country or for the States in question can think of it as an average for the farms studied in the Farm Management Survey.

7. See A. K. Sen, "An Aspect of Indian Agriculture," *The Economic Weekly*, Annual Number, February 1962. See also A. K. Sen, "Size of Holding and Productivity," *The Economic Weekly*, Annual Number, February 1964. Dipak Mazumdar ("On the Economics of Relative Efficiency of Small Farmers," *The Economic Weekly*, Special Number, July 1963) notes that in peasant agriculture "as the size of farm decreases the output per acre increases" and observes that "the higher output per acre in smaller farms is really a function of the higher input of labour per acre—the other factors varying more or less in the same proportion as labour." He seeks to provide an over-elaborate explanation for this higher input of labour in terms of lower supply price of family labour in small farms compared to large ones. He also cites the findings of Professor P. T. Bauer in Malaya "that output per acre in small holdings was much more than in large plantations."



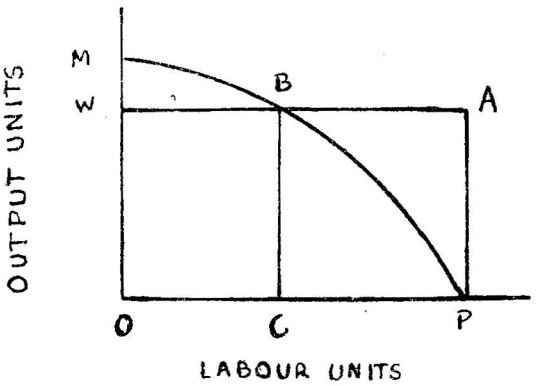
work can claim no more than that it has brought to light the generality and perhaps the universality of these phenomena in all the regions studied and may provide one or two additional explanations of behaviour. The behaviour of farm business income per acre, on the other hand, had not been analysed earlier. It is the contention of the present study that this is a crucial and highly relevant variable for farm decisions. It is a true index of returns which farmers will seek to maximize and its behaviour explains many things which the behaviour of the other two variables does not.

One of the most satisfying explanations of the phenomena of declining per acre gross output and increasing per acre net profits with an increase in farm-size has been given by Professor A. K. Sen.[8] This explanation may be presented in Sen's own words :

"In the Diagram, curve MP represents the schedule of net marginal product of labour applied to a given acre of land. If cultivation is family-based, and if the per acre supply of labour in the family equals or exceeds OP, we can expect that OP amount of labour will be applied, provided labour has no outside opportunity of employment and provided there is no significant disutility of work in the relevant range of effort. Next imagine that the wage rate ruling in the area is

8. *Ibid.*, p. 245.

OW. If we impute OW wage to each unit of OP labour, OWAP is the total 'cost' of labour.



"Now let us look at the observations needing interpretation. The area OMP (net output) could be more or less than area OWAP (labour cost). If it is more, there is a profit; if less, a loss. There is no particular reason why it should be more, and so there is nothing in the least surprising in Observation I (that when family labour employed in agriculture is given an 'imputed value' in terms of the ruling wage rate, much of Indian agriculture seems unremunerative).[9] It is a natural result of an economy with surplus labour which has family based non-wage cultivation. There is nothing particularly 'alarming' in this, and in fact, if production were restricted to OC, where a profit must necessarily be earned, the overall position would have been much worse.

"Next, it should be noted that in practically all the areas studied, the proportion of family labour to hired labour falls with the size of farms, as indeed one would expect.....Given this relationship, Observations II and III are the obvious ones to expect (*viz.*, that the net profit per acre increases with the size of holding and that productivity per acre decreases with the size of holding). If the wage rate is OW, a wage-based farm will restrict labour input to OC, and have more profit (area MWB as opposed to area MWB minus area BAP) compared with family-based farming. Since size is positively correlated with wage-based farming, Observations II and III are immediately explained."

The interesting thing about this explanation is that it is at once an explanation of three important observations : it explains why net profit is negative in the smallest of farms, why net profit per acre increases and why gross output per acre decreases with an increase in farm-size. We note, however, a few qualifications to it.

(1) Professor Sen's explanation requires the non-existence of outside opportunities for family labour which may or may not be the case.

9. Sen's statement which creates the impression that this non-remunerativeness of Indian agriculture is a wide-spread phenomenon, perhaps needs qualification. Table I-B and Diagram 1 show that only in some States, and within these in some size-groups alone net profit is negative. Only 16 out of the 50 observations—and if Andhra Pradesh is left out only 9 out of 42 observations—show negative net profits. Moreover, for net profits to be properly defined not only the imputed value of family labour but of other inputs owned by the farmer has to be deducted. Sen, however, only deducts the value of family labour. On such a procedure almost all farms will probably turn out to have positive net profits.

(2) More importantly, it is only an explanation of the difference in productivity per acre in, say, a 3-acre family farm and a 10-acre or 15-acre wage-based farm. But once, say, a 15-acre size is reached, family labour which is more or less a fixed quantity having been stretched fully, begins to wear thin. The per acre use of family labour is negligible both in the 15-acre farm and the 50-acre farm; both begin to depend heavily on hired labour and it is no explanation of the higher output per acre in the 15-acre farm to say that it uses more of family labour and uses it intensively while the 50-acre farm uses hired labour and uses less of it.

(3) The explanation also assumes homogeneity of quality between family labour and hired labour so that the area under the marginal product curve (area OMP) is taken to be the same whichever kind of labour is applied to an acre of land. Now, if it is true, as it probably is, that in agriculture a unit of family labour does more or better work than a unit of hired labour, the product will be larger for the former even if the quantities of labour applied were the same in both cases. In that case a mere increase in the *proportion* of hired to family labour, as farm-size expands, gives a smaller per acre product. To say this is not to deny that a part of the observed decline in output per acre in larger farms may also be due to a reduced *total quantity* of labour per acre and not just a shift in the *proportion* of hired to family labour.

(4) We note further that the explanation is couched in terms of diminishing product of labour alone as more and more of it is applied to a *single* acre of land. But there is the further possibility[10] that in the case of indivisibilities like a pair of bullocks while a comparatively larger farm will have optimum intensity of bullock use per acre, a small farm with surplus bullock-power, under circumstances of an all-round surfeit of bullocks and very low opportunity cost for them, will intensify bullock use and hence obtain a larger per acre output.[11]

(5) And then there is the clear possibility that as farm-size expands the land taken on lease and cultivated on the basis of tenancy increases as a percentage of total land.[12] This too might bring about a decline in returns per acre if the presumption is correct that farmers apply themselves and other inputs qualitatively better on their own lands than on lands leased-in.

