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BALANCING THE ECOLOGY AND DEVELOPMENT OF AGRICULTURE THROUGH SOIL CONSERVATION MEASURES—A CASE OF NALA-CHECK SCHEME

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The basic intention behind agricultural development in India is to increase agricultural production in order to meet the ever-rising demand for agricultural produce. Increase in agricultural production can be achieved by adopting both extensive and intensive agriculture for which a number of programmes/projects were formulated and implemented during the era of Green Revolution. These programmes/projects are in operation for about a decade or two. Consequently, agricultural productivity no doubt increased considerably but lately, the effects of these programmes/projects on the environment and ecology have become glaringly evident. A sizable number of these programmes have had an adverse effect on the environment and ecology resulting in decrease in productivity which has more than offset the initial increase. For example, implementation of land development scheme results in the loss of the fertile layer which takes approximately five to ten years for restoration. Secondly, heavy doses of chemical fertilisers and excess irrigation have resulted in increasing the salinity of land rendering it almost useless for cultivation for approximately 15-20 years. Likewise, deforestation undertaken to increase the area under cultivation and for other reasons has resulted in serious ecological imbalances like soil erosion, recurring floods and droughts, etc., which will require more than 30-40 years to regain its balance if serious steps are taken now. The list is not exhaustive. Such adverse effects on environment and ecology have more than nullified the agricultural development achieved so far. The time has come to devise and adopt such projects in agricultural development which may change the environment to suit our purposes without disturbing the ecology. Nala-check is one of such measures adopted to balance ecology and agricultural development.

Nala-check is one of the measures of soil conservation used to prevent soil erosion without disturbing the ecology. The scheme is generally made operative on comparatively smaller nalas with lesser breadth. It proposes to construct a bund across the nala, with a provision to allow the smooth outflow of excess water by constructing a waste-weir. This helps in the prevention of soil erosion by checking gully formation. As a result of the waste-weir,

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the drainage problem also gets resolved and in the process accumulation of fine silt (soil) behind the main weir, *i.e.*, in the nala-bed results in reclamation of this land for cultivation, except in the main rainy season. This reclaimed land can be considered as an additional benefit, besides the prevention of soil erosion due to nala-check. Thus, the main objectives of the nala-check are (*a*) to prevent soil erosion resulting from gully formation along the course of nala, (*b*) to bring the area of nala-bed under cultivation, and (*c*) to increase the water-table of the wells situated along the course of the nala.

OBJECTIVES AND SAMPLE FRAME OF THE STUDY

The twin objectives of this study are to examine the economic benefits accrued to the sample farmers by implementing the Nala-check scheme on their farm and also to examine the economic feasibility of the technique at the farm level. The data used in the present study were collected through primary investigation of the cultivators at the Integrated Dry Land Agricultural Development Project (IDLADP), Mandrup, district Sholapur (Maharashtra) where the nala-check scheme was implemented. The nala-check scheme was implemented on a limited number of farms (*i.e.*, 20 schemes in three villages) at IDLADP, Mandrup depending upon the physical lay-out of the land. In the present study the data relating to all the 20 nala-check schemes have been taken into account. The reference year of the present study pertains to 1976-77.

RESULTS AND DISCUSSION

The long-term benefits which are of a permanent nature in the case of nala-check scheme are: (*i*) additional land brought under cultivation through control of soil erosion, and (*ii*) greater availability of irrigation water, due to the increase in the water-table of the wells situated along the nala-course. The yearwise details of the number of plots and the area affected/reclaimed, etc., are presented in Table I. The data show that almost 17 per cent of the

TABLE I. YEARWISE DETAILS OF THE NUMBER OF PLOTS AND THE AREA AFFECTED/RECLAIMED

Sr. No.	Year	Number of plots surveyed/schemes completed	Area eroded by nalas (areas)	Reclaimed land (after) nala-check scheme (acres)	Area not reclaimed but likely to be reclaimed (acres)
(1)	(2)	(3)	(4)	(5)	(6)
1.	1971-72	2	3·00	1·00	2·00
2.	1972-73	11	48·00	43·00	5·00
3.	1973-74	4	32·00	19·00	13·00
4.	1974-75	2	5·00	3·00	2·00
5.	1976-77	1	1·00	1·00	Nil
Total		20	89·00*	67·00	22·00

* Out of the total area of 537 acres in the 20 surveyed plots, the area eroded by the nala was 89 acres.

area of the sample plots had remained out of cultivation due to soil erosion, etc., as a result of the flooding by the nala. The nala-check scheme has resulted in bringing almost 75 per cent of this land under cultivation. The remaining 25 per cent (*i.e.*, 22 acres) of land had still not been put under cultivation because of some technical fault in the work undertaken in the field.

