

IMPACT OF SOIL & WATER CONSERVATION WORKS ON LAND PRODUCTIVITY, SOCIO-ECONOMIC AND LIVELIHOOD CONDITION OF BENEFICIARIES IN CHATTISHGARH STATE, INDIA

V.U. KOUNDANYA

General Manager (IWRM), WAPCOS Ltd

DR. K. P. S. MALIK

Dy. Chief Soil Conservation Officer, WAPCOS Ltd

ABSTRACT

Impact Evaluation Studies of National Watershed Development Project for Rainfed Areas (NWDPA) implemented during X Five Year Plan in six selected micro-watersheds in Chattishgarh State under East Zone was carried out by WAPCOS Ltd during 2009-10.

The programme activities were mostly concentrated in the agricultural land areas which form the major portion of the land use. The arable land treatments included contour bunding, contour bunding supported vegetative hedges (CVH). Biological measures like tree plantation, growing grass and shrubs, agro-forestry, horticulture, etc. were complementary to these activities at appropriate locations.

Surface water storage capacity of 93,375 cum has been created through construction of Farm Ponds and other water harvesting structures. While small dugout-ponds do not collect enough water for irrigation, they facilitate ground water recharge and provide life saving irrigation. It is, however, estimated that the stored water provides irrigation benefit for 350.88 ha of cultivated land in the sample watersheds.

The ground water level has increased by 0.5 to 2.46 m after the treatment of sample watersheds. An increase of 384.06 ha cultivated area has been recorded in the sample watersheds. Thus an overall increase in crop area sown has increased by 12.69 % in post-project period

The cropping intensity in all sample watershed at pre stage varied from 57% to 110.24% while at post project stage it touched 87.52 to 121.71% which indicate significant increment in cropping intensity. There has been a substantial increase in yields of almost all Kharif and Rabi crops grown in the watershed areas in the post-project periods compared to that in the pre-project period.

The percentage of migration is reduced to 65% from 85% at post project stage as compared to pre project stage.

The average income per household was also increased from Rs 11366/- at pre project stage to Rs. 14044/- at post project stage.

In an overall assessment, there has been all round improvement in terms of social and economic aspects.

Keyword: *Impact assessment; cropping intensity; agriculture income; social impact.*

INTRODUCTION

Soil and Water Resources are of utmost importance for fulfilling the requirements of food, fodder, fiber, fuel and timber of developing countries for burgeoning population. Green Revolution started in India during 1967-68 was a successes story of obtaining higher food production specially in irrigated areas. However, the gains of this agriculture development revolution were confined only to the irrigated areas and the requisite attention was not given to the development of rainfed and dry agricultural areas. Rainfed agriculture has a prominent role to enhance the Indian Economy as well as GDP; food security and rural livelihood. About 60% of the country's net sown area is rainfed and it contributes 40% of human and 60% of Livestock population. This disparity between the irrigated and rainfed areas has resulted in continuance of poverty, unemployment and under employment in dry land areas viz-a-viz the process of ecological degradation.

A National Watershed Development Project for Rainfed Area (NWDPA) was launched in 1990-91 in 25 states and two UTs. The project was continued during Tenth Five Year Plan in 28 states inclusive of three newly created States and two UTs with the purpose of increasing agriculture productivity and production in rainfed areas.

During the 10th Plan period under NWDPA programme out of 212 watersheds, 196 watersheds have been treated and developed covering 1,22,061 ha area. The impact evaluation study of five sample micro watersheds treated and developed was carried out in Chhattisgarh state during 10th Plan period.

NWDPA PROGRAMME

The National Watershed Development Project for Rainfed Areas (NWDPA) is a major thrust programme launched by the Deptt. of Agriculture & Cooperation, Ministry of Agriculture, Govt. of India during the 8th Five Year Plan in the year 1990-91 in 25 states and 2 Union Territories. The project continued during the Ninth Five Year Plan in 28 states, including the three newly formed states of Uttarakhand, Jharkhand & Chhattisgarh and 2 Union Territories with the purpose of increasing agricultural productivity and production in rainfed areas through sustainable use of natural resources by adopting watershed approach.

