



# INNOVATIVE TOILET CONCEPTS FOR URBAN INDIA



WATER



SANITATION



HYGIENE

# IH UWASH

Innovation Hub for Urban Water, Sanitation & Hygiene Solutions in India

Supported by USAID

AUGUST 2018

Innovative Toilet Concepts For Urban India  
National Institute of Urban Affairs (IHUWASH Project), 2018

Supported by USAID  
USAID's Urban WASH Alliance Partnership Program  
AID-386-F-16-00010

Year of Publishing  
2018

GRAPHIC DESIGN  
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Photo Credits  
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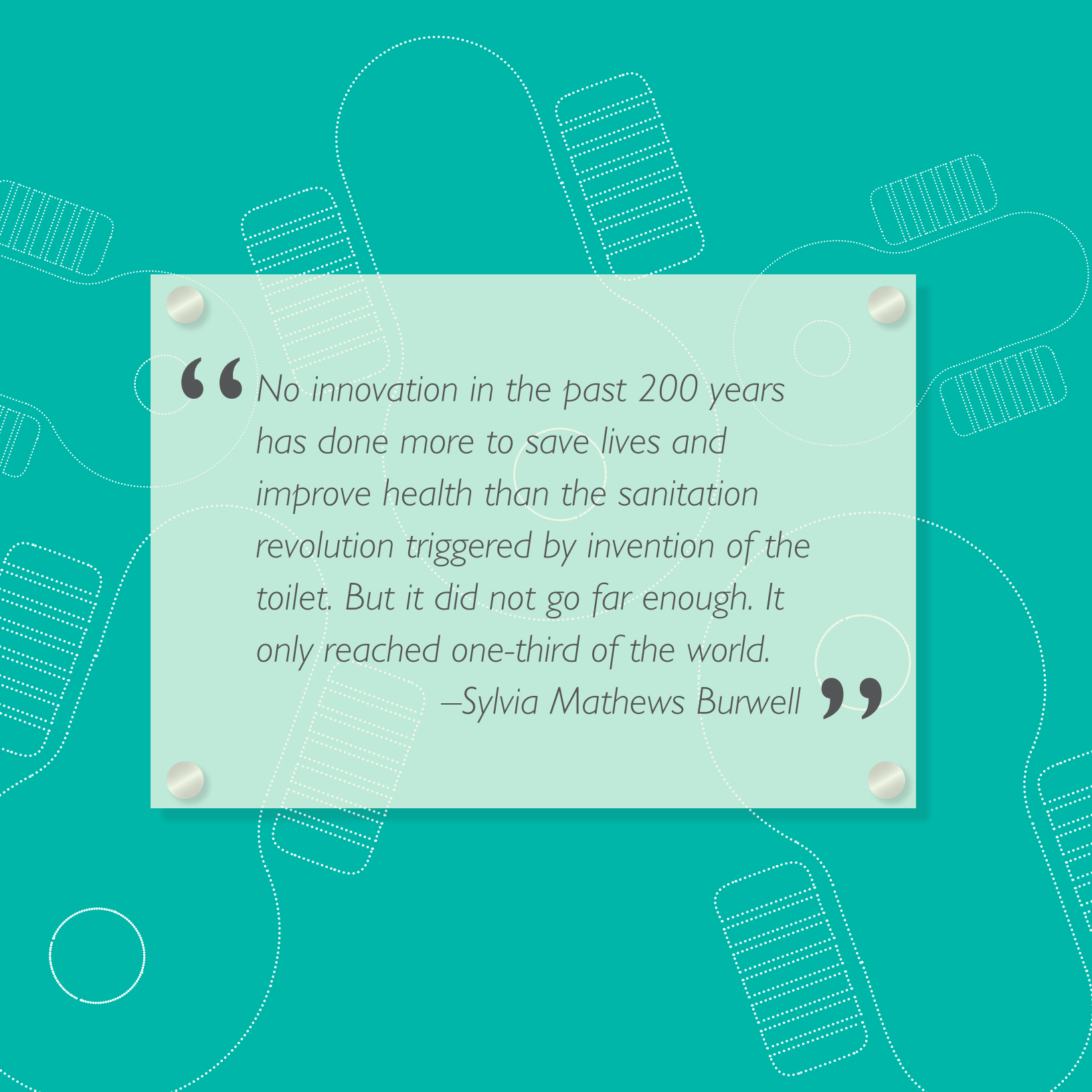


**SANITATION**

# IHUWASH

Innovation Hub for Urban Water, Sanitation & Hygiene Solutions in India

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*“ No innovation in the past 200 years has done more to save lives and improve health than the sanitation revolution triggered by invention of the toilet. But it did not go far enough. It only reached one-third of the world. —Sylvia Mathews Burwell ”*



## **FOREWORD**

The goal of the IHUWASH project is to improve the performance of the urban WASH sector in the country through agglomeration, incubation and acceleration of innovations to address WASH issues. The first stage of the process, agglomeration refers to the compilation of existing key and promising innovations in the WASH sector. The case studies documented in this booklet can be grouped into three broad categories - public toilets, community toilets and individual household toilets. These case studies were selected based on the following criteria: addressing sanitation solutions in urban India, particularly focusing on the needs of women, children and differently-abled and low-income communities, sustainability in terms of life cycle costs and business model and finally, delivery of quality services at an affordable cost.

It is hoped that the document will not only serve to sensitize important stakeholders in the IHUWASH pilot cities - Faridabad, Mysore and Udaipur, but also encourage other practitioners to improve sanitation conditions in their respective locations. The document is also an effort to encourage adoption and adaptation of similar innovations by WASH stakeholders, thus creating an ecosystem for a simplified and sustainable approach to sanitation in our cities.

## PREFACE

Safe Sanitation is an important parameter for the clean environment as well as in securing public health and hygiene. It also plays a pivotal role in the economic development of society. The goal of the Innovation Hub for Urban Water, Sanitation and Hygiene Solutions (IHUWASH) supported by United States Agency for International Development (USAID) is to improve the urban WASH sector performance through incubation and acceleration of innovative solutions, technologies, programs and service delivery models within a collaborative framework.

Access to essential, basic facilities such as toilet for everyone is a minimum requirement for safe sanitation. To eliminate open defecation by the year 2019, under the national flagship programme – Swachh Bharat Mission (SBM-Urban) launched by the Government of India construction of individual, community, and public toilets in urban areas have made a remarkable progress. In the process of achieving the overarching goal of SBM, various innovative concepts have evolved and emerged to augment access to toilets. There have been innovations in terms of technologies, behavior changes, waste disposal, treatment, etc. Gender sensitivity, user-friendly design for the differently abled, implementation models with a public-private partnership, Corporate Social Responsibility (CSR) etc. were also rigorously experimented in past few years for public and community toilets.

The document “Innovative toilet concepts for urban India” prepared under the IHUWASH project aims to highlight the latest efforts of individuals and organizations across the country in providing access to safe sanitation services with clean toilet facilities and achieve the SBM Goal. The case studies documented in this booklet have been grouped into the broad categories - public toilets (in markets, tourist places) community toilets, toilet in schools, and individual household toilets. The case studies presented in the booklet highlights how innovations in toilet design have evolved in the past decade and how each of them is different from the conventional toilet.

The selection of the examples is based on innovative solution proposed in designs, operation, and maintenance model, ensuring health and hygiene in services, and sustainability in terms of O&M. The narratives also mention the challenges in implementing the solutions. The unique features of these facilities are provided with financial details, so that based on requirements and available resources the documented models can be replicated by other cities in the country. The business model looks into the life-cycle cost, delivery of quality services at an affordable cost has also been considered. The information presented in the documented case studies is collated primarily from the respective project proponents, from secondary sources, and by visiting some of these facilities.

At the end of the document, an inclusive Sanitation facility design proposed in one of the IHUWASH pilot city of Mysuru is presented. The document is an effort to encourage other cities across India to adopt similar innovations. It is envisaged that the document will provide a guide to urban local bodies and other practitioners for adopting the suitable features & solutions and will contribute in achieving the goals of Swachh Bharat Mission.

## ACKNOWLEDGEMENT

The booklet 'Innovative toilet concepts for urban India' prepared under the Innovation Hub for Urban Water, Sanitation and Hygiene Solutions (IHUWASH) would not have been possible without the support from the United States Agency for International Aid (USAID), I sincerely thank USAID for supporting the IHUWASH project. I extend my special thanks to Mr. Anand Rudra, Agreement Officer Representative, USAID for IHUWASH project, who stimulated critical discussions on this document as well as various components of the project from time to time.

Compiling the case studies in this booklet would not have been possible without the generous support of those individuals and organizations who shared the required information. I sincerely extend my high regards to the following individuals who represent Academia, Government Organizations, Institutions, Companies, Industries, and Civil Society Organizations for their cordial responses during the compilation of this document.

Ms. Berna Mary Ignatius, Project Co-ordinator- Research, Water, Sanitation and Hygiene (WASH) Institute; Dr.Y. Malini Reddy, Associate Professor, Urban Governance Area, Administrative Staff College of India (ASCI); Ms. Bincy Baby, Director & CGM Eram Scientific; Mr. Mouli, Head, Mysore Zoo, Confederation of Indian Industry (CII); Mr. M. Elangovan, Executive Director, Gramalaya; Ms. Padmapriya T. S, Chief Executive - India, Sanitation First; Mr. Rajeev Gaur, Assistant Secretary - Technical, and Ms. Shilpi Madnawat, Consultant, Delhi Urban Arts Commission (DUAC); Mr. Ramineni Krishnamohan, Managing Director, Urbane Industries Limited; Mr. Sanjay Banka, Banka Bio Loos; Er.T.R. Meena, SE(R-I), NDMC, Mr. G.S. Rawat, Managing Director, Supreme International Private Ltd.; and Prof. Sudhakar M. Rao, Indian Institute of Science, Bangalore.

