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PEOPLE-CENTRED APPROACHES TO WATER AND ENVIRONMENTAL SANITATION

Influence of surface water harvesting on ground water regime – a case of village Rozam

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Over exploitation and mismanagement of natural resources have resulted in the loss of valuable natural resources of semi-arid regions. Groundwater depletion problems and growing water crises are common in drought prone area of eastern Gujarat region, in western India. Harvesting and managing natural resources on sustainable basis is the most commonly advocated solution to this problem. The water harvesting measures when done in an integrate manner in a series are the best possible programme for restoring the degradation of natural resources. The present study was aimed at assessing the impact of water harvesting structures in rural tribal village Rozam of district Dahod of Gujarat State. A prominent NGO namely, N M Sadguru Water and Development Foundation, Dahod helped village in developing a series of water harvesting structures in May 2002. The aim of programme was to conserve water resources by the local tribal people. Under this programme series of 8 low cost small check dams were constructed and one existing percolation tank was renovated on a rivulet in village Rozam of district Dahod. Through the study an attempt has been made to analyze the impact on ground water levels, agricultural production and people livelihoods in this village. Total 50 open wells on both sides of the rivulet were selected for observing and recording the ground water levels and yields in these wells. Ground water level observations indicated that the average water table has gone up by 2.57m in year 2002 and 2.10m in year 2003 in 50 open wells. The well yield has increased from 0.64 lps to 1.50 lps in year 2002 and 1.72 lps in year 2003 after the programme intervention. Before programme the total area under different crops was 75.58 acre during Rabi season bur after programme, area under Rabi season has increased by 142.41 acre in year 2003 and by 173.26 acre in year 2004. Area under different crops has increased by 88.42% in year 2003 and 129.24% in year 2004. This is a significant improvement which gave sustainability to the peoples lives. The pre and post programme intervention situation comparison of data indicates that the programme has resulted in increased productivity, improved income and better food availability. These structures were found useful in improving the ecosystem & developing water resources base in the village. The study suggests that the approach of a series of check dam is sustainable and viable option to rehabilitate depleting ecology among the tribals of eastern Gujarat.

Water is a prime natural resource, a basic human need and a precious national asset. The extent to which water is abundant or scarce, clean or polluted, beneficial or destructive has a major influence on our planet in its rapidly changing face brought about by rapid development on all fronts, ever increasing population and fast rate of scientific and technological advancements.

Groundwater is the most important and significant source of water in eastern part of Gujarat, in western India. Groundwater management is among the most important, least recognized and highly complex of natural resources challenges facing society. A critical question in many of the water management strategies has been the optimum role for groundwater storage. In many ways the vast natural storage of groundwater systems is the most valuable strategic asset. The efficient water resources management can evolve by rainwater harvesting. The technology directly influences water availability in the areas immediately surrounding the structure, and helps tap the runoff, which would otherwise be lost to downstream.

The ever-increasing demand for water and the deteriorating quality of available groundwater resources have already precipitated a major water crisis in the eastern part of Gujarat. The most obvious and adverse feature of Dahod District (eastern part of Gujarat) is little or no water during long periods of the year amidst good runoff during rainy season. The recurring droughts, very poor yields in agriculture, extremely low rate of irrigation and almost complete deforestation made the lives of inhabitants miserable. As a result, large number of people migrate to other areas in search of wages, though all these tribal have their own land, houses and cattle. The magnitude of compulsory migration increases the dangers of destroying or depleting the natural resources beyond recovery.

Over the past few years, local water harvesting and ground water recharge have emerged as a major strategy in eastern part of Gujarat to mitigate the impact of recurring droughts, which are manifested as severe shortage of water for irrigation, drinking and fodder availability. A prominent NGO namely N M Sadguru Water and Development Foundation, Dahod implemented a series of water harvesting structures in the village Rozam. The aim of programme was to harvest water resources by local tribal people. It is important to analyze the impacts of these interventions, before advocating them as a "viable approach" for resolving water problems and drought proofing.

Materials and methods

Programme Area Profile

The programme area Rozam is situated at 15 kms from the district headquarter, Dahod of Gujarat which lies between $74^0$7'49''N to $74^0$10'21''N longitude and $22^0$49"37''E to $22^0$51"3''E latitude. Total geographical area of the village is 758.02 ha. Net sown area was 44.73 per cent of total geographical area in village Rozam. As per the census 2001, the total population of the village Rozam was 2079 (288 households). The whole village (100%) is predominated by the tribal *(Adivasi)* community.

