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Assessing the Effectiveness of Jalyukt Shivar and Related Water Conservation Measures in Karjat Tahasil (Ahmednagar), Maharashtra

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Abstract

While water scarcity remains a severe issue in this semi-arid region of Maharashtra, located in the western part of India, and one of the 5-6 major drought-prone states. In reaction, the Government of Maharashtra introduced Jalyukt Shivar Abhiyan (2016) to advocate for village-scale and decentralised water conservation measures to solve the drought issues. The study employs a descriptive-analytical method using secondary data (government audit reports, research papers published in peer-reviewed literature, GIS mapping and processed remote sensing indices) to assess the JSA impacts on Karjat. The key interventions evaluated include compartment bunding, percolation tanks, check dams, farm ponds and integrated watershed management structures. Partial ecological improvement and localised change in groundwater recharge, irrigated area based on GIS and Remote Sensing Ecological Index (RSEI) analyses from 2015 to 2020. Though CAG reports and ground studies in a number of villages point to serious implementation lapses, poor technical planning and longevity sustainability. Case studies from similar drought-prone regions suggest that, with good planning, such interventions have important benefits. The results suggest improved village-level scientific planning, with broad stakeholder support, ecological and watershed considerations for demand-side water management, and integration with community participation. Conclusively, with the potential to increase water availability both in terms of quantity and quality, restoration work via JSA offers some promise; yet it faces challenges due to inconsistent intervention design, variable implementation, lack of monitoring mechanisms and institutional accountability, which collectively call for a more holistic inclusionary approach as seen in suggested alternative models of water governance.

Keywords: *Jalyukt Shivar Yojna, Water scarcity, groundwater recharge, water management.*

Introduction

Maharashtra is the worst-affected State with respect to both food production and general rural livelihoods due to water scarcity problems, but analyses show that these are not evenly distributed across its territory (Reddy, 2010). Karjat Tehsil, one of the major sub-regions in Ahmednagar, receives an annual average rainfall of about 540 mm having undulating topography which restricts natural water retention (Deshmukh, 2017). To ix such chronic water stress, the Government of Maharashtra initiated the Jalyukt Shivar Abhiyan (JSA) in 2016 to make villages drought-resilient through decentralised water conservation practices (Kadam, 2018). The methods were the construction of farm ponds, compartment bunding, deepening and widening of nalas and creation of percolation tanks to capture rainwater for recharging the groundwater (Gaikwad 2019). The interventions are targeted to increase soil moisture and make water available for irrigation and drinking (Jadhav, 2021). Thus, hundreds of such structures were implemented in the vulnerable villages identified from the watershed mapping technique in the larger Karjat Tehsil, spread over an area of 1503 km² under the JSA programme (Shinde,2020). It shows a trend in shift towards community-based, and location-specific water management to counter the short-term climate fluctuation but also achieve long-term agricultural sustainability (Patil & Pawar, 2020)

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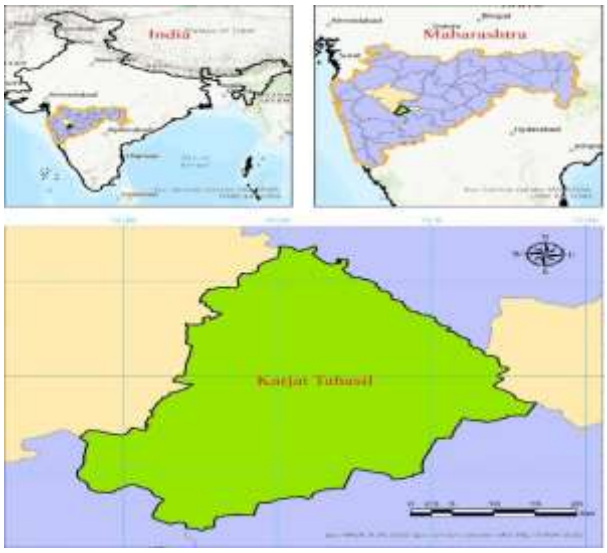
Study Area

