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# A case study of Nenmeni Rural Water Supply Scheme, Wayanad district, Kerala, India: The Pursuit for Sustainability, Equity and Inclusion

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## Abstract

The concept of sustainability gained prominence in development discourse following the publication of 'The Limits to Growth' (Meadows et al., 1972) and 'Our Common Future' (WCED, 1987). Since then, debates on sustainability have expanded beyond environmental concerns to include social and economic dimensions. Ensuring the sustainability of rural water supply system has consequently become a major global challenge. This paper presents a qualitative, longitudinal case study of the Nenmeni Rural Water Supply Scheme (NRWSS), a medium-sized, community-managed rural water supply system in Wayanad district, Kerala, India. Using participatory chronicling from inception to the present, the study examines how NRWSS expanded from 727 house service connections in 2007 to over 5,100 connections by 2025 under the management of a community-based organization. The findings demonstrate how sustainability has been pursued as a central objective through equity and inclusion, cost recovery, professionalized community management, and institutional adaptation over time. The study contributes to global debates on sustainable rural water governance by illustrating how community-managed systems can sustain service delivery while addressing both resource and methodological challenges.

**Keywords:** community-managed water supply, Sustainability, Inclusion, Asset Pentagon, water CBO

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## Introduction

The Nenmeni Rural Water Supply Scheme (NRWSS) is located in Nenmeni Grama Panchayat (GP) in Wayanad district, Kerala, India. NRWSS was originally designed, implemented, and commissioned in 1991 by Kerala Water Authority (KWA), the state public-sector water utility, which operated and maintained the system until 2005. In 2005, Nenmeni GP was included under the Jalanidhi rural water supply project and as part of the reform agenda and the agreement between the Government of Kerala and the GP, NRWSS was technically and institutionally rehabilitated during 2005–2007 and subsequently transferred to a community institution, the Nenmeni Water Supply Society (NWSS), in December 2007.

For the past eighteen years, NRWSS has been operated, maintained, and managed by NWSS without interruption. Over this period, the scheme has evolved into a widely cited model of community-managed rural water supply in Kerala. This paper presents a qualitative case study of NRWSS as a model of sustained rural water service delivery under community management, with particular attention to sustainability, equity, and inclusion.

- **Study context: Wayanad district**

Wayanad district, formed in 1980, covers an area of 2,130 sq.km, of which approximately 40% is under forest cover. The district is landlocked, sharing borders with the states of Tamil Nadu and Karnataka, as well as the districts of Kozhikode, Malappuram, and Kannur in Kerala. Physiographically, Wayanad is largely a plateau, located on the eastern side of the Western Ghats and gradually merge into the Deccan Plateau. The district's altitude ranges from about 700 m to 2,100 m above sea level, resulting in a relatively cooler climate compared to the plains of Kerala.

Kabani is the only major river in the district, originating in the eastern slopes of the Western Ghats and flowing eastwards to join the Cauvery river system. Wayanad has experienced heterogeneous migration over several centuries from neighboring states and the plains of Kerala. Wayanad has the lowest population density in Kerala (383 persons per sq.km; 2011 Census). Notably, 18.5% of the district's population belongs to Scheduled Tribe communities, making Wayanad socio-demographically distinct within Kerala.

### ❖ Nenmeni Grama Panchayat

Nenmeni Grama Panchayat was constituted on 9 March 1973 through the bifurcation of Noolpuzha GP. It comprises 24 wards and had a population of 46,950 (2011 Census). The demographic composition includes approximately 79% general category population, 4% Scheduled Caste population, and 17% Scheduled Tribe population. Nenmeni GP is located in the south-eastern part of Wayanad district and represents a socially diverse rural setting with significant water-access challenges. Figure No. 1 presents the location of NRWSS.

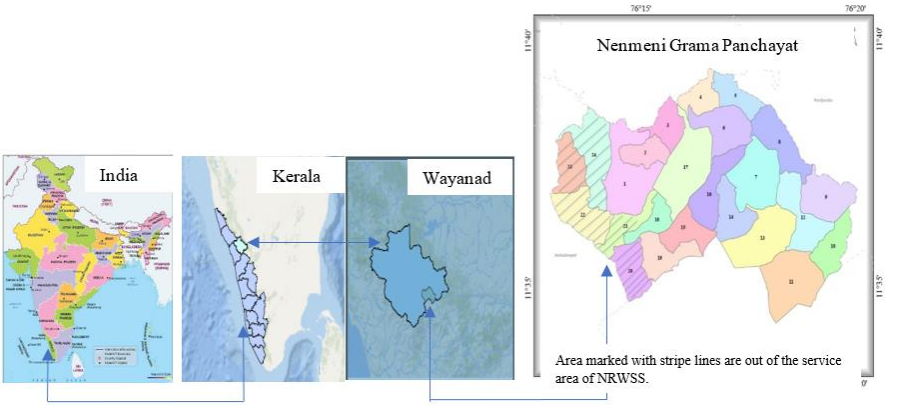


Figure 1: - Location Map of NRWSS

### ❖ Local water situation

Historically, Nenmeni and the surrounding areas of Wayanad were endowed with diverse local water sources. Streams once flowed year-round but now largely dry up during summer, reflecting ecological stress and changing hydrological conditions. Traditional water sources such as keni (shallow spring wells), ponds, and open wells have been relied upon for domestic use. However, these local water management practices have gradually declined, while piped water supply schemes have become the dominant intervention across the district.

Prior to the rehabilitation of NRWSS, households dependent on public stand posts (PSPs) managed by KWA experienced highly erratic water supply, sometimes receiving water only once in several days or even weeks. Women residents described long-distance water collection, physical strain, poor water quality, and informal coping mechanisms such as filtering turbid and storing clarified water for domestic use. Water scarcity also triggered collective protests, including symbolic 'Poojas' at

PSPs, reflecting both frustration and the social unrest for irregular water supply. The economic dimension of water stress in Nenmeni GP is equally significant. Open wells, despite the local cultural preference, require substantial household investment and often fail during summer months. In this context, a reliable piped rural water supply scheme offering household-level access represents not only a social intervention but also an important economic alternative to costly and uncertain self-provisioning.

## Interventions in the rural water sector

Water has been described as the "most unforgiving" natural resource, given the absence of viable substitutes (Engelman & Le Roy, 1993). Globally, nearly one billion people experience water scarcity, while approximately 2.3 billion live in water-stressed countries. India, with 18% of the global population and only 4% of global freshwater resources, faces acute water challenges. Since the first UN initiated observance of Water Decade (1981–1990), rural water supply has attracted increasing attention from governments and international agencies.

**Indian Interventions in rural water sector:** Government of India intervened in rural water sector through several initiatives since 1954. Accelerated Rural Water and Sanitation Program (ARWSP-19773-1999), National Drinking Water Mission (1986), Sector Reforms Project (SRP-1999-2003), Swajaldhara Project (2003-2008), National Rural Drinking Water Program (NRDWP) (2009-2019) and Jal Jeevan Mission are some notable interventions by Government of India in rural water sector (Kansal, M. L 2010). The 73rd Constitutional amendment in India provided mandatory responsibilities on drinking water and sanitation to Gram Panchayats (Naidu. 2002). However, GPs have huge capacity gap in technical and managerial aspects to effectively intervene in rural water sector. JJM has set an ambitious target of providing functional household tap connection (FHTC) to all rural households in India by 2024, subsequently extended to 2028. Rural water sector has gone through some reform since the 'SRP' days, which include community participation and management in O&M and cost recovery for operation and maintenance. (NRDWP - 2013 and JJM -2019).

**Interventions in rural water sector by Kerala:** Kerala's rural water sector is a hybrid model of private household level self-provisioning and governmental interventions. Rural water supply projects implemented in Kerala include: (1) Dutch

(1988) and DANIDA (1987) supported projects, (2) SRP (1999-2003) (Kollam and Kasaragod districts), (3) Jeevadhara (Idukki and Alapuzha districts-2003-2006) and (4) Jalanidhi Phase-I (2000-2008), and Phase-II (2012-2019). Dutch and DANIDA projects introduced 'Socio-Economic Units' (SEU) as a facilitation agency to demonstrate the viability and effectiveness of a user-orientation (Karthikeyan Achary, 1996) and social aspects in rural water and sanitation (Kurup, & Abdulla 1996).

**Sustainability, participation, and community management in rural water supply**

Debates on sustainability in development gained prominence following the publication of The Limits to Growth (Meadows et al., 1972) by Club of Rome and Our Common Future by WCED (WCED, 1987), emphasizing environmental constraints. Subsequent discussions on sustainability expanded to include economic and social dimensions. In the rural water sector, earlier development approaches based on either state control or market mechanisms often failed to deliver reliable and equitable services (Dearden & Rizvi, 2008; Joshi, 2004). Community participation and management emerged partly as a response to these failures. A distinction is commonly drawn between community participation—understood as involvement in decision-making and development processes (Cohen & Uphoff, 1980)—and community management, which combines governance and service provision responsibilities within local institutions (Schouten & Moriarty, 2003). Sustainability in rural water supply has therefore been closely associated with community management, particularly in relation to post-construction operation and maintenance (Riswan, 2021). Participation is increasingly framed as a continuum, ranging from consultative involvement to citizen control (Arnstein, 1969; Pretty, 1998), with sustainability linked to the extent to which communities influence decisions, resources, and institutions (World Bank, 1996; Nelson & Wright, 1995).

