GAU Res. J. 1994, 19 (2) : 102-107

Returns to Investment in Agricultural Research in Gujarat A Preliminary Investigation

P. K. Singh and V. K. Gondalia

Department of Agricultural Economics, B. A. College of Agriculture,
GAU, Anand Campus, Anand - 388 110 (India)

ABSTRACT

Research expenditure is public expenditure therefore, it is important for planners and policy makers to look for the estimates of returns from such investment. The analysis showed that the investment in agricultural research in the State has grown at an annual rate of 11.96 per cent and gave a maximum return after a time lag of four years. The average returns to one rupee investment were over Rs. 38.

(Received on 12th Aug. 1993)

INTRODUCTION

Agricultutal sector constitutes the most strategic component of the economy. The agricultural research plays an essential role in improving production of crops and livestock. As the agricultural research system has expanded, research productivity and research resource allocation have become issues of prime importance (Bal and Kahlon, 1977). In Gujarat State the expenditure on agricultural research has increased over time but not much is known about the contribution of research to agriculture and the State economy. In this light, therefore, an attempt has beeen made here to analyse the role of agricultural research in the State. Specifically, following are the objectives of the study :

1. to estimate the time lag between a particular investment in agricultural research and its returns in Gujarat.
2. to estimate the rate of growth of returns and investment in agricultural research in the State and,
3. to estimate the returns to the investment in agricultural research in Gujarat.

MATERIALS AND METHODS

For the purpose of this investigation time series data from 1972-73 to 1987-88 have been used. To measure the returns to investment in agricultural research, the gross domestic product of Gujarat State from agriculture only (GDP(agri.)) was taken as a proxy to returns.

the output variable (Y_t). Thus GDP (agri) is the difference between the GDP (primary sector) and the GDP from forestry, logging, mines, fishing, etc. The expenditure made on agricultural research by Gujarat Agricultural University (GAU) under the plan schemes, non-plan schemes and the schemes financed by ICAR and other agencies was taken as input variable (I_t). These input and output data were then deflated by the wholesale price index (1970=100) to eliminate the effect of price changes.

Any investment in research does not yield its returns in the same year in which it is made. Therefore, the time lag between an investment on research and its returns was estimated. For working out the time lag the correlation coefficients between Y_t and I_{t-k} for different values of k (k = 0, 1, 2,....., 16 years) were computed. The correlation coefficients for different values of k were then adjusted for the degrees of freedom.

Adjustment for past investment

There is need to adjust the Y_t for the past investment i.e., I_{t-k}. For this purpose data on Y_t prior to the formation of GAU i.e., 1972-73-k were also taken and the growth rate of Y_t was computed for this peroid using exponential function of the type $Y = ab^x$, were Y = GDP, X = time period. Thus, growth rate in past returns i.e., 1972-73=Y_0 served as the base for the study period 1973-74 onwards. Similarly the rate of growth in returns from 1973-74 onwards was also worked out i.e., returns in 1973-74-Y_1. The adjustment factor "P" for the past investment was worked out as under —

$$P = \frac{Y_1 - Y_0}{Y_1}$$

This constant multiplier (P) of the returns gives the GDP value adjusted for the effect of past investment ($y'_t = P\ Y_t$).

Basic model for allocating returns to investment

If k denotes the time lag between an investment and its returns then the functional relationship of adjusted output (y'_t) with the previous investment can be written as $Y'_t = f(I_{t-k}, Y'_{t-1}, T)$.

Where, I_{t-k} = investment in agricultural research for the year t-k,

Y'_{t-1} = lagged adjusted returns,

T = time trend.

Linear, log-linear and quadratic equations were fitted to estimate the parameters.

RESULTS AND DISCUSSION

As explained earlier in this study the GDP from agriculture was estimated and considered as returns or output (Y_t). In Table 1, the state GDP from primary sector, GDP (agric.) both at current and constant prices and the investment in agricultural research are given. While analysing the data it was observed that the begining year and the last three years of the series, i.e., 1972-73 and 1985-86 through 1987-88 respectively were unusual years. Hence, these years were dropped from the further analysis. Thus, the time series from 1973-74 to 1984-85 only was considered for analysis and interpretation of results.

