“Beyond Recharge: Climate-Adaptive Rainwater Storage Options for Drinking Water Security and Strengthening School WASH in Hilly Regions of Palghar, Maharashtra”

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CWAS CENTER FOR WATER AND SANITATION
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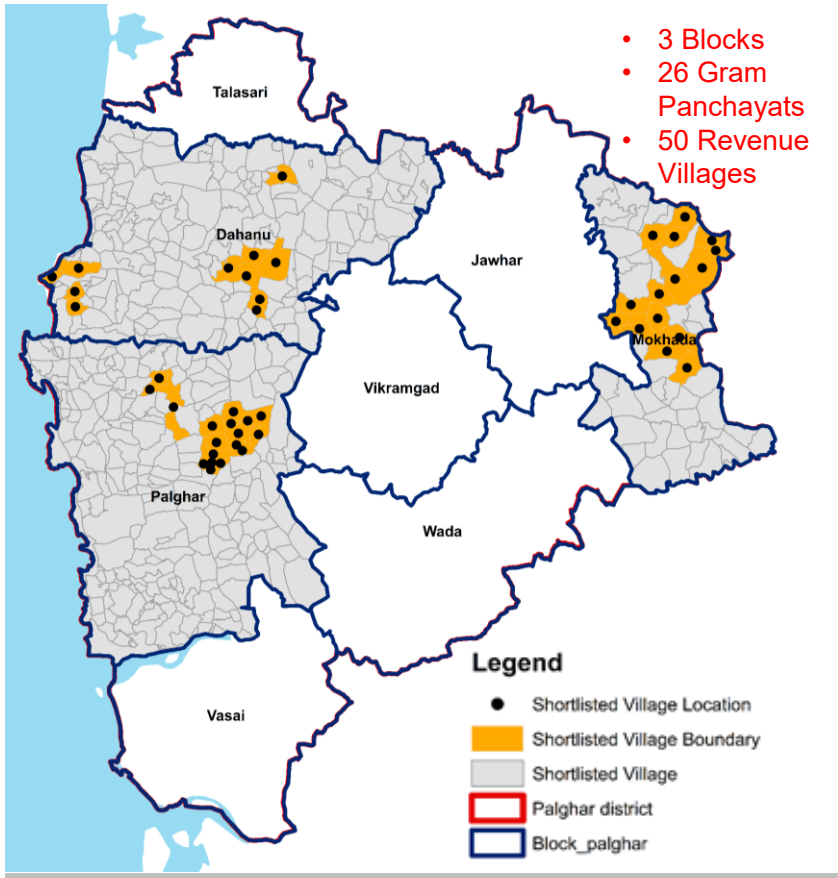
A three-year program: Making Villages Secure for Drinking Water and Waste Management Facilities under HDFC Bank's Parivartan Program

Key proposed project activities for three years (2024 – 2027)

Outcome: To provide safe and equitable water and waste management services by providing technical support, building capacities of local stakeholders including gram panchayats and communities, and strengthening planning, implementation, and monitoring systems.

The Need for Climate-Resilient Strategy for Sustainable WASH and Drinking Water Security

- Hilly regions of Palghar district in Maharashtra **receive heavy annual rainfall** (1700–2400 mm), flood like situations, Inundation of low-lying areas
- 65% of the **tribal rural** population **depends on groundwate**r, yet many habitations and schools face **acute seasonal drinking water scarcity (December to June).**
- **Basaltic geology** results in shallow water tables during monsoon
- **Low natural recharge rates** (4–10% of effective rainfall)
- **Low to moderate aquifer yields** (10–100 LPM)
- **Due to limited aquifer storability,** much of the infiltrated rainwater is lost as **rejected recharge runoff** through **fractures and lineaments**, draining toward the west coast.
- **JJM** implementation is not completed in villages.
- **Tanker dependency** during summer months, lack of storage facilities at HHs.
- **Conventional recharge-only rainwater harvesting systems are insufficient** for sustained water availability.
- **Utilise untapped high rainfall** through Rainwater Harvesting as a key **climate adaptation strategy.** And **Strengthen climate-resilient WASH systems** to safeguard health, livelihoods, and sustainability.



Study Region- Palghar, Maharashtra

(Source: Literature Analysis by CWAS team)

Drinking Water Security Assessment

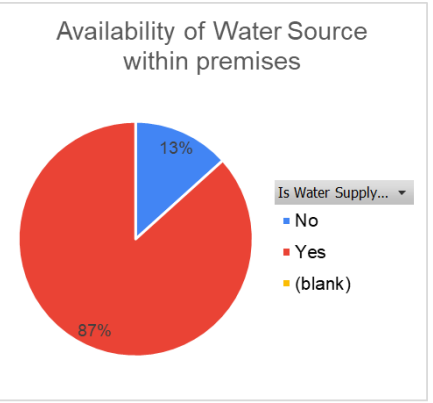
1	2	3	4	5
Surface water sources (lakes/river) and groundwater (wells)	Water quality assessment and treatment systems	Water Distribution systems and ESR	Water supply reliability	User end water supply