Within this broader shift, different models of community management have evolved. In the Indian context, these include community management through local self-government institutions, such as the VWSC model and the Society model (Hutchings, 2018). The VWSC embeds water management within Panchayat structures, the society model vests operational responsibility in autonomous consumer organizations with accountability to their general body. Experience since

the International Drinking Water Supply and Sanitation Decade (1981–1990) suggests that community management gained policy traction as governments sought to address fiscal constraints and operational inefficiencies (Amerasinghe, 2009). However, evidence also indicates that ceremonial participation, particularly within committee-based models, can undermine sustainability (Chukwuma, 2016). Closely related is the Demand Responsive Approach (DRA), which emphasizes expression of demand, cost sharing, cost recovery, local capacity building, and community ownership (Harvey & Reed, 2007). Interpretations of DRA vary across disciplines—ranging from consumption-based demand in engineering, to willingness to pay in economics, and socially constructed needs and preferences in sociology (Wedgwood, 2005). Together, these strands of literature underline that sustainable rural water services depend not only on infrastructure and resources, but on the institutional capacity of community organizations to integrate financial, human, and social capital in service delivery.

**Analytical framework: The Asset Pentagon**

This study adopts the Asset Pentagon framework—comprising natural, physical, financial, human, and social capital—to analyze sustainability in NRWSS. Natural capital is understood narrowly as the water resource, assessed in terms of quantity and quality required to meet household needs without compromising long-term availability (Gatto & Lanzafame 2005); (https://wedc-knowledge). Physical capital refers to water supply infrastructure—from source, treatment, storage and distribution—and its sustainability is reflected in functionality, adequacy of the asset base, and effectiveness of operations and maintenance. Armanios (2012); Carter et al (1999) and Kruijf, J. (2005). Financial capital is defined as the scheme's ability to generate sufficient revenue to recover operation and maintenance costs, finance asset replacement, and maintain reserves, recognizing water as an economic good. Peter Rogers et al (2002); Aloyce W. Mayo and Lwazi Nkiwane (2013); Lila Prasad Limbu (2017). Human capital encompasses leadership, technical and managerial skills, and organizational capacity to operate and adapt the system reliably over time, moving beyond volunteerism towards professionalized community management. Hussain & Langendijk (1994); Hutchings et al (2020). Social capital includes institutional arrangements, participatory platforms, governance mechanisms, trust, and linkages with local government and external agencies that enable collective action, accountability, and inclusion. Fabio Rojas-2013; Bhandari & Grant (2007); Alvarez and Corrales (2014); Hutchings (2018); Smets

and Weitz (2016). While natural and physical capital are largely established during the planning and construction phase of a funded project, the long-term sustainability of rural water supply depends critically on how community institutions develop and integrate financial, human, and social capital during post-commissioning.

- **The Kerala Rural Water Supply and Sanitation Project (Jalanidhi)**

Government of Kerala implemented the World Bank–supported Jalanidhi rural water supply and sanitation project in two phases between 2000 and 2019. Under the project, 5,884 community-managed rural water supply schemes were implemented across 227 Grama Panchayats in 13 districts of Kerala (https://jalanidhi.kerala.gov.in/). Jalanidhi supported two categories of rural water supply schemes: (a) New water supply schemes, implemented in locations where no formal piped water systems previously existed; and (b) Rehabilitated water supply schemes, which involved restoring or upgrading existing systems to improve service delivery, efficiency, water quality, and reliability and previously owned by KWA or GP.

The Nenmeni Rural Water Supply Scheme (NRWSS) in Wayanad district is a rehabilitated scheme originally designed and implemented by the KWA. Under Jalanidhi, NRWSS underwent comprehensive technical and institutional rehabilitation before being transferred to community management. The scheme is widely regarded as a success, both in terms of the rehabilitation process and sustained improvement in service delivery. This paper examines the NRWSS experience to understand how sustainability, equity, and inclusion have been achieved and maintained over time.

- **Nenmeni Rural Water Supply Scheme (NRWSS)**

NRWSS was formally taken over by Nenmeni Grama Panchayat from KWA and rehabilitated by addressing technical, institutional, social, and political challenges (Kurian et al., 2014). The rehabilitation process involved infrastructure upgrading, institutional restructuring, and the formation and strengthening of a community-based organization to assume responsibility for operation and management.

## Methodology

### ❖ Analytical framework: Asset Pentagon and sustainability

This study applies a modified Asset Pentagon framework to assess the sustainability of NRWSS. The framework conceptualizes sustainability through five interrelated forms of capital relevant to rural water supply systems:

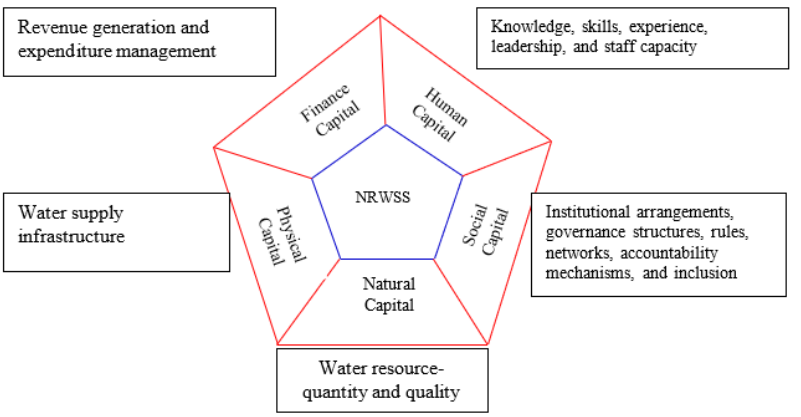


Figure 2: Asset-Pentagon Framework for assessing Sustainability of a Rural Water Supply Schemes

Each capital is defined in the context of rural water supply and assessed using a combination of qualitative and quantitative indicators. The adapted Asset Pentagon framework is used to examine how these capitals have evolved over time and how their interaction has contributed to the long-term sustainability of NRWSS.

### ❖ Longitudinal case study approach

The study adopts a longitudinal qualitative case study approach. The authors have maintained regular and continuous engagement with NWSS, the CBO operating and managing NRWSS—since 2011. In addition, the historical background of the scheme has been closely followed since its rehabilitation phase across multiple dimensions, including technical performance, institutional development, financial management, leadership, and service delivery outcomes. Data were collected using multiple qualitative methods to enable triangulation. These included: (1) Focus group discussions; (2) Key informant interviews; (3) Consumer interviews; (4) Direct and participant observation; (5) Review of documents such as asset registers, audit reports, Minutes of meeting, and logbooks; (6) Analysis of data from management information system (MIS) and (7) Most Significant Change (MSC) stories and

narrative analysis. Table 1 summarizes the domains of assessment, indicators, and tools used for data collection.

**Table 1: Domain of assessment, indicators and tools used in the case study**

| Domain of Assessment | Indicators/ Sub-domains | Tools/ Methods |
|---|---|---|
| Natural Capital | 1. Source Sustainability<br>2. Water quality management | 1. MIS<br>2. Consumer Feedback<br>3. Direct observation<br>4. FGD with GP Members, office bearers and staff of NWSS<br>5. Key Informant Interviews<br>6. MSC- Most Significant Change Stories and analysis<br>7. Verification of Asset Register, audit reports, records and minutes of meeting<br>8. Participant Observation of SLEC Meetings<br>9. Verification of Log Book data<br>10. Verification of water quality monitoring arrangements and water quality test reports |
| Physical Capital | 1. Functionality of water infrastructure<br>2. Enhancement Asset<br>3. Operational Management | |
| Finance Capital | 1. Tariff structure<br>2. Tariff history<br>3. Affordability of tariff<br>4. Billing and Collection System<br>5. Cost Recovery in O&M<br>6. Connection Policy-New HSCs<br>7. Accounting & Auditing<br>8. Procurement during O&M<br>9. Post-construction capex grants<br>10. Consumer behavior<br>11. Loans and Liabilities<br>12. Savings and Deposits | |
| Social Capital | 1. Governance and institutional arrangements<br>2. Legal status & Rule of law<br>3. GRM and Responsiveness<br>4. Management Information System<br>5. Inclusion<br>6. Relationship with GP/ Local Polity<br>7. Knowledge generation | |
| Human Capital | 1. Champion Leadership<br>2. Availability of Skilled staff<br>3. Staff welfare<br>4. Staff discipline<br>5. Advisory Committee<br>6. Gender balance<br>7. Crisis Management | |

### ❖ Sustainability scoring approach

To support systematic assessment, the study developed a Sustainability Score Card, assigning weighted scores to sub-components under each capital of the Asset Pentagon. A similar scoring approach was previously applied in the Sustainability Evaluation Exercise (SEE) conducted for rural water supply schemes implemented under the World Bank–financed Jalanidhi Project during 2003–2006, undertaken by

PLANET Kerala for the Kerala Rural Water Supply and Sanitation Agency (PLANET Kerala & KRWSA, 2003).

In the SEE, sustainability was assessed through technical (60%) and managerial components (40%). Technical sustainability included source, system, and water quality, while managerial sustainability comprised financial and institutional dimensions. Building on this approach, the present study modifies the scoring pattern to reflect the central importance of post-construction institutional and financial performance in community-managed schemes. Accordingly, sustainability in this case study is assessed using a balanced weighting of technical and institutional dimensions, as shown in Table 2.