OBJECTIVES OF NWDPA

The project endeavours to achieve the twin objectives of sustainable production of biomass and restoration of ecological balance in the vast tracts of rainfed areas. It specifically focuses on :

- Conservation, development and sustainable management of natural resources including their use.
- Enhancement of agricultural productivity and production in a sustainable manner.
- Restoration of ecological balance in the degraded and fragile rainfed eco-systems by greening these areas through appropriate mix of trees, shrubs and grasses.
- Reduction in regional disparity between irrigated and rainfed areas.
- Creation of sustained employment opportunities for the rural community including the landless household.

Thus the ultimate objective of this project was to develop the natural resource base, sustain its productivity, improve the standard of living of poor farmers and landless labourers and endeavour for restoration of ecological balance.

ACTIVITIES CARRIED OUT UNDER PROGRAMME

The programme activities under the programme were implemented for arable lands, community lands which form the major portion of the land use and treating natural drainage outlets in the project area. Subsequently the promotional activities for moisture conservation, green manuring, horticulture and agro-forestry plantation were taken up in successive years of programme implementation. The workshops, farmers training and awareness camps were also organized for capacity building and encouraging participation of local community. The details of activities carried out under programme are as under:-

S.N.	Activities	
1	Entry point activity	Kisan Mela organised, Construction of Bathing Ghat, Construction of Chabutra
2	Training Programme	No of training conducted for farmers
3	Development Component	
A	Arable land	Soil & Moisture Conservation, Agro-Conservation practices.

B.	Non-Arable land	Water harvesting structure, Dry land horticulture, Biomass generation
C	Drainage Line Treatment	Upper reaches/ Middle reaches/ Lower reaches
4	Farm Production system for land owning families	Establishment of Nursery, Testing & Demo. of new Technology Adoption of Technology, Diversification of Production system
5	Livelihood support system for landless families	House hold Production system, Bio Mass based rural industry activities Livestock Dairy / Sericulture

METHODOLOGY

The five micro watersheds located in five districts of Chhattisgarh State were selected for the impact assessment study. The Watershed Project Reports (WPRs) have been collected and used for the overall comparison of pre- and post –project scenario of each watershed.

The salient features of sample watershed are given in Table 1:

Table 1 : Salient features of Sample Watersheds

S.No.	Particular	Sample Watershed				
		Karua Nalla Dhuma	Agar	Marga Nala	Karrajaor	Jharan
1	Code of Watershed	4G3A5B-I	4G3C7A-2	4G2B5H-I	4G2C2K	4E2D7B
2	District	Bilaspur	Durg	Jashpur	Raigarh	Rajnand-gaon
3	Block	Kota	Dhamdha	Manora	Pussore	Mohala
4	Agroclimatic Zone	Chhattisgarh Plain	Chhattisgarh Plain	Northern Hills	Chhattisgarh Plain	Chhattisgarh Plain
5	Total Area (ha)	1102.45	601.11	1105	505.00	1204.39
6	Agriculture land	382 ha	415 ha	630 ha	400 ha	442 ha
7	Treated Area	585 ha	560 ha	796 ha	472 ha	948 ha
8	Year of start	2002-03	2002-03	2002-03	2002-03	2002-03
9	Year of Completion	2006-07	2006-07	2006-07	2006-07	2006-07
10	Average annual rainfall (mm)	1250	1321	1589	1430	724
11	General Slope	< 8%	< 8%	4 to 8%	4 to 8%	<8%

Three sample villages, one each from upper, middle and lower reach of watershed area were selected for household data collection. In each village, the care had been taken for selection of households representing marginal, small, medium and large size farm holdings. Focused group discussions with the participation of knowledgeable village people and official field functionaries were held to assess socio-economic status of the people.

