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Watershed-based Development for Rural Prosperity — Evidences from Kerala

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Abstract

Watershed development programmes mainly aim to generate such activities, which would have *in-situ* conservation of as much precipitation as possible in soil profile and collection, storage and reuse of harvested water. The positive impact of the watershed programme in the Elanad watershed in Thrissur district of Kerala is reflected in increase in the number of beneficiaries adopting the soil conservation measures like contour bunding, construction of earthen bunds, terracing, and mulching. The water-harvesting techniques like rain pitting, digging and renovation of wells have been instrumental in raising the depth of water table in the watershed area. There has been a significant rise in the levels of water resources of the beneficiaries, indicating a positive impact on the moisture regime and groundwater recharge. The increase in crop productivity as a result of various factors like increased human labour-use, rise in manure application and increased moisture availability have been translated into higher farm income in nominal as well as real terms. The non-availability of irrigation water, untimely availability of inputs and subsidy on time, inadequacy of sanctioned amount, lack of awareness about the beneficial programme, lack of supervision and follow-up, and lack of technical guidance have been identified as the major constraints. To sum-up, the watershed-based development programme has resulted in increased crop production, productivity, employment generation, farm income and groundwater status, leading to overall rural prosperity in the area.

Introduction

Water resources management is an essential component of sustainable development as economic development is accompanied by increase in water-use. Proper watershed management entails triple benefits to human beings. Firstly, it maintains the productive capacity of natural resources in the watershed area; secondly, it arrests the degrading processes; and, thirdly, it is more cost-effective than rehabilitation of degraded watersheds. Watershed development programmes mainly aim to generate such activities, which would have *in situ* conservation of as much precipitation as possible in the soil profile; and collection, storage and reuse of such harvested water according to land capabilities. The ultimate purpose of development of a

watershed is to increase the economic and social well being of the participants of the basin in particular and of the nation as a whole.

In Kerala, out of 22.4 lakh ha of cultivated land in the state, around 9.0 lakh ha is prone to soil erosion, which constitutes 40.18 per cent of the total cropped area (Government of Kerala, 2004). Due to the predominance of small and fragmented holdings, massive interventions on a contiguous basis shall form the central strategy of any conservation measure. That is how an integrated soil and water conservation programme on watershed basis assumes significance. The National Watershed Development Project for the Rainfed Areas (NWDPA), a centrally sponsored project, is being implemented in Kerala from 1990-91 onwards. During the Ninth Plan, the Project was implemented in 74456 ha, covering 114 watersheds, at

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an outlay of Rs 25.69 crore (Government of Kerala, 2004).

There are various views on the impact of watershed-based programmes on rural development. A majority of researchers agree that increased cropping intensity, crop productivity, income, increased availability of fodder and improved groundwater status have been resulted as reported by Narayana and Prahalladiah (1999) from *Relegan Siddhi* of Maharashtra, Kumar *et al.* (1999) from *Bareilly* district of Uttar Pradesh, Chandrakanth (2001) from *Haikal* watershed in *Chitradurga* district of Karnataka, and Sripadmini *et al.* (2001) from *Venkateshpura* and *Taarehalla* watersheds in *Chitradurga* district of Karnataka. Similarly, a number of studies have reported that the economic impact of watershed development programmes accrue in terms of favourable benefit-cost ratio (Singh *et al.*, 1995; FAO, 1997; Dhruvanarayana *et al.*, 1997; Nalathwadmath *et al.*, 1997; Samuel, 1999; Farrington *et al.*, 1999; Sastry *et al.*, 2004; and Shaw *et al.*, 2004).

The present paper forms part of a project entitled, "Impact Evaluation of NWDPR Schemes Implemented during the IXth Five-Year Plan". The main objectives of the study were: (i) to evaluate the impact of NWDPR implementation in Kerala in terms of physical achievements, agronomic changes and socio-economic benefits, (ii) to assess the changes in land-use pattern and cropping pattern in the area, (iii) to examine the income and employment generation from agriculture and allied activities, and (iv) to analyze the constraints experienced in implementation of the programme.