**Table 2: Comparison of sustainability score used in the current case study and SEE-III**

| Sustainability Capitals | Score proposed in the case study | Score used by PLANET Kerala to assess sustainability in SEE-III | |
|---|---|---|---|
| Natural Capital | 20 | Source | 25 |
| Physical Capital | 30 | System | 20 |
| Finance Capital | 25 | Quality | 15 |
| Social Capital | 15 | Finance | 25 |
| Human Capital | 10 | Institutional | 15 |
| Total | 100 | Total | 100 |

A detailed sustainability score sheet, indicating sub-component scores under each capital, is provided in Annexure 1.

- **Conceptual framework**

The conceptual framework for this study is adapted from Hutchings et al. (2017) and Hussein (2017). It distinguishes between two temporal phases of sustainability capitals: (1) Pre-commissioning capitals, consisting of natural and physical capital; and (2) Post-commissioning capitals, consisting of financial, human, and social capital.

During the pre-commissioning phase, state agencies, local governments, and support organizations play a dominant facilitative role. Following commissioning, responsibility increasingly shifts to the CBO, which assumes primary role in operating and managing the scheme. While earlier evaluation frameworks placed

greater emphasis on technical components, this study intentionally gives equal analytical weight to technical and institutional-financial dimensions to better capture long-term sustainability under community management.

**Methodological transparency statement:** The manuscript was language edited for clarity, structure, and academic style using AI-assisted tools (ChatGPT), under the full intellectual responsibility and authorship of the researcher.

- **Objectives of the case study**

The primary objective of this study is: To assess the sustainability of the Nenmeni Rural Water Supply Scheme through a longitudinal case study using the Asset Pentagon framework, and to explain how sustainability has been achieved and maintained under community management.

NRWSS has completed eighteen years of continuous operation and service delivery under community management. While this longevity itself indicates sustainability, there remains a need to analytically explain how sustainability has been achieved, particularly in relation to equity, inclusion, and institutional performance. The following section presents a component-wise analysis of NRWSS through the lens of the Asset Pentagon.

- **Natural Capital (Water)**

The water source for NRWSS is the Noolpuzha stream, a tributary of the Kabani River, originating in the Panthallur hills of Nilgiri district, Tamil Nadu. The source is perennial and has historically provided sufficient water to meet pumping requirements, including during summer months. Assessment of natural capital in this study focuses on source sustainability, water quality, and water quality management practices.

While the quantity of water available at the source has remained adequate, physical water quality has been a persistent challenge, with year-round turbidity caused by colloidal particles. Initial technical interventions—including construction of an infiltration gallery in 1991 and the installation of a pressure filter during rehabilitation (2005–2007)—resulted in marginal improvements. A more decisive improvement occurred with the commissioning of a water treatment plant (WTP) in 2017.

A comparison between the pre-rehabilitation period (prior to 2005) and the current operational context (2025) highlights significant improvements in water quality management, even though raw water turbidity persists at the source. Table 3 presents a comparative overview of the natural capital status before and after rehabilitation and transfer of management to NWSS.

Table 3. Comparison of natural capital status before and after rehabilitation

**Table 3: Comparison of natural capital status pre and post-commissioning**

| Natural capital | Pre-2005 Commissioning of NRWSS | 2025-Current Context |
|---|---|---|
| Source Sustainability | Source is sustainable. Pumping not disrupted during summer. | Source continues to be sustainable. Uninterrupted pumping in summer[2] |
| Water quality | Water is turbid throughout the year with colloidal particles. | Turbidity persist in raw water |
| Water quality management | Infiltration gallery constructed, but poorly maintained. | Infiltration gallery cleaned and made functional; pressure filter installed with limited impact (2005–2007); WTP commissioned in 2017 substantially improved treated water quality; in-house water quality laboratory established and operational |

By 2017, NWSS secured a government grant of ₹20 million to construct a water treatment plant, resulting in substantial improvement of treated water quality and visual appeal. In 2021, NWSS further strengthened water quality management by establishing an in-house water quality testing laboratory. The laboratory conducts routine testing of both raw and treated water and has been formally recognized by the Department of Health and Nenmeni Grama Panchayat. Notably, the laboratory also functions as a small sub-enterprise, generating surplus revenue beyond operational costs. The sustainability score assigned to natural capital under NRWSS is presented in Table 4.

[2] Sustainability of water source is considered for the summer (non-monsoon) months, as Wayanad district gets copious rainfall which replenishes the river. Therefore, the consideration is whether sufficient water is available at the source during summer so as not to disrupt pumping due to lack of water at source.

Table 4. Sustainability score for natural capital

| Natural Capital (Water Source) under NRWSS | Source of data | Total Score | Score awarded | Rationale for score/ Remarks |
|---|---|---|---|---|
| 1) Sustainable Water source | Log Book | 10 | 10 | Pumping not disrupted due to water scarcity during summer |
| Management of Water quality | | | | |
| 2.1) Regularity of Water quality tests | Test Result | 2 | 2 | Consistent testing undertaken since commissioning |
| 2.2) Quality of water during monsoon for 2024 | Test Result | 2 | 2 | Physical, Chemical, and Bacteriological parameters within desirable limits |
| 3. Quality of water during summer for 2024 | Test Result | 2 | 2 | |
| 4. Frequency of water quality testing | Test Result | 2 | 2 | Daily/weekly testing protocol followed |
| 5. Own water quality testing facility | Direct Observation | 2 | 2 | Laboratory approved by Health Department and Nenmeni GP |
| **Sub Total** | | **20** | **20** | |

Overall, the analysis demonstrates that the natural capital component of NRWSS is sustainable, primarily due to the reliability of the water source and systematic water quality management practices. Although raw water turbidity remains a structural characteristic of the source, the institutional capacity developed by NWSS—particularly commissioning of WTP and establishment of laboratory—has ensured safe and reliable water delivery. The enhanced demand for new HSC further reinforces the conclusion that natural capital, as managed under community stewardship, supports the long-term sustainability of the scheme.

- **Physical Capital**

The sustainability of physical capital under NRWSS is assessed across three interrelated dimensions: (1) functionality of water infrastructure; (2) asset enhancement during post-commissioning phase; and (3) operational sustainability of water supply system.

Table 5 presents a comparative overview of the physical capital status prior to 2005—when NRWSS was managed by the Kerala Water Authority—and the current context after eighteen years of continuous O&M by NWSS.

Table 5: Comparison of physical capital status pre and post-commissioning

| Water infrastructure | Pre-2005 Commissioning of NRWSS | 2025-Current Context |
|---|---|---|
| **Functionality of Scheme components** | | |
| Collection Chamber | Choked collection chamber | Collection chamber cleaned and filled with fresh filter material and is functional. |
| Infiltration Gallery | Choked with slush and sediments | Infiltration gallery cleaned and filled with fresh filter media; new perforated pipes, indicator device to monitor water level laid with regular annual cleaning of infiltration gallery. |
| Jackwell | Raw-unfiltered water in Jackwell | Jackwell cleaned three times during 2007-2025 depositing stone metal around the well to improve filtering of raw water. |
| Pump House | Leaking roof of pumphouse; | Pumphouse provided a tin sheet roof cover |
| Pumps | 3 pumps; Total HP capacity-160 | 4 pumps of submersible type available and operational. Total HP capacity - 260. |
| Panel Board | Available | Panel board replaced for higher capacity pumps |
| Pumping Main | Pumping Main 5840 Meters of Cast Iron Pipe, original installed in 1991, is still used. | |
| Filtering System | None | Pressure Filter introduced during rehabilitation (2005-2007) and a full-fledged water treatment plant installed in 2017. |
| Disinfection arrangement | Bleaching powder deposited into the GLSR- Storage Tank | Chlorine Doser installed in 2012, injecting chlorine solution into distribution mains. |
| Gate/Compound wall for pumphouse | Not available | Gate installed and compound wall erected. |
| Storage Tank | 375 kL GLSR; Storage capacity remains the same currently | |
| Water Treatment Plant | Not available | 1.5 MLD WTP implemented in 2017 adjacent to GLSR. |
| Water quality testing lab | Not available | WQT Lab with trained, experienced staff opened at WTP in 2019; Physical, Chemical and Bacteriological parameters are tested. |
| **Asset Enhancement in NRWSS** | | |
| Distribution Network | 96 km of distribution network available in 2005 | 362 km of distribution network, (40 to 300 mm). 277% increase. |
| Pubic Stand Post | 253 PSPs available; | 54 PSPs retained on the request of the GP; Annual fees @ Rs.5250/PSP is paid by GP. |
| House Service Connection (HSC) | 389 HSCs in 2005. | 727 HSCs available in 2007 December. 5100 HSCs in 2025-an increase of 602%. |
| Land holding (cents) | Land for Pumphouse and GLSR:38 cents | 20 cents added, taking total to 58 cents currently. 53% increase |

| | | |
|---|---|---|
| Office building | Not available | Office of NRWSS/NWSS moved to own new building (450 sq.feet) in 2008. Additional office space of 1250 sq.feet added; 1700 sq.feet of office space available |
| Vehicles Owned | None | Three vehicles; one Mobile Service Van –and Two Wheelers- Two. |
| Additional schemes taken over for O&M | None | NWSS took over O&M of 8 (Eight) small schemes[3], besides, a new scheme at Thovarimala with 269 HSCs financed by Sulthan Bathery Block Panchayat is also handed over to NWSS. |
| **Operational Sustainability** | | |
| Pumping regularity | Data not available<br>16 hours of pumping/Two shifts[4]. | 98.51% operational efficiency is achieved; pumping disruption is only 1.49%. |
| Frequency of supply | Supply is on alternate days for 12 hours on the day of supply/ | DMA and Zoning introduced in distribution; 40% of HSCs at lowlands gets 24 hours of supply; HSCs on the higher elevation get water for 6-8 hours every day. |
| Regularity of supply | Supply on alternate days. | Daily water supply |
| Adequacy of water supply | Unlimited | 70 LPCD assured |
| Consumer Satisfaction | Very Poor | 70% satisfied and 30% moderately satisfied. |
| Equity in Distribution | None; complaints of not receiving water supply was responded with over-pumping | DMA-wise distribution timing is rotated every day to ensure equity in distribution. |
| Breakdowns and repair response time | Slow and delayed. | Breakdowns in main pipes are repaired within 12 hours of damage reporting, using services of Mobile service unit. |

### ❖ Overall sustainability of Physical capital

Asset enhancement include: Land holdings increased from 38 cents to 58 cents, office space totals 1,700 sq. ft., and the scheme acquired vehicles to support emergency operations and maintenance. Nenmeni GP entrusted NWSS with the operation and maintenance of eight additional small schemes constructed under Jalanidhi, as well as a newly commissioned scheme at Thovarimala, reflecting institutional confidence in its operational capacity.

