

Impact Assessment of ACA Watersheds Through Mid-Term Evaluation In Kalahandi District of Odisha, India

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Abstract- The overall performance of watershed programmes has been examined for 16 nos. of micro-watersheds for the first 3 years through mid-term evaluation in the state of Odisha. The impacts of major watershed programmes have been outlined in terms of bio-physical impacts, environmental impacts, socio-economic impacts and overall economic impacts. The watershed development activities have made significant positive impacts on various bio-physical aspects like soil and water conservation, soil and water erosion in the cropped area, changes in cropping pattern, cropping intensity, rise in water table, perennality of water in wells, water availability for livestock and other domestic purposes. The peoples' participation in watershed development activities, training and capacity building of farmers has been found very effective in gaining technical knowhow. The different commercial ventures taken up by the stakeholders in the watersheds were also found to increase.

Key Words – Watershed; impact; socio-economic; environmental; afforestation; water resources

I. INTRODUCTION

Indian agriculture is predominantly rainfed. Out of 143 million hectare of total cultivated area in the country, nearly 70 per cent areas are rainfed and about 42 per cent are dry land areas. Erratic distribution of rainfall in the country has always posed a serious threat to Indian agriculture and hence shattered the socio-economic status of Indian farmers. The reduction in productivity, deforestation and ground water depletion have also posed a serious concern to the path of agricultural development.

In India most of the watershed projects are implemented with the twin objectives of soil and water conservation and enhancing the livelihood status of the rural poor [6]. Different types of interventions carried out in a watershed include, soil and moisture conservation measures in agricultural lands (contour/field bunding and summer ploughing), drainage line treatment (loose boulder check dam, minor and major check dam, retaining walls etc.), water resource development and management (farm pond, dug well, percolation pond and micro-irrigation), crop diversification, crop demonstration, horticultural and silvicultural plantation and afforestation [1]. The aim has been to ensure the accessibility and availability of drinking water, fuel wood and fodder and raise income and

employment for farmers and landless labourers through improvement in agricultural production and productivity [3]. Active participation of people is a good indicator for sustainable development in a watershed [4]. The other impact indicators were far ahead in watersheds having greater people's participation. The importance of watershed programme was recognized by the villagers through awareness created by Project Implementation Agencies (PIAs) and watershed development team members through meetings, display boards, wall painting etc. [5]. The impacts of the Integrated Watershed Management Program in selected tribal areas of Gujarat and Chhattisgarh, India was assessed and positive link between watershed management and sustainable development was found [2].

Additional Central Assistance (ACA) watersheds under Revised Long Term Action Plan (RLTAP) is one of the major schemes launched and implemented to improve and conserve the natural resources through watershed basis. The Government of Odisha introduced this programme in all the hilly districts following the direction outlined by the Govt. of India. More than 80 per cent upland areas in all the hilly districts are mostly rainfed. In Western Undulating Zone of Odisha i.e. in Kalahandi district, the watershed development programme was implemented over geographical area of 10532 ha, from which, arable and non-arable land was 6472.5 ha and 2917.5 ha, respectively. The treatable arable area and non-arable area was to the tune of 3466.12ha and 1337.7 ha, respectively (Table 1). Thus impact assessment of those watersheds is necessary for further development.

II. MATERIALS AND METHODS

Mid-term evaluation of ACA watersheds was conducted in all the eight randomly selected watersheds out of the total 16 nos. of ACA watershed located in 8 blocks of the district (Table 1). The watershed evaluation team had detailed discussion with project implementation agencies and watershed committee members separately during their visit. Interactions with the beneficiary farmers, members of user groups (UGs), self-help groups (SHGs) and watershed committees were made. The factors on which the team emphasized in assessing the achievements

were physical and financial progress, status of water harvesting structures (WHS), increase in ground water level, plantation, soil conservation measures etc., participation in project implementation and contribution, constraints in achieving the target, training and skill development, social management of resources and socio-economic development of the UGs and SHGs. For impact assessment study, emphasis was given on women and SC/ST representation in watershed committees, constitution of SHGs and UGs, conduct of training/capacity building, exposure visits to stake-holders, conduct of regular meetings of watershed committees and watershed association, preparation of micro action plan, soil and moisture conservation works executed, water harvesting structures executed, methodology adopted for afforestation and horticulture.

III. RESULTS AND DISCUSSION

The different interventions taken in the watersheds were contour and graded bunding, continuous and staggered contour trenches, ring ditches, vegetative barriers, rock fill dams, loose boulder structures, farm ponds, percolation tanks, sunken ponds, check dams, runoff management structures, water harvesting structures, afforestation, renovation of existing structures, vermi compost pits, agro forestry plantation, agri-horti system, silviculture, mushroom cultivation, broiler farming, goat rearing, sheep rearing, cow rearing, bee-keeping, duckery, pisci-culture and kitchen gardens.

