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MANAGING GREYWATER IN TWO AGROCLIMATIC ZONES

PALI (RAJASTHAN) AND BANDA (UTTAR PRADESH)

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PALI (RAJASTHAN) AND BANDA (UTTAR PRADESH)

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Citation: Swati Bhatia, Pradeep Kumar Mishra, Vivek Kumar Sah 2026, *Managing Greywater in Two Agroclimatic Zones—Pali (Rajasthan) and Banda (Uttar Pradesh)*, Centre for Science and Environment, New Delhi

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Executive summary

Jal Jeevan Mission (JJM) has reached approximately 81.71 per cent of rural households—nearly 15.81 crore homes with a functional tap water supply, achieving what seemed almost impossible. This achievement also brings a parallel and largely unaddressed challenge: the rapid increase in greywater generation. Using the standard thumb rule that 65–70 per cent of supplied water becomes wastewater, a rural household receiving 55 litres per capita per day produces roughly 215 litres of greywater daily for a six-member family. This translates into the production of huge quantities of wastewater at the village, block and district levels. In the absence of adequate systems for its collection, treatment and disposal, this wastewater will accumulate across village streets, contaminate ponds and groundwater, flood agricultural fields, and create conditions conducive to waterlogging and vector-borne diseases.

The Centre for Science and Environment conducted survey studies in two districts with different ecologies—Pali in Rajasthan and Banda in Uttar Pradesh—to understand how these challenges are unfolding on the ground. Based on a survey of 589 households across 30 villages in Pali and Banda, field observations, community interactions, stakeholder consultations, and verification of government dashboard data, the study finds that greywater generation remains inadequately mapped and lacks proper planning and management. The absence of metering at both the household and system levels for supplied water forces reliance on approximations, introducing significant uncertainty. In practice, water consumption levels vary due to the use of multiple water sources, such as hand pumps and borewells, further complicating estimation and proper management in the absence of available infrastructure.

Drainage infrastructure in both districts is fragmented and poorly designed. In Banda, a significant proportion of households lack drains altogether, and existing drains are often built in isolated segments without adequate connectivity, slope or discharge planning. The predominance of clayey soil in Banda severely limits infiltration, leading to persistent waterlogging, damage to agricultural land, and contamination of local waterbodies. In contrast, Pali's more permeable soils reduce visible water accumulation but increase the risk of groundwater contamination from unmanaged infiltration, which remains unmonitored. Across both districts, there is no systematic planning for end-point disposal or treatment, and greywater is typically discharged untreated into open areas or natural systems.

Treatment and reuse practices are minimal. Only a small fraction of households reuse greywater, primarily through informal practices such as diverting kitchen water to small garden plots. The main intervention promoted under existing programmes—community soak pits—has limited effectiveness, with many found to be non-functional, improperly constructed, or absent despite being recorded in official data systems. In several cases, soak pits are waterlogged, lack essential components such as silt chambers, or have exceeded their design capacity. No village in the study had a functioning, planned system for greywater treatment or reuse at scale.

In Banda, the situation is further complicated by the mixing of greywater with black water. A substantial proportion of households lack functional toilets, and even where toilets exist containment systems are often poorly designed. Effluent from septic tanks or pits frequently discharge directly into open drains, increasing contamination risks and undermining any potential for safe reuse. This also has more complex challenges towards community health. In Pali, higher toilet coverage and the absence of such mixing simplifies the problem but does not eliminate the risks associated with unmanaged wastewater.

Institutional and governance approach in silos and fragments is also a barrier to effective management. Village Water and Sanitation Committees (VWSCs) are not functional and have a little role and involvement in planning or maintenance. Coordination between key programmes such as JJM and the Swachh Bharat Mission (Grameen) is limited, resulting in fragmented investments and disconnected infrastructure. Village-level planning instruments, including Village Action Plans and Gram Panchayat Development Plans, do not adequately integrate water supply and wastewater management. Community awareness is also low, with most households viewing greywater as waste rather than a potential resource. Information, education and communication activities are largely absent, and there is minimal engagement of local institutions or self-help groups in addressing the issue.

The study identifies a set of priority actions to address these gaps. These include establishing basic water measurement systems to generate reliable data, developing village-level drainage plans that map flows and infrastructure before construction, and adopting technologies suited to local soil and hydrogeological conditions rather than relying on uniform solutions such as soak pits. In areas like Banda, containing black water and preventing its mixing with greywater is critical. Strengthening local institutions, particularly Village Water and Sanitation Committees, and ensuring dedicated funding for operation and maintenance are necessary for long-term functionality. Equally important is sustained community engagement to build awareness and encourage behavioural change, alongside stronger coordination between implementing agencies through joint planning and monitoring mechanisms. In water-scarce regions such as Pali, there is also a clear opportunity to promote the reuse of treated greywater for non-potable purposes, thereby reducing pressure on freshwater resources.

India is at a critical juncture, and the expansion of rural water supply must be matched by an equally robust approach to wastewater management. Findings from Pali and Banda indicate that greywater is already a serious issue in some regions and an emerging risk in others. Without timely intervention, environmental and public health impacts are likely to intensify as water access continues to improve. At the same time, the institutional framework and funding mechanisms required to address the problem are already in place. What is needed is a shift towards integrated, evidence-based planning, supported by political commitment, inter-agency coordination, and community participation. Managing greywater effectively offers an opportunity not only to mitigate risks but also to enhance water security, support livelihoods, and ensure the sustainability of rural water supply investments.

1. Introduction: Context and rationale

Expansion of rural water supply and the emerging greywater challenge

India is currently witnessing a major transformation in rural water supply through the implementation of the Jal Jeevan Mission (JJM), which aims to provide functional household tap connections to all rural households. According to data from the Department of Drinking Water and Sanitation under the Ministry of Jal Shakti, the programme has already connected approximately 81.71 per cent of rural households, representing nearly 15.81 crore households (as in February 2026).[1]

Improved household-level water access has significant implications for rural living conditions, including better hygiene, improved sanitation practices and reduced drudgery associated with water collection. However, the expansion of water supply also leads to a proportional increase in wastewater generation, particularly greywater generated from household activities such as cooking, bathing and washing clothes.

Greywater constitutes the largest share of domestic wastewater generated at the household level. According to the SBM-Grameen Greywater Management (GWM) Manual and the JJM Guidelines, approximately 65–70 per cent of supplied water becomes wastewater.

Scale of the greywater management challenge

India's rural population remains substantial. According to the 2011 Census, approximately 68 per cent of the population lives in rural areas.

Under the Jal Jeevan Mission, rural households are expected to receive water at a minimum service level of 55 litres per capita per day (lpcd). Based on this service level, a typical rural household with six members would consume approximately 330 litres of water per day, generating roughly 215 litres of greywater daily.

When aggregated across entire villages and districts, the quantity of greywater generated becomes substantial. Estimates based on rural population data illustrate the scale of the challenge (see *Table 1: Estimated greywater production in rural India*).

Table 1: Estimated greywater production in rural India

Region	Rural population (crore)	Estimated greywater production @36 lpcd (MLD)
Rajasthan	5.07	1,825.89
Uttar Pradesh	16.74	6,024.669
India	91.85	33,066.94

Source: Compiled from JJM dashboard data

These estimates highlight the magnitude of wastewater that rural settlements must manage as water supply expands.

In many villages, however, the infrastructure required to collect, convey, treat and reuse greywater has not been developed alongside water supply systems.

Environmental and public health implications

In the absence of adequate management systems, greywater often creates multiple environmental and public health challenges in rural areas.

In many rural areas, greywater generated at the household level is discharged directly into open spaces, drains, ponds or agricultural fields due to lack of appropriate collection and treatment systems. This can lead to waterlogging, contamination of waterbodies and increased risk of vector-borne diseases.

Greywater entering waterbodies is especially problematic because many rural-water-supply systems depend on groundwater or surface-water sources located near settlements. If wastewater enters these sources untreated, it can degrade water quality and undermine long-term water security.

Previous field studies by the Centre for Science and Environment (CSE) have also observed that restored rural waterbodies often deteriorate again due to the uncontrolled entry of greywater. This indicates that waterbody restoration efforts cannot succeed without addressing wastewater flows into those systems.

Policy recognition of greywater management

The growing challenge of rural wastewater management has been acknowledged in national policy frameworks and programmes (see *Table 2: Acts and policies influencing management of rural greywater at national level*).

Table 2: Acts and policies influencing management of rural greywater at national level

Acts and policies at Central level which influence the greywater management at national level
• Water (Prevention & Control of Pollution) Act, 1974 • Environment (Protection) Act, 1986 • National Water Policy • National Environment Policy/National Conservation Strategy • National Green Tribunal Act, 2010 acts as an enforcement agency

Source: Compiled by CSE

While most of the programmes and schemes that launched so far focused on behavioural change and construction of toilets, SBM G-II and JJM focus on management of greywater in rural areas (see *Table 3: Programmes and schemes that have been launched so far and how each focused on greywater*).

Table 3: Programmes and schemes that have been launched so far and how each focused on greywater

Year	Programme
1986 onwards	Central Rural Sanitation Programme (CRSP)
1999–2012	Total Sanitation Campaign (TSC)
2012–14	Nirmal Bharat Abhiyan (NBA)
2014–19	Swachh Bharat Mission
2020–25	Swachh Bharat Mission–Grameen Phase II (ODF Plus), SUJALAM Campaign (Phase 1) and SUJALAM Campaign (Phase 2)
2019–present	Jal Jeevan Mission (JJM)
2013 onwards	Neer Nirmal Pariyojana (World Bank–assisted) project

Source: Compiled by CSE

Liquid Waste Management Rules

The Liquid Waste Management Rules, launched in 2025, propose management of domestic wastewater among other wastewater streams in both rural and urban areas. They talk about proper collection, treatement and reuse of domestic wastewater, inlcuding greywater. The rules also mention the roles and responsibilities of various stakeholders.

Swachh Bharat Mission-Grameen

The Swachh Bharat Mission initially focused on eliminating open defecation through toilet construction. In its Phase II, the programme expanded its scope to include solid and liquid waste management, including greywater management.
SBM-G emphasizes:

- management of greywater at the household level wherever feasible;
- decentralized solutions such as soak pits, kitchen gardens and small treatment systems;

- community participation and village-level planning; and
- convergence of funds from multiple government schemes.

Jal Jeevan Mission

The Jal Jeevan Mission (JJM) recognizes greywater as a natural byproduct of household water supply and emphasizes the need to manage it in order to protect village environments and water resources.

The JJM Guidelines highlight:

- preparation of Village Action Plans that include greywater management;
- convergence with SBM-G programmes;
- mapping and geotagging of greywater infrastructure; and
- integration of water supply and wastewater planning.

Jal Jeevan Sarvekshan was also initiated in 2023 to audit the water functionality, sustainability and water quality testing aspects on monthly basis. However it is not done regularly as SBM-G. Audit reports beyond 2023 are not made available on a public platform. However, despite focus of greywater in the guidelines, it does not have any component for audits on greywater management—probably to avoid duplication.

Sujalam campaign

Sensing the urgency to manage greywater, on 22 March 2022, while marking World Water Day, the Union Minister of Jal Shakti launched Sujalam 2.0, a campaign to mobilize communities and institutions to undertake greywater management. This campaign followed the first phase of Sujalam in 2021, which was a 100-day initiative on wastewater management at the village level, particularly through the creation of one million soak pits and other greywater management activities. Sujlam 3.0 was launched in 2023. Funds were proposed to be sought from the Swachh Bharat Mission-Grameen (SBM-G) 2.0, MGNREGS, the 15th Finance Commission, or a convergence of all these avenues. Under the campaign, nine Union ministries also signed a joint advisory detailing how they will take up greywater management through a convergence model.

Recently, the Ministry of Drinking Water Jal Sewa Aankalan launched where the VWSCs, panchayat, system operators and representatives from water users would assess the regularity of water supply, water quality, O&M, source sustainability and village-level institutional and management arrangements and share the audit findings with the gram sabha for deliberation.

Institutional context of rural greywater management

Several institutions are involved in rural water and sanitation management in India.

At the national level:

- Ministry of Jal Shakti oversees drinking water and sanitation programmes;
- Department of Drinking Water and Sanitation (DDWS) implements JJM and SBM-G;
- Central Pollution Control Board (CPCB) sets water quality standards; and
- National Green Tribunal (NGT) oversees environmental compliance.

At the state and district levels, implementation typically involves:

- Public Health Engineering Departments (PHED);
- Rural Development Departments;
- Panchayati Raj institutions; and
- State Water and Sanitation Missions.

Although these institutions operate under related policy frameworks, field evidence suggests that coordination between water supply programmes and sanitation initiatives remains limited. As a result, planning for water supply expansion often occurs independently of wastewater management planning.

Understanding the existing policies and strategies for greywater management in rural areas of Uttar Pradesh

According to media reports,[2] the state is in the process of drafting its policy on rural sanitation. These acts, policies and guidelines form an important part of the implementation detailing the institutional structure, roles and responsibilities, identifying the source of funds and other technical aspects to look into the implementation of safe sanitation. The study comes in at the right time, as the policy aspects should address aspects of adoption of terrain-specific technologies to ensure sustainability in the long run.

Table 4 details some acts and policies that directly or indirectly deal with managing wastewater in rural areas to protect waterbodies and groundwater in the state and ensure safe drinking water to the community. The Rural Development Department, Uttar Pradesh looks into implementation of various water-linked programmes and other rural development projects under schemes such as Mahatma Gandhi National Rural Employment Guarantee Scheme (MGNREGS), now Viksit Bharat – Guarantee for Rozgar and Ajeevika Mission (Gramin), (VB-G RAM G) and JJM. The State Water and Sanitation Mission (SWSM)[3] has been established under the Government of India 1999 reform initiatives for rural water and sanitation. It guides the policy decision and implementation of community-led projects in the state. SWSM in the state is led by the Chief Secretary with the Principal Secretary or Secretary in charge of the Public Health Engineering Department (PHED), Rural Water Supply (RWS) Department, Rural Development and Panchayati Raj Department, and various other departments as members. The other members, such as officials from departments, subject matter experts and consultants, also form a part of the SWSM cell on a deputation basis. The cell is responsible for implementing Jal Jeevan Mission in the state, finalizing state action plan, ensuring proper utilization of groundwater and ensuring safe sanitation for the urban and rural areas and also protect the waterbodies in the state. The Department of Panchayati Raj[4] looks into implementation of Swachh Bharat Mission-Grameen (SBM-G) and the Gram Panchayat Development Plan (see *Table 4: Important policies and acts in Uttar Pradesh that deal with the safe management of grey and black water in rural areas*).

Table 4: Important policies and acts in Uttar Pradesh that deal with the safe management of grey and black water in rural areas

Policies/Regulations
• Panchayat Raj Act, 1947 • Uttar Pradesh State Water Policy, 2020 • State Rural Water Supply guidelines, 2016 • Uttar Pradesh Water Management and Regulatory Commission Act 2008, 2014 • Policy for Groundwater Management, Rainwater Harvesting and Groundwater Recharge in Uttar Pradesh, 2013

Source: Compiled by CSE

Understanding the existing policies and strategies for greywater management in rural Rajasthan

Rajasthan has a state sewerage and waste water policy which was released in 2025. However, it doesnot in detail address that it applies to rural Rajasthan. However, it does rural water per capita supply and that the greywater and black water in unsewered areas should be managed separately. It addresses treated wastewater as a resource and to be used for agriculture purpose. But it doesn't make it binding to rural areas. A need to address sanitation and standards for rural areas exists. A draft version of rural sanitation strategy developed in 2011 exists (see *Table 4a: Important policies and acts in Rajasthan that deal with the safe management of greywater and black water in rural areas*).