[3] Small water supply schemes taken over by NWSS include: (1) Kalanoor 50 HSCs; (2) Kalloor 27 HSCs; (3) Nambiarkunnu 84 HSCs; (4) Muthachikunnu 40 HSCs; (5) Punchavayal 41 HSCs; (6) Makkutty 41 HSCs; (7) Kollivayal 42 HSCs: (8) Kuzhimalam 74 HSCs;

[4] Personal conversation /interview with Srinivasan alias Money, Plumber and Operator of NRWSS under KWA management. No data records and log book details are available for the period prior to 2007.

NWSS undertook multiple operational innovations to ensure equity and reliability in water distribution. Given the settlement pattern in Nenmeni, where approximately 40% of households are located in low-lying areas and the remainder in elevated terrain, NWSS introduced district metering areas (DMAs), zoning, and strategically placed control valves to regulate pressure and timing. Operational efficiency of NRWSS is 98.51% and an assured supply of 6–8 hours to higher elevations while maintaining continuous supply in lowland areas.

All HSCs are metered. Regularity and predictability of supply strengthened consumer trust and contributed to the rapid expansion of HSCs. Predictable supply schedules, regular billing, and responsive maintenance have contributed to high consumer satisfaction levels.

NWSS also developed strong operational resilience in managing external infrastructure-related damages and consequent conflicts, particularly those arising from road widening and pipeline damage. NWSS ensured timely repairs while avoiding prolonged service disruption through negotiation with the Grama Panchayat, line departments, and affected farmers. These experiences enhanced institutional credibility and reinforced NRWSS's capacity for sustained operations under complex local conditions.

- **Sustainability score for physical capital: The sustainability score assigned to physical capital is summarized in Table 6.**

**Table 6: Sustainability of physical capital (Water Infrastructure)**

| | Source of data | Total Score | Score awarded | Rationale for score/ Remarks | |
|---|---|---|---|---|---|
| **Functionality of water infrastructure**[5] | Direct observation, Log Book/ Data from Water Meters | 9 | 9 | All components of NRWSS are functional. | |
| **Enhancement of Assets under NRWSS** | | | | **2007** | **2024** |
| Distribution Network | Asset Register | 1 | 1 | 114 | 362 (218% enhanced) |

[5] Water infrastructure includes (1) Infiltration gallery; (2) Jackwell; (3) Pumps; (4) Pumping Main; (5) WTP; (6) Storage Tanks; (7) Distribution network and (8) Metered HSC; (9) Public Stand Posts

| | | | | | |
|---|---|---|---|---|---|
| Number of Pumps | Asset Register | 1 | 0.33 | 3 | 4 (33% enhanced) |
| Storage capacity in KL | Asset Register | 1 | 0 | 375 | 375 |
| Land holding (cents) | Asset Register | 1 | 0.53 | 38 | 58 (53% enhanced) |
| Vehicles Owned | Asset Register | 1 | 1 | 0 | 3 (300% enhanced) |
| Building- area in sq. fee | Asset Register | 1 | 1 | 0 | 1700 |
| Small schemes taken over for O&M | Asset Register | 1 | 1 | 0 | 9 (900% enhanced) |
| Total | | 7 | 4.86 | | 69.43% |
| **Operational Sustainability** | | | | | |
| Rate of pumping efficiency[6] | MIS/ Log Book verified | 2 | 1.97 | Total days of operation/days of full disruption (87) *100=98.51%*2= 1.97 | |
| Frequency of supply[7] | Consumer Feedback survey | 2 | 1.12 | Responses from consumer survey converted into score applying weighted score average | |
| Regularity of supply[8] | | 2 | 1.25 | | |
| Adequacy of water supply[9] | | 2 | 1.80 | | |
| Consumer Satisfaction[10] | | 2 | 1.84 | | |
| Management of operations for equity in water supply | MIS | 2 | 2 | Operational area is divided into Two DMAs and 13 Zones[11] | |

[6] Pumping was fully disrupted for 87 days since the commissioning of the rehabilitated NRWSS from 2008 and the rate of disruption is 1.49%. A score equivalent to 98.51% of the total score under this sub-component is awarded to NRWSS

[7] Less than one hour (0.5); One to two hours (1); Two three hours (1.5); More than three hours-(2). Data from Household survey

[8] Daily (2); Once in two days (1.5) Once in three days or three days plus (1); Data from Household survey

[9] 70 LPCD or more (2); 50 to 69 LPCD (1.5); 40 to 50 LPCD (1) Less than 40 LPCD (0.5); Data from Household level consumption data

[10] % of HSCs who are satisfied (Satisfied -2) Moderately Satisfied (1.5); (Data from Household survey)

[11] There are two DMAs: Cheeral and Koliyadi and the 13 Zones include: Cheeral DMA (1) Pazhoor, (2) Cheeral, East. (3) Cheeral, (4) Kozhuvana, (5) Nambiarkunnu, (6) Thazhathoor); Koliyadi DMA (1) Koliyadi, (2) Kazhampu, (3) Madakara, (4) Malankara, (5) Malavayal, (6) Puthenkunnu; (7) Thovarimala) Zone is a cluster of HSCs with a single valve control;

| | | | | |
|---|---|---|---|---|
| Rate of increase in House Service Connections. | MIS | 2 | 2 | Current No. of HSCs –No. of HSCs at commissioning/HSCs at commissioning (5100-727=4373)/ 727*100=602% |
| Total | | 14 | 11.98 | Score percentage is 84.46% |
| Cumulative score for Physical capital = 9+4.86+11.98 =25.84=86% | | | | |

NRWSS scored highly across all three sub-components: infrastructure functionality, asset enhancement, and operational sustainability. Overall, physical capital achieved a composite score of 25.84 out of 30 (86%), indicating strong and sustained performance. The analysis demonstrates that while the basic infrastructure inherited from the pre-transfer phase remains largely unchanged, management efficiency, asset optimization, and operational discipline under community management have significantly enhanced system performance.

**Finance Capital:** Financial sustainability in the context of NRWSS refers to the scheme's ability to generate sufficient revenue to recover the costs of operation, maintenance, management, and periodic asset renewal. Finance capital is assessed using multiple indicators, including cost recovery, tariff design, billing and collection efficiency, investment mobilization, inclusiveness of access, accounting practices, and cost efficiency.

**Cost recovery in operation and maintenance**: During 2023–24, NRWSS generated revenue of ₹85.47 lakhs against an expenditure of ₹80.68 lakhs, resulting in an operational surplus of ₹4.79 lakhs. Over eighteen years of continuous operation, cumulative revenue amounted to ₹653.33 lakhs, while cumulative expenditure stood at ₹649.84 lakhs, demonstrating sustained cost recovery over the long term.

**Incremental Block Tariff (IBT)**: NRWSS follows an Incremental Block Tariff structure designed to encourage judicious water use and demand management. The base tariff of ₹130 covers consumption up to 10 kL per household per month. Higher consumption slabs are charged progressively, with sharply increasing rates beyond 15 kL. This tariff structure discourages over-consumption while ensuring affordability for basic domestic needs.

**Billing and tariff collection system**: Billing and collection are managed through a combination of digital systems and manual verification. Meter readers visit all HSCs monthly to record consumption and issue demand-cum-disconnection notices. Multiple payment options—including cash payment at household, office payments, bank transfers, and UPI—are available, reducing transaction barriers and improving compliance. The use of IT-enabled billing systems has enhanced transparency, accountability, and real-time monitoring of revenue flows.

**Investment mobilization and capital formation:** Total cumulative investment in NRWSS from 1991 to 2025 amounts to ₹1,076.15 lakhs. This includes initial capital investment by the state, rehabilitation support under the Jalanidhi Project, post-commissioning grants for infrastructure expansion, household contributions for new connections, and funds mobilized under national program. With 5,100 household service connections currently served, the average cost per household works out to ₹21,101. This compares favorably with the estimated average household cost of 1,11,671 under the Jal Jeevan Mission for the Multi-GP project covering Ambalavayal, Nenmeni, Poothadi and Pulpally in Wayanad district. The ability of NRWSS to attract post-commissioning capital grants reflects stakeholder confidence in its operational and financial performance.