Karjat Tehsil covers 1,503.61 kilometres, 76.3% of which is agricultural land, 8.7% forested and the rest divided as other uses (Ahmednagar district). blogspot. Com). Geographically, lies at coordinates 18°20′N–19°30′N and 74°10′E–75°43′E, forming part of a drought-prone region in southeastern Ahmednagar (scienceletters. researchfloor. org). It is characterised by low and erratic rainfall, with average annual precipitation between 493–565 mm, marked by large inter-annual variability. It consists of Deccan Trap basalt formations, which form a plateau feature with a combination of moderately dissected and undulating landforms, having implications in terms of their effect on groundwater recharge potential. The stony and gravelly soil profiles are further made up of deep "munjal" clay soils - although these fertile substrates also make this hydrological region one of the most productive on Earth, it also happens to remain under an agriculture-improvement paradigm wracked with issues from abiotic degradation, giving what may be some of the least moisture-retentive, most agriculturally-challenging soils in India (gazetteers. maharashtra.gov.in)

Agriculture here is continuous with the semi-arid conditions of Western Maharashtra to the south: jowar (sorghum) and bajra (pearl millet) predominate in downland fields, while water-intensive post-monsoon rotary farming has taken hold in irrigated areas (either directly via canals from Kukdi Bandhara and Ghod as well as Ujjani Dam or, on a smaller scale, using overhead cisterns). In sum, due to its low precipitation, perched geology and resistive estate matrix, Karjat is a classic scarcity zone - drought-prone and in need of both sound water conservation and irrigated agriculture to withstand stressors on climate change adaptation.



Location Map of the Study Area

Research Methodology

Based on descriptive analytical research design and secondary data sources, it assesses the effectiveness of water conservation initiative i.e. Jalyukt Shivar as a case study in Karjat Tahasil, Ahmednagar District. Research gateways based on research articles, government reports (including CAG), audit reports and GIS-based studies give impetus to the influx of scholarly information rather than controversial data in a detailed case study and Ph.D thesis papers written over the last decade and a half to draw an overall picture of public service delivery in India. D. theses. The RSET data is evaluated for 2015 and 2020, covering changes in vegetation growth in Karjat villages; surface wetness change & land surface temperature modification. This Analysis includes GIS mapping of water conservation structures over the years to derive inference wrt spread/implementation intensity across Karjat villages. Reports of audit and evaluation by government bodies Audit Committee, have pointed out the deficiencies in implementation, effectiveness of investments and trends in improving the groundwater levels Frontline 2020, Times of India 2019. The paper finds that successful interventions could indeed be transferred and have wider relevance to Karjat based on the recorded comparative case studies from drought-prone areas of Vaijapur in Aurangabad and Mandakhali in Parbhani. It is an integrated approach that helps in getting a holistic view of the success of these schemes as an outcome for ecological restoration, water availability and sustainability.

Data Collection (Secondary Sources)

The study is based entirely on secondary data collected from diverse and credible sources. Various water conservation interventions-including compartment bunding, farm ponds, and nala deepening-have been widely implemented in Karjat Tehsil. Secondary data from platforms like ResearchGate and Read Kong provide detailed mapping and spatial distribution of 16 types of such interventions across the region. Improvements in ecological health have been recorded through the Remote-Sensing Ecological Index (RSEI), which shows a rise from approximately 0.3 in 2015 to 0.5 in 2020 in villages such as Bargewadi, Nandgaon, Sonalwadi, and Benwadi, as documented in the Frontiers journal. Government audit reports, including those from the Comptroller and Auditor General (CAG), published in Frontline and The Times of India, highlight that despite significant financial investments (about ₹9,634 crore across 22,586 villages), many areas witnessed limited groundwater recharge and inadequate water storage due to execution gaps. Supporting case studies from Vaijapur and Mandakhali (Parbhani), sourced from jasianresearch.com and Krishikosh, indicate positive outcomes such as improved groundwater levels (rising by 1.1 to 1.5 meters),

increased irrigated area (by 68%), better crop yields, and reduced migration, reflecting the potential benefits of well-implemented conservation measures.