For collection of primary data, 30 households were selected from the sample micro watershed. The sample households comprised of 10 marginal, 10 small and 10 medium and large farmers. In addition to the above due weightage was given to caste composition while selecting sample households.

The present status of developed micro watersheds has been studied through the field visits and discussion with the beneficiaries and field functionaries. The information was examined critically and analyzed not only for physical and financial achievements but also for evaluation and determination the direct and indirect impacts of programme. The pre & post project data have been collected from Watershed Project Report and District Statistical Abstracts.

The information pertaining to socio-economic aspects have also been collected from the sample households of selected villages from different farm size groups to analyze and compare with the benchmark data. Some of the important indicators for comparison pre and post scenario of the project are as under:

1. Impact on Productivity of major crops (kg./ha.)
2. Change in Major cropped area (ha)
3. Change in Cropping Intensity (%)
4. No. of Farmers benefited
5. Farm income per ha. per year (Rs.)
6. Family income. per year (Rs.)
7. Landless people benefited (Nos.)
8. Migration of Rural Labour (Nos.)
- 9- Income generated from Horticulture (Rs.)
- 10- Green Cover / Biomass (%)
- 11- Fodder availability & its major sources
- 12 No. of micro – enterprises developed/created
- 13- Water storage capacity created (cum)
- 14- Change in Ground Water level (m)
- 15- Impact on Livestock
- 16 Income generation and employment
- 17- Impact on family assets and status of infrastructure facilities
- 18- Education and standard of living.

DATA INTERPRETATION AND ANALYSIS

The sample watershed wise secondary and primary data were compiled, processed and analyzed for assessing the overall impact of watersheds program.

RESULT AND DISCUSSION

Impact on Crop Sown Area

The sample watershed wise data on pre and post crops sown area was compiled and analyzed for assessing the overall change in season wise cropped area in all sample watersheds. The table reveals that during Kharif season, 173.49 ha has increased from 2126.59 ha to 2301.0 ha while in Rabi season an additional 86 ha area brought under cultivation. Thus an overall, the crops sown area increased by 256.56 ha has been recorded in all five sample watersheds i.e. 10.54%. The Table 2 indicating the impact of programme on season wise crop sown area in sample micro watersheds.

Table 2: Impact on area sown in Pre and Post Project Stage

Name of Watershed	Area (ha)						
	Kharif		Rabi		Annual Area		Additional Area
	Pre	Post	Pre	Post	Pre	Post	
Karua Nala Dhuma-	318.00	373.00	160.00	169.00	478.00	542.00	64.00
Agar	389.96	378.06	82.04	130.94	472.00	509.00	37.00
Marga Nalla	623.63	685.94	14.93	22.68	638.56	708.62	70.06
Karrajar	397.00	428.00	32.00	44.00	429.00	472.00	43.00
Jharan	398.00	436.00	18.00	22.50	416.00	458.50	42.50
Total	2126.59	2301.00	306.97	389.12	2433.56	2690.12	256.56

IMPACT ON IRRIGATED AREA

The area irrigated by tanks and farm ponds also increased through watershed management activities. The details of irrigated area in the sample watersheds are presented in Table 3. The table indicates that increase in irrigated area vary from 24% to 170%. The maximum increase in irrigated area after watershed completion was found in Jharan watershed of Rajnandgaon district (170.23%) followed by Marga Nalla, Jashpur (66.67%), Agar, Durg (56.06), Karrajar, Rajgarh (38.02) and Dhuma Karua Nalla, Bilaspur districts (24.13%).

