



# REPORT OF CONSTRUCTION OF MODEL BIO TOILET COMPLEX FOR THE CONSERVATION OF FRESH WATER HABITAT & THREATENED SPECIES

Conducted as part of:

PROTECTION OF FRESH WATER ECOSYSTEMS FOR THE CONSERVATION OF  
THREATENED SPECIES IN MUNNAR, WESTERN GHATS, INDIA.

Project Code: 2023A-41



Funded by:

INTERNATIONAL UNION FOR CONSERVATION OF NATURE (IUCN)  
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FONDATION SEGRÉ

Conducted by:

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## REPORT OF CONSTRUCTION OF MODEL BIO TOILET COMPLEX FOR THE CONSERVATION OF FRESH WATER HABITAT & THREATENED SPECIES

Implemented as part of the project: Protection of Fresh water Ecosystems for the  
Conservation of Threatened Species in Munnar, Western Ghats, India.

Project Code: 2023A-41

Funded by : International Union for Conservation of Nature (IUCN)  
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Implemented by : Tropical Institute of Ecological Sciences (TIES)

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All figures are correct as on 31st December 2024 unless otherwise stated.

Disclaimer: The findings and conclusions presented are generalized insights derived from the collective responses of the community members who participated in the survey. The information is used solely for the purpose of understanding and improving community conditions and should not be construed as reflecting the views or conditions of any specific individual or group.



## 1. Introduction

The freshwater ecosystem of Munnar consists of valleys and reservoirs formed by the tributaries of the Periyar, Muthirapuzha, and Pooyamkutty rivers. The region has two major watersheds: Periyar and Muvattupuzha, with 448 and 320 micro-watersheds, respectively. The TAs are divided into three zones based on human influence: agricultural areas, tourism zones, and forest areas, including revenue lands.

Freshwater ecosystems in Munnar are heavily exploited by humans, putting pressure on species diversity and populations. Major threats include deforestation, river regulation, development, pollution, agricultural and tourism activities, over-harvesting, invasive species, and climate change.

Munnar faces significant conservation challenges in protecting its freshwater biodiversity and habitats, particularly in tourism, agricultural, and forest zones. A lack of knowledge among stakeholders impedes conservation efforts. An in-depth assessment and ongoing monitoring are essential for developing a strategic, participatory conservation action plan.

The current initiative mainly focuses on safeguarding Munnar's unique freshwater ecosystems, housing threatened species like *Indosticta deccanensis* (Saffron Redtail Damselfly), *Protosticta sanguinostigma* (Red Spot Redtail Damselfly), *Chlorogomphus xanthoptera* (Anamalai Mountain Hawk Dragonfly), *Garra hughii* (Cardamom Garra Fish), and *Indoreonectes keralensis* (Kerala Loach). The Conservation

Action Fund, backed by Fondation Segré, supports critical conservation initiatives worldwide.

## 2. Background

The freshwater resources of Munnar are highly polluted mainly due to sewage, septage, and solid wastes. The water quality test done for more than 100 samples collected from 42 locations in Munnar showed extremely high level of pollution especially of coliforms indicating septage pollution. Almost 67% of tested samples including drinking water resources showed high level of faecal contamination. A model bio-toilet mini-complex is proposed as part of the project, aiming to create awareness among the stakeholders on the importance of proper hygiene, sanitation, and waste disposal. The toilet is now an informal education centre on fresh water conservation, too.

KDHP is the major landholder in Munnar and the major tourist inflow is at KDHP properties. Hence, we approached KDHP to construct the proposed model toilet at Mattupetty, on the property of KDHP.

The model toilet is based on a unique technology called bio-digestion, and known as a bio-toilet. The septic tank is modified as a bio-septic tank, which allows for three times faster digestion. Hence, it is good for public use. Low-cost, locally made, proven sensory taps will be used. Thus, repairs and maintenance are very easy and cost-effective.