Results & Findings

Various water conservation methods applied under Jalyukt Shivar in Karjat.

Jalyukt Shivar Abhiyan launched by the Government of Maharashtra with a long-term vision to make drought-free villages apply scientific principles in water conservation. Under this scheme, in Karjat taluka many such measures have proven effective to increase water availability and agricultural sustainability. They have more to do with 'recharging the groundwater', 'preventing run-off of rainwater' and involving the community in water management. The above information is explained in detail under the following points.

1. Compartment Bunding and Earthen/Nala Bunds

Compartment bunding is a practice where the agricultural fields are divided into small compartments without disturbing the original topography (usually around 8×5 meters) by making use of bund formers to maximise rainwater harvesting, minimise runoff and protect the moisture in soil. These bunds enable slowing down and spreading out runoff, which allows more time for water to percolate into soil.These features make it appropriate also for arid and semi-arid areas with low average rainfall. Construction of a series of earthen embankments along the contour (contour bunds) is done for the retention and moisture conservation, one of the most common soil conservation practices in India. This is highly efficient in capturing monsoonal runoff that would soon roll off the undulating terrain of Karjat Tehsil which records -540 mm rainfall otherwise (Deshmukh, 2017). These interventions are in line with various watershed management manuals (like the NREGS watershed manual) where it is said that bunding increases infiltration and reduces soil loss, thus recharges ground water (Kulkarni, 2019).

But experts caution against this because removing soil layers or disturbing the soil profile can compromise recharge during development. Farm ponds and bunded structures were in many instances, resulting in the inadvertent exposure of rocky layers, thereby limiting the efficiency of recharge, said Vijay Borade (member of the State Water Conservation Advisory Council). So, while compartment bunding and earthen bunds are fundamental drought-proofing and water-harvesting tools, if they are to help the people of Karjat, they have to be designed with skill and attention to protecting the soil that builds them up and deployed context-specifically based on local geology.

2. Percolation Tanks, Check Dams, Kolhapur Weirs, and Gabion/Boulder Structures

In essence, Jalyukt Shivar promotes a package of small water storage structures- percolation tank, check dam, Kolhapur type weir, gabion structure and Loose Boulder Structure, which in turn decelerate surface water flow, thus leading to enhanced infiltration and arresting the water for utilising groundwater recharge (IIT Bombay / CTARA evaluation). nano bunds of earth or cement structures are constructed in combination to ensure controlled runoff and, support the sustainable recharging of groundwater (as per Maharashtra government guidelines by MRTBA-Semite). The Times of India cites expert comments to assert that these structures are eight times more efficient than a conventional check dam, such as in Shirpur and Tamaswadi projects, where a stream bed has been blasted 10m into the ground along a ridge-to-valley alignment to encourage percolation. Given that these techniques have shown a good response in the basalt dominated terrains, such as Dhule and Vidarbha, it could be helpful to test them in similar terrains like Karjat. The Times of India still cautions there is poor technical planning, for example, disregarding slope classes or that the feature functions extremely if regions are treated according to certain geological formations (unscientific planning call for). Properly planned and engineered storage systems can be a linchpin in the strategy to preserve and recharge water in Karjat Tehsil.

3. Farm Ponds and Plastic-Lined Storage Facilities

So, farm ponds are tiny at-source rainwater storage units constructed on every individual farm. Without lining-Recharge water to the groundwater through function as percolation zones; Lined with plastic, retention water for longer period by which are use GI to always direct irrigation and household need (MRTBA official overview on Jalyukt Shivar) Already in Maharashtra, more than 2.5 lakh farm ponds have been constructed as part of Jalyukt Shivar scheme and some lines with the plastic lining to ensure long term storage (MRTBA report). But experts also stress the need to bundle farm ponds into larger watersheds of which they are only a part for effective recharge of groundwater. In the absence of linkages to soil conservation or recharge measures, they may end up only mining groundwater as extraction points rather than as recharge zones (SANDRP analysis 2017). The optimal mix of lined and unlined ponds should be decided on a "case by case" basis, meaning, the possibility for Karjat should be to go for lined ponds when it comes to drinking and livestock only; while all rainwater harvested in otherwise an (unlining one instead) would be linked with the recharge system. This dual nature, matching some global best practices in rainwater harvesting designs (c.f., World Bank water resource guidelines), underlines the fact that farm ponds cannot be a standalone solution but must be integrated into wider watershed-based water budgeting and recharge efforts.