Table 3: Impact on Irrigated Area

District	Name of Watershed	Total Area Irrigated (ha)		% Increase
		Pre	Post	
Bilaspur	Dhuma Karua Nalla	136.96	170.00	24.13
Durg	Agar	66.00	103.00	56.06
Jashpur	Marga Nalla	12.0	20.0	66.67
Raigarh	Karrajar	121.00	167.00	38.02
Raj Nandgaon	Jharan	62.45	168.74	170.23

IMPACT ON GROUND WATER TABLE

The soil conservation measures like contour bunding, drainage line treatment, farm ponds, water harvesting structures resulted in augmentation of ground water recharge in the project area. The information on ground

waters level fluctuation was obtained during the field visit from the sample households. Pre and post monsoon data of groundwater fluctuation in pre and post project stage are given in Table 4

Table 4: Impact on Groundwater Fluctuation (m)

Name of Watershed	Pre-Project		Post-Project		Change	
	Pre-Monsoon (m)	Post-Monsoon (m)	Pre-Monsoon (m)	Post-Monsoon (m)	Pre-Monsoon (m)	Post-Monsoon (m)
Dhuma (Kadwa Nala)	14.00	13.20	13.00	11.50	1.00	1.70
Agar	15.00	14.50	14.50	13.75	0.50	0.75
Marga Nalla	4.25	3.87	3.50	2.90	0.75	0.97
Karrajor	20.00	18.90	19.70	18.60	0.30	0.30
Jharan	5.00	4.00	3.00	2.50	2.00	1.50

Due to successful implementation of programme ,the ground water level has increased by 0.3 to 2 m in both pre and post monsoon season .During the passage of time with irrigated agriculture ,ground water level may rise further to some extent thereby more farmers may affordably use it for supplemented lifesaving irrigation.

IMPACT ON CROPPING INTENSITY

The cropping intensity in all sample watersheds at pre stage varied from 94% to 125% while at post project stage it varied from 103 to 142% which indicate an increment in cropping intensity. The maximum increment in cropping intensity was observed 16.75 in Karua Nala Dhuma in Bilaspur while minimum in Agar – Durg i.e. 8.92 %. The micro watershed wise cropping intensity during pre and post project situation given in Table 5

Table 5 : Impact on Cropping Intensity

District	Name of Watershed	Agriculture Land (ha)	Area Sown (ha)		Cropping Intensity (%)		Change % (+)
			Pre	Post	Pre	Post	
Bilaspur	Dhuma (Karua Nala)	382.00	478.00	542.00	125.13	141.88	16.75
Durg	Agar	415.00	472.00	509.00	113.73	122.65	8.92
Jashpur	Marga Nalla	630.00	638.56	708.62	101.36	112.48	11.12
Raigarh	Karrajar	400.00	429.00	472.00	107.25	118.00	10.75
Raj Nandgaon	Jharan	442.00	416.00	458.50	94.12	103.73	9.62

IMPACT ON CROP YIELD

The crop yields were recorded before the inception of the projects and crop wise yields also recorded in post project-stage during the field surveys from sample households. The increase in crop yields in all major crops has been observed. The watershed wise yields of paddy, arhar, urd, groundnut, pulses during Kharif and wheat, gram, oilseeds during Rabi have been given in **Table 6**.

Table 6 : Impact on Crop Yield

Name of Watershed	Name of Crop	Area (ha)		Average Yield (q/ha)		Production (q)		Increase crop yield (%)
		Pre	Post	Pre	Post	Pre	Post	
Karua Nalla Dhuma	Paddy	315	373	15.2	16.75	4788.00	6247.75	11.67
	Wheat	20	22	8	9.1	160.00	200.20	13.75
	Gram	20	21	5	6.2	100.00	130.20	24.00
	Pulses	123	126	7.2	8.6	885.60	1083.60	19.44
Khabari Nalla	Paddy	389.96	378.06	18	20	7019.28	7561.20	11.11
	Wheat	12	15	8.25	10	99.00	150.00	21.21
	Pulses	37.97	68.94	7.9	8.05	299.96	554.97	1.90
	Oilseeds	32.07	47	4.21	6	135.01	282.00	54.22

