IMPACT OF SOIL AND MOISTURE CONSERVATION ACTIVITIES ON SOURCES OF IRRIGATION THROUGH WATERSHED MANAGEMENT

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ABSTRACT: *The development of surface and ground water resources is critical in improving land productivity in the rainfed areas. Different types of treatment activities were carried out in the watersheds. These included soil and moisture conservation measures in agricultural lands, drainage line treatment, water resource development/ management, crop demonstration, horticultural plantations and afforestation as per the needs and priorities of the community. Development of water resources received prime attention in all the watersheds, and average fourty to fifty per cent of the total project expenditure allocated for creation of additional water storage capacity through the construction and rejuvenation of ponds, construction of check-dams, construction of gully plugs/ Pakka nala bunds, Gabion structures, stop dams, percolation tanks, well-recharge, farm-ponds etc. which also influence the groundwater recharge of the nearby wells. These may result in increase in the net and gross irrigated area; irrigation intensity as well as gross irrigated area as a proportion of gross cropped area. A cumulative effect of all the land-based interventions and development of surface and groundwater resources may result in significant changes in ground water table and irrigation facilities as well as productivity levels of all the major crops in the watersheds over the pre-project situation. To know the impact of soil and moisture conservation practices on sources of irrigation this study was undertaken.*

Keywords: *Soil and moisture conservation, watershed, Ground water table.*

INTRODUCTION:

One of the major expected outcomes of the Integrated Watershed Management Program should be improving in groundwater recharge and its availability. Increase in ground water table in watershed areas is also an important measurable indicator of successful implementation of watershed programme. Due to various *in-situ* and *ex-situ* soil and water management and other watershed interventions, there should be significant increase in groundwater levels and surface irrigation facilities. Various factors are accountable for increase in ground water. The water harvesting structures play a key role by storing water and allow sufficient time for water to percolate into the ground. Land development activities such as contour bunding, land leveling and cultivation practices also contribute towards accumulation of ground water. The increased water levels also render some respite in the drinking water situation in the project villages.

OBJECTIVE OF THE STUDY:

To study the impact of watershed development work on soil and moisture conservation, ground water recharge, changes in land use pattern, crop productivity, changes in agricultural and animal husbandry practices and subsequent impacts on rural livelihood.

RESEARCH METHODOLOGY:

In order to study the objectives of the study, ex-post-facto research design was selected, for that a well-structured interview schedule was prepared. There are 34 watersheds implemented in 3 batches of IWMP Phase I in the Surat District, out of which 6 watersheds selected and studied for this research. The interview schedule consisted of specific questions pertaining to soil and moisture conservation activities and its impact on various parameters was operated among total 150 core activity beneficiaries (25 from each watershed) i.e. farm land owners of the selected micro-watersheds. The respondents were selected by simple random method from the list derived from Watershed Development Team members and Village Watershed committees (VWC) and Watershed User Association (WUA).

RESULTS AND DISCUSSION:

Generally the farmers utilize well, bore well, river, pond, canal etc. as their irrigation sources. The farmer beneficiaries were asked about the changes in their irrigation sources whether they experienced. Out of total 150 respondents majority of the respondents (72.70 per cent) agreed for having such type of changes due to watershed interventions. Further all the respondents asked about the position of their different types

of irrigation sources, its numbers, and water-table in feet, duration of water availability in months and irrigated land in hectares before the watershed intervention and if changes may occur due to the watershed treatments. The responses for the same were registered and tabulated as given in **Table 1**.

The data presented in Table 1 revealed that, before the watershed intervention nearly one-third of the respondents were utilizing well as a source of irrigation. There were total 48 numbers of wells which farmer respondents utilizing for their source of irrigation. Among these, majority of wells (37 numbers) had water-table between 21-40 feet depth, followed by 7 numbers of wells had water at 41-60 feet depth. Only 4 numbers of well had the water-table at the 20 feet depth. There were 33 wells which could provide irrigation facilities for more than 5 months but, less than 8 months. Ten numbers of wells could irrigate the fields for 9-12 months whereas, 5 wells could hardly serve their fields up to 4 months. It was also found that, 36 numbers of wells could irrigate up to 1 ha of land, while 4 wells had a capacity to irrigate between 1 ha to 2 ha of land. Only 5 numbers of wells were irrigated more than 2 ha of land and 3 wells were dry in condition.

