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CONTRIBUTION OF EXTENSION SERVICES IN AGRICULTURAL PRODUCTION

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It is imperative to increase agricultural production in India through the introduction of better technology which should provide training and on the spot guidance to the farmers. It is also equally important to persuade the farmers to adopt improved agricultural technology to increase agricultural production. Hence, during the past few decades, considerable interest has been focused on the need to establish effective systems of agricultural extension in India. The major role of extension organizations is to communicate the latest research findings to the farming community to optimize the use of land, water, fertilizers, labour, etc., through the introduction of the latest technology. The success of the extension programme needs the services of well qualified, properly trained and highly motivated extension staff.

Considerable emphasis has been laid on extension services in the successive Five-Year Plans and it is relatively high in the Sixth Five-Year Plan. Over the past 30 years different systems and approaches in agriculture extension have been experimented. It is necessary to examine the contribution of extension services to the increased agricultural production. Thus, an attempt is made in this paper (1) to examine (*a*) the level of significance of extension services, and (*b*) the marginal contribution of extension services to the increased agricultural production; and (2) to compare the marginal contribution of extension services in the high productivity areas with that in the low productivity areas.

As the required information on extension services is not available at the national level, the scope of this paper is limited to Gujarat State. To study the above objectives, the data on the expenditure on extension services, the gross agricultural production in rupees (at 1960-61 prices), gross cropped area, gross area irrigated and the quantity of fertilizers (in NPK) were collected from different secondary sources for all the 19 districts of Gujarat State. The above information is collected for the agricultural year 1976-77.

METHODOLOGY

To examine the importance of extension services and its marginal contribution to the increased agricultural production in Gujarat, the expenditure incurred on extension services is used as one of the important independent variables in the production function. The specific model of the production function in mathematical term is the following:

$$\text{Log}^{Y} = \text{Log}^{A} + b_1 \text{Log}^{L} + b_2 \text{Log}^{I} + b_3 \text{Log}^{F} + b_4 \text{Log}^{E} + U$$

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where

Y = total agricultural production in rupees,
L = gross cropped area in hectares,
I = gross area irrigated in hectares,
F = total consumption of fertilizers (NPK) in tonnes,
E = total expenditure incurred on extension services in rupees,
U = error term.
A, b_1, b_2, b_3 and b_4 are constants.

To study the marginal contribution of extension services in the high productivity areas and in the low productivity areas, all the districts of the Gujarat State were arranged in descending order according to their gross output per hectare of gross cropped area in the agricultural year 1976-77. The gross output per hectare of gross cropped area was computed by dividing the total agricultural output in rupees with the gross cropped area for the same year. Then the first half of the districts was classified as relatively high productivity areas and the second half of the districts as relatively low productivity areas. A double-log regression function was fitted using the above variables with the help of cross-section data for the 19 districts of the Gujarat State separately for the high productivity areas and for the low productivity areas for the reference year 1976-77. The data used in the model are given in the Appendix.

Finally, the marginal contribution of extension services is estimated as below:

$$MCE = (b).\frac{(Y)}{(E)}$$

where

MCE = the marginal contribution of expenditure on extension services,
b = the elasticity of agricultural output with respect to the expenditure on extension services,
Y = total agricultural output in rupees,
E = total expenditure on extension services.

The total agricultural output and the expenditure on extension services vary from district to district. Thus, MCE is variable. Hence, the unique value of MCE has been computed by using the arithmetic mean values of Y and E.

RESULTS OF THE REGRESSION ANALYSIS

The empirical results of the regression equation for all the districts (for Gujarat) are presented below.

$$\underset{}{\text{Log}^Y} = \underset{(60.01^*)}{6.804} + \underset{(1.18)}{.021\ \text{Log}^E} + \underset{(31.72^*)}{.807\ \text{Log}^L} + \underset{(7.72^*)}{.159\ \text{Log}^I} - \underset{(1.02)}{.018\ \text{Log}^F}$$

Number of observations = 19.

$R^2 = .998$

The empirical results of the regresssion equation for the ten high productivity districts are as follows:

$$\text{Log}^{Y} = \underset{(627.38^*)}{6.83} + \underset{(2.28^*)}{.028\ \text{Log}^{E}} + \underset{(85.06^*)}{.669\ \text{Log}^{L}} + \underset{(39.75^*)}{.336\ \text{Log}^{I}} - \underset{(2.82^*)}{.006\ \text{Log}^{F}}$$

Number of observations = 10.