Marga Nalla	Paddy	623.63	685.94	15.8	18.57	9853.35	12737.91	17.53
	Arhar	2.88	4.68	3.6	4.30	10.37	20.12	19.44
	Wheat	7.38	11.05	7.88	11.05	58.15	122.10	52.03
	Pulses	4.67	6.95	4.67	6.95	21.81	48.30	34.21
Karrajor	Paddy	381	400	37	40	14097.00	16000.00	8.11
	Ground nut	7	9	15	16	105.00	144.00	6.67
	Arhar	5	7	9	10	45.00	70.00	11.11
	Urd	11	21	11	12	121.00	252.00	9.09
	Wheat	10	14	16	20	160.00	280.00	52.00
	Sunflower	10	15	21	22	210.00	330.00	4.76
Jharan	Paddy	383	418	8.66	20	3316.78	8360.00	130.95
	Arhar	15	18	2.5	3.2	37.50	57.60	28.00
	Gram	8	11	2.1	2.6	16.80	28.60	20.00

It is observed that in case of paddy crop overall increase of 8.11 % i.e. from 37 q/ha to 40 q/ha has been recorded whereas in wheat the same has been increased by 25%.

In sample watersheds of Karua Nala Dhuma increase in paddy yield was found 11.67 % whereas in gram the yield increased up to 24 %.

In sample watersheds of Durg district in paddy crop overall increase of yield was 11.11% whereas in wheat the average yield has increased up to 21.11%.

It is found in sample watersheds of Jashpur district that in case of paddy crop yield increased by 17.53 % whereas in wheat the same has increased up to 52.03 %.

As regards sample watersheds of Rajnandgaon district, an increase in paddy yield from 8.66 q/ha to 13.85 q/ha i.e 130 % has been recorded whereas in wheat the it has increased by 15.38 %. The other crops like pulses and oilseeds during kharif have also shown improvement in crop yields in all the micro watersheds under study. Similarly during rabi season crops like gram, also showed incremental yield.

IMPACT ON HUMANE MIGRATION

In general people migrate seasonally for employment to the nearest town while no migration of livestock has been observed in the developed watershed. However, there is reduction in the migration of rural labourers at post project stage in all sample watersheds. The percentage of migration was reduced from 27.27 to 33.33 % at post project stage as compare to pre project stage.

The livestock migration is always associated with the shortage of pasture lands and drinking water as such no migration was reported in pre & post project condition. The table showing migration pattern of rural folk in the project area is given in Table 7.

Table 7: Migration Pattern of Human and Livestock

Name of Watershed	Migration of rural labour (No)		% Change
	Pre	Post	
Dhuma (Karua Nala)	495	135	27.27
Agar	30	10	33.33
Marga Nalla	0	0	0.00
Karrajar	300	100	33.33
Jharan	0	0	0.00

From the above analysis of data, it is evident that after the implementation of the project, the seasonal migration was also checked. In majority of watersheds, the households are deriving their livelihood from the available resources base and compulsive migration for need of employment is minimized.

IMPACT ON LAND VALUES

As result of soil moisture conservation activities and land development works in sample watershed area, the land topography has been transformed in the terraces of gently slopping lands. As a result of in-situ moisture conservation and enhanced ground water recharge, the groundwater level and groundwater yield has also improved in all watersheds. This has resulted into conversion of farm lands from single cropping to double cropping in addition to higher crop yields. Further during field visit it was informed by some of the stakeholders that after treatment of gullied areas, the soil erosion is controlled and expanding gully heads are checked.. The value of land for irrigated and unirrigated area in pre and post project situation is given in Table 8 .This has also made positive impact on land values

Table 8:. Impact on value of Farm Land (Rs. Lakh/ ha)

S. No.	District	Watershed Code No.	Name of Watershed	Irrigated Land Value		Unirrigated Land Value	
				Pre	Post	Pre	Post
1	Bilaspur	4G3A5B-I	Dhuma (Karua Nala)	1.50	2.70	0.87	1.22
2	Durg	4G3C7A-2	Agar	1.25	2..35	0.70	0.95
3	Jashpur	4G2B5H-I	Marga Nalla	0.75	1.60	0.40	0.72

4	Raigarh	4G2C2K-I	Karrajor	0.85	1.90	0.42	0.76
5	Raj Nandgaon	4E2D7B-I	Jharan	0.60	1.25	0.31	0.56
		Average		0.99	1.49	0.54	0.84

The data indicated that there was a significant impact on land values in all the treated areas. The increase in land value varied from Rs. 0.65 lakh per ha to Rs. 1.10 lakh per ha in irrigated lands where as in unirrigated areas, it increased from Rs. 0.25 lakh per ha to Rs. 0.35 lakh per ha in post project situation as compared to pre project stage.