Table 4a: Important policies and acts in Rajasthan that deal with the safe management of greywater and black water in rural areas

Policies and Regulations in UP
• Rajasthan Panchayati Raj Act, 1994 • Rajasthan State Water Policy, 2010 • Rajasthan Rural Sanitation Policy, 2011-Draft • Rajasthan Groundwater Policy, 2020

Source: Compiled by CSE

Need for evidence from the field

While policy frameworks acknowledge the importance of greywater management, there is limited evidence on how rural communities actually manage wastewater in practice.

Key questions remain, including:

- How much greywater is being generated in rural households?
- What infrastructure exists to manage this greywater?
- How does greywater move from households to disposal points?
- Are communities prepared to manage increasing wastewater volumes?
- What institutional and technological gaps exist?

Understanding these questions is particularly important because greywater management solutions must be adapted to local conditions, such as soil type, groundwater levels, settlement patterns and water-use practices.

Rationale for selecting the study districts

To address these questions, the Centre for Science and Environment conducted an evidence-based study in two districts representing contrasting ecological and hydrogeological conditions:

- **Pali district in Rajasthan**, located in a semi-arid desert region with limited water availability; and
- **Banda district in Uttar Pradesh**, located in the Indo-Gangetic plains, with different soil and groundwater characteristics.

These districts were selected to examine how differences in terrain, soil conditions and water-supply patterns influence greywater generation and management.

2. Aim, objective and scope of the study

Aim

By comparing these two districts, the study aims to:

- understand how greywater behaves in different hydrogeological settings;
- identify gaps in infrastructure and institutional arrangements; and
- highlight opportunities for improving greywater management in rural areas.

Objective

This study surveys the current state of greywater in the rural areas of Banda district in Uttar Pradesh and Pali district in Rajasthan. Its objectives include the following.

1. Understanding water-usage practices as both lie in water-scarce regions; practices and effects on greywater quantums produced;
2. Both the district lie in different hydrogeological terrains. This will help understand the existing greywater management practices and compare the differences. It would also help understand what kind of solutions should be adopted in different terrain.
3. Assessing challenges of the communities with increased greywater production;
4. Understanding the journey of greywater from source of generation to point of disposal—identifying gaps, challenges and opportunities;
5. Understanding the state of existing infrastructure and state of operation and maintenance;
6. Understanding the role and preparedness of communities and community-led institutions on greywater management practices and readiness to reuse treated greywater; and
7. Developing an action agenda aimed at proper management of greywater—addressing proper estimation of greywater generated, planning and technology selection according to the soil type and groundwater table, proper conveyance system, operation and maintenance and opportunities for reuse of water.

Scope

This study undertakes an evidence-based assessment of greywater in selected villages of Pali district (Rajasthan) and Banda district (Uttar Pradesh). The study surveys the ground realities on growing greywater generation, lack inadequate drains, infrastructure and adequate technical knowledge and understand the available opportunities in case the treated water is promoted for reuse. The study further tries to understand the institutional arrangements, community approach, issues and challenges with Operation and Maintenance and adherence on the ground with respect to JJM and SBM-G guidelines.

What this study does not cover

The study doesn't compare greywater production in different seasons, primary data collected was only from the households and community interaction. No water quality testing was done. The report would also not quantify the exact quantums of greywater generated and is estimated basis 70 per cent thumb rule on per capita water supply- the water consumption estimations were also based on assumptions made by the surveyor basis household interactions.

3. Study methodology

Key highlights

The study area was selected based on different parameters required to understand the different ground situations.

The research areas for the landscaping study have been selected in Pali district of Rajasthan and Banda district of Uttar Pradesh. To conduct the landscaping study on the issues of source sustainability and greywater management in rural areas of Pali district (Rajasthan) and Banda district (Uttar Pradesh), villages have been chosen based on different criteria as mentioned below:

1. **Hydrogeology:** The villages from different blocks in Pali district have been selected from different hydrogeology. The hydrogeology of these villages consists of granite, older alluvium, gneiss and phyllite. These hydrogeological formations are present in the entire district. So, the sample of villages selected would represent all kinds of formations in the district. In Banda district the rock types present are older alluvium, newer alluvium and granite.
2. **Household population:** The chosen sample of villages cover different number of households in villages, ranging from 33 to 961 households in village in Pali district and 127 to 2,255 households in villages in Banda district.
3. **Percentage of households covered under drinking water supply:** The selected villages also represent different percentage of households covered under drinking water supply, as mentioned in Jal Jeevan Mission dashboard. This ranges from 0 to 100 per cent coverage in selected villages. This would also give us an estimate of the changing water consumption patterns in the villages due water supply.
4. **Har Ghar Status in JJM:** Out of all the villages where 100 percentage of households have been covered under JJM, the selected villages represent the Har Ghar Status as 'reported' and 'certified'.
5. **Type of water supply scheme:** The sample villages are selected based on water supply schemes and sources of water used for supplying drinking water. The sample villages cover both Single Village Schemes (SVS) and Multi Village Schemes (MVS). (See *Table 5: Details of selected villages in Pali and Banda district*)

Table 5: Details of selected villages in Pali and Banda district

State	District	Block	Village	Total household	Population	Household coverage (%)	Rock type	Har Ghar Jal status (Reported*/ certified**)	Type of water supply scheme (SVS/MVS)
Rajasthan	Pali	Bali	Velar	266	1332	90.23%	Granite		SVS
			Kothar	961	3,074	100	Granite	Reported*	SVS
			Berdi	353	1,911	60.97	Granite		SVS
			Khetarli	254	1,328	7.87	Older alluvium		SVS
			Goriya	641	3,448	4.06	Gneiss		SVS
		Sumerpur	Barli	151	585	100	Older alluvium	Certified**	MVS
			Gogra	364	1,956	0	Older alluvium		SVS
			Rojra	326	1,560	54.29	Granite		SVS
			Basant	598	3,018	100	Granite	Certified	MVS
			Dholasasan	221	1,378	100	Granite	Reported	SVS
		Rani	Keerwa	500	2,572	100	Older alluvium	Reported	MVS
			Vingarla	227	1,232	100	Phyllite	Certified	SVS
			Pratapgarh	333	1,133	100	Granite	Certified	SVS
			Septawa	167	754	100	Granite	Reported	SVS
			Nawagura	497	1,325	100	Older alluvium	Certified	MVS
Uttar Pradesh	Banda	Baberu	Samgara	815	5,402	100	Older alluvium	Certified	SVS
			Jugrehlee	159	1,011	100	Older alluvium	Certified	SVS
			Milathu	502	3,237	100	Older alluvium	Certified	SVS
		Jaspura	Bhatha	127	811	100	Newer alluvium	Certified	MVS
			Jaspura	1,406	8,057	100	Older alluvium	Certified	SVS
			Gadariya	1,549	9,107	100	Older alluvium	Certified	SVS
			Lasada	290	1,613	100	Older alluvium	Certified	SVS
		Badokhar Khurd	Lohara	133	691	100	Older alluvium	Certified	MVS
			Achharaund	609	3,840	80.62	Newer alluvium		SVS
			Mohan Purwa	639	3,684	85.92%	Newer alluvium		SVS
			Jaurahi	547	3,666	100	Newer alluvium	Certified	SVS
			Tindwara	2,255	13,773	100	Newer alluvium	Certified	SVS
			Bhawani Purwa	232	1,395	100	Newer alluvium	Certified	SVS
		Naraini	Bahadurpur Kalinzar	706	3,805	100	Granite	Reported	SVS
			Sadha	1,329	7,550	100	Granite		SVS

Source: JJM dashboard (https://ejalshakti.gov.in/jjmreport/JJMIndia.aspx) as viewed on 10 September 2025 and Central Groundwater Board

**Har Ghar Jal Status (Reported): The Rural Water Supply Department of the state declares the village as having 100 per cent tap water coverage in the JJM Integrated Management Information System*

***Har Ghar Jal Status (Certified): The gram sabha passes a resolution confirming that all households, schools and anganwadis are receiving functional tap water, supported by a video documentation.*

Selection of number of households to be surveyed in the study area and duration of the study

A total of 281 households across 15 villages in Pali (Bali, Sumerpur, and Rani blocks) and 308 households across 15 villages in Banda (Baberu, Jaspura, Badokhar Khurd, and Naraini blocks) were surveyed (see *Table 6: Details of survey statistics*, *Map 1:* Location of surveyed villages in Pali district and *Map 2: Location of surveyed villages in Banda district*). The methodology prioritized spatial representation, ensuring that larger villages yielded larger sample numbers while smaller villages maintained a minimum representation to capture local variations.

In Pali, the achieved sample of 281 households was marginally lower than the target of 301 households, but the shortfall of less than 7 per cent does not materially affect the robustness of the diagnostic assessment. In Banda, the 308-household sample exceeded 100 per cent of the calculated requirement, providing a statistically acceptable basis for district-level findings. Detailed survey summaries show these samples covered a total population of 3,481 residents across 30 villages (see *Table 6: Details of survey statistics and Map 1: Location of surveyed villages in Pali district* and *Map 2: Location of surveyed villages in Banda district).*

Table 6: Details of survey statistics

Districts surveyed	Total community meetings	Number of villages covered	No. of households covered
Pali	6	15	281
Banda	14	15	308
Total	20	30	589

Source: Compiled by CSE

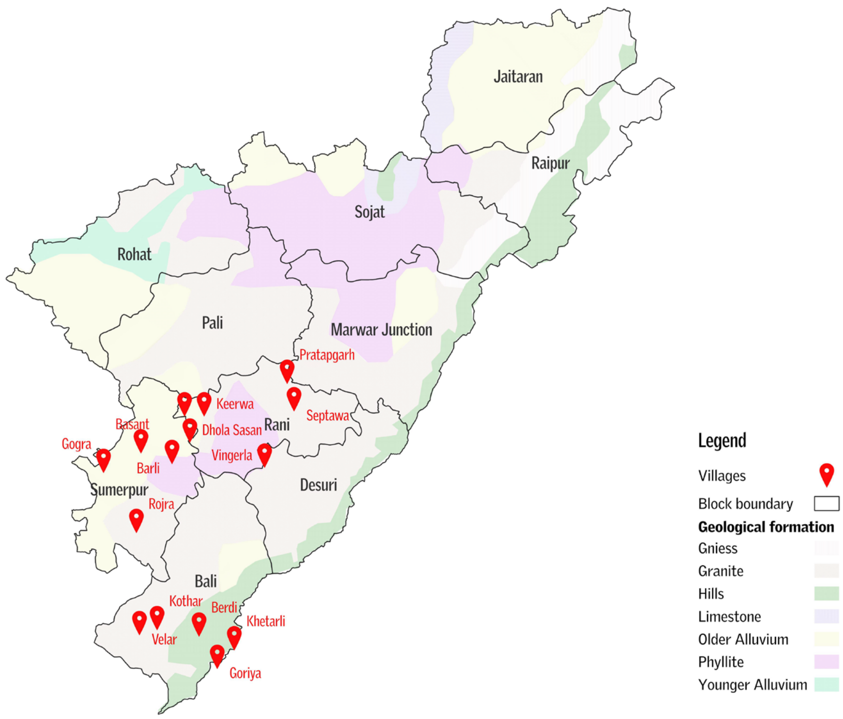
Stakeholders consulted

The team met the household owners, gram panchayats, Village Water and Sanitation Committees, school teachers, anganwadi and ASHA health workers. Meetings were also held with the officials of the JJM (under Public Health Engineering Department/ Water Utility), Rural Development Department, Panchayati Raj Department and the Watershed Department and other relevant departments responsible for household supply, managing greywater and building water conservation structures in the villages.

Data collection

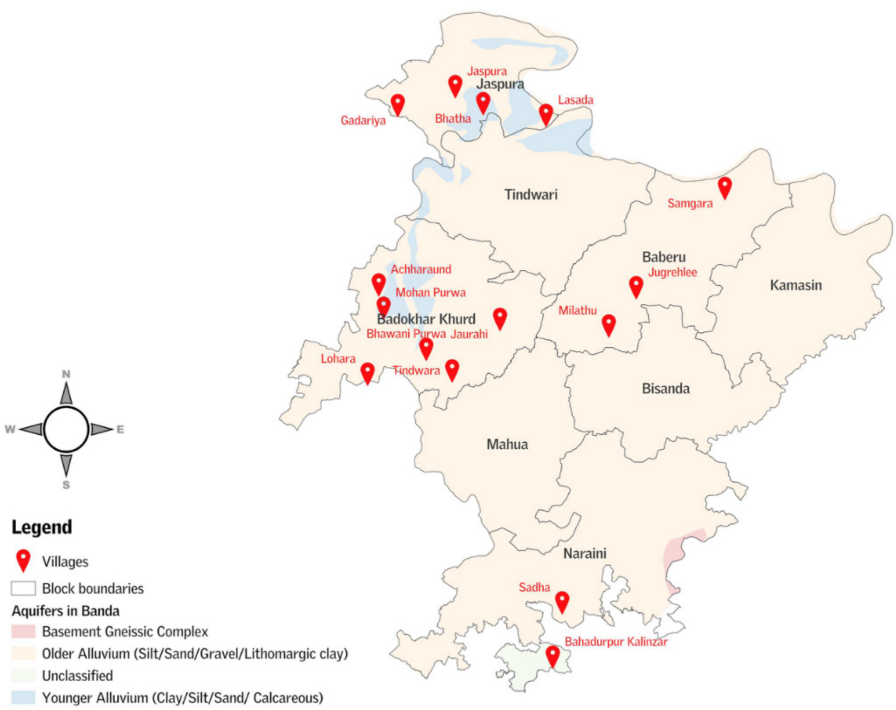
This report assesses the situation of greywater in the rural areas of Banda and Pali as the two districts have almost completed and achieved the implementation of

Map 1: Location of surveyed villages in Pali district



Source: Compiled by CSE

Map 2: Location of surveyed villages in Banda district



Source: Compiled by CSE

the Jal Jeevan Mission (JJM) targets. The data used for study was a combination primary data collected through stakeholder interaction, household surveys and field observations and secondary data to understand the journey of greywater from house to final point of disposal and community participation. Hydrogeological and lithological data from the National Aquifer Mapping and Management Programme (NAQUIM) and Central Groundwater Board data helped understand terrain characteristics, while state groundwater reports helped evaluate the groundwater recharge and decline trends. These sources provided information on aquifer characteristics, groundwater depth and soil profiles of the district. Such information was important for evaluating the suitability of different greywater management technologies, as inappropriate technological choices may lead to groundwater contamination. For example, in areas with shallow groundwater tables, technologies such as soak pits or waste-stabilization ponds may pose a risk of contaminating groundwater resources.

Primary data was collected through a combination of household surveys and field observations in selected villages. Household consumption patterns were assessed through series of questions to estimate roughly the greywater production. Apart from this, observations also included assessment of household-level greywater management practices, the condition and functionality of village drains, their adequacy and drain network, and the methods used for treatment, disposal or reuse of greywater if any. In addition, the operation and maintenance status of existing infrastructure was examined. Waterlogging due to inadequate drains, the status of ponds, and the mixing of black water and greywater were also studied. Secondary data from the SBM-G and JJM dashboard was also collected to analyse existing greywater management developments on the ground. This information was validated during field visits to understand the ground realities. These findings are enriched by extensive stakeholder meetings with government officials, NGOs and gram panchayats, which identify ground-level implementation challenges and gaps in institutional convergence gaps. Ultimately, these combined household and community interactions provide a critical understanding of greywater conditions and long-term community-led governance.

Tools used in data collection

Different softwares were used for preparing maps, graphs, charts and illustrations. Open-source software like QGIS were used to prepare maps, based on primary and secondary data. Free available data from different portals such as www.data.gov.in and Bhuvan portal (www.bhuvan.nrsc.gov.in) were used for extraction of district boundaries and other data. Mobile-based applications were used to capture photographs and geo-coordinates of important locations. A survey questionnaire each, specific to government officials, community meetings and households, was developed which was used in the field during visits to the villages.