	1	2	3	4	5
Existing scenario and issues	• Dependency on dug wells for water supply • Water scarcity issues after Dec-Feb due to lack of groundwater availability • dependency on tanker supply	• TCL dosing in open well - No filtration unit available • Open well requires refurbishment as it is affecting water quality	Small overhead tanks with **solar pumping** Solar systems not working during monsoon- Villagers to walk till source	• **Community tap connections** are present. People **walk long distance** to fetch water. • **No household tap connections** observed in the village- planned under JJM	• Some storage infrastructures built by development partners but are not functional due to lack of O&M. • Inadequate storage facilities at the household level.
		Water quality testing through district labs- once in 2 months			
Proposed Plan	**Source sustainability:** • Rainwater harvesting storage structure for summer months at household and institutional level; raised platforms for flood resilience.	**Quality assurance:** • Water filtration system to improve water quality • Testing of water through FTKs and water quality surveillance	Water storage (ESR) and distribution network planned under JJM	Household tap connections planned under JJM	• Public awareness for use of rainwater for drinking purposes and • Training of villagers about various water harvesting techniques
	Rejuvenation of existing open/dug well.				

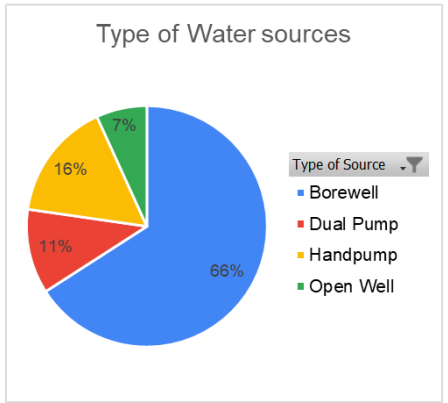
(Source: Water Supply Value Chain Assessment by CWAS team at Palghar, Maharashtra, 2024-2025)

Assessment of WASH Facilities in Schools- Palghar Block

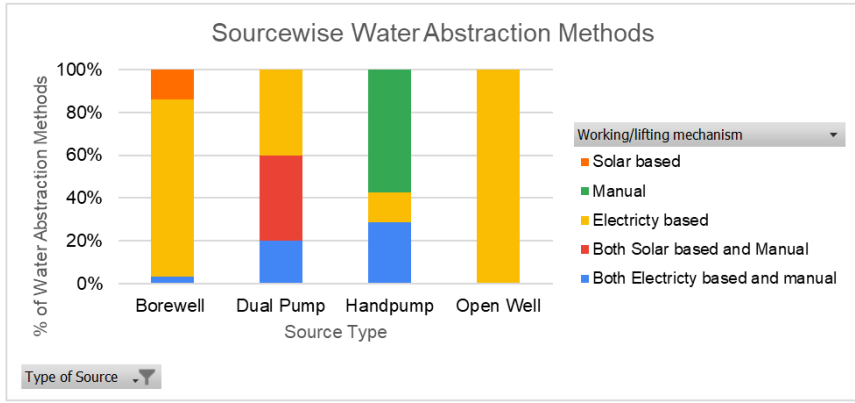
48 Schools | **1,798** students | **Primary Schools** are higher in numbers | **22** Revenue villages | **10** GPs



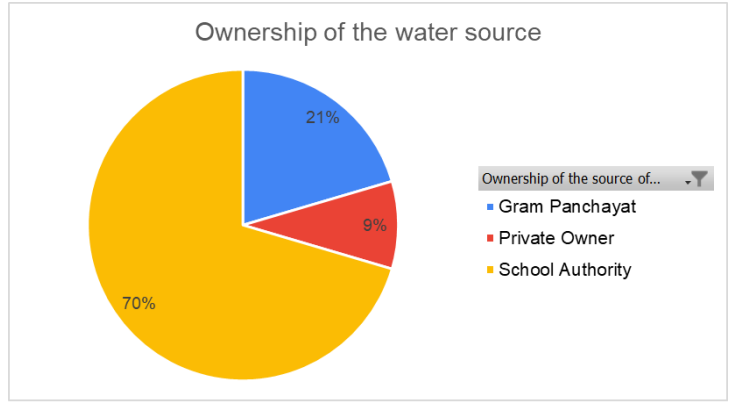
6 schools **do not have water source** on their premises.



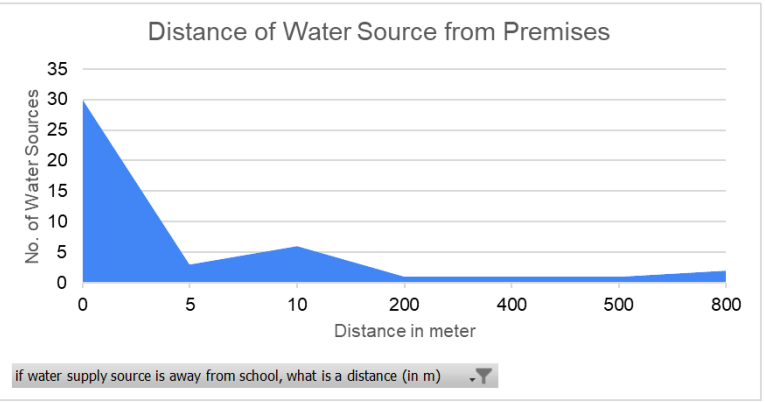
Majority of schools (32) have borewells (**GW**).