$R^2 = 1.00$

The empirical results of the regression equation for the nine low productivity districts are as follows:

$$\text{Log}^{Y} = \underset{(56.22^*)}{6.957} - \underset{(-.06)}{.0004\ \text{Log}^{E}} + \underset{(30.16^*)}{.793\ \text{Log}^{L}} + \underset{(6.60^*)}{.129\ \text{Log}^{I}} + \underset{(.36)}{.005\ \text{Log}^{F}}$$

Number of observations = 9.

$R^2 = .99$

Figures in parentheses indicate the t-values of the coefficients.
* Significant at 5 per cent level.

The coefficients of determinations (R^2) for Gujarat, for the high productivity areas, and for the low productivity areas indicate that more or less 100 per cent variations in agricultural production are explained by these independent variables.

In all the three production functions the gross cropped area (L) and the gross irrigated area (I) turned out to be significant variables. The extension services and fertilizers turned out to be significant variables only in the function for the high productivity areas.

The elasticity of agricultural production with respect to the expenditure on extension for the high productivity areas (.028) was higher than that for Gujarat (.021). But it was negative and negligible (−.0004) for the low productivity areas. Its value reveals that a one per cent increase in the expenditure on extension will result in an increase of agricultural production by .021 per cent and .028 per cent for Gujarat and high productivity areas respectively. But for the low productivity areas, its negative value indicates that a one per cent increase in the expenditure on extension will reduce agricultural production by .0004 per cent.

The b value of gross cropped area indicates that due to a one per cent increase in the gross cropped area, agricultural production could be increased by .807 per cent in Gujarat, by .669 per cent in the high productivity areas and by .793 per cent in the low productivity areas. Similarly, a one per cent increase in the gross irrigated area would be accompanied by .159 per cent, .336 per cent and .129 per cent increase in agricultural production in Gujarat, in the high productivity areas and in the low productivity areas, respectively. A decrease of one per cent in the use of fertilizers will result in an increase in agricultural production by .018 per cent in Gujarat and by .006 per cent in the high productivity area. But in the low productivity areas, a one per cent increase in the use of fertilizers will result in an increase in agricultural production by .005 per cent.

The results of the regression analysis indicate that to increase agricultural production in Gujarat and in the high productivity areas, the most important variable is gross cropped area, followed by gross irrigated area and expenditure

on extension services. The results of the regression equation for the low productivity areas show that the expenditure on extension has negative impact on agricultural production.

Marginal Contribution of Extension Services

To examine and compare the marginal contribution of expenditure on extension services in the high productivity areas with that in the low productivity areas, the data on marginal contribution of the inputs used in the production function for Gujarat, high productivity areas and low productivity areas are presented in Table I, II and III, respectively. As the objective of this paper is to examine the marginal contribution of only extension services, the marginal contribution of other inputs is presented in the tables, but not taken up for discussion.

In Gujarat, the marginal contribution of extension services (MCE) was found to be Re. 0.90 only. Hence, the additional expenditure on extension services would result in a 10 per cent loss, indicating the need to reduce the expenditure on extension services or to change the present organization of extension services to make them more effective and to shift the production curve upward.

In the high productivity areas, the MCE was Rs. 1.19. Hence, the marginal profitability of extension services was about Re. 0.19 in the high productivity areas. Thus, the extension services have contributed more than the cost incurred on them. By increasing the expenditure on extension services by one rupee, agricultural production could be increased by about Rs. 1.19 in the high productivity areas.

The MCE was found to be negative (Re. −0.02) in the low productivity areas. Hence, the net marginal contribution of extension services was Rs. −1.02. An increase in the expenditure on extension services by one rupee would result in a reduction in agricultural production by Re. .02.

The MCE was found to be positive but not profitable in Gujarat, while in the high productivity areas, it was found profitable. But it was negative in the low productivity areas. Thus it was found to be higher in the high productivity areas than in the low productivity areas. This might be due to the higher rate of adoption of new technology by the farmers in the high productivity areas as compared to those in the low productivity areas.

CONCLUSIONS

The results of the regression analysis indicate that the extension investment has played a significant role in increasing agricultural production only in the high productivity areas, while in the low productivity areas, it has played an insignificant and negative role.