III

Variations in Returns per Corrected Acre with Changes in Corrected Acreage

But we must now raise a somewhat fundamental issue which throws doubt on the very estimates of returns and costs per acre and hence to some extent on

10. This is noted in some of the Farm Management Studies themselves and is also accepted by Sen.

11. There is yet another theoretical explanation which, however, does not seem to fit the Indian case. The marginal product curve drawn by Sen is for a single acre of land and assumes the same marginal product of labour for small and large farms. But with an expansion of farm-size and of all other inputs, might it not be that per acre returns decline owing to a fixity of entrepreneurship (the usual argument for diminishing returns to scale)? Entrepreneurship in underdeveloped farming being what it is, the point where it cannot cope with the expansion of other inputs ought to arrive at a smaller farm-size than in developed farming. But as we shall see later Indian farming exhibits constant returns per unit of cost (all inputs) as farm-size expands and could not therefore be said to suffer from large scale diseconomies in the observed ranges of size. See also C. H. Hanumantha Rao: Size of Holdings and Productivity: Some Empirical Verifications. (Unpublished.)

12. See A. M. Khusro : An Analysis of Agricultural Land in India by Size of Holding and Tenure (Mimeographed), Institute of Economic Growth, 1962.

the very generalizations that have been sought to be explained. In the Farm Management Studies whose data we use here, acreage is simple, unstandardized, acreage with no correction for good or bad lands, wet and dry lands, etc. One of the most plausible hypotheses of a negative response of gross output per acre and farm business income per acre to changes in acreage seems to us to be that as farm-size expands the proportion of bad and indifferent land to total land increases, this in turn accounting for the decrease in per acre output and farm income. This hypothesis is worthy of close examination inasmuch as the behaviour of land revenue (land tax) data seems to substantiate it. Land revenue in India reflects, at any rate at the time of original fixation and at successive revisions, the fertility differences between farms of the same region.[13] Column 3 of Table II shows clear trends, in almost all States, of declining land revenue per acre as farm-size expands and confirms the hypothesis of decreasing soil fertility. The process of averaging of interpolated values of land revenue for specified farm-sizes for all the seven States results in a similar 'all-India' behaviour of declining land revenue per acre with an expansion of size.[14] It is clear that the acreage in successive size-groups of Farm Management Studies is not of uniform but of decreasing quality and has to be corrected or standardized before true generalizations could be obtained. Such a correction can be undertaken with the help of a land revenue index itself. If the mean acreage, A, in each size-group is multiplied by an index of efficiency based on land revenue per acre, L/A, we get a corrected or standardized acreage A_c [$=A(L/A)=L$] in column 5 of Table II.[15] Hereafter, in this section, by acreage or size we mean corrected acreage, A_c, while returns per acre refer to output, income and profits per corrected acre, that is, O/A_c, Y/A_c and P/A_c, unless otherwise specified.

In columns 6, 7 and 8 of Table II, we obtain the behaviour of the three returns per *corrected acre* as farm-size, A_c, expands. This behaviour is also seen in Dia-

13. This is not the natural and original fertility of the soil but a combination of natural and man-made productive capacity, and admits of improvements made from time to time through investment. In India land revenue assessment is undertaken periodically with a rather large gap of 20 to 30 years, and sometimes more, between one assessment and another. It is true that during the interim period the prevailing land revenue does not always take account of improvements brought about such as conversion from dry to wet cultivation, etc. Nevertheless, at the time of the original assessment and again at the time of revision, land revenue data do differentiate on various economic grounds between one land and another. A land revenue index, therefore, would appear to be a fairly reasonable, if not a highly efficient, indicator of relative soil fertilities and land conditions.

14. One of the most plausible explanations of declining soil fertility by size of farm has been provided by A. K. Sen, "Size of Holdings and Productivity" (*The Economic Weekly*, Annual Number, February, 1964). "If two pieces of land are of the same size but holding A is more fertile than holding B, the former will provide a greater opportunity of earning income, so that family size may expand faster in the former case. This will lead to quicker subdivision of A than of B, and soon a correlation may be established between smallness of the size of the holdings and the fertility of soil. This argument is easy to see in the context of inter-regional variation, because it has been often observed that in fertile areas population expands faster both because of natural increase as well as migration. But the picture can be expected even within a given region, particularly because the ability of a family to withstand famines and other catastrophes is greater if the land it owns is fertile than if it is not. Thus, the correlation between size and fertility is not an odd result, but one that can be expected on good economic grounds." Incidentally, A. K. Sen's reference to an unpublished note by the present writer entitled "Some Basic Generalizations in Indian Agriculture" is actually a summary of the present paper whose title has had to be altered since the appearance of Sen's article. For a critique of Sen's explanation of declining fertility, see C. H. Hanumantha Rao: *Op. cit.*

15. In constructing the index of land revenue the lowest figure of land revenue per acre among the various size-groups in each State has been taken to be 100.

TABLE II—RETURNS AND COSTS BY SIZE OF FARM (CORRECTED ACRES)

(Rs.)

Size-group (Acres)	Mean Size of Holding	Land Revenue Per Acre	Land Revenue Index	Corrected Mean Size of Holding	Per Corrected Acre				
					Gross Output	Farm Business Income	Net Profits	Paid-out Cost	Retained Cost
1	2	3	4	5	6	7	8	9	10
Andhra Pradesh									
Below — 1·25	0·72	16·9	2·64	1·90	178·2	85·4	1·6	92·8	83·8
1·26 — 2·50	1·81	12·8	2·00	3·62	216·5	67·5	—14·8	149·0	82·3
2·51 — 5·00	3·54	10·7	1·67	5·91	225·4	83·4	— 3·7	142·1	87·1
5·01 — 7·50	6·15	7·8	1·22	7·50	252·1	86·1	—22·9	165·9	109·0
7·51 — 10·00	8·97	10·5	1·64	14·71	199·0	55·1	—26·1	144·0	81·2
10·01 — 15·00	12·33	6·4	1·00	12·33	379·2	105·5	—16·8	273·7	122·3
15·01 — 20·00	17·01	8·9	1·39	23·64	288·2	83·7	— 4·0	204·5	87·7
Above 20·00	31·82	9·3	1·45	46·14	230·5	106·2	0·0	124·3	106·2
Bombay									
Below 5	2·8	1·9	3·8	10·64	31·8	10·7	— 6·9	21·0	17·6
5 — 10	7·7	1·1	2·2	16·94	54·3	27·2	0·1	27·1	27·1
10 — 15	12·1	1·0	2·0	24·20	32·7	13·6	— 3·1	19·0	16·7
15 — 20	17·0	0·9	1·8	30·60	47·3	13·8	4·3	33·5	9·5
20 — 25	22·3	0·8	1·6	35·68	32·0	16·8	0·6	15·2	16·2
25 — 30	27·6	0·6	1·2	33·12	50·5	28·4	9·3	22·0	19·1
30 — 50	37·3	0·7	1·4	52·22	48·3	16·8	4·3	31·6	12·5
50 & above	66·4	0·5	1·0	66·40	41·9	20·3	4·7	21·6	15·6
Madhya Pradesh									
Below 5	2·95	2·7	1·50	4·43	67·6	37·6	11·1	20·0	26·5
5 — 10	7·35	2·2	1·22	8·97	71·6	36·5	7·9	35·1	28·6
10 — 15	12·45	2·2	1·22	15·19	73·1	37·3	13·8	35·8	23·5
15 — 20	17·05	2·6	1·45	24·72	55·2	28·9	7·7	26·3	21·2
20 — 30	24·25	2·1	1·17	28·37	67·5	36·0	15·7	31·5	20·2
30 — 40	34·65	1·8	1·00	34·65	81·3	45·0	18·0	36·3	27·1
40 — 50	44·25	2·1	1·17	51·77	77·2	40·7	20·4	36·6	20·3
50 & above	85·40	2·2	1·22	104·19	70·6	35·2	16·9	35·3	18·4