Challenges in data collection

However, the process of data collection was affected by various challenges such as error in proper estimation of greywater quantity generated. The source of water being used in the two districts for consumption was not only the government supply under JJM, but also household and community borewells, hand pumps, wells and rivers. In such a case it was difficult to quantify the exact water consumption, and hence the greywater generated. Estimations of greywater generated are based on the rule of thumb (i.e., 65–70 per cent water forms greywater).

The estimations during survey may be affected due to seasonal bias, understanding the biases of the surveyor, changing water-usage patterns as JJM is still under implementation phase, etc. Other reasons that affected the availability of data and survey studies included lack of awareness, communities not in sync with government planning, and in some cases community or caste biases. Timing of sampling also affected the data-collection process as in some villages were, due to scarcity of time, accessed in the morning while others were in afternoon or evenings, depending on the size of the village, affecting availability of dwellers in some cases.

4. Field findings from Banda and Pali districts

BANDA

Challenges in estimating of water consumption and greywater generation

Estimating greywater production is important to be able to plan and manage the greywater better. Estimating greywater at the household level along with an understanding on availability of space and feasible soil and groundwater conditions would help plan greywater management at smallest scales possible—at the household or community level. Estimation of greywater quantums generated at a household level can be done by using the 65 per cent rule of the thumb, according to which 65 per cent of the per capita water consumption is generated as greywater. This may include collection of survey data on hours of water supply, water storage practices, and estimating all the sources of water supply and number of members in a household, including the cattle. The other way to verify quantity of greywater generated is measuring the flow in drains to end points. This would also give us a correct estimate of the quantity and also of the peak hours and peak flows which form an essential component while design of wastewater treatment systems which presently is not done very commonly.

A. **Multiple sources of water:** Households in Banda depend on multiple sources of water, including Jal Jeevan Mission (JJM) piped supply, hand pumps, borewells, open wells, and, in some cases, rivers or ponds. Because households frequently supplement piped supply with these additional sources, total water consumption cannot be accurately derived from JJM supply data alone (see *Table 7: Estimated greywater production as per JJM water supply estimates in surveyed villages of Banda*). According to the JJM dashboard, six out of the 15 surveyed villages in Banda have 70–170 lpcd of water supply, and nine villages have 40–60 LPCD of water supply. However, on the ground, these supplies remain untracked with measuring systems absent or dysfunctional at the pumping source. Metering systems at the household level also do not exist, with supplies provided free of charge.

   In most of the villages surveyed in Banda, the ground findings suggest that the village is saturated with water supplies. In these villages, households remain

Table 7: Estimated greywater production as per JJM water supply estimates in surveyed villages of Banda

Block	Village	Population as on JJM dashboard	Per capita supply as per JJM dashboard (lpcd)	Village-wise greywater production estimates assuming 65 per cent of average per capita water supply on JJM dashboard) (litres/day)	Surveyed-Average per capita consumption (lpcd)	Village-wise greywater production estimates basis per capita water usage (as per the surveyed data) (litres/day)
Baberu	Jugrehlee	1,011	52.43	34,454.37	56	36,800.4
	Milathu	3,237	55	115,722.8	54	113,618.7
	Samagra	5,402	103.48	363,349.3	50	175,565
Badokhar khurd	Achharaund	3,840	40	99,840	57	142,272
	Bhawanipurwa	1,395	94.22	85,433.99	57.65	52,274.14
	Jaurahi	3,666	60.32	143,736.52	67	159,654.3
	Lohara	691	70	31,440.5	57	25,601.55
	Mohanpurwa	3,684	60.26	144,298.59	54	129,308.4
	Tindwara	13,773	55	492,384.75	54	483,432.3
Jaspura	Bhatha	811	55	28,993.25	50	26,357.5
	Gadariya	9,107	40	236,782	71.5	423,247.8
	Jaspura	8,057	40	209,482	75	392,778.8
	Lasada	1,613	172.8	181,172.16	58	60,810.1
Naraini	Bahadurpur Kalinjer	3,805	68.63	169,739.14	68	168,181
	Sadha	7,550	69.02	338,715.65	51	250,282.5

Source: JJM dashboard and CSE survey data

dependent on groundwater sources as an additional source of water when JJM supplies are insufficient. In Banda, villages have easy access to hand pumps, and only in case of issues, does the community resort to usage of river or ponds for water requirements. Table 8 details the source of water for JJM supplies in the surveyed villages and the alternate sources on which these villages depend. These highlight the fact that per capita consumption may also differ due to reliance on alternative sources, thus making it tough to estimate the quantities of greywater generated in households in the absence of proper metering. In such a case, planning would suffer and would lead to over-designing or under-designing of systems at both household and community level due to a lack of proper estimates in the absence of data.

B. **Water metering systems are largely absent**. Most villages have no functional meters at pumping stations or at the household level. As a result, neither government agencies nor village institutions have reliable data on the actual quantity of water supplied or consumed.

C. Rural households often store water in containers or tanks of varying capacities, and water use varies significantly, depending on supply hours, household size and seasonal needs. This makes it difficult to estimate consumption through direct observation.

Due to these constraints, the study relied on approximate estimation methods. Greywater generation was calculated using commonly applied engineering rules of the thumb that assume:

- approximately **70–80 per cent of water used becomes wastewater**, and
- most of this wastewater comprises **greywater generated from kitchens, bathrooms and washing areas**.

Household surveys were conducted to estimate average water consumption based on:

- Number of household members
- Water storage capacity
- Frequency of tank filling
- Hours of water supply

CSE survey studies estimated average per capita consumption at household level. The average per capita consumption was in the range of 50–70 LPCD (see *Table 7: Estimated greywater production as per JJM water supply estimates in surveyed villages of Banda*). However, these estimates should therefore be interpreted as conservative approximations rather than precise measurements and may be affected by surveyors bias and understanding also. Also, apart from this the unchecked water loss through leaking taps and pipes, wastage of excess water, etc. remains untracked. Also, in most cases, the communities continue with old storage practices of storing a maximum of 100–200 litres water and opt for hand pump supplies on a need basis, except for a few households that store water. This affects estimates and calculations of greywater generation.

Understanding pre-JJM scenario on water consumption

We also need to understand how JJM has changed the water consumption pattern to understand how it will affect greywater production. Also, this may remain an underestimation in the absence of proper measurements, as these estimates are

Table 8: Source of water supply in surveyed villages of Banda

Block	Village	Fully covered with tap connections under JJM (Y/N)	JJM sources	Alternative sources
Baberu	Samgara	Y	Shallow tube well	Borewell + hand pump + open well
	Jugrehlee	Y	Yamuna water	Hand pump + borewell + open well
	Milathu	Y	Shallow tube well + Yamuna water	Hand pump + borewell + open well
Jaspura	Bhatha	Y	Shallow tube well	Hand pump + borewell + open well
	Jaspura	Y	Shallow tube well + Yamuna water	Hand pump + borewell + open well + ponds
	Gadariya	Y	Yamuna water + shallow tube well	Hand pump + borewell + open well + ponds
	Lasada	Y	Yamuna water	Hand pump + borewell + open well + ponds
Badokhar Khurd	Lohara	Y	Shallow tube well	Hand pump + borewell + open well + ponds
	Achharaund	N	Ken River + shallow tube well	Hand pump + open well + ponds
	Mohan Purwa	N	Ken River + shallow tube well	Hand pump + open well + ponds
	Jaurahi	Y	Yamuna water	Hand pump + borewell + open well + ponds
	Tindwara	Y	Yamuna water + shallow tube well	Hand pump + borewell + open well + ponds
	Bhawani Purwa	Y	Yamuna water	Hand pump + borewell + open well + ponds
Naraini	Bahadurpur Kalinzar	Y	Yamuna water	Hand pump + borewell + open well + ponds

Source: CSE survey data

based solely on interviews from the households and community interactions. In villages such as Sadha and Bhawani Purva in Banda, where JJM water supply has still not started (which may be similar to the pre-JJM scenario), households continue to consume 40–50 lpcd of water supply through borewells/hand pumps (private/panchayat). Similarly, in water-stressed villages such as Achharaund, where there is irregular or no water supply from JJM and communities depend on rivers and existing wells, water consumption per capita is in the range of 30–50 lpcd, depending on the season and storage capacity of the households. In case of Jaspura, however, where water supply is in full swing, the average water consumption is 75 lpcd or more and in some cases even crosses 100 lpcd, which means the consumption patterns have doubled in cases in households where JJM water supplies are fully operational. If the households have in-house borewells and hand pumps, the consumption will be still higher. Also, in these villages, substantial amounts of water are wasted through leakages and broken taps. *Table 7* estimates data may even increase once villages are used to the regular water supplies at households, meaning doubling greywater production.

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Top: *Water-storage practices in rural areas of Banda. Most households store water in small drums, buckets or jerry cans. Picture from Mohanpurwa village , Badokhar Khurd block, Banda district*

Centre: *Jaspura village, Jaspura block, runs its water pumps for five to eight hours per day to ensure last-mile connectivity. Households end up wasting water by leaving open untapped pipes, thus generating greywater that often remains underestimated.*

Bottom left: *JJM water supplies need proper regulation and tapping. A substantial amount of freshwater overflows in Jugrehlee, a village in Baberu block in Banda district, as the water supply floods village roads.*

Understanding quality aspects of greywater

- **Household's lack toilets:** Open defecation was found in many households. Roughly 44 per cent of households surveyed did not have toilets and resorted to open defecation. Some of these households had single pits—previously made under SBM-G incentives—which had collapsed due to lack of water or due to inappropriate structures, and the households thus reverted to open defecation. Some households found the incentives under SBM-G inadequate for constructing toilets. In rare cases, households had for the past 15–20 years been using old slab-pit toilets.
- **Type of toilets:** Households in the villages surveyed were found to have septic tanks of non-uniform sizes and design. Most people were not aware of the size of septic tanks/holding tanks, which are built below the toilet. General discussions with some households revealed the size of these tank were 8–10 feet deep and 10 feet wide. Once a tank fills, the villagers break open the floor slab to get the tank desludged.

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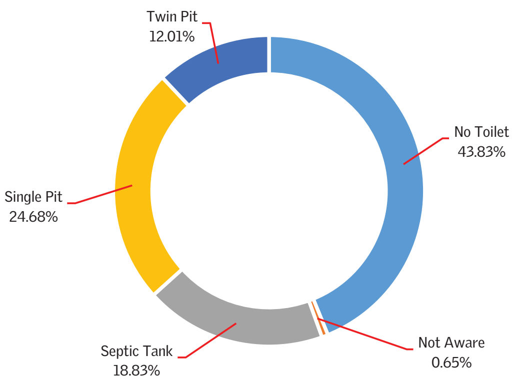
Septic tank/holding tank opening in open drains in Tindwara village, Badokhar Khurd block

According to communities in Bhatha village, Jaspura block, toilet pits are collapsing due to unstable soil.

Graph 1: Type of containment in the surveyed households



Source: CSE survey data

A septic tank with an outlet in open drains in Achhraundh village, Badokhar Khurd block

Generally the tanks were nothing but holding tanks, or cylindrical or cube-shaped single pits. The effluent from these septic tanks/holding tanks flows out into open drains through an exit pipe. In some cases, septic tanks/single pits either have a kutcha base, with the potential to contaminate groundwater.

An accurate estimate of the number of septic tanks connected to the drains could not be made due to a lack of access to observations by the surveyors or inability of the community to provide exact information about the structural designs of the tank. Roughly 50 per cent of households of those with a toilet report not having any idea of the structure of the septic tank. However, the surveyors found some instances in every village where at least three to four households were seen with an outlet discharging into open drains out of average eight households surveyed per village. In other cases, observations could not be verified with household interviews or as the pipes were not visible. Hence a deep understanding of the structural design is suggested before any planning process is undertaken. This is suggested as once known, the design can be retrofitted or this will affect the treatment design and usage of the treated water further (see *Graph 1: Type of containment in the surveyed households*).

Drainage facilities/conveyance system

Effective greywater management requires a well-planned drainage network capable of conveying wastewater from households to designated treatment or disposal points. In rural settlements, drains form the primary infrastructure connecting individual households with village-level wastewater management systems. Without proper conveyance, greywater generated at the household level stagnates in open spaces or flows uncontrolled into waterbodies and agricultural land.

Importance of drainage systems in greywater management

Greywater must be safely conveyed to treatment systems or disposal points. The Swachh Bharat Mission-Grameen (SBM-G) technical manual emphasizes that greywater and stormwater drains should ideally be constructed separately to reduce hydraulic load and facilitate effective wastewater management. In situations where separate drainage systems are not feasible, the drains must be designed to handle combined stormwater and wastewater flows. This requires careful consideration of hydraulic load, slope and drainage capacity.

Proper drainage networks are also important to:

- identify the final discharge point of greywater;
- estimate the quantity of wastewater generated in the village;
- plan the capacity and location of treatment systems; and
- ensure gravity-based flow of wastewater.

Without these elements, wastewater management systems are difficult to design and maintain.

Planning requirements for village drainage networks

A well-planned village drainage network should be developed as part of the Village Action Plan under Jal Jeevan Mission and the Gram Panchayat Development Plan (GPDP) framework.

Planning of drainage networks typically requires the following steps:

- mapping households and settlement layout;
- identifying sources of greywater generation;
- mapping existing drains and wastewater flow paths;
- assessing topography and slope;
- identifying natural drainage channels and low-lying areas; and
- locating potential sites for greywater treatment or disposal

These elements help ensure that wastewater flows through a connected drainage system and reaches designated treatment points without causing waterlogging or environmental contamination.

However, during the field survey, village drainage maps or action plans could not be accessed, making it difficult to assess whether drainage networks had been systematically planned.

Status of drains in surveyed villages

Field observations reveal that drainage infrastructure in many villages remains inadequate and poorly designed. Approximately 30 percent of surveyed households did not have drains outside their homes. In these cases, wastewater from households flows directly onto village roads or open spaces, resulting in frequent waterlogging.

Residents reported several problems associated with stagnant wastewater, including:

- mosquito breeding;
- foul odour;
- difficulty in walking along flooded streets; and
- risk of slipping on wet surfaces

Where drains exist, they are often improperly constructed or insufficient in capacity to handle the current wastewater load, let alone the increased volumes expected with expanded water supply.

a) Fragmented and poorly designed drainage networks

In many villages, drains were observed to be constructed in isolated segments rather than as part of a connected network. These drains vary widely in width and depth and are often constructed without considering settlement layout, slope, or final discharge points.

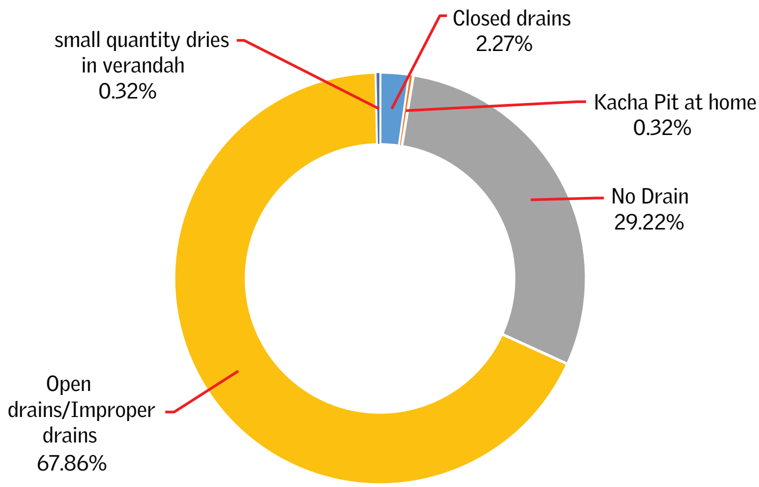
As a result:

- drains frequently terminate abruptly without connecting to a larger network;
- wastewater accumulates in open areas or agricultural land; and
- waterlogging occurs in low-lying sections of the village.