TABLE 1

GDP and investment on agricultural research-Gujarat State.

(Rs. crore)

Years	GDP primary sector at current price	GDP-only agriculture		Investment Constant price (1970=100)
		Current price	Constant price (1970=100)	
1972-73	775	730.83	628.94	0.4596
1973-74	1473	1418.34	1015.27	1.0193
1974-75	1014	929.49	531.44	0.9330
1975-76	1518	1413.14	816.84	1.0145
1976-77	1771	1658.49	939.12	1.2421
1977-78	1886	1777.91	956.89	1.5834
1978-79	1897	1747.81	940.69	1.7920
1979-80	2178	2038.62	936.86	2.0026
1980-81	2496	2354.75	915.18	2.0127
1981-82	3305	2981.95	1060.06	1.8818
1982-83	3071	2673.33	925.99	2.6648
1983-84	3768	3308.62	1047.03	2.8873
1984-85	3990	3508.84	1036.89	3.1735

Compound growth rates

Compound growth rates (r) of Y_t and I_t were worked out to know the behaviour of each variable individually. These are presented in Table 2. The table reveals that during 1973-74 to 1984-85 the Y_t increased at a rate of 2.72

TABLE 2

Compound growth rates (r) of Y_t, I_t. equation : $Y = ab^X$.

Variable	Coefficient		R^2	(r)
	a	b		
Y_t (1969-70 to 1972-73)	102332.9	0.923359+	0.2193	-7.664
Y_t (1973-74 to 1984-85)	76769.86	1.027219**	0.2721	2.7219
I_t (1973-74 to 1984-85)	82.06478	1.119675**	0.9457	11.9675

** = Significant at 10% level of probability.
+ = Significant at 20% level of probability.
r = Compound growth rate (% per annum).

per cent per annum. As against this the investment in agricultural research grew at an annual rate of 11.96 per cent. The growth of GDP (agri.) for the period 1969-70 to 1972-73 showed a negative trend and the rate of decline was 7.66 per cent per year.

TABLE 3

Correlation coefficients between Y_t and I_{t-k}.

Variables	*Correlation coefficients*	*Corr coeffi adjusted to degree of freedom*	
Y_t, I_t	0..5433**	0.4740	
Y_t, I_{t-1}	0.6444*	0.5418	
Y_t, I_{t-2}	0.6222**	0.5573	
Y_t, I_{t-3}	0.5321	0.4250	
Y_t, I_{t-4}	0.64996**	0.57117	Selected
Y_t, I_{t-5}	0.6014	0.4837	
Y_t, I_{t-6}	0.5467	0.3516	
Y_t, I_{t-7}	0.3839	0.3698	

* Significant at 5% level of significance.
** Significant at 10% level of significance.

Interrelationship and computation of time lag

Correlation coefficients between return and investment, which have been depicted in Table 3 tell the degree of association between two variables. Direct correlation between Y_t and I_t at 0.5433 was positive and significant. To know the full realisation of returns of an investment in research the lagged correlation coefficients were worked out for different time lag i.e., t-1, t- 2, ... t-7. As seen from the table 1st, 2nd and 4th lags were statistically significant. These lagged correlation coefficients were then adjusted for the degree of freedom. The highest adjusted correlation coefficient (0.5711) was observed for fourth year and same was selected for the analysis. It implied that in the State any investment made in agricultural research gave maximum returns after a time lag of four years. The impact of investment was visible in 5th, 6th and 7th years too but was insignificant.

Adjustment of returns for past investment

In order to estimate the returns to I_{t-4}, the Y_t was adjusted for the effects of past investment and for general trend in the use of factors of production. For this purpose the proportion (P) of Y_t which accounts for I_{t-4} over the period of study was studied.

The growth rate of Y_t was worked out for periods (1) 1969-70 to 1972-73 and (2) 1973-74 to 1984-85. The estimated returns for the year 1972-73 i.e., Y_o served as the base for the study. Similarly, from the growth rate of returns for the second period the returns for 1973-74 were estimated and denoted as Y_1. Using the procedure explained in methodology the proportion (P=0.05671) was worked out. Assuming that a constant proportion of Y_t is due to I_{t-4} the values of returns adjusted to past investment (Y'_t) were derived (Table 4).