**Inclusive connection policy:** NRWSS adopted a socially differentiated connection policy to promote inclusion. Differential enrolment fees for Below Poverty Line (BPL) and Scheduled Caste/Scheduled Tribe households significantly reduced entry barriers. As a result, BPL households constitute a majority of connections under NRWSS. In addition, NRWSS supplies water to orphanages, old-age homes, and tribal hostels at the basic tariff slab, irrespective of consumption, and provides water free of charge to government offices and public health institutions. These provisions reinforce the equity dimension of financial sustainability.

**Periodic tariff revision:** Water tariffs have been revised periodically in response to rising costs and system expansion. The base tariff increased from ₹50 in 2008 to ₹130 in 2024 through phased revisions. Incremental adjustments have ensured cost recovery while avoiding tariff shocks, maintaining consumer acceptance and political feasibility.

**Accounting and financial governance:** NWSS follows standardized accounting procedures supported by software-based systems. All transactions are conducted

through bank accounts, and annual audits are undertaken by a professional chartered accountant. Audited statements and governance disclosures are submitted annually to the Registrar of Societies in compliance with statutory requirements, reinforcing financial transparency and regulatory accountability.

**Cost of water production:** The cost of producing treated water in NRWSS during 2024–25 was estimated at ₹16.10 per kL. This estimate excludes unmetered supply through public stand posts and is therefore conservative. Metering of PSP supply would further reduce the calculated unit cost.

**Diversification and external revenue streams:** Beyond Nenmeni GP, NWSS has expanded its role as a service provider by undertaking operation and maintenance contracts for multiple rural water supply schemes across different Grama Panchayats. This diversification has strengthened institutional capacity, generated supplementary revenue, and reduced dependence on a single service area.

**Sustainability score for finance capital:** The sustainability score for finance capital is summarized in Table 7. NRWSS achieved 24 out of 25 points (96%), indicating strong performance across tariff design, cost recovery, affordability, billing efficiency, inclusive policies, accounting systems, and financial resilience.

**Table 7: Sustainability of Finance Capital in NRWSS**

| **Finance Capital** Sub-components | **Source of data** | **Total Score** | **Score awarded** | **Rationale for score/ Remarks** |
|---|---|---|---|---|
| Tariff System and structure | MIS | 2 | 2 | NWSS follows Incremental Block Tariff (IBT) |
| Tariff history | MIS | 2 | 2 | Tariff revised four times during 2007-2025 (2016; 2018; 2019 and 2024) |
| Affordability of services in terms of tariff[12] | Consumer survey | 2 | 2 | Proxy indicators: (1) Mobile Phone and (2) Electrified House were checked and found that consumer households were paying for these services. |

[12] Affordability was tested using two proxy indicators during consumer household survey; Availability of Electrified house and Use of Mobile Phones. All surveyed households (110) were electrified and a total of 250 mobile phones were available in 110 houses @2.27 mobile phones per household, of which 95 (86%) households had smart phones. People were paying for electricity and phones and hence water charges of Rs.130 was an affordable amount.

| | | | | |
|---|---|---|---|---|
| Cost Recovery in Operation and Maintenance | MIS | 6 | 6 | % of cost recovery for the period 2003-2024 was calculated and found 100% cost recovered. |
| Billing and Collection System | MIS | 2 | 2 | Functional and sound Software for Billing and Collection is used by NWSS |
| Connection policy for New HSCs | New HSC Policy | 2 | 2 | Well defined new connection policy with provisions for differential charges for socially and economically backward sections of society exist. |
| Accounting and Auditing systems | Audited Statement | 1 | 1 | Software based accounting and auditing by a professional Chartered Accountant since 2008. |
| Procurement during O&M period | Note on Procurement Practice | 1 | 1 | Transparent procurement system based on three competitive quotations is practiced for purchase of Goods and services. Procurement monitored by a Purchase sub-committee in the SLEC. |
| Post-construction capex grants | MIS | 4 | 4 | Total amount of funds received for various activities from Government, PRIs & Others[13] |
| Consumer behavior on tariff payment & water use | MIS | 1 | 1 | Regular payment of Tariff by majority of consumers[14] as evidenced from MIS on Billing and Collection |
| Outstanding Loans for Water CBO currently? | Audited Statement of Accounts | 1 | 1 | Total outstanding liabilities as of 2024[15] |

13 Scoring system is (1) Five crores+ 4; (2) 2 to 5 Crores=3; (3) 1 to 2 crores =2; (4) 5 lakhs to < 1 crore=0.5; (5) No funds received =0.

14 See table on cost recovery, where income and expenditure details are provided for 2023-24 and 2024-25

15 No Loans =1; Up to 10 Lakhs = 0.75; 10.1 to 25 Lakhs = 0.5; More than 25 Lakhs=0.25

| | | | | |
|---|---|---|---|---|
| Savings and Deposits | MIS/ Audited Statement of Accounts | 1 | 0 | Total amount in Fixed Deposit as of 2024[16] |
| Total | | 25 | 24 | 96% of achievement |

**Synthesis: Finance capital and sustainability:** Financial sustainability in NRWSS is rooted in institutionalized payment discipline, socially sensitive tariff design, and transparent financial governance. Regular metering, predictable billing cycles, and consistent communication have normalized tariff payment among consumers. Households recognize piped water supply as a reliable and economically viable alternative to costly self-provisioning, reinforcing willingness to pay. On the basis of the evidence presented, the finance capital of NRWSS is assessed as sustainable and resilient, providing a stable foundation for long-term service delivery under community management.

**Social Capital:** Social capital in NRWSS encompasses the institutional arrangements, participatory platforms, governance practices, norms, and relationships that enable collective action and sustain service delivery. It includes both structural social capital (formal organizations and participation mechanisms) and relational social capital (trust, legitimacy, responsiveness, and conflict management).

**Structural social capital and participation:** The NWSS constitutes the core structural social capital of the consumer community. The consumer community is organized into zonal groups, each electing representative to zonal committees, which together form the General Body of NWSS. The General Body elects a 13-member Scheme Level Executive Committee (SLEC), ensuring layered representation and democratic decision-making.

These participatory platforms function through regular, rule-bound meetings, with decisions recorded and monitored through formal minutes. Since 2005, NWSS has convened 39 General Body meetings and 290 SLEC meetings, indicating sustained organizational vitality. Voting rights are restricted to members without arrears in water tariff and membership fees, reinforcing accountability and payment

[16] No FD = 0; Up to Rs.10 Lakhs= 0.25; 10.1 to 25 Lakhs = 0.5; 25.1 to 35 Lakhs = 0.75; 35 Lakhs + = 1

discipline. The SLEC includes representatives from multiple political affiliations, contributing to pluralism and institutional legitimacy.

NWSS maintains close working relations with the Nenmeni Grama Panchayat, which regularly entrusts water-sector responsibilities to NWSS and seeks its technical and managerial advice. This relationship reflects mutual trust and the embeddedness of NWSS within local governance structures. Regular meetings of the General Body and SLEC, systematic documentation of decisions, and compliance with statutory registration and reporting requirements have strengthened institutional legitimacy. Political representation within the SLEC and close coordination with the Grama Panchayat further enhanced trust and problem-solving capacity. These governance arrangements provided NWSS with both authority and accountability, enabling it to manage NRWSS effectively while maintaining community confidence.

- **Governance and institutional arrangements**

NWSS operates under formally approved by laws governing both the Society and the operation and maintenance of NRWSS. Governance is understood here as the interaction of rules, institutions, and decision-making processes that enable collective management of water services. Authority, roles, approval mechanisms, and accountability arrangements are clearly specified in the bylaws and operationalized.

Institutional legitimacy is reinforced through statutory compliance. NWSS is registered under the Societies Registration Act (1860) and has obtained registrations under Sections 12A and 80G of the Income Tax Act, CSR-1, and the NGO Darpan portal. Annual disclosures—including audited accounts and committee details—are submitted to the Registrar of Societies, strengthening regulatory accountability.

- **Responsiveness and Grievance Redressal**

NWSS has established a robust and software-enabled Grievance Redressal Mechanism (GRM). Over eighteen years, a total of 30,975 complaints have been registered and resolved, demonstrating high levels of responsiveness. The GRM allows tracking of complaint resolution and serves as an important interface between consumers and the water CBO, contributing to trust and service credibility.

❖ **Management Information System and transparency**

A comprehensive Management Information System (MIS) supports operational monitoring, including pumping, treatment, distribution, consumption, billing, accounting, and GRM. Maintenance events and consumer-level consumption and payment data are systematically recorded. The MIS enhances transparency, enables evidence-based decision-making, and improves operational efficiency. Together with public communication platforms, including digital messaging groups and a website, the MIS has strengthened public confidence in NWSS.

❖ **Conflict resolution and rule enforcement**

NWSS has demonstrated the capacity to manage disputes through graduated responses, ranging from internal mediation to formal legal recourse. In cases involving deliberate damage to infrastructure or persistent violations, NWSS has approached law enforcement agencies and courts, resulting in deterrence and restitution. The willingness and ability to invoke formal legal mechanisms underscores the rule-bound nature of community management and reinforces institutional authority.

❖ **Socially embedded practices and innovations**

Beyond core service delivery, NWSS has undertaken a range of socially embedded practices that enhance legitimacy and trust. These include maintaining public stand posts in tribal and low-income settlements through formal agreements with the Grama Panchayat, providing subsidized or interest-free loan support to vulnerable households to obtain HSC, operating a recognized water quality testing laboratory, and functioning as a support organization for other rural water schemes. NRWSS has also emerged as a demonstration and learning site for local governments and sector professionals. These activities, while not central to water delivery, have strengthened the social embeddedness of NWSS and reinforced stakeholder confidence in its role as a public-service-oriented institution.

