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AN ECONOMIC STUDY OF WATER MANAGEMENT PROGRAMME IN SAMBALPUR DISTRICT (ORISSA)

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Recent technological advances in the field of agriculture have led to a distinct change in the thinking of the Indian farmer who is moving from traditional and low productivity to modern high productivity potential farming system. What is now needed is the co-operative efforts of agricultural scientists, extension workers and above all the policy-makers to sustain this dynamism in Indian farming. The new high-yielding agricultural production technology requires judicious management of resources at the disposal of the farm operator especially water which plays a very crucial role. It is important for the agricultural scientists, especially water management specialists, to focus their attention on this urgent and crucial problem and to evaluate the economic benefits of better water management. Some efforts are already underway in this country. The present study is a step in that direction.

This study relates to the irrigation system in an area covered by the Hirakud canal system. In this system, water flows continuously from the water course to the field. Irrigation is by gravity flow from field to field. This system of irrigation causes over-irrigation at the upper reaches and water shortages at the tail end areas. The continuous flow through ungraded terraces with different shapes and sizes of plots generally causes heavy percolation loss of irrigation water. Besides, in the absence of proper drainage system, there is water accumulation in the valley lands. It also results in the washing away of fertilizer and other nutrients from the plots at the upper end to those at the lower end. But the yields on the low lands do not improve with these nutrients because of waterlogging which creates the problem of pests and diseases. Existing field to field irrigation system stands in the way of adoption of suitable cropping patterns in different types of land[1] and in controlling the quantity of water and its timely use.

To overcome these problems and also to make the best use of Hirakud water in Sambalpur district of Orissa, a pilot demonstration programme for providing field channels was undertaken by the Intensive Agricultural District

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1. The cultivated land of this region has been classified into four types according to their location with respect to watershed. They are *Att* (uplands), *Mal* (the slopes), *Berna* and *Bahal* (the low lands).

Programme (IADP) in 1966-67. The IADP provided technical and some financial assistance to the villagers in digging a network of field channels to help control the water supply by providing each farmer with a small direct channel to his field. Each farmer can turn in the water when needed and shut it off at other times without stopping the flow of water to the farms at a lower level. Also the farmers at the lower end would not have to wait for the water to flow through all the upper fields.

The present study attempts to evaluate the impact of field channels on cropping pattern, cropping intensity, irrigation problems faced by the farmers, and the effect of field channels on spreading the available water on larger area. It also studies the structure of input use, farm income and the benefit-cost ratio of the project.

DESIGN OF THE STUDY

The Attabira block of Sambalpur district was taken up for this study since the water management programme was first introduced in this block. The villages of this block were stratified into two categories: (*i*) villages having field channels for several years (improved villages), and (*ii*) villages that do not have field channels (control villages). Two villages were selected from each set randomly. Twenty per cent of the total farms from each set of villages were then studied. The sample consists of 60 cultivators from the improved villages and 63 from the control villages selected randomly. The data were collected by personal survey method, interviewing the farmers on the basis of questionnaires prepared for the purpose, and relate to the agricultural year 1970-71.

Cost of Field Channels

The villages for this programme are selected on the initiative of the IADP staff in co-operation with the elected and other respected leaders of the village. Those farmers who have their fields near the outlets and get adequate water supply do not readily agree to participate in the programme. Once a village has been selected for the programme by enlisting the co-operation of the farmers, a 500-1000 acres area is taken up for laying out the system for demonstration. The IADP water management staff provides all the technical help such as the survey for laying out field channels on a scientific basis and designing the outlets and drop structures. The cost of masonry structures such as concrete pipes for road crossings and drop structures is borne entirely by the IADP. The farmers are required to dig the field channels and supply labour in completing the masonry work. Since the water management team has been divided into three units, *viz.*, approach and survey of new villages, installation of new system and repair and maintenance of existing systems, they can handle three villages easily at one time and complete them within one year.

The canal authorities provide outlets from the water courses depending upon the size of the cultivated area in the village. The work of the IADP water management team starts from these outlets. The field channels are dug by the farmers according to the specification laid down by the team. The field channels are approximately one foot deep, one and one-third feet wide at the base and two feet wide at the top. On an average, there are approximately 110 feet of field channels per acre.