The IHUWASH team at NIUA and in the respective project cities (Faridabad, Udaipur & Mysuru) constantly works to upscale the existing innovations in the WASH sector through research, and consultation with various organizations in the project cities. Their support in compiling, editing and finalizing this document is noteworthy. Last but not the least, efforts of the dedicated design team at NIUA in giving the presentable outlook to this document deserves special mention.

Prof. Jagan Shah  
Director, NIUA



## TIMELINE OF INNOVATIVE SANITATION FACILITIES

**2009**

GROSAN TOILET

**A**

**2010**

CHILD FRIENDLY TOILET

**B**

E-TOILET

**C**

**2012**

SHE TOILET

**D**

NAMMA TOILET

**E**

BIOLOOS

**F**

**2014**

SMART PUBLIC TOILETS (DUAC)

**G**

PERMEABLE REACTIVE BARRIER TOILETS (PRB TOILETS)

**H**

**2015**

NIRMALA SAULABHYA

**I**

SMART TOILET (NDMC)

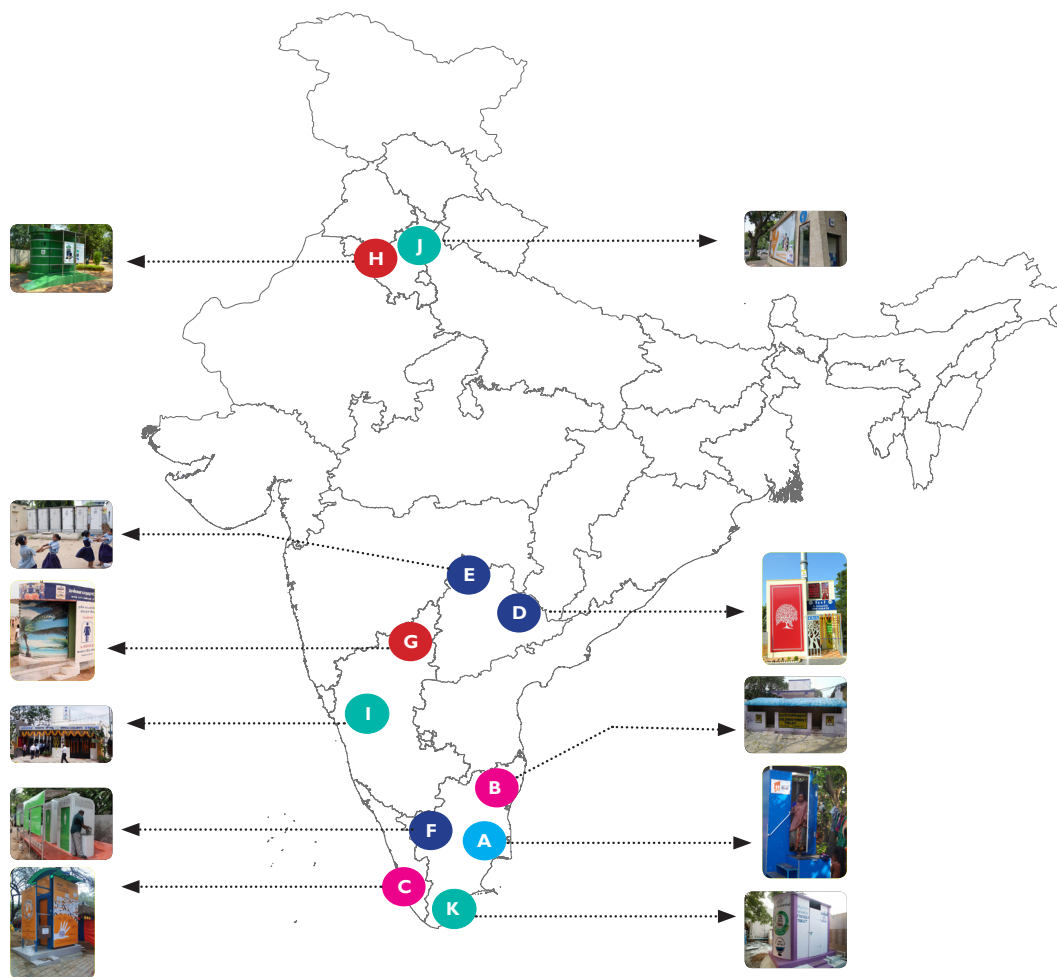
**J**

SUNIDHI TOILET

**K**

*The timeline mentioned is only indicative in nature*

# INNOVATIVE SANITATION FACILITIES



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# GROSAN TOILET

*Environment-Friendly Toilet with Closed Resource Loop*

## Background

The most essential prerequisite to escape poverty is good health and the single greatest contributor to this is good sanitation and clean water. Very often slum areas do not have the space or the infrastructure for constructing permanent toilets while many times water availability is a challenge to use the toilet. With this challenge in mind, Sanitation First, a UK and India based non-profit organization, has developed a container-based system suitable for use in India, which they call a "GroSan Toilet" has an interface based around that of a urine diverting dry toilet (UDDT).

The upgraded design of GroSan toilet is developed by leading WASH specialist Dr. Paramasivan with support from Sanitation First. These toilet designs are considerate to community needs, especially slums to address the challenges of water availability, space constraints and most importantly to tackle waste management and eradicate manual scavenging. the container-based model that addresses the above challenges.

The design of GroSan is modified keeping user convenience in consideration. The urine-diverting dry toilet (UDDT) is designed with a unique feature that liquid and solid waste are separated and collected in different containers.

All toilets are fabricated in-house by the team from Sanitation First. Three to four toilet units can be fabricated in a week's time. The team is involved in constant research and development to improve quality and value addition in the toilets. Recently, hinge-mounted tickers to monitor usage of the toilets on an ongoing basis has been included.



*GroSan Toilets are Safe for Use by Women and Girls*

## Innovation Geography

Originally in 2009, the GroSan toilet was built using stainless steel sheets and basins. This, however, wasn't durable against environmental corrosion in the coastal areas in Cuddalore, Tamil Nadu and had to be replaced.

In 2012, individual toilets were built using Fiberglass, Sintex panels, thin polyethylene sheets, corrugated steel



### Changing Containers in a GroSan Toilet

sheets and Aluminium sheets for the superstructure with steel tubes as the frames and doors. This was further improved in 2014, to the current model using 'Aluminium Composite Panels' for the toilets and ceramic squat plates for the basin. Over the years, the changes were brought about not just based on team observation, but also ongoing feedback and survey with the users by the community organizers. Till date over 5000 GroSan toilets have been built across slum communities, schools and individual households across Tamil Nadu.

## The Innovation

The Gro San Toilet is a low-tech model comprising a semi-permanent and movable four-container system UDDT. It has evolved from the static, twin chamber EcoSan toilet model that has been used extensively by people and organisations all over the world.

It is based on the urine-diverting composting technology to produce a container-based sanitation system (CBS) that can meet the specific needs of the ever-expanding urban slum communities of India and is capable of operating within the challenging environmental conditions presented by slum habitats. This container-based sanitation system's design has been developed keeping in view the requirements of the Prohibition of Manual Scavenging Act, 2013.


## Key Features

- ✓ Compact size, able to be placed in slum areas where space availability is a constraint.
- ✓ Safe Collection service within space restricted slums where vehicular access is not possible
- ✓ Self-contained toilet model with little or no sewerage infrastructure needed
- ✓ Very little water is needed for usage and maintenance
- ✓ Easy and cost effective to clean and maintain
- ✓ Easy for the communities to understand and use
- ✓ Free to users
- ✓ Each toilet caters to about ten families – around 40-45 users per day

The GroSan toilet is made up of Aluminium Composite Panels. This ensures the toilet does not disintegrate easily while being exposed to the elements of nature in coastal and cyclone prone areas. The squat plate is urine diverting and is made of ceramic for ease of use and maintenance. Four containers are placed on rollers beneath the toilet. The user covers the fecal matter with ash, sawdust or soil after use. This cover material is available within the toilet unit so that user can cleanse at the spot. The urine and wash water are collected in separate collection tanks below the toilet which are collected separately for further treatment and reuse. The solid waste is that is collected in the container is mixed with organic matter by each user that enhances the natural decomposition of fecal matter. Each container is filled in a 7-day cycle, which is then covered using specially design lid and handling tools to avert human contact. The four containers in the system are used in rotation and each filled container is removed after the cycle of 21 days. During the 21 day cycle, the fecal matter is safe to handle and is converted to compost. After this, the container is transported to a yard where waste is kept for 150 days to further convert into market-based agricultural compost.

GroSan toilets are constructed and maintained by Sanitation First through support from donors and are





free for the communities to use. Toilets have steps or ramps depending on the space available within the area of installation and can be used by all members of the community comfortably. The toilets also provide a safe avenue for women and girls to practice menstrual hygiene.

The location or slums where the toilets are to be placed are decided through consultation with the local administrative body. Once the location is finalized, a baseline study is conducted to understand the socio-economic, health and behavioral aspects of the people in that slum. The individual location of each toilet within the slum and the families who would be accessing were decided by the community members through a participatory process. Once the locations and the sites have been finalized, the community education and mobilization exercise are initiated. This continues until such time the toilets are fabricated and installed. Post installation, the community is trained for adopting the new toilet system and using it optimally. Initial doubts, hesitations, and errors in usage are corrected by the community organizers through ongoing training. The toilets are run and managed by Sanitation First and the urban local bodies sanitation team inspects the facilities from time to time.