❖ **Sustainability score for social capital**

The sustainability score for social capital is presented in Table 13. NRWSS achieved the maximum score of 15 out of 15, reflecting strong performance across participation, legality, effectiveness, efficiency, accountability, transparency, responsiveness, inclusion, information systems, and dispute resolution.

**Table 8: Sustainability of Social Capital**

| Social Capital under NRWSS | Source of data | Total Score | Score awarded | Rationale for score/ Remarks |
|---|---|---|---|---|
| Social Platforms for Participation | Minutes of Meetings and Bylaw of NWSS | 2 | 2 | • Platforms of participation, representing gender, social and economic class interests exist through SLEC of NWSS (13 Members- 9 F and 4 M), General Body of NWSS- 65 members (13 zone @5 members- 39 women and 26 men); Zonal Executive Committee and General Body<br>• NWSS facilitated a development coalition that includes Nenmeni GP, KWA, KSEB, PWD, KSRRDA, KIIFB, KRFB, Police, Health, Forest, KVVES, Revenue dept, Village office, Education department, Tribal hostel, Old age home and High School, which in turn aided the created a goodwill for NWSS in the society and facilitated sustainability of NRWSS. |
| Rule of Law and Legal status of NWSS | Certification of Registration and Annual renewal of registration | 2 | 2 | • Written and approved Bylaws for NWSS and O&M of NRWSS available<br>• NWSS is a registered society under the Societies Registration Act-1860 and has renewed its registration every year since 2008, submitting: (1) Application for renewal of registration; (2) list of members of the SLEC and (3) a copy of audited statement of accounts.<br>• NWSS has taken a registration under 12A and 80G of Income Tax Act and CSR Registration |
| Active and Vibrant Water CBO | | 2 | 2 | • The SLGB and SLEC meet, discuss and decide on all matters concerning NRWSS since commissioning[17] |
| Effectiveness | MIS | 1 | 1 | • HSCs increased six-fold in 18 years. |
| Efficiency[18] | MIS | 1 | 1 | • Net present cost for one HSC works approximately to Rs.21101, in NRWSS while inclusion cost for a HSC in JJM is Rs. 111671/Household[19]. |

[17] No. of Years * No. of Annual SLGB/SLEC Meetings =percentage of meetings

[18] Efficiency in the context of NRWSS is considered with regard to the use of input financial resources to achieve one House Service Connection

[19] Figure arrived at from answer provided by Public Information Officer under RTI Act from the office of Executive Engineer, KWA, Wayanad.

| Table 8: Sustainability of Social Capital | | | | |
|---|---|---|---|---|
| Accountability[20] | Minutes of Meeting and Annual Reports | 1 | 1 | • Regular meetings of NWSS GB and SLEC. 39 SLGB and 290 SLEC meetings have been held in 18 years. Detailed reports and statement of accounts are presented to all GB and SLEC meetings. |
| Transparency[21] | MIS | 1 | 1 | • Management Information System (MIS) and data is available regarding all aspects of operation, maintenance and management of NRWSS.<br>• Website of NWSS is operational<br>• Monitoring and communication systems are in place, including WhatsApp Group for consumers, office staff and SLEC members. |
| Responsiveness[22] | MIS | 1 | 1 | • Software based GRM implemented in the O&M of NRWSS. It has received 24687 complaints in 18 years and all these have been resolved. |
| Inclusion | MIS | 1 | 1 | • Special provisions made to facilitate households that belong to SC/ ST and BPL categories to avail a HSC and inclusive, differential connection fee introduced.<br>• Public Stand Posts are located in resettlement colonies to cater to the needs of people who do not wish to avail a HSC. |
| Management Information System | MIS based Reports | 1 | 1 | • Existence of a functional MIS[23]<br>• Ability to generate customized reports on operation and maintenance |
| Socially useful activities | MIS | 1 | 1 | • Karunya Kudumba Sahaya Nidhi- Rs.1000 given to destitute families which have terminally ill persons at home to purchase medicines, besides lending health-related equipment |

[20] 'Accountability' in the context of NRWSS means that NWSS as a water CBO is answerable and accountable to the community of consumers, individually through GRM and collectively to the forums of participation such as the General Body, SLEC and Zonal committees.

[21] Information should be accessible to the public and should be understandable by the application of simple tools and methods

[22] Responsiveness means that office bearers of the institution shall respond to issues and complaints raised by the clientele and resolve the complaints at the earliest so as to gain confidence of the consumer community. Grievance Redressal Mechanism –GRM is considered the key tool for Responsiveness in the context of NRWSS. (https://unacademy.com/content/upsc/study-material/public-administration/grievance-redressal-mechanism. Grievance Redressal Mechanism refers to the receiving and handling of customer complaints

[23] Software based Transparent MIS and monitoring system developed and functional =2; (2) Manual and Record based MIS= 1; (3) No MIS=0

| Table 8: Sustainability of Social Capital | | | | |
|---|---|---|---|---|
| Settlement of Disputes | MIS | 1 | 1 | • NWSS seeks the help of police, courts and judicial system to settle disputes and conflicts |
| Total | | 15 | 15 | |

The evidence demonstrates that social capital in NRWSS extends beyond participation to encompass institutional credibility, procedural legitimacy, transparency, and enforceability of rules. These attributes have enabled NWSS to sustain collective action, manage conflicts, maintain payment discipline, and adapt to emerging challenges. Social capital thus functions as a critical enabling condition for the long-term sustainability of NRWSS under community management.

❖ **Human Capital**

Human capital has been a decisive factor in sustaining NRWSS over the past eighteen years. It encompasses leadership continuity, staff competence, organizational discipline, and ability to manage crises effectively. The synergy between human capital and social, financial, and physical capital has been central to the long-term sustainability of NRWSS.

❖ **Champion leadership**

NRWSS has benefited from stable and committed leadership since the rehabilitation phase. The Executive Secretary, who was involved in planning and implementation during rehabilitation, continues to hold office and provides continuity, institutional memory, and strategic direction. Leadership is not individualized alone but embedded within collective structures, including a General Body of 65 members and a 13-member SLEC. The President of the Grama Panchayat serves as an ex-officio member of the SLEC, strengthening coordination with local government. This combination of continuity and collective leadership has enabled innovation, incremental improvement, and adaptive decision-making, contributing significantly to scheme sustainability.

❖ **Skilled staff for operations, maintenance, and accounting**

NRWSS employs a team of 23 staff responsible for technical operations, maintenance, customer service, and financial management. Although formal educational qualifications are modest, staff possess strong practical skills developed through experience and on-the-job training. Skill sets include operation of pumps,

water treatment plant, plumbing, meter reading and repair, accounting, water quality testing, and computer operations. Most staff members are from within the scheme area. Women constitute approximately 40% of the workforce, reflecting a conscious effort to maintain gender balance.

- **Staff welfare, discipline, and work culture**

NWSS has fostered a disciplined and motivated workforce through a combination of welfare measures and rule enforcement. Staff welfare provisions include provident fund contribution, festival allowances, maternity benefits, medical support for work-related injuries, travel reimbursements, mobile communication support, and compensatory leave. At the same time, NWSS enforces discipline through clearly defined procedures. Instances of misconduct or negligence are addressed through written memos, penalties, suspensions, or dismissal where necessary. This dual emphasis on welfare and accountability has contributed to high work morale and operational reliability.

- **Advisory support and external expertise:**

NWSS has constituted a six-member Advisory Committee comprising sectoral experts who provide technical, managerial, and strategic guidance. The committee functions as a knowledge resource, supporting decision-making and problem-solving during both routine operations and exceptional situations.

- **Capacity building and sectoral outreach**

NWSS has played an active role in sectoral capacity building beyond its immediate service area. It has provided exposure and training support to medium and large rural water supply schemes in Kerala and other states. Representatives from 168 Grama Panchayats have visited NRWSS. Since 2022, the Indian Institute of Management Kozhikode has organized annual exposure visits to NRWSS for international participants of its Management Development Programs. These engagements position NRWSS as a learning site for community-managed water supply.

- **Crisis management and organizational resilience**

NRWSS has faced multiple crises during its post-commissioning phase, including financial pressures, political resistance to tariff revisions, institutional conflicts, and infrastructure-related disputes. Across these episodes, NWSS demonstrated the capacity to negotiate with political actors, mobilize community support, engage

government agencies, and pursue formal remedies when necessary. The ability to absorb shocks, maintain service continuity, and resolve conflicts underscores the organizational resilience embedded in its human capital.

### ❖ Sustainability score for human capital

The sustainability score for human capital is presented in Table 9. NRWSS achieved the maximum score of 10 out of 10, reflecting strong performance across leadership, staff capacity, welfare and discipline, advisory support, capacity building, and crisis management.