### 3. The story of implementation of the Project

Toilet construction activities were adjusted after a thorough study of the condition and need for public toilets during a survey on sanitation, hygiene, and waste management. The survey revealed that the most urgent need was in Munnar town, where both tourists and locals struggle to find clean, suitable toilet facilities. Based on this, various discussions and approaches were initiated with the Munnar and Devikulam Gram Panchayats, as well as Kannan Devan Hills Plantations Pvt Ltd.

#### 3.1 Internal Meeting on Discussing Design

Dr. Bindu B.K., Head of Environmental Engineering at TIES, presented a proposal along with an estimated cost for the construction of the toilet complex. To discuss the plans, an online meeting was held on March 16, attended by Dr. Punnen Kurien, Dr. Abraham Samuel K., Dr. Nelson P. Abraham, Dr. Bindu B.K., Mr. Sarath Babu, Ms. Anoop Mathews, Mr. Nihal Hussain T.P., Mr. Praful V. Panicker, Mr. Bechu Punnen Abraham, and Ms. Neethu Nair M.N. The discussions focused on the feasibility of the proposal and the identification of an optimal location for its implementation.

#### 3.2 Approach with Munnar and Devikulam Grama Panchayath

On April 9, 2024, Dr. Punnen Kurien V, Secretary of TIES, chaired meetings with the secretaries and presidents of the Devikulam and Munnar Gram Panchayats to discuss the allocation of a site for a model toilet complex. Project officers and assistants presented a comprehensive proposal detailing the project's scope and objectives. The proposal was well-received, sparking further discussions on the site allocation, which will be put forward for approval at an upcoming Panchayat meeting. This collaborative effort aims to enhance community facilities and address sanitation needs in the region.

##### 3.2.1 Finding Land

Munnar Grama Panchayath enthusiastically proposed the construction of a toilet complex near the parking ground at Old Munnar Junction, which is under their jurisdiction. To move forward with this initiative, project officers held several meetings with Mrs. Deepa Rajkumar, President of Munnar Grama

Panchayath, and Mr. Abhilash K., Junior Superintendent, to thoroughly evaluate the project's feasibility.

##### 3.2.2. Internal Meeting and with Authorities

A key meeting took place on May 15th at the Munnar Grama Panchayath headquarters, chaired by Mrs. Deepa Rajkumar, and attended by project officers Mr. Nihal Hussain and Mr. Praful V. Panicker. During this session, they identified an ideal site within the town limits, covering 4 cents of land, for the proposed toilet complex. After a detailed site analysis, the meeting concluded with plans to present this site decision at the upcoming Panchayat assembly for formal approval.

##### 3.2.3. Site Inspection

On June 8, 2024, Dr. Bindu B.K., an expert from TIES and the Head of Environmental Engineering, conducted a comprehensive inspection of the proposed site for the toilet complex in Old Munnar. She was accompanied by Dr. Punnen Kurien, Mr. Sarath Babu, Mr. Praful V. Panicker, and Ms. Neethu Nair M.N. The inspection concluded that the site holds good potential, though some structural adjustments will be necessary to fully align with the location's requirements.

##### 3.2.4. Land Survey

A digital survey of the proposed site for the toilet complex in Old Munnar was carried out on June 27, 2024. The survey was supervised by Mr. Shaankumar P.K. of Space Builders and Consultants, Adimali. As part of the survey process, a report, location sketch, and survey sketch were prepared. A licensed consultant surveyor conducted the survey of the 4.5-cent land, identifying its boundaries. A digital map was created, and the survey number was obtained from the Kannan Devan Village Office in Munnar. Mr. Praful V. Panicker coordinated the arrangements for the digital survey.

##### 3.2.5. Toilet Sanctioning

During the meeting on June 19, 2024, at Munnar Grama Panchayath, a decision was made to approve the construction of the toilet complex in Old Munnar. Following this, Mrs. Deepa Rajkumar, President of Munnar Grama Panchayath, handed over the sanction letter, signed by Junior Superintendent Mr. Abhilash K., to Dr. Punnen Kurian, Secretary of TIES.