### Cost and Business Model

The cost of each GroSan toilet is around INR 83,000. This includes the cost of material, labor, and associated consumables. Each toilet caters to about 40 users, and the cost per user works out to roughly INR 2,000 per month. The operation and maintenance cost is about INR 150 per

person per toilet per month. The toilets are free for the communities to use, as Sanitation First works with the poorest of the poor communities. The staff who maintain the toilets and transport the containers and process them are all paid for by Sanitation First through donor funding.

### Challenges

GroSan is an upgraded version of Ecosan toilets which includes container-based systems (CBS). Adopting CBS toilets can be challenging in a way to shift people's acceptability from a flush toilet to dry toilet in the urban settlement. The toilet is designed to collect liquid and solid waste separately which is later collected and converted into a compost. Upscaling this model in an urban settlement seems challenging from the perspective of logistic requirements- transport and land required from its treatment. This model needs to be integrated with a city-wide sanitation value chain where compost produced is utilized within the sanitation chain.

### Key Highlight

This project has achieved significant impact and results. Going forward it would be interesting to see Sanitation First is considering expanding its scope of operation into other urban locations. Hybrid technologies that are more cost efficient as far as operations are concerned are also being explored. Presently the organization is providing innovative technology as well as covers service part of operations. Some innovative self-sustaining operation models need to be explored with the focus on closing the sanitation chain at the neighborhood /household scale.

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**References:** <https://youtu.be/f-Hgs7dJkpc> (video)

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“

*You will never solve poverty  
without solving water and sanitation.*

*— Matt Damon*”

# CHILD-FRIENDLY TOILETS

## *Integrating & Inclusive Designs*

### **Background**

Children as a group are the most vulnerable to health hazards associated with poor hygiene and inadequate sanitation system.. Shri. S.Damodaran, Founder of the NGO, Gramalaya, was moved by the sight of children defecating in the open drains and at the rear side of the community toilets in the slums of Tiruchirapalli, decided to design and construct children friendly toilets (CFT). He conceptualized a project for eight selected slums in Tiruchirapalli Corporation covering 1133 families in 1996. The project was supported by WaterAid, United Kingdom.

A baseline survey revealed that these communities had been practicing open defecation. The children in the targeted slums had to defecate in open drains in front of their houses. In addition, the slums lacked drinking water and sanitation facilities and basic amenities. The absence of good personal hygiene such as hand-washing using soap or cleaning agents, after defecation, were the other major problems. After discussion with the local self-help group, the need of constructing separate toilets for children came up. It was also decided that children could use these facilities without any user fee.



Child Friendly Toilet at Kalmandai Slum near to Gandhi Market, Trichirappalli

The first CFT was constructed in 2000. Since then, Gramalaya has adopted 186 urban slums in Tiruchirapalli City Corporation in Tamil Nadu. Further, Gramalaya was also entrusted to build 61 pay and use toilets in the same Municipal Corporation. Additionally, the organisation has implemented several innovative models across five States in South India. The organisation was instrumental in announcing India's first village – Thandavampatti and India's first slum – Kalmandhai, open defecation free and helped 47 villages and 100 slums to achieve the ODF tag so far.

The eight community toilets in Tiruchirapalli have separate toilets for men and women. In addition to that, there is an additional block called Child-Friendly Toilet (CFT). These included smaller size toilets to accommodate child-friendly needs. To make it more attractive, stories through pictures and cartoons of plants and animals are depicted through wall paintings. Provision for cleaning and hand washing facilities are made in such a way that accompanying person with children has no problems. The toilet cubicles have piped water facilities in 'press and use' mode to ensure judicious use of water. 8" PVC pipes are cut it into semi-circles and used as pans. These were connected through a pipeline and finally with the underground drainage. Through trial and error, Mr. Damodaran further developed the design to match with a high slope water closet and small footrest with Poly Propylene (PP), Poly Vinyl Chloride (PVC), concrete slabs and floor tiles and cuddappa



- ✓ Child friendly design that ensures easy and safe usage for children
- ✓ Attractive and colourful design to promote toilet use among children
- ✓ Water efficient fixtures installed
- ✓ Integrated bio gas plant produces cooking gas for community kitchen
- ✓ Unique design of the toilet pan to suit the need of a child

slabs for cubicle separation. Each unit has taken about a one-week time to complete.

The community toilets were initially connected to septic tanks. Later, provisions were made to connect them with a biogas plant to produce cooking gas. For this, vegetable waste and food waste generated by the slums residents and nearby market areas were added to the sludge. The gas thus generated was connected to the community kitchen with 15 gas stoves. The community toilets were annexed with an incinerator to dispose of used sanitary napkins.

Along with the construction of such toilets, massive awareness campaigns were also carried out through school health programmes so that children were encouraged to use toilets and maintaining good personal hygiene. Resource materials such as pamphlets, posters, flashcards, booklets, and training manuals for community health workers were also developed.





Children Friendly Toilet Model at Urban Slum with Community Toilet at Karuvattupettai slum

Gramalaya also helped form self-help groups (SHG) in these slums. The maintenance of toilets was handed over to the community. Before taking up the responsibility of maintenance of community toilets, Gramalaya had formed “Women’s Action for Village Empowerment (WAVE) Federation” which is the apex governing body to steer and has control over the SHGs, which would maintain community toilets.

### Cost and Cost and Business Model

The cost of construction of one community toilet along with a child-friendly toilet is about INR 2.50 lakh. On an average, the Operation cost works out to be around INR 800/ to INR 1000 per Community Toilets block per month.

The design is flexible and can be customized according to the space available. Community toilets were built and maintained by women self-help groups as pay and use system through a daily token system or a monthly pass system. Children, elderly, and physically challenged are exempted from paying the user fee. This was done through intensive participatory stakeholder engagement approaches. The caretaker is paid INR 80/- for every 8 hours.

### Challenges

During the initial stages, it was a challenging task to change the mindset of the community. This was primarily due to the lack of awareness and knowledge about the benefits of using toilet facilities.

### Key Highlights

The SHG teams comprising of Sanitation and Hygiene Education (SHE teams) or WAVE federation have been proactive and have taken up the operation and maintenance of the 350 the community toilet blocks in Tiruchirappalli. This initiative has been instrumental in Tiruchirappalli becoming India’s first city with open defecation free slum practices. In 2015, the Ministry of Drinking Water and Sanitation, Government of India appointed Gramalaya as the National Key Resource Centres for providing WASH (Water, Sanitation and Hygiene) training and capacity building to senior government officials and NGOs in Andhra Pradesh, Karnataka, Telangana and Tamil Nadu. Due to this initiative, Gramalaya has won many accolades including India Today Safaigiri Awards 2017 - Toilet Titan Award.



Safai Giri Award from Vice President of India, 2017

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# E-TOILETS

*Auto-flushing, Clean, & Hygienic Smart Public Toilet*

## Background

Provision of cost-effective and hygienic public toilets has always remained prime concerned in growing urban areas. Conventional public toilets require land which is costly in cities. Most of the time they aren't well maintained. Effective cleaning of the toilet was always concerned and new generation toilet was required which is clean, hygienic, and user-friendly. The electronic toilet or 'E-toilet' was developed through a participatory planning method, research by Thiruvananthapuram, Kerala, based Eram Scientific Solutions (ESS), a Private Limited Company. ESS started working on the E-toilet toilet prototype in 2009 and were able to successfully develop one by 2010. By 2011, the product was market-ready.

ESS has won the country's maiden Swachhathon 1.0, the first-ever Swachh Bharat Hackathon, organized by the Ministry of Drinking Water and Sanitation to crowd-source solutions to some of the sanitation and hygiene problems in various parts of the country. It also won the Toilet Titan award in 2015 during the Safaigiri Summit & Awards, instituted by the India Today Group in the light of the Swachh Bharat Abhiyan. E-toilet was commemorated in the "Reinvent the Toilet Challenge" awards by the Bill & Melinda Gates Foundation (B&MGF).

The design has already been scaled up in twenty-three states across India including fifteen smart cities with over three thousand E-toilets.


## The Innovation

E-toilet by ESS works on the principle of automated user-friendly interfaces. It is a modular, pre-fabricated public toilet prepared out of stainless steel material which



Toilet unit at Surajkund Fair, Faridabad

ensures safety against vandalism, enhancing durability and ensures cleanliness and hygiene for every user. Coin operated, automated, E-toilets can be remotely monitored with the facility to track its operation status via the internet. These toilets incorporate a full-cycle approach for sustainable sanitation by integrating electrical, mechanical, web and mobile technologies and thus derives its name as "E-Toilet".



The area requirement of the E-toilet varies from 25-35 sqm which addresses the major challenge of space availability in urban centers public places. Thus, the solution offered by ESS has been widely adopted due to its compact size and quick installation.

The innovation that catches attention in “E-toilet” is its self-cleaning mechanism that requires minimum maintenance. The toilet gets flushed automatically before and after every use and its floor is automatically washed after every 10 usages. To conserve water, the toilets have been set up to flush water as per the duration of usage, (i.e. 1.5 liters of water after three minutes of usage and 4.5 liters of water for more than three minutes usage). In addition, it is supported by location-specific maintenance through cleaning and technical personnel at regular intervals to ensure proper cleaning and functioning of the unit round the clock. The E-toilets are connected using a GPRS network called Connected e-Toilet Infrastructure (CeTI). Users can also access the e-Toilet map through [www.eramscientific.com](http://www.eramscientific.com) and can view the locations of E-toilets on a mobile phone., through an app has been developed to locate the nearest e-toilets.