The marginal contribution of extension investments was found greater than one in the high productivity areas, while it was less than zero in the low productivity areas. Hence, the marginal profitability of extension investments is positive in the high productivity areas and negative in the low productivity areas.

TABLE I—MARGINAL CONTRIBUTION OF INPUTS IN GUJARAT

Variable	Arithmetic mean	Coefficient	Marginal contribution (Rs.)
Agricultural production (Rs.)	24,84,21,050	6·804	—
Expenditure on extension services (Rs.)	42,838	0·021	0·90
Gross cropped area (hectares)	4,65,553	0·807	375·70
Gross irrigated area (hectares)	80,789	0·159	12·85
Fertilizers—NPK (kg.)	10,601	—0·018	—0·19

TABLE II—MARGINAL CONTRIBUTION OF INPUTS IN HIGH PRODUCTIVITY AREAS

Variable	Arithmetic mean	Coefficient	Marginal contribution (Rs.)
Agricultural production (Rs.)	26,02,60,800	6·83	—
Expenditure on extension services (Rs.)	42,377	0·028	1·19
Gross cropped area (hectares)	4,46,210	0·669	298·98
Gross irrigated area (hectares)	1,05,020	0·336	35·29
Fertilizers—NPK (kg.)	10,813	—0·006	—0·07

TABLE III—MARGINAL CONTRIBUTION OF INPUTS IN LOW PRODUCTIVITY AREAS

Variable	Arithmetic mean	Coefficient	Marginal contribution (Rs.)
Agricultural production (Rs.)	23,52,65,770	6·957	—
Expenditure on extension services (Rs.)	43,350	—0·0004	—0·02
Gross cropped area (hectares)	4,86,267	0·793	385·61
Gross irrigated area (hectares)	53,867	0·129	6·95
Fertilizers—NPK (kg.)	10,365	0·005	0·05

APPENDIX

THE DATA FOR PRODUCTION FUNCTIONS

(reference year 1976-77)

District	Per hectare agricultural production (Rs.) at 1960-61 prices	Agricultural production (thousand rupees) at 1960-61 prices	Extension expenditure (thousand rupees)	Gross cropped area (thousand hectares)	Gross area irrigated (thousand hectares)	Consumption of fertilizers—NPK (thousand tonnes)
A. High productivity districts						
1. Mehsana	644·74	462,088	21·571	716·7	224·7	10·805
2. Gandhinagar ..	628·02	30,208	1·140	48·1	14·3	1·113
3. Kaira	616·81	337,952	36·467	547·9	152·7	27·568
4. Surat	585·38	186,912	66·422	319·3	76·3	16·670
5. Bulsar	575·29	103,840	52·829	180·5	41·0	6·646
6. Baroda	572·81	273,288	86·040	477·1	106·2	16·356
7. Junagadh	567·72	309,632	18·070	545·4	118·0	13·878
8. Banaskantha ..	565·40	393,176	8·221	695·4	148·6	4·815
9. Ahmedabad ..	539·50	286,032	96·785	530·2	95·9	8·254
10. Kutch	537·28	219,480	36·223	408·5	72·6	2·020
B. Low productivity districts						
1. Broach	531·35	181,720	65·364	342·0	58·6	4·318
2. Sabarkantha ..	515·04	241,192	64·957	468·3	70·1	15·886
3. Rajkot	507·21	378,072	7·489	745·4	104·7	22·677
4. Bhavnagar	504·34	278,952	115·181	553·1	75·5	20·663
5. Jamnagar	484·68	283,672	20·106	587·7	64·2	9·891
6. Amreli	475·48	232,224	5·779	488·4	49·1	13·284
7. Surendranagar ..	444·58	277,064	16·606	623·2	38·1	2·550
8. Panch Mahals ..	431·99	230,336	76·190	533·2	24·3	3·992
9. Dangs	403·42	14,660	18·478	35·1	0·2	0·027

Source: 1. The data on expenditure on extension services, gross irrigated area and gross cropped area were collected from the Office of the Directorate of Agriculture, Gujarat State, Ahmedabad.

2. The data on agricultural production were collected from the Office of the Bureau of Economics and Statistics, Gandhinagar (Gujarat State).

3. The data on consumption of fertilizers were collected from Fertiliser Statistics, 1978-79, Fertiliser Association of India, New Delhi.