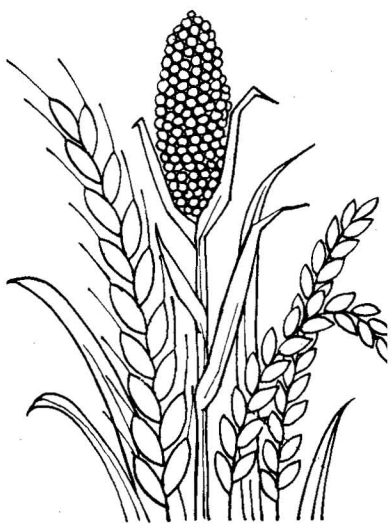
Vol XXXIX
No. 3

ISSN 0019-5014

CONFERENCE
NUMBER

JULY-
SEPTEMBER
1984

INDIAN JOURNAL OF AGRICULTURAL ECONOMICS



INDIAN SOCIETY OF
AGRICULTURAL ECONOMICS,
BOMBAY

ECONOMICS OF COMMAND AREA DEVELOPMENT IN INDIA

Damodar Tripathy *

Low effective utilization of the irrigation potential created in the major and medium irrigation projects[1] has caused considerable concern in the face of sharp increase in the marginal cost of irrigation in this sub-sector.[2] Of greater concern is the low crop productivity from irrigated areas under the commands of these projects, which is much below the *ex ante* productivity estimates. The Sixth Plan document has pointedly drawn attention to this fact and has indicated that the productivity of food crops per hectare from the irrigated areas, on an average, has been of the order of 1.7 tonnes as against the assumed target of 4 to 5 tonnes.[3] Various factors associated with the irrigation development have contributed to the low utilization and low productivity which have been discussed in detail by several bodies and researchers.[4] To recount, structural inadequacy of the present irrigation systems above the outlet level, poor maintenance of the system and non-availability of field irrigation channels below the government outlet of 40-hectare blocks have led to poor crop and water management, resulting in low utilization and poor productivity.

Command Area Development (CAD) Programme has been in operation since 1974-75, as a Centrally Sponsored Scheme under a system of matching financial contribution from the Centre and the States/Union Territory for selected items, with the principal objectives of *(i)* increasing the utilization of irrigation potential in selected major and medium irrigation projects, *(ii)* raising productivity per unit of irrigated land through adoption of proper land, water and crop management, and *(iii)* equitable distribution of irrigation water as between different size holding class of farmers in various system

* Indian Economic Service, Dy. Director, Ministry of Irrigation, CAD and Water Management Division, Government of India, New Delhi and Consultant, Committee on Agricultural Productivity in Eastern India, Reserve Bank of India.

The views expressed are entirely those of the author and not of his employer.

1. By the end of 1981-82, out of 28.46 million hectares of potential created in the major and medium sector, 24.70 million hectares were utilized in India. For Statewise potential creation and utilization, see the Report of the High Level Committee on Organisational Set-up of Command Area Development Programme in Major and Medium Irrigation Projects and Creation of a Water Management and Land Development Wing in State Irrigation Departments, Ministry of Irrigation, Government of India, New Delhi, 1982.

2. Leslie Abbie *et al.* have clearly brought out this aspect in their work on Economic Return to Investment in Irrigation in India, World Bank Staff Working Papers No.536, Washington, D.C., U.S.A., 1982, see Table 3.

3. Government of India:Sixth Five-Year Plan 1980-85, Planning Commission, New Delhi, 1981, p.149.

4. Report of the High Level Committee on Organisational Set-up of Command Area Development Programme in Major and Medium Irrigation Projects and Creation of a Water Management and Land Development Wing in State Irrigation Departments, *op.cit.*; Abbie *et al.* and R.S. Saksena and D. Tripathy, "Planning for Command Area Development", in Proceedings of the National Symposium on Planning and Design of Water Resource Systems, 1983, pp.IV-16-29.

reaches (head, mid and tail) of the command area.[5] The principal achievement in the physical structures below the outlet has been the On-Farm Development works (OFD) with construction of earthern field channels and linking at vulnerable reaches. The principal issue is whether the CAD Programme with main stress on the physical aspects has been able to augment irrigated productivity. The related issue is the question of economics of the additional investment of OFD works taken up to augment productivity. The objectivity of this paper is to examine these twin issues, *i.e.,* productivity and economics of additional investment on OFD.