In one of the project with Biotechnology Industry Research Assistance Council (BIRAC), wastewater is also recycled and is used for flushing whereas the sludge is converted to fertilizer.

e-Toilet offers comprehensive solutions for sewage treatment. It can be connected to Biodigester (DRDO technology), which is an anaerobic treatment system. Alternatively, e-Toilet can be connected to the existing sewer line or septic tank. Eram Scientific is an authorized licensee and Transfer of Technology (ToT) Holder of the Defence Research and Development Organization’s (DRDO) Bio-digester technology.

Another model of e-toilets is called “She-toilets” which has features such as Sanitary Napkin Incinerator, Sanitary Napkin Vending Machine. Child-friendly toilets for usage in schools are also available.

### Key Features

- ✓ Takes care of Space constraint in urban areas
- ✓ Auto-flushing technology after each usage
- ✓ Coin-operated, ensuring user charges collection
- ✓ Easily locatable with bright LED light
- ✓ Remotely monitored via the internet

E-toilets are available in 3 variants – Stainless Steel model, Mild Steel model and Civic model. Stainless Steel & Mild Steel models can be customized exclusively for women users by integrating sanitary napkin vending machine and napkin incinerator. Civic models are a scaled-down version of the public model. While it features almost similar functionalities of the public model, some functions such as GPRS connectivity, coin validator etc. are excluded. e-Lite I 4 is the new model launched exclusively for schools.

The toilets can be manufactured having separate booths for men and women. E-toilets has following variants

Smart She Toilet with restroom – Stainless Steel  
e-Lite I 4 – Mild Steel  
e-Toilet 9007 LCM – Mild Steel  
e-Toilet 9007 LCS – Stainless Steel  
e-Toilet 9009 LCM – Mild Steel

### Innovation Geography

At present more than 2,500 e-toilets have been installed across twenty-three states in India - Assam, Andhra Pradesh, Bihar, Chhattisgarh, Delhi, Gujarat, Haryana, Himachal Pradesh, Jharkhand, Jammu and Kashmir, Karnataka, Kerala, Maharashtra, Madhya Pradesh, Punjab, Tamil Nadu, Telangana, Tripura, Uttarakhand and Uttar Pradesh, etc. These have been installed at Public Places, institutional buildings like schools & offices and also in low socioeconomic communities. ESS has fabrication facilities in three States and service network across 23 States in India.

### Costing and financial aspects

The basic E-toilet model costs INR 200,000, while the advanced stainless-steel versions cost up to INR 400,000 -500,000 per unit which includes unit cost, transportation,

installation, insurance, and one year warranty. After installation, the operation costs are covered through the minor user charge. Interior and exterior walls could be used to generate revenue from the advertisement as well as can be used for awareness.

A coin validator is provided to use the E-toilets. Every toilet is pre-programmed to accept a minimum amount of INR 1/2/5 as per user charges fixed by local government or any other toilet maintaining group.

The e-Toilet model is a self-sustainable one. It is an attempt to tackle pressing issues like lack of manpower by using automatic cleaning technology. The operational expenses, when compared to conventional toilets, are significantly low. These toilets have a comprehensive annual maintenance plan which includes the aspects of preventive and corrective maintenance. The maintenance services are monitored by an online system for governance transparency.

## Challenges

Since the toilet is completely automated, technology phobia in the users is something very likely to follow. Coins are stuck up and therefore toilet usage is not possible. In dense market areas where space is constraint single seat toilet are not preferred by a female. Interactive voice features need to customize as per the regional language. A key limitation of this toilet is non-inclusive nature for the physically challenged group.

## Key highlights

Auto-flushing ensures a clean and hygienic environment for every user. Interactive technology facilitates users.



*E-Toilet Unit Installed at Bengaluru Airport*

Coin operated e-toilet ensures that every user pays for the toilet usage. Remote monitoring ensures that operation and maintenance of the toilet. Stainless steel superstructure prevents it from damage and ensures durability. Easily locatable from distance with bright LED lights.

E-Toilets are easy to install due to its comprehensive sanitation design and compact model. Integrated IoT which makes this Public toilet unmanned and aids significantly in the ease of operation and maintenance which is why they are fast becoming popular as mentioned earlier and this can be seen from its uptake in the country.

**References:** References: <http://www.eramscientific.com/eLiteFAQ.pdf>

### To know more about E-Toilets, please contact:

Ms. Bincy Baby, Director & CGM Eram Scientific, Email: [binicy@eramscientific.com](mailto:binicy@eramscientific.com)

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# THE SHE TOILET

*Gender Sensitive & Women Centric*

## Background

To understand the status of sanitation, a detailed diagnostic study was carried out by the Administrative Staff College of India (ASCI) and a city wide Sanitation Plan for Warangal city has been prepared. The study shows that the lack of “Access to toilets” was one of the key reasons for open defecation in Warangal. Based on these findings, the Project Monitoring Unit (PMU) of Greater Warangal Municipal Corporation (GWMC) focused on interventions to improve access to toilets in households, public/commercial spaces and institutions.

The study revealed that, in Warangal, the poor and unhygienic condition of public toilets was attributed to inadequate maintenance, lack of continuous supply of water, unscientific toilet design and construction. The toilets also lacked facilities for children and differently abled persons. Users were also deterred by the absence of safe disposal for both solid and liquid waste, absence of separate blocks for men and women with separate entrances (only 5 out of the 27 toilets had separate entrance for women), and safety related concerns due to lack of privacy. The issues were compounded by the absence of robust service level agreements between the contractor and GWMC.

The assessment also brought to light interesting findings related to safety and privacy, which were found to be key rationale for why women avoided using public toilets. It was further established that public toilets were largely



*The “First Ladies Only” SHE Toilet in GWMC Office, Warangal*

designed to cater to men. The distribution of toilet seats between men and women was on an average around 2:1. One of the important reasons why women expressed reluctance in using public toilets was common entrance





November 2017). Additional five toilets will be funded by the ULB. As per the agreements, user charges will be collected by third party and viability gap funding will be provided by GWMC. A minimum footfall of around 100 users per day is required for the toilet to be cost effective. Indus Towers has proposed to use the roof of SHE-Toilet and available open space by telecommunication service providers for 10 years on lease basis

### Challenges

The project experienced minor roadblocks during development and implementation stages for eg. challenge in construction of SHE-toilet at GWMC premises due to presence of drain near the allotted site. In operation and maintenance, to ensure regular water supply identifying suitable women caretakers for day to day maintenance of the toilet has been a challenge.

### Key Highlights

The need of SHE-Toilets has been welcomed across municipalities. Even in e toilets models, exclusive toilets are installed in various urban local bodies. Additionally, to make these units self-sustainable through different revenue streams like advertising, space for sale (vending machine) for women related hygiene products etc needs to be explored. Depending on availability of space, other women friendly facilities like childcare units, breast-feeding facilities etc can be added.



*SHE Toilet - Woman Caretaker with a Feedback Machine*

**References:** <http://www.newindianexpress.com/states/telangana/2016/aug/02/KTR-promises-She-Toilets-across-all-towns-and-cities-by-ctoher-2-1500999.html>  
<https://twitter.com/ktrtrs/status/932095731556532224?lang=en>  
<http://www.swachhwarangal.com/Access.aspx>

To know more about She toilets, please contact:

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The background is a solid teal color. It is decorated with several white dotted lines that form loops and swirls. Scattered throughout are white dotted outlines of bandages of various sizes and orientations. Some bandages have horizontal lines, while others have vertical lines. There are also small white circles and four metallic-looking circular fasteners (two at the top and two at the bottom) that appear to be holding a central light green rectangular card in place.

“

*We shall not defeat any of the infectious diseases that plague the developing world until we have also won the battle for safe drinking water, sanitation, and basic health care.*

*- Kofi Annan*

”

# NAMMA TOILETS

*Modular, Easy to Install, Portable Public toilets*

## Background

The Namma Toilet is an initiative to eradicate open defecation in Tamil Nadu by the Commissionerate of Municipal Administration with support of Urbane Industries Ltd. It is considered as one of the flagship programmes of the State Government. The first pilot testing of the toilets was launched in Srirangam, Trichy Corporation and in Tambaram in year 2012-13. The National Institute of Design (NID), Ahmedabad conducted a 'Cultural Appropriateness Study' to understand the user's requirement before designing the Namma Toilet. The study highlighted that open defecation was not a choice but, unfortunately a compulsion for the people. The Namma toilet took about seven months of designing (May to November 2012) to incorporate all modifications suggested in the study. The first prototype was demonstrated in January 2013. Dr. Ray, Prof. and Head of the Industrial Design, Indian Institute of Technology (IIT) Mumbai inspected the first prototype and with a few modifications, it was finalized for public use. As a part of their corporate social responsibility (CSR) institutions

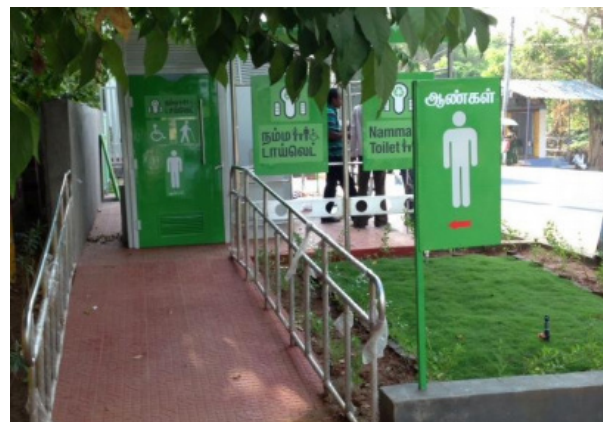
and industries like the Confederation of Indian Industries (CII) Foundation, Gurgaon, Mitsubishi Electrical & Delhi Cloth Mill (DCM), National Buildings Construction Corporation (NBCC), Mahindra and Mahindra Limited etc. have installed Namma Toilets at various locations. Indian Railways has also adopted Namma Toilets for their platforms. The Hon. Prime Minister of India has also awarded the "National Best Practice" to The Namma Toilet.