(*Contd.*)

TABLE II—RETURNS AND COSTS BY SIZE OF FARM (CORRECTED ACRES) (CONTD.)

(Rs.)

Size-group (Acres)	Mean Size of Holding	Land Revenue per Acre	Land Revenue Index	Corrected Mean Size of Holding	Per Corrected Acre				
					Gross Output	Farm Business Income	Net Profits	Paid-out Cost	Retained Cost
1	2	3	4	5	6	7	8	9	10
				Madras					
Below 2·5	1·54	2·7	2·7	4·16	94·5	36·0	—17·1	58·5	53·1
2·5 — 5·0	3·59	2·2	2·2	7·90	103·2	59·4	19·5	43·7	39·9
5·0 — 7·5	5·93	1·9	1·9	11·27	104·2	59·4	15·7	44·8	43·7
7·5 — 10·0	8·66	2·2	2·2	19·05	87·8	53·1	18·5	34·7	34·5
10·0 — 15·0	11·64	1·5	1·5	17·46	83·6	48·3	8·4	35·3	39·9
15·0 — 20·0	16·93	1·0	1·0	16·93	73·5	38·0	— 4·3	37·3	40·5
20·0 — 25·0	22·07	1·0	1·0	22·07	90·4	54·6	— 4·0	35·8	58·5
25 & above	46·24	1·3	1·3	60·11	52·1	28·0	13·2	24·1	14·8
				Punjab					
Below 5	3·76	2·1	3·00	11·28	66·8	29·6	—13·1	37·2	42·6
5 — 10	7·40	2·1	3·00	22·20	61·9	27·4	— 5·7	46·5	33·1
10 — 20	14·35	1·8	2·57	36·88	67·3	30·3	— 2·8	37·0	33·2
20 — 50	29·09	1·6	2·29	66·62	67·5	30·6	0·0	36·9	30·6
50 & above	78·76	0·7	1·00	78·76	142·3	72·3	16·4	70·0	55·9

(Contd.)

1	2	3	4	5	6	7	8	9	10
				Uttar Pradesh					
Below 5	3·3	9·1	1·23	4·06	236·9	82·6	— 2·8	154·4	85·4
5 — 10	7·6	8·2	1·11	8·44	240·0	100·6	35·6	139·4	65·0
10 — 15	12·1	8·7	1·17	14·16	185·9	72·7	31·4	113·2	41·3
15 — 20	16·9	8·2	1·11	18·76	204·7	89·9	47·5	114·7	42·4
20 & above	27·6	7·4	1·00	27·60	233·4	117·5	83·7	115·9	33·8
				West Bengal					
Below 1·25	0·66	7·6	1·55	1·02	150·1	81·8	5·8	68·3	76·0
1·26 — 2·50	1·81	7·0	1·43	2·59	168·6	89·3	23·7	79·3	65·7
2·51 — 3·75	3·10	5·7	1·16	3·60	200·2	99·0	25·9	101·1	73·2
3·76 — 5·00	4·35	5·5	1·12	4·87	180·2	98·3	9·8	81·9	88·5
5·01 — 7·50	6·23	5·5	1·12	6·98	212·0	106·2	40·0	105·8	67·2
7·51 — 10·00	8·36	5·7	1·16	9·70	192·7	110·9	47·0	81·8	63·8
10·01 — 15·00	12·13	4·9	1·00	12·13	174·9	76·5	34·9	98·3	41·7
Above 15·00	23·23	5·9	1·20	27·88	157·4	88·4	23·4	69·0	65·0

DIAGRAM 2

RETURNS PER CORRECTED ACRE BY SIZE OF FARM (CORRECTED ACREAGE)

(a) GROSS OUT-PUT

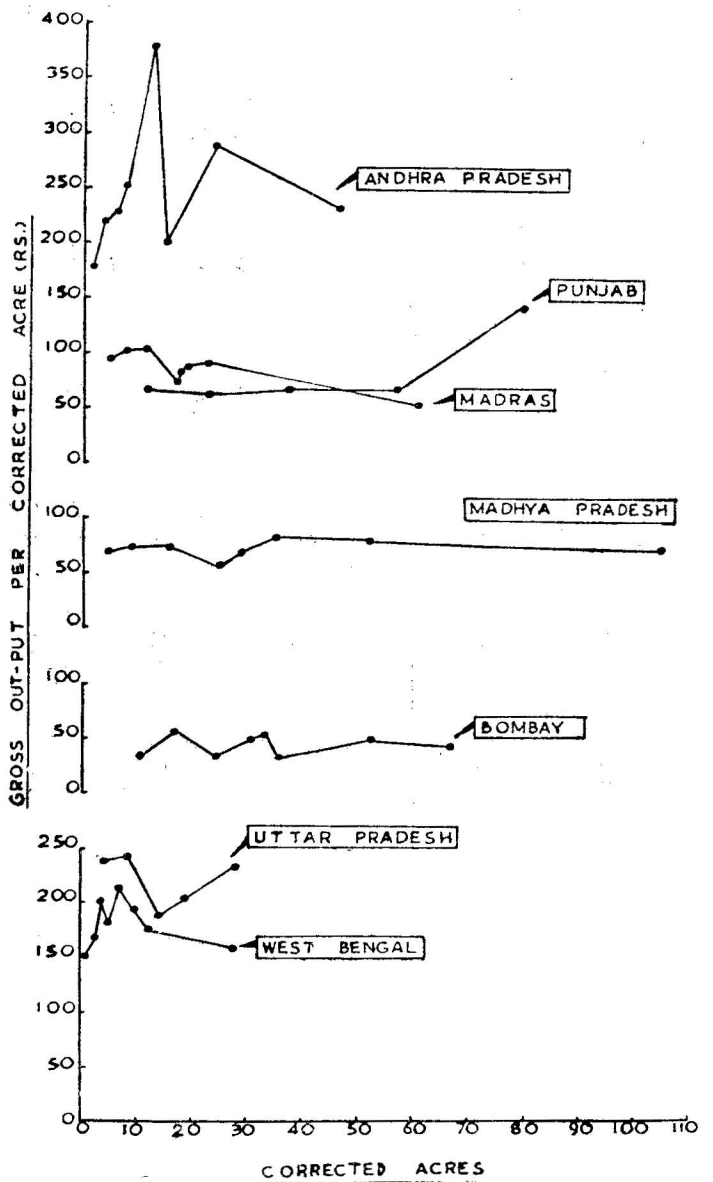


DIAGRAM 2

RETURNS PER CORRECTED ACRE BY SIZE OF FARM (CORRECTED ACREAGE)