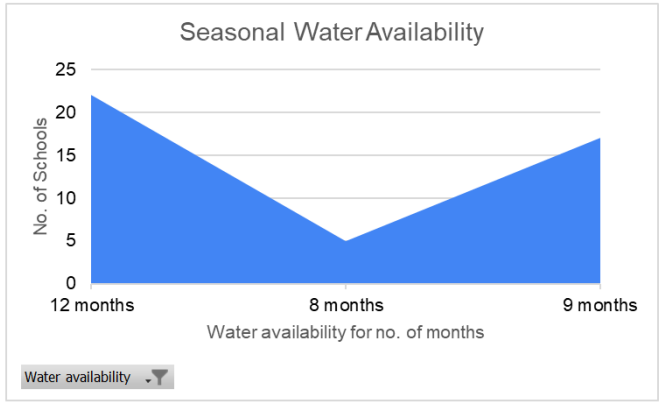
Electricity based pumps have been installed to abstract water, followed by **manually** collected through handpumps. And few schools have solar pumps.



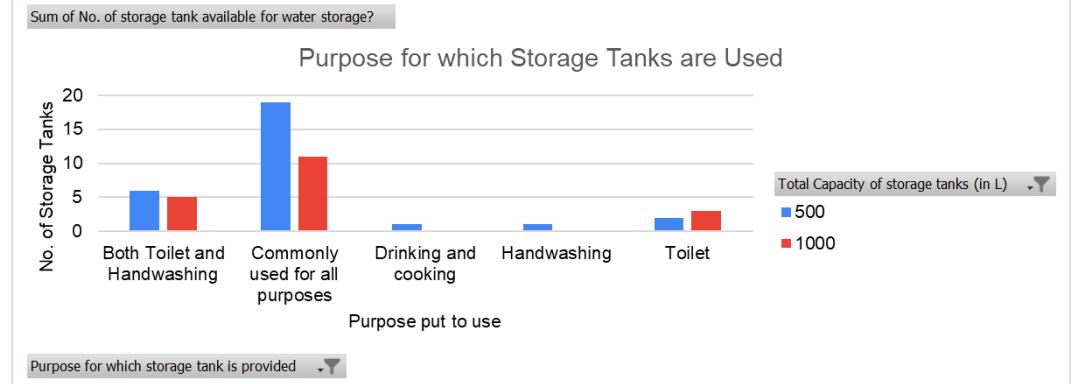
Schools who do not have their own source of water supply are **dependent on external sources.**



Students from 5 schools which are dependent on external sources have to **walk around 800 m to fetch water**.



22 schools faces **seasonal water scarcity for 3-4 months**. Yield of water sources is also poor.