Over half the cost of installing field channels per acre is met by technical assistance, which on an average is Rs. 18 per acre. The material and masonry charges are approximately Rs. 10 per acre, and the cost of labour is Rs. 6.30 per acre. The maintenance cost comes to nearly Rs. 6.40 per acre. This cost could be reduced with the experience gained with time.

The details of the installation and maintenance costs of channels are given below :

Installation cost of field channels per acre (Rs.)

Cost of administrative and technical staff*	18.00
Cost of material and masonry inputs*	10.00
Cost of labour†	6.30
Total ..	34.30

Maintenance cost of field channels per acre per year (Rs.)

Cost of administrative and technical staff*	2.00
Cost of material and masonry inputs*	2.00
Cost of labour†	2.40
Total ..	6.40

* Information supplied by the Project Officer, IADP, Sambalpur.
† Based on survey.

Water Control Problem

The farmers in the canal irrigated area of Sambalpur are fast realising the usefulness and the need for water control measures for scientific agriculture. This has been the result of the demonstration of its usefulness in the two villages by the project staff by the construction of the field channels on a pilot basis. The idea has spread to other villages, and wherever village factionalism has not been much of a hurdle, farmers are planning to lay down the field channels. It is now becoming difficult for the meagre technical staff at the district headquarters to cope with the demand for digging field channels. Still the work has been taken up in many villages. The need to adopt appropriate water control for scientific agriculture has been realised by the farmers. Table I clearly illustrates the thinking of the farmers in the two sets of villages selected for the study.

TABLE I—OPINIONS OF FARMERS ON WATER CONTROL PROBLEMS IN THE IMPROVED AND CONTROL VILLAGES OF SAMBALPUR DISTRICT DURING 1970-71

Opinions of farmers on water control problems	Control villages	Improved villages
	Percentage of farmers	Percentage of farmers
Inadequate field channels	50	5
Undependable water supply	31	7
Insufficient water	66	16
Land not levelled	28	10
Inadequate drainage	20	7
No problem	25	65

A comparison of the water management problems between the two sets of villages—improved and control—, clearly reveals that the laying down of the field channels has considerably solved the irrigation problems in the improved villages. As many as 65 per cent of the farmers in the improved villages have now few irrigation problems compared to only 25 per cent of the farmers in the control villages who are free from such problems. In the control villages at least 50 per cent of the farmers expressed the need for field channels and 66 per cent of the farmers indicated that they had insufficient water supply. The comparison should not be taken to mean that all the problems have been solved in the improved villages. There are still the problems of land levelling, inadequate drainage and undependable water supply. However, it may be stressed that water management and water control have improved their irrigation system to a considerable extent in the improved villages.

IMPACT OF FIELD CHANNELS

The comparative study of the farm structure and organization in the improved and control villages reveals that the farmers in the improved villages are doing much better than the farmers in the control villages. To attribute all this difference only to field channels may appear erroneous to some. Part of these differences may be due to some other factors such as management skills, soil and topographical differences and availability of inputs at proper times.[2] But the fact remains that most of these differences are due to either direct and or indirect results of field channels. Therefore, a comparative study of these two sets of villages will reveal the impact of field channels.

2. While the control and improved villages had generally similar soil conditions, the difference, if any, between the fields in soil fertility in the two sets of villages could not be specifically taken into account.

Irrigated Area and Cropping Intensity

One of the significant results of field channels has been increased area under irrigation because with the control of water it is now possible to spread the available water to a larger area. This has obvious effects on the increase in the gross cropped area and the intensity of cropping (Table II). The intensity of cropping in the control villages was 184.7 per cent. In the improved villages before the field channels were constructed the intensity of cropping was 187 per cent which has now increased to 196 per cent. This gap in the increment of the percentage area irrigated and the percentage intensity of cropping is perhaps due to the change in the cropping pattern to such crops which remain in the field for almost two seasons.