(b) FARM BUSINESS INCOME

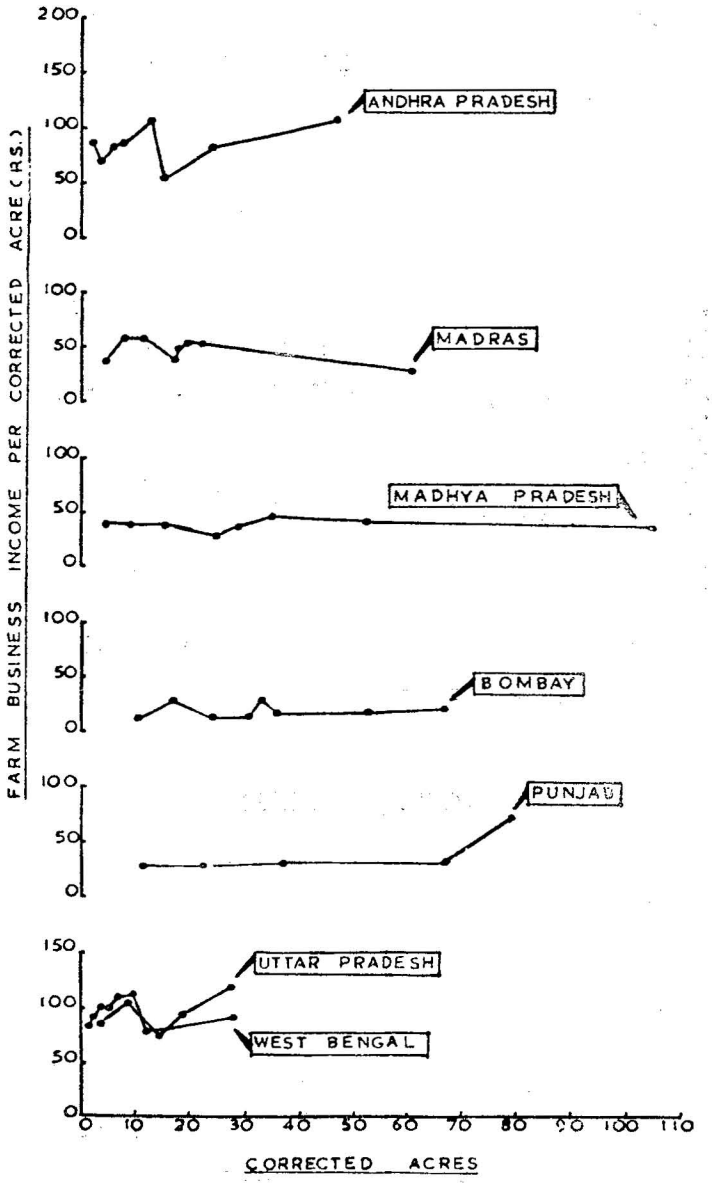
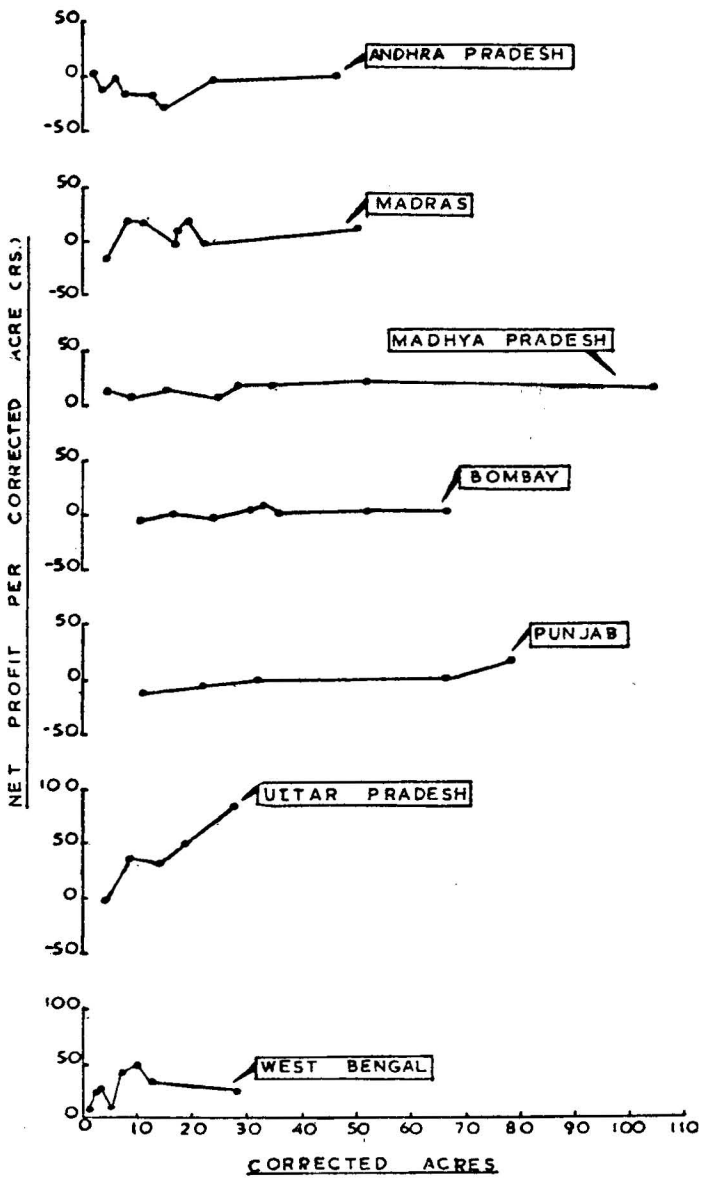


DIAGRAM 2

RETURNS PER CORRECTED ACRE BY SIZE OF FARM (CORRECTED ACREAGE)

(C) NET PROFITS



STATEMENT II—EQUATIONS FOR LEAST SQUARE REGRESSION LINES FITTED TO BEHAVIOUR OF RETURNS PER CORRECTED ACRE BY SIZE OF FARM (CORRECTED ACREAGE)

