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A Paradigm of Water Conservation Excellence Kirkasal, Man, Satara, Maharashtra, India

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Abstract: ***The failure of conventional approaches to achieve equitable and sustainable water management and conservation has prompted a new way of perceiving and acting with groundwater. This is creating a 'new water conservation paradigm' that emphasizes broader stakeholder involvement; integration of sectors, issues and disciplines; attention to the human dimensions of management; and wider recognition of the economic, ecological and cultural values in Kirkasal village of Man block of district Satara, Maharashtra, India. This paper presents the success story of Kiraksal through innovative, community-driven water management initiatives, Kiraksal has undergone a remarkable transformation into a water-secure region, setting a benchmark for sustainable development.***

Keywords: Sustainability, Groundwater, Artificial recharge, Groundwater management, agriculture, GSDA

1. Introduction

Ground water has played an important role in increasing food and agricultural production, providing safe drinking water and facilitating industrial development in India. It contributes fresh water to meet the requirement of nearly 65% of total irrigated area, nearly 85% of the rural drinking water supply and 50% of the urban drinking water needs of the country. Over the last three decades, the rapid expansion in the use of groundwater, primarily for irrigation, has contributed significantly to its agricultural production and overall economic development. This has also resulted in India becoming the largest ground water extractor in the World. The rapid and extensive extraction of ground water, however, has come at a price. The limited ground water resources in the country are under threat due to indiscriminate use. Intensive and unregulated ground water pumping in many areas has caused rapid and widespread decline in ground water levels. As per the latest Dynamic Ground Water Resources Assessment (2017), carried out by CGWB jointly with the GSDA, about Satara District, Maharashtra. Out of total number of 11 blocks / mandals /taluks / firqas, 4 have been categorized as 'Semicritical, meaning that the groundwater extracted for various purposes from these areas is more than what is replenished annually from rainfall and other sources and stage of Dewvelopment of Groundwater is more than 90%. Further, as per studies conducted by GSDA Satara, and observation wells monitored by GSDA, Satara in these blocks are showing a long-term declining trend in ground water levels. There is, therefore, an urgent need for improving groundwater governance and management in the said blocks. Atal Bhujal Yojana (Atal Jal) is a central sector scheme that envisages improving groundwater management in select water-stressed areas of identified blocks of Satara district named Man, Khatav, Wai and Mahabaleshwar. There are total 97 Grampanchayat are identified in these 4 blocks.

Groundwater supplies more than 85 % of rural India's domestic and agricultural water needs, which is depleting fast in many areas due to its large-scale withdrawal (Bhalerao and Kelkar 2013). The stress on groundwater in most of the rural areas of Maharashtra state can be ascribed to changes in the precipitation pattern and exploitation. Recharge enhancement with subsurface storage is a known technology and has already successfully been implemented in many countries at different scales (Tuinhof et al. 2002). The basic requirements for recharging the ground water reservoir are availability of non-committed surplus monsoon run off in space and time, Identification of suitable hydrogeological environment and sites for creating sub surface reservoir through cost effective artificial recharge techniques. A Recharge Shaft is one of the key recharging measures used for direct recharging of an Aquifer. It is an efficient and cost-effective option appropriate for augmenting the recharge into the phreatic aquifers where water levels are much deeper and the aquifer zones are overlain by strata having low permeability like tightly jointed massive basalt or almost impermeable strata like amygdaloidal basalt. Its relevance is particularly pronounced in areas where the stream flows are available during the monsoon and limited post monsoon periods.

Attempt has been made to highlight the unique initiative taken towards strengthening ground water monitoring and analytical facilities through Atal bhujal yojana at Gram Panchayat level of Kirkasal (The location map is given in fig.1) Special emphasis has been given to create community awareness and active involvement of community in monitoring, water budgeting, planning and implementation of demand and supply side interventions to improve the groundwater situation, to ensure the long-term source sustainability. One of the critical steps in the implementation of the Atal Bhujal scheme is preparation of water budget at GP level. To appraise the water balance worked out at the level of gram panchayat, GP level meetings organized by Kirkasal village Water and Sanitation Committee (VWSC) involving the farmers and other stakeholders and willingness were sought to adopt suitable demand and supply side measures to ensure sustainability of ground water. Eventually, a community led Water Security Plan (WSP) has been prepared with the help of DIP/DPMU by incorporating all the suggested interventions that has been finalized during the GP level meetings. Collective and collaborated efforts by the community, DIP/DPMU/SPMU and the line departments in implementation of the water security plan has fostered significant increase in areas under water efficient practices, shift from high water consuming to low water consuming crops eventually leading to a positive impact in terms of improvement in groundwater levels at the level of Gram Panchayat. The scheme has also successfully demonstrated the benefits of the participatory groundwater management at local level.