The physiology of programme area is undulating, rolling uplands with varying slopes. The depth of soil was shallow in upland area whereas in plain area it was sufficient enough to grow food grains. The area is well water divided and crossed by rivers, streams and number of rivulets. The basin is well drained thus the length of the overland flow is very short intern surface runoff concentrate quickly. The flood peaks are high in all probability and the minimum flow is correspondingly low. The average annual rainfall at Dahod is 730.75mm (on the basis of last 30 years rainfall data). The rainguage was installed at Patadungri (Dahod, Gujarat) station located at coordinate $22^0$50'N longitude and $74^0$16'E latitude at an altitude of 333m according to Indian Meteorological Department Standards.

Methodology of Data Collection and Analysis

Assessing the need for harvesting water for the community in their own village, N M Sadguru water and Development Foundation, Dahod helped village in developing a series of water harvesting structures in May 2002. The aim of programme was to harvest and conserve water by the tribal people. The work started in the month of May 2002 with the construction of series of 8 low cost small check dams and renovation of one existing percolation tank on a rivulet in village Rozam of district Dahod. The involvement and participation of the users was exemplary. The whole dam design approach was low cost. The other major reasons for the low cost and quality work were the supervision of work exercised by the beneficiaries and their participation in terms of labour. The salient features of the water harvesting structures are given in following Table 1.

For the purpose of study, data were obtained from field observations, semi-structured interviews with the farmers and discussions with field staff of Sadguru Foundation. Total 50 open wells on both sides of the rivulet were selected for observing and recording the ground water levels in the wells. These wells were found to be under the radius of influence of these wells. The total surrounding area of wells was divided into three water recharging zones, i.e.

- Upper reach of rivulet:
  - Right side of rivulet
  - Left side of rivulet
- Middle reach of rivulet
- Lower reach of rivulet.

Water levels in the wells were recorded in the month of Nov 2001, Nov 2002 & Nov 2003 and also the data of land under agricultural in Rabi season 2003 and 2004. Pre programme data of land under agriculture in Rabi season 2002 were obtained by semi-structured interviews with the farmers. The annual rainfall data collected from local irrigation department for the period of 1974 to 2003. Depth of water table measured from ground level at a fixed point. Population and other secondary information have been extracted from the Census 2001. The discussions were held with the village committee of Rozam village to further cross check the information.

Results and discussion

Impact on Agriculture

Before the programme intervention, the data of village Rozam showed the farmers were taking only Kharif crop and depend on the rainfall on their field. Partial Rabi was done when water was available in wells, but the irrigation was too less as yield of wells were poor. Now tribals cultivate lands more intensively and get higher yields due to better water availability. Surface and ground water storage has led to stabilisation of fluctuating cropping pattern, crop yield and total agriculture output.

Table 1. Detail of water harvesting structures on rivulet in Rozam village

Sl. No	Name of Water Harvesting Structure	Area to be benefited (ha)	Storage capacity (mcft)	Total Cost (Rs. lakh)
1	Rozam-I	0.78	0.25	0.57
2	Rozam-II	0.89	0.25	0.75
3	Rozam-III	2.64	1.00	1.41
4	Rozam-IV	2.98	0.50	0.79
5	Rozam-V	3.54	1.50	4.85
6	Rozam Culvert-I	1.55	0.10	0.19
7	Rozam Culvert-II	0.66	0.10	0.34
8	Rozam (Govt. Reno.)	3.45	2.00	1.44
9	Rozam Percolation tank	16.19	2.54	4.61
	Total	**32.68**	**8.24**	**14.95**

(Source: N M Sadguru Water & Development Foundation, Dahod, Gujarat).