### 3.2.6. Withdrawing the Plan

After conducting detailed surveys and studies of the proposed site, it was determined that there were several issues preventing its use for the toilet complex. The site is subject to a construction ban because of CRZ (Coastal Regulation Zone) Violation due to impact from the Great Flood of Munnar in 1924. Additionally, the land is owned by KDHP Pvt Ltd, which has leased it to Munnar GP for managing parking congestion. The site is also located along the banks of the Muthirapuzha River, and with ongoing extension activities by NHAI in Old Munnar, it was deemed unsuitable for the proposed toilet complex. Given these constraints, the TIES IUCN Project decided to withdraw the plan for this site and is now seeking a new, more suitable location within Munnar.

### 3.3. Meeting with KDHP Pvt. Ltd.

In response to the urgent need for a bio-toilet complex in Munnar, a meeting was held with Kannan Devan Hills Plantation Pvt Ltd on 25 July 2024, as they own most of the land in the area and have a well-established administrative structure. The meeting was attended by Mr. Mohan C. Varghese, Vice President, Tea Manufacture, KDHP, along with Dr. Shaju Thomas, Head of the Division of Environmental Education and Conservation at TIES, Dr. Punnen Kurien (Secretary), Sarath Babu (NEO), Mr. Ajay (KDHP) and Mr. Nihal Hussain (Project Team Lead).

During the meeting, Mr. Mohan highlighted the challenges associated with constructing the toilet

complex at the originally proposed site. He then suggested an alternative location on KDHP land near Chayabazar on Mattupetty Road, Tea Museum or Mattupetty Tea Factory. The meeting concluded on a positive note, with a verbal agreement reached on the new location. We are now awaiting formal permission to proceed with the construction at the newly proposed site.

#### 3.3.1. Site Inspection

Site inspection for potential toilet complex was analysed at KDHP Tea Museum, Nallathanni on 10 august 2024 by Mr. Nihal Hussain and Mr. Bechu Punnen Abraham from TIES. Site was studied and measurements were taken. Site was allocated near to the ticket counter area, an existing parking ground. But, The KDHP suggested their immediate need of a toilet complex at Mattupetty Tea Factory, which is most crucial than this, plans changed to visit that site and discuss.

On 20 august 2024, Mr. Praful V. Panicker and Mr. Bechu Punnen Abraham from TIES along with Mr. Johnson Paul Raj (Surveyor, KDHP) and Mr. Joseph Alex (Manager, Mattupetty Tea Factory) inspected the site. Measurements were taken and an estimate plan was executed with further discussion with them.

meeting was executed on 09 september 2024 for discussing the works to be started and developing terms and conditions to form an agreement between TIES and KDHP in the combined effort of toilet construction.



Figure 1. Model Bio toilet complex at KDHP Tea Factory Campus, Mattupetty

#### Advantages of Bio Toilet

- Accelerate digestion/degradation process by 10 times, compared to a normal septic tank.
- Decomposition happens in 3-4 days as compared to normal septic tank which takes approximately 40 days
- No methanogens in the consortium hence less greenhouse gases.
- Wide range of ambient operating temperature.
- 95% organic sludge degradation within 72 hours of retention
- Reduced contamination in discharge water
- No requirement for scavenging/emptying under normal operating condition.
- Scalable and sustainable.
- Provision for water reuse.
- Sturdy and rigid tank design
- A maintenance-friendly design that permits easy inspection chambers compared to the normal septic tank.
- 100% virgin material to ensure long life & recyclability, thereby ensuring reduced impact to the environment.





Figure 2. Location map of the biotoilet

### 3.3.2. MoA and Agreement between TIES and KDHP

As efforts progressed, a Memorandum of Agreement (MOA) was signed between TIES and KDHP to ensure the smooth execution, management, and sharing of responsibilities for the model toilet complex. Construction timelines were also established. The agreement was finalized and signed by the authorities from both parties on September 18, 2024, marking the formal commencement of construction discussions.

On September 25, both parties conducted a joint inspection of the proposed site at Mattupetty and provided their feedback.