Table 1 Areal distribution for treatment of ACA Watershed under RLTP of Kalahandi district

Block	Name of watershed	Code No.	Treatable area (ha)	Area treated (ha)	Percentage of area treated
Bhawanipatna	Sardhapur	04-07-01-02-08-07-02-03	520	251.00	48.27
	Dorapadar	04-07-01-02-08-07-02-01	506	232.00	45.85
Kesinga	Kundabandha	04-07-01-02-08-10-01-02	660	246.00	37.27
	Gaudtola	04-07-01-02-08-11-02-01	463	264.00	57.02
Narla	Sripali	04-07-01-02-06-27-02-03	700	214.00	30.57
	Dengsargi	04-07-01-02-06-27-01-02	700	210.00	30.00
M. Rampur	Podagudi	04-07-01-02-04-04-01-01	550	238.00	43.27
	Kadamdunguri	04-07-01-02-04-04-01-02	600	261.00	43.50
Lanjigarh	Gopalpur	04-07-01-02-07-10-02-02	660	405.00	61.36
	Sikerkupa	04-07-01-02-07-09-01-02	700	372.00	53.14
Th. Rampur	Raj Khandual	04-07-01-05-03-01-01-02	300	278.00	92.67
	Maa Manikeswari	04-07-01-11-06-01-01-02	300	278.00	92.67
Koksara	Bangomunda	04-07-01-05-06-07-01-01	600	297.39	49.57
	Badpodaguda	04-07-01-05-06-07-01-01	500	303.47	60.69
Golamunda	Siva Shakti	04-07-01-05-01-03-02-04	700	353.96	50.57
	Bordi – Kuhura	04-07-01-05-01-06-02-01	650	600.00	92.31
Total			9109	4803.82	55.54

Women representatives in the committee ranged from 25 to 57 per cent. Majority of the representatives of Sardapur (53%), Dorapadar (57%), Rajkhandual (30%) and Maa Manikeswari (30%) watershed committees (WCs) were actively participating and raising their voice and feelings in different watershed activities and meetings for decision making (Table 2). The SC and ST representation in the watershed committee ranged from 25 to 90 per cent in all the 16 watersheds of the district. The maximum SC/ST representation was from Raj Khandual (90%) and

Maa Manikeswari (90%) watersheds. A total of 479 numbers of SHGs and UGs consisting of male and female were constituted in all the watersheds. Some of the women SHGs had been engaged in vegetable marketing, tailoring, preparation of spice powder, black gram products like noodles and cakes making, poultry farming, mushroom cultivation and preservation of fruits and vegetables. The SHG of Gaudtola has taken keen interest in pisciculture.

Table 2 Peoples' participation in ACA Watershed of Kalahandi district

Name of watershed	Women representative (%)	SC/ST representative (%)	Constitution of SHGs / UGs (No.)
Sardhapur	53	42	27
Dorapadar	57	39	36
Kundabandha	30	30	37
Gaudtola	30	30	35
Sripali	30	30	52
Dengsargi	25	25	43
Podagudi	30	30	33
Kadamdunguri	30	40	56
Gopalpur	25	70	12
Sikerkupa	25	60	10
Raj Khandual	30	90	10
Maa Manikeswari	30	90	13
Bangomunda	30	80	23
Badpodaguda	30	70	29
Siva Shakti	30	30	35
Bordi – Kuhura	30	30	28
Total	515	786	479
Average	32.19	49.13	29.94

A. Soil and Moisture Conservation Measures

There were 149 earthen bunds and 281km of continuous contour trenches (CCTs) in 109.8 ha of land. Different areas of the watersheds had been treated with 103 vegetative check dams, 40 rock fill dams, 162 loose boulder structures (Table 3). These structures were found to be functioning well in Dorapoadar and Gopalpur watersheds except at few places, where the structures had been damaged/silted up or both and needed maintenance.

There were 102 farm ponds, 29 percolation tanks, 42 drought/sunken ponds, 33 check dams, 38 nala bunding structures and 101 other structures like runoff storage structures/ water harvesting structures/ runoff management structures and ring wells (Table 4). Maximum 85 water harvesting structures including different types of water storage bodies had been constructed in Kadamdunguri watershed, which indicated the active participation the people.

