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**AN ECONOMIC ANALYSIS OF ON-FARM DEVELOPMENT PROGRAMME—  
A CASE STUDY OF CHAMBAL COMMAND AREA DEVELOPMENT  
PROJECT, MADHYA PRADESH**

The Chambal Command Area Development Project is one of 50 irrigation projects in India which commenced in September 1975 covering a period of three years (Stage I) with the assistance of World Bank credit. This project primarily aims at the improvement, modernization and completion of the existing irrigation facilities, construction of drainage works, improvement of the road system and provision of agricultural supporting services throughout the project area. A strong multi-disciplinary organization has been set up in the command area, invested with authority to raise corporate funds, to plan and carry out all necessary works and to recover their cost from individual beneficiaries. The project area is located in Morena and Bhind districts covering 9 towns and 1,446 villages. The total geographical area of the command is 6,579 sq. km. The total cultivable area is 3,87,000 hectares while the cultivated area is 3,20,000 hectares. The total area under irrigation at the time of commencement of the project was 1,57,000 hectares of which 12,000 hectares were under *kharif* and 1,45,000 hectares under *rabi* crops.

On-farm development of 12,000 hectares of undulating land in Bhind and Morena districts of Madhya Pradesh became effective since the inception of the project and the land development work has been in progress since then. This scheme has statutory support of Madhya Pradesh *Bhumi Sudhar Yojna Adhiniyam*, 1967. It envisages selection of *chaks* of about 100-120 acres each on the basis of the command of an outlet and execution of the following jobs: (1) detailed survey; (2) analysis of soil characteristics and profiles; (3) land shaping; (4) provision of water courses; (5) provision of drains; (6) provision of access roads; (7) laying of property bunds; and (8) consolidation of holdings. The target fixed for on-farm development till the end of December 1976 was 1,200 hectares. On-farm development work has been carried out in 760 hectares upto this period.

#### *Objectives*

The economic analysis of land development programme is directed towards determining empirically whether an investment on the project is likely to contribute significantly to the development of the economy as a whole. The present study attempts to evaluate the impact of Chambal Command Area Development Project on cropping patterns, cropping intensity, and yield levels of principal crops. It also studies the structure of input use, farm income and benefit-cost ratio of the project. All these aspects have been related to the pre-project conditions (before land development).

In order to evaluate the economic feasibility of irrigation land development, the data have been taken from the terminal report of "Soil and Water Use Management Pilot Project Chambal Command Area." The "Pilot Project of Soil and Water Management" was started in an area of 1,000 acres in different parts of the command area with a total cost of Rs. 11.11 lakhs

for the period from 1972-73 to 1975-76. The actual work on the project was started in February 1973 and it has ended in February 1976 due to the termination of the scheme. In this scheme the jobs performed were more or less identical as that of on-farm development works which are being carried out in the Chambal Ayacut Development Project.

In this scheme seven sub-projects, named, Karari-Bhatari, Hadwasi, Sunehra, Sabalgarh, Hingona-Khurd and Suzarma II in Morena district and Gurikha in Bhind district were taken up. In this analysis one sub-project, namely, Sabalgarh was dropped for want of some useful input-output data. The findings of this study are based on the analysis of these six projects as a whole. The year 1972-73 has been considered as pre-project condition (before land development) and subsequent years as post-project (after land development) conditions. The year 1972-73 was a normal year.

### *The Study Area*

The number of schemes studied in the project area was six, benefiting 226 cultivators with a gross command area of 433.73 hectares and cultural command area of the outlet of 337.48 hectares. An area comprising 218.87 hectares was levelled and the total excavation per hectare amounted to 31,803 cu. ft. The average excavation cost worked out to 18 paise per cu. ft. The total number of holdings for which input and output data are analysed was 226. The average size of holding in the study area worked out to 2.16 acres. Nearly 71.19 per cent of the total holdings were less than one hectare. Forty-five per cent of the area was waterlogged before the inception of the scheme.

### *Cost of Land Development Measures*

One of the most interesting and popular measures of irrigation land development is land levelling. Specifically, land levelling need not mean bringing land to a level flat plane, but merely shaping it to a pre-determined specification which may include a specified cross slope as well as a down slope. The break-up of total costs of land development and annual costs of installing and operating a full development irrigation system in Chambal Command Area are given in Table I.

The average cost per acre for land development worked out to Rs. 1,170.91 in the Chambal Command Area. Land levelling alone accounted for about 58 per cent of the total cost, followed by construction of distribution channels and drainage ditches which together accounted for about 20 per cent.

The costs have been amortized over the lesser of the expected life of the item or over a period of 25 years, which reflects the maximum period during which the cultivator's decisions will determine farm operations and when the investments should be paid off. The annual cost of the development installations amounted to about Rs. 143 per acre per year.