In several locations, drains were little more than manually carved channels rather than engineered structures.

Field observations also indicated that solid waste dumping and household encroachment often block drains, leading to wastewater backflow and further stagnation (see *Graph2: Journey of grey water as it exits households*).

Graph 2: Journey of grey water as it exits households



Source: CSE survey data

b) Mixing of greywater and black water

Another issue observed during the field survey was the mixing of greywater with black water due to faulty sanitation systems. In several cases septic tank outlets discharged directly into drains. This mixing increases the contamination level of wastewater flowing through drains and raises potential health risks for communities.

c) Risks to drinking water infrastructure

The survey also found instances where drinking water pipelines were laid through or alongside open drains. In the event of pipe leakage or damage, contaminated wastewater from drains could infiltrate drinking water pipelines, posing a risk to water quality and public health.

Implications of fragmented drainage development

Official data from the SBM-G dashboard indicates that drains are being constructed in many villages through annual development plans. However, field observations suggest that these drains are often built in piecemeal segments, sometimes influenced by local priorities or political decisions rather than technical planning.

Instead of forming a continuous network, drains are constructed in disconnected stretches, which reduces their effectiveness and often worsens local drainage problems.

In some villages, communities reported that drainage construction decisions were made based on visible waterlogging problems rather than systematic planning of the entire drainage network.

Consequences of inadequate drainage infrastructure

Due to clayey soil, the greywater from households and community places was often found waterlogging the village roads. The absence of properly designed drainage systems leads to several environmental and social impacts, including:

- Wastewater stagnation on village roads;
- Contamination of village ponds and waterbodies;
- Flooding of nearby agricultural land;
- Mosquito breeding and associated health risks; and
- Community disputes over wastewater discharge into fields.

In Banda district specifically, where clayey soils restrict infiltration, inadequate drainage infrastructure exacerbates waterlogging problems. The CSE survey studies revealed that 38 per cent of households surveyed had waterlogged roads in front of the households. The remaining 57 per cent ends up polluting the river and ponds or flooding agricultural fields. Villages like Jaspura complained of acres

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Drinking water pipeline passing through a greywater drain in Mohan Purwa village, Badokhar Khurd block. In case of leakage, the greywater would contaminate the drinking water supply (left). Drain or no drain? Sadha village, Naraini block (right).

of fields rendered unusable due to the submergence of the fields with greywater. This is another example of lack of planning as in village Jaspura, the drains were constructed without considering the final end point disposal. Bahadurpur Kalinjhar is seeing complaints and community disputes as some farmers now face these issues. Many other villages had a similar story.

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In the absence of proper drains, household wastewater ends up waterlogging roads and entering nearby agricultural fields in Bahadurpur Kalinjar village, Naraini block (top); clogged drains in Lasada village, Jaspura block (bottom left); household wastewater in village drains in Achraundh village, Badokhar Khurd block (bottom right)

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Partial drains are made of random size and capacity, often ending up nowhere and worsening the situation. Those created are also clogged and/or encroached on. Picture from Sadha village, Naraini block

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Closed drains in Milathu village, Baberu block are usually not cleaned properly

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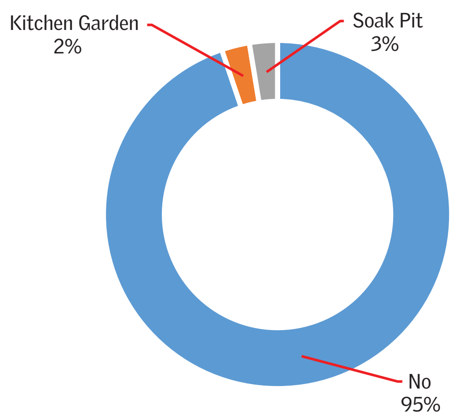
A drain in Bhatha village, a small village in Jaspura block, ends up in agricultural fields. The image shows a disconnect in the segments of drains: while one part of the village has a drain, its lower elevation lacks one, leading to waterlogged roads. Communities report that these drains are made in small parts by the gram panchayat.

Treatment and disposal of greywater

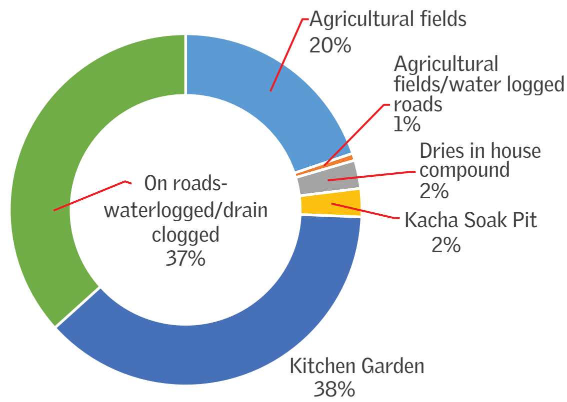
According to the CSE survey, an only 2 per cent of households reuse greywater for kitchen gardens or have a household-level soak pit—usually a kutcha soak pit—or a soak pit for cluster of households. The remaining 95 per cent dump greywater in the open (see *Graph 3: Reuse of greywater*).

As a matter of old practice, households would dig small collection pits made of bricks, kutcha—not sealed—at the base. This would then be adequate as water consumption was less and the water generated from the kitchen would be used for cattle to drink. This practice is now almost extinct, with the survey's findings revealing that such soak pits existed in only 3 per cent of surveyed households where they had issues due to lack of drains. Rarely does household use greywater, treated or untreated, for kitchen gardens and most of it usually ends up in drains or on roads. There is no plan for end-point disposal in the villages (see *Graph 4: Greywater end use and disposal*).

Graph 3: Reuse of grey water



Graph 4: Greywater end use or disposal



Source: CSE survey data

The CSE team mapped the SBM-G dashboard data for the villages to be surveyed, and visited the locations to verify the structure on the ground. Most of the locations mentioned on the dashboard did not exist on the ground. In some cases, the locations were geo-tagged incorrectly, and on the SBM-G dashboard was shown even out of village boundaries. At least 10–12 of the 18 community soak pits visited across the surveyed villages have gone into disuse due to various reasons, as in case of Milathu, Lasada and Mohanpurwa, due to lack of maintenance or inablility to bear the load of greywater generated. Communities in Lasada village tell that they are now neglected as water supplies at households have reduced the need to use hand pumps.

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Wastewater ends up in a village pond in Gadariya village, Jaspura block, polluting groundwater and rendering it unusable for villagers.

Table 9: Data on greywater management as per SBM-G dashboard as on 9 February 2026—surveyed villages of Banda district

Block	Village	Drainage facility	Household soak pits	Household kitchen garden	Community soak pits	Community-/ village-level treatment system	Number of soak pits visited on the ground by CSE surveyors
Jaspura	Lasada	3			6	1	1
	Gadariya	6			25		3
	Jaspura	9			13	2	1
	Bhatha	2			1		1
Baberu	Jugrehlee	1			1		0
	Samagra	7			16		4
	Milathu	3			9		3
Badokhar Khurd	Lohara	1			2		0
	Achharaund	7			1		0
	Mohan Purwa	11	4		5		2
	Jaurahi	15			5		1
	Tindwara	6			6		1
Naraini	Bahadurpur Kalinzar	1	5		1		0
	Sadha	1	5		1		1

Source: SBM-G dashboard and CSE survey

The probable reasons for soak pits going into disuse is discussed as follows. None of the community soak pits had silt chambers designed or wherever found they were mostly silted. Silt chambers are advised to increase the life of soak pit. The designs of the soak pits could not be verified. However, according to the community interaction, honeycomb leach pit model is used for greywater soakage in Banda villages (see *Table 9: Data on greywater management as per SBM-G dashboard as on 9 February 2026—surveyed villages of Banda district*).

Status of infrastructure

Need for creation of infrastructure

An important aspect that gets highlighted from *Table 7* is the urgent need to create infrastructure to manage greywater. In a case example of Samagra village, with an estimated population of 5,402 people—assuming generation of 67 lpcd of greywater—the whole village generates 3.63 lakh litres of greywater per day. As per the SBM-G dashboard data, only 16 community soak pits and seven drains have been constructed to manage the entire greywater of the village. Community

Household wastewater flows in backyard-empty field behind the house in Bahadurpur Kalinjhar village, Naraini block

A proper functioning soak pit in a school in Samagra village, Baberu block

Households dug kacha soak pits to manage greywater in the old days in the absence of drains. This practice still exists, with some households digding kachha soak pits to maintain cleanliness in the lane. Picture from Jugrehlee village, Baberu block.

Very few households were found during the survey where greywater generated is dried up in the verandah due to few people and low consumption of water in Jaspura village, Jaspura block.

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Wastewater is often left untreated in agricultural fields. Drains submerge the fields and render huge tracts of agricultural land unusable in Jaspura village, Jaspura block interactions revealed that the village has 28 soak pits. In that case, it is clear that the existing infrastructure is not sufficient and also these are only made at community places, the greywater from households is not catered to and tapped for treatment. This is then dumped in rivers or was found waterlogging the village roads. The interactions with the community highlight the lack of space and the willingness of households to spend money to construct a soak pit. This is also the case for other villages surveyed. The available infrastructure remains insufficient, hence the need to create infrastructure. The story repeats for every village such as in case of Tindwara, which generates an estimated 5 lakh litres of greywater, Sadha generates 3.38 lakh litres of greywater and villages like Milathu, Jaurahi, Mohan Purwa, Lasada and Bahadurpur Kalinjar generate roughly 1.5–2 lakh litres of greywater every day. *Table 7* tries to validate its data with per capita supply data from JJM dashboard and the per capita usage data from the survey—both remain comparable.

With the growing household water consumption, the issues will only multiply. The lack of data on water supply and usage, and proper drains the village makes planning ahead a huge challenge.

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An old treatment structure—now defunct—created for treatment of greywater in Gadariya village, Jaspura block. Often such structures suffer due to lack of ownership and O&M.

Operation and maintenance

Maintenance of infrastructure is an issue. As also mentioned in the previous section soak pits visited were found unable to cater to the water load and were overflowing in many cases—clearly not functioning properly. Old infrastructures such as the old soak pits and the primary treatment systems in case of Gadariya (*see picture*) were also found to be in disuse due to lack of maintenance. Also, the communities remain indifferent as in case of Mohan Purwa; if the soak pit went to disuse due to a non-functional hand pump, a kutcha soak pit arrangement was done in an open area nearby but a properly designed soak put was not considered to be made again. The drains that were made were clogged with solid waste and clearly not cleaned at the frequency required. The communities said that they are rarely cleaned due to lack of funds and/or intent. They said that solid waste was also dumped in open drains, clogging them, or in open areas.

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Soak pit in Lasada village, Jaspura block in disuse due to lack of maintenance (left); condition of a community soak pit in Milathu village, Baberu block (right); an old hand pump and soak pit in disuse on the left, and new handpump on the right without a soak pit in Mohan Purwa village, Badokhar Khurd block. The old soak pit was left redundant and a new kutcha soak pit was dug a few metres ahead, which manages wastewater from households and hand pump (bottom).

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A soak pit not properly functioning in Milathu village, Baberu block (top); the condition of a community soak pit in Mohan Purwa village, Badokhar Khurd block (bottom)

Understanding management of greywater with changing groundwater and soil conditions (with case examples)

A significant observation that came up during community interaction was the collapse of honeycomb pits made for toilets. The communities said that the soil outside the pit had collapsed, making the pit making it unusable. There is also a lack of understanding on the size requirements for design of soak pits at the community and household levels.

Observations from the field and interactions on the ground during the study survey suggests that water stagnates on the soil surface in Banda and does not percolate in the ground easily. Banda villages demonstrated failing community soak pits due to lack of maintenance and inability to cater to the water load- due to evident water logging at many places. The answer lies in understanding the soil profile of Banda district. Varying soil and ground water conditions means adoption of suitable technology for greywater management to avoid contamination of groundwater and affect the sustainability of restored waterbodies.

Profile of Banda soil: The dominant topsoil in the district is clay; however regolith and sand are also seen in some eastern and north-eastern parts of the district. The thickness of the soil is in the range of 20–35 metres. Since the clay is porous but non-permeable in nature, it allows water during rainfall to be absorbed in the ground very slowly. The soil of the district is mainly black cotton soil. Studies show a sequence of regolith, mud, clay silt and weathered sandstone from top to bottom in Banda soil.

Groundwater level also forms an important consideration in selection of technology, as for example in case of Sadha and Jaspura, two of the surveyed villages. Sadha has a much shallower groundwater table, with water at 6–10 metres below the ground level (mbgl) as against Jaspura village, where water is deeper than 20 mbgl.[5] In this case, Sadha village will end up polluting its groundwater if it randomly adopts soak pits of any size or design for management of greywater.

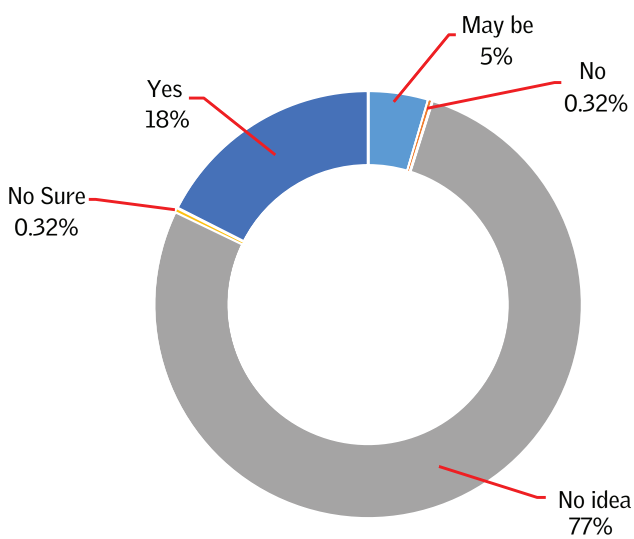
Community involement

- All the 15 villages surveyed had VWSCs. However communities claim that no meetings are held and the Village Water and Sanitation Committees (VWSCs) remain non-functional.
- No wall paintings or messages were seen in the villages during the survey. Over 80 per cent of the respondents denied that greywater can be used a resource as at present it is a reason for loss of land and community disputes. Communities

also claimed that they remain uninformed about panchayat meetings or, if they happen at random frequencies, their voices often remain unheard of and they are not involved in the planning process and hence remain uninterested in attending them.

Due to mismanagement of greywater, communities face issues of mosquitoes and stench. Some sanitation committee workers claim that the malaria cases have risen over the last two to three years and the village roads are dirtier. Households end up spending more on health expenditure in case medicines at government dispensary is not available. Only a few households said that previously, as a practice, kitchen water was collected in a kutcha soak pit which was consumed by cattle for the purpose of drinking. The practice is now almost extinct. Households now bring freshwater from hand pumps for cattle; with one cattle consuming over 25–30 litres of water per day. Roughly 60 per cent felt that if there was proper awareness and initiatives are taken with appropriate infrastructure in place, greywater can be reused for agriculture and various other purposes and the community would come forward to use it as well. However, a fraction of the community felt that storage would be an issue and if the odour and proper storage is managed, greywater could be managed (see *Graph 5: Is greywater reuse beneficial?*).

Graph 5: Is greywater reuse beneficial?



Source: CSE survey

SUCCESS STORIES OF GREYWATER MANAGEMENT

Manpur Ojha uses silt chambers, soak pits and kitchen gardens to turn water from washing areas & kitchens into a valuable resource

Manpur Ojha, a village of around 1,400 households, stands tall in the Bilaspur block of Rampur district for its economically and effectively managed groundwater. Officially, every household is connected to a tap under the Jal Jeevan Mission of the Union Ministry of Jal Shakti (water resources), but still half of the households have a hand pump on their premises. Additionally, there are 1,100 hand pumps constructed across the village for the communities. As per the government records, the groundwater for the taps under JJM are also extracted from the groundwater. Thus the groundwater levels plunged by three meters.