Table 3 Conservation measures taken in ACA watersheds

Name of watershed	Bunding (m)	Area coverage under CCT (ha)	Vegetative checks (Nos.)	Earthen bunds (Nos.)	LBS (Nos.)	Rock filled dams (Nos.)
Sardhapur	1664	55	32	63	3	2
Dorapadar	2551	47	38	72	12	10
Kundabandha	200	49	10	0	0	8
Gaudtola	250	53	15	0	8	0
Sripali	524	43	03	2	2	2
Dengsargi	618	42	04	5	12	3
Podagudi	201	48	02	3	2	0
Kadamdunguri	1012	52	02	4	10	0
Gopalpur	805	81	03	0	40	0
Sikerkupa	328	74	04	0	13	0
Raj Khandual	258	56	03	0	10	10
Maa Manikeswari	277	55	05	0	20	0
Bangomunda	481	59	15	0	10	5
Badpodaguda	251	61	08	0	8	0
Siva Shakti	286	71	-	0	12	0
Bordi – Kuhura	249	120	-	0	0	1
Total	9955	966	144	149	162	41
Average	622.19	60.38	10.29	9.31	10.13	2.56

Table 4 Water harvesting measures taken in ACA watersheds

Name of watershed	Farm ponds (Nos)	Percolation tanks (Nos)	Drought/Sunken ponds (Nos)	Check dams (Nos)	Nala bunding structures (Nos)	Ring wells (Nos)
Sardhapur	13	2	4	5	1	15
Dorapadar	22	2	5	7	0	23
Kundabandha	0	3	0	2	0	6
Gaudtola	1	1	16	0	0	7
Sripali	1	2	2	5	2	0
Dengsargi	4	2	1	3	3	0
Podagudi	20	6	3	0	7	5
Kadamdunguri	40	5	4	11	25	0
Gopalpur	0	0	0	0	0	9
Sikerkupa	0	0	0	0	0	6
Raj Khandual	0	0	0	0	0	1
Maa Manikeswari	0	0	0	0	0	1
Bangomunda	1	3	1	0	0	3
Badpodaguda	0	1	6	0	0	4
Siva Shakti	0	2	0	0	0	8
Bordi – Kuhura	0	0	0	0	0	13
Total	102	29	42	33	38	101
Average	6.38	1.81	2.63	2.06	2.38	6.31

Afforestation was done in private and common lands separately over an area of 303.45 ha with 2,60,520 numbers of seedlings like teak, cashew, mango, acacia, amla, gamhari, bamboo, subabul, chakunda, karanja, simaruba and golmohur plants. Major plantations of acacia, amla, gamhari, bamboo, subabul, chakunda, karanja,

simaruba and teak had been taken up in community lands and fruit plants like mango, cashew and some forest species in private lands. It was found that around 153.55 ha of private and community land was under fruit tree plantation. The survival rate of the horticultural plantation varied from 50 to 60 per cent (Table 5).

Table 5 Afforestation in ACA watersheds of Kalahandi district

Name of watershed	Area covered (ha)		No of seedlings planted		Survival percentage (%)	
	Private land	Common land	Private land	Common land	Private land	Common land
Sardhapur	26	15	41600	24000	80	75
Dorapadar	18	12	18800	15360	95	82
Kundabandha	2.5	-	4500	4500	60	-
Gaudtola	2.5	30	50000	50000	70	72
Sripali	-	20	-	32000	-	71
Dengsargi	-	20	-	34000	-	50
Podagudi	-	41	-	10000	-	65
Kadamdunguri	-	48	-	10500	-	70
Gopalpur	10	-	16000	-	95	-
Sikerkupa	-	-	-	-	-	-
Raj Khandual	10	-	16000	-	82	-
Maa Manikeswari	15	-	24500	-	85	-
Bangomunda	16	-	21000	-	83	-
Badpodaguda	10	20	15350	33240	90	81
Siva Shakti	16	22	23500	35600	75	71
Bordi – Kuhura	8	12	11400	17350	65	76
Total	134	240	242650	266550	880	713
Average	12.18	24.00	22059.09	24231.82	80.00	71.30

B. Impact Assessment

Different watershed activities were taken up to conserve soil and moisture, develop water resources and increase green cover in the watershed area so as to maintain the ecological balance. From the ground water study it was revealed that the water level in the watershed area increased by 0.15 to 3.0 m after the developmental activities taken up in the watersheds. As evidence to ground water rise, 100 dug wells had been rejuvenated in the watershed area as per the observation of evaluation

experts. In addition to this 101 additional dug wells were also constructed in the watersheds during the programme. An additional area of 1497.8 ha had been brought under cultivation with rehabilitation of gullied lands and bunding of uplands, which helped to increase the infiltration opportunity time of runoff water in the watershed. Then the above area was brought under irrigation due to development of water resources in the boundary of watersheds (Table 6).