**Table 9: Sustainability score of Human Capital**

| Sustainability of Human Capital under NRWSS | Source of data | Total Score | Score awarded | Rationale for score/ Remarks |
|---|---|---|---|---|
| Champion Leadership for Water CBO | FGD with staff and SLEC | 2 | 2 | Stable and champion leadership is available for NWSS |
| Skilled staff for O&M and Accounting | MIS on staff | 2 | 2 | Number of skilled and experienced staff |
| Staff welfare and discipline/ Gender balance in the staff | MIS/ FGD with staff | 2 | 2 | Staff welfare measures include: Provident Fund/Hospital expenses for accidents /maternity benefits/ Travel expenses/Mobile phone recharge/compensatory leave etc. |
| Advisory Committee | MIS/ Minutes of Meeting | 2 | 2 | Multi-disciplinary expertise of an Advisory Committee is available. |
| Capacity building support to other GPs and SLECs | List of exposure visits | 1 | 1 | Number of exposure visits from within Kerala and outside |
| Crisis Management | | 1 | 1 | Number of major crises resolved by NWSS. |
| Total | | 10 | 10 | |

Human capital in NRWSS is characterized by leadership continuity, professionalized operations, institutional discipline, and adaptive capacity. Rather than relying on volunteerism alone, NWSS has evolved into a professionally managed community institution capable of sustaining complex water services over time. This human capital base has been instrumental in translating physical

infrastructure and financial resources into reliable, equitable, and resilient service delivery.

- **Jal Jeevan Mission, Nenmeni Grama Panchayat, and NWSS**

The Jal Jeevan Mission (JJM), a flagship program of the Government of India launched in 2019, aims to provide every rural household with a Functional Household Tap Connection (FHTC). KWA is the designated implementing agency for JJM in Kerala. Core features of JJM include a household-focused approach, time-bound implementation (2019–2024-2028), community participation through collaboration with Grama Panchayats and VWSCs, integrated water resource management, geo-tagging of assets, emphasis on water quality, and a strong pro-women orientation.

Despite these stated principles, JJM implementation in Kerala has largely followed a technocratic and infrastructure-intensive pathway, emphasizing large-scale hydraulic paradigm approach with limited operational roles for community institutions and Grama Panchayats. Against this backdrop, the experience of Nenmeni Grama Panchayat represents a notable departure. On 10 June 2021, Nenmeni GP resolved (Resolution No. 146/2021) to entrust the operation and maintenance of JJM-supported HSCs to NWSS. Under this arrangement, 1,753 FHTCs were sanctioned and financed under JJM, while water supply was provided through the existing NRWSS infrastructure and managed by NWSS. This decision reflected institutional confidence in the capacity and performance of the community-based organization and strengthened the overall sustainability of NRWSS.

Importantly, this model was not replicated elsewhere in Kerala. In several Grama Panchayats already covered under the Jalanidhi project, KWA implemented parallel JJM distribution networks, resulting in duplication of infrastructure and institutional arrangements. Rather than building upon existing functional community-managed schemes, JJM investments in these contexts tended towards large capital-intensive systems.

Based on information obtained through a Right to Information (RTI) query, a proposed multi-Grama Panchayat JJM scheme covering Ambalavayal, Nenmeni, Poothadi, and Pulpalli is estimated to cost ₹425.60 crores. Using Census 2011 household data (38,112 households), the per-household investment cost under this

scheme is approximately ₹111,671. Notably, three of these Grama Panchayats—Nenmeni, Poothadi, and Pulpalli—were already served by community-managed schemes under Jalanidhi. From an economic perspective, this approach reflects the continued dominance of the hydraulic paradigm in rural water planning.

The Nenmeni case thus illustrates an alternative pathway, where JJM resources were used to complement existing infrastructure and institutions rather than replace them. The Grama Panchayat's decision to integrate JJM investments with NRWSS demonstrates how locally embedded governance arrangements can enhance efficiency, avoid duplication, and reinforce long-term sustainability. This contrast highlights the need for greater policy flexibility within national Programs to recognize and build upon functioning community-managed systems.

## Discussion and Conclusions: Explaining Sustainability in a Community-Managed Rural Water Scheme

The sustainability of NRWSS is best understood as the outcome of convergent and mutually reinforcing interactions among the five capitals of the Asset Pentagon. Rather than being driven by a single factor, sustainability emerged through a sequential and cumulative process in which improvements in one form of capital strengthened others.

During the planning and rehabilitation phase, a structural community platform for mobilization and participation was established, and the scheme inherited a perennial water source (natural capital) and a rehabilitated primary infrastructure system (physical capital). While these "hardware" components were largely created through external project support under Jalanidhi, the long-term sustainability of NRWSS has depended primarily on how the community institution—NWSS—developed the "software" capitals during the post-commissioning phase.

Following handover in 2007, NWSS progressively strengthened financial, social, and human capital. Improvements in service quality—enabled by better operations, water treatment, and distribution management—attracted increasing numbers of households to adopt household service connections. This expansion enlarged the revenue base, reinforced cost recovery, and stabilized finance capital. In turn, predictable revenues enabled professional staffing, system maintenance, and

institutional consolidation. These feedback loops illustrate how sustainability in NRWSS is not static but dynamic and path-dependent.

Table 10 summarizes the cumulative sustainability performance of NRWSS, which achieved an overall score of 94.81 out of 100, indicating strong performance across all five capitals.

Table 10- Cumulative distribution of sustainability score

| Sustainability Capitals | Score awarded | Total Score |
|---|---|---|
| Natural Capital | 20.00 | 20 |
| Physical Capital | 25.84 | 30 |
| Finance Capital | 24.00 | 25 |
| Social Capital | 15.00 | 15 |
| Human Capital | 10.00 | 10 |
| Total | 94.81 | 100 |

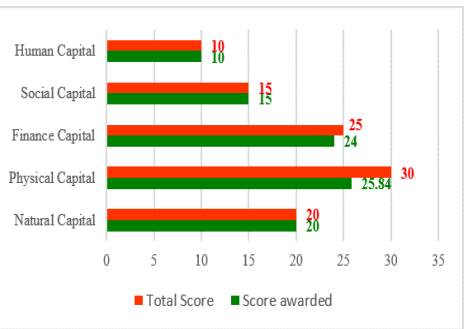


Figure 3: Bar Diagram on overall sustainability of NRWSS

**Sequencing of sustainability capitals:** The NRWSS case highlights an important sequencing effect in rural water sustainability. External agencies and governments are well positioned to create natural and physical capital through investment and technical expertise. However, the sustainability of rural water services ultimately depends on the capacity of post-commissioning institutions—whether utilities or community-based organizations—to develop financial, social, and human capital.

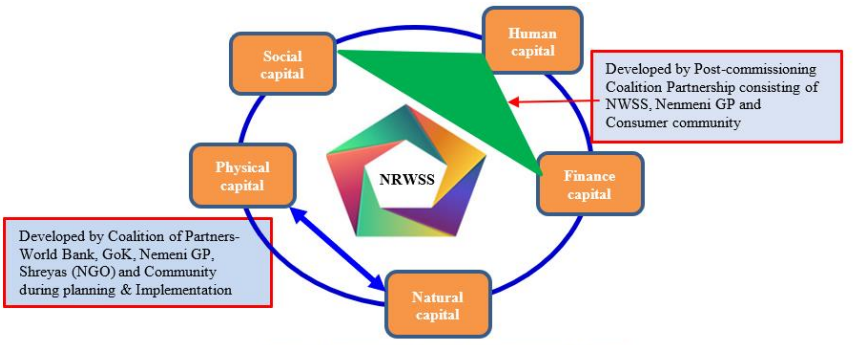


Figure 4 Sustainability Capitals and Development Coalition

In NRWSS, NWSS assumed responsibility for this transition. It institutionalized tariff payment behavior, professionalized operations, maintained participatory governance, and invested in staff capacity. Information systems and monitoring tools were used not merely for administration but as knowledge instruments to guide decision-making and sustain performance. This finding reinforces the argument that sustainability requires more than voluntarism; it requires institutionalized professionalism within community management.

Earlier critiques of community participation have argued that marginalized groups are often excluded from benefits. While acknowledging the importance of active citizenship in mobilizing communities, the NRWSS case challenges the claim that community-managed schemes systematically exclude the poor. In Nenmeni, 62% of HSCs belong to the BPL category and 13.5% to SC/ST communities, reflecting deliberate inclusive design through differential connection charges, tariff subsidies, and retention of public stand posts. NRWSS thus demonstrates that equity and sustainability can be mutually reinforcing, rather than competing objectives.

**Sustainability as lived experience**

The sustainability of NRWSS is also reflected in its impact on everyday life, particularly for women. Household water connections reduced the time and physical burden of water collection, enabling women to engage more consistently in paid work and household responsibilities. Testimonies from women consumers illustrate how reliable domestic water supply contributed to livelihood security, dignity, and resilience. These experiences underline that sustainability should be assessed not only through technical or financial indicators, but also through social outcomes and lived realities.

**Integrating the Asset Pentagon**

Figure 8 (referenced earlier) illustrates how NRWSS achieved sustainability through two interlinked phases. The first phase produced natural and physical capital through a broader development coalition involving the donor, state agencies, the Grama Panchayat, the support organization, and the community. The second phase relied on a narrower but more intensive coalition—NWSS, the Grama Panchayat, and consumers—to develop financial, social, and human capital.

As the scheme transitioned from collective mobilization to routine service delivery, social capital naturally shifted in form. NWSS had to carefully consolidate trust, legitimacy, and rule enforcement while managing the transformation of "active partner-community" into "consumer community". The evidence shows that NWSS successfully navigated this transition by strengthening governance systems, grievance redressal, leadership continuity, and crisis management capacity.