TABLE I—PER ACRE INITIAL AND ANNUAL COST OF LAND DEVELOPMENT IN THE CHAMBAL COMMAND AREA

Cost item	Initial cost per acre (Rs.)	Amortization period (years)	Annual amortization cost* per acre (Rs.)	Annual operating and maintenance cost per acre (Rs.)	Total annual cost per acre (Rs.)
Land levelling by bulldozer .. ..	683.14 (58.34)	25	67.36	11.75	79.11
Any other cost incurred in levelling ..	20.76 (1.77)	25	2.05	—	2.05
Bordering .. ..	49.22 (4.20)	25	4.85	—	4.85
Drainage ditches .. ..	110.21 (9.41)	25	10.87	5.17	16.04
Distribution channels .. ..	122.79 (10.48)	25	12.11	3.40	15.51
Access roads .. ..	93.11 (7.95)	25	9.18	—	9.18
Bunding .. ..	53.32 (4.58)	25	5.26	7.00	12.26
Miscellaneous .. ..	38.16 (3.26)	25	3.76	—	3.76
Total .. ..	1,170.91		115.44	27.32	142.76

\* Amortized at 9 per cent interest rate.

### *Impact of Land Development on Irrigated Area, Cropping Intensity and Cropping Pattern*

As may be noted from Table II, the intensity of cropping and irrigated area in the project areas increased significantly after land development as compared to the situation before land development.

One of the most significant changes in the cropping pattern of the projects studied is the sudden spurt in the area under paddy crop which increased from 6.92 per cent in 1972-73 to 24.63 per cent in 1975-76. The increased area under paddy crop is an encouraging feature because irrigation water will be utilized properly during the *kharif* season if this crop comes up gradually. The second notable effect of land development is the emerging importance of *kharif* crops. In the post-land development period (1975-76), *kharif* crops accounted for 40 per cent of the total cropped area, as against only about 28 per cent before land development. Due to improvement in

TABLE II—IRRIGATED AREA, CROPPING INTENSITY AND CHANGES IN CROPPING PATTERN

Particulars	Before land development (1972-73)				After land development			
					1973-74	1974-75	1975-76	
Net cropped area (acres)	..	..	..	508.77	508.77	508.77	508.77	
Gross cropped area (acres)	..	..	..	404.46	407.51	565.48	729.23	
Cropping intensity (per cent)	..	..	..	79.50	80.10	101.15	143.33	
Irrigated area (per cent)	..	..	..	37.72	63.94	94.82	94.82	
Crop pattern	(percentage of total gross cropped area)							
Paddy	..	..	..	..	6.92	2.94	15.70	24.63
Jowar	..	..	..	..	4.73	1.23	0.06	1.99
Bajra	..	..	..	..	8.85	4.30	4.34	0.76
Jowar + tur + moong	..	..	..	..	0.99	0.26	0.27	0.24
Bajra + tur + moong	..	..	..	..	1.52	4.03	1.06	6.65
Urd	..	..	..	..	—	0.37	0.07	—
Moong	..	..	..	..	0.75	—	0.18	0.02
Tur	..	..	..	..	2.24	—	2.01	1.51
Jowar + bajra	..	..	..	..	—	—	—	3.47
Sugarcane	..	..	..	..	1.85	1.84	0.59	0.67
Groundnut	..	..	..	..	—	0.25	0.04	0.20
Sesamum	..	..	..	..	—	—	0.21	—
Sub-total : <i>Kharif</i>	..	..	..	..	27.75	15.22	24.52	40.14
Wheat	..	..	..	..	33.91	39.28	37.54	38.61
Gram	..	..	..	..	9.59	13.21	10.07	4.74
Mustard	..	..	..	..	10.39	8.70	8.02	3.50
<i>Sonha</i>	..	..	..	..	1.24	1.00	1.71	1.06
Wheat + gram	..	..	..	..	12.78	19.91	14.56	11.11
Linseed	..	..	..	..	0.65	—	—	—
Lentil	..	..	..	..	3.71	2.45	2.48	—
Berseem	..	..	..	..	—	0.06	0.35	—
Sunflower	..	..	..	..	—	0.02	—	—
Gram + peas	..	..	..	..	—	0.15	—	—
Wheat + mustard	..	..	..	..	—	—	0.75	—
<i>Methi</i>	..	..	..	..	—	—	—	0.84
Sub-total : <i>Rabi</i>	..	..	..	..	72.25	84.78	75.48	59.86

the irrigation system and land development, the area under wheat crop also increased from about 34 per cent of the cropped area to about 39 per cent in 1975-76. Another interesting feature is the introduction of some new crops, like sunflower, groundnut, *methi*, etc., during the post-development period. The area under low value crops has declined considerably due to the availability of irrigation water in the project areas.

The higher use of inputs and irrigation water resulted in higher yields per acre of all the crops. The comparative picture of yield levels of different crops is given in Table III.