For the last five years, groundwater has been found at 48 metres below the ground. On the one hand, the village was considering replenishing its groundwater, on the other hand the huge volume of greywater generated from the kitchen, bathroom and washing areas needed to be managed. Officially, water is supplied at 55 litres per capita per day, which shows that 36 litres of greywater is generated per day per capita (the rule of thumb is 70 per cent of the water used is converted to the greywater). But there are individual and community hand pumps all over the village. Excess water flowing out during the use of these hand pumps also add to the village's greywater. Previously, a large volume of greywater flowed into open drains in the village, which were chocked with solid waste. As a result, just a short spell of rain used to cause waterlogging. Moreover, many households lacked proper bathing and washing structures, as a result of which water stands for a long time outside the houses. Villagers raised concerns of foul smell and mosquitoes.

In 2022, the Manpur Ojha Gram Panchayat, along with Bilaspur block officials, took an initiative to manage greywater at the household level under the Swachh Bharat Mission-Grameen. Since then, greywater from washing, bathing and hand pump goes directly first into the silt chamber, which has a size of 0.5 m x 0.5 m and depth of 0.3-0.45 m. After grit and suspended solids are removed in this chamber, the water directly goes into kitchen garden created in households that found space on their premises. Usually 60 per cent of the water goes to the kitchen gardens and the remaining is diverted to soak pits of 1.2 m diameter and 1 m depth. The soak pits are economic and done under MGNREGS.

According to Alok Kumar Saxena, assistant development officer, Bilaspur block, Rampur, household pits cost Rs 10,000 and community soak pits cost Rs 14,000, which can tackle greywater from over 1,000 households. 'We were made aware of the management of greywater from the community meetings in our village. We have in total 150 soak pits at the household level and 11 at the community level in our village. Almost every household in our village has a kitchen garden. The toilets are connected to leach pits. We have planted ornamental flowers and vegetables such as bottle guard and lemon to use at our houses,' said Dayanand, farmer and resident of Manpur Ojha, said. Currently, the pits built

in 2022 are in working condition, added Saxena. 'If any maintenance work is required, we along with the technical team work on the same. The funds from the fifth State Finance Commission and MGNREGS are utilized for operation and maintenance.'

The low-cost model for the management of greywater has been efficient. The system hardly requires any maintenance —only the media in the silt chambers and soak pits need to be replaced every seven to eight years. As the construction is new, not much maintenance has been done in a long time, Saxena shared.

The groundwater level has also improved by 5 metres in two years, said the 38-year-old village head Virat Kirtunia. Before 2022, during summers, the yield of our hand pumps would reduce to half, but now we get a good yield throughout the year, he added. In villages where groundwater usage is very high, there is an immediate need to manage the huge amount greywater coming out of washing areas and kitchens. Manpur Ojha shows how treated greywater can be used to irrigate the kitchen garden and recharge the depleting groundwater after appropriate treatment.

Source: https://www.downtoearth.org.in/water/this-up-village-puts-its-greywater-to-good-use-to-combat-local-flooding-recharge-groundwater

PALI

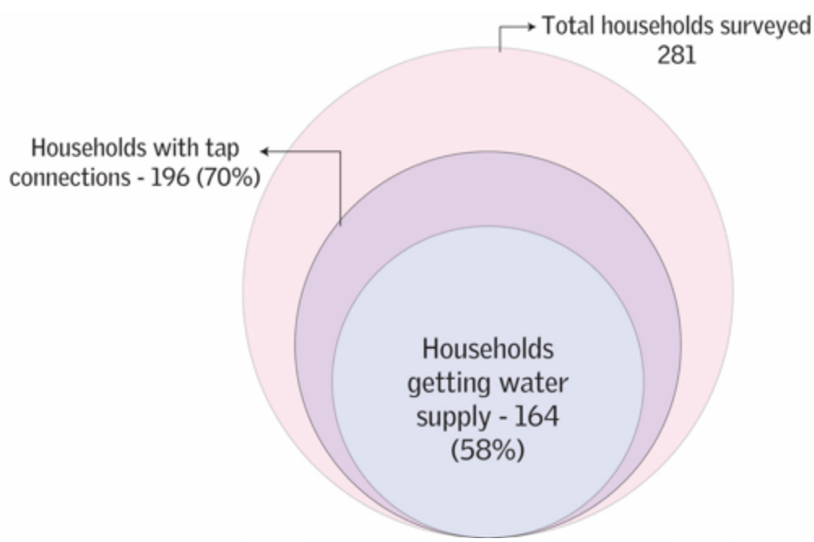
Estimation of groundwater quantums generated

According to the JJM dashboard, 70 per cent of the surveyed villages have been connected with 90–100 per cent household tap water supply, and they are receiving 55 lpcd of water supply. In reality, the surveyed households across 15 villages in Pali district have a different story to tell (see *Figure 1: Details of households surveyed, provided tap connections and getting water supply under JJM*). The survey indicates a difference in the number and per capita consumption is lower than in case of Banda, but once tap connections are fully functional, the per capita water consumption may increase. Also, the practice of the community gathering at specific points for activities would cease to exist and the household greywater consumption will increase. Nevertheless, this section examines current estimates; once tap supplies are fully functional, estimates need to be re-evaluated.

Multiple sources of water: All the 15 surveyed villages are dependent upon government as well as alternative sources (see *Table 10: Sources of water for surveyed villages in Pali*).

A. In the villages where JJM supply has not reached, people fetch water from the nearby hand pumps and stand posts/ground-level reservoirs (GLRs). In villages where JJM supply is provided, alternative local sources still play a crucial role in providing drinking water. In Velar village, water supply from

Figure 1: Details of households surveyed, provided tap connections and getting water supply under JJM



Source: CSE field study

Table 10: Sources of water for surveyed villages in Pali

Block	Village	Fully covered with tap connections under JJM (Y/N)	JJM sources	Alternate sources
Bali	Kothar	Y	Jawai Dam + open well	Borewells
	Velar	Y	Jawai Dam + open well	Borewells
	Berdi	N	No JJM supply	Open wells + borewells + hand pumps
	Goriya	N	No JJM supply	Open wells + borewells + hand pumps + rivers
	Khetarli	N	No JJM supply	Open wells + borewells + hand pumps
Sumerpur	Basant	Y	Jawai Dam + open well	Hand pumps + borewells
	Barli	Y	Jawai Dam + borewells	Hand pumps + borewells
	Dhola Sasan	Y	Jawai Dam + borewells	Hand pumps
	Gogra	N	No supply	Borewells + hand pumps + pond
	Rojra	N	No supply	Borewells + hand pumps
Rani	Nawaguda	Y	Jawai Dam + borewell	Borewells
	Pratapgarh	Y	Jawai Dam + open well	Borewell
	Septawa	Y	Jawai Dam (supply paused)	Borewell
	Vingarla	Y	Jawai Dam + open well	Borewells
	Keerwa	Y	Jawai Dam + borewell	Hand pump

Source: Compiled by CSE

the Jawai Dam covers 50 per cent of the total households of the village. The remaining households are supplied drinking water from open well in the village. In Basant village, an old open well works as backup for household water supply. Keerwa supplies water from village's borewell to its households. Khetarli, Berdi and Goriya villages fetch water from hand pumps, borewells and open wells. These villages are yet to get water supply under Jal Jeevan Mission. There is no metering system at the household level and therefore the actual supply amounts were difficult to calculate. However, the JJM dashboard provides the amount of water supplied from the source location (see *Table 11: Estimates of greywater quantums as per JJM water supply estimates in surveyed villages of Pali*). *Table 11* calculates greywater generation basis the JJM dashboard water supply data. Only in four villages, greywater generation crosses 0.8–1 lakh litres. The household survey also intended to understand per capita water usage at the household level in the villages to analyse the estimated greywater generation.

B. Another important aspect that needs to be noted is that in case of Pali, community places become major points of greywater generation rather than households. This is in contrast to Banda, where the households formed the major contributors. This highlights that the greywater generation in households. This distribution further helps manage and plan greywater accordingly.

C. Water metering systems remain absent in case of Pali, and hence water supplied from the source, water received and consumed at the household level largely remains unmeasured at all the levels.

D. Due to scarcity of water, storage practices in Pali remain different from those in Banda. Households mostly tend to store water in 5,000-litre tankas and use it as needed, making it difficult to estimate per day water consumption as it reduces and increases with availability and supply of water.

Table 11: Estimates of greywater quantums as per JJM water supply estomates in surveyed villages of Pali

District	Block	Village	Population	Per capita supply as per JJM dashboard	Village-wise greywater production estimates considering 65% of average per capita water supply on JJM dashboard (litres/day)	Surveyed per capita consumption	Village-wise greywater production estimates basis per capita water usage (as per the surveyed data)
Pali	Bali	Kothar	3,074	42.91	85,738.47	50	99,905
		Velar	1,332	34.41	29,792.18	43	37,229.4
		Bardi	1,911	12.34	15,328.13	41	50,928.15
		Goriya	3,488	55	124,696.00	53	120,161.6
		Khetarli	1,328	55	47,476.00	59	50,928.8
	Sumerpur	Basant	3,018	55	107,893.50	52	102,008.4
		Barli	585	55	20,913.75	55	20,913.75
		Dholasasan	1,378	55	49,263.50	59	52,846.3
		Gogra	1,956	55	69,927.00	55	69,927
		Rojra	1,560	43.53	44,139.42	43.53	44,139.42
	Rani	Pratapgarh	1,133	55	40,504.75	51	37,558.95
		Septawa	754	17.04	8,351.30	62	30,386.2
		Vingarla	1,232	55	44,044.00	44	35,235.2
		Keerwa	2,572	55	91,949.00	60	100,308
		Nawaguda	1,325	55	47,368.75	47	40,478.75

Source: JJM dashboard and CSE survey

Thus, in Pali, an approximation of greywater generated was calculated using JJM data and the survey attempted to verify the estimate with per capita usage. CSE survey studies estimated average per capita consumption ranging at 50–65 lpcd. However, a proper survey and reverification is suggested.

These are mainly conservative estimates based on discussions with households. However, personal discretion, understanding and the size of storage will affect the water consumption pattern. These estimates exclude water used for laundry, typically drawn from outdoor sources such as hand pumps or rivers, and cattle consumption, usually managed via communal village troughs.

PRADEEP KUMAR MISHRA, CSE

Greywater from households flows into open drains in Pratapgarh village, Rani block

Understanding pre-JJM scenario on water consumption

In case of Pali the villages were connected to Janta Jal Yojna, where water was made available in every village through stand posts. There was always waterlogging around the stand posts due to greywater generation. JJM has now ensured this water supply reaches every doorstep. As per the CSE survey an average increase of 10–20 lpcd was seen in villages where JJM is now fully functional. However, due to water management and traditional water-conservation practices in Pali, greywater generation is lower than in Banda. The current study did not have the scope to measure the volume of greywater generated, and these analyses were based on interviews with household members and community interactions. The leakages remain unaccounted for, as seen in the case of Vingarla and Keerwa villages, where the wastage of water due to leakages increased the greywater production which caused water logging in and around the villages during the peak water supply hours. The low-lying areas of Kothar village received regular and excess water resulting in wastage. Hence, greywater generated causes waterlogging in these areas.

MANISH MISHRA, CSE

Community water collection points are the main source of greywater generation in Gogra village, Sumerpur block.

PRADEEP KUMAR MISHRA, CSE

Households greywater is connected to open drains in Basant village, Sumerpur block.

Understanding quality aspects of greywater generated

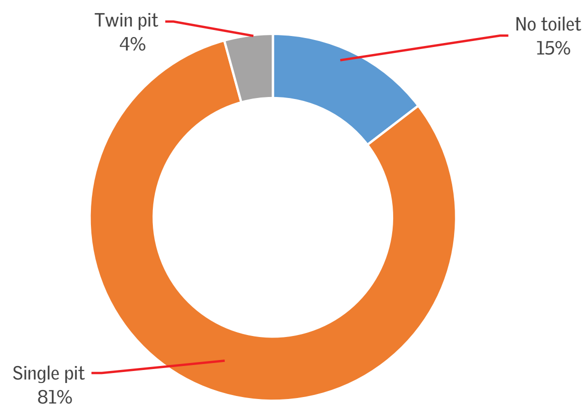
During the field study, it was found that around 85 per cent of the surveyed households had toilets (see *Graph 6: Type of containment system in surveyed households of Pali district*). In some villages, however, open defecation is still practised due to the shortage of water at the household level. In Bali block, open defecation is practised more as the villages are located in hilly terrain, and fetching water from long distances is time consuming.

About 85 per cent of the total surveyed households had toilets of which 95 per cent had single-pit toilets 2.5–3-metre deep and 1–1.5-metre wide (diameter), with an unlined base. The other 4 per cent of households had honeycomb twin pit toilets, 1–1.5 metres deep. Hence no greywater and black water mixing was observed in Pali.

MANISH MISHRA, CSE

Single-pit toilets are prevalent in Khetarli village, Bali block, Pali district.

Graph 6: Type of containment systems in surveyed households of Pali district



Source: CSE survey data

Drainage facilities/conveyance system

Status of drains in surveyed villages

In all the cases across the surveyed villages of Pali, households were connected to a drainage network. Since the soil is permeable in Pali and greywater production is not high at the household level, the issue of poorly designed drains remains unresolved. However, Pali also had similar issues with drains as Banda, including:

- In some cases they were not qualified to be categorized as drains but small manually carved channels for water to flow through.
- Drains laid seemed fragmented and unplanned.
- The drains were lined or unlined and of varying length and width clearly not

enough to accommodate stormwater and greywater in most cases.

- The drains are often made in small segments without the slope or connectivity considered, and without a plan of diversion towards the final discharge points. They often led to open areas where there was waterlogging for a smaller period of time and then water was soaked into the soil.
- Drains were often found clogged with plastic waste or were silted due to which the water would stagnate in these drains.

Implications and consequences of fragmented drainage development

The SBM-G dashboard gives the number of drain segments made in each village. The gram panchayat development plan also mentions the drain segments taken up for construction in each village every year. This should translate to sequential

Drain or no drain? Sepatwa village, Rani block

Drain of irregular shape and size in Nawgura village, Rani block

Drain of inadequate depth in Basant village, Sumerpur block

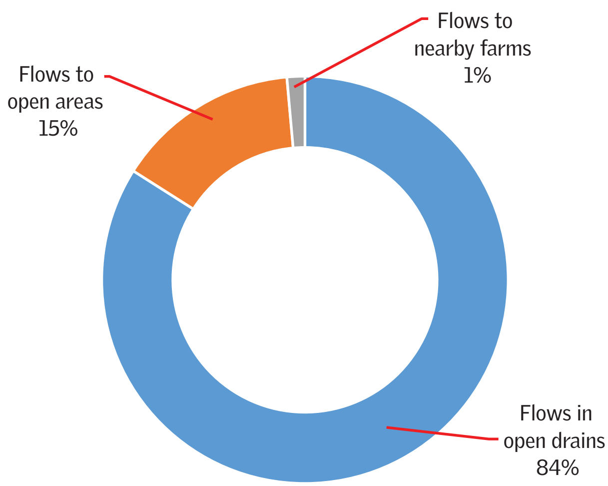
Drains in Vingarla village, Rani block

PRADEEP KUMAR MISHRA, CSE

and logical drain segments taken up every year, connecting the previous ones. However, the ground realities are different in Pali also. Due to soil permeability and low greywater production, the consequences of open flowing of greywater may not be immediately visible, but its impact on groundwater needs to be assessed to avoid long-term consequences.

Treatment and disposal of greywater

Graph 7: What happens to greywater from households?