4. Integrated Geospatial Planning, Monitoring, and Institutional Governance

Water conservation is based on a robust planning and monitoring system. So wouldn't it be good if the government had used GIS mapping, drone surveys and geo-tagging of 1.4 million plus water conservation structures (farm ponds, percolation tanks, check-dams, Kolhapur weirs and nala bunds) spread across Maharashtra, with phase III mapping through Hindustan Times report. The targets under Jalyukt Shivar 2.0 include drought-proofing 5,000 villages per year, the rejuvenation of village tanks and plantation along with creating water budget awareness. These are: district water conservation officers, technical vetting committees, Gram Sabhas and Water Committees for technical oversight and local participation (MRTBA).

However, the CAG audits revealed glaring discrepancies in planning, execution and monitoring with poor storage norms, zero cess collection for maintenance, no maintenance monitoring and incorrect work certification (reports in the Times of India and followed up by Indian Express). It also highlights the fact that geospatial and institutional frameworks exist, but their

operational ability, as seen in Karjat, to address implementation challenges is not strong enough, which implies that capacity building, transparent oversight, and community ownership are required for them to become operationally effective.

Evaluate their effects on groundwater levels, water storage, irrigated area expansion, and ecological status.

Jalyukt Shivar that was implemented at Karjat Tehsil has shown mixed results, with the groundwater recharge, water storage and irrigated land improved in some areas, but in other areas suffered from ecological degradation due to flawed works of filtration. Interventions differ in effectiveness depending on planning and upkeep. All this information is illustrated using the following points.

1 Groundwater Levels

Groundwater level rise Soil-water conservation works A deep soils water conservation work in village reported a downstream rise of average 1103m groundwater boring to get water and an upstream rise of 1487m following soil and water conservation measures such as constructing of graded bunds, farm ponds, CCTs, and CNBs under Jalyukt Shivar: (Krishikosh). In a hard rock terrain like Karjat Tehsil, these sound findings announce that recharge can be surely added by implementing such interventions. But by looking at broader audit data from the CAG report it can only be considered that this had an alarming extent as well: perhaps all of Karjat was covered in the 120 surveyed villages across Maharashtra but storage created was insufficient in 83 villages, no increase in groundwater could be recorded in 38, and only scanty increases ranging from (somewhere between) 4% to 15% were noted in a mere less than quarter of them. The mixed results show that while successes in some parts of the world are a promising signal, the broader scale-up across regions has been uneven, which may be attributed to problems with planning, design and monitoring.

2. Water Storage Capacity

A research based on GIS based assessments in Karjat Tehsil reveals that 15 to 125 water stock making ponds (Talav) and 135 cement nala bunds were built/rejuvenated under the Jalyukt Shivar framework aiming at enhancing surface water retention. This type of infrastructure is the hallmark of programs to capture and save monsoon runoff for use during dry times. To support this, the article of TOJQI (Turkish Online Journal of Qualitative Inquiry) identifies that the Jalyukt Shivar produced an additional 19,655 villages in five years that will be drought-free forever. The CAG audit, however, belied those expectations by revealing that actual storage in 83 of the 120 villages was significantly less than the planned capacity by up to 1.64 lakh thousand cubic meters (TCM), which affected availability for drinking and irrigation needs. This contrast underscores that design objectives are not sufficient and the actual quality of construction is critical for the effectiveness of all these physical structures introduced to create increased spatial storage.

