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A STUDY ON MANAGEMENT INPUT IN FARMING

A. S. Kahlon and S. S. Acharya

INTRODUCTION

Throughout the history of farm management thinking and research, it has been found difficult to handle management input. Many farm management workers have observed that with resource mix about the same, some farmers obtain distinctively higher yields than others. Studies in the United States show that conventional inputs do not explain all the increments in output. Management factor explains quite a large amount of these variations.

Farm resources are very much limited in India. Their efficient use depends to a large extent on the management ability of farmers. The measurement of managerial ability represents a synthesis between Agricultural Economics, Sociology, Psychology, and Philosophy. Once a clearer understanding of the decisions which constitute management input is obtained, the way will be opened up for more effective extension work and more accurate interpretation and predictions of the effects of changing economic events on production programme planned by farmers.

Raising management ability or improving the quality of human factor will open up new vistas for our farm population and make possible for them to achieve substantial gains in farm incomes. Raising the quality of the human element is the fundamental problem which needs to be carefully tackled if a long run solution of the problem of under-developed agriculture is to be found.

Important though the management input is, the attempts of agricultural economists to develop suitable measures to quantitatively measure the management input and to evaluate its contribution to farm income have not been a great success. But the role of this factor could not be ignored in the production process. The consequences of omitting this input in production function studies are clearly brought out by Griliches.[1]

The present study is an attempt to identify the management factor and devise criteria to measure this factor. Throughout this study, profit maximization was considered as management goal. It is frequently suggested that profit maximizing models are unrealistic because other goals are also relevant to the decisions of management. To the extent that profits are one of the major goals of the farmers, the results of this study using the traditional profit maximizing assumption are quite meaningful.

A distinction needs to be made between management ability and management input. Management ability may not be used to capacity. It would presumably place an upper limit on the optimum size of business. On the other hand, the management input is only that part of management ability which has actually gone into the production process.

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1. Zvi Griliches, "Specification Bias in Estimates of Production Functions," *Journal of Farm Economics*, Vol. XXXIX, No. 1, February, 1957, pp. 8-20.

In this study management was considered to consist of decision-making and implementing these decisions. Within this framework, management was separated into two distinct levels. The first level is strategic management. The responsibility of the strategic management includes decision-making with respect to purchase or sale of land, location of farm buildings and other long run policies which determine the profit potential of the farm. This concept of management becomes inoperative in the context of peculiar economic and institutional framework prevalent in Indian farming. The second level of management is operational management. Its main objective is to make farming business as profitable as possible within the restrictions of strategic management. This study is primarily concerned with operational management.

Specifically, the objectives of this study are : (*a*) to identify the factors or decisions constituting the management input in bullock-operated crop farms; (*b*) to quantify these factors and construct management index for the selected population of farmers; and (*c*) to study the contribution of management input to the farm income.

The hypothesis used in this study was that with conventional inputs remaining the same, difference in output was distinct which could be explained by a management index representing the component of decision-making part of managers.

MATERIALS AND METHODS

The study was located in Lalton-Khurd village of Ludhiana Development Block which was purposively selected to obtain homogeneous cropping mix and soil types among the farm organizations. The resource composition of all the 52 farm organizations was studied and 18 farmers, who obtained nearly homogeneous resources were interviewed for identifying the management factors. Whereas the resource mix of these farm organizations was quite homogeneous, differences in farm income were conspicuous. These were divided into two sub-groups, one having low incomes and another obtaining higher incomes. Those decisions which contributed to the difference in the two levels of farm income were identified as management factors. Decisions taken by different farmers pertaining to these factors were ranked based on the research findings relating to them. These ranks were converted into scores using Fisher and Yates' table XX^2 which normalises the scores based on ranks. A weighted sum of these scores for each farmer was used as management index. Management index was also calculated for another group of 20 farmers selected on random basis out of the population of same village. There was no homogeneity in the resources of this group. Production function equations were estimated using management index as an independent variable. Two equations of the following model were estimated for each group separately :

$$(1) \quad Y = a\, X_1^{b_1}\, X_2^{b_2}\, X_3^{b_3}\, X_4^{b_4}\,.$$

$$(2) \quad Y = a\, X_1^{b_1}\, X_2^{b_2}\, X_3^{b_3}\, X_4^{b_4}\, X_5^{b_5}\,.$$

2. R. A. Fisher and F. Yates, "Statistical Tables for Biological, Medical and Agricultural Research," Oliver & Boyd, Edinburgh, London, 1938.