Source: CSE survey data

The study shows that greywater from around 84 per cent of the surveyed households flows in open drains, while greywater from the 15 per cent of the households flows into open areas and roads. Only 1 per cent of the surveyed households reported that greywater from their homes flowed in nearby farms (see *Graph 7: What happens to greywater from households?*). However, the field observations also show that, in most of the villages, the greywater flowing from open drains too, is discharged in the open and depressed areas (at lower elevations) in the outer part of the village. There is no plan for end-point treatment or disposal. Due to porous and permeable nature of the soil, the greywater is absorbed in the soil. Since Pali district has water scarcity, its greywater can be treated and reused, adding on to the source sustainability.

The CSE team mapped the SBM-G dashboard data for the villages to be surveyed to and visited the locations to verify the structure on the ground. Most of the locations mentioned on the dashboard did not exist on the ground. In some cases, the locations were geo-tagged wrongly on SBM-G dashboard was even out of village boundaries.

HOUSEHOLDS IN KHETARLI VILLAGE REUSE GREYWATER FOR IRRIGATING KITCHEN GARDEN

Households of Khetarli village of Bali block in Pali district have demonstrated good practices of greywater management at the household level by reusing it in the kitchen garden. Some households wash their utensils near kitchen gardens and allow the used water to flow towards the kitchen garden, saving fresh water. They said that it is their traditional practice to utilize used water from their kitchen in the kitchen garden as it saves their fresh water, which they earlier used to fetch from very long distances. This knowledge is still in practice.

Bhura Ram, a household member, said that while they reuse their used water from the kitchen, they do not use detergents or chemicals to wash utensils but wood or cow dung and soil. Used water from bathrooms, however, is not used in kitchen garden as it contains detergent. Bhura Ram said that the detergent could harm their crops, and that why they diverted used water from the bathrooms to open drains. Even the ground-level reservoir (GLR) in the village has a cattle troughs where the water is filled for animals.

PRADEEP KUMAR MISHRA, CSE

Such practices can be propagated where spillover water can be made available for cattle to drink.

Another practice that has been developed by the Rajasthan-based non-profit Centre for Microfinance is to connect a cluster of households to water storage tanks and then with taps, the spillover from which goes to the nearby farms, thus avoiding wastage.

The CSE survey could only find four community soak pits in three villages. These lacked in proper design, lacked silt chamber and remained waterlogged and hence were non-functional. Clearly the communities do not feel the need to have soak pits, though the survey team identified a few water logged areas in the villages and at community places in the surveyed villages, thus highlighting the need for soak pits(see *Table 12: Data on greywater management as per SBM-G dashboard)*

PRADEEP KUMAR MISHRA, CSE

VIVEK KUMAR SAH, CSE

Water percolates into the soil quickly in Vingarla village, Rani block (top); water stagnates before percolating into the soil in Velar village, Bali block (centre); Water stagnates in an open area outside Gogra village, Sumerpur block (bottom).

Table 12: Data on greywater management as per SBM-G dashboard as on 9 February 2026—surveyed villages of Pali district

Block	Village	Drainage facility	Household soak pits	Household kitchen garden	Community soak pits	Community/ village-level treatment system	Number of soak pits visited
Bali block	Velar	4			1	2	1
	Kothar	1					
	Berdi	1			8	1	1
	Khetarli	3			3	2	
	Goriya	2			7		2
Sumerpur block	Barli	3			1		
	Gogra	3	1		2		
	Rojra	2			3		
	Basant	2			1		
	Dholasasan	2	1		2		
Rani	Keerwa	1			7		
	Vingarla	1			8		
	Pratapgarh	1			2		1
	Septawa	1			6		2
	Nawaguda	1			1		

Source: Compiled by CSE

Status of infrastructure

Need for infrastructure creation: It was clearly evident from the aforementioned survey findings that the villages will need to create infrastructure to manage their greywater. For example, Keerwa village in Pali district (see *Table 10: Estimates of greywater quantums as per JJM water supply estomates in surveyed villages of Pali*) generates almost 1 lakh litres of greywater per day, and to tackle this greywater seven community soak pits have been created (see *Table 12: Data on greywater management as per SBM-G dashboard as on 9 February 2026—surveyed villages of Pali district*) as per the SBM-G dashboard. This could not be found on the ground. Also, these may not be enough to cater to the incoming load of greywater. The village needs to consider space, terrain and available funds to identify a proper plan for conveyance and management of greywater. This applies to all the villages surveyed as clearly the infrastructure is not sufficient and of appropriate design standards and requirements.

Operation and maintenance: Maintenance of infrastructure is an issue. Several soak pits were waterlogged and in disuse. The drains that were made were clogged and clearly not cleaned at the frequency required. They were clogged with solid waste and silt. The villages remain indifferent due to lack of ownership and no visible issues due to greywater.

PRADEEP KUMAR MISHRA, CSE

Soak pit in disuse and without silt chamber in Berdi village, Bali block

MANISH MISHRA, CSE

Soak pit clogged in Goriya village, Bali block

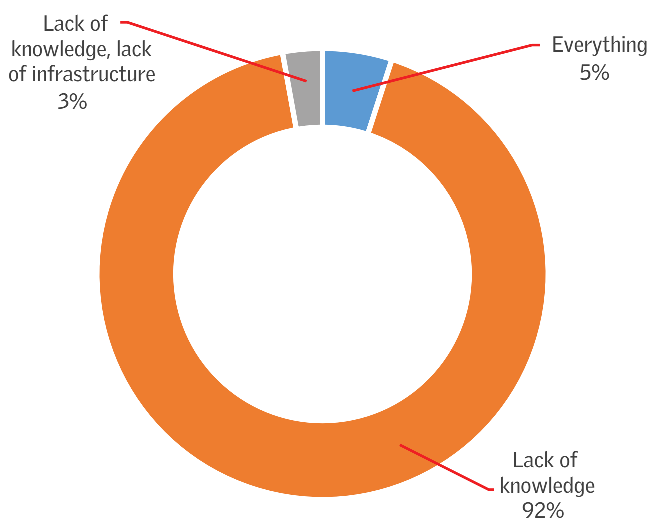
Understanding management of greywater with changing groundwater and soil conditions (with case examples)

In Banda, the community explained the reasons for the pit collapsing, while in Pali wastewater is quickly absorbed in the soil. In both casees it is important to understand the soil and groundwater conditions to manage groundwater and prevent groundwater contamination.

Pali soil profile: The Aravalli Range forms the eastern boundary of the Pali district and the southern boundary is at Bamnera village in Sumerpur tehsil. A zone of foothills lies to the west, through which run the many tributaries of the Luni River. The western portion of the district includes the alluvial plain of the Luni. Soils in the district may be classified as loamy sand to sandy loam in Sumerpur and loam to heavy loam in case of Pali, Bali and Rani blocks.[6]

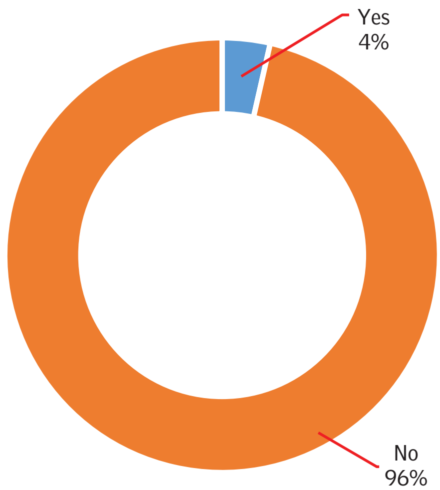
Groundwater forms important aspect to plan management of greywater along with the soil. In a similar example Keerwa village has groundwater available at 6mgbl and may have much shallow groundwater during monsoons.[7] This indicates towards a higher probability of polluting ground water than Basant village which has its ground water at 25–30mgbl level (see *Graph 8: What are the challenges do communities feel in reuse of greywater?*).

Graph 8: What are the challenges do communities feel in reuse of greywater?



Source: CSE survey

Graph 9: Do communities in Pali reuse greywater in the surveyed households?



Source: CSE survey

Community involvement

Of the surveyed households, 96 per cent reported not reusing greywater at the household level (see *Graph 9: Do communities in Pali reuse greywater in the surveyed households?*). However, some practices exist for segregating greywater for use by cattle for drinking purposes and for use in the kitchen garden. The same should be propagated. Communities remain unaware of the potential of greywater reuse and were willing to participate in community initiatives and reuse of greywater. However, in the case of Pali, awareness generation and initiatives from the gram panchayat also remained lacking. Communities cited different reasons for not reusing greywater at the household level: 92 per cent of surveyed households reported that they do not have adequate knowledge about reusing greywater, the methods of treatment or reusing as a water-conservation practice—they just treat it as wastewater that has no value and is thus wasted—3 per cent of the respondents reported a lack of infrastructure for the treatment of greywater before reusing it, while the remaining 5 per cent said that they don't have any idea about reusing greywater, and hence they lack knowledge, infrastructure, awareness, education and motivation.

This becomes more important in terrains like Pali where tapping greywater could mean a sustainable alternative to provision of freshwater for the purposes of toilet flushing and gardening. Communities tell surveyors that once wastewater is tapped and communities are explained its benefit greywater could be reused also. VWSCs remain non-functional in case of Pali also.

5. Conclusion and recommendations

The two surveyed districts—Pali (Rajasthan) and Banda (Uttar Pradesh)—have declared most of their villages as open-defecation free and also as model villages, which means the issue of greywater is managed for clean village surroundings.

However, the reality is vastly different from the SBM-G dashboard picture. The JJM reality also differs.

Broadly the issues, challenges and gaps that emerged from the survey of the villages from the two districts are as follows:

- **Lack of data for planning greywater management:** Pali generates less greywater due to smaller per capita usage and JJM supplies are still under process. Banda generates larger quantums due to higher per capita usage and continued dependence on groundwater for a long time, and, in addition, the JJM supplies unmeasured water. However, one thing that remains common is that, due to JJM supplies, greywater production has increased and it has begun to affect the communities. In the absence of data, planning may be difficult and faulty. Greywater production would increase further as the taps become fully functional. These issues are further triggered as water supplies remain unmetered. Both districts also remain dependent on alternative sources, differ in water supply, storage and usage patterns. This makes it difficult to estimate the water supply, water consumed and hence difficult to understand household-level greywater generation.

- **Mixing of greywater and black water:** Another issue is the mixing of greywater and black water. Banda survey findings revealed faulty toilets, and resulting mixing of black water, while Pali only had single and twin pits with no observed mixing of grey and black water. Banda has to take this into consideration.

- **Lack of proper drains:** Greywater that exits from households enters drains to be taken to a point of treatment. Both Pali and Banda largely had open drains and similar issues such as lack of proper drains which ended up waterlogging the roads, village ponds or rivers, or agricultural fields. In some cases, the drains ended in nowhere and inadequate planning of the drains was evident.

In Jaspura and Bahadurpur Kalinjar village in Banda district, villages had drains in fragments that ended up flooding the fields as the end points of drains lacked any treatment of possible planning of proper disposal. Agricultural fields are thus rendered useless, community disputes are increasing, and the villages don't have a solution. These have become reason for losses to farmers, rising cases of diseases and lack of visual cleanliness. In Pali, due to less water consumption and soil with high percolation capacity, the issue isn't apparent with regard to drains. But the district has to urgently look into its geology and manage greywater to prevent contamination of groundwater.

- **Lack of proper treatment:** There was no treatment practised. Household soak pits are few. Those found may not be adequate for future increased water consumption patterns. The soak pits at community places could not be verified for design aspects.

- **Lack of operation and maintenance** was another observed issue where villages and communities failed to maintain the existing structures rendering them unusable. The 15th Finance Commission and VB-GRAM-G (MGNREGS renamed in 2024) scheme is available to maintain the infrastructure created to make it more sustainable

- **Fragmented governance and management:** CSE observations also suggest that the management of greywater remains fragmented despite multiple mechanisms in place for regulation. Regulation on groundwater extraction in rural areas and monitoring of faulty sanitation systems are absent. JJM guidelines have clearly mentioned the role of different agencies to create a village action plans that have to be included in the district and state action plans for approval of funds and to ensure better planning. The CSE survey in both districts showed clearly that the two main agencies—SBM-G and PHED implementing the JJM scheme—are not in sync.

- **Lack of awareness and capacity building:** There is lack of technical guidance on proper design and technology to be adopted and also lack of awareness on available funding sources and schemes for proper design, planning and sustainability of the structures.

- **Lack of community involvement:** The JJM guidelines also specify the role of community-led organizations and the frequency to conduct community meetings to involve communities. VWSCs and communities are not just the beneficiaries but are also the owners of the assets and in future the entire management of water and greywater has to be led by community members. The guidelines also mention on how communities can generate revenue by reuse of greywater that can be used for the O&M of the water and greywater infrastructure. Both the schemes clearly aim to bring communities at the forefront. They intend to slowly hand over the water and sanitation to trained SHGs, VWSCs and/or pani samitis. These exist to remain inactive in absence of funds and both the agencies remain clueless on how to create a successful community-led model. Both districts have non-functional VWSCs and communities remain aloof from the entire process of planning, implementation and monitoring.

- **Wastage of freshwater sources:** Water supply under JJM is wasted if it not used, resulting in wastage of freshwater resources and its conversion into wastewater, unnecessarily increasing the cost burden for treatment while other communities fail to get enough water.

The districts also need to understand the opportunities and harvest opportunities of treating and reusing the treated greywater to reduce the demand for freshwater in the districts and the state. JJM guidelines promote usage of greywater as a resource to reduce the freshwater consumption. It promotes reuse of greywater in kitchen garden and other non-potable purposes. In big villages and areas with water scarcity, it even promotes a dual plumbing system to recycle treated greywater or through conjunctive use. SBM-G prioritizes that greywater should be managed at the lowest level possible, i.e. it should be managed first at the household level through soak pits. The villages now need to plan judiciously to use greywater as an opportunity wherever possible as a resource and also understand the available funds to adopt solutions. Treating greywater is more expensive than managing it at household level with a soak pit. It is also important to consider what fits where and this will be possible if the villages are aware about the available quantums of greywater. Lower quantums of greywater collected and treated may only increase the cost while, if the ground conditions do not permit, adopting soak pits may also not be a good choice either.

Currently, the following is needed:

1. **Reduction in wastage of water:** A metering system has to be created which ensures the households take ownership of the water wastage. Currently, a large number of pipelines remain leaking and taps missing in connections at the household level, resulting in wastage of freshwater.
2. **Plan for community ownerships and community audits:** Gram panchayats should focus on creation of properly planned and designed greywater

management structures and plan for O&M of the existing structures. It can further consider extending the role of the community as desired in Jal Sewa Aankalan to maintain greywater structures.

3. **Development of a village action plan:** A survey-based village action plan should be developed in consultation with the communities, which would have:

- **Correct estimation of greywater generated:** The quantitative and qualitative estimation of the greywater generated by households at all levels is imperative, not only to gauge their management but also because this water contains pollutants can that pose a threat to human health. Alongside it must be ensured that black water is not mixing with greywater generated by retrofitting the faulty sanitation systems and connecting them to soak pits or managing them separately. Greywater can be easily managed with simple nature-based treatment systems if management at the household level is not possible. Estimating greywater generation would be difficult in the scenarios of the two districts as both groundwater and JJM supplies are used by communities. Hence, flow measurement studies should be taken up at the final drain points to ensure correct design capacity of the treatment systems. Over-designed and under-designed systems would create further issues and hence flow-estimation-based decision-making is essential.
- **A mapped and pre-planned drainage network:** Villages should take up mapping and planning studies to create a drainage network map and should act according to the plan. This would help avoid design of faulty drainage systems. There is a need for integrated and systematic drainage planning at the village level**.** The planning should consider estimation of greywater quantities, mapping of drainage flows, identification of treatment locations and integration with village water supply planning. Without a planned drainage network, any attempt to introduce greywater treatment systems will remain ineffective. Entry of untreated greywater into ponds should be prohibited.
- **Create a manual of the suitable technologies for managing greywater for each of the district-** It is important to understand the soil permeability and groundwater conditions of each village before adopting use of any technology. High flood-prone and shallow groundwater table areas may opt for raised soak pits or community-based treatment systems. Clayey, black cotton soil areas are more likely to adapt concrete ring pre-casted, magic soak pits. Hilly terrains should not opt for soak pit-based greywater management due to non-permeability of the soil. This creates a need for developing design manuals for site-specific nature-based and decentralized solutions at the household, community and village levels (see *Table 13: Technology matrix for selection of on-site and off-site solutions depending on soil and groundwater*).