3. Irrigated Area Expansion

The cumulative effect of the conservation works in the present study is evident on the ground, as reflected from the quantification of the area used for rabi irrigation: pre-graded bunds, CCTs and CNBs were 36.50ha, which rose to 61.38ha post-treatment (Krishikosh), indicating increased irrigated land area by a significant 68.16%. That suggests hands-down benefits to apply the irrigation within screens when it is dry. Observational field reports also indicate substantial run-off arrest and stream recharge, which leads to 4–5 months of water availability to Kharif crops following rains. However, the CAG findings also highlighted unintended side effects. In the absence of well-developed alternative sources, villagers might have dug additional borewells for irrigated area expansion or further expanded water-intensive cash crop cultivation, thus offsetting some gains in increased irrigated area.

4. Ecological Status

While there are few direct ecological assessments of Karjat Tehsil as such, general critiques such as those provided by the SANDRP field study on Ahmednagar do give an idea about what can be expected. In Hiwargaon-Pawasa, unplanned construction of farm ponds without proper soil conservation measures led to overexploitation of groundwater along with increased occurrences of soil erosion and evaporation losses, thereby restricting its rechargeability. While well-known economist H. M.Desarda had come down heavily on the scheme terming it as contractor driven and virtually driving boom of ecologically destruction due to heavy machinery being used in fragile river basins; In fact, hydrological planning had been relaxed to such an extent that even as the NITI Aayog assessment indicated that "recharge benefits have been very poor," it also flagged the scheme's inability to restore irrigation potential and recharge of groundwater. Together, these reviews all highlight both the necessity of structural intervention and the importance of ecological concern for environmental health.

Propose recommendations for enhancing scheme effectiveness and resilience.

Jalyukt Shivar Abhiyan Effect and Outcome Based on the study in Karjat Tahasil of Ahmednagar district, Jalyukt Shivar Abhiyan needs to make scientific implementation with stakeholder involvement and local support, work towards envisaged outcomes, strengthen the Implementation system, promotion for maintenance as a routine and fortify climate-resilient planning. These efforts will create solutions that lead to day-after-day water security. The above is elucidated with the help of the points listed below.

1. Strengthen Detailed Planning with Village-Level DPRs & Hydro-Assessment

Robust planning is crucial. A Ph. D. thesis using the case of drought-prone Ahmednagar highlights that DPRs, including village water budget and treatment map and hydro-geological assessment, should be a must for preparation, for which these have to be made available at Gram Panchayats so that local people understand and own them (Deshmukh 2017). Jadhav (2021) also emphasises that the lack or non-availability of DPRs caused unsynchronised interventions as a result of which cement nala bunds with a propensity to leak, and percolation tanks sited in inefficient areas became common. The above passage underlines the significance of DPRs in conjunction with GIS mapping, drone surveillance and real-time monitoring for efficient project delivery

as evident from government guidelines through Jalyukt Shivar 2.0 (GoM, Jalyukt Shivar. As such, upscaling of the adoption of scientifically elaborate water-balance DPRs in the community ought to be the focal point with a village-scale approach.

2. Enhance Community Participation, Capacity Building & Accountability

It requires the citizenry to be active stakeholders in water conservation efforts. Acknowledging the fact that "Involvement of local Gram Panchayats and villagers through structured capacities such as Paani Samitis, Gram Sabhas, and awareness campaigns are highlighted for ensuring sustainability of the scheme" (Patil & Pawar, 2020) To assist this assertion, an advocacy report mentions that Jalyukt Shivar 2.0 has adopted methods like Gram Sabha meetings, competitions and media interface to foster local ownership (GoM, Jalyukt Shivar 2.0 features). However, the CAG audit also found either poor collection of maintenance cess or weak community-led maintenance across villages, bringing down long-term upkeep (Frontline, 2020). By doing this, the power of ownership and accountability will be strengthened through more training to make local volunteers and Panchayat members good monitors, along with transparency in reporting.