Where

Y = Gross value of produce in rupees,

X_1 = Land in standard acres,

X_2 = Labour in man-days of 8 hours each,

X_3 = Operating capital in rupees,

X_4 = Capital investment (present value) in rupees,

X_5 = Management index.

The hypothesis of the study was tested by (*a*) testing the significance of partial regression coefficients of management input; (*b*) testing the significance of the difference between adjusted coefficient of multiple determination of equation (1) and (2); and (*c*) calculating the correlation between residuals of the production function (without incorporating management input) and the management index.

RESULTS AND DISCUSSION

Identification of Management Factors

The first group comprising 18 farm organizations was divided into 6 sub-groups based on their land holdings because some qualitative difference was observed in land operated, although not so important as far as farm decisions were concerned. The frequency distribution is shown in Table I.

TABLE I—LOWER AND UPPER PROFILE FARMERS BY GROUPS

Group No.	Size of holding (acres)	Frequency		
		Lower profile	Upper profile	Total
1.	8.9 — 10.5	3	4	7
2.	7.0 — 7.75	1	3	4
3.	5.5 — 6.5	4	3	7
	Total	8	10	18

Management decisions were confined to maize (corn) and wheat crops because these along with dairy enterprise contributed 86.7 per cent of the gross income of farmers. Dairy was mainly for domestic use.

Out of a total of 46 factors studied (see Appendix), the upper and lower profile farmers indicated a clear-cut distinction with respect to 21 factors which were aggregated in the following ten factors indicating that often the choices are not between the various quantities of resources to use but between methods of production.

Sr. No.	Factors	Weights assigned
1.	Sowing the crops on time	15.0
2.	Use of proper dose of farmyard manure	13.5
3.	Preparation of good seed bed	11.5
4.	Applying fertilizers in proper time	10.0
5.	Irrigating the crops in proper time and recognition of correct critical periods for irrigation	15.0
6.	Proper inter-cultivation of crops	10.0
7.	Adjustments in acreage from year to year	7.0
8.	Adjustments in inputs from year to year	3.0
9.	Selecting least cost methods for shelling maize and threshing wheat	3.0
10.	Adjusting time of sale so as to get higher prices	12.0
	Total	100.00

These weights were assigned on the basis of judgment of the subject matter specialists in this area.

Empirical Findings

The difference in farm income[3] between the upper and lower profile farmers was found to be significant at 0.1 per cent level. The management input was also significantly different between the two profiles at 0.1 per cent level. This indicated that higher management input had significant effect on farm income in this group of farmers. The coefficient of correlation between farm income and management input worked out to be 0.88 which was significant at 0.1 per cent level.

The results of production function analysis are presented in Table II. In all the equations, only the partial regression coefficients for operating capital and management were significant, which indicated that under the average conditions prevailing in the sample, the major determinants of output were the inputs of the operating capital and management. The negative signs of the coefficients of land in equation A_1 and B_1 could be explained by the fact that more extensively the land was used, the less would be the response to additional input of land, which in this sample held good. The capital-land ratio was also very low. Again, labour due to fixity of family labour was being used at such intensive levels where increased inputs of labour did not add much to output. The capital-labour ratio was very low, which affected productivity of additional labour rather adversely.

The negative signs of the coefficients for land and labour turned out positive when management was incorporated as a variable, which indicated the ill-effects of exclusion of this input from the production function analysis.

The simple correlation coefficients for management with land and labour were 0.08 and 0.26 respectively and with operating capital and capital investment were 0.58 and 0.29, which gave the indication that if management were not incorporated in the equation, production elasticities were under-estimated for the factors with which management was not correlated (land and labour) and were over-estimated with those with which it had relatively higher correlation.

3. Net Farm Family Earning Concept was used.

TABLE II—RESULTS OF PRODUCTION FUNCTION ANALYSIS (COBB-DOUGLAS MODEL)

Particulars of equation	Value of constant (a)	Land			Labour			Operating capital			Capital investment			Management input			Sum of production elasticities $\Sigma bi =$
		b_1	E	't'	b_2	E	't'	b_3	E	't'	b_4	E	't'	b_5	E	't'	
I Group																	
Without Management Input (A_1)	229	— .01	0.36	0.03	−1.12	0.82	1.36	0.90	0.25	3.53**	0.52	0.47	1.08	—	—	—	0.29
With Management Input (A_2)	0.19	.022	0.24	0.09	0.43	0.66	0.65	0.65	0.18	2.65**	0.28	0.32	0.86	0.18	0.04	4.22**	1.56
II Group																	
Without Management Input (B_1)	12.72	−0.14	0.35	0.4	0.34	0.38	0.9	0.57	0.26	2.24*	0.01	0.47	0.026	—	—	—	0·78
With Management Input (B_2)	16.31	0.02	0.25	0.07	0.42	0.27	1.53	0.53	0.18	2.93*	−0.16	0.33	0.47	0.17	0.04	4.00**	0.98