### 3.3.3. Quotations and Construction Contract

Quotations were invited for the construction of

the toilet complex at the Mattupetty Tea Factory to assess estimates and plan execution. After carefully reviewing the submitted quotations, the contract for the construction was awarded to Mr. Sunil K. Diwakaran. The entire construction project was entrusted to his company, with a commitment to complete the work within the timeframe outlined in the agreement.

### 3.3.4. Stone Laying Ceremony

On October 8, 2024, the construction of the toilet complex officially began. The inauguration ceremony was led by Mr. Mohan Varghese, Vice President of Tea Manufacture at KDHP. The event was attended by Mr. Raju Warriar, Head of Engineering at KDHP, Mr. Joseph Alex, Factory Manager, Dr. Punnen Kurien, Secretary of TIES, Mr. Nihal Hussain, Project Team Lead, and Mr. Sunil K. Diwakaran, the contractor.

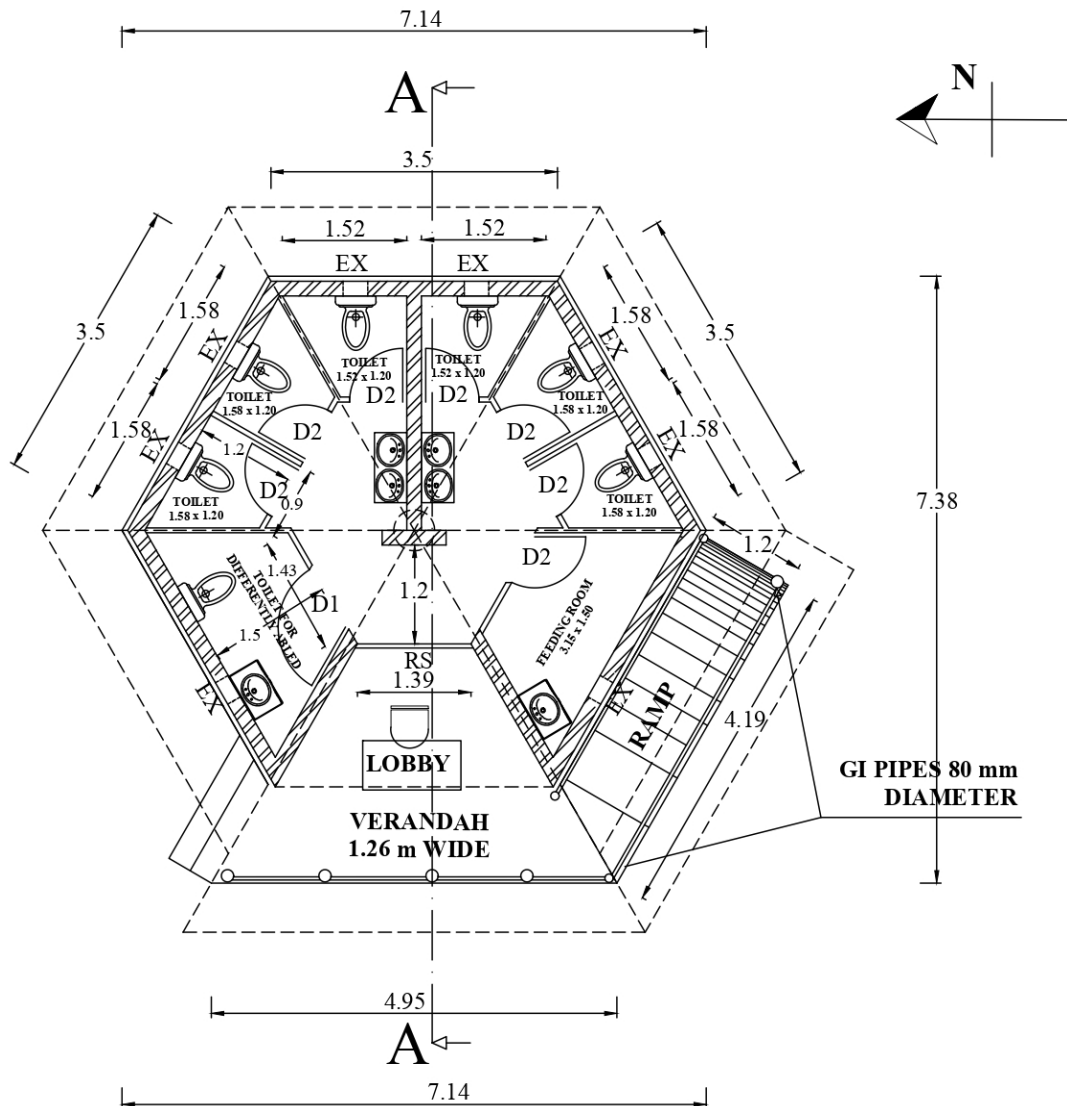


Figure 3. Stone laying ceremony by Mr. Mohan Varghese, Vice President of Tea Manufacture at KDHP



Figure 4. Mr. Raju Warriar, Head of the Engineering Division at KDHP; Mr. Joseph Alex, Manager of the Madupetty Tea Factory; Dr. Punnen Kurian, Secretary of TIES, attending the stone laying ceremony

## 4. Plan and Construction of the Toilet



Plinth area of Proposed Bio toilet complex = 38.21 Sq.m.

Total area of Proposed Bio toilet with  
buffer zone of 1 m all around = 66.63 Sq.m.

### **PROPOSED MODEL BIOTOILET MINI COMPLEX PLAN**

ALL DIMENSIONS ARE IN m  
SCALE : 1:100

Figure 5. Layout of the bio-toilet

## 4.1. Construction

Construction officially began on October 8 with the laying of the foundation stone. This was followed by masonry work, framework construction, interior work, and other tasks that are scheduled to be completed in the coming days.

### 4.1.1. Stone Foundation Works

Work commenced on October 8, with laborers and a supervisor, along with project staff from the TIES IUCN Project, overseeing and monitoring the progress. Weather conditions contributed to a slower pace of work. By October 17, 2024, the following tasks were completed: foundation setting, excavation, stone laying, dressed rubble masonry, RCC belt construction, and soil earth filling.