IMPACT ON HOUSEHOLD INCOME

An attempt was also made to get the information from the beneficiaries about their annual income from various sources. Since the farmers do not maintain any record, it is very difficult for them to report the correct figures of their annual income. However, based on the information provided by the farmers the average annual family income from farming and non-farming sources for different reaches as well as for different categories of farm sizes is presented in Table 9.

Table 9: Impact on House hold Income (Rs)

S. No.	District	Name of Watershed	All Sources		Change (%)
			Pre	Post	
1	Bilaspur	Dhuma (Karua Nala)	12860	17670	37.4
2	Durg	Agar	13500	21700	60.54
3	Jashpur	Marga Nalla	11800	15870	34.49
4	Raigarh	Karrajor	13250	18450	39.25
5	Raj Nandgaon	Jharan	10570	13420	26.96
		Average	12396	17422	40.55

The analysis reveals that annual income per household was higher among large farmers. Since the main sources of income was from farming, the income increases with the increase in farm size. The figures of annual income per household from farming are significantly higher in post project stage as compared to pre project stage. The average income from all sources was significantly higher in post project stage i.e. Rs 17422/- as compared to pre project stage Rs. 12396/-. On over all basis the condition of household in monetary terms in post project stage was better than pre project stage. It is also revealed from the table that maximum change in the income was recorded in the sample watershed of Durg District i.e. 60.74% and minimum in Rajnandgaon 26.96%. The reason of maximum increment in the household income in Durg was due to crop diversification and adoption of vegetable crops of, tomato and chilly.

CONCLUSION

Making an overall assessment of the programme activities as implemented and the impacts made on various aspects of the watershed development, it can be concluded that the watershed programme has been implemented in depth & dimension, and the multidimensional benefits have accrued to all sections of the resident population who have almost owned the programme.

References:

- 1-Harrasing Opportunities in Rainfed Areas,-A pathway to prosperity .Vision-2025 published by National Rainfed Area Authority, Planning Commission, Government of India
- 2-Common Guidelines for Watershed Development Projects published by National Rainfed Area Authority, Planning Commission, Government of India-2008
- 3-WARSA – JAN SAHBHAGITA, Guidelines for National Watershed Development Project for Rainfed Areas (NWDPPRA) Government of India, Ministry of Agriculture & Cooperation.

BRIEF PROFILE OF THE AUTHORS

***Vinayak U. Koundanya:** Presently working as a General Manager (IWRM), in WAPCOS Limited. He is honored by “Bharat Jyoti Award” and “Best Citizen of India” award during 2011. Has over 35 years of Rich Engineering experience and presently giving overall guidance to IWRM, D&AS and PA&A divisions for several National and International projects. Looking Business Development activities and giving guidance on policy matters. Research papers published in National and International Conferences. Worked in various organizations like Tulzapurkar and Associates private org., Irrigation Dept. Govt. of Maharashtra, CSMRS, CWC and as a Secretary in Brahmaputra Board. Participated in TV discussions on “Flood Management in Assam” from Guwahati Doordarshan on July 1997.

**** Dr K.P.S.Malik:** Presently working as a Dy Chief Soil Conservation Officer in WAPCOS Limited.He has completed his MSc and Ph.D. (Soil Science) from G.B. Pant University of Agriculture & Technology, Pantnagar, U.P .He has over 20 years experience of consultancy in Soil Survey, Monitoring and Evaluation of projects like CAD, Integrated Agriculture, land reclamation, watersheds, irrigation and command area development projects in India and abroad.