Changes in Productivity

Productivity is defined here in terms of physical output of a crop per hectare during a specific season. Productivity change has been estimated in two ways: differential between *(a)* 'before' and 'after' the implementation of OFD, and *(b)* 'with' and 'without' the OFD, 'before' and 'without' serving as control. The latter approach, *i.e., (b)*, in effect provides a better estimation since the interaction aspects of various other programmes operating simultaneously with the main CAD programme in question and having significant bearing on productivity is taken care of by it.[6] Data, crop-cutting as well as survey, on both the approaches have been examined in this study.

'Before' – 'After' (BA) Approach

Productivity data in respect of specific principal crops in various projects 'before' and 'after' OFD are presented in Table I. Productivity increase of *kharif* paddy varies from 24.60 quintals in Nagarjunasagar (left bank) to 2 quintals in Kadana project. The increase is more than 10 quintals per hectare in 4 project commands and above 5 quintals in 5 commands. Out of ten commands, the range of increase varies from ten per cent in Kadana to 121 per cent in Nagarjunasagar (left bank). In respect of summer paddy, in Itiadoh and Bagh projects of Maharashtra, the increases are 4 and 10 quintals respectively, while in Sriramsagar project the difference is only about 2 quintals.

The observed productivity differences in other cereals in many projects are also quite high. The *kharif* and *rabi* maize productivity, for example, has gone up by 12 quintals and 15 quintals respectively in Sriramsagar project of Andhra Pradesh. While *desi* wheat has recorded an increase of 3.5 quintals in Tawa, in the same project HYV wheat productivity has gone up by 11.52 quintals in OFD areas. In the context of steady increase of wheat area from 30 per cent in 1974-75 to 42 per cent in 1977-78, and programming higher

5. For issues on 'equity', see R.S. Saksena and D. Tripathy, "Efficiency and Equity in Irrigation Management", Symposium on Water Management: Experiences of the Past and Directions for Future, Central Board of Irrigation and Power, Government of India, New Delhi, 1983, pp.59-64.

6. The issues on selection of 'control' have been discussed in detail by D. Tripathy, "Evaluation of Command Area Development–Some Issues on Methodology", National Seminar on Impact of Command Area Development Programme on Land and Water Productivity and Economy of the Command Areas, Technical Presentation, Vol.I, Lucknow, 1983, pp.65-71.

area coverage and HYV wheat, the productivity increase of 11.52 quintals assumes added significance.

The increase is moderate in Kadana, RCP, Gandak and Ghataprabha (upto 5 quintals). In the case of Chambal project of Rajasthan and Malaprabha project of Karnataka, the productivity has gone up by 12.50 quintals and 11.06 quintals respectively. *Kharif* bajra productivity has almost trebled in OFD areas of Kadana project. Pulses and groundnuts have also recorded substantial increase as are evident from the data available.

TABLE I— YIELDS OF PRINCIPAL CROPS IN SOME SELECTED COMMAND AREAS

(quintals/hectare)

State	Crop/Name of the command	Before OFD	After OFD	Increase	Percentage increase
1. Andhra Pradesh	*Kharif* paddy				
	Sriramsagar	25.22	40.24	15.02	59.55
	N.S.P.R.B.	18.85	33.69(79-80)	14.84	78.72
	N.S.P.L.B.	20.40	45.00	24.60	120.59
	Tungabhadra	22.21	32.31	10.10	45.47
2. Bihar	Gandak				
	West Champaran	30.46	38.34	7.88	25.87
	Saran	29.33	34.72	5.39	18.37
	Gopalganj	24.31	29.80	5.49	22.58
3. Gujarat	Kadana	20.00	22.00	2.00	10.00
	Ukai-Kakrapar	10.00	12.25	2.25	22.25
4. Maharashtra	Itiadoh	26.00	30.00	4.00	15.38
	Bagh	25.00	30.00	5.00	20.00
5. Uttar Pradesh	Gandak	10.25	16.90	6.65	64.88
6. Rajasthan	Chambal	34.93(PW)	39.19 (79-80)	4.26	12.19
1. Andhra Pradesh	Summer paddy				
	Sriramsagar	29.76	31.57	1.81	6.08
2. Maharashtra	Itiadoh	40.00	44.00	4.00	10.00
	Bagh	30.00	40.00	10.00	33.33
	Kharif bajra				
1. Andhra Pradesh	Tungabhadra	10.47	11.89	1.42	13.56
2. Gujarat	Kadana	5.16	14.50	9.34	181.00
3. Karnataka	Malaprabha	20.00	23.00(79-80)	3.00	15.00
	Ghataprabha	20.00 (PW)	23.00(79-80)	3.00	15.00
	Wheat				
1. Gujarat	Kadana	25.00	30.00	5.00	20.00
2. Rajasthan	Chambal	12.00	23.06	11.06	92.16
3. Karnataka	Malaprabha	22.50 (PW)	35.00 (79-80)	12.50	55.55
	Ghataprabha	30.00 (PW)	35.00 (79-80)	5.00	16.66
4. Rajasthan	R.C.P.	20.25	24.26 (77-79)	4.01	40.00
5. Uttar Pradesh	Gandak	14.70	19.20	4.50	30.61
6. Madhya Pradesh	Tawa	8.75(d)	12.25	3.50	40.00

(Contd.)