Another long-term benefit of the nala-check scheme is the availability of additional water for irrigation. The scheme results in increasing the water availability in the old wells and in addition, it is expected to make feasible the sinking of new wells adjacent to the scheme area.

Table II presents the data regarding water-table of the old (2) and new wells (4) and the cropwise area irrigated by these wells in the three different seasons, *viz.*, *kharif*, *rabi* and summer. For this purpose the water-table of the wells adjacent to the nala was measured at the beginning of the three seasons. It was found that after the implementation of the nala-check scheme, the water-table of these two wells increased considerably. Consequently, there was an increase in the area irrigated under the old wells. But it was found that only under one well the area had increased. In the case of the second well, although the water-table had increased, the area irrigated under this well did not increase due to some domestic problems.

The total area irrigated by these old wells in all the seasons (*i.e.*, the gross irrigated area) increased by 10.50 acres. In calculating gross irrigated area we have added the area under sugarcane thrice—in all the three seasons. Thus, we find that as a result of the nala-check scheme the gross irrigated area under old wells had increased by 84 per cent. The new wells are situated adjacent to nala-check schemes and were sunk after the implementation of the

TABLE II. WATER-TABLE OF THE WELLS AND THE CROPWISE AREA IRRIGATED IN DIFFERENT SEASONS UNDER NALA-CHECK SCHEME

Type of wells	Water-table (in feet)					
	June-July		October-November		April-May	
	Present	Past	Present	Past	Present	Past
(1)	(2)	(3)	(4)	(5)	(6)	(7)
Old wells						
	2	1	20	15	2	2
	15	4	20	10	15	2
New wells						
	3	—	30	—	3	—
	3	—	20	—	3	—
	Nil	—	9	—	Nil	—
	Nil	—	9	—	Nil	—

(Contd.)

TABLE II (*Concld.*)

Type of wells	Cropwise total area irrigated in different seasons													
	Kharif		Area (acres)		*Rabi*		Area (acres)		Summer		Area (acres)		Total area of all seasons (acres)	
	Present	Past	Present	Past	Present	Past	Present	Past	Present	Past	Present	Past	Present	Past
(1)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)	(19)	(20)	(21)
Old wells														
	—	—	—	—	Wheat	Wheat	0·5	1·0	—	—	—	—	0·5	1·0
	Sugar-cane	Ground-nut	4·0	1·0	Sugar-cane	—	4·0	—	Sugar-cane	—	4·0	—	12·0	1·0
New wells														
	—	—	—	—	Jowar	—	2·0	—	—	—	—	—	2·0	—
					Wheat	—	3·0	—	—	—	—	—	3·0	—
	—	—	—	—	Wheat	—	3·0	—	Ground-nut	—	1·0	—	4·0	—
	—	—	—	—	Jowar	—	10·0	—	—	—	—	—	10·0	—
	Bajra	—	3·0	—	Wheat	—	2·0	—	—	—	—	—	5·0	—
	Total		3·0	—	—	—	20·0	—	—	—	1·0	—	24·0	—

scheme. It was observed that the total area irrigated by these new wells in all seasons resulted in a substantial addition of area (*i.e.*, 24 acres) during the reference year.

Benefit-Cost Analysis (Nala-Check Scheme)

To work out the benefit-cost analysis of the nala-check scheme, we are mainly interested in economic analysis because our point of view is that of the society as a whole and it is assumed that all capital is supplied by the society and it is not necessary to recover this capital from the direct beneficiaries. In conducting a benefit-cost analysis of the nala-check scheme the following items of cost were considered:

1. Capital cost on nala-check scheme: The distribution of capital cost incurred on the nala-check scheme was reported from the year 1971-72 to 1974-75 and also in 1976-77, *i.e.*, for the five-year period and the cost reported was at the respective year's prices.

2. Capital cost incurred by the beneficiaries on sinking new wells and energising them: It has been reported that the investment on sinking four new wells was made during the years 1971-72 to 1973-74 while the investment on energising these new wells was made in the year 1974-75. The reported cost in sinking new wells was also at the respective year's prices.

The capital cost of the nala-check scheme and well sinking, etc., carried out over the five years was adjusted to 1976 prices by using price indices. The prices of oil engines used in the computation are those of 1976 and are net of excise duties and taxes. These were obtained from some major manufacturers of such equipment.