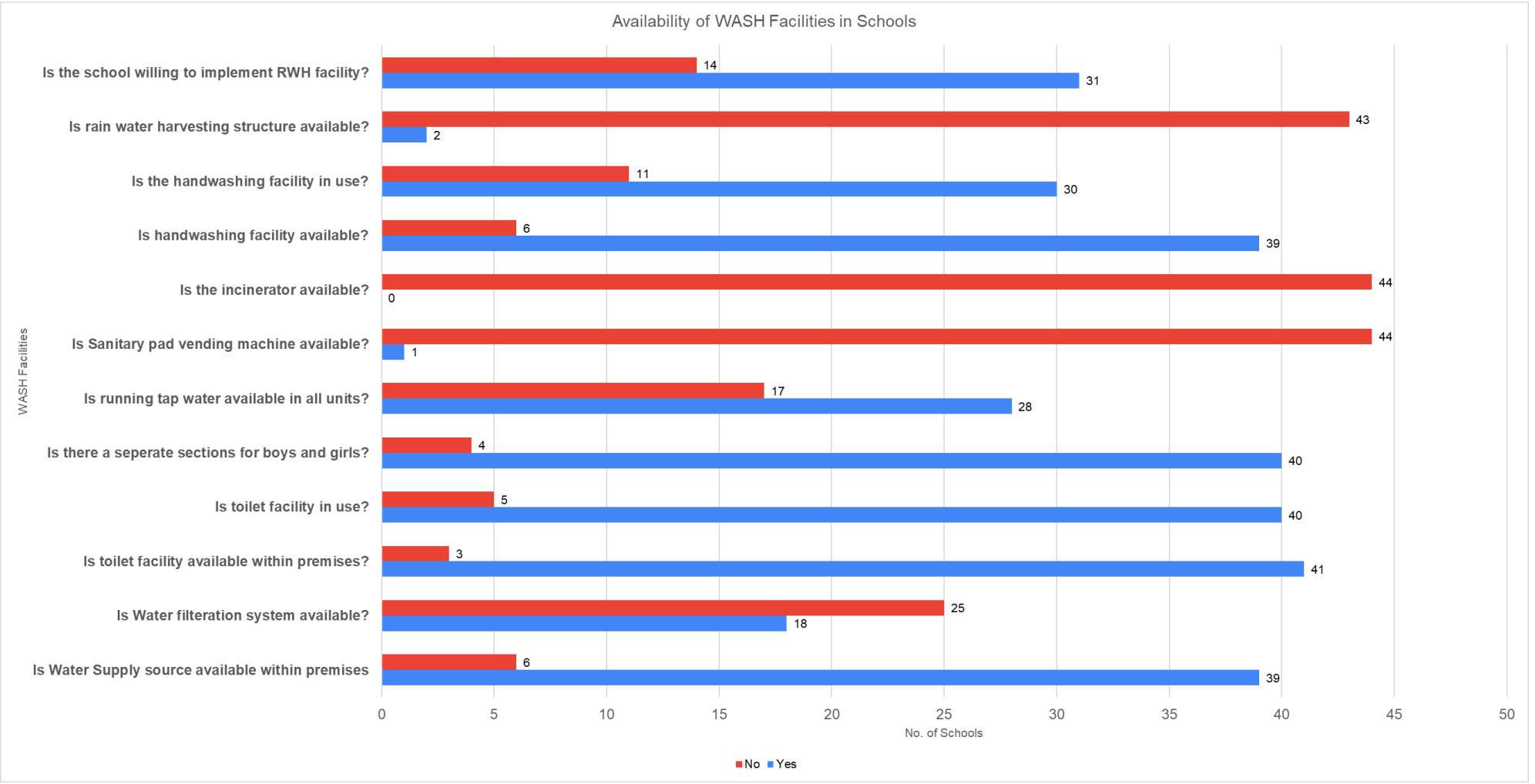


11 schools- No storage facility, **affects the sanitation and hygiene practices.**

Installed **above toilet blocks** affects it's usage for drinking.

(Source: School WASH Assessment surveys carried out by CWAS team at Palghar, Maharashtra, 2025-2026)

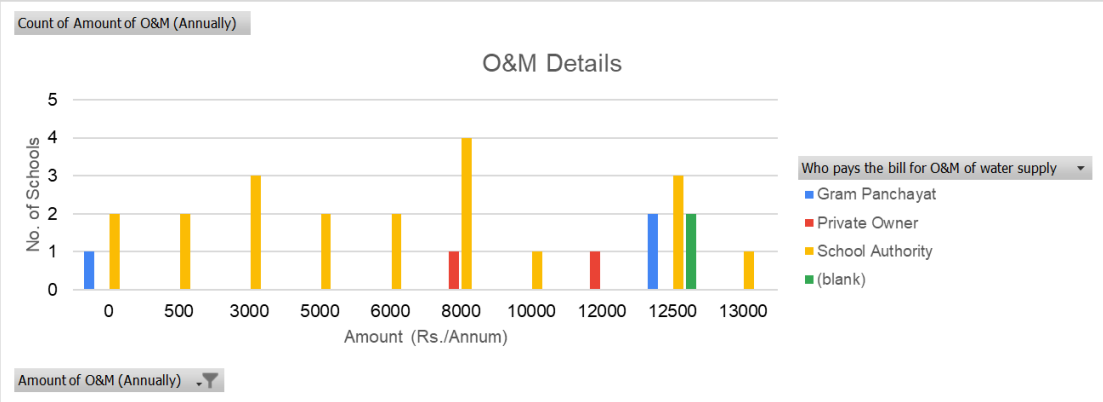
Assessment of WASH Facilities in Schools- Palghar Block



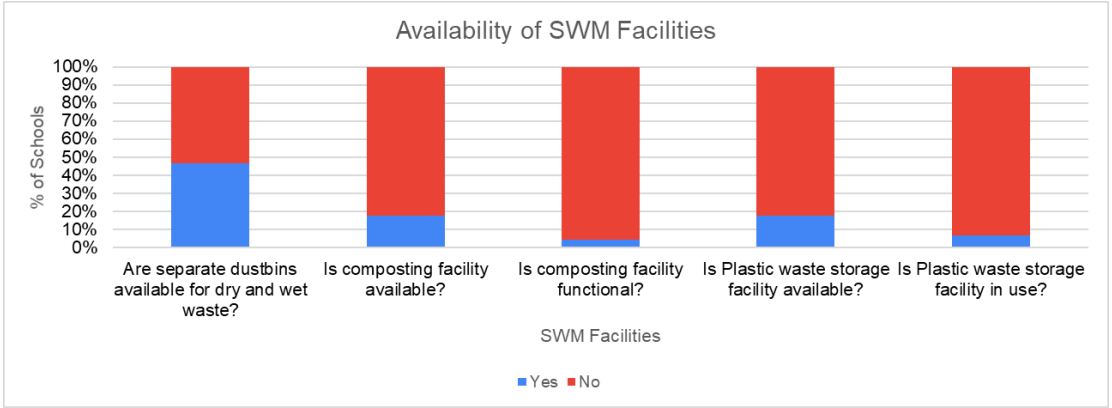
- Though the handwashing facilities are available, they are **not being used** due to multiple issues.
- **Three** schools **lack toilet facilities** and separate sections for boys and girls.
- Most schools have 1–2 toilet seats and 2–3 urinal seats, but the **condition is poor due to unavailability of water,** lack of running water taps, broken taps, damaged doors, missing latches, and nut bolts.
- **Manual/RO filter** system available with 18 schools.