TABLE II—IRRIGATED AREA AND CROPPING INTENSITY FOR THE IMPROVED AND CONTROL VILLAGES OF SAMBALPUR DISTRICT (1970-71)

Particulars	Control villages	Improved villages	
		Before field channels	After field channels
Irrigated area (per cent) ..	84.0	84.0	97.0
Gross cropped area (acres) ..	733.8	800.1	838.6
Total cultivated area (acres) ..	97.4	427.9	427.9
Cropping intensity (per cent)..	184.7	187.0	196.0

Cropping Pattern

With the introduction of high-yielding varieties (HYV) of paddy there was a rush for bringing in as much area as possible under the HYV paddy during the *rabi* season. The HYV failed during the *kharif* season mainly due to gallmidge (*Pachydiplosis oryzae, Cecidomycidea : Diptera*) menace and continuous waterlogging, which is not conducive to the proper growth of these varieties. The field channels have helped in the judicious use of water, making water available for more area during the *rabi*, and thus increasing the potential area under the *rabi* crop. As a result, 72.14 per cent of the total cultivated area during the *rabi* was under the HYV in the improved villages as compared to only 53.97 per cent in the control villages (Table III). Even during the *kharif*, the improved villages have higher percentage area under the HYV as compared to the control villages, *viz.*, 4.67 per cent and 1.13 per cent respectively. While the percentage of area under the HYV in the *kharif* season is still very low, the small difference is probably due to the fact that field channels have helped in reducing waterlogging and washing away of plant nutrients in some areas during the *kharif*.

TABLE III—CROPPING PATTERN OF SAMPLE FARMS IN THE IMPROVED AND CONTROL VILLAGES OF SAMBALPUR DISTRICT (1970-71)

Crops	Percentage of total cropped area in different seasons			
	Kharif season		*Rabi* season	
	Improved	Control	Improved	Control
Local paddy	91.86	94.15	27.00	44.23
High-yielding paddy ..	4.67	1.13	72.14	53.97
Wheat	—	—	0.86	0.21
Pulses	0.41	1.22	—	—
Oilseed crops	1.97	1.08	—	0.47
Vegetables	0.71	0.68	—	0.21
Other crops	0.38	0.94	—	0.91

Another interesting feature is the introduction of wheat crop during the *rabi* season, the percentage area under wheat in the improved villages and control villages being 0.86 and 0.21 respectively. The evidence presented indicates an improvement in the cropping system in the improved villages, in contrast to the control villages. Further improvement can be expected provided a co-ordinated effort is made by the agriculture and the irrigation departments in laying down field channels and in installing an efficient drainage system.

Inter-village Irrigation System : Comparison of Inputs and Output Levels

To examine the impact of field channels on the levels of inputs and yields, a comparison has been made between villages with and without field channels and the relevant data are presented in Table IV.

TABLE IV—COMPARISON OF AVERAGE LEVELS OF YIELD AND INPUTS PER ACRE FOR PADDY CROPS BETWEEN THE IMPROVED AND CONTROL VILLAGES OF SAMBALPUR DISTRICT (1970-71)

Items	Yield (quintals)	Human labour (days)	Bullock labour (days)	Manures and fertilizers (Rs.)	Plant protection (Rs.)
Local paddy (*Kharif*)					
Improved villages ..	10.03	49.84	8.01	87.25	6.34
Control villages	7.05	55.78	9.01	84.24	3.61
Difference	2.98*	5.94**	1.00	3.01	2.73**
S. E.	1.58	1.68	0.79	3.28	1.19
Local paddy (*Rabi*)					
Improved villages ..	13.60	47.02	6.39	119.22	1.97
Control villages	10.23	45.52	6.35	91.36	1.65
Difference	3.43*	1.50	0.04	27.86***	0.31
S. E.	2.06	1.85	1.63	3.24	1.03
HYV of paddy (*Rabi*)					
Improved villages ..	18.92	47.10	7.11	178.11	15.20
Control villages	15.55	43.90	6.12	139.91	6.59
Difference	3.37*	3.20**	0.99	38.20***	8.61**
S. E.	2.02	1.33	0.60	3.75	1.69

* Significant at 10 per cent level.
** Significant at 5 per cent level.
*** Significant at 1 per cent level.

The use of manures and fertilizers was generally higher in the improved villages as compared to the control villages because the construction of field channels made it possible to control the time and quantity of water use. This has reduced the risk of fertilizers being washed away in the improved villages compared to the control villages which have only flood irrigation. The use of plant protection measures was higher in the improved villages as compared to the control villages. Once the farmers had control over water, they started adopting technological improvements in farming. Having made sizable investments on inputs like fertilizers, the farmers did not hesitate in putting more money on plant protection measures to increase the yield. The use of human labour was higher in the improved villages as compared to the control villages for *rabi* season paddy crops, while the use of human labour was significantly higher in the control villages as compared to the improved villages during the *kharif* season. So far as the use of bullock labour is concerned, there was not much variation between the villages with and without field channels. The higher use of inputs and better water control resulted in higher yields per acre of the HYV and local varieties of paddy in the improved villages as compared to the control villages in both the seasons.