2. Study Area

Kiraksal Village, nestled in the Man (Dahiwadi) Taluka of Satara District, Maharashtra,India spans 1,802.64 hectares, with 35% (616 hectares) covered by forested hilly terrain. It is situated 10km away from sub-district headquarter Dahiwadi (block office) and 75km away from district headquarter Satara. Historically, the village grappled with acute drought conditions and limited water resources, exacerbated by inadequate conservation measures. Kirkasal is covered by horizontally disposed basaltic lava flows of Deccan trap formed due to fissure type volcanic eruption activity during Upper Cretaceous to Lower Eocene in age about 65 million years ago. Lower part of the basaltic lava flow is fine grained, grayish black in color, compact and jointed while upper part is vesicular. The individual flows vary greatly in thickness from few meters to 40m. Climate ranges from the rainiest in the Mahabaleshwar area which has an average annual rainfall over 6000mm to the driest in Man tahsil where the average annual rainfall is about 500mm. in the study area the average annual rainfall is about 300-400mm. Under this project one mechanical rain gauge has been installed in the gram panchayat Kirkasal to monitor the rainfall, monitoring is being carried out on daily basis and a register is maintained in the GP. It is one of the important parameters in preparation of Water Budget / Security Plans in Atal Bhujal Yojana. The rainfall data helps in the estimation of Water Availability, which gives an account of the status of Water Resources in each Gram Panchayat. At the same time, the rainfall data helps in arriving at runoff and planning supply side interventions. Rainfall is the major source of water for irrigation and hence quantitative assessment of rainfall helps in planning the crops. Maintaining a regular data /record of rainfall will also help in the year-on-year updating of Water Security Plans.

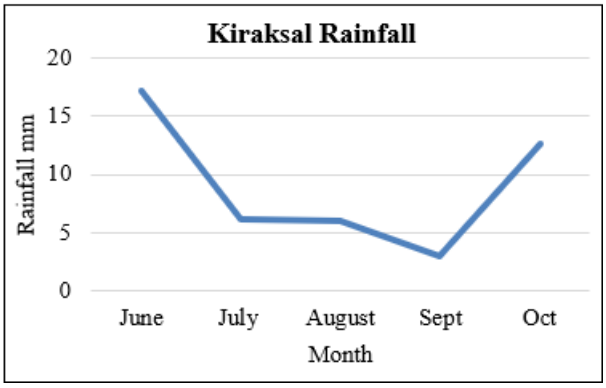
3. Methodology

Some pre-Implementation project challenges seen in the villages are reliance on bore wells and the absence of adequate storage infrastructure rendered the village vulnerable to water shortages, Agricultural Stagnation, Minimal productivity due to erratic water supply and suboptimal irrigation practices, Environmental Degradation, Overgrazing, deforestation, and frequent forest fires led to significant biodiversity loss, soil erosion, and accelerated water runoff, Drinking water for humans and livestock had to be transported via tankers, highlighting the critical nature of the crisis.

Ten number of observation wells in the Village are identified to monitor water level data and water quality data using a digital water level recorder device. 10 number of wells equipped with water flow meter device (functional meters for measuring energy consumption or volumetric ground water usage) are installed. Water security Plan of each of identified villages of each blocks are also prepared every year. The objective of this scheme is to improve the management of groundwater resources in water stressed areas. So, in order to improve the groundwater situation, it is necessary to artificially recharge the depleted groundwater aquifers. The management of groundwater poses challenges in basaltic terrain of Man, as its availability is not uniform due to the absence of primary porosity. Indiscriminate excessive withdrawal from shallow as well as deep aquifers for meeting increased demand can be higher than natural recharge, causing imbalance in demand and supply and leading to a scarcity condition. A total 66 nos. of wells have been inventoried in the gram panchayat using the Atal Jal Mobile App and available in the Atal Jal MIS. The data generated through inventory has been critically analyzed. The objective of well inventory is to capture GW related data to understand the spatial variations in GW regime at GP level and help in preparing water budget and WSP. As per the program design, community led water budget and Water Security Plan (WSP) has been prepared for the Gram Panchayat. The demand and supply side interventions proposed in the WSP have been implemented through convergence of funds from the ongoing schemes of central and state by the line departments as well as using the incentive funds.