3. Focus on Integrated Watershed & Ecological Approaches, Not Quick Fixes

India Water Portal, EPW India Water Portal through a detailed analysis of Jalyukt Shivar warns the overemphasis on fast returns in deepening rivers and largely ignores upper catchment and ecological measures like stream bank stabilisation, tank-desilting (India Water Portal, EPW). Study by SANDRP in Sangamner (Ahmednagar) echoes this warning: indiscriminate farm-pond construction without soil conservation fast tracked groundwater depletion (Banerjee, 2017). So the suggestion is that integrated watershed development -a combination of deepening, desilting, plantation, soil -moisture conservation and catchment restoration- interspersed with eco-sensitive design to ensure recharge and biodiversity.

4. Improve Monitoring, Transparency & Third-Party Audits

To deter variances, it is indispensable to have a strong oversight. With only a third of the villages conducting them (Frontline, 2020), the monitoring process has been exposed as poor, and the CAG report identified over 1,300 implementation discrepancies, many leading to corruption or substandard work, also due to the lack of third-party audits. At the same time, news reports detail a lack of follow-up on financial accountability, particularly regarding donations from private sources. Consequently, the introduction of mandatory third-party social and technical audits, public expenditure monitoring and transparent dashboards at district and village level will play a big role in making the system accountable.

5. Integrate Demand Management, Crop Planning, and Water Use Regulation

Water harvesting has to be structural, but in the absence of demand-side regulation, it may stand on a weak footing. The EPW analysis highlights that Jalyukt Shivar has no strategy for demand management, which includes stable revenue sources such as field crops, groundwater extraction schedules and water use norms (India Water Portal; EPW). Such patterns need to be understood, where higher water availability is perpetually translating into more land under cash crop cultivation and more intensive borewells. It is therefore suggested to promote the water-efficient crops and drip irrigation, regulation of drilling borewells and community regulations for water use will lead us to resilience and sustainability.

Summary Table of Recommendations

Recommendation	Description
Village-level DPRs & hydro-budgets	Mandate scientific, locally approved planning documents with water-balance assessments
Community participation & capacity building	Empower Paani Samitis, Gram Sabhas, awareness, training to ensure maintenance and ownership
Integrated watershed & ecological design	Combine storage with soil conservation, catchment restoration, tank desilting, eco-habitats
Monitoring & transparency	Enforce independent audits, public dashboards, strict financial & execution tracking
Demand-side regulation	Promote crop diversification, drip irrigation, regulate groundwater use, foster water budgeting

Conclusion

While Jalyukt Shivar and allied measures in Karjat Tehsil show a progressive level of ecosystem health and water storage in many localities. But massive discrepancies, low impact Study The study employs a descriptive-analytical research design to review the influence and effectiveness of water conservation schemes like Jalyukt Shivar in Karjat Tahasil, Ahmednagar District, however, limited solely to secondary information sources. The sources range from peer-reviewed research papers, government reports, CAG audit findings, to studies using GIS-based mapping and doctoral theses. These dimensions are probed in the analysis of the main spatial pattern of WBM at the village level using GIS mapping to understand how wide and concentrated the interventions are scaled up across villages. Figure 4: Ecological cure of the awesome- picture the effect on ecology, measured through Remote Sensing Ecological Index (RSEI) compares changes in surface conditions and vegetation health from 2015 to 2020; most prominent for intervention villages like Bargewadi and Sonalwadi. An audit of government programmes and reports (CAG Report, 2020), reviews documents (Times of India, 2019; Frontline, 2020) to determine gaps in practices of implementation/storage inefficiency, together with limited impact on groundwater levels in some locations. More work on how groundwater rise has manifested in the expansion of irrigated areas at Vaijapur (Aurangabad) and Mandakhali (Parbhani), with its impact on crop yields through case studies. These are meant for looking at how successful strategies can be transferred to Karjat. This two-pronged approach is able to provide a full scope over the progress and failures of these schemes. While monitoring, the lack of implementation and sustainability factor affects the impact.

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Conflicts of Interest

The authors declare that there are no conflicts of interest regarding the publication of this paper.

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