### 4.1.2. Roofing and Frameworks

Work continued immediately after the foundation concrete had been set for one week. Framework construction began on October 29, 2024. By November 6, 2024, the installation of pillars, aluminum roofing sheets, and railings was completed.

### 4.1.3. Masonry

Masonry work with bricks began on November 6, 2024, and was completed by November 12, 2024. Fly ash blocks were used for constructing the outer structure. During this period, steps and a handi-cap-accessible slope were also built.

### 4.1.4. Ceiling, Plumbing and Electrical Works

Work on the ceiling began on November 15, 2024, and was completed by November 20, 2024. During this phase, channels for plumbing and electrical installations were also created.

### 4.1.5. Tile Paving

Due to the non-cooperative attitude of the current

contractor, who exceeded the proposed budget and was involved in other issues and scams, the contractor was removed from the project. In the meantime, an independent quotation was called for the paving tiles. On November 23 and 24, 2024, Mr. Shaiju and Mr. Joby, along with the TIES IUCN staff, visited the toilet complex to measure the floor and estimate the costs.

After careful evaluation, the tile work contract was awarded to Mr. Shaiju. Work commenced on November 28, 2024, and 1,024 sq ft of tile work, including both floor and wall tiles, was successfully completed within the budget by December 2, 2024.

On November 29, 2024, authorities from TIES Kottayam, along with KDHP officials, visited the site to review the progress and identified a location for the installation of the bio-septic tank.

### 4.1.6. Remaining Plumbing, Electrical, Partition Works

Following the change in contractor, a new contractor, Mr. Annaraj, was appointed to carry out the remaining plumbing, electrical, painting, septic tank installation, and partition work for the toilet complex.

The plumbing, painting, and electrical works were completed between December 12 and December 20, 2024.

### 4.1.7. Installation of Bio Septic Tank

The bio-septic tank for the TIES Model Bio Toilet at Mattupetty Tea Factory was transported to Munnar and installed following excavation work behind the proposed toilet complex. The installation of the bio-septic tank was completed on December 20, 2024. Special training will be provided to the toilet handlers to ensure proper maintenance and efficient operation of the bio-toilet.