3. Operation and maintenance cost: Every year the project authorities have to incur some repair and maintenance cost for keeping the waste-weir clear and repairing any damages to the main bund. It has been decided to consider the annual maintenance cost as equivalent to 5 per cent of the total capital cost.

4. Cost of cultivation of crops: Only the incremental cost of cultivation of crops has been taken into account.

For the purpose of working out the benefit-cost ratio of the nala-check scheme, the items of benefits considered were (*a*) total crop production from reclaimed land, (*b*) incremental production from new wells and (*c*) incremental production from old wells.

Appraisal of the Nala-Check Schemes

The benefit-cost (B-C) ratio of the nala-check scheme turns out to be positive (1.18) at ten per cent social rate of discount, assuming the opportunity cost of labour (both family and hired) to be zero. This indicates that the scheme is economically viable. However, if the cost of labour at the going wage rate is taken into account while calculating the total cost of production of crops, the ratio comes to be less than unity (0.61), thereby indicating the economic unfeasibility of the scheme (for details, see Tables III and V).

TABLE III. NALA-CHECK: BENEFIT-COST ANALYSIS WITH AND WITHOUT LABOUR (FAMILY+HIRED) COST

Sr. No.	Period	Investment on water-lifting devices	Maintenance cost	With labour cost†			Gross cost
				Net increase in the production cost			
				New wells	Old wells	Reclaimed land	
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
1.	1971-72	—	—	—	589·58	196·07	785·65
2.	1972-73	—	955·40	2,041·75	1,179·16	8,627·08	12,803·39
3.	1973-74	—	4,677·50	2,041·75	1,768·74	12,352·40	20,840·30
4.	1974-75	759·80	6,435·00	4,083·50	2,358·32	12,352·40	25,989·02
5.	1975-76	759·80	6,654·35	4,083·50	2,947·90	12,352·40	26,797·95
6.	1976-77	759·80	6,654·35	4,083·50	3,537·50	27,548·42	27,583·57
7.	1977-78	759·80	6,902·45	4,083·50	3,537·50	12,548·42	27,831·67*

Sr. No.	Period	With labour cost†			Gross benefit	Net benefit
		Net increase in the crop production				
		New wells	Old wells	Reclaimed land		
(1)	(2)	(9)	(10)	(11)	(12)	(13)
1.	1971-72	—	1,683·33	150·00	1,833·33	1,047·68
2.	1972-73	981·62	3,366·66	20,175·00	24,523·28	11,719·89
3.	1973-74	981·62	5,059·99	25,300·00	31,331·61	10,491·22
4.	1974-75	1,963·24	6,733·32	25,300·00	33,996·56	8,007·54
5.	1975-76	1,963·24	8,416·65	25,300·00	35,679·89	8,881·94
6.	1976-77	1,963·24	10,100·00	25,560·00	36,723·24	10,039·67
7.	1977-78	1,963·24	10,100·00	25,560·00	37,623·24*	9,791·57*

(*Contd.*)

TABLE III (*Concld.*)

Sr. No.	Period	Without labour cost‡					
		Net increase in the production cost			Gross cost [a] (cols. 3+4+14+15+16)	Gross benefit	Net benefit
		New wells	Old wells	Reclaimed land			
(1)	(2)	(14)	(15)	(16)	(17)	(18)	(19)
1.	1971-72	—	297·33	105·88	403·21	1,833·33	1,430·12
2.	1972-73	965·50	594·66	4,658·72	7,174·28	24,523·28	17,349·00
3.	1973-74	965·50	891·99	6,670·44	13,205·43	31,331·61	18,126·18
4.	1974-75	1,931·00	1,189·32	6,670·44	16,985·56	33,996·56	17,011·00
5.	1975-76	1,931·00	1,486·65	6,670·44	17,502·24	35,679·89	18,177·65
6.	1976-77	1,931·00	1,784·00	6,776·10	17 905·25	36,723·24	19,717·99
7.	1977-78	1,931·00	1,784·00	6,776·10	18,155·35*	37,623·24*	19,469·89*

Notes:— † The present worth at ten per cent social rate of discount at the end of the 50th year is Rs. 89,593·56.

‡ The present worth at ten per cent social rate of discount at the end of the 50th year is Rs. 1,71,504·60.

* The same figure will continue upto the 50th year.

a = Gross cost includes investment on water-lifting devices, maintenance cost and net increase in the production cost.