Table 13: Technology matrix for selection of on-site and off-site solutions depending on soil and groundwater

Soil type	Groundwater	Technology that can be adopted for greywater management at household level	Technology that can be adopted for grey water management at community level	Reference documents
Permeable and structurally stable—loamy soil	Deeper	• Soak pit/leach pit at household level and at community places. • Kitchen garden	Small bore sewers connecting to a community-level nature-based treatment system (NBS) such as DEWATS/constructed wetland.	• SBM-Grameen Technical Manual for grey water- https://swachhbharatmission.ddws.gov.in/technical-notes. • CSE toolkit- https://www.cseindia.org/toolkit-managing-faecal-sludge-in-rural-areas-10059 • Case studies from across the country (https://www.cseindia.org/big-change-is-possible-11594) • Climate-resilient sanitation technical designs (https://swachhbharatmission.ddws.gov.in/sites/default/files/Technical-Notes/technical-designs-and-service-delivery-management-protocols.pdf) • SBM-Grameen Technical Manual for grey water (https://swachhbharatmission.ddws.gov.in/technical-notes).
	Shallow	• Raised soak pit (can be made above the ground with appropriate soil compaction on the walls, ensuring a minimum of 2-metre distance between the groundwater and base of the pit during monsoon season) • Kitchen garden with raised beds ensuring distance from groundwater	Small bore sewers connecting to community-level nature-based treatment system (NBS) such as DEWATS/constructed wetland. Avoid waste stabilization ponds in such terrain. The structure should be concrete and sealed to avoid groundwater contamination	
Permeable but structurally weak, like sandy soil	Deeper	• Modified soak pit/leach pit • Magic pit • Kitchen garden	• Small bore sewers connecting to community level nature based treatment system (NBS) such as DEWATS/Constructed wetland/ WSP depending on space available.	
	Shallow	• Raised soak pit • Kitchen garden ensuring raised beds	• Small bore sewers connecting to community-level nature-based treatment system (NBS) such as DEWATS/constructed wetland. • Waste stabilization ponds in such terrain should be opted with caution, ensuring proper distance from ground and surface water sources.	
Less permeable—black cotton soil, red soil, clayey soil.	Deeper	• Modified soak /leach pits • Kitchen garden with raised beds and proper drainage	• Small bore sewers connecting to community-level nature-based treatment system (NBS) such as DEWATS/constructed wetland. • Waste stabilization ponds should be avoided in these soils.	

Source: Compiled by CSE

*As per CPHEEO guidelines, there should be a minimum of 2 metre distance between the groundwater and pit bottom in the post-monsoon groundwater levels. However, this rule will differ depending on infiltration capacity of the soil and density of households. The guidelines mention considering raised pits in case of high subsoil water levels.

Managing funds from different sources

Gram panchayats have several funds available which can be used in convergence to create better resilient infrastructures (see *Table 14: Sources of funds and convergence to manage rural sanitation*).

Table 14: Sources of funds and convergence to manage rural sanitation

Activity	Primary fund	Convergent funds	GP role	Key outputs
Household/community toilets (gap filling)	SBMG	15th FC Untied, SFC grants	Beneficiary identification, site facilitation	Toilet coverage, ODF+
Faecal sludge management	SBMG	15th FC Tied (Sanitation), State PR grants	Land provision, O&M oversight	FSM treatment units/ plants
Greywater drains and soak pits	15th FC Tied (Water & Sanitation)	MGNREGS (labour), SFC	Planning and supervision	Reduced water logging
Doortodoor collection system	SBMG	GP own revenue	Procurement and user charges	Regular waste collection
Waste segregation sheds	SBMG	15th FC Untied	Construction and monitoring	Source segregation
Compost/biogas units	SBMG	MGNREGS, CSR	Community mobilization	Organic waste treatment
Plastic waste collection and disposal	SBMG	District/CSR	Tieups with recyclers	Reduced plastic dumping
Pond/talab desilting	MGNREGS	15th FC Tied (Water), SFC	Work identification	Increased storage
Pond embankment strengthening	MGNREGS	State water schemes	Supervision	Flood resilience
Recharge pits and check dams	Jal Jeevan Mission/ Atal Bhujal	MGNREGS	Community planning	Groundwater recharge
River/stream rejuvenation (local)	Namami Gange (where applicable)	MGNREGS, state funds	Local stewardship	Improved water quality
Asset maintenance	GP own revenue, SFC grants		Annual maintenance plans	
User charges collection	Local revenue		Fee setting and enforcement	
Behaviour change communication	SBMG		Community engagement	

Source: Compiled by CSE

4. **Building capacity**: There is an urgent requirement for tailor-made capacity building initiatives at various stakeholder levels. The village communities and the gram panchayats along with the block officials should be trained on the proper planning exercise to develop a proper village level action plan and allocate funds for specific activities for approvals, the masons should be capacitated for proper designs.

5. **Awareness of the communities:** Sensitization drives should be made a regular feature among villages. Communities should be involved in greywater management, drawing on local wisdom and practices. The communities should

HOW TWO VILLAGES IN CHHATTISGARH SOLVED THEIR GREYWATER PROBLEM: GHUGWA AND PATORA VILLAGES IN DURG DISTRICT USED HOUSEHOLD- AND COMMUNITY-LEVEL SOAK PITS TO PREVENT WATERLOGGING

Patora and Ghughwa villages (both are also the gram panchayats) in Patan block, Durg district struggled with grey water management issues. Some households in these villages are directly connected to open drains. Greywater from the drains used to flow into the village ponds and pollute the pond water. Communities who bathed in these ponds complained about foul smell and skin rashes. Households and community water points in some places were not connected to the drain network. These households did not have proper bathing and washing places and as a result, water stagnated outside houses or at water points. Villagers raised concerns about the foul smell and mosquitoes.

The change

Durg has red sandy soil with high permeability. With technical help from WaterAid India, a non-profit with headquarters in the UK, both Patora and Ghughwa Gram Panchayats planned interventions that would suit their soil condition. The agenda for the villages was to sort the problem of grey water flooding through different interventions at the household and community levels. The village panchayat initially tried to solve the issue of grey water by developing a community-level grey water treatment plant in Patora village. The initiative was highly appreciated at the state level as it was a low cost system made with the involvement of the gram panchayat and communities.

SWATI BHATIA, CSE

Household-level modified soak pit with a platform and silt chamber in Durg district

Community-level modified leach pit with nahani trap and silt chamber in Patora village

It was realized, however, that to solve the problem of stagnation of wastewater in the villages, interventions at the household level would be a better option than developing community-level systems that were difficult to maintain.

Hence the village panchayat now seeks to develop household leach pits while maintaining the community-level treatment plant at Patora village. In Ghughwa village, however, as a portion of the greywater flowed to the lower reaches of the villages, community-level greywater management systems were planned. The drive to construct leach pits in these villages began in 2020. The gram panchayats are continuing this drive to cover 100 per cent of households. Community-level interventions for greywater management started in 2017 in Patora and in 2020 in Ghughwa village.

Household- and community-level soak pits in Ghughwa and Patora
Financial assistance from Standard Chartered Bank Foundation under Corporate Social Activity and cooperation from the communities in both the villages worked in managing grey water from households. WaterAid India provided technical support while labour and material support were provided by the beneficiaries themselves.

The gram panchayat along with WaterAid made beneficiaries aware about the need to manage grey water at the household level. Modified leach pits were suggested based on soil type. A honeycomb leach pit was constructed at each household. The leach pit was lined with a 0.7–1 m layer of gravel to allow enough percolation time for better treatment of grey water. The leach pits were raised approximately 0.3 m above the ground and closed with a concrete lid to facilitate cleaning and operation.

Closing the pits also ensured the safety of children playing around the pits. In place of honeycomb brick structures, readymade perforated concrete was used. Concrete rings—with perforations of size 65–75 mm throughout the effective depth on similar patterns as in honeycomb soak pits—of 1 m diameter and 1 m depth were also used. The perforations were planned to have four or five holes in a ring.

GRAM PANCHAYAT PATORA

Construction of community-level leach pit in Patora village

GRAM PANCHAYAT, PATORA, DURG

Community-level soak pit in Patora village

Before a leach pit is constructed

Before a leach pit is constructed, the water-generation point is fitted with a nahani trap to prevent larger particles from escaping into the pit. After passing through the nahani trap, wastewater flows into the silt chamber, where silt and other suspended particles settle and grease and oil float as scum over the clear liquid. The outlet pipe is made at a lower level than the inlet pipe. Eventually, water passes through the outlet pipe into the leach pit. Similar structures are planned for community water points, with larger leach pits measuring 2 m x 2 m. A gravel layer 1–1.5 m thick is placed around all sides of the leach pits. The gravel layer covers the full depth of the pit. The community-level soak pits are constructed using gram panchayat funds (15th Finance Commission, Viksit Bharat-Guarantee for Rozgar and Ajeevika Mission (Grameen) (VB-G RAM) (formerly MNREGS) provide technical support).

Constructed wetlands: Patora

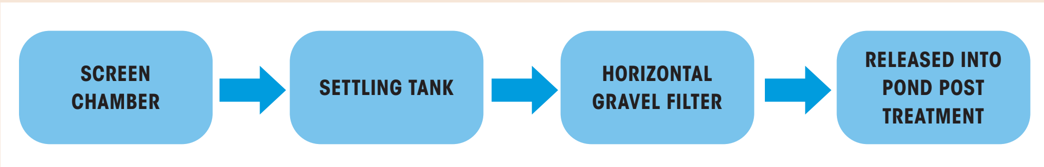
With the help of WaterAid India, Patora gram panchayat planned a constructed wetland for the village to manage grey water at the community level. Open drains were laid out in selective areas the village, connecting 190 households to carry grey water to lower reaches by the force of gravity.

Initially, untreated greywater flowed to the existing village pond, resulting in algal growth. Villagers complained about its ill effects. In 2017, the Gram Panchayat with technical handholding from WaterAid started constructing the grey water management system.

It was designed by WaterAid, India, and constructed by local labour and with locally available material. The gram panchayat provided monitoring support at all stages. Open drains connected to a larger drain that passes through the constructed wetland from where treated greywater passes to the pond.

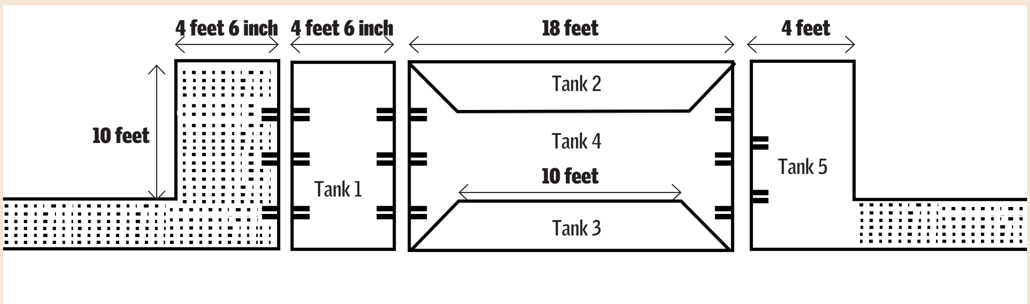
Three parallel wetland tanks have been designed—these were incidentally designed by the labour and were not in the original plan—through which grey water passes before going through the last layer of filtration media and is released into the pond.

Figure 2: Scheme of treatment at Patora village greywater treatment plant



Source: Compiled by CSE

Figure 3: Design of constructed wetland in Patora village



Source: Compiled by CSE

Not to scale

SWATI BHATIA, CSE

Canna indica growing in the constructed wetland used to treat grey water at the community level in Patora

Before entering the horizontal gravel filter system, grey water passes through a screen chamber and has a bypass system for high flow of storm water during rainy seasons. It then enters the settling tank (2.5–3 cubic metres). The plant has a capacity of 5 cubic metres per day.

Currently, there is an inflow of black water from septic tanks that has disturbed the system. Hence, the village Panchayat is planning to initiate interventions at the household level and add an extra treatment module to cater to the high BOD load.

Local *Canna indica* plants are planted in the wetland so that the roots of the plant pick up the nutrients, thereby cleaning the water. Although this method is capable of removing up to 75–80 per cent of BOD, the gram panchayat is not testing regularly.

They no longer face algal growth, which was usually the case post-monsoon. Algal growth indicates the presence of nitrates in water and causes eutrophication of the waterbody.

SWATI BHATIA, CSE

Greywater treatment plant in Ghughwa village

Soak pit in Ghughwa greywater treatment plant

Anaerobic treatment of greywater: Ghughwa

A similar community-level greywater management system was designed for Ghugwa village (also a gram panchayat). The system is based on anaerobic treatment designed by 5D Buildcon, an Ahmedabad-based consultancy firm.

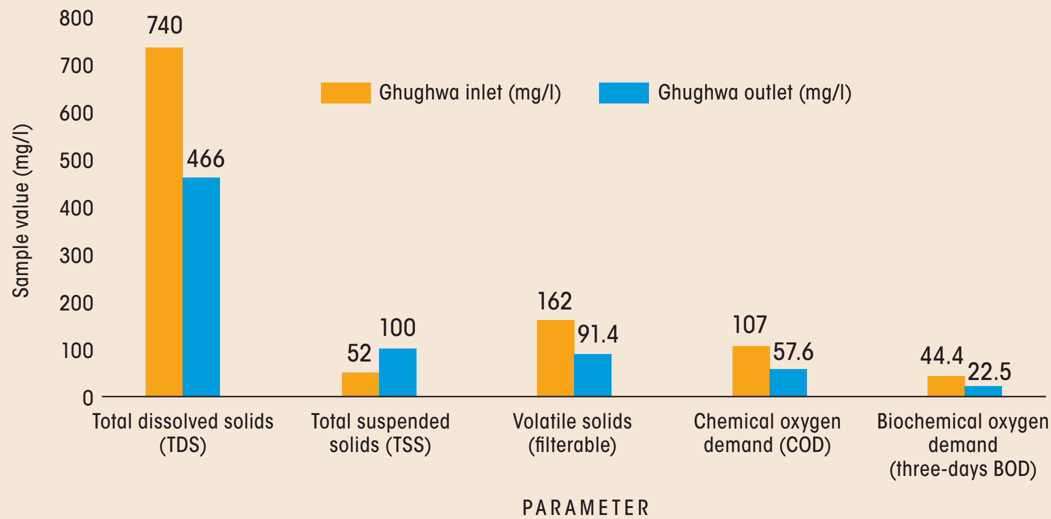
The gram panchayat and WaterAid India helped implement the system in 2020. The greywater management system was constructed at the end of a drain, which in turn was connected to a drainage network serving 159 households.

As in Patora, untreated greywater from the drain flowed into the village pond. To prevent grey water from entering the pond, the grey water treatment unit was planned to be installed at the final collection point of the drain network in Ghughwa village.

Detailed studies were done, and on the basis of data available and calculations of flow rate, it was estimated that approximately 5 cubic metres per day (m^3) of greywater is produced. On the basis of population projections, a plant with capacity of 7 m^3 per day capacity was proposed.

The plant currently caters to grey water from 159 out of 272 households. An anaerobic filtration module was proposed on the basis of availability of space, easy flow of water, operation and maintenance and budget requirement. The DEWATS model was adopted keeping in mind the cost of operation and maintenance (see *Figure 4: Scheme of treatment at Ghughwa village greywater treatment plant*).