(Source: School WASH Assessment surveys carried out by CWAS team at Palghar, Maharashtra, 2025-2026)

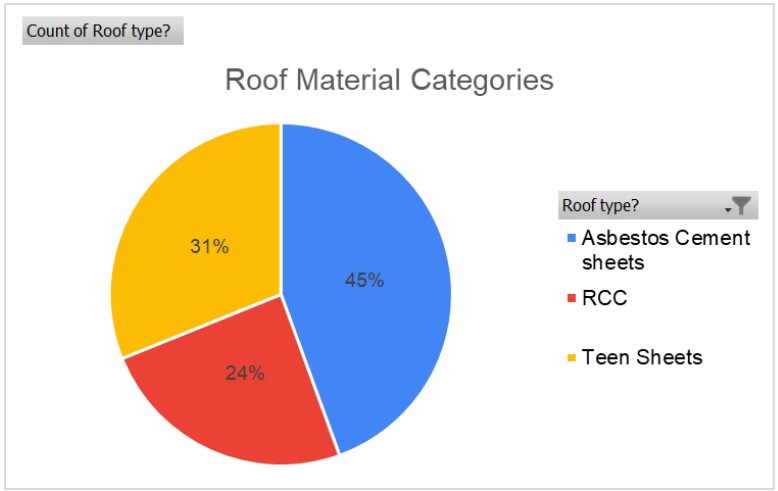
Assessment of WASH Facilities in Schools- Palghar Block



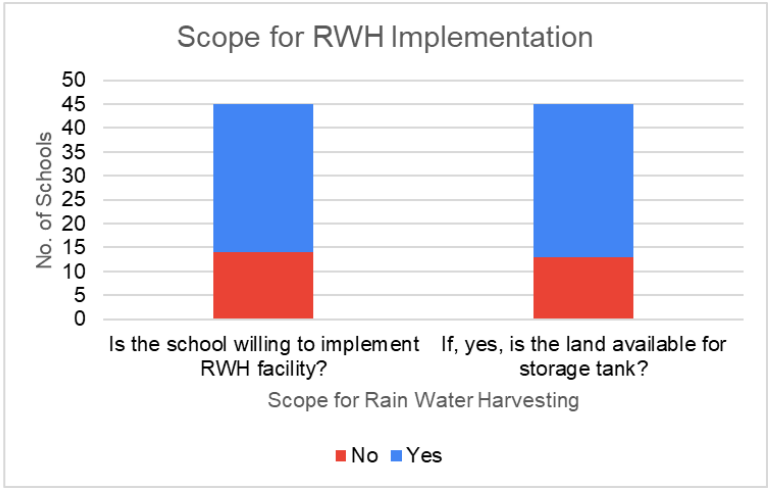
In most cases, the Operation and Maintenance (**O&M**) is handled by the **school authorities**. Few by Private owners.



Facilities remain **unused due to lack of awareness and access**.



Roofs made of **asbestos cement sheets** are most common, followed by **RCC and tin** sheets.



Only two schools have gutters and down-take pipes installed. Most schools are **willing to implement rainwater harvesting facilities**, except a few with land availability issues. Additionally, **schools with clean roof structures, and no. of students- taken into consideration for such initiatives.**

Scope for Implementation of RWH in Schools

(Source: School WASH Assessment surveys carried out by CWAS team at Palghar, Maharashtra, 2025-2026)

Climate Resilient Strategy: Underground Storage-inclusive Roof-top Rainwater Harvesting System

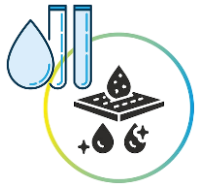
Focus on **enhancing rainwater storage capacity** at local level **instead of just recharge**. These can **help mitigate drinking water shortages** during dry periods and, **where feasible, two-pronged approach of combining storage and recharge** based on local site conditions.

Design **Simple, Low-Cost, Cost Effective Prototype Models-** Underground Storage Tanks with **raised platform for flood resilience**, First Flush System, Filter and Mounted Handpump for easement.

Alignment with Jal Jeevan Mission “Catch the rain, where it falls and when it falls”.

Demonstrate Rainwater Harvesting System at Community and Institutions to be used during lean period (**3- 6 months**).

Formation of **Water User Groups** and **School Committee**



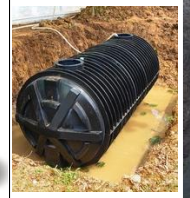
Continuous drinking water **quality monitoring with additional precaution at consumer level- Boiling, cloth filtration, use of filters/RO.**

Capacity building, training and exposure visits for **operation and maintenance** of RWH facilities.

To ensure affordability and scalability- **a convergence approach is essential** with national and state-level schemes.