**Policy implications**

The NRWSS case carries important policy implications for Kerala's rural water sector. First, it demonstrates that professionalized community management is feasible and effective in the Kerala context. Second, it suggests that large, techno-finance–heavy multi-Grama Panchayat schemes may be poorly suited to Kerala's dispersed settlement patterns and varied physiography. Small and medium community-managed schemes are often more adaptable, efficient, and socially embedded.

Rather than relying on 'spasmodic' and episodic reform projects, the Government of Kerala could adopt a sector-wide approach to rural water services, recognizing community-based organizations and Grama Panchayats as co-producers of public services. In such a framework, the state utility could focus on urban systems and provide technical backstopping to rural schemes, while community institutions manage day-to-day operations. The Nenmeni experience illustrates how national Programs can be aligned with existing local institutions to avoid duplication, enhance efficiency, and strengthen sustainability.

**Concluding remarks**

Sustainability in NRWSS did not arise automatically from infrastructure investment or community participation alone. It was achieved through the deliberate integration of natural, physical, financial, social, and human capital over time, anchored in strong local institutions and professionalized community management. As rural water sectors across India and beyond grapple with post-construction sustainability, the NRWSS case offers transferable insights into how community-managed systems can mature into reliable, equitable, and resilient service providers.

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**Annexure-1**

## 1 Indicative sustainability scoring framework

Annexure-1 presents an indicative scoring framework developed specifically for this longitudinal case study to operationalize sustainability assessment using the Asset Pentagon Framework. The framework is not intended as a universal index, but as an internally consistent analytical aid to examine how different forms of capital evolved over time within a single community-managed scheme. The weights, thresholds, and indicators reflect contextual priorities, data availability, and practitioner experience, and are used here to support interpretation rather than to claim objective measurement or cross-scheme comparability. The scoring system was developed iteratively, drawing on: (1) long-term engagement with the scheme; (2) availability and reliability of administrative and field data, and (3) practitioner experience in rural water supply management. Weights, thresholds, and indicators therefore reflect contextual priorities and are used as an analytical aid to examine the evolution of sustainability over time.

## 2 Allocation of weights across sustainability capitals

| Domain of Assessment | Weightage | Indicators/ Sub-domains and proposed score |
|---|---|---|
| 1) Natural Capital | 20 | Focus: Source sustainability and water quality management.<br>1. Source Sustainability- (10): Continuity of pumping over time, measured as the proportion of operational days without disruption due to source inadequacy.<br>2. Water quality management (10)<br>**2.1** Regularity of water quality testing (2)<br>**2.2** Quality of treated water during monsoon (2)<br>**2.3** Quality of treated water during summer (2)<br>**2.4** Frequency of testing (daily/weekly to annual) (2)<br>**2.5** Existence of an in-house, recognized water quality testing facility (2) |
| **Data sources:** Logbooks, water quality test reports, direct observation. | | |
| 2) Physical Capital | 30 | **2.1** Functionality of water infrastructure (9)<br>**1.** Infiltration gallery<br>**2.** Jackwell<br>**3.** Pumps and pump house<br>**4.** Pumping main (Rising Main)<br>**5.** Water treatment plant<br>**6.** Storage tank/ Reservoirs<br>**7.** Distribution network<br>**8.** Metered household service connections<br>**9.** Public stand posts<br>Each component is assessed as *functional (1)* or *non-functional (0)*. |

| | | |
|---|---|---|
| | | **2.2** Asset Enhancement since commissioning (7)<br><br>Indicators capture post-commissioning investment and expansion:<br>1. Distribution network length<br>2. Pump capacity and Number<br>3. Storage capacity and Number<br>4. Land holdings- Area by Cent<br>5. Vehicles- Type and Number<br>6. Buildings- Area by Sq. Feet<br>7. Additional schemes taken over for O&M<br><br>Scores are calculated as percentage increase since commissioning, capped at the maximum score for each indicator.<br><br>**2.3** Operational Management (14)<br><br>**1.** Rate of pumping disruption due to electrical, mechanical and civil disruptions (2)<br><br>**2.** Frequency of supply (2)<br><br>**3.** Regularity of supply (2)<br><br>**4.** Adequacy of supply (LPCD) (2)<br><br>**5.** Consumer satisfaction (2)<br><br>**6.** Equity management through DMAs/zoning (2)<br><br>**7.** Rate of increase in household service connections (2)<br><br>**Data sources:** MIS, logbooks, consumer surveys. |
| 3. Finance Capital | 25 | Focus: Cost recovery, affordability, transparency, and resilience.<br>1. Tariff structure (2)<br>2. Tariff history (2)<br>3. Affordability of tariff (2)<br>4. Billing and Collection System (2)<br>5. Cost Recovery in O&M (6)<br>6. Connection Policy-New HSCs (2)<br>7. Accounting & Auditing (1)<br>8. Procurement during O&M (1)<br>9. Post-construction capex grants (4)<br>10. Consumer payment behaviour (1)<br>11. Loans and Liabilities (1)<br>12. Savings and Deposits (1) |

| | | |
|---|---|---|
| 4. Social Capital | 15 | Focus: Governance quality, legitimacy, participation, and responsiveness.<br>1. Participatory platforms (SLGB, SLEC, zonal structures) (2)<br>2. rule of law and legal compliance (2)<br>3. Vibrancy of the water CBO (meeting regularity) (2)<br>4. Effectiveness (growth in service coverage) (1)<br>5. Efficiency (unit cost of inclusion) (1)<br>6. Accountability (financial and activity reporting) (1)<br>7. Transparency (MIS, website, communication systems) (1)<br>8. Grievance Redressal Mechanism (1)<br>9. Inclusion of marginalized groups (1)<br>10. MIS and monitoring systems (1)<br>13. Socially useful activities and Innovations (1)<br>14. Dispute resolution capacity (1) |
| 5. Human Capital | 10 | Focus: Leadership, professional capacity, and organizational resilience.<br>1. Champion Leadership (2)<br>2. Availability of Skilled staff (2)<br>3. Staff welfare, discipline and Gender balance (2)<br>4. Advisory Committee and expert support (2)<br>5. Crisis Management capacity (1)<br>6. Capacity-building support to other schemes (1) |
| Total | 100 | |

**Acronyms used in this document**

| No | Acronym | Elaboration |
|---|---|---|
| 1 | AC | Asbestos Cement |
| 2 | APL | Above Poverty Line |
| 3 | ARWSP | Accelerated Rural Water and Sanitation Program |
| 4 | BG | Beneficiary Group |
| 5 | BMBC | Bituminous Macadam and Bituminous Concrete |
| 6 | BPL | Below Poverty Line |
| 7 | CBO | Community Based Organization |
| 8 | CSR | Corporate Social Responsibility |
| 9 | DANIDA | Danish International Development Agency |
| 10 | DMA | District Metering Area |
| 11 | DRA | Demand Responsive Approach |
| 12 | FGD | Focus Group Discussion |
| 13 | FHTC | Functional Household Tap Connection |
| 14 | GLSR | Ground Level Storage Reservoir |
| 15 | GP | Grama Panchayat (Village Panchayat) |
| 16 | GRM | Grievance Redressal Mechanism |
| 17 | HSC | House Service Connections |
| 18 | IBT | Incremental Block tariff |
| 19 | JJM | Jal Jeevan Mission |
| 20 | KIIFB | Kerala Infrastructure Investment Fund Board |
| 21 | KKSN | Karunya Kudumba Sahaya Nidhi |
| 22 | kL | Kilolitre |
| 23 | KSRRDA | Kerala State Rural Road Development Agency |
| 24 | KRWSA | Kerala Rural Water Supply and Sanitation Agency |
| 25 | KSEB | Kerala State Electricity Board |
| 26 | KWA | Kerala Water Authority |
| 27 | LPCD | Litres Per Capita Per Day |

| | | |
|---|---|---|
| 28 | LSGD | Local Self-Government Department |
| 29 | MDGs | Millennium Development Goals |
| 30 | MIS | Management Information System |
| 31 | MLD | Million Liters Per Day |
| 32 | MSC- | Most Significant Change |
| 33 | NRDWP | National Rural Drinking Water Program |
| 34 | NRW | Non-Revenue Water |
| 35 | NRWSS | Nenmeni Rural Water Supply Scheme |
| 36 | NWSS | Nenmeni Water Supply Scheme |
| 37 | O&M | Operations and Maintenance |
| 38 | OHT | Over Head Tank |
| 39 | PLANET | Participatory Learning and Action Network Kerala |
| 40 | PMGSY | Pradhan Mantri Gram Sadak Yojana |
| 41 | PRI | Panchayat Raj Institution |
| 42 | PSP | Public Stand Posts |
| 43 | RWSS | Rural Water Supply Scheme |
| 44 | SC | Scheduled Caste |
| 45 | SDGs | Sustainable Development Goals |
| 46 | SEE | Sustainability Evaluation Exercise |
| 47 | SEU | Socio-Economic Units |
| 48 | SLEC | Scheme Level Executive Committee |
| 49 | SLGB | Scheme Level General Body |
| 50 | SO | Support Organization |
| 51 | SRA | Societies Registration Act |
| 52 | SRP | Sector Reforms Project |
| 53 | ST | Scheduled Tribe |
| 54 | STM | Scheme Transfer Memorandum |
| 55 | UPI | Unified Payment Interface |
| 56 | VWSC | Village Water and Sanitation Committee |

| | | |
|---|---|---|
| 57 | WCED | World Commission on Environment and Development |
| 58 | WTP | Water Treatment Plant |

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