Table 2: Rainfall of Kirksal Circle

June 2014	July 2024	August 2024	Sept 2024	Oct 2024
17.18	6.1	6.0	3.04	12.60

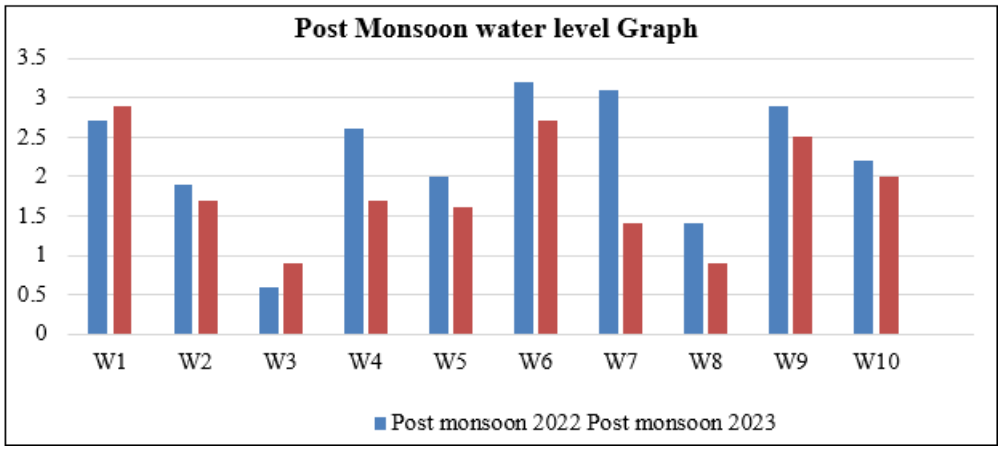


Graph 1

The pre- and post-monsoon water levels for the pre-and post-project situations are shown in Table 2. It should be mentioned that pre-monsoon (Month of May) observations means those taken before the precipitation period, and post monsoon (Month of October) observations are those taken after the precipitation period i.e. Monsoon. It may be observed in Table2 that there is significant rise in post-monsoon groundwater levels (month of September to November). The comparisons of post and pre monsoon water levels for the pre- and post-project scenarios have been graphically presented in Graph No.2. A precipitation of 890 mm was recorded in the year 2024 and the pre-monsoon groundwater levels of year 2024 show significant rise. This increase in groundwater level may be due to conservation and recharge structures from different central projects, state projects, private organizations.

Table 2

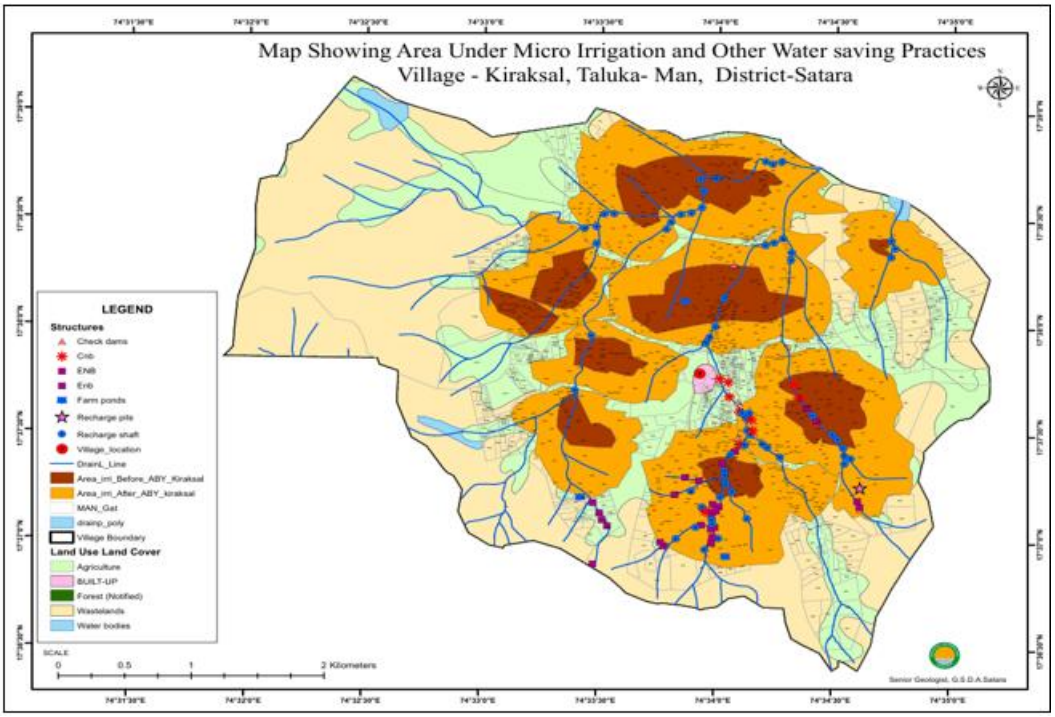
Well No.	W1(m)	W2 (m)	W3 (m)	W4 (m)	W5 (m)	W6 (m)	W7 (m)	W8 (m)	W9 (m)	W10(m)
Post monsoon 2022	2.7	1.9	0.6	2.6	2	3.2	3.1	1.40	2.9	2.2
Post monsoon 2023	2.9	1.7	0.9	1.7	1.6	2.7	1.4	0.9	2.5	2.0