State	Regression Coefficient	Standard Error of Regression Coefficient
	A	
Gross Output per Corrected Acre (O/A_c) *and Farm Size in Corrected Acres* (A_c)		
Andhra Pradesh	$O/A_c = 237{\cdot}34 + 0{\cdot}61\ A_c$	1·7492
Bombay	$O/A_c = 39{\cdot}62 + 0{\cdot}08\ A_c$	0·2012
Madhya Pradesh	$O/A_c = 69{\cdot}08 + 0{\cdot}04\ A_c$	0·0975
Madras	$O/A_c = 103{\cdot}25 - 0{\cdot}86\ A_c$	0·1949*
Punjab	$O/A_c = 44{\cdot}48 + 0{\cdot}85\ A_c$	0·5240
Uttar Pradesh	$O/A_c = 227{\cdot}77 - 0{\cdot}52\ A_c$	1·4678
West Bengal	$O/A_c = 184{\cdot}41 - 0{\cdot}57\ A_c$	0·9780
	B	
Net Farm Business Income per Corrected Acre (Y/A_c) *and Farm Size in Corrected Acres* (A_c)		
Andhra Pradesh	$Y/A_c = 76{\cdot}34 + 0{\cdot}537\ A_c$	0·5290
Bombay	$Y/A_c = 16{\cdot}80 + 0{\cdot}049\ A_c$	0·1425
Madhya Pradesh	$Y/A_c = 37{\cdot}08 + 0{\cdot}002\ A_c$	0·0583
Madras	$Y/A_c = 54{\cdot}77 - 0{\cdot}386\ A_c$	0·2276
Punjab	$Y/A_c = 173{\cdot}70 + 0{\cdot}479\ A_c$	0·2914
Uttar Pradesh	$Y/A_c = 88{\cdot}73 + 0{\cdot}269\ A_c$	1·0382
West Bengal	$Y/A_c = 95{\cdot}30 - 0{\cdot}175\ A_c$	0·5577
	C	
Net Profit per Corrected Acre (P/A_c) *and Farm Size in Corrected Acres* (A_c)		
Andhra Pradesh	$P/A_c = -32{\cdot}09 + 1{\cdot}469\ A_c$	0·2855
Bombay	$P/A_c = -4{\cdot}18 + 0{\cdot}173\ A_c$	0·0894
Madhya Pradesh	$P/A_c = 11{\cdot}05 + 0{\cdot}085\ A_c$	0·0479
Madras	$P/A_c = 2{\cdot}46 + 0{\cdot}190\ A_c$	0·3023
Punjab	$P/A_c = -15{\cdot}88 + 0{\cdot}344\ A_c$	0·1000
Uttar Pradesh	$P/A_c = -7{\cdot}93 + 3{\cdot}220\ A_c$	0·6340
West Bengal	$P/A_c = 22{\cdot}84 + 0{\cdot}401\ A_c$	0·6500

* denotes significant.

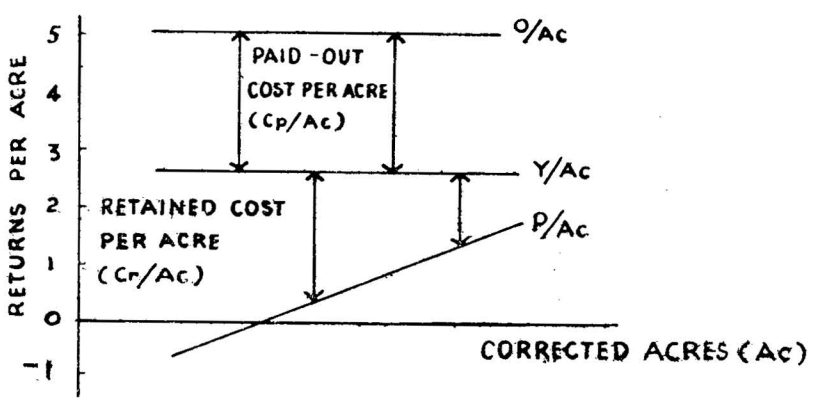
gram 2 and Statement II in which least square regression line equations have been presented for each State. It now appears that in three cases out of seven, gross output per corrected acre, O/A_c, still declines while in the other four cases, it increases with farm-size. Apart from this mixed behaviour, the values of the regression coefficients, both positive and negative, are very small being + 0.61, + 0.08, + 0.04, — 0.86, + 0.85, — 0.52 and — 0.57. These compare with the much larger and consistently negative values of earlier coefficients for O/A and A which were —2.66, —0.98, —0.03, —3.87, —0.68, —2.25 and —2.15. Judged by the 't' test for the significance of the regression coefficients, all the coefficients except the one for Madras can be regarded as having a value equal to zero. Thus it cannot be asserted that O/A_c either decreases or increases with A_c and the hypothesis of constant gross output per corrected acre as size changes appears to be as good as any.

Farm business income per corrected acre, Y/A_c, shows an upward slope in five cases out of seven (Diagram 2 (b) and Statement II-B) and a nominal downward slope in the remaining two cases. Here again, neither the negative nor the positive slopes are significant as judged by the 't' test and can be taken to be zero in all the seven cases. Thus the hypothesis of constancy of Y/A_c is obviously the most valid. This behaviour is in marked contrast with that of farm business income per uncorrected acre which was negatively related to uncorrected acreage. As for net profit per corrected acre, P/A_c, this variable increases with an increase in corrected acreage in all the seven cases (Diagram 2 (c) and Statement II-C) but reveals a more steeply rising slope with corrected acreage than with uncorrected one.

It is clear that the correction factor which takes into account the qualitative aspect of land is important in that it makes a substantial difference to the crude uncorrected relationships.

We thus reach what is perhaps an important conclusion: in Indian farming of the 1950s gross output and farm business income per corrected acre had no general tendency either to increase or decrease, while net profit per acre increased with farm-size, starting often with a negative figure for small farms and rising to a positive one. These generalizations may be expressed in diagrammatic form as follows :

DIAGRAM. 2 (d)



A constancy of O/A_c and Y/A_c by size of farm means obviously a constancy of C_p/A_c as C_p is the difference between O and Y. If acreage, A_c, is taken to represent not just one input but the whole *scale* of operation, a constancy of C_p/A_c with changing acreage spells constant returns to scale in Indian farming. As there is no evidence of statistically significant upward or downward slopes of C_p/A_c in any of the seven States studied, the phenomenon of constant returns appears to be general and universal and some of the prevailing ideas about decreasing returns to scale (as judged approximately by a declining output per acre) seem to be out of focus.[16] Farmers' efficiency judged by their success in maximizing farm business income per acre or minimising paid-out cost per acre does not decrease by size.