TABLE 1: IMPACT OF MOISTURE CONSERVATION ACTIVITIES ON SOURCES OF IRRIGATION OF IWMP BENEFICIARIES

Irrigation Source	Pre IWMP							Post IWMP						
	Total Numbers	Range of Water Table in Feet	Count	Duration of Water Availability in Months	Count	Irrigation in Hectare	Count	Total Numbers	Range of Water Table in Feet	Count	Duration of Water Availability in Months	Count	Irrigation in Hectare	Count
Well	48	<= 20.00	4	<= 4.00	5	<= .00	3	66	<= 20.00	20	<= 4.00	2	<= .00	0
		21.00 - 40.00	37	5.00 - 8.00	33	.01 - .99	36		21.00 - 40.00	45	5.00 - 8.00	19	.01 - .99	47
		41.00 - 60.00	7	9.00 - 12.00	10	1.00 - 1.99	4		41.00 - 60.00	1	9.00 - 12.00	45	1.00 - 1.99	12
		61.00 - 80.00	0			2.00 +	5		61.00 - 80.00	0			2.00 +	7
		81.00 - 100.00	0						81.00 - 100.00	0				
		101.00+	0						101.00+	0				
Bore	27	<= 20.00	1	<= 4.00	2	<= .00	1	52	<= 20.00	4	<= 4.00	1	<= .00	0
		21.00 - 40.00	6	5.00 - 8.00	18	.01 - .99	22		21.00 - 40.00	27	5.00 - 8.00	13	.01 - .99	34

Irrigation Source	Pre IWMP							Post IWMP						
	Total Numbers	Range of Water Table in Feet	Count	Duration of Water Availability in Months	Count	Irrigation in Hectare	Count	Total Numbers	Range of Water Table in Feet	Count	Duration of Water Availability in Months	Count	Irrigation in Hectare	Count
		41.00 - 60.00	14	9.00 - 12.00	7	1.00 - 1.99	0		41.00 - 60.00	14	9.00 - 12.00	38	1.00 - 1.99	12
		61.00 - 80.00	1			2.00 +	4		61.00 - 80.00	4			2.00 +	6
		81.00 - 100.00	3						81.00 - 100.00	2				
		101.00+	2						101.00+	1				
Farm Pond	0	<= 20.00	0	<= 4.00	0	<= .00	0	1	<= 20.00	1	<= 4.00	0	<= .00	0
		21.00 - 40.00	0	5.00 - 8.00	0	.01 - .99	0		21.00 - 40.00	0	5.00 - 8.00	1	.01 - .99	1
		41.00 - 60.00	0	9.00 - 12.00	0	1.00 - 1.99	0		41.00 - 60.00	0	9.00 - 12.00	0	1.00 - 1.99	0
		61.00 - 80.00	0		0	2.00 +	0		61.00 - 80.00	0		0	2.00 +	0
		81.00 - 100.00	0						81.00 - 100.00	0				
		101.00+	0						101.00+	0				
Group-Well	2	<= 20.00	0	<= 4.00	0	<= .00	0	15	<= 20.00	1	<= 4.00	2	<= .00	0
		21.00 - 40.00	2	5.00 - 8.00	2	.01 - .99	2		21.00 - 40.00	14	5.00 - 8.00	9	.01 - .99	14
		41.00 -	0	9.00 - 12.00	0	1.00 - 1.99	0		41.00 -	0	9.00 - 12.00	4	1.00 - 1.99	1