In the Satara district, under the Atal Bhujal Yojana, Adoption of practices for efficient water use has seen the implementation of water-efficient practices on 78,255 hectares, with 4 blocks showing an arrest in groundwater decline. In kirkasal village of man the area irrigated before the project was only 12 Hectares out the total area of the village but after the implementation of the water saving practices in the Kirkasal, the micro irrigation area is increased to 68.16 Hectares shown in the table no.4. The increased in the micro irrigation area before and after the implementing of the project is shown In the Map No.4

Table 4: Area covered under micro irrigation

Sr. No.	District_ Name	Block_ Name	Gram_Panchayt_ Name	Irrigated Area (Ha)	
				2020-21 (Before the implementing the ABHY project	2024-2025 (After the implementing the ABHY project)
1	Satara	Man	Kiraksal	12	68.16

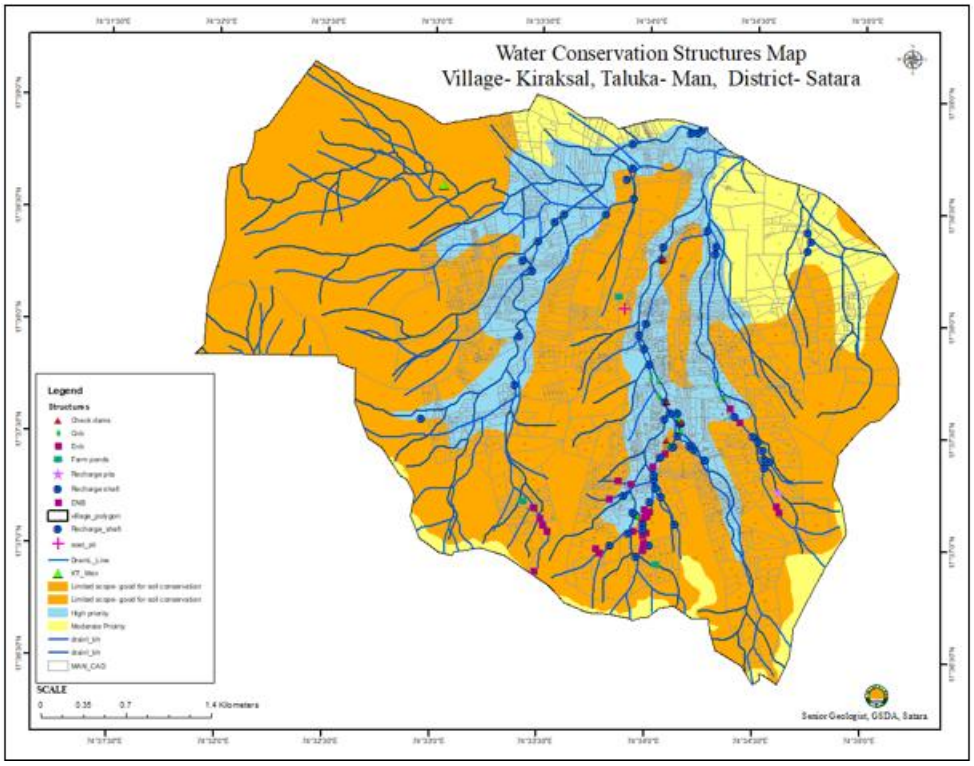


Map No.4

The Transformation: Post-Implementation Achievements of the Project

The different types of innovative natural, artificial recharge and storage structures were constructed in hard rock basaltic terrain in Kirkasal under Atal Bhujal Scheme, with other department convergence, funded by central government, state government and world bank with community participation. The village revitalized numerous water conservation structures through community efforts in Atal bhujal Yojana shown in Map No.5. 71 Loose Boulder Structures (LBS) are constructed to minimise soil erosion and store runoff, 3 Percolation Tanks and 3 Earthen Bunds are constructed to enhance groundwater infiltration. 2 Traditional Step Wells and 4 Kolhapur-Type Bunds (KT) are repaired which help to improved access to stored water. 21 Deep Continuous Contour Trenches (CCT) are constructed to strengthened groundwater recharge across 250 hectares. 16 Compartment Bunds and 24 Contour Bunds are constructed till date to improve moisture retention for agricultural purposes. The village participate in an innovative Practices for Groundwater