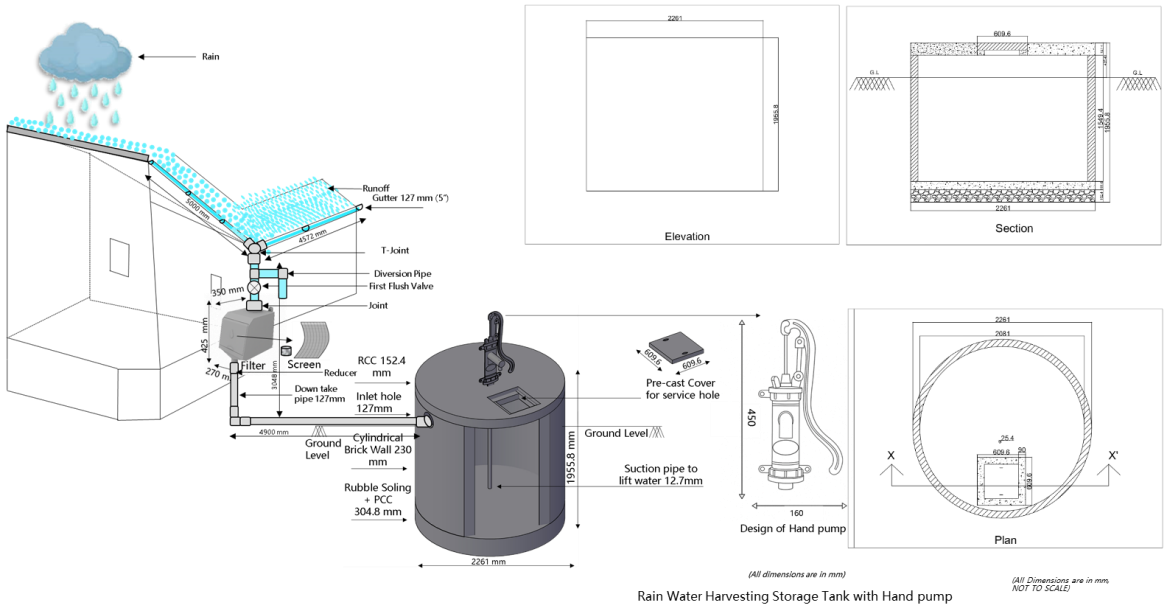
(Source: Strategy developed by CWAS team)

Rainwater Storage Options

Sr. No.	Parameters \ Material Type	RCC	Precast RCC	Ferrocemnt	Brick-Masonry	Steel Tank	Zinc-Aluminium	PE (Polyethylene)		PP (Polypropylene)	FRP (Fiberglass)	GRP SMC panels
								LDPE	HDPE			
0	Showcase											
1	Cost (Rs. Per litre)	Rs. 20-30	Rs. 11 - 16	Rs. 12 - 22	Rs. 13-15	Rs. 15-20	Rs. 17-25	Rs. 6-8	Rs. 8-15	Rs. 8-15	Rs. 10-25	Rs. 18-25
2	Durability/Expected Lifespan	Highly Durable 40-50 Years	Highly Durable 25-30 Years	Highly Durable 25-30 Years	Highly Durable 20-30 Years	Moderately durable 15-20 Years	Highly Durable 20-30 Years	Less durable 10-15 Years	Moderately durable 15-20 Years	Moderately durable 15-25 Years	Highly Durable 20-30 Years	Highly Durable 20-30 Years
3	Strength	Very High	High	High	High	Very High	High	Low to Moderate	Moderate to High	Moderate to High	Moderate	Moderate
4	Space Efficiency/Placement (Underground/Aboveground)	UG/AG	UG/AG	AG preferred	UG/AG	UG/AG	AG only	AG only	AG preferred	AG preferred	AG Only	AG Only
5	Ease of Installation	Low	Low	Moderate	High	Moderate	Moderate	Very High	Very High	Very High	Very High	High
	Time	Slow	Moderate	Moderate	Moderate	Fast	Fast	Very Fast	Very Fast	Very Fast	Fast	Fast
	Accessibility	Moderate	Moderate	Good	Good	Moderate	Good	Very Good	Very Good	Very Good	Good	Excellent
	Transportaion	Easy	Difficult	Easy	Very Easy	Moderate	Easy to Moderate	Easy	Easy	Easy to Moderate	Moderate	Very Easy
6	Design Flexibility	Low	Moderate	High	High	Moderate	Moderate	Low	Low	Low	Very High	Very High
7	Shape availability	Cuboid	Cylindrical	Cylindrical	Cylindrical and Cuboid	Cylindrical and Cuboid	Cylindrical	Cylindrical	Cylindrical	Cylindrical	Customised shapes possible	Customised shapes possible
8	Maintenance Feasibility	Service Cover for Cleaning operations, Stability, Cracks/Leaks if misplaced or mishandelled Needs periodic waterproofing, crack repair, internal cleaning; accessible but labour-intensive.	Higher Mantenance-Check for stability, joint and sealant inspection needed	Requires occasional surface waterproof coating; minor crack repair possible by unskilled labour.	Minimal maintenance-Cleaning and colouring	Prone to corrosion; needs frequent repainting, anti-rust coating.	Better corrosion resistance; minimal maintenance if protected from dents.	Low maintenance-easy cleaning, check for leaks and quality degradation, lid inspection	Low maintenance-easy cleaning, check for leaks and quality degradation, lid inspection	Low maintenance- easy cleaning, check for leaks and quality degradation, lid inspection	Minimal maintenance; check surface coating every few years.	Highly durable; smooth panels prevent algae; very low maintenance
9	Availability of Materials Locally?	Limited Availability	Rare / Imported	Easily Available	Easily Available	Rare / Imported	Rare / Imported	Easily Available	Easily Available	Moderately Available	Rare / Imported	Rare / Imported
10	Human Resources required (Skilled/Semi-skilled/Unskilled)	Highly Skilled	Skilled	Highly Skilled	Semi-skilled	Skilled	Skilled	Semi-skilled	Semi-skilled	Semi-skilled	Skilled	Skilled
11	Quality of Material	High- Workmanship dependent	High- Factory-made consistency	Good- Depends on-site availability	High- Workmanship dependent	High	High	High- Virgin and Foodgrade	High- Virgin and Foodgrade	High- Virgin and Foodgrade	High	High
12	Exposure (Structural Integrity) to Extreme Weather Conditions	Excellent	Excellent	Excellent	Excellent	Moderate	Good	Moderate	Good	Good	Good	Excellent
13	UV- Resistance	High	High	High	High	Low to Moderate	Good	Low to Moderate	High	Poor UV resistance	High	High
14	Key Strengths	Strong, long lifespan	Strong, long lifespan	High tensile strength, Thin walls save space	Local, low cost, Easy rural construction	Strong & quick install	Corrosion-resistant & modular	Cheapest, Light Weight, easy install	Durable, easy install	More rigid than PE	Customizable, UV-resistant	Customizable, UV-resistant
15	Key Limitations	Requires skilled labour & waterproofing, Not movable	Transport of heavy units difficult, Joints need perfect sealing	Micro-cracking risk, Moderate durability, Needs periodic waterproof coating	High seepage risk, need good workmanship	Corrosion-prone, Not usable underground	Can deform under load, Not for UG	Poor UV resistance, Short lifespan, Not for underground	weak for underground use, Shorter life than RCC/brick work	Moderate UV resistance, Mainly for above-ground only	Can crack under soil pressure, Needs quality installation	Requires skilled assembly, Joints can leak if poorly installed
16	Suitability Ranking	Low	High	High	Very High	Moderate	Low	Moderate	Moderate	Moderate	High	Low