Irrigation Source	Pre IWMP							Post IWMP						
	Total Numbers	Range of Water Table in Feet	Count	Duration of Water Availability in Months	Count	Irrigation in Hectare	Count	Total Numbers	Range of Water Table in Feet	Count	Duration of Water Availability in Months	Count	Irrigation in Hectare	Count
		60.00							60.00					
		61.00 - 80.00	0		0	2.00 +	0		61.00 - 80.00	0		0	2.00 +	0
		81.00 - 100.00	0						81.00 - 100.00	0				
		101.00+	0						101.00+	0				
Check Dam	0	<= 20.00	0	<= 4.00	0	<= .00	0	15	<= 20.00	15	<= 4.00	6	<= .00	0
		21.00 - 40.00	0	5.00 - 8.00	0	.01 - .99	0		21.00 - 40.00	0	5.00 - 8.00	9	.01 - .99	14
		41.00 - 60.00	0	9.00 - 12.00	0	1.00 - 1.99	0		41.00 - 60.00	0	9.00 - 12.00	0	1.00 - 1.99	1
		61.00 - 80.00	0		0	2.00 +	0		61.00 - 80.00	0		0	2.00 +	0
		81.00 - 100.00	0						81.00 - 100.00	0				
		101.00+	0						101.00+	0				
River	1	<= 20.00	1	<= 4.00	1	<= .00	0	2	<= 20.00	2	<= 4.00	1	<= .00	0
		21.00 - 40.00	0	5.00 - 8.00	0	.01 - .99	1		21.00 - 40.00	0	5.00 - 8.00	1	.01 - .99	2
		41.00 - 60.00	0	9.00 - 12.00	0	1.00 - 1.99	0		41.00 - 60.00	0	9.00 - 12.00	0	1.00 - 1.99	0
		61.0	0			2.00	0		61.0	0			2.00	0

Irrigation Source	Pre IWMP							Post IWMP						
	Total Numbers	Range of Water Table in Feet	Count	Duration of Water Availability in Months	Count	Irrigation in Hectare	Count	Total Numbers	Range of Water Table in Feet	Count	Duration of Water Availability in Months	Count	Irrigation in Hectare	Count
		0 - 80.00				+			0 - 80.00				+	

After the completion of IWMP, the numbers of wells increased 37.50 per cent (66 numbers) with the studied farmer respondents. The ground water-table also improved and increased due to watershed treatments. Due to this effect nearly seventy per cent (45 numbers) of the wells had raised water-table at 21-40 feet level, followed by 20 wells (30.30 per cent) improved its water availability within 20 feet depth. Those wells which had water-table at 41-60 feet depth in pre-IWMP were tremendously reduced in numbers after completion of the project, 85.72 per cent decrease was observed in this category. Duration of water availability was also improved, as majority of wells (nearly 70.00 per cent) were providing irrigation water up to Summer season (9-12 months), followed by 19 wells had capacity to provide irrigation up to Ravi season (5-8 months). Only two wells were remained having capacity to irrigate the crop up to 4 months after the completion of the project. Out of 66 wells, more than seventy per cent (47 numbers) of the wells acquired the capacity to irrigate the land up to 1 ha, followed by 12 wells irrigated between 1ha to 2 ha field area, and 7 numbers of wells irrigated more than 2 ha of land. Thus, it can be concluded that all the wells in study area were recharged up to certain mark and increased its capacity to irrigate in number of months and area (**Table 2**) also.

TABLE 2: IMPACT OF MOISTURE CONSERVATION ACTIVITIES ON IRRIGATED AREA

Irrigation Source	Pre-IWMP		Post-IWMP		Change in Area (in ha)	Per cent Change
	Counts	Irrigated area (in ha)	Counts	Irrigated area (in ha)		
Wells	48	41.11	66	76.42	35.31	85.89
Bore-wells	27	27.46	52	61.04	33.58	122.87

Source: Field Data 2017-18

The data shown in above table 2 revealed that, before IWMP intervention 41.11 ha of land could be irrigated by 48 wells. The due effect of soil and moisture conservation activities increased in number of wells and water table simultaneously, which led to increase area under irrigation. After IWMP the area under well irrigation increased by 85.89 per cent having capacity to irrigate 76.42 ha of land now. Thus watershed beneficiaries could irrigate 35.31 ha of land more from previous one in the project area after watershed intervention.

Bore-well is the second most important source of irrigation water. It requires much investments and electricity for the potential use. There were 27 bore wells existing with the farm beneficiaries before the watershed project (Table 1). Overwhelming growth was observed in number of bore wells (92.59 per cent) after the completion of the project. Before the IWMP more than fifty per cent (51.85 per cent) of the bore wells were having water-table between 41-60 feet, followed by one bore well at 61-80 feet depth, 3 bore wells at 81-100 feet depth and two bore wells at more than 101 feet depth. There were only 7 bore wells had less than 40 feet depth of water-table. After completion of watershed project nearly sixty per cent (59.62 per cent) of the bore wells showed increase in their water-table and water was available up to 40 feet depth, followed by more than one-fourth (26.92 per cent) of the bore wells had water-table at 41-60 feet depth. Only 7 bore wells were remained to drag out water from more than 60 feet depth. It was also