The finding that efficiency does not decrease by farm-size will be substantiated further in our alternative study of size-efficiency relationship in the following section. Meanwhile we observe that as farm-size expands, owned labour resources being almost a fixed quantity, spread more and more thinly per acre so that (imputed) costs of owned labour decline per acre as seen in the diminishing gap between the Y/A_c curve and the P/A_c curve in Diagram 2(d). This results in an increasing net profit per acre as size expands. As for the negative value of P/A_c in small-sized farms, Professor Sen's explanation is probably as satisfactory as any.

IV

An Alternative Study of Size-Efficiency Relationships : Output and Average (paid-out) Cost

Having examined size-efficiency relationships where size was defined by acreage and efficiency by returns per acre, we proceed to examine these relationships through alternative concepts.

Variations in Average (Paid-out) Cost per Unit of Output with Changes in Output

Here, as promised earlier, we define farm-size by *output* O, and farm-efficiency by *average (paid-out) cost per unit of output*, C_p/O. It has been maintained throughout this study that farmers will try to minimize those costs which they pay out to factors they purchase or hire or borrow from outside the farm as distinct from those they own themselves. The present calculations of O and of C_p/O have

16. As a matter of fact, there is a temptation to interpret our data as showing a slight increase in Y/A_c with an increase in size owing to 5 out of the 7 regression coefficients being positive and the sum of the values of these five being + 1·336 compared to a sum of — 0·561 for the two negative coefficients. Thus if the Y/A_c curves have any direction at all they have an upward direction. This, in the face of a constancy of O/A_c means a slightly declining C_p/A_c. From this rather weak upward tendency, while one should not rush into making a statement about increasing returns to scale, it is clear that there is no evidence of diminishing returns to scale.

an advantage in that no doubtful correction with an index of fertility is required as in the case of acreage.[17]

In Table III and in Diagram 3 are given the behaviours of C_p/O as output changes. Taking each State separately, the great similarity in the behaviour of average cost is very striking, to say the least. Statement III-A shows the regression coefficients for all the seven States to have extremely small values, the slopes of the average cost curves being almost zero and the values of C_p/O fluctuating within narrow limits for all sizes of output. If these data are any indication of the generality of cases in India, one might surmise that the Indian farm economy is a clear instance of constant returns to scale.

As distinct from the negligibly small *slopes* of the curves the other feature which can hardly fail to attract attention is a surprisingly small *regional variation in the levels* of C_p/O from one State to another. A frequency distribution of all the values of C_p/O shows that 36 out of the 50 observations—or 72 per cent of the total—fall in the range of 0.4 to 0.6, the most common value being 0.5.[18] So much so that it is possible to treat the 50 observations from the seven different States as a single body of data and estimate a single regression equation and draw a scatter diagram for 'all-India' without distinguishing between one State and another. Such a treatment results in Diagram 3 (a) and yields a correlation coefficient of—0.33 which is significant at 5 per cent level, the regression equation working out to be :

$$C_p/O = 0.521 - 0.000041\ O$$

17. On the other hand, there is the difficulty that the Farm Management data under study are based on a size-classification by acreage and our classification by output cannot free itself entirely from the strait-jacket of acre-size. If the original data were reclassified by output-size we should deem it possible that the results would be somewhat different, were it not for the unmistakable and remarkably strong relationship between acreage and per farm output. It is also possible that grouped data, such as farm management data are, may have some aggregative bias. The difficulty, nevertheless, is minimized by the fact that we are concerned with the direction and not with the rate of change.

18.

Range of Paid-out cost/output	Frequency	
0·350 — 0·399	2	
0·400 — 0·449	8	36
0·450 — 0·499	14	
0·500 — 0·549	8	
0·550 — 0·599	6	
0·600 — 0·649	3	
0·650 — 0·699	5	
0·700 — 0·749	4	
	50	

92 per cent of all values of C_p/O lie within a range twice the standard deviation and all values within three times the standard deviation.

TABLE III—PAID-OUT COSTS PER UNIT OF RETURNS

Size-group (Acres)	Mean Size of Holding	Paid-out Cost per Unit of	
		Gross Output	Farm Business Income
1	2	3	4
Andhra Pradesh			
Below 1·25	0·72	0·521	1·09
1·26 — 2·50	1·81	0·688	2·21
2·51 — 5·00	3·54	0·630	1·70
5·01 — 7·50	6·15	0·658	1·93
7·51 — 10·00	8·97	0·723	2·61
10·01 — 15·00	12·33	0·722	2·59
15·01 — 20·00	17·01	0·701	2·44
20·00 & Above	31·82	0·539	1·17
Bombay			
Below 5	2·8	0·662	1·96
5 — 10	7·7	0·499	1·00
10 — 15	12·1	0·582	1·39
15 — 20	17·0	0·708	2·42
20 — 25	22·3	0·475	0·90
25 — 30	27·6	0·437	0·78
30 — 50	37·3	0·653	1·88
50 & above	66·4	0·515	1·06
Madhya Pradesh			
Below 5	2·95	0·444	0·80
5 — 10	7·35	0·490	0·96
10 — 15	12·45	0·490	0·96
15 — 20	17·05	0·477	0·91
20 — 30	24·25	0·467	0·88
30 — 40	34·65	0·446	0·81
40 — 50	44·25	0·473	0·90
50 & above	85·40	0·501	1·00
Madras			
Below 2·5	1·54	0·619	1·62
2·5 — 5·0	3·59	0·424	0·74
5·0 — 7·5	5·93	0·430	0·75
7·5 — 10·0	8·66	0·396	0·65
10·0 — 15·0	11·64	0·422	0·73
15·0- — 20·0	16·93	0·508	1·03
20·0- — 25·0	22·07	0·396	0·66
25 & above	46·24	0·463	0·86

Size-group (Acres)	Mean Size of Holding	Paid-out Cost per Unit of	
		Gross Output	Farm Business Income
1	2	3	4
Punjab			
Below 5	3·76	0·557	1·26
5 — 10	7·40	0·557	1·26
10 — 20	14·35	0·549	1·22
20 — 50	29·09	0·547	1·21
50 & above	78·76	0·492	0·97
Uttar Pradesh			
Below 5	3·3	0·651	1·87
5 — 10	7·6	0·581	1·39
10 — 15	12·1	0·609	1·56
15 — 20	16·9	0·561	1·28
20 & above	27·6	0·496	0·99
West Bengal			
Below 1·25	0·66	0·455	0·84
1·26 — 2·50	1·81	0·470	0·89
2·51 — 3·75	3·10	0·505	1·02
3·76 — 5·00	4·35	0·454	0·83
5·01 — 7·50	6·23	0·500	1·00
7·51 — 10·00	8·36	0·425	0·74
10·01 — 15·00	12·13	0·562	1·28
15·00 & Above	23·23	0·438	0·78

DIAGRAM: 3

AVERAGE PAID-OUT COST PER UNIT OF OUT-PUT BY SIZE OF FARM (OUT-PUT)