TABLE III—YIELD RATES OF PRINCIPAL CROPS

Crop	Before land development (1972-73)	After land development (quintals/acre)		
		1973-74	1974-75	1975-76
<i>Desi</i> wheat	2.79	3.66	5.18	6.37
Mexican wheat	8.03	6.91	9.54	10.64
Gram	3.88	4.27	6.71	8.45
Paddy	6.00	9.10	9.92	9.87
Jowar	3.08	6.89	4.32	7.14
Bajra	6.94	7.08	7.31	7.34
Mustard	3.46	4.64	6.02	5.37

The yield rates of *desi* wheat, jowar and gram has doubled in the post-land development period. The yield rates of Mexican wheat and mustard increased by 33 per cent and 55 per cent respectively in 1975-76 as compared to 1972-73.

#### *Comparison of Costs and Returns*

To examine the effect of land development on returns, the gross returns (output), farm business income and net income per acre are worked out in Table IV.

TABLE IV—FARM INCOME BEFORE AND AFTER IRRIGATION LAND DEVELOPMENT PROGRAMME

Irrigation development condition	Gross return	Farm business income	Net income (Rs./acre)	
Before development (1972-73)	474.60	349.47	161.62	
After development (1973-74)	756.03	478.65	353.37	
1974-75	1,159.27	497.54	510.48	
1975-76	831.74	484.76	364.01	

The concepts of costs and incomes adopted for this analysis were as follows:

*Costs:*

- (1) Cost  $A_1$  includes the value of hired human labourers, of hired and owned bullock labour, of seed, manures and fertilizers, of pesticides, irrigation charges, land revenue, depreciation, interest on working capital.
- (2) Cost  $A_2$  includes cost  $A_1$  plus rent paid for leased-in land.
- (3) Cost B includes Cost  $A_2$  plus rental value of owned land plus interest on fixed capital (excluding land).
- (4) Cost C includes Cost B plus imputed value of family labour.

*Income:*

- (1) Farm business income: Gross value of farm output — Cost  $A_1$  (Cost  $A_2$  in the case of tenant operated land).
- (2) Net income: Gross value of farm output — Cost C.

It is observed that the gross returns, farm business income and net income per acre were higher in the post-development conditions as compared to the pre-development conditions. It is, therefore, clear that the farmers of these project areas are now able to do much better than they did previously on the same land.

*Benefit-Cost Ratio*

The benefit-cost ratio has been worked in Table V for the entire project area as a whole under post-irrigation land development conditions. The difference in net income under pre-and post-irrigation land development conditions has been taken as the benefit accruing from the irrigation land development programme. The table combines information developed in the previous analysis of costs of land development measures.

TABLE V—BENEFIT-COST RATIO OF IRRIGATION LAND DEVELOPMENT PROGRAMME

Particulars	Benefit-cost (Rs.)
Annual direct benefit per acre:	
1973-74 .. .. .	191.75
1974-75 .. .. .	348.86
1975-76 .. .. .	202.39
Annual cost per acre (Rs.)	
(a) Land levelling .. .. .	79.11
(b) Additional development cost .. .. .	63.65
Per acre total cost (a + b) .. .. .	142.76
Ratio of costs to returns	
1973-74 .. .. .	1.00 : 1.34
1974-75 .. .. .	1.00 : 2.44
1975-76 .. .. .	1.00 : 1.41



An investment of one rupee of annual cost resulted in a benefit of Rs. 1.34, Rs. 2.44 and Rs. 1.41 in 1973-74, 1974-75 and 1975-76 respectively, indicating a high degree of feasibility for the cultivator. More benefit is expected in the subsequent years as the cultivators will start growing more crops in the *kharij* season, which will increase the intensity of cropping resulting in an increase in net income also.

We may now examine the effect of development programme on the productivity of irrigation water and investment. Table VI shows the increased volume and value of production per acre for the irrigation land development alternative.

TABLE VI—AVERAGE ANNUAL VOLUME AND VALUE OF PRODUCTION PER ACRE BEFORE AND AFTER IRRIGATION LAND DEVELOPMENT PROGRAMME

Irrigation development condition	Average annual production*		Average annual value of production†		Annual cost of development (Rs./acre)	Production increase per rupee of development cost	
	Total quantity (quintal/acre)	Increase over pre-development condition (quintal/acre)	Gross value (Rs./acre)	Increase over pre-development condition (Rs./acre)		Quantity (kg./Rs.)	Gross value (Rs.)
	Before development (1972-73)	3.48	—	474.60	—	—	—
After development							
1973-74	4.40	0.92	756.03	281.43	127.19	0.72	2.21
1974-75	8.32	4.84	1,159.27	684.67	127.19	3.81	5.38
1975-76	6.71	3.23	831.74	354.14	127.19	1.82	2.81
Average (1973-76)	6.48	3.00	915.68	441.08	127.19	2.36	3.47

\* Grain and oilseeds.

† All products including fodder and other by-products.

It also shows the increase in production and value of production per rupee of investment cost. The development alternative costing Rs. 127.19 per acre per year is expected to increase the production of grain and oilseeds by an average of about 2.36 kilogrammes per rupee of investment. The gross value of the production increase is about 3.47 per rupee of investment.

The foregoing analysis implies that while it is profitable to undertake land development work, there must be a sizeable increase in production inputs and management ability for realising the full potential of the land and water resources as reflected by the net income.

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