Figure 6. Ground work preparation and removal of debris



Figure 7. Foundation work progressing





Figure 8. Foundation work completed



Figure 9. Truss work progressing





Figure 10. Truss work completed



Figure 11. Side wall construction





Figure 12. Toilet structural work completed



Figure 13. Plumbing work completed

#### 4.1.8. Installation of Partition boards in Toilet

Partition boards were installed to separate the toilets, feeding room, and the toilet for disabled access. Work on the partitions began on December 20, 2024, and was completed by December 22, 2024. Separate doors were also placed to ensure privacy for each section.



Figure 14. Installation of partition boards began

#### 4.1.9. Installing Information Boards

As the toilet complex is being constructed under the TIES IUCN Project for the conservation of threatened species in Munnar and the protection of freshwater ecosystems, an agreement was made to display informative materials about the project. These materials will educate visitors to the factory on how the bio-toilet works and the project's goals. The information was displayed on the outer walls of the toilet.

On December 19, 2024, Mr. Jijomon, TIES Graphic Editor, along with Dr. Punnen Kurian, visited the site to determine the locations for the information boards. The posters were then successfully placed on the walls on December 23, 2024.



Figure 16. Installation of information boards



## 4.2. Inauguration of TIES- KDHP Model Community Bio Toilet

On December 23, 2024, the final works on the Model Community Bio-Toilet at the KDHP Tea Factory campus in Mattupetty, Munnar, were closely monitored by the TIES team, along with contractor Mr. Annaraj. Together, they ensured that all necessary actions were taken to complete the project.

At 3 PM in the afternoon, the inauguration event was held. The program was officially launched by Mr. Raju Warriar, Chief Engineer of the Engineering Department at KDHP, in the presence of Mr. Joseph

Alex, Manager of the KDHP Mattupetty Tea Factory. Dr. Shaju Thomas, Head of the Division of Environmental Education, Conservation & Natural Resource Management at TIES, delivered a felicitation address, while Dr. Nelson P. Abraham, Vice-President of TIES, extended the vote of thanks.

Dr. Punnen Kurian, the Project Lead, provided a comprehensive briefing on the project, highlighting its interventions and anticipated outcomes. The event was meticulously coordinated by Sarath Babu N B, Nihal Hussain TP, Praful V Panicker, and Bechu Punnen Abraham, all of whom are part of the TIES team.



Figure 17. The event was attended by Mr. Joseph Alex, Manager of KDHP Mattupetty Tea Factory; Dr. Punnen Kurian, Project Lead; Dr. Shaju Thomas, Head of the Division of Environmental Education, Conservation & Natural Resource Management, IES & Nelson P. Abraham, Vice-President, TIES.



Figure 18. Bio-toilet inauguration by Mr. Raju Warriar, Chief Engineer, Engineering Department, KDHP



## 5. Sustainability Report on the Construction of Toilet Complex

### 5.1. Introduction

This report highlights the sustainable practices adopted in the construction of a 1200 sq. ft. one-storied toilet complex in the tea factory area of Madupetty, equipped with a bio-septic mechanism. The project aims to provide a hygienic and eco-friendly sanitation solution for the community while minimizing environmental impact. The project aligns with the United Nations Sustainable Development Goals (SDGs), emphasizing sustainable development through innovation and inclusivity.

### 5.2. Project Overview

- Location: Tea Factory Area, Mattupetty
- Built-Up Area: 1200 sq. ft.
- Purpose: Sanitation facility for the community
- Completion Date: [Insert date]

### 5.3 Alignment with SDG Goals

The project directly contributes to the following SDG goals and sub-goals:

- **Goal 6: Clean Water and Sanitation**
  - Sub-goal 6.2: Achieve access to adequate and equitable sanitation for all.
  - Sub-goal 6.3: Improve water quality by reducing pollution and promoting safe reuse.
  - Sub-goal 6.b: support and strengthen the participation of local communities in improving water and sanitation management.
- **Goal 11: Sustainable Cities and Communities**
  - Sub-goal 11.6: Reduce environmental impact through sustainable infrastructure. (for review)
  - Sub-goal 11.7: providing universal access to safe, inclusive and accessible, green and public spaces in particular for women and children, older persons and person with disabilities (for review)

- **Goal 12: Responsible Consumption and Production**

- Sub-goal 12.2: achieve sustainable management and efficient use of natural resources
- Sub-goal 12.5: Substantially reduce waste generation through recycling and reuse.
- Sub-goal 12.6: Encourage companies, especially large and transnational companies, to adopt sustainable practices and to integrate sustainability information into their reporting cycle

- **Goal 13: Climate Action**

- Sub-goal 13.1: Strengthen resilience to climate-related hazards through sustainable practices.
- Sub-goal 13.3: Improve education, awareness-raising and human and institutional capacity on climate change mitigation, adaptation, impact reduction and early warning.

### 5.4. Sustainability Goals

- Reduce water consumption and ensure waste treatment through eco-friendly mechanisms.
- Utilize sustainable materials to lower the carbon footprint.
- Ensure energy efficiency during construction and operation.
- Promote community awareness of environmental conservation and sustainable practices.

### 5.5. Sustainable Practices in Design and Construction

#### 5.5.1. Site Selection and Preparation

- The site was selected to minimize disruption to the local ecosystem.
- No parts of the Western Ghats were destroyed during the construction of the toilet complex.

### 5.5.2. Materials Used

- Bricks: Fly ash bricks were used, reducing waste and energy consumption (recycled product).
- Foundation: Rocks were reused without reducing structural strength.
- Floor and Walls: Tiles were used instead of granite or marble to lower environmental impact.
- Paints: Non-toxic, VOC-free paints were used to ensure indoor air quality.
- Recycled plastics: Recycled plastic bins were utilized for waste disposal. Awareness boards were installed to encourage proper disposal of waste, including sanitary napkins, in the waste bin instead of in the toilet and flushing them.

### 5.5.3 Bio-Septic Mechanism - Bio Digester Septic Tank (Model 4 Ultra Series III - 75 Flushes)

- Dimensions:
  - Height: 1245 mm
  - Length: 2230 mm
  - Width: 1105 mm
- Technology:
  - The Bio Digester Septic Tank uses advanced bio-septic technology that doubles the efficiency of septage cleaning, supporting up to 75 flushes per day.
- Water Recycling:
  - Clean, treated water from the septic process is directed to a soak pit, ensuring safe disposal and promoting groundwater recharge.
- Odor Control:
  - The system operates without odor, maintaining a hygienic and comfortable environment for users.
- Eco-Friendly Bacterial Inoculum:
  - The septic action is enhanced by a high-quality, eco-friendly bacterial inoculum.
  - Bacteria convert waste into gas and water, neutralizing odors and improving waste breakdown.
  - Protects the septic tank by preventing clogging and ensuring optimal system performance.

- Inoculum Usage Interval:
  - Initial Application: 100g of the inoculum is applied continuously for 5 days.
  - Ongoing Maintenance: After the initial 5-day period, 100g of inoculum should be applied once a month to maintain system efficiency and protect the septic tank.
- Additional Benefits:
  - Revives and restores failing or under-performing septic systems.
  - Organic, safe, and easy to use for long-term maintenance.
  - Protects the environment by preventing illegal scavenging and promoting sustainable waste management.
  - Reduces costs associated with septic tank repairs and frequent emptying.

This combination of advanced technology and biological treatment provides an efficient, cost-effective, and environmentally friendly solution for septic tank management.

### 5.5.4. Energy Efficiency

- Lighting: LED lighting fixtures were used for energy conservation.
- Natural Ventilation: Optimized to reduce reliance on mechanical systems.

### 5.5.5. Water Management

- Low-Water Fixtures: Strategically installed faucets and pipes minimize water usage.
- Awareness Boards: Installed throughout the facility to educate users on water conservation and sustainability.