TABLE I *(Concld.)*

(quintals / hectare)

State	Crop/Name of the command	Before OFD	After OFD	Increase	Percentage increase
	Jowar				
1. Andhra Pradesh	Tungabhadra *(kharif)*	18.01	27.29	9.78	54.30
2. Gujarat	Ukai-Karkrapar	6.00	8.07	2.07	34.50
3. Karnataka	Malaprabha *(kharif)*	27.50	35.00 (79-80)	7.50	27.27
	Malaprabha *(rabi)*	25.00	35.00 (79-80)	10.00	40.00
	Ghataprabha *(kharif)*	30.00	35.00 (79-80)	5.00	16.66
	Ghataprabha *(rabi)*	30.00	35.00 (79-80)	5.00	16.66
4. Madhya Pradesh	Tawa	10.00	15.00 (78-79)	5.00	50.00
5. Rajasthan	Chambal *(kharif)*	7.58	8.40 (78-79)	0.82	10.81
	Maize				
1. Andhra Pradesh	Sriramsagar *(kharif)*	17.00	29.17	12.17	71.59
	Sriramsagar *(rabi)*	22.50	37.52	15.02	66.75
2. Karnataka	Malaprabha *(kharif)*	27.50	35.00 (79-80)	7.50	27.27
	Malaprabha *(rabi)*	27.50	35.00 (79-80)	7.50	27.27
	Ghataprabha *(kharif)*	30.00	35.00 (79-80)	5.00	16.66
	Ghataprabha *(rabi)*	30.00	35.00 (79-80)	5.00	16.66
	Groundnut				
1. Karnataka	Malaprabha *(kharif)*	12.50	18.00 (79-80)	5.50	44.00
	Malaprabha (summer)	15.00	18.00 (79-80)	3.00	20.00
	Ghataprabha *(kharif)*	15.00	18.00 (79-80)	3.00	20.00
2. Madhya Pradesh	Tawa	7.80	16.88 (78-79)	9.08	116.41
	Sunflower				
1. Karnataka	Malaprabha *(kharif)*	5.00	12.00 (78-79)	7.00	140.00
	Ghataprabha *(kharif* and *rabi)*	10.00	12.00 (78-79)	2.00	20.00
2. Rajasthan	R.C.P.	8.60	10.21 (77-78)	1.61	18.72
	Pulses				
1. Karnataka	Malaprabha *(kharif* and *rabi)*	3.40	12.00 (77-78)	8.60	252.94
	(summer)	10.00	12.00 (77-78)	2.00	20.00
	Ghataprabha *(kharif* and *rabi)*	10.00	12.00 (77-78)	2.00	20.00
	Gram				
1. Rajasthan	Chambal	6.00	7.15	1.15	19.16
	R.C.P.	10.85	13.26	2.41	22.21
2. Madhya Pradesh	Tawa (Teora)	10.05	17.50	7.45	74.12

(d) = *Desi* wheat
(PW) = Project as a whole.

A study from Chambal (Madhya Pradesh) indicates substantial productivity increases in respect of almost all major crops.[7] The increase is 128 per cent in *desi* wheat, 32 per cent in Mexican wheat, 118 per cent in gram, 132 per cent in jowar and 55 per cent in mustard. In Chambal

7. Impact and Evaluation Study of the Chambal CAD Phase I Programme, 1982-83, CAD Avacut Development Project and Chambal Division, Madhya Pradesh (mimeo.).

(Rajasthan), *kharif* paddy production per hectare has touched 4.5 tonnes with an increase of 55 per cent over the 'before' OFD situation, as reflected in a recent study.[8] *Rabi* wheat has recorded an increase of 31 per cent after OFD.

To a considerable extent, irrigated paddy contributes to the low productivity of foodgrains in India. There is need for a 'Green Revolution' in other cereal crops in general and paddy in particular. A productivity potential of about 5 tonnes per hectare in paddy is achievable with proper water and crop management.

