Vol XVII
No. 3

ISSN 0019-5014

JULY-
SEPTEMBER
1962

INDIAN JOURNAL OF AGRICULTURAL ECONOMICS

INDIAN SOCIETY OF
AGRICULTURAL ECONOMICS,
BOMBAY

NOTES

LAND VALUE AS MEASURE OF PRIMARY IRRIGATION BENEFIT IN TRIBENI CANAL[1]

The main aim of this note is to identify the determinant of increasing land value in an area where irrigation is newly introduced. This study tests the hypothesis that increase in land value is due to irrigation water facilities.

Brief History of the Canal

The year 1896 was the year of crop failure all over the province of Bengal. The spread of famine compelled the then ruling power to launch a canal irrigation system in the north of Champaran district. The government took immediate action and the actual execution of the canal was started in the year 1903 as a famine relief measure. The first 31 miles of the canal was completed and irrigation started in 1910 though the project was finally completed in 1914. Since then Champaran district is utilizing the canal water and the provision of water has ushered in a new era of crop pattern and land utilization in the canal area of the district. As a matter of fact, it was the maturity of the canal and the experience gained by the farm people during last 50 years that led the Planning Commission of India to select this particular canal for fact-finding study.

Objective of the Survey

One of the most difficult problems in irrigation projects is the identification of the degree and extent of utilization of water facilities by the rural people for different agricultural practices. Since water facilities involve a large sum of public money, this caught the attention of the public agencies and the planners. It has generally been observed that a very large proportion of the water facilities are not utilized by the rural people. This certainly leads to a great deal of wastage of public money and other allied productive resources. Taking into consideration these problems, the Research Programmes Committee of the Planning Commission intended to investigate the degree and extent of irrigation facilities utilized by the rural people in the Tribeni Canal area and the magnitude of costs and benefits involved in the said project. On the basis of this enquiry and the informations obtained, the aim of the planners is to ascertain how effectively proposed water projects may be expected to use economic resource. The necessary conditions for optimum use of resource include[2] : (1) meeting an existing or potential demand; (2) being designed to maximize net benefits; (3) determining the least costly of alternative means; and (4) development of projects in the order of their relative desirability.

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1. Tribeni Canal is situated in northern Champaran district in Bihar on Indo-Nepal border. It was one of the five projects selected by the Research Programmes Committee for intensive measurement of direct and indirect benefits of irrigation. The Final Report was submitted to the Research Programmes Committee in August, 1960.

2. J. F. Timmons and M. M. Regan, "Current Concepts and Practices in Benefit-Cost Analysis of Natural Resource Developments," Benefit-Cost Analysis, Report No. 3 (pp. 1-5), Paper presented at the meeting of the American Association for the Advancement of Science, Berkeley, California.

In other words, the purpose of project analysis is to determine the type and size of projects that will yield maximum net benefits. This involves selecting the most advantageous project or combination of projects from among alternative types that are appropriate in scale.

Data

Sampling design was a kind of multi-stage area sample. Ten per cent of the villages irrigated by the canal including the extensive canal[3] and an equal number of non-irrigated villages to be identified as control villages were selected randomly. Then out of the total households in the sample villages, only 20 per cent was selected for intensive survey. The farm business survey covered 1,177 households of which 743 households were surveyed in the project area[4] and 434 in the control area.

A detailed survey questionnaire was supplied by the Research Programmes Committee, though some modifications were made by the Director of the project. The unit of observation was considered to be farm household and the method of survey as personal interview.

The year of enquiry was crop year 1959-60.

Empirical Model

From the stand-point of methodology, we are using a combination of two methods. We compare the agro-economic structure of an area based on an intensive irrigation development with another area not having such an irrigation base. This involves, firstly, the case study approach. Secondly, the idea of comparing two areas is very similar to, if not identical with, the method of using matched samples. That is, we will compare two areas which are as nearly identical as possible with the exception of the existence of irrigation in one area.

Our general assumptions are as follows : (*a*) The two samples are from the same population in regard to variance, 6^2; (*b*) the two samples are independent; (*c*) the project and control area chosen for survey have almost the same economic characteristics, such as soil, climate, rainfall, and sociological features; (*d*) cultivators in the two selected areas are exposed to the market and make rational decision in the allocation of resources.

This study attempts to test the following two null hypotheses.

Null hypotheses : $\mu_1=\mu_2$; $\mu_1-\mu_2=0$

(1) There is no significant difference in the average land value per acre between the project and control area;

(2) There is no significant difference in the average farm income per acre between the project and control area.

3. The commanded area of the old Tribeni Canal is about 427 sq. miles, an extension of 32 miles was completed during 1957-58.

4. Project area is considered to be area of irrigation, whereas control area is classified as non-irrigated area.

Data collected from the enquiry are presented in Tables I and II.

TABLE I—AVERAGE LAND VALUE PER ACRE BY SELECTED SIZE GROUPS OF FARMS BETWEEN THE PROJECT AREA AND THE CONTROL AREA

Size Groups (acre)	Project Area	Control Area
	Land Value per Acre (In Rs.)	Land Value per Acre (In Rs.)
0—1	2,350.00	1,200.00
1—2	2,231.50	1,150.00
2—3	2,300.00	1,196.50
3—4	2,110.75	1,141.11
4—5	2,590.60	1,103.41
5—10	2,400.00	1,175.02
10—15	2,125.35	1,100.25
15—25	2,212.50	1,124.00
25—50	2,100.30	1,098.75
50 and over	2,312.00	1,075.03
Total	22,733.00	11,364.07

Source : Farm Business Table No. 44, 'Evaluation of Benefits of Irrigation (Tribeni Canal),' p. 293, Report submitted to the Research Programmes Committee, Planning Commission.