## Innovation Geography

The first Namma toilet was installed at the Tambaram suburb in Chennai in February 2013. Since then about 3,000 toilets have been constructed across 50 Municipalities and 7 Corporations in Tamil Nadu State, 5 Corporations in Andhra Pradesh, 2 Corporations in Punjab, Navi Mumbai Municipal Corporation and 20 in various municipal corporation of Delhi. Namma Toilets are also installed in about 150 Railway Stations all over India. The first Namma toilet installed by Indian Railway is at Katra Railway Station, Ferozepur, and Division.



Figure 1 Namma Toilet in Tamil Nadu



Physically challenged toilet view



## The Innovation

Namma toilet has been designed keeping in mind the specific requirements of the Indian sanitary practices, which meets the needs of male, female, and the physically challenged users. The uniqueness of the toilet is its modular design, user friendly-universal toilet, sustainability and can be used by people from all socio-economic backgrounds. The module for female has a sanitary disposal unit located at the rear end to ensure proper disposal of sanitary napkins. Physically challenged section has a ramp for wheel chair, wide doors, and grab bars on the interiors for easy usability.

This toilet's superstructure is made of composite fiberglass sandwiched material with excellent durability and strength, which is required to withstand harsh conditions and high footfall. The material used is retardant, acid, and alkali proof, water and termite resistant, and has high strength. Due to its dependence on continuous water supply, ground water extracted from bore wells is a common feature in Namma toilet sites. In urban areas where underground drainage connections are available, Namma toilet can be connected to these lines. In areas where drainage connections are not available, a septic tank with bio-enzyme based treatment system is needed. This will help to control the (Chemical Oxygen Demand) COD/ Biochemical Oxygen Demand (BOD) levels and Ecoli in sewage.

Indian Railways in an effort to ensure hygienic conditions in toilets situated at railway platforms has opted to install the state of the art Namma Toilet across the country. Namma toilets installed at the platforms come with customized septic tanks with a bio-enzyme based treatment system to treat faecal matter, which is best suited for the current system. The effluent water led out from treatment tanks can also be used for watering purpose.

## Key Features

- ✓ Modular and Portable Design
- ✓ User friendly
- ✓ Multiple design options
- ✓ Inclusive design for women and differently abled
- ✓ Made up composite fiberglass material – durable, retardant, acid and alkali proof, water and termite resistant
- ✓ Due to its modular design, it is highly recommended for public places or high footfall areas, and temporary requirements (i.e. fairs, carnivals, construction sites, public gatherings etc.)

## Costing & Business Model

Capital cost for one public toilet that includes one unit for men, one for women and one urinal is about 13 Lakhs and the operation and maintenance (O&M) cost is about 24,000 per month. The front panels of the toilets can be used for advertisement and signage. Public places like bus stands usually have footfall of about or more than 200 users per day. The user fees charged per usage is sufficient to recover the cost of procurement and operational during the lifecycle.

## Challenges

Namma toilets are dependent on continuous water supply; therefore, they are not suitable for areas with disruptive water supply and high footfall.

## Key highlights

Due to its robust, modular, and easy to install super structure, Namma toilet is highly recommended in public places or high footfall areas, and temporary requirements (i.e. fairs, carnivals, construction sites, public gatherings etc.), provided they have continuous water supply. Cost-effectiveness through its life cycle makes it favourable to be adopted in the urban areas.

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# BIOLOOS

## Onsite Waste Treatment Solutions

### Background

To provide sanitation services in varied conditions requires different solutions. The lack of toilet facilities and thereby open defecation poses health hazards, raises environmental concerns, and leads to water contamination.

These impacts are further enhanced by the Indian Railways' open-chute toilet system; where human waste drops onto rail tracks below. To address these challenges Bio Loo provides sustainable and environmentally friendly sanitation infrastructure with onsite waste treatment



*BioLoos in School*

DRDO has developed this technique of eco-friendly degradation human waste for armed forces deployed at high altitude locations and glaciers, as sub-zero temperature does not allow natural degradation. In 2010, the DRDO decided to extend the benefits of the technology to the civilian population by licensing the biotechnology to commercial firms. A host of businesses, including Banka BioLoo, signed the transfer of technology. Since then, Banka BioLoo has developed the necessary infrastructure to inoculate the bacteria and has built a business model that positions bio-toilets as a cost-effective and environmentally friendly sanitation solution. Over 6,000 bio-loos have been constructed and installed in 20 states, including in Indian Railways. Bio loos are now also installed especially through corporate social responsibility (CSR) funds in the form of public, community or individual toilet.

The bio-digester is a consortium of anaerobic bacteria, adapted to work at temperatures as low as  $-5^{\circ}\text{C}$  and as high as  $50^{\circ}\text{C}$ . It is composed of four clusters of bacteria belonging to hydrolytic, acidogenic, acetogenic and methanogenic groups with high efficiency of biodegradation. These convert the organic waste into water, methane and  $\text{CO}_2$ . The anaerobic process inactivates the pathogens responsible for water-borne diseases. Bio-digesters serve as reaction vessels for biomethanation and provide anaerobic conditions and the required temperature for the bacteria.

- ✓ Disposes human waste in 100% eco-friendly manner
- ✓ Effluent is free from odour and solid waste (organic matter reduced 90% after treatment)
- ✓ Does not require any septic tank, sewage tank connectivity or external sewage transformation and treatment infrastructure.
- ✓ Suitable for most temperatures (withstand temperature  $-5^{\circ}\text{C}$  to  $50^{\circ}\text{C}$ ) and terrains
- ✓ Continuous biological process of treatment
- ✓ Elimination of pathogens
- ✓ Cost effective solution
- ✓ No dependence on the limited and costly energy sources
- ✓ Quick installation and operationalization within 8-10 hours
- ✓ Inoculum (bacteria) charging is required only once, during the lifetime of the bio-toilet
- ✓ Use of routine cleaning chemicals such as phenyl, soap etc. do not harm bio-toilet or the inoculum
- ✓ 100% customizable in respect to number of users, materials, situation and condition

A household unit of a bio-toilet costs INR 35,000 inclusive of GST (18%) for up to 10 users, and others are priced based on quantities per block. Bio Loos have also been

constructed through a CSR revenue model, apart from pay and use model. Bio-toilets requires minimum maintenance as compare to conventional toilets. These are mostly individual or institutional toilets. Land requirement for one unit is about 6 feet X 10 feet.

## Challenges

One of prerequisite of bio digester toilet is to ensure that it is used on regular basis. If a bio digester toilet is left alone unused for 15 to 30 days, the inoculum inside it might render inactive. This leads to break down in the system and biological treatment would not take place further into this.

Another issue that Bio-Loos are facing, users have shown a tendency to throw garbage and other waste into the toilet. This can severely interfere with operation of the bio digester, which further choke in the system and inhabit the bacteria to conduct the treatment process.

## Key Highlights

In addition to Indian railways, bio Loos are suitable flood prone areas, high water table regions and rocky terrain where leach pit toilets are not recommended. Banka Bio-Loo is a very successful initiative and has won many awards – Devi Awards 2015 by The New Indian Express Group, Sankalp 2013 Healthcare, Water & Sanitation Award Winner, Cartier Women's Initiative Awards, 2013: Asia-Pacific Laureate, Changing Markets Awards 2013, Confederation of Women Entrepreneurs (COWE) Best Entrepreneur Award in Bio-Technology category, 2013,



WaSH4Work Bioloos (Construction Workers)

NSIC/MSME Best Technology Award at Techmart, New Delhi, 2013, The LBF Visionary Award of Excellence – 2014 and many others.

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“

*So long as you do not take the broom and the bucket in your hands, you cannot make your towns and cities clean.*

*— Mahatma Gandhi* ”

# SMART PUBLIC TOILETS – DUAC

*Design Sourcing, Manufacturing, Modular, Low Cost*

## Background

Considering the deplorable condition of public toilets in Delhi, the Delhi Urban Art Commission (DUAC), decided to drive an initiative under which self-sustaining state-of-the-art public toilets could be developed and set up in high footfall locations i.e. slums, market places, etc.. DUAC's idea was to develop a product using locally

available material to reduce the overall cost, and support effortless installation. In 2012, DUAC with support from Government of India (GoI) organized a nation-wide competition to design and develop a prototype public toilet. Based on the designs selected from the competition, prototypes for smart public toilets were developed. The prototype of the first DUAC Smart Public Toilet was



Smart Public Toilets (DUAC) : Design 4

developed and installed in May 2014 at Dr. Ram Manohar Lohia (RML) Hospital, New Delhi (Opp. Gate no,6). From the inception / idea stage to on ground implementation the entire process took two years. Since then, four prototypes developed by DUAC have been successfully constructed and handed over to ULBs in Delhi for operation and maintenance. DUAC has been awarded the “WB Honours 2014” award by “Washrooms and Beyond” under the category “Innovation in Public Washroom Design” for its relentless efforts in the promotion of innovation in public convenience design.

### The Innovation

The form and structure of the toilets have been designed to be a streetscaping element for the urban cityscape. The toilets have a distinctive & aesthetically pleasing design appropriate for modern requirements. Each version of the DUAC toilet has male and female booths. There is also a provision of ramp for easy access to the toilets for differently abled users. Stainless steel and galvanized iron have been extensively used in the interiors to improve the aesthetic appearance, long life, and be vandalism proof. This has been prepared by fabricated industrial metal waste. The Defence Research and Development Organization (DRDO) bio-digesters have been provided wherever sewer connection is unavailable.

Solar panels have been installed to aid the self-sustaining energy requirements of the toilet booth. The provision of LED lighting further ensures lower energy consumption. Ample light and cross ventilation have been provided for each design to reduce reliance on electrical lights. For better efficiency, toilet booths have been supported with Program Logic Controller.

As per the requirements, these toilets can be relocated without any wastage of resources. Five different versions of the product have been designed. One of the designs have been further developed with four internal layout options suitable to the requirement of specific public places.

### Key Features

- ✓ Unique procurement method adopted by DUAC
- ✓ efficient design for urban city scape
- ✓ Suited for densely populated areas
- ✓ Energy efficient – Solar powered
- ✓ Uses locally available material
- ✓ Adaptive design – multiple options available to suit varying needs
- ✓ Inclusive design – male, female

What makes the DUAC public toilet model different is that unlike mobile toilets, these toilets are assembled and only need to be installed at a site. The average installation time for a single unit is 2 to 3 days. Each DUAC Smart Public Toilet has been designed for mass production and transportation to various locations in cities through truck / trailers. The units are then erected on an already laid foundation and made operational in a day or two. In coordination with the local authorities for water, sewer, and electricity connections.

### Innovation Geography

The first prototypes of a DUAC designed toilet (twin cabin elliptical shape) were installed in various parts of Delhi (The RML Hospital, Old RK Asharm Marg). They were pilot tested for three months before handing over to the New Delhi Municipal Council (NDMC) for its operation, maintenance and security. Currently, the DUAC prototypes have been placed at various locations in Delhi viz. Attaturk Marg, Swami Dayal hospital, Mandi house, RML hospital. They have been strategically placed at public places with high footfall and locations that have good access to wide footpaths. It can be seen that design of public toilet was made keeping in mind its requirement as street furniture and was integrated with the existing street design.

### Costing and Financial aspects

Since it was a prototype, based on various design options prepared by the DUAC, to reduce the overall development cost, different alternative materials were





Smart Public Toilets (DUAC) : Design 1

explored. For mass scale production, the basic cost envisaged in the year 2016 was approximately Rs. 1.50 lakh per seat. The operation and maintenance costs of the public toilet are borne by the respective city authority, under whose jurisdiction the toilets are installed. For design option 4 and 5, the cost of each unit is between Rs. 12-13 lakhs. The toilet booths have been provided with adequate space for revenue generation and advertisement panels. The caretaker's fee shall be decided by the concerned ULB under whose jurisdiction the prototypes are installed.

DUAC toilets are designed through an open source competition. Prototypes were developed by invited agencies to whom designs were made available to mass

replicate, provided the individual cost of each toilet stays under Rs 1 lakh. Vendors were involved in the construction of the prototype toilet through open tendering. After installation and pilot testing, the toilets were handed over to NDMC for operation and maintenance.

## Challenges

Each city has different design requirement for public toilets due to various criteria followed for street designs, hence customization of DUAC toilet is what needs to be taken up along with participation of local manufacturing agencies to maintain the cost and transportation of the model.

DUAC developed prototypes of customised designs toilets by inviting vendors. The challenge for replicating such designs in other cities might be in finding local vendors for manufacturing. Moreover, since these are factory made installations, transportation cost is a considerable challenge for other cities to replicate the model.

## Key highlights

DUAC's approach to design the smart toilet is unique. Designs are sourced through competition and prototypes were developed by inviting vendors to manufacture the toilets. The toilets are prepared using locally available material. The toilets are space efficient that is a pressing issue in dense urban areas. The use of solar panels also conserve on the energy needs. Since the installation of the prototypes in and around New Delhi, several city authorities i.e. NDMC, DDA, DUSIB, Municipal Corporations of Delhi, Government of Punjab, and ULBs from Varanasi and Mathura have reached out to DUAC for implementing innovative public toilets. Owing to its compact and innovative design the smart toilets can be also be installed at high footfall institutional buildings (e.g. Nirman Bhawan's).

**To know more about Smart Toilet (DUAC), please contact:**

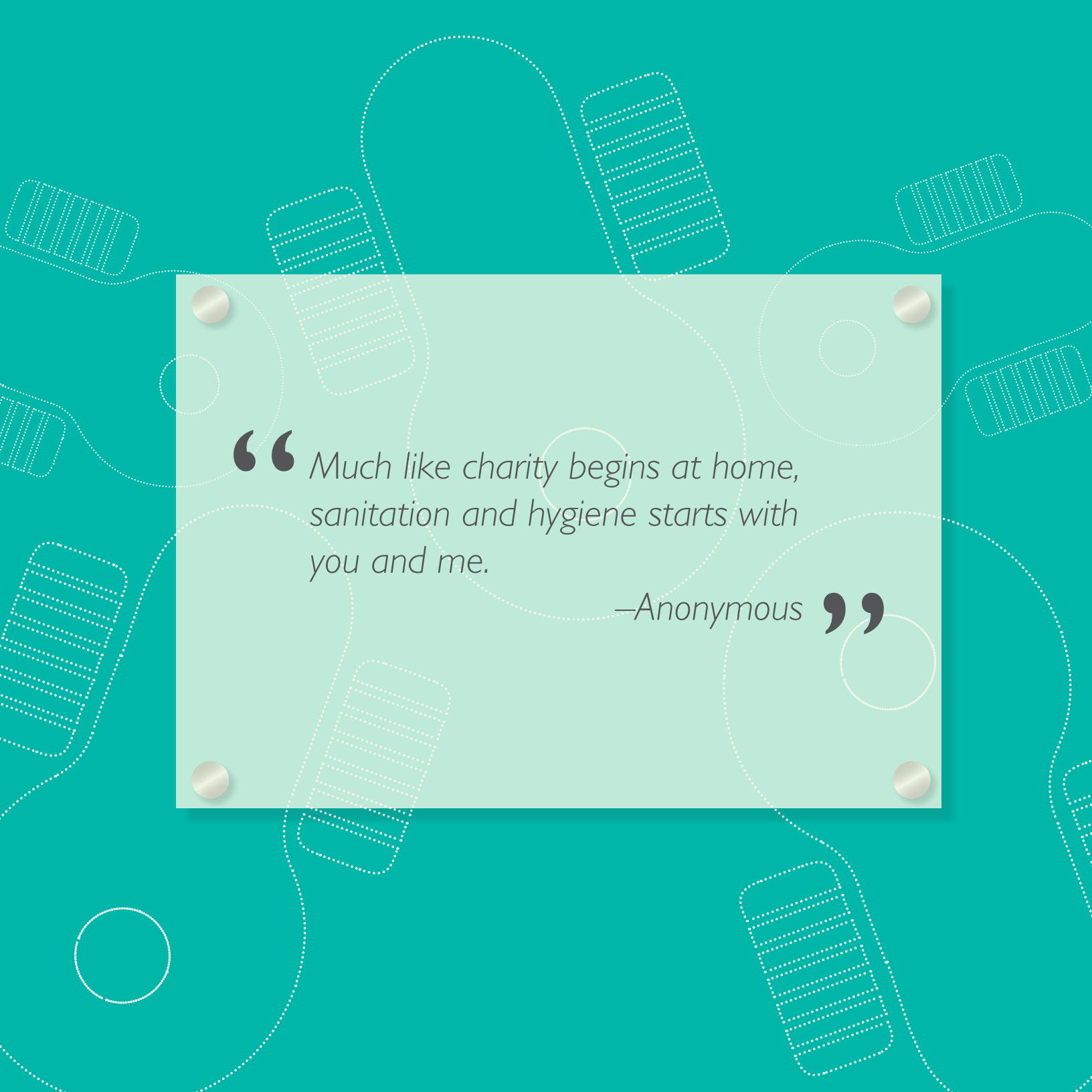
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*“ Much like charity begins at home,  
sanitation and hygiene starts with  
you and me.*

*—Anonymous ”*

# PERMEABLE REACTIVE BARRIER TOILETS (PRB TOILETS)

*Low-cost toilet to protect Groundwater source, Mulbagal, Karnataka*

## Background

Nitrates in drinking water can cause anaemia and can even react with amines to form carcinogenic nitrosamines. Groundwater in most of the urban and peri-urban areas in India have high nitrate concentration in almost all hydrogeological formations. This is because of the nexus between on-site sanitation and reliance on groundwater for potable needs in urban India. The technology used in Permeable Reactive Barrier (PRB) toilets offers in-situ anaerobic, aerobic, denitrification, and anammox process that utilizes indigenous microbes to reduce organic load, nitrate load, and pathogen load in pit toilet sewage.

Single or double pit toilet systems mainly perform collection, isolation, temporary storage, and partial treatment of the sewage. Efficiency of pit toilets for in-situ treatment of sewage is necessary. The low-cost toilets rely entirely on a refuse-collection pit - a design that ends up leaching nitrates into the groundwater below. Besides the contamination of groundwater resources by pathogens, ammonia produced during the hydrolysis of proteins in faecal matter and hydrolysis of urea to convert to nitrate upon release of the pit toilet leaches to sub-surface environment.



Chennai Corporation's modern bio toilets near footpath at Elliots Beach, Besant Nagar, Chennai

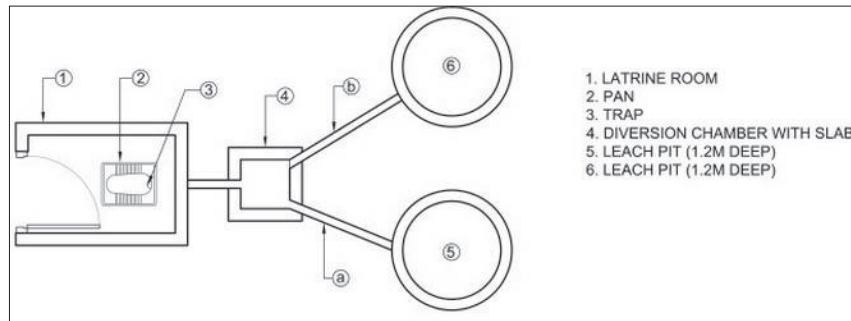
Cognizant of the issue of ground water contamination, Prof. Sudhakar Rao from Department of Civil Engineering, Ms A. Lydia, Project Assistant, and Mr. Nitish VM, Research Student, Centre for Sustainable Technologies, Indian Institute of Science, Bangalore has developed innovative toilet called the PRB.

## The Innovation

The team from Indian Institute of Science (IISc), Bengaluru, in a research project supported by Arghyam Foundation,

## KEY FEATURES

- ✓ Low cost sanitation solution
- ✓ Extremely effective for reducing nitrate concentration in groundwater
- ✓ Versatile technology – can be used with easily available local materials
- ✓ Viable alternative to the conventional twin pit latrines
- ✓ Environmental friendly



Plan for Twin leach pit

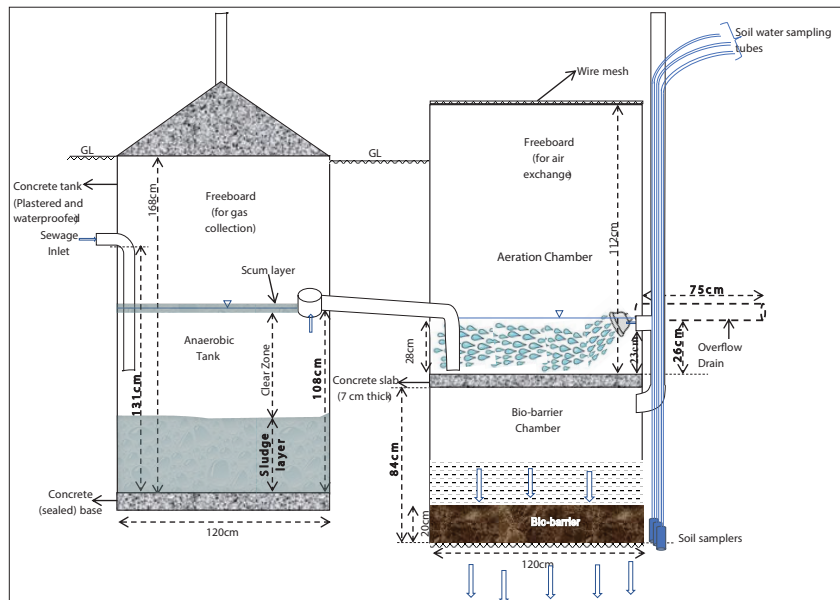


Figure 1: A schematic diagram of A2B twin pit

constructed the first PRB toilet. PRB toilets are low-cost solutions that rely on a refuse-collection pit and use a mixture of sand and bentonite clay. The clay regulates the flow of leachates by swelling when in contact with water. A mixture of sand (95%) and bentonite clay (5%) ensures a suitable anaerobic environment for de-nitrifying bacteria, which convert nitrates into gaseous nitrogen compounds. Bentonite is not easily available in rural areas or small towns; instead, a mixture of cow dung and sand (1:1 ratio) can be used as an effective alternative. The research published in the *Journal of Water, Sanitation and Hygiene for Development* 2015, shows the barrier reducing nitrate concentration by 66 per cent within 12 hours and nearly 94 per cent within a day.

The researchers developed a “cost-effective” set-up, nearly 100 cm thick top gravel layer below the pit-base followed by a 32cm thick sand layer and a bottom 20cm thick layer of sand plus clay. The design has many benefits as it is economically viable, it can be made at very low cost. It will especially benefit rural and poor people. Moreover, it is environmentally viable as it controls the leaching process.

This twin pit toilet can remove nitrate from its leachate in a three-step process.

1. First step reduces organic carbon in sewage to levels that are favourable for ammonium oxidation
2. Second step facilitates oxidation of treated sewage to convert ammonium to nitrate by microbial mass
3. Third step involves removal of nitrate by denitrification reactions

Monitoring the A2B twin pit for over 300 days revealed that anaerobic, aerobic, and bio barrier treatment reduces COD of sewage by 90 to 95 %. Ammonium majorly transforms to nitrite in the aerobic chamber that are removed by anammox reactions in the bio-barrier chamber (lower half of pit 2). Nitrate produced in the aerobic chamber is removed by denitrification reactions on passage of the aerated liquid through bio-barrier. A2B twin pit reduces the faecal coliform count by 2.5 log

cycles. A schematic diagram of A2B twin pit is shown in Figure 1

Mixture of air-dried cattle manure, sand, and gravel is used as bio-barrier media for nitrate reduction. Cattle manure serves as affordable organic C source; sand particles act as media for attached bacterial growth, while gravel improves permeability of the barrier.

Combined anaerobic, aerobic and bio-barrier (A2B) system was implemented in a twin pit toilet in Mulbagal town, Karnataka and the quality of field samples is being monitored for over 300 days. The first pit serves as an anaerobic chamber, while the second pit facilitates the aerobic reactions in the upper half and is equipped with a bio barrier in the lower half to facilitate the anammox/ denitrification/biochemical reactions. Air-exchange is facilitated in the upper half of pit 2 by leaving the upper surface open to atmosphere and by installing a water circulation pump. The upper surface of the aerobic chamber is covered by a strong wire mesh.

The waste passes through an anaerobic chamber, an aerobic chamber and a bio-barrier chamber before being discharged to sub-surface and is termed as A2B (Anaerobic, aerobic, bio-barrier) twin pit toilet. It is environment friendly as it reduces COD of sewage by 90 to 95 %, reduces the dissolved inorganic nitrogen (includes nitrate and ammonium) by 71 % and reduces the faecal coliform count by 2.5 log cycles, thereby, protecting the potable groundwater from sewage contamination.

Concrete rings are used to construct the anaerobic chamber, aerobic chamber and bio-barrier chambers. Concrete dome is used to cover anaerobic chamber (pit 1) and split second pit into two halves. The upper half of pit 2 is open to atmosphere (aerobic chamber), while the sealed lower half of pit 2, houses the bio-barrier at its base and is termed as bio barrier chamber. Bio-barrier is constructed using sand, gravel and cow-dung to facilitate denitrification reactions upon passage of aerated waste



liquid through it. The construction process takes around 5 days and the design can be improvised as per the number of the users and available site.

## Innovation Geography

The A2B twin pit was constructed in Karnataka Electricity Board residential quarters premises, in Mulbagal Town, Kolar District, Karnataka. The research team periodically monitors the different chambers of the pit for quality parameters like ammonium, nitrate, COD, etc. It was observed that under optimal conditions, the first pit reduces COD in sewage; near complete removal of ammonium ions occurs in the nitrification chamber of the second pit; and near complete removal of nitrate and residual ammonium ions should occur in the bio-barrier at the bottom of the second pit.

## Costing and Business Model

The construction cost worked out of one PRB toilet was INR 18,750. The annual Operation & Maintenance (O&M) cost worked out for this toilet is INR 4,750. This includes electricity charges for running the re-circulation pump in the aerobic chamber at the rate of INR 250 per month and annual cost for de-sludging the aerobic chamber and anaerobic chamber, which amounts to INR 1,750. While a conventional twin-pit system (without superstructure and sanitary fittings) costs about INR 10,000, the proposed twin-pit toilet costs around INR 15,000. While there is an increase of 50% in the cost, the benefits far outweigh the higher cost as it offsets the costs involved in treating nitrate-contaminated drinking water, which is removed by using reverse osmosis devices. Further, if one has to treat

the aquifer source to remove pit toilet contaminants, costs are way beyond the realm of a community.



A2B Twin Pit Toilet at Mulbagal Town

## Key Highlights

A2B twin pit toilet is recommended in areas with shallow groundwater level as the discharge has significantly lesser pollution loads. Also, A2B model can also be scaled to replace conventional septic tank, so that it greatly reduces the environmental impact of faecal sludge and septage on the environment. It is hoped that the A2B twin pit will reduce the conventional single pit, twin pit toilets in the country as it protects the potable groundwater resources from faecal coliform and nitrate contamination due to in-built anaerobic, aerobic, denitrification and anammox reactions. Also, the research team is working on the design of the smart twin-pit toilets which could just be the solution to decentralised sewage treatment at a household level.

### To know more about PRB Toilets, please contact

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# NIRMALA SAULABHYA

## *Innovative Partnership Model*

### Background

To provide support towards the Clean India Campaign, an eco-friendly public toilet complex near Sri Chamundeshwari Temple atop the hills in Mysuru, Karnataka was developed by the Confederation of Indian Industries (CII). State-of-the-art green public convenience facility is called 'Nirmala Saulabhya' with an investment of INR 1.25 crore. The Nirmala Saulabhya is carbon positive and water positive with boasts of a rainwater harvesting facility, sewage treatment plant and a rooftop solar power system.

### Innovation Geography

Nirmala Saulabhya is constructed at Sri Chamundeshwari Temple atop the hills in Mysuru, Karnataka and proposed to be constructed at three other locations around Mysuru at Mysuru Zoo, Karanji Lake, and the proposed Tourist Plaza at Dasara exhibition ground. A similar toilet is also constructed at Amba Vilas Palace (Mysuru Palace) in 2018.

### The Innovation

Designed by Mr. G. K. Sudheendra, a renowned urban designer, the first toilet was constructed in July 2015 and Chief Minister Sidaramaiah inaugurated the toilet complex on 1st October 2016. Each toilet complex comprises 27 Indian and European water closets and 15 urinals. The

complex has 15 urinals, along with 17 toilets for women and 9 for men. Apart from this, the facility also has a separate toilet facility for differently abled people that can be easily accessed using wheelchairs. The complex also has a childcare facility.