interesting to note that before watershed intervention more than two-third of the bore wells (66.67 per cent) could provide irrigation for 5-8 months in agricultural calendar, whilst about one-fourth of the bore wells (25.93 per cent) useful during summer season. But, after the IWMP implementation nearly three-fourth of the bore wells (73.08 per cent) had built the capacity to provide irrigation up to summer season i.e. 9-12 months. Rest one-fourth of the bore wells could provide irrigation up to Ravi season. Before IWMP out of 27 bore wells, more than four-fifth (81.48 per cent) had the capacity to irrigate up to 1 ha only. Hardly 4 bore wells could provide irrigation to more than 2 ha at that time. After IWMP nearly two-third of the bore wells (65.38 per cent) had increased its efficiency to irrigate the one ha of field. Whilst nearly one-fourth (23.07 per cent) of the bore wells had sufficient water to irrigate up to 2 ha., and 11.54 per cent bore wells acquired capacity for watering crops in more than 2 ha. Thus, increased ground water storage in the project area had improved the numbers of bore wells and efficiency of old ones.

As per data given in table 2 about bore well irrigation, 27 bore wells could irrigate 27.46 ha of agricultural land before IWMP intervention. After the watershed intervention the area under bore well irrigation reached up to 61.04 ha i.e. 33.58 ha land converted under irrigation. The soil and moisture conservation activities increased in number of bore wells as well as improvement in water table. After IWMP the area under bore well irrigation remarkably increased by 122.87 per cent.

Before IWMP there was no any existence of Farm-pond as a source of irrigation. In the study area this structure was utilizing by a respondent as a source of support irrigation in one ha of land up to Ravi season after IWMP.

There was two farmer respondents founded to utilize Group wells for the irrigation purpose before watershed intervention. The water-table of these group wells was between 21-40 feet depth and had the capacity to provide irrigation within 1 ha of land for Ravi season only. After the implementation of IWMP, Group wells were increased to 15 in numbers and majority (93.33 per cent) of them had water-table at the depth of 21-40 feet. Among the newly constructed Group wells, sixty per cent of them could retain the water between 5-8 months, followed by 26.67 per cent of them could provide water for 9-12 months. Most of the Group wells (93.33 per cent) were irrigating up to 1 ha of field of each respondent, except one group well was utilized for 2 ha of land. Thus, Group well activity was influenced positively after watershed intervention.

Construction of Check-dams in project area also became the secondary sources of support irrigation directly. Also improvement in ground water-table of the primary irrigation sources benefitting the farmer respondents indirectly. After IWMP, 15 respondents could get the benefit of Check-dam for the support irrigation directly for their fields. Majority of the respondents (60.00 per cent) could get this benefit up to Ravi season (i.e. 5-8 months duration), while rest of the respondents were utilizing this water for support irrigation in their rainfed crops. Due to various treatments in small rivulets and drains of watershed area, availability of flowing water in rivers increased added one more farmer respondent to utilise this resource for irrigation after the completion of the project.

CONCLUSION:

Gabion structure, Pakka Nala plugs and Gully plugs were the major structures adopted by beneficiaries as individual activity, whilst check dams as collective activity. Majority of Soil and Moisture conservation works done through watershed projects were fairly good in condition. Due to these works majority of farmer respondents (88.67 per cent) got benefitted by reduction in soil erosion followed by increment in crop production and irrigated area (82.00 per cent and 46.70 per cent respectively). Sources of irrigation also increased incredibly, due to watershed treatment. Total number of wells increased from 48 to 66 counts; due to this 35.31 ha more land (85.89 per cent growth) came under irrigation. Likewise number of tube wells/ bore wells increased from 27 to 52 counts. Through which 33.58 ha more land was brought under irrigated crop area (122.87 per cent). Improvement in ground water table had increased duration and holding capacity of water resources, ultimately increases the area under irrigation. It can be revealed that due to water conservation activities and drainage line treatments in the watershed area, various new sources of the irrigation were increased properly as well as necessary improvements were seen in old ones. Sources were also getting better in increasing water level as well as capacity to cover more area under irrigation in more than one season.

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