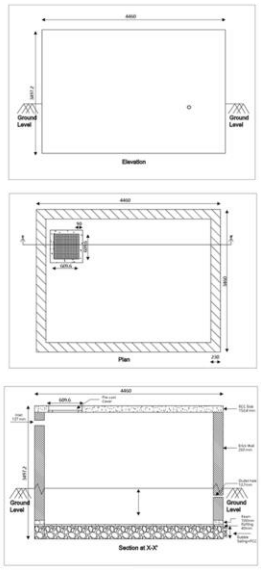
(Source: Market Rates, Analysis carried out by CWAS team at Palghar, Maharashtra, 2025-2026)

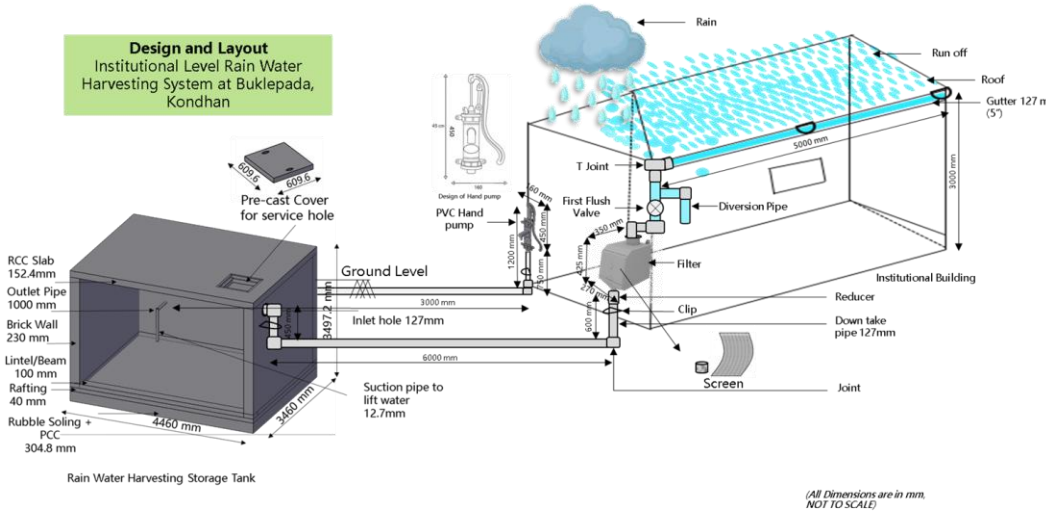
Prototype Design and Layout- Community and Institutional Level RWH System



Rain Water Harvesting Storage Tank with Hand pump

Capacity: 5000 L, demonstrated at 33 locations





Capacity: 25000-35000 L, demonstrated at 07 Schools

Specific Treatment Instructions

A. Boiling (The Gold Standard)

Rolling boil (where large bubbles rise rapidly).

Let it cool naturally and store it in a clean, covered container.

Keep it boiling for at least **3-4 minutes**

B. Filtration

Use of Table mounted **filter** or cloth filter.

C. Chlorination

1 teaspoon of bleach for 20 L.

7 grams per 1,000 L.