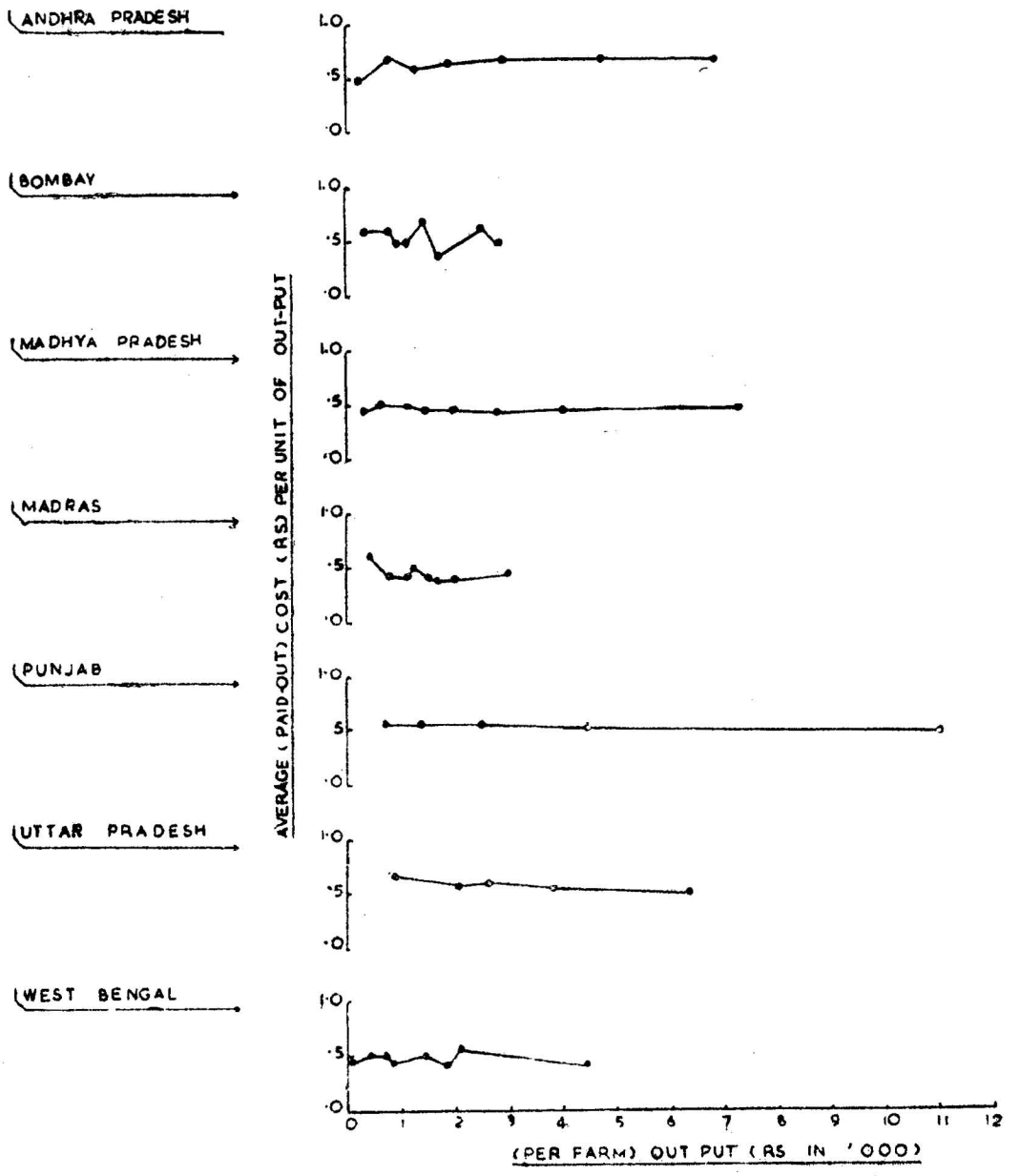
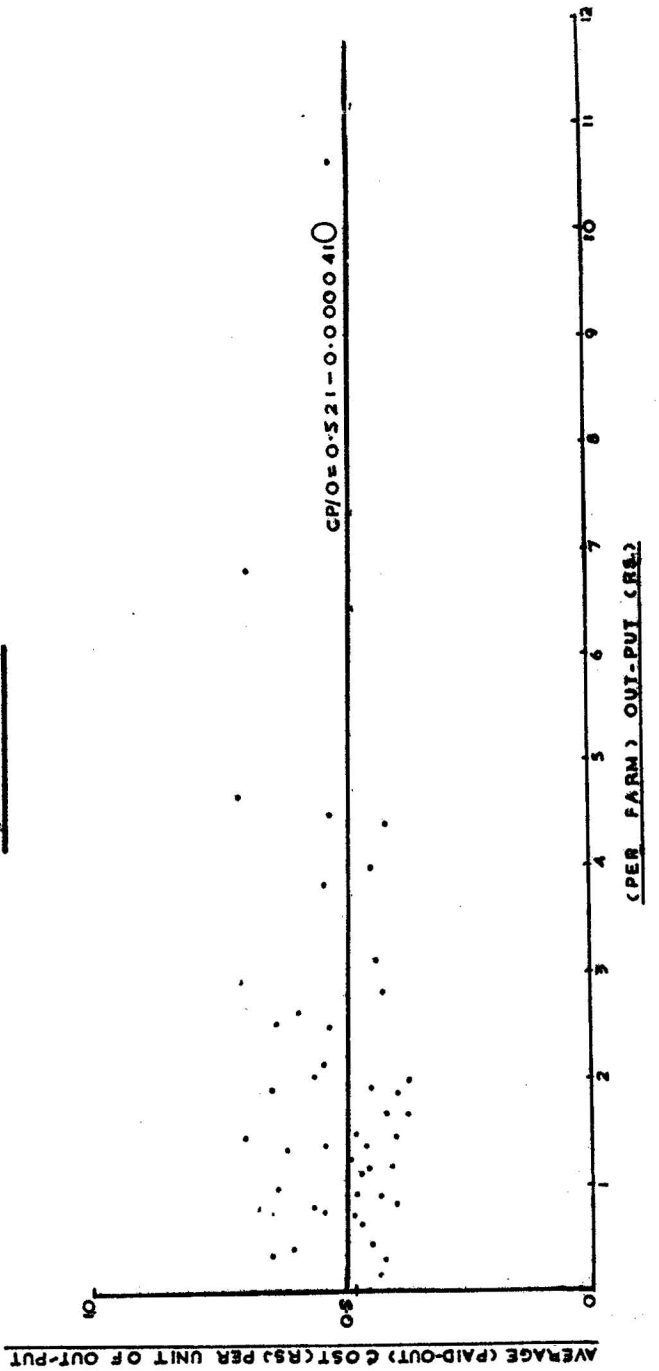