Table 2. Change in area of crops in Rabi Season

Sl. No	Name of Crop	Area under crop (acre)			Increment			
		Before Programme 2002	After Programme		in acre		in per cent	
			2003	2004	2003	2004	2003	2004
1	Wheat	38.37	83.81	86.51	45.44	48.14	118.43	125.46
2	Gram	19.30	32.35	49.22	13.05	29.92	67.62	155.02
3	Maize	6.70	7.60	4.00	0.90	-2.70	13.43	-40.30
4	Vegetable	7.09	13.49	22.97	6.30	15.78	87.62	219.47
5	Floriculture	4.02	5.16	10.56	1.14	6.54	28.36	162.69
Total		**75.58**	**142.41**	**173.26**	**66.83**	**97.68**	**88.42**	**129.24**

After the intervention of series of water harvesting structures, the village Rozam is able to take not only crops in Kharif but also in Rabi and Summer in normal mansoon years. The area under crops grown has changed significantly as expressed by the respondents. Major changes have come in Rabi crops. In area of 215 acres of all farmers are now growing wheat, gram, maize, vegetable and onion under irrigation in Rabi and on part of the land vegetable, maize, pulses and fodder in summer. The changes in area under different crops in Rabi season before and after the programme are given in Table 2 and also show in Figure 1 below.

The above table shows significant increase in crop area in village Rozam though the crop pattern has remained the same. After the programme intervention the total area under different crops has increased by 88.42% in year 2003 and 129.24% in year 2004. Before programme the total area under different crops was 75.58 acre during Rabi season bur after programme, area under Rabi season has increased by 142.41 acre in year 2003 and by 173.26 acre in year 2004. The area under wheat crop has changed from 38.37 acre to 83.81 acre in year 2003 and 86.51 acre in year 2004. Similar trends were visible in other crops like gram, maize, vegetable and onion also. The area under Maize has decreased in year 2004 due to proportionate increase in vegetable and floriculture area. This is not only a dramatic improvement but it also giving sustainability to people lives by maintaining the hydrological balance between water withdrawn and water recharged.

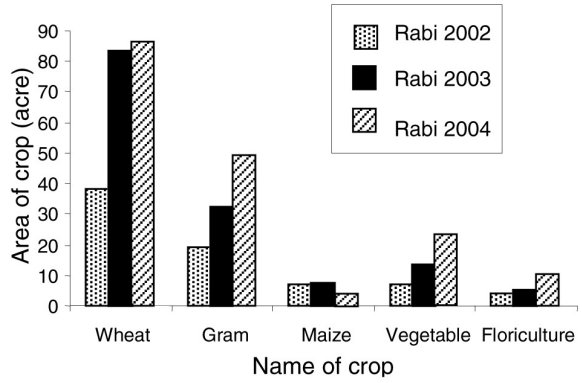

Figure 1. Change in cropping pattern in Rabi season

Impact on Ground Water

Recharge of ground water due to intervention of series of water harvesting structures was observed through wells located in the study area. The water levels in the wells were recorded in the month of Nov 2001, Nov 2002 and Nov 2003. Depth of water table measured from ground level at a fixed location.

Pre programme and post programme data of ground water levels and well yield in the wells of the tribal farmers are shown in Figures 2 to 5. Ground water level observations

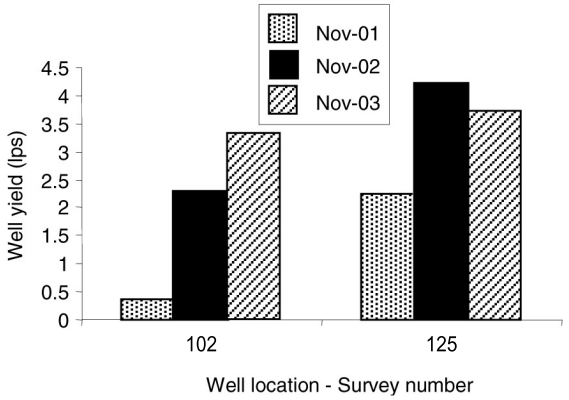

Figure 2. Well yeild for upper reach of rivulet (Right side of rivulet)

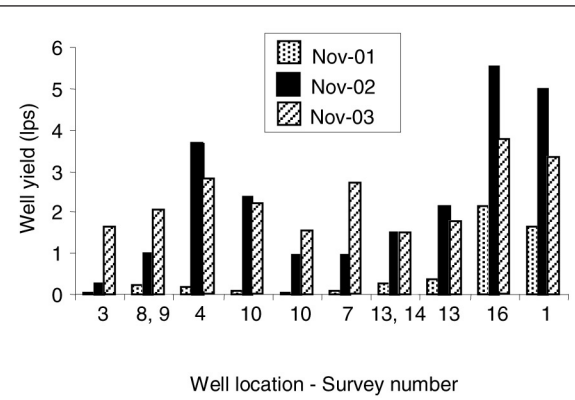

Figure 3. Well yeild for upper reach of rivulet (Left side of rivulet)