A close look at the data on the productivity of paddy from three States, Andhra Pradesh, Bihar and Rajasthan shows some encouraging results. It has reached 4 tonnes per hectare in two projects of Andhra Pradesh, 3.9 tonnes and 3.5 tonnes per hectare in two of its other projects. In West Champaran district of Gandak project of Bihar it is 3.8 tonnes and in Chambal (Rajasthan) it is nearly 4 tonnes. Analysis of data from other Eastern India projects would have thrown some interesting facts regarding productivity of paddy. Unfortunately, OFD works in the Eastern States like Orissa and West Bengal have not progressed much. Data available from one eastern project Gandak (Uttar Pradesh) indicate that even with OFD works, the productivity is not different from the national level. However, on the basis of available information, with crop and water management achieving 4 to 5 tonnes of paddy per hectare will not be a very difficult task.

'With' and 'Without' (WW) Approach

The yield differential in BA approach may not reflect the true impact of OFD due to two reasons: *(a)* the presence of interaction of other related programmes having a bearing on productivity and *(b)* likely higher concentration of other inputs (including extension) as a result of greater CADA attention. In both the cases, there is a possibility of over-estimation.

A careful choice of 'without' can eliminate the possibility of over-estimation in pure yield effect. The impact under *(b)* could be estimated by having a careful study of input use in both 'with' and 'without' situation.

Only from five projects data are available for 'with' and 'without' comparison. Systematic studies were conducted in these projects. There appears to have been substantial changes in productivity in respect of crops like paddy, maize and jowar (Table II) in Andhra Pradesh whereas for paddy in Orissa the change has been moderate.[9] But it is interesting to observe that

8. "On-Farm Development in Chambal Command and Study of Binayaka I Catchment, ADC, CAD, Chambal", quoted in R.S. Saksena and D. Tripathy, "Water Scarcity and Command Area Management", Paper presented at the International Workshop on Contingency Irrigation Planning during Deficit Rainfall Years, held in Hyderabad, India, in 1983 (forthcoming in a volume).

9. Paddy and HYV paddy productivity has increased by 1.89 quintals and 3.07 quintals respectively. See Economic Evaluation of the Command Area Development Programme, Puri Delta, Puri, Department of Agricultural Economics, Orissa University of Agriculture and Technology, Bhubaneswar, 1983, p.75 (mimeo.).

TABLE II—NET BENEFITS OF CAD PROGRAMME, 1977-78

(Rs.)

Name of the project	Crop	Project with CAD			Without CAD			Additional net benefit due to CAD programme
		Gross return per hectare	Expenditure per hectare	Net return per hectare	Gross return per hectare	Expenditure per hectare	Net return per hectare	
Pochampad	Maize	4,054	1,040	3,014	2,045	1,018	1,027	1,987
	Paddy	3,615	1,334	2,281	2,576	1,050	1,526	755
Nagarjunasagar L.B.C.	Paddy	4,001	2,181	1,820	2,366	1,047	1,319	501
Nagarjunasagar R.B.C.	Paddy	3,418	2,302	1,116	2,095	1,675	420	696
Tungabhadra	Paddy	4,301	1,482	2,819	3,017	1,057	1,960	859
	Jowar	3,308	1,094	2,214	2,197	743	1,454	760
	Bajra	1,513	795	718	1,277	578	699	19

't' values of statistical differences in yield levels between the farms of the beneficiaries and non-beneficiaries in all the three system reaches (head, mid and tail) of Mahanadi Delta, Puri, in respect of crops, paddy (local), HYV paddy and groundnut, are significant at one per cent level (Table III). For sesamum, a

TABLE III—'T' VALUES OF DIFFERENCES IN YIELD RATE OF SELECTED CROPS BETWEEN BENEFICIARY AND NON-BENEFICIARY IN MAHANADI DELTA, PURI

Crops	Head		Middle		Tail		Overall	
	't' value	Significance level	't' value	Significance level	't' value	Significance level	't' value	Significance level
Paddy local	3.19	1%	3.88	1%	2.84	1%	3.51	1%
Paddy HYV	4.07	1%	7.61	1%	4.12	1%	5.10	1%
Gram	0.24	NS	0.11	NS	1.35	NS	0.97	NS
Groundnut	2.82	1%	3.06	1%	3.98	1%	3.02	1%
Sesamum	2.30	5%	2.26	5%	0.66	NS	2.14	5%

Source: Economic Evaluation of the CAD Programme, Puri Delta, *op.cit.*, p. 96.
NS=Not significant.

very light duty crop, 't' values are significant at 5 per cent level for head and mid reaches and for all the farms together, the productivity differences for sesamum, before 'with' and 'without' OFD, are significant at 5 per cent level.