Recharge like 57 Recharge shafts facilitated deeper percolation, In Jaltara project Farm-level sock pits are constructed to augmented groundwater levels, Rooftop Rainwater Harvesting implemented in schools to maximize water capture, 292 Nanded Pattern Soak Pits ensured widespread water infiltration. 7 Earthen Bundsare constructed which Storage capacity is of 4.2 CL (Ham). 9 Cement Concrete Dams: Capacity of 90 CL (Ham).Deep CCTs: Spanning 290 hectares with a capacity of 6.96 CL (Ham).Compartment Bunding: Covering 280 hectares with a capacity of 1.42 CL (Ham).In comprehensive watershed management Trenching and Stream Widening of 5,000 running meters of streams, adding 2,15,875 cubic meters of storage, Contour Bunding: Enhanced water retention with an additional 4,282 cubic meters of capacity, Over 16,000 native saplings were planted, fostering biodiversity restoration and reducing runoff, Percolation Tanks and Farm Ponds: Collectively retained an estimated 31.37 KL (Ham) of water. Kiraksal executed a comprehensive suite of interventions that redefined its ecological and agricultural landscape. Construction of innovative conservation structures, Enhanced groundwater recharge and biodiversity restoration, Sustained water availability for agriculture and domestic use. Revival of Water Bodies.



Map No.5

4. Result and Conclusion

Groundwater levels are Increased by 25% (GSDA Satara data). Agricultural Productivity is Enhanced by 35% (Taluka Agriculture Officer data). Milk Production grew from 2,000 liters to 4,850 liters daily (Block Veterinary Officer data). Economic Gains are Annual per-hectare income rose by ₹2,00,000. Due to increase the water storage in the Kirkasal Biodiversity Restoration is documented 204 bird species, 91 butterfly species, 30 herpetofauna species, and 13 mammal species (WWF-India Project data). Strengthened community cohesion and environmental stewardship, Reverse migration from urban areas due to improved living conditions, Enhanced quality of life through reduced water stress. The Kiraksal model exemplifies a low-cost, high-impact approach to water conservation, emphasizing community participation and resource efficiency. Its scalability across drought-prone regions is ensured through partnerships with government programs and CSR funding, offering a replicable template for nationwide implementation. Transitioned from water-intensive crops (sugarcane, banana) to sustainable alternatives (onion, jowar, wheat, and dates), Adopted drip irrigation and sprinklers, reducing water usage by 40% while boosting yields, Water literacy workshops educated 93 stakeholders on efficient water management, Farmers implemented water budgeting techniques to optimize irrigation. Capacity building of Master trainers of the village, women, Children, Senior citizens. Awareness campaigns through students of school and colleges. Some grampanchayat level trainings are conducted by Yashada, Maharashtra, in the project 42 youth are trained to surveyors, equipped with technical tools for groundwater conservation work. Kiraksal's success has cultivated a strong sense of environmental responsibility. Villagers now prioritize water budgeting and efficient cropping, Actively participate in maintaining water bodies and groundwater structure. They are Collaborating on wildfire prevention and sustainable agriculture initiative

Kiraksal Village's journey is a testament to the transformative power of community-driven conservation efforts. Through innovative practices, unwavering commitment, and collaboration, the village has set a gold standard for water resource management. As a model of resilience and sustainability, Kiraksal is a worthy contender for the prestigious National Water Awards, symbolizing hope for drought-prone regions nationwide. In general, the

groundwater storage has improved over the time, but simultaneously stresses on groundwater has also increased, however, it may be noted that the water level recoups and maintaining a rising trend, displays the aquifer potential to withstand the stresses acting upon it. There is need to establish mechanism and train the Community Resource Parsons (CRP) to continue water level and quality monitoring and update the water security plan at frequent interval by involving the community and VWSC members. The understanding developed from the analytical results as discussed above shall be used in future planning including GP wise annual / seasonal ground water resource estimation as well in day to day management of ground water. By implementing both demand and supply-side interventions, it is anticipated that groundwater management in the Gram Panchayat will significantly improve.

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Collage 1

Collage 2

Collage 3

Collage 4

Collage 5

Collage 6