Methodology

The study was undertaken in the Elanad watershed in Thrissur district of Kerala. The secondary data was collected from the records maintained by the Implementation Committee of the respective watersheds. The primary data was collected by personal interview method, using a structured, pre-tested schedule of enquiry. For collecting primary data, the respondents were categorized as beneficiaries and non-beneficiaries (control group). A beneficiary was operationally defined as any individual benefited by the watershed project for better living and non-beneficiary was defined as any resident in the non-project area

defined above, who did not receive any benefit of the project because the watershed development programme was not implemented. A total of 50 beneficiaries were selected randomly and 25 respondents were selected from the non project area for comparing the impact as a control group. The approach of "with" and "without" the project had to be adopted as bench mark information "before" the project implementation was not available with respect to all impact indicators. The primary data pertains to two periods, viz. pre-project period (1998-99) and post-project period (2003-04). As both observations were measured in current prices, the Agricultural Wholesale Index (AWI) was used as a deflator so that comparisons could be made at the 1998-99 constant prices.

Results and Discussion

Based on the impact indicators identified, the findings related to the land-use pattern, cropping pattern, labour-use pattern, productivity of crops, crop-wise expenses, income pattern and soil and water conservation measures. The watershed development programme could bring about a small change in the pattern of land-use for agriculture (Table 1). There was about 4.7 per cent increase in the area for agricultural purposes. It could be attributed to the conversion of non-arable land for cultivation of fodder crops, fodder trees, etc.

Table 1. Land-use pattern of the sample farmers in the watershed

Land use	Beneficiaries		Non-beneficiaries
	Before WDP	After WDP	
Agriculture	0.84	0.88	0.86
Non-agriculture	0.08	0.04	0.07
Total	0.92	0.92	0.93

Cropping Pattern

The cropping pattern of respondents, presented in Table 2, revealed that paddy was the major crop grown in the area. It occupied nearly 36.36 per cent of the total cropped area of the beneficiary farmers. It was followed by rubber (19.32 per cent), and coconut (18.18 per cent).

Table 2. Cropping pattern of sample farmers in the watershed
(in ha)

Sl. No.	Crop	Beneficiary	Non-beneficiary
1	Paddy	0.32 (36.36)	0.34 (39.53)
2	Coconut	0.16 (18.18)	0.18 (20.93)
3	Rubber	0.17 (19.32)	0.15 (17.44)
4	Banana	0.06 (6.82)	0.03 (3.49)
5	Pepper	0.04 (4.55)	0.06 (6.98)
6	Arecanut	0.05 (5.68)	0.06 (6.98)
7	Others	0.08 (9.09)	0.08 (4.65)

Note: Figures within the parentheses indicate the percentages to the respective totals

There was no significant difference between the cropping pattern of beneficiary and non-beneficiary farmers. The project could not make any significant impact on cropping pattern and cropping intensity in the watershed area.

Labour-use Pattern

The labour-use pattern of the beneficiary and non-beneficiary farmers, shown in Table 3, revealed that there was a substantial increase in labour-use following the implementation of the project in the case of beneficiaries. The labour use increased by 10.34 per

cent during this period. The increase in labour use was substantial for pepper (15.96%), arecanut (16.88%), rubber (20%) and coconut (20%). However, the average labour intensity was higher for the non-beneficiaries than beneficiary farmers. It was because of higher labour use per hectare by the non-beneficiary farmers in paddy and banana cultivation. There has been an increase in employment generation on account of the increase in labour use in agriculture-related activities during the post-project period.

Productivity of Major Crops

The productivity of major crops grown in the watershed area is depicted in Table 4. It can be noted that productivity of all the major crops in the area underwent significant improvements. The highest increase in productivity was noted in the case of coconut (26.92 per cent). In general, the increase varied from 13.54 per cent in rubber to 18-21 per cent in pepper, banana and areca nut. Thus, the project could achieve the productivity improvement envisaged in the watershed development programme.