Input Use and Net Returns

Uncontrolled field to field flow irrigation discourages use of optimum doses of critical inputs due to fear of leeching. Presence of a well laid-out

water distribution structures with a system of equitable and controlled distribution of water ensures certainty and helps in the use of higher doses of strategic inputs like fertilizers, consistent with various growth periods of crops. A comparison of the input expenditure with 'WW' approach reveals substantial increase of expenditure in OFD farms for paddy and jowar (Table II). This higher input use gets reflected in substantial differences in gross returns per hectare between the two categories. Additional net benefit attributable to CAD varies from Rs. 501 per hectare in the case of Nagarjunasagar (LBC) to Rs. 859 in Tungabhadra project.

In respect of maize, additional net benefit has been about Rs. 2,000 without any significant change in the use of inputs in Sriramsagar project. Maize, a crop requiring drained irrigation, can increase yield substantially under controlled irrigation system possible through OFD structures and strict water management schedules. In the case of bajra, the value of additional yield and the increase in expenditure on input almost match, leaving very little margin.

From the survey data for Mahanadi Delta, Puri, it is seen that the incremental income due to on-farm development is Rs. 389 per hectare (Table IV).

TABLE IV—RETURNS TO INVESTMENT IN ON-FARM DEVELOPMENT, MAHANADI DELTA, PURI

(Rs./hectare)

System reach	Net income		Incremental income	Incremental income as percentage of OFD investment	Incremental income as percentage of OFD investment inclusive of supervision cost of establishment.
	Beneficiaries	Non-beneficiaries			
Head	3,439.27	3,068.20	371.07	80.66	63.27
Middle	3,823.10	3,317.50	505.60	109.91	86.21
Tail	3,128.07	2,837.38	290.69	63.19	49.56
Overall	3,463.48	3,074.35	389.13	84.59	66.34

Source: Economic Evaluation of the CAD Programme, Puri Delta, Puri, *op.cit.*

Note:–(i) Cost of OFD at the rate of Rs. 460 per hectare.
(ii) Establishment cost, etc., forms about 27.5 per cent of the OFD investment cost.

The incremental income varies between Rs. 291 per hectare in tail reaches and Rs. 506 in mid reach farms. At head reaches the farmers reap a net benefit of Rs. 371 per hectare. The spurious argument that the head reach farmers will not be prepared to pay for the cost of OFD as they are not likely to benefit from OFD and others (*i.e.,* mid reach and tail reach farmers) will benefit at their expense, falls flat on the ground in the presence of substantial benefits accruing to those who are closer to the government outputs (head reaches), of major and medium projects, on account of OFD works.

Finally, the question of returns to investment on OFD. Saxena, in his analysis of Tawa project of Madhya Pradesh, shows that with the investment of Rs. 2,750 on OFD which is equivalent to an annualised cost of Rs. 337 per

hectare, the resultant additional income generation is Rs. 940 (1978-79 estimate).[10] In Orissa, the construction cost of field channels is Rs. 460 per hectare. Survey, planning, design and establishment costs taken together constitute about 27.5 per cent of the investment cost. Total investment cost of OFD adds up to Rs. 586.50. On an average, net return to investment on OFD is 66 per cent and it varies between 50 per cent in tail reaches and 86 per cent (in mid-reach farms). Even if the maintenance cost of about 5 to 10 per cent per annum is added, the return to investment on OFD will still be high.

Data on a wider scale are required to draw firm conclusions. Surveys intended to be taken up in various projects of India in near future will throw up much data for analysis and closer examination of various aspects determining the returns to investment on OFD.

Conclusion

Two basic issues associated with CAD programme are productivity and economics of on-farm development. Examination of the first issue on the basis of available data indicates that there has been substantial change in the productivity of major cereals, specifically paddy, in various projects in India.

Data available, on a limited scale, also indicate high returns to investment on on-farm development works taken up under CAD programme. This exploratory study underscores the need for more detailed evaluation studies with wide spatial dispersal to have firm conclusions.

10. Calculated from the paper of V.M. Saxena, "Impact of OFD Works on Land and Water Productivity, Tawa Command in Madhya Pradesh" in National Seminar on Impact of Command Area Development Programme on Land and Water Productivity and Economy of the Command Areas, *op.cit.*, pp.39-40.