DIAGRAM: 3(a)

AVERAGE PAID-OUT COST PER UNIT OF OUT-PUT BY SIZE OF FARM (OUT-PUT)

'ALL INDIA'



STATEMENT III—EQUATIONS FOR LEAST SQUARE REGRESSION LINES FITTED TO BEHAVIOUR OF AVERAGE (PAID-OUT) COSTS PER UNIT OF RETURNS

State	Regression Coefficient	Standard Error of Regression Coefficient
	A	
Average (Paid-out) Cost per Unit of Output (C_p/O) *and Farm Size in Output* (O)		
Andhra Pradesh	$C_p/O = 0{\cdot}658 - (0{\cdot}0000028)\ O$	0·0027
Bombay	$C_p/O = 0{\cdot}583 - (0{\cdot}0000114)\ O$	0·0017
Madhya Pradesh	$C_p/O = 0{\cdot}466 + (0{\cdot}0000033)\ O$	0·0003
Madras	$C_p/O = 0{\cdot}516 - (0{\cdot}0000396)\ O$	0·0017
Punjab	$C_p/O = 0{\cdot}566 - (0{\cdot}0000063)\ O$	0·0004
Uttar Pradesh	$C_p/O = 0{\cdot}664 - (0{\cdot}0000265)\ O$	0·0027
West Bengal	$C_p/O = 0{\cdot}482 - (0{\cdot}0000038)\ O$	0·0021
	B	
Average (Paid-out) Cost per Unit of Farm Business Income (C_p/Y) *and Farm Business Income* (Y)		
Andhra Pradesh	$C_p/Y = 2{\cdot}112 - (0{\cdot}0001097)\ Y$	0·0200
Bombay	$C_p/Y = 1{\cdot}848 - (0{\cdot}0006665)\ Y$	0·0100
Madhya Pradesh	$C_p/Y = 0{\cdot}854 + (0{\cdot}0003804)\ Y$	0·0002
Madras	$C_p/Y = 1{\cdot}202 - (0{\cdot}0003882)\ Y$	0·0079
Punjab	$C_p/Y = 1{\cdot}292 - (0{\cdot}0000551)\ Y$	0·0018
Uttar Pradesh	$C_p/Y = 1{\cdot}800 - (0{\cdot}0002667)\ Y$	0·0155
West Bengal	$C_p/Y = 0{\cdot}959 - (0{\cdot}0000455)\ Y$	0·0084

As the value of the 'all-India' regression coefficient as well as that of the separate regression coefficients is extremely small and almost amounts to zero, the interpretation of constant returns to scale again seems most plausible.

It is now possible to reconcile the result of this study with that of the previous section. If output per acre, O/A_c is generally constant and paid-out cost per acre, C_p/A_c is also constant as size (acreage) expands, then paid-out cost per unit of output must also be constant. This is so inasmuch as C_p/O is nothing but $C_p/A_c \div O/A_c$.

The similarity in the levels of average (paid-out) cost curves in all States is all the more striking when we note that paid-out cost is the difference between gross output, O and farm business income, Y, and that both O and Y have vastly different levels in different States. (Judged by Statement II, O/A_c remains around 240 in Andhra Pradesh, 40 in Bombay, 70 in Madhya Pradesh, 184 in West Bengal and so on; while Y/A_c fluctuates somewhat around a level of 80 in Andhra, 17 in Bombay, 38 in Madhya Pradesh, 95 in West Bengal, etc.) And yet the difference between O and Y which is C_p emerges to be the same everywhere when related to output.

One of the explanations for the small variation in C_p/O from one size-group to another may be that while small farmers working with family labour have very small hired-labour bill and a relatively large bullock labour and rent

bill in relation to output, large farmers, working largely on own lands have a very small rent payment and small bullock labour charges but a relatively large hired-labour payment to make inasmuch as their family labour does not go very far. Thus as one moves from small to medium-sized and to large farms the wage component of paid-out cost increases, but the rent component and bullock component decreases relative to output, keeping the total C_p approximately constant in relation to output.

Variations in Average (Paid-out) Cost per Unit of Income with Changes in Income

It is possible to modify the concept of efficiency still further and let it stand for average paid-out cost per unit of farm business income, C_p/Y, where the numerator represents what the farmers will minimize and the denominator what they will maximize. C_p/Y worked out in column 4 of Table III can then be measured against size as indicated by Y itself. Such a treatment reveals that, as in the case of C_p/O and O, least square trend lines fitted to the data of C_p/Y and Y have a very small though negative slope for six States out of seven, the regression coefficients in Statement III-B having negligibly small values in all States.

It is clear that whether farm-size is judged by standardized acreage, A_c, or output, O, or farm business income, Y, and whether efficiency is measured by farm business income per standard acre, Y/A_c (or paid-out cost per standard acre, C_p/A_c) or paid-out cost per unit of output, C_p/O, or paid-out cost per unit of income, C_p/Y, the phenomenon of constant efficiency by size or constant returns to scale seems to be the rule, almost everywhere among the areas studied.

V

The Summing Up

It only remains to sum up the generalizations about Indian farming.

1. *If acreage is taken at its (uncorrected) face value*, then as acreage increases, gross output per acre, O/A, decreases.
2. With an increase in (uncorrected) acreage, farm business income per acre, Y/A (which is a reasonable measure of efficiency and signifies returns which farmers ought to maximize), decreases though at a slower rate than O/A.
3. With an increase in (uncorrected) acreage, net profit per acre, P/A, increases and though frequently negative in the smallest farms, rises to positive but small values in all cases.
4. As farm acreage increases, the average quality of the soil generally decreases and this is seen in the decline in land revenue per acre in almost all States.
5. *If acreage is corrected with an index of fertility*, (which can be land revenue per acre itself), gross output per *corrected* acre remains constant as farm-size increases.

6. Farm business income per *corrected* acre generally remains constant with an expansion of farm-size.
7. Net profit per *corrected* acre, negative in a few cases, generally increases with an expansion of farm-size.
8. An alternative study of efficiency and size can be conducted with efficiency measured by average (paid-out) cost per unit of output, C_p/O, and size by output itself. This reveals, in all areas studied, a remarkable constancy of C_p/O as output increases. The impression of constant returns to scale is quite strong.
9. No less remarkable than the absence of a *slope* in the average (paid-out) cost curve is the similarity in the *levels* of C_p/O in all the areas studied. C_p/O varies generally between 40 and 60 per cent, the most common value being 50 per cent.
10. Paid-out cost per unit of income, C_p/Y, also remains constant with an increase in the size of income.
11. Judging by all these results it would appear that the use of simple, uncorrected acreage as a measure of farm-size is apt to create an optical illusion about the behaviour of returns to scale and if proper variables are chosen, there is a strong general tendency towards constant returns to scale in Indian agriculture.