Crop-wise Farm Expenses

The cost of cultivation of major crops grown in the area was estimated on nominal as well as real terms on per ha basis (Table 5). It revealed that the cost of cultivation of paddy, arecanut and rubber did not undergo any significant change during the project period. But, there was a visible change in the cost of cultivation of crops like coconut, banana and pepper. Input-wise analysis of farm expenses revealed that human labour was the major cost item in all the crops. Expenses on manures were the second important item

Table 3. Labour-use pattern of sample farmers in the watershed

Crop	Beneficiaries			Non-beneficiaries	Percentage change over control
	Before WDP	After WDP	Percentage change over time		
Coconut	70	84	20	81	3.7
Arecanut	77	90	16.88	89	1.12
Paddy	156	160	2.56	177	-9.6
Banana	166	167	0.67	183	-8.74
Pepper	94	109	15.96	104	4.81
Rubber	130	156	20	154	1.3
Mean	116	128	13	131	-1.24

Table 4. Productivity of major crops in the watershed area

Crop	Beneficiaries			Non-beneficiaries	Percentage change over control
	Before WDP	After WDP	Percentage change over time		
Paddy (kg/ha)	3250	3829	17.82	3749	2.13
Coconut (nuts/palm)	26	33	26.92	30	10
Arecanut (nuts/palm)	96	116	20.83	109	6.42
Rubber (kg/ha)	901	1023	13.54	960	6.45
Banana (kg/ha)	5132	6120	19.25	5960	2.68
Pepper (kg/ha)	183	216	18.03	209	3.35

Table 5. Crop-wise expenses in the watershed

Crops	(Rs/ha)				
	Before WDP (at 1998-99 prices)	Beneficiary		Non-beneficiary	
		(at 1998-99 prices)	(at 2003-04 prices)	(at 1998-99 prices)	(at 2003-04 prices)
Paddy	19,112	22,196	19,555	21,642	19,066
Coconut	9182	11,276	9934	10,748	9469
Arecanut	10,405	12,251	10,793	11,776	10,374
Banana	32,476	37,917	33,404	37,216	32,787
Pepper	13,880	16,040	14,131	15,870	13,981
Rubber	19,830	22,520	19,841	22,500	19,823

of expenditure. The increase in human labour was more evident in coconut, arecanut and rubber. There was a perceptible increase in the outlay on manures and chemical fertilizers once the soil moisture regime improved. This was more noticeable in coconut, arecanut and banana crops.

Income Pattern

The farm income of farmers in the project area and non-project area, depicted in Table 6, revealed that on an average, the farm income increased by 4.63 per cent in real terms during the project period. The crop-wise analysis of farm income per hectare revealed that the increase was modest in paddy, rubber, pepper and banana and was highest in coconut (11.82 per cent). The increase in crop productivity as a result of various factors like increased human labour-use, increase in manure application and increased moisture availability have been translated into higher farm income in nominal as well as real terms.

Livestock Status

The watershed programme had provided thrust to the livestock management components. It was observed

that cow, goat, pig and poultry were the common livestock components in the area. About 24 per cent of the beneficiaries owned cow, whereas 30 per cent reared goat. Poultry rearing was undertaken by 42.11 per cent of the beneficiaries. The livestock population was higher on the beneficiary than non-beneficiary farms.

The expenses incurred by the beneficiaries and non-beneficiaries declined during the project period (Table 7). It was on account of reduction in expenditure on human labour, concentrate feed and dry fodder. Cultivation of fodder crops and planting of fodder trees in the farm boundaries resulted in abundant availability of green fodder. This helped in reducing expenses on fodder and its collection.

It was observed that the livestock income during the project period increased considerably (Table 8). The income from livestock was higher for the beneficiary than non-beneficiaries farmers.

The watershed development programmes have brought certain changes in the livestock production systems using increased quantity of fodder, improvement of livestock management systems, etc.