** Significant at 1 per cent level. *Significant at 5 per cent level.
Calculations based upto 5 decimal points. b_1 = Partial regression coefficients; E = Standard error; 't' = Value of 't'.

TABLE III—PARTIAL CORRELATION COEFFICIENTS

Equations and variables		Land	Labour	Operating capital	Capital investment	Management input
A_1	Income	−0.007	−0.354	0.699**	0.288	—
	Land	1	0.329	0.328	−0.083	—
	Labour		1	0.110	0.489	—
	Operating capital			1	0.164	—
A_2	Income	0.027	0.186	0.725**	0.242	0.773**
	Land	1	0.266	0.592*	−0.086	−0.040
	Labour		1	−0.116	0.386	−0.469
	Operating capital			1	0.116	−0.417
	Capital investment				1	−0.078
B_1	Income	−0.104	0.224	0.500*	0.007	—
	Land	1	0.661**	0.128	0.311	—
	Labour		1	0.159	−0.282	—
	Operating capital			1	0.674**	—
B_2	Income	0.019	0.380	0.617*	−0.124	−0.738**
	Land	1	0.577*	0.064	0.332	−0.121
	Labour		1	0.001	−0.207	−0.321
	Operating capital			1	0.675**	−0.420
	Capital investment				1	0.176

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

The sum of the production elasticities in all these equations indicated severe decreasing returns to scale with respect to land, labour, operating capital and capital investment ($A_1 = 0.29$, $B_1 = 0.78$) on these farms. Their existence emphasized the importance of management input in farming in this area, granted that no other inputs of importance were omitted from the analysis and that constant returns to scale prevailed relative to all inputs. When management was incorporated, the sum of elasticities ($A_1 = 1.56$, $B_2 = 0.98$) indicated that constant returns to scale (they were not significantly different from unity) prevailed.

A study of partial correlation coefficient (Table III) indicated that operating capital and management input were highly correlated with income. Land and labour had significant correlation in equation B_1, which caused the regression coefficient of land to be negative, although it was not significant. The operating capital and capital investment were also significantly correlated in the second group of farmers which was due to the fact that farmers using pumping sets as source of irrigation had greater proportion of operating capital consisting of fuel and repairs for the engine.

The study showed that management input was not correlated with any of the other conventional inputs. This non-correlation of management input with other conventional inputs biased the productivity estimates for other inputs when this input was excluded from the production function.

The coefficients of multiple correlation (R) were found to be significant at 1 per cent level, which indicated that this model gave a good fit to the data (Table IV). The coefficients of multiple determination (R^2) showed that land, labour, operating capital and capital investment explained for 64.2 per cent and 75.3 per cent of variation in the first and second group of farmers respectively, but these inputs when combined with management explained for 84.6 per cent and 88 per cent of variation respectively. The additional variation in output explained by the management input, *i.e.*, 20.4 per cent and 12.7 per cent was tested and it was found significant at 1 per cent level in both the cases.

TABLE IV—MULTIPLE CORRELATION MEASURES

Equations	R	R^2
A_1	0.801**	0.642
A_2	0.918**	0.846
B_1	0.868**	0.753
B_2	0.94**	0.88

**Significant at 1 per cent level.

The hypothesis of the study was also tested by calculating the correlation coefficient between residuals of the fitted function A_1 and B_1 where management was not included as an input and the index of management input. The value of the coefficient came out to be 0.55 and 0.608 for the first and second group of farmers which were significant at 2 per cent and 1 per cent levels respectively. This indicated that management input could explain the variation in output, which conventional inputs did not.

CONCLUSIONS

The conclusions of the study are :

(1) An index of management, based on the ten factors, identified in this study could largely explain the variation in output.

(2) These ten factors can be quantified by awarding ranks and scores. Suitable weights should be used to aggregate the score.

(3) A very high significant correlation existed between farm income and management input.

(4) The average index of management input was significantly different (at 0.1 per cent level) between high income and low income farmers.