Returns and Irrigation System

To examine the effect of the irrigation system on returns, the gross returns (output), farm business income, family labour income and net income per acre were worked out which are given in Table V.

TABLE V—ESTIMATES OF INCOMES ON FARMS IN THE IMPROVED AND CONTROL VILLAGES OF SAMBALPUR DISTRICT

Particulars	Rupees per acre			
	Gross returns	Farm business income	Family labour income	Net income
Improved villages	1,445.79	699.95	413.10	370.63
Control villages	942.70	414.57	162.27	100.71

It can be observed that the gross returns, farm business income, family labour income and net income per acre were higher in the improved villages as compared to the control villages. It is, therefore, clear that the farmers in the improved villages with better water control and higher use of inputs were able to do much better than the farmers in the control villages.

Benefit-Cost Ratio

The benefit-cost ratio has been worked out for the water management project in Table VI. The field channels afforded the opportunity of increasing the intensity of cropping, bringing larger area under irrigation and high-yielding varieties and higher use of modern inputs. All these combined together raised the benefits to the producers. The difference in net income between the improved and control villages has been taken as the benefit from the water management programme. The project cost has been worked out by including the depreciation and interest rate on the project investment and its annual maintenance cost.

TABLE VI—BENEFIT-COST RATIO OF WATER MANAGEMENT PROJECT FOR THE YEAR 1970-71

Particulars	Benefit-cost (Rs.)
Annual direct benefit per acre	269.92
Annual costs per acre	
(*a*) Depreciation on investment at 20% rate	6.86
(*b*) Interest on investment at 9% rate	3.09
(*c*) Annual maintenance cost	6.40
Per acre project cost (*a*+*b*+*c*)	16.35
Benefit-cost ratio	10.39 : 1

The above table indicates benefit of Rs. 10.39 on an investment of one rupee as annual cost. Thus the installation of field channels is a very low cost venture compared to the benefits from it.

CONCLUSIONS

The benefits obtained from the water management programme measures during the year 1970-71 exceed the annual costs of the project by 1039 per cent. Thus the high profitability of this programme has attracted farmers in other villages of he district. The farmers of different villages are putting pressure on the IADP staff to include their villages in this programme. This is reflected in the work being started in nine other villages. The farmers of other villages, which have not been covered so far, have started the construction of field channels on their own. In the absence of technical assistance and systematic planning the work is going on in a haphazard manner.

There are several bottlenecks in the expansion of this programme. The first and the foremost is the technical assistance. With the existing small

size of water management unit of IADP, it may take nearly 50 years to cover all the villages with field channels in the Hirakud dam area of Sambalpur district alone. Now it is up to the policy-makers to extend it to a larger area within a short period subject to the availability of resources and technical personnel. If the policy-makers are satisfied with the profitability of this programme which has been proved by this study and if enough resources could be mobilized for this type of project, it would be worthwhile to suggest here that instead of *kutcha* channels, *pucca* channels should be constructed with more durable drop structures, etc. *Pucca* channels may prove economical in the long run. Costs incurred on such a project can be realised from the farmers along with the land revenue.

If such a proposition is considered feasible, it would be advisable to consolidate the holdings before launching such a programme with adequate provision for field channels. The latter will remove the objection of some of the farmers who lose more land in the process of construction of field channels.

A related and very important aspect of this problem is the construction of drainage channels. The farmers owning land in valley lands may not agree to the construction of drainage channels as it would take away a sizable portion of their holdings. But if land for drains is provided through consolidation, the task would become relatively easy.

Therefore, it is suggested that such a programme should be undertaken even if it is on a pilot basis. This may be evaluated and cost-benefit ratios worked out. In such study, it is suggested that soil fertility and topography should be taken into consideration, as it may explain some of the differences in net returns. In this study details of soil fertility could not be considered mainly due to time and resource constraints.