Wait for **30 minutes.**

O&M Summary Checklist

Tasks	Frequency	Purpose
Clean Roof & Gutters	Every 15 days (In season)	Prevent debris from entering pipes
Divert First 2-3 Rains	Start of Monsoon	Flush out roof dust and contaminants
Check Tank Seals	Monthly	Prevent algae and mosquito breeding
Inspect for Leaks	Monthly	Ensure structural integrity
Maintain Surroundings	Weekly	Prevent pests, weeds, and unhygienic conditions
Boil/Treat Water	Before every use	Ensure water is safe for drinking

Water User Groups and School Committees for O&M

(Source: CWAS Team, 2025-26)

Cost Effective RWH Storage Tank with mounted Handpump

Demonstration of 5KL raised rainwater storage tanks for flood resilience at HH level


Multipurpose usage of Storage Tank as a stage


Community empowerment and strengthening through visits to the demonstration sites.



Water Quality Training


Retrofitting of RWH by demolishing old building


Engagement of Women SHG, formation of school committee for O&M


Mobile Roof- Community Level RWH


MS/PVC handpump to fetch water


Additional Precaution- Use of Filter

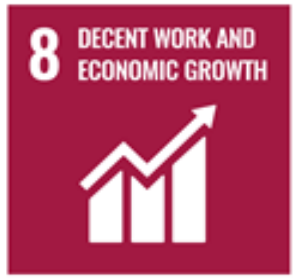
- Capacity building and training for operation and maintenance of infrastructure.
- Community empowerment and strengthening through visits to the demonstration sites.

(Source: Field Visits by CWAS Team)

Water Security Initiatives– Contribution to SDGs

SDG 3
Good Health & Well-being

SDG 6 (6.1, 6.4, 6.5)
Clean Water & Sanitation



SDG 8
Decent Work & Growth

SDG 10
Reduced Inequalities

SDG 15
Life on Land

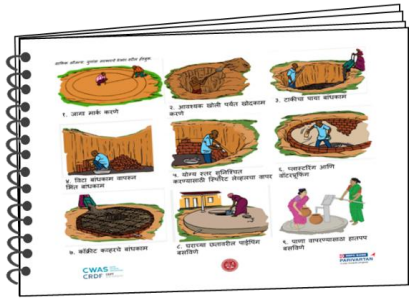
SDG 11
Sustainable Communities

Impact Highlight: Rain Schools like initiatives provide 0.5–1 L/student/day, while these **initiatives ensure ~3 L/capita/day in marginalized habitations and schools for lean period.**

Scaling up of the Initiative

Scaling up and dissemination through documentation

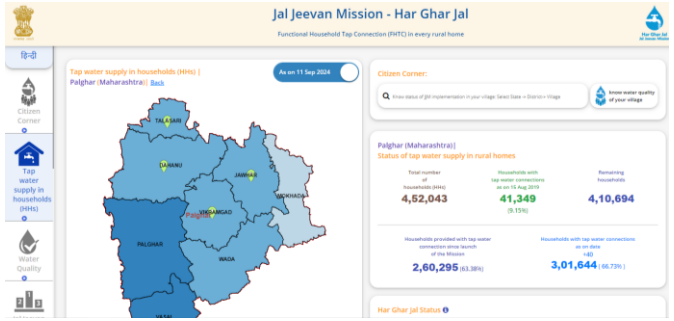
- **Rainwater harvesting awareness booklet** prepared showcasing simple step-by-step approaches, different technology and material options.
- **Various awareness materials** - pamphlets, posters, training booklet prepared.



Through programme convergence, capacity building and monitoring support

Strategic support for programme implementation at district and block level

Support strengthening monitoring system at district level



Organise district and state level workshop to disseminate learnings from Palghar District

Scaling up of the Initiative

Convergence support of JJM with National/ State Programme

- While the VB- G RAM G Act and MGNREGS acknowledges "rooftop rainwater harvesting and other decentralised recharge systems", **the current focus is primarily on ground water recharge**, **under-emphasising the critical need for provision of a storage unit at household/institution/community/habitation levels.** The absence of adequate storage infrastructure significantly **limits the overall effectiveness of rainwater harvesting systems and hinders** the successful implementation of sustainable groundwater recharge measures aimed at achieving **long-term drinking water security and strengthening school WASH in Hilly Regions like Palghar.**
- This gap presents an opportunity to **advocate for greater emphasis on storage infrastructure** alongside recharge facilities.
- **Therefore, it is strongly recommended to include both skilled, semi-skilled, and unskilled human resources, as well as material components for the construction of rainwater storage tanks and small handpumps, in addition to recharge structures.** These components need to be incorporated into the list of permissible activities under the Annual Master Circular of the MGNREGA, 2005, or VB- G RAM G, Act 2025 issued by the Ministry of Rural Development, Government of India.
- Such convergence is vital for the successful implementation of sustainable groundwater recharge measures and **for achieving long-term drinking water security in vulnerable rural and hilly regions.**

(Source: Analysis of VB- G RAM G Act and MGNREGS , *2025-26)*

Partnerships and Collaboration to attain Scale . . .

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Special thanks to HDFC Bank's Parivartan Programme, ZP Office Palghar, and Majhi Vasundhara- Environment and Climate Change Department, GoM for their valuable support.

Thank You

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