## 5.6. Construction Waste Management

- Segregation: Construction waste was segregated on-site for recycling and disposal.
- Recycling: Materials such as scrap metal and wood were reused where possible.
- Disposal: Non-recyclable waste was disposed of in compliance with local regulations.

### 5.7. Post-Construction Initiatives

- Maintenance Plan: Cleaning and maintenance staff were employed with cleaning protocol to ensure the facility's functionality and hygiene.
- Community Training: Local community members were educated on the use and benefits of the facility.
- Awareness Boards: Information on freshwater ecosystems, water usage, and threatened species in Munnar was displayed.

### 5.8. Environmental and Social Benefits

- Reduction in Open Defecation: Improved hygiene and sanitation standards in the community.
- Water Conservation: Efficient use and recycling of water resources.
- Energy Savings: LED lighting reduces operational energy costs.
- Employment Opportunities: Job creation for cleaning and maintenance staff.

### 5.9. Challenges and Mitigations

- Challenge: Initial resistance to bio-septic technology.
  - Mitigation: Conducted comprehensive awareness programs for local communities and stakeholders, emphasizing the environmental, cost-saving, and long-term benefits of bio-septic systems. Hands-on demonstrations and case studies were shared to build confidence in the technology.
- Challenge: Sourcing sustainable materials locally.
  - Mitigation: Established strong partnerships with local vendors and suppliers to ensure the availability of eco-friendly materials while supporting the local economy. In addition, we explored regional supply chains to minimize environmental impact and cost.
- Challenge: High altitude, cold climate, and unavailability of frequent public transport to the area, creating logistical and construc-

tion challenges.

- Mitigation: Collaborated with KDHP (Kannan Devan Hill Plantations) to provide accommodation facilities for workers near the construction site. This helped reduce the impact of transportation issues, ensured worker availability, and improved overall productivity in the harsh climate.
- Challenge: Breach of contract by the initial contractor hired for constructing the toilet complex.
  - Mitigation: Promptly identified and onboarded alternative contractors to avoid major delays. By maintaining flexibility and working closely with the new contractors, we minimized time delays and ensured that the project stayed on track.
- Challenge: High transportation costs for construction materials due to remote location.
  - Mitigation: Developed a strategic plan to optimize material delivery, including bulk orders and careful scheduling of transport, to minimize trips and reduce transportation costs. In some cases, local sourcing was explored to further reduce logistical expenses.
- Challenge: Large distance between the Munnar office and the construction site, making daily and weekly monitoring by the project staff difficult.
  - Mitigation: Implemented additional measures such as extra working hours for project staff, along with remote monitoring tools and frequent virtual meetings. This allowed for continuous oversight and immediate intervention when necessary.
- Challenge: Harsh weather conditions and limited construction windows due to seasonal changes.
  - Mitigation: Careful planning of construction phases to align with favorable weather periods. Seasonal adjustments were made to prioritize critical tasks during optimal weather conditions, ensuring mini-



- mal delays during the rainy season.
- Challenge: Difficulty in maintaining a consistent workforce due to high turnover in remote areas.
  - Mitigation: Improved worker engagement and retention by providing incentives, offering

skill-building workshops, and ensuring proper accommodations and safety measures on-site. This helped to maintain a motivated and consistent workforce throughout the project.

## 5.10. Conclusion



Figure 19. Visitors reading the information boards.

The construction of this toilet complex demonstrates a commitment to sustainable development by integrating eco-friendly materials, energy-efficient technologies, and waste management systems. By aligning with the SDG framework, it not only provides a functional infrastructure but also addresses broader global challenges such as sanitation access, climate resilience, and resource conservation. The project serves as a model for future infrastructure projects aiming to balance functionality with environmental stewardship.



Figure 20. Bio-toilet at KDHP Tea Factory Campus, Madupetty, Munnar, Idukki

Report of construction of model bio toilet complex for the conservation of fresh water habitat & threatened species.

Conducted as part of  
**Protection of fresh water ecosystems for the conservation of threatened species in munnar, western ghats, india.**  
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