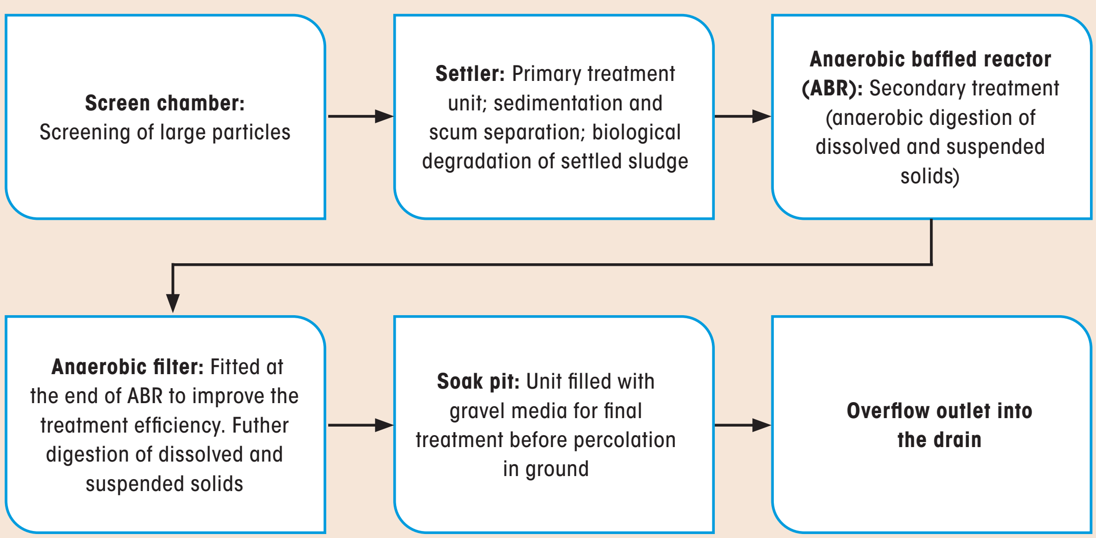
Graph 10: Water quality results of the inlet and outlet samples from the Ghughwa greywater treatment plant



Source of data: Gram panchayat, Ghughwa Jal Sewa Charitable Foundation, results from report dated 16/08/2021, graph created by CSE India

The plant currently caters to greywater from 159 out of 272 households. An anaerobic filtration module was proposed on the basis of availability of space, easy flow of water, operation and maintenance and budget requirement. The DEWATSTM model was adopted keeping in mind the cost of operation and maintenance (see *Figure 4: Scheme of treatment at Ghughwa village greywater treatment plant*).

Figure 4: Scheme of treatment at Ghughwa village greywater treatment plant



Source: Compiled by CSE as per DPR shared by WaterAid India

Operation and maintenance

Household- and community-level soak pits in Ghughwa and Patora villages:

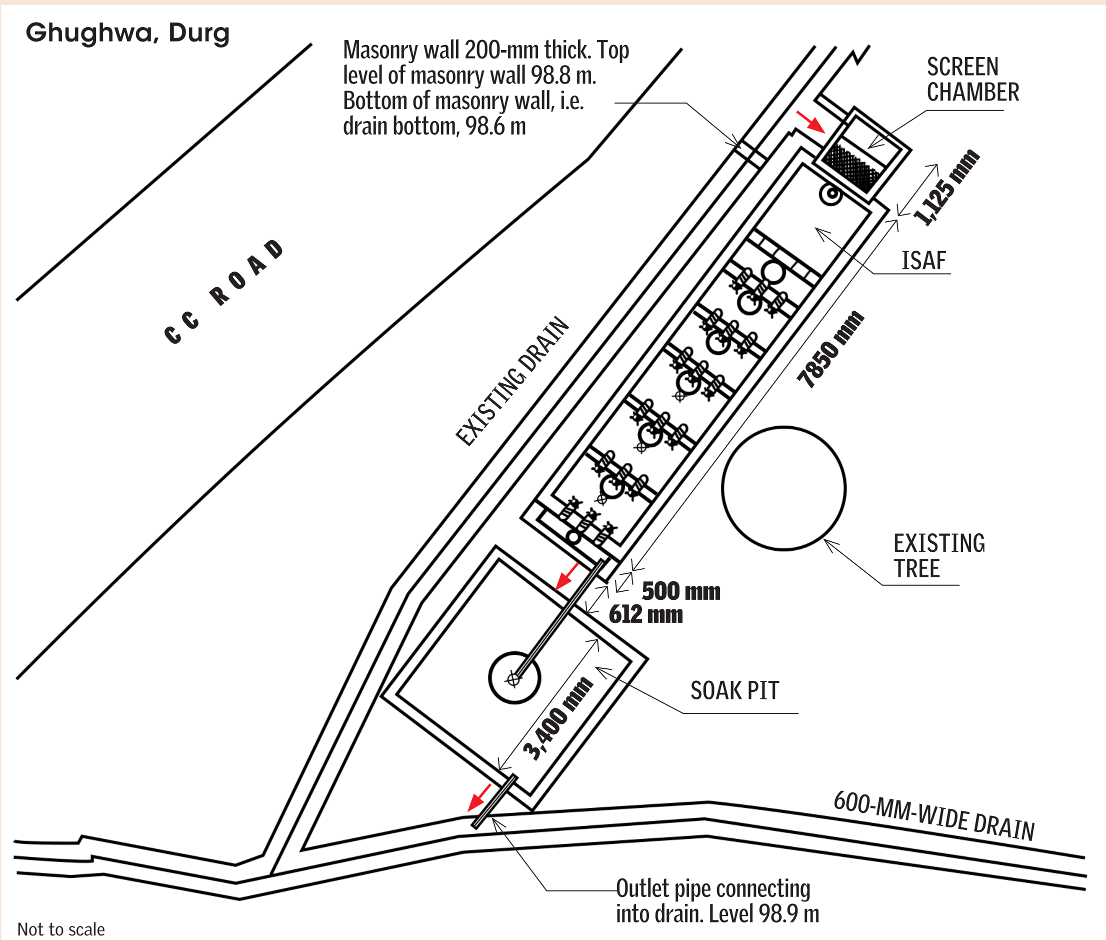
Household-level soak pits are maintained by individual-household beneficiaries. There is no cost-sharing by the Panchayat as of now. The community-level leach pits/soak pits are maintained by the gram panchayat. The sarpanch estimates, however, roughly Rs 3,000–5,000 per annum towards the cost of cleaning the soak pits.

Community-level greywater treatment unit at Patora and Ghughwa

The annual maintenance cost is approximately Rs 15,000–20,000 per annum and borne by the gram panchayats. The constructed wetland at Patora required media replacement every three to four years, adding an additional cost to the gram panchayat.

The plan is to change the filter layers every three to four years. As both systems are new, a significant amount of maintenance work has not been done. The gravel filter layer in the constructed wetland in Patora has been changed (see *Figure 5: Drawing of the greywater treatment plant using ABR in Ghughwa village*).

Figure 5: Drawing of the greywater treatment plant using ABR in Ghughwa village



Source: DPR, WaterAid; https://www.downtoearth.org.in/water/75-years-of-people-s-power-how-these-two-villages-in-chhattisgarh-solved-their-grey-water-problem-84310 be made aware of the challenges and health effects of greywater and black water and the importance of its proper management. This shall help pave the way for a community dialogue and solutions acceptable to the communities.

6. **Monitoring toilets:** Contamination of greywater with waste from toilets is a concern. All onsite systems, toilets and outlets of septic tanks connected to drains need to be surveyed and checked for its design and retrofitted appropriately.

7. **Ensuring maintenance of implemented systems:** VB-GRAM-G (formerly MGNREGS) funds can be used for maintaining the implemented systems, and the workers can be trained to manage and maintain the systems with periodic cleaning, replacement of the filter material, and monitoring the outflows and inflows.

8. **Planning for reuse of treated greywater:** Treated greywater can be diverted to village ponds or create adequate storage spaces in agricultural fields so as to ensure that the fields are not destroyed due to waterlogging. The villages should also plan for the reuse of treated greywater and reduce dependency on fresh water resources for non-potable purposes.

PRADEEP KUMAR MISHRA, CSE

Greywater from kitchen and washing area inside the house flowing into the open drains, village Pratapgarh, block Rani, Pali district (Rajasthan)

TAMIL NADU'S NATTATHI VILLAGE SHOWS THE WAY TO GREYWATER MANAGEMENT

Over 35 per cent of the households had kitchen gardens in their backyards and they began to use grey water to irrigate the gardens

Nattathi Gram Panchayat, in Srivaikuntam mandal of Thoothukkudi district in the state of Tamil Nadu, is spread over 1,268.97 hectares (3,135.69 acre). It has a population of 2,874 (967 households). The eight habitations that comprise Nattathi Gram Panchayat suffered mismanagement of grey water. Greywater from households flowed into open drains, causing water stagnation in the lower reaches of hamlets and giving rise to mosquito breeding and increase in vector-borne diseases.

RAVI KUMAR, CSE

A kitchen garden set up by an individual household in Nattathi gram panchayat

The change

Panchayat officials took strong steps to address the problem of grey water flowing into the open. Communities were asked to manage the grey water in their own premises. Over 35 per cent of the households had kitchen gardens in their backyards and they began to use greywater to irrigate the gardens. Water from kitchens and bathrooms was led into open kitchen gardens with ridges and furrows. Greywater flowed through the furrows where plants are placed.

The gram panchayat took the initiative to plan more. They mapped the village to include the location of households, layout of drains, existing toilets and bathrooms (at the individual and the community levels). The panchayat was supported by district and mandal officials and self-help and youth groups.

Solutions implemented included construction of individual and community soak pits, provision for kitchen gardens and implementation of horizontal soak pit at the end of the drainage channel (for households that lacked space for construction of individual soak pits) (see *Table 15: Plan for management of greywater in Nattathi*).

Table 15: Plan for management of greywater in Nattathi

S. no.	Hamlet	Total number of households	Individual soak pit	Kitchen garden	Drainage leading to horizontal community soak pits
1	Kumarapuram	69	40	29	NA
2	Mullanvilai	134	80	NA	54
3	Pattandivilai	354	205	149	NA
4	Vaigunthapuram	6	6	NA	NA
5	Chinna Nattathi	108	63	45	NA
6	Kanandivilai	84	47	37	NA
7	Kombukaranpotal	132	77	55	NA
8	Nattathi	80	47	33	NA
	Total	967	565	348	54

Source: District Rural Development Agency, Thoothukudi district, Tamil Nadu

The gram panchayat constructed—over and above individual soak pits, kitchen gardens, and horizontal community soak pits—20 soak pits near public taps, primary schools, and religious places. These soak pits are larger than the household soak pits. In 2002–03, Nattathi village constructed an Integrated Women Sanitary Complex (IWSC) in the Pattandivillai hamlet, serving 15 households. Women and children use the IWSC for bathing and washing clothes. Greywater generated from the complex is led into empty land, where a women's self-help group, Magalir, uses the water to grow vegetables, including brinjal, tomato, chilli, bottle gourd and spinach. Magalir maintains an account of the vegetables sold (see *Table 16: Fund allocation for implementation of household soak pits in Nattathi gram panchayat*).

Table 16: Fund allocation for implementation of household soak pits in Nattathi gram panchayat

Panchayat	70 per cent SBM funds (Rs)	30 per cent 15th Finance Commission fund (Rs)	Total fund
Natthati	5,63,304	2,41,416	8,04,720

Source: District Rural Development Agency, Thoothukidi district, Tamil Nadu

The successful implementation and functioning of the vegetable garden—which was also profitable—urged the district administration to recommend Nattathi gram panchayat for the Clean Village Award in 2007. In Mullanvilai hamlet, which has a drainage system, the panchayat constructed a horizontal soak pit system at the end of the drain. Greywater from 54 households passes through a screen and is conveyed to this horizontal soak pit.

An inspection chamber is placed at the end of the drain to trap solid particles (such as plastics and covers). Grey water then flows to a horizontal filter bed where suspended particles and solids are collected. Treated greywater is then diverted to land by ridges and furrows. Banana and coconut trees have been planted on the ridges. The produce is harvested by the panchayat. Funds—amounting to Rs 1,33,000—were allocated for construction of horizontal soak pit under MGNREGS.

Operation and maintenance

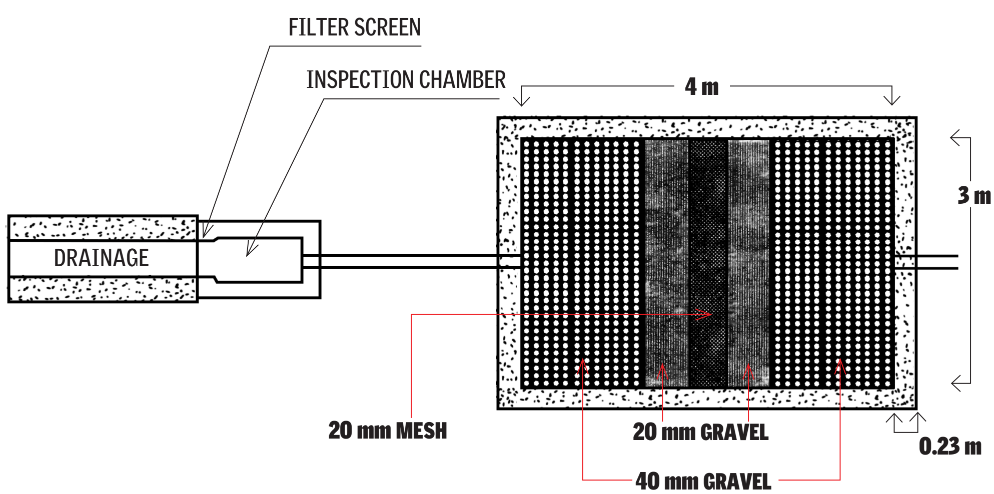
Households take care of their own soak pits. Solid waste is easily trapped in the inspection chamber of the horizontal soak pits. The soak pits require cleaning at least once in two weeks. As the soak pits are community-level systems, this is taken care of by the gram panchayats.


RAVI KUMAR, CSE

Greywater from a horizontal soak pit is conveyed to a community garden where banana and coconut trees are grown in Nattathi gram panchayat.

The garden at the Integrated Sanitary Complex for Women (IWSC) is maintained by a self-help group. Maintenance activities involve removing blockages in the garden's furrows (irrigated with treated greywater) and harvesting produce (see *Figure 6: Sketch of a plan for horizontal soak pit*).

Figure 6: Sketch of a plan for horizontal soak pit



Not to scale

Source: Senthil Kumar, district coordinator, SBM, Thoothkodi, Tamil Nadu; https://www.downtoearth.org.in/water/75-years-of-people-s-power-tamil-nadu-s-nattathi-village-shows-the-way-to-grey-water-management-84296

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Jal Jeevan Mission (JJM) has not only ensured water supply at the doorstep of each rural household but it also focuses on managing greywater from kitchens, bathrooms and washing areas. JJM went, for the first time in India, beyond water supply alone to tackle wastewater-related issues.

To understand the state of greywater management in rural areas, the Centre for Science and Environment (CSE) examined two ecologically distinct districts—Pali in Rajasthan and Banda in Uttar Pradesh. Around 30 villages and 589 households were surveyed in these two districts. Multi-village surface-water-based schemes have been planned under JJM in both districts, but due to irregular supply both districts have shifted largely to groundwater-based sources—public or private.

CSE's analysis shows that underestimating greywater generation has led to the installation of undersized or improperly sited greywater management structures. The greywater conveyance systems in both districts also remain a challenge. Poor maintenance of the conveyance and the greywater management structures exacerbates the problems. The report suggests a matrix of soil-specific solutions for both districts.

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