TABLE II—AVERAGE FARM INCOME PER ACRE BY SELECTED SIZE GROUPS OF FARMS BETWEEN THE PROJECT AND THE CONTROL AREA

Size Groups (acre)	Project Area	Control Area
	Farm Income per Acre (In Rs.)	Farm Income per Acre (In Rs.)
0—1	766.88	659.00
1—2	736.78	370.50
2—3	601.00	294.08
3—4	757.04	296.24
4—5	572.90	404.32
5—10	572.75	299.70
10—15	595.13	167.19
15—25	699.09	251.59
25—50	788.01	246.20
50 and over	980.70	297.36
Total	7,070.28	3,288.18

Source : Computed from figures in Farm Business Table Nos. 6 and 32, 'Evaluation of Benefits of Irrigation (Tribeni Canal),' *Op. cit.*

The attempt is to test the above two hypotheses by determining the probability of t, where t is the ratio of $\bar{X}_1 - \bar{X}_2$ to an estimate of the standard error of the difference between the two sample means.

Our t ratio would be computed by the following formula :

$$t = \frac{\bar{X}_1 - \bar{X}_2}{\sigma_{\bar{x}_1 - \bar{x}_2}}$$

$$(1) \quad t = \frac{2273.30 - 1136.41}{50.06} = \frac{1136.89}{50.06}$$

$$= 22.07$$

From the t table of Appendix I[5] with 18 degrees of freedom, we consider the difference in the mean land value per acre between the project area and the control area very significant and we failed to accept the null hypothesis at .001 level of probability.

$$(2) \quad t = \frac{707.02 - 328.61}{58.48} = \frac{378.41}{58.48}$$

$$= 6.47$$

With 18 degrees of freedom our t table gives the result of 3.922 at .001 per cent confidence level and we obtain the t ratio of 6.47. Hence, the null hypothesis is not accepted. This magnitude of difference cannot be encountered due to the margin of random error.

Conclusion

Our empirical findings indicate that land value and estimated farm income per acre are relatively much higher in irrigated region than in non-irrigated region. This reveals some interesting economic implications and could work as reliable guideline for our future resource planners in their decision to allocate investment funds towards alternative water projects. In an economy where there is shortage of allocable investment funds, the decision is very strategic as to what kind of project should be given the priority which would contribute maximum value to the public treasury and would work towards opening the economic frontiers for long-run public benefits. Our findings do reveal that public investment in Tribeni Canal project explored the economic opportunities for farm people to make higher contribution to the national income. Having overcome the technological uncertainty in terms of provision of irrigation water, farmers in the irrigated region made significant changes in the allocation of resources towards profitable enterprises and hence, this resulted in an increase of farm income. Technological uncertainty in non-irrigated region did not encourage the farmers to make changes

5. F. E. Croxton and D. J. Cowden : Applied General Statistics, pp. 750-751.

in order to bring in new profitable enterprises. Naturally, this kept the farm income at a very low level. The supply of land being inelastic and its substitute being not in large supply the profits in irrigated regions get capitalized largely in the form of increased land values. In other words, farmers in the irrigated region deriving enough margin of economic surplus over water charges imputed the residual value to land input and thereby increased the value of land.

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and
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REGIONAL VARIATIONS IN LABOUR INPUTS PER ACRE‡

The Farm Management Studies,[1] conducted in different regions of India during 1954-55 and 1955-56 showed that there are significant differences between regions in the per acre input of labour in agricultural operations. An attempt is made in this paper to focus attention on the extent of such differences and also to enquire into the factors responsible for this. Data on employment in different regions are given in Table I. In U.P., 49.1 labour days were employed per

TABLE I—LABOUR INPUTS PER ACRE IN MAN-DAYS ACCORDING TO THE SIZE OF LAND CULTIVATED IN 1955-56

Size of holding (acres)	Regions				
	U. P.	West Bengal	Madras	Bombay	Punjab
Less than 5	67.7	53.4	73.6	40.5	24.0
5 — 10	53.6	47.9	42.2	35.2	24.0
10 — 20 (10 — 15)*	48.3	33.1	25.9	25.9	22.5
20 and over (15 and over)*	38.9	37.0	21.6	17.2	19.4
Average	49.1	48.5	37.3	21.8	21.1

Note : The above table has been compiled from the data collected by the Farm Management Studies in 1955-56.

*In case of West Bengal size of holding follows 10 to 15 acres instead of 10 to 20 acres and 15 and over instead of 20 and over.

cropped acre, while in the case of Punjab, it was only 21.1. In the case of West Bengal the average was 48.5 labour days, in Madras 37.3 and Bombay only 21.8. The range of variation is indeed not small. Relatively the per acre employment

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‡The author is very grateful to Shri P. V. John for guidance and encouragement in preparing this paper.

1. Farm Management Studies were conducted in 1954-55 and 1955-56 in the regions of Punjab, U.P., M.P., West Bengal, Madras and Bombay. Two contiguous districts were selected in each of these regions for conducting this enquiry.