Table 6 Impact assessment of ACA watersheds of Kalahandi district with respect to water resources development

Name of watershed	Increase in water levels (m)	Dug wells rejuvenated (nos.)	Additional dug wells (nos.)	Average soil depth deposited across check dams* (cm)	Percentage of runoff loss (%)
Sardhapur	1.5	17	15	12.0	25.5
Dorapadar	1.8	38	23	15.0	18.0
Kundabandha	1.0	-	5	11.5	28.3
Gaudtola	0.9	10	5	12.5	27.5
Sripali	0.15	6	-	13.6	24.0
Dengsargi	0.20	2	-	14.1	24.5
Podagudi	2.1	2	10	11.6	31.5
Kadamdunguri	2.6	6	11	9.8	33.2
Gopalpur	1.0	2	-	10.9	27.0
Sikerkupa	1.0	-	2	13.3	21.0
Raj Khandual	1.2	1	2	12.6	25.3
Maa Manikeswari	3.0	5	10	9.8	32.0
Bangomunda	1.6	2	4	12.7	22.1
Badpodaguda	1.8	-	3	13.2	28.0
Siva Shakti	2.2	6	6	12.8	26.5
Bordi – Kuhura	2.1	3	5	11.7	16.5
Total	24.15	100	101	197.1	410.9
Average	1.51	7.69	7.77	12.32	25.68

*After 2 years of construction

The average cropping intensity increased from 80 to 166 per cent after 75 per cent treatment of the watersheds in 3 years (Table 7). Most of the user groups / beneficiaries were growing vegetables and other commercial crops like cotton, sunflower, spices crop like onion, chilly in the catchment areas. The high intense rains in monsoon period damaged the paddy crop in the watersheds. Due to creation of series of water harvesting structures/dug wells/farm ponds/percolation ponds/sunken ponds etc., the excess runoff resulting from high intensity rainfalls were successively stored and the same were used effectively during winter season for vegetable cultivation. The farmers of the catchments area not only saved their paddy in principal growing season (June –October) during initial dry spells by providing supplemental irrigation but also grew vegetables as their second crop.

The quick growing forest species like chakunda, subabul, simaruba ensured the availability of fuel wood as well as fodders for the goats and sheep. The availability of timber wood would take time as most of the forest species

like teak, gamhari, acacia plants were only of 2 to 3 years old. The average bio-mass production was increased by 24.73 per cent in case of timber and non-timber products (Table 7).

The labour migration was reduced to 7 per cent from maximum of 50 per cent due to successful implementation of watershed activities (Table 7). Most of the labourers were getting enough wage employment due to different watershed activities, facilities created for growing second crop and other allied agricultural activities during the project period. However, the stake holders were apprehending that after completion of project the labour employment might be reduced.

In Sardhapur and Dorapadar watershed the number of milch cows increased from 100 to 290 and 80 to 200 respectively. In other watersheds the increase in milch cows was not so much encouraging but there was enough scope for enhancing the number of milch cows in the treated areas.

There was considerable improvement in drinking water facility in all the watersheds due to enhancement in ground water recharge either naturally or artificially or both. Now, good quantity drinking water is made available to all the watershed dwellers in the project area.

Around 2790 nos of families had been found to be benefited directly and/or indirectly through watershed development activities, crop production, live stock production and management, fuel wood collection and other forest products, marketing of agricultural produce and value added products by SHGs and also through employment generation. From a sample estimate it was found that the annual income of stakeholders was increased from 50 to 60 per cent after 3 years of implementation of watershed programmes.

Some commercial interventions like vermi compost pits, mushroom cultivation, broiler farming, goat and sheep rearing, bee keeping, pisciculture and duckery, agri-horticultural system and kitchen garden were taken up in most of the watersheds. The average percentage increase of above interventions in sequence per watershed was found 38.46, 24.31, 37.86, 11.60, 9.60, 19.68, 30.80, 36.79 and 24.20 respectively (Table 8). The stakeholders were getting higher returns from the above commercial ventures through watershed development programme as per the discussions made with them.

The user groups and SHGs were in opinion that they would look into the post project maintenance of the structures created, continue growing water efficient crops following improved cropping pattern and modern agricultural practices based on the capabilities of lands. The officials of the bank and co-operative societies were also in agreement of providing adequate loan facilities for post project maintenance activities.