Table 6. Income pattern of sample farmers in the watershed

Crop	Beneficiary					Non-beneficiary	
	Before WDP (1998-99)	After WDP			At current prices (2003-04)	At constant prices (1998-99)	
		At current prices (2003-04)	At constant prices (1998-99)	% change at constant prices			
Paddy	19500	22974	20240	3.79	22494	19817	
Coconut	16224	20592	18142	11.82	18720	16492	
Arecanut	16320	19720	17373	6.45	18530	16325	
Rubber	30634	34782	30643	0.03	32674	28786	
Banana	46188	55080	48525	5.06	53640	47257	
Pepper	14640	17280	15224	3.99	16720	14730	
Mean	23918	28405	25025	5.19	27130	23901	

Table 7. Cost of livestock production in the watershed area

Item	Beneficiary					Non-beneficiary	
	Before WDP	After WDP			At current prices (2003-04)	At constant prices (1998-99)	
		At current prices (2003-04)	At constant prices (1998-99)	% change at constant prices			
Concentrate	3450	3300	2907		3250	2863	
Dry fodder	1250	900	793		1100	969	
Labour charge	5300	5330	5242		5600	4934	
Miscellaneous expenses	950	875	771		1050	925	
Total	10,950	11,125	9801		11,000	9691	

Table 8. Livestock income in the watershed area

Item	Beneficiary					Non-beneficiary	
	Before WDP	After WDP			At current prices (2003-04)	At constant prices (1998-99)	
		At current prices (2003-04)	At constant prices (1998-99)	% change at constant prices			
Milk	11,200	13,800	12,158		13,100	11,541	
Dung	1750	1850	1630		1750	1542	
Total	12,950	15,650	13,788		14,850	13,083	

There was an increase in the livestock population during the post-project period. The livestock income had also recorded an increase in the real terms during this period. There was an increase in the green fodder availability among beneficiary farmers. Cultivation of fodder crops as a part of crop farming and raising of fodder trees on

the farm fences had increased the green fodder availability.

Soil and Water Conservation Measures

The watershed area lies in a range of physiographic classes and the slope ranges from gentle sloping to

steep areas. Sedimentation, transportation and rapid nutrient depletion from surface soil were the fundamental problems in the watershed. The watershed development programmes are addressed mainly to areas suffering from soil degradation and moisture stress. It could be observed from Table 9 that the practice of mulching, contour bunding, earthen bunds and rain pitting were the more adopted practices.

Table 9. Adoption of soil and water conservation measures in the watershed area

Category	(No. of respondents)	
	Beneficiaries	Non-beneficiaries
Contour bunding	15 (30)	11 (44)
Treching	4 (8)	6 (24)
Live fencing	24 (48)	12 (48)
Rain pit	15 (30)	12 (48)
Bunds	20 (40)	8 (32)
Terrace	36 (72)	16 (64)
Centripetal terrace	18 (36)	11 (44)
Mulching	38 (76)	23 (92)
Earthen bunds	34 (68)	18 (72)

Note: Figures within the parentheses indicate percentages to the respective totals

The positive impact of the watershed programme is reflected in the increase in the number of beneficiaries adopting the soil conservation measures like contour bunding, construction of earthen bunds, terracing, and mulching. The adoption of such measures by non-beneficiaries was only nominal. It was limited to the adoption of mulching construction of the bunds and fencing with live trees. There were no efforts to have conservation measures in non-arable lands.

Organic Matter Content of Soil

The organic matter content of the soil was analyzed both in the beneficiary sample as well as control plots. It was found that the organic matter ranged from 1.3 per cent to 6.1 per cent in the beneficiary samples, with a mean of 3.0 per cent. In the control plots, the range varied from 1.5 per cent to 3.5 per cent and the mean was 2 per cent. The average content of organic matter in the soil was higher for the beneficiaries than non-beneficiaries. The implementation of the watershed programme could be a major reason for the higher level of organic matter content in the soil of beneficiary farmers.