(5) The partial regression coefficient for management input was significant at 0.1 per cent level.

(6) The management input explained for 20.4 per cent and 12.7 per cent of variation in output for the two groups of farmers respectively. The additional variation explained by this input was significant at 1 per cent level.

(7) The change in the signs and magnitude of partial regression coefficients of other conventional inputs by the inclusion of the management input in the equation indicated that resource productivity studies were biased, if management input was not incorporated in the equation. The productivities of those factors with which management was not correlated were under-estimated, while of those with which it was correlated were over-estimated.

(8) The sum of production elasticities indicated that returns to scale were under-estimated if management was excluded from the production function analysis.

(9) Management input did not have significant correlation (partial) with any of the conventional inputs.

(10) The correlation coefficient between residuals of the fitted function (without incorporating management input) and management input worked out to be 0.55 and 0.61 in the two groups which were significant at 2 per cent and 1 per cent levels respectively.

(11) It was not found possible to reject the basic hypothesis of this study.

Limitations of the Study and Suggestions for Future Research

This study focussed its attention on the operational management only. Inclusion of strategic management in measurement problem and exploring the per-

sonal characteristics of farmers influencing the operational decisions will necessitate an inter-disciplinary approach.

Throughout this study, profit maximization was the assumed management goal which was based on studies conducted in U.S.A. Studies of this nature in India are pre-requisites for this type of investigation. Experience during this research had shown that the cost accounting method would have been better suited for this type of study, because then the researcher could watch all the operations and decisions as dynamic phenomena throughout the year.

The factors selected in this study may not apply to other areas where crop mix or type of farming differs. It will be necessary to standardize the factors which can be applied to any farming area for measuring management input on different farms. This will first need this type of studies to be conducted for different farming systems and then devising a common criteria to measure this factor. Similarly, separate study will be needed for mechanized farms, because decision making on this type of farms will be different from those of bullock-operated farms.

The nature of responses to management at its various levels is unknown. Therefore, different mathematical equations need to be tried to find the most suitable model which can explain management returns. Finally, the results of production function study were limited by the sample size.

APPENDIX

List of the Factors or Decisions Studied to Identify the Management Input

(1) Selection of crop rotations;
(2) Method of sowing;
(3) Time of sowing;
(4) Adjustments made in other practices with time of sowing;
(5) Depth of seeding;
(6) Adjustments made in depth of seeding with moisture contents of the soil;
(7) Seed treatment;
(8) Effect of seed treatment expected;
(9) Dose of farmyard manure used in maize;
(10) Dose of farmyard manure used in wheat;
(11) Dose of N. fertilizer used in maize;
(12) Dose of N. fertilizer used in wheat;
(13) Dose of P. fertilizer used in maize;
(14) Dose of P. fertilizer used in wheat;
(15) Dose of K. fertilizer used in maize;
(16) Dose of K. fertilizer used in wheat;
(17) Rationale of using these doses (whether based on soil tests, recommended by extension agency, results of your own trial or because used by neighbours);
(18) Method of fertilizer application in maize;
(19) Method of fertilizer application in wheat;
(20) Timing of fertilizer application in maize;
(21) Timing of fertilizer application in wheat;
(22) Number of irrigations applied in maize;
(23) Number of irrigations applied in wheat;
(24) Intensity of each irrigation;
(25) Recognition of critical periods for irrigation in maize;
(26) Recognition of critical periods for irrigation in wheat;
(27) Extent to which irrigation could be applied in critical periods;
(28) Reasons for failure of irrigation in critical periods;
(29) Number of weed control operation practices;
(30) Knowledge of insect pests and diseases affecting crops;
(31) Extent to which prevention measures were used;
(32) Extent to which control measures were used;

(33) Selection of most economic post-harvest operation;
(34) Knowledge about various markets and *mandies* in the area;
(35) Selection of market for selling the produce;
(36) Information of prices in various markets;
(37) How the credit-borrowing was analysed;
(38) Knowledge of various credit agencies and their interest rates;
(39) Ability to analyse the choice between tractor and bullocks as source of power;
(40) Choice of the factors to be considered for above analysis;
(41) Ability to make decision between custom-hiring or owning a particular machine;
(42) Extent to which incentives are given to the hired labour;
(43) Adjustments made in area under different crops from year to year;
(44) Adjustments made in inputs for different crops from year to year;
(45) Number of ploughing done in maize;
(46) Number of ploughing done in wheat.