IV. CONCLUSION

Impact assessment of ACA watersheds indicated that women representation and their empowerment were very encouraging. The SC and ST representation in the watershed committee was also quite impressive. The SHGs and UGs were strengthened technically through training and exposure visits and financially through banks and co-operatives. Construction of water harvesting structures, dug wells construction and renovation, afforestation, horticultural and silvicultural development were quite impressive in terms of quality and quantity. It was realized from the study that there was considerable development of water resources due to construction of water harvesting structures, dug wells and rise in ground water table from 0.15m to 3.0m. There was also enhancement in cropping intensity from 80 to 166% due to adoption of improved cropping pattern and modern agricultural practices. Promising developments were also found in the improvement of drinking water facilities, reduction in labour migration, increase in milching cows and other animal resources like sheep, goat and poultry birds etc. In a nutshell, 174 farm families per watershed had been found to be benefited from the project. The commercial ventures taken up by the stakeholders were found to be very remunerative. The assessed programmes were economically efficient, technically feasible and socially acceptable while emphasizing on equity. Regular monitoring of environmental parameters is important for sustainable development as environmental enhancement increases the credibility and acceptability of the watershed programme.

Table 7 Impact assessment of ACA watersheds of Kalahandi district with respect to socio-economic values

Name of watershed	Additional area under cultivation (ha)	Cropping intensity increase (%)		Increase in bio-mass, timber and non-timber (%)	Improvement of pasture land for fodder (ha)	Labour migration (%)	Increase of milch cow (No.)	Families benefited (No.)
		Before project	After project					
Sardhapur	18.6	70	150	22	25	10	290	172
Dorapadar	20.6	85	160	29	15	10	200	180
Kundabandha	104	75	140	18	10	0	50	411
Gaudtola	85.4	55	150	20	13	0	30	402
Sripali	10.5	80	150	15	12	1	10	100
Dengsargi	12.2	90	175	27	15	1	20	120
Podagudi	91.2	85	150	25	10	0	0	210
Kadamdunguri	97.6	90	175	35	15	0	20	215
Gopalpur	285.0	82	200	40	21	0	40	20
Sikerkupa	270.0	75	150	35	12	12	45	25
Raj Khandual	90.6	80	160	18	25	0	68	100
Maa Manikeswari	101.5	90	170	32	24	0	20	41
Bangomunda	85.5	75	120	12	2	50	23	252
Badpodaguda	88.5	70	150	14	1	50	5	175
Siva Shakti	106.4	95	250	33	1	3	5	180
Bordi – Kuhura	30.2	90	200	18	14	3	12	187
Total	1497.8	1287	2650	393	215	140	838	2790
Average	93.61	80.44	165.63	24.56	13.44	8.75	52.38	174.38

Table 8 Percentage increase in different commercial activities in ACA watersheds of Kalahandi district

Name of watershed	Vermi compost pits	Mushroom cultivation	Broiler farming	Goat rearing	Sheep rearing	Bee-keeping	Pisci-culture and duckery	Stake holders in agri-horti system	Kitchen garden
Sardhapur	100	30.2	52.0	15.1	13.2	15.2	50.0	48.5	22.5
Dorapadar	30	20.2	44.2	13.5	11.1	-	40.0	33.4	23.6
Kundabandha	35	22.5	42.3	12.6	12.0	-	-	30.2	30.4
Gaudtola	30	24.7	45.6	13.4	9.7	7.5	-	32.2	28.8
Sripali	20	15.2	41.7	11.2	-	-	15.5	40.5	-
Dengsargi	20	-	40.8	13.6	-	-	17.5	42.5	18.8
Podagudi	30	-	50.5	-	10.3	20.0	30.3	50.0	24.0
Kadamdunguri	-	-	45.4	9.5	7.8	-	31.5	35.0	-
Gopalpur	-	25.0	35.0	15.0	-	25.4	-	30.5	-
Sikerkupa	20	30.3	30.5	14.2	6.6	-	-	22.5	26.5
Raj Khandual	30	22.2	15.8	8.6	-	-	-	34.0	27.2
Maa Manikeswari	100	-	25.4	9.0	-	-	-	25.0	19.0
Bangomunda	-	14.0	-	-	12.4	20.0	-	-	-
Badpodaguda	20	12.6	-	3.5	-	-	-	22.6	-
Siva Shakti	50	50.5	46.5	-	-	30.0	-	45.0	21.2
Bordi – Kuhura	15	-	14.4	-	3.3	-	-	60.0	-
Total	85	63.1	60.9	3.5	3.3	30	0	127.6	21.2
Average	38.46	24.31	37.86	11.6	9.6	19.68	30.8	36.79	24.2

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