Groundwater Status

The details of assistance provided for the renovation of wells and ponds are given in Table 10. Out of the 50 beneficiaries, 43 had owned wells and 18 had ponds in their households. Following the implementation of watershed programme, 13 beneficiaries had availed the assistance for the renovation of wells, while 5 farmers had received assistance for the renovation of ponds.

Table 10. Assistance for rain water harvesting structures in the watershed

Respondents	(Number)	
	Well	Pond
Beneficiaries	43 (13)	18 (5)
Non-beneficiaries	19 (0)	4 (0)

Note: Figures within the parentheses indicate the number of respondents who had availed benefits

A comparison of the average height of water column indicated that there was 21.78 per cent increase in the groundwater level in the wells of beneficiary farmers after the implementation of the programme (Table 11). The water harvesting techniques like rain pitting, digging and renovation of wells were instrumental in raising the depth of water table in the watershed by around 20 per cent. As a result, even during the dry months water was available, while water scarcity was a serious problem in these areas before the implementation of project as wells used to start drying from February onwards. There was a significant rise in the water levels of the beneficiaries, indicating a positive impact on the moisture regime and groundwater recharge.

Constraints in Watershed Development Programme

The major constraints experienced by the sample farmers were identified and are presented in Table 12. These included: the non-availability of irrigation water, non-availability of inputs and subsidy on time, inadequacy of sanctioned amount, lack of awareness about the beneficial programme, lack of supervision and follow-up, and lack of technical guidance. Many respondents reported political interference also as a constraint, but they assigned lower importance to it as a factor limiting the programme. The project failed to address women-based activities, landless households

Table 11. Height of water column in the watershed area

				(in metres)
Height of water column for beneficiary	BeforeWDP	AfterWDP	Increase, %e	Non-beneficiary
Lowest	0.52	0.61	17.30	0.55
Highest	9.12	11.12	21.92	9.80
Average	4.82	5.87	21.78	5.18

Table 12. Constraints in the watershed development programme in the watershed area

Sl.No.	Constraint	Rank
1	Non-availability of irrigation water	1
2	Non-availability of inputs and subsidy on time	2
3	Lack of awareness about the beneficial programme	3
4	Lack of supervision and follow-up	4
5	Lack of technical guidance	5
6	Political interference	6
7	Inadequacy of sanctioned amount	7
8	Insufficient credit availability	8

and firewood availability. However, the women folk benefited indirectly through livestock-related activities because they were involved in livestock rearing.

Conclusions

The success of watershed development crucially depends on the holistic approach, whereby arable and non-arable lands receive priority in treatments. The positive impact of the watershed programme reflected in increase in the number of beneficiaries adopting the soil conservation measures like contour bunding, construction of earthen bunds, terracing, and mulching. The water-harvesting techniques like rain pitting, digging and renovation of wells have been instrumental in raising the depth of water table in the watershed. There has been a significant rise in the levels of water resources of the beneficiaries, indicating a positive impact on the moisture regime and groundwater recharge. There has been an increase in employment generation due to increase in labour use in agriculture-related activities during the post-project period. The increase in crop productivity as a result of various factors like increased human labour-use, rise in manure application and increased moisture availability have been translated into higher farm income in nominal as well as real terms.

The watershed development programmes have brought out certain changes in livestock production

systems using increased quantity of fodder, improvement in livestock management systems, etc. However, the project could not make any significant impact on the cropping pattern and cropping intensity in the watershed area. No efforts have been made to implement conservation measures in non-arable land. The project has failed to address women-based activities, landless households and firewood availability. However, the women folk has been benefited indirectly through livestock-related activities. There was a reasonable level of people's participation in the project planning and implementation in the project. The non-availability of irrigation water, non-availability of inputs and subsidy on time from *Krishi Bhavan*, inadequacy of sanctioned amount, lack of awareness about the beneficial programme, lack of supervision and follow-up, and lack of technical guidance are the major constraints perceived by the beneficiaries. To sum up, the watershed based development programme has resulted in increased production, productivity, employment generation, farm income and groundwater status leading to overall rural prosperity in the area.

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