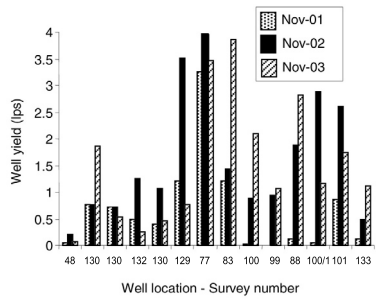

Figure 4. Well yeild for middle reach of rivulet

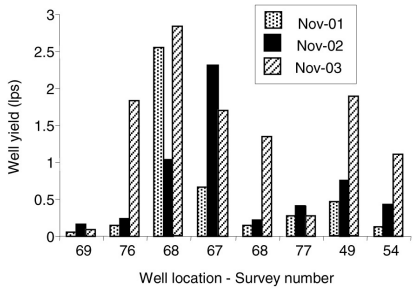

Figure 5. Well yeild for lower reach of rivulet

indicated that the average water table went up by 2.57m in year 2002 and 2.10m in year 2003 for 50 open wells in an area of 215 acres. The well yield has increased from 0.64 lps to 1.50 lps in year 2002 and 1.72 lps in year 2003 after the programme intervention. Data analysis showed that this programme has increased the surface water availability by 8.24 mcft from July to December and 16.00 mcft of ground water recharge (based on water budget equation), which is available for round the year.

Horticulture & Floriculture Development

With very small holdings, even with irrigation, the income level may not go up very high or improved income level may not sustain when further division of land takes place with in a family. To sustain higher per capita income level, the diversification from cereal crops to more profitable activities such as horticulture & floriculture are necessary with better water availability in the programme village for round the year. These highly profitable activities on even a meagre land 0.10 - 0.20 ha. may sustain family very well, particularly, when linked with advanced technology of drip irrigation systems, the operation would become cost effective, with better water management and higher yields. A combination of agriculture, floriculture, horticulture and vegetable on one hectare of land is giving an income of between INR'75,000 to INR'1,50,000 annually. On sizeable land of the project, this combination is likely to be adopted. The families who have raised roses, is getting INR' 250 to INR' 750 every day by selling roses for almost round the year and those who have raised marigolds, each family gets about INR'150 every day. This is a good income in Indian rural and tribal conditions. The tribal village Rozam has more than 258 horticulture plots and 276 floriculture plots raised by tribal families.

Conclusions

The following conclusions could be drawn from this study:

- Water harvesting benefits people, land and overall ecology. The programme of water harvesting improves the natural resource base, which is depleting fast. The programme has capacity to turn a water deficit villages into water surplus.
- Water harvesting measures positively impact on ground water levels. An increase in mean ground water levels in the wells of the programme area in village Rozam is reported after the programme intervention.
- Ground water level observations indicated that the average water table went up by 2.57m in year 2002 and 2.10m in year 2003 for 50 open wells in an area of 215 acres.
- The well yield has increased from 0.64 lps to 1.50 lps in year 2002 and 1.72 lps in year 2003 after the programme intervention.
- After programme intervention total area under crops in Rabi season was increased by 88.42 % in year 2003 and 129.24 % in year 2004.
- Study reflects that the increase in ground water recharge has its impact on agriculture and drinking water.
- The programme has resulted in increased productivity, improved income and sustainability of water resources. The programme of water harvesting measures is very rational approach of development and necessary in sustaining the ecosystem.

References

Anonymous (2003) Annual Report, N M Sadguru Water & Development Foundation, Dahod (Gujarat).

Census Book (2001) Census book of Dahod District of Gujarat State.

Pandey, R. (1993) Water Resources Potentials of Eastern Panchmahal, Gujarat, India. Unpublished P.G. Diploma Programme Report, Loughborough University of Technology, U.K.

Roy, T.K. (1983) Impact of Rajasthan Canal Programme on Social, Economic and Environmental Conditions, Ncaer, New Delhi.

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