Relationship between returns and investment in research

The GDP (agric) of the State which has been adjusted for past investment (Y'_t) still includes the effects of general trend in the use of factors of production on returns. That means the return will change even if there is no investment in research. Therefore, past returns (Y_{t-1}) and time trend (T) together with lagged investment (I_{t-4}) were taken as explanatory variables

TABLE 4

GDP (agri) adjusted for past investment.

(Rs. lakhs)

Sr. No.	Year	GDP (agri) (Y_t) at constant price (1970=100)	GDP (agri) adjusted to past investment (Y'_t)
1.	1973-74	101527.56	5757.63
2.	1974-75	53144.08	3013.80
3.	1975-76	81684.39	4632.32
4.	1976-77	93912.23	5325.76
5.	1977-78	95689.45	5426.55
6.	1978-79	94069.43	5334.68
7.	1979-80	93686.58	5312.97
8.	1980-81	91517.68	5189.97
9.	1981-82	106006.04	6011.60
10.	1982-83	92598.89	5251.28
11.	1983-84	104703.16	5937.72
12.	1984-85	103689.13	5880.21

to estimate the effect on Y'_t. For the regression analysis linear, log linear and quadratic equations were fitted with different combinations of explanatory varibles. However, the linear equation with Y'_{t-1} and I_{t-4} was selected as it gave the best fit in terms of R^2 and the number of significant coefficients. The estimated parameters of the chosen equation are as follows :

$$Y'_t = 7845.2853 - 0.6010^{**} \quad Y'_{t-1} + 6.8101^{*} \; I_{t-4}$$

$$R^2 = 0.6695$$

Note : *Significant at 5% level of probability
** Significant at 20% level of probability

The estimated returns to investment in agricultural research are displayed in Table 5. Average returns of Rs. 38.23 to one rupee investment were encouraging. It was also observed that the returns per rupee of investment have shown a declining trend over the period of study.

TABLE 5

Returns to investment on agricultural research.

(Rs. lakhs)

Year	GDP (agri) adj. to past investment (Y'_t)	Estimated returns (Y'_t)	Investment on research for time lag (I_{t-4})	Returns per rupee of investment
1977-78	5426.55	5249.67	101.93	51.50
1978-79	5334.68	5190.91	93.30	55.63
1979-80	5312.97	5246.41	101.45	51.71
1980-81	5189.97	5401.41	124.21	43.48
1981-82	6011.60	5633.83	158.34	35.58
1982-83	5251.28	5775.89	179.20	32.23
1983-84	5937.72	5919.31	200.26	29.44
1984-85	5880.21	5926.19	201.27	29.44
Average	5543.12	5542.95	144.99	38.23

From the results it is clear that the agricultural research has played crucial role in agricultural production and at the overall level it yielded over 38 times more returns than the investment made in it. Further the trend analysis of the productivity of bajra, cotton and groundnut, three most important crops of the State, revealed that the regression coefficients of time variable at 49.25, 7.60 and 0.404 respectively were positive and significant. As per the growth rate analysis the productivity of these crops in the State has been increasing at a simple rate of growth of 6.87, 4.25 and 3.30 per cent respectively. The higher average return due to investment in research also indicate that there has been underinvestment in research in the State, more so during the earlier years. However, it is advised that the results of this analysis must be cautiously observed as there is scope for further improvement in form of quality of data on research expenditure, specification of the form of variables and relationship. While, collecting data on research expenditure, many inconsistencies and inadequacies were observed. The present system of classification of expenditure in budget is irrelevant from the view point of such an investigation. In the allocation of fund for research there should be more meaningful classification of expenditure.

REFERENCES

Bal, H. K. and Kahlon, A. S. (1977). Returns from investment on Agricultural Research : Methodological Issues on Measurement of Returns to Investment in Agricultural Research, IJAE, XXXII (3), pp 181-192.

Vashist, G. D., Sharma, N. L., Kaistha, B. L. and Moorti, T. V. (1989). Contribution of Agricultural Research & Development to the Agricultural Production in Himachal Pradesh, Dept. of Ag. Econ., Himachal Pradesh Krishi Vishva Vidyalaya, Palampur.