TABLE IV. NALA-CHECK: WITH AND WITHOUT LABOUR (FAMILY + HIRED) COST (EXCLUDING NEW WELLS/FARM-PONDS IRRIGATION)

(*Rs.*)

Sr. No.	Period	With labour cost[a]			Without labour cost[b]		
		Gross cost*	Gross benefit	Net benefit	Gross cost*	Gross benefit	Net benefit
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
1.	1971-72	785·65	1,833·33	1,047·68	403·21	1,833·33	1,430·12
2.	1972-73	10,761·64	23,541·66	12,780·02	6,208·78	23,541·66	17,332·88
3.	1973-74	18,798·64	30,359·99	11,561·35	12,239·93	30,359·99	18,120·06
4.	1974-75	21,145·72	29,033·32	7,887·60	14,294·76	29,033·32	14,738·56
5.	1975-76	21,954·65	33,716·65	11,762·00	14,811·44	33,716·65	18,905·21
6.	1976-77	22,740·27	35,660·00	12,919·73	15,214·45	35,660·00	20,445·55
7.	1977-78	22,988·37	35,660·00†	12,671·63†	15,462·55†	35,660·00†	20,197·45†

Notes:— *a* = The present worth at ten per cent social rate of discount at the end of the 50th year is Rs. 1,10,613·45.
b = The present worth at ten per cent social rate of discount at the end of the 50th year is Rs. 1,74,837·25.

* Includes only maintenance cost and net increase in the production cost on old wells and reclaimed land (see Table III) under the two categories respectively.

†The same figure will continue upto the 50th year.

TABLE V. NALA-CHECK: BENEFIT-COST RATIO (INCLUDING AND EXCLUDING NEW WELLS)

Sr. No.	Period	Investment on nala-check scheme	Investment on new wells/farm-ponds sinking	Total (cols. 3+4)	D.F. (10%)	Including new wells			Excluding new wells		
						Present worth at 10 per cent social rate of discount	B-C ratio		Present worth at 10 per cent social rate of discount	B-C ratio	
							With labour cost	Without labour cost		With labour cost	Without labour cost
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
1.	1971-72	19,108·33	13,086·90	32,195·23	0·909	29,265·26			17,369·17		
2.	1972-73	74,441·59	18,828·44	93,270·03	0·826	77,041·02			61,489·09		
3.	1973-74	35,150·04	9,815·40	44,965·44	0·751	33,768·72			26,397·65		
4.	1974-75	4,388·36	—	4,388·36	0·683	2,997·00			2,997·00		
5.	1975-76	—	—	—	0·621	—			—		
6.	1976-77	4,962·49	—	4,962·49	0·564	2,798·57			2,798·57		
	Total					1,45,870·57	89593·56	171504·60	1,11,051·48	110613·45	174837·25
							145870·57 =0·61	145870·57 =1·18		111051·48 =0·996	111051·48 =1·574

Incidentally, it was observed that sinking of new wells and energising them add to the total capital cost stream of the nala-check scheme. These added costs result in losses which means that the proposition of sinking new wells is uneconomical and therefore adversely affects the total nala-check scheme. If this is so, the above programme will have to be withdrawn. If the programme is withdrawn the estimated results of the scheme will show a different picture.

The results under the new situation, *i.e.*, withdrawing of the programme of the new well but retaining the benefits accruing from old wells, have also been analysed (Table IV). The benefit-cost ratio under the new situation is positive with or without the cost of labour in the total cost of production. If the labour cost (family and hired) at the going wage rate is taken into account, the scheme is economically feasible (B-C ratio = 1.0) and if labour cost is not taken into account the scheme is profitable (B-C ratio = 1.57) (see Table V).

It should be noted that out of the 22 acres of uncultivated area, there is very remote possibility of nine acres being reclaimed and brought under cultivation. The balance of 13 acres of land is likely to be reclaimed. The gullies formed earlier due to the implementation of the scheme are slowly getting filled up and the land therefore got reclaimed and brought under cultivation is difficult to estimate. In view of the above, the benefits accruing over time from this land of 13 acres cannot be taken into consideration and have not been considered in the calculation of benefit-cost ratio. At whatever period of time this area of 13 acres is brought into productive use, the benefit-cost ratio will obviously improve.

The above analysis clearly shows that the nala-check measure does not go against the ecology although it checks the hostile environment to a certain extent, by avoiding soil erosion. The secondary benefits accrued from this measure are increase in water-table of adjacent wells and after a certain period, the possibility of increase in land under cultivation. These benefits are of a permanent nature and hence the nala-check scheme may be taken up on a large scale.