The facility has been constructed using mud bricks, concrete, and construction steel. The interiors of the toilet extensively use stainless steel (sanitary fittings, baggage platforms, and childcare units), glass (urinal partitions) and ceramic (Wash Basins, floor tiles, and WC). The doors of the toilet cabins are made of Polyvinyl chloride (PVC). The urinal flush and wash basin fixtures are automated with motion sensors. The average installation time for one toilet complex is approximately one year. The design has been developed in such a way that it can be improvised or altered as per requirement.

Nirmala Saulabhya toilets have been constructed with a sensor-based hand-washing system with narrow orifices of pipes in order to prevent wastage of water. A rooftop solar power system produces 5KW of electricity that is double the requirement of the toilet complex and is connected to a grid making it a net-zero energy building. A sewage treatment plant with a capacity of treating 10,000



Inauguration of Nirmala Saulabhya at Mysuru



Decentralized Sewage Treatment Plant, Behind the Nirmala Saulabhya Complex

cusecs of water per day has also been set up. The waste that is generated is converted to manure with the help of a solid waste management plant.

The total water requirement of the complex is approximately 8,000 liters per day. 70% of the complex's water requirement is met by recycled water that is used for maintaining the garden and flushing the toilets. The facility has been fixed with a Drinking Water kiosk with a Reverse Osmosis (RO) plant that can supply 200 liters per hour of water. The complex has been constructed in such a way that it does not require artificial lighting during the daytime. The LED lighting and the solar power system in the complex help conserve energy. The toilet complex can be located by using GPS.

### Costing and Business Model

The capital cost of construction of the entire toilet complex is approximately INR 1.25 crore. Pilgrims visiting Chamundeshwari Temple and other tourists are charged a nominal fee of Rs 2 (for urinals) to Rs 4 (for female users) per user. Approximately 55 lakh pilgrims visit the temple every year and during the Hindu month of Ashaada (July – August) the daily footfall goes up to 2 lakh. In the first three months of its opening, the complex received 1.2 lakh users. On an average, a tourist destination like Chamundi Hills attracts 20,000 people every day. The minimum footfall required for the toilet complex to be cost-effective is 2000 per day. Seven people manage the complex and the caretakers work in two shifts.

Automotive Axles Limited and Meritor India have majorly funded Nirmala Saulabhya with the contribution of INR 4.65 Lakhs for this facility to support Swachh Bharat Mission. The space for the toilet belongs to the District administration and was allotted by then Deputy

### Key Features

- ✓ Innovative partnership model for development, construction, and maintenance
- ✓ Smart sensor based operation
- ✓ Water and resource efficient design
- ✓ Drinking Water kiosk with a Reverse Osmosis (RO) plant that can supply 200 litres per hour of water
- ✓ Solar power system with up to 5KW of electricity is connected to a grid making it a net-zero energy building
- ✓ Caters to all demographics – male, female, children, and differently abled

Commissioner, Shri. D. Randeep. A Trust under Build Own Operate and Transfer (BOOT) basis is responsible for maintaining the toilet complex for five years. Corporate groups that had built the complex are a part of this Trust.

### Challenges

One of the major hindrances for the construction of the facility was the opposition from locals who had occupied the land illegally. Apart from this, high capital costs were hindrances at inception level. The area faces a shortage of water; therefore, around 6000 liters of water is bought from tankers every week, to operate and maintain the complex.

### Key Highlights

A similar facility has been constructed in Amba Vilas Palace (Mysuru Palace). Construction of more of such facilities is proposed in major tourist destinations in and around Mysuru. The Indian Green Building Council has declared the complex as the country's first 'Green Public Convenience' facility. The facility is a good example for public-private partnership model and can be replicated in other tourist places having high footfall, through corporate social responsibility funding from private sector.

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# SAPL SMART TOILETS

*Public Toilets with an Innovative Revenue Model*

## Background

The Swachh Bharat Mission (SBM) drive, also emphasizing on public toilets motivated the New Delhi Municipal Corporation (NDMC) for the innovation in the public toilets. NDMC is spread across an area of 43.7 square kilometers and has central government institutions and houses some ministries. In addition to the central government hub, NDMC area also has one of the most significant Central Business District (CBD) of the city. NDMC area has several heritage structures and a floating population of more than 15,00,000 population. Although, the demand for basic sanitation services has been fulfilled, due to a large number of visitors from the city and also outsiders that visit the NDMC area; the existing sanitation infrastructure often ends up being inadequate. In order to address this, NDMC came up with an innovative Public-Private Partnership (PPP) model for providing public toilet facilities. In this, NDMC provided space for construction of Public Toilet Utilities (PTUs) with some additional space, for revenue generation to the private sector for a specific concession period. Union Home Minister, Sh. Rajnath Singh inaugurated the complex in the presence of several dignitaries including the Lt. Governor of Delhi.

In order to make this possible, a competition was launched for 'Smart Public Toilets' in December 2015. The competition was open to consultants, architectural firms, and students. The challenge was to design a public toilet which would recycle wastewater, odorless and easy access for differently-abled persons etc. The call for entries also laid emphasis on the fact that the NDMC area has several



Smart Toilet at Park Street, Talkatora Street





Smart Toilet at Faridkot House Lane 2

heritage structures and a floating population of more than 15,00,000 population. It was asserted that the design of the smart public toilet should be easily accessible to the floating population, has separate units for ladies, gents and differently-abled and no user fee would be charged.

Earlier, the urban local bodies used to be the main providers of public toilets, but these facilities lack proper maintenance and cleanliness. The concept of pay-and-use public toilets have become well established across India, most of them are funded by municipalities and a large proportion are operated by non-governmental organizations (NGOs) or small contractors. These are often better maintained than standard municipal toilets and are consequently more popular with the public. Delhi has witnessed a new initiative that involves private entrepreneurs via Build, Operate, and Transfer (BOT) contracts. The concept of BOT was proposed to utilize for developing public toilets in Delhi and draws out some important lessons for meeting the sanitation needs of the city as a whole.

## The Innovation

The innovative concepts of the proposed design were by the winning team members Amberker Yallappar, Himanshu Raj, and Mridul Kumar, the master students of infrastructure planning in the University of Stuttgart, Germany, and Master of Planning at IIT Kharagpur. Construction in a limited space (200-300 sqft.), innovative implementation model for

## Key Features

- ✓ Unique operational model that has high revenue potential
- ✓ BOT model ensures that the facility is eventually transferred to civic body
- ✓ This design is self-sustaining and operates on a 'pay and use' basis
- ✓ One stop shop facility with Bank ATM, water ATM, blood testing facility, sanitary napkin vending machine, soft drinks vending machine, digital health clinic, and Wi-Fi
- ✓ Energy and water conserving features



Source: TNN Illustration: Arya Praharaj, Times Internet

revenue generation to secure operation & maintenance, and water conservation are some of the novel features of the proposed public toilet. The toilet caters to the need of a male, female and differently abled. It has a Bank ATM, water ATM, blood testing facility, sanitary napkin vending machine, soft drinks vending machine, digital health clinic, and Wi-Fi. This design is self-sustaining and operates on a 'pay and use' basis. It is also planned to connect them via sensors to one maintenance server at NDMC for regular maintenance. Vacuum-based water closets will be used to minimize water consumption. ATMs, vending machines, free WiFi and smart water dispensers are other highlights of the proposed model.

## Innovation Geography

The city's first smart toilet on PPP model was constructed by Supreme Advertising at the Chelmsford Club on Rafi Marg. The New Delhi Municipal Council (NDMC)





SAPL Smart Toilet, Rafi Marg

has also partnered with Google on its toilet locator awareness campaign through which public toilets across Delhi, Gurugram, Faridabad, Ghaziabad and Noida zones can be located on Google Maps. Locating public toilets in the NDMC area has been made easy as one can now find of them on Google Maps using NDMC mobile APP – NDMC311. Currently, 333 public toilets have been mapped on Google to enable citizens and visitors to locate the nearest public toilet in an area. The Smart Public Toilets are operational from 6 am to 10 pm in the respective locations.

NDMC has to contribute Rs 604.74 crore towards the cost of the project while the urban development ministry, centrally-sponsored schemes, and public-private partnership funds will provide the rest over a period of five years.

### Costing and Financial aspects

These toilets are being constructed and operated on a public-private partnership basis for a period of five years.

The construction cost is about INR 5,00,000 to INR 20,00,000 per toilet block depending on availability of space. The maintenance cost (that includes supervision and administration) is INR 30,000-60,000 per toilet. The cost of electricity and water is about INR 10,000 per toilet; consumables, INR 5,000 per toilet; maintenance and replacement, INR 3,000 per toilet; and concession fee of INR 20,000 per toilet. Therefore, approximately INR 90,000 per toilet per month is spent on operation and maintenance. Cleaners (both male and female) are hired to clean the toilet premises on a 24x7 basis. The senior supervisors are each responsible for about 75-80 toilets. The caretaker is hired at minimum wages by the concessionaire. As the smart toilets are located in prominent places, those ad-sites (15 sq metre per Smart PTUs / CTUs subject to maximum 18 sq. meter) are in high demand, thus making it economically viable to build and run the public toilets and pay the concession fee.

## Challenges

The selection of sites for constructing public toilets (PT) has been a major challenge as no RVVA, individual, or shopkeeper wants PTs to be built in the vicinity of his/her property. A number of toilets are located in slums areas. The users from these clusters need to be educated about the benefits of hygiene and about using the toilets without damaging or stealing fixtures or fittings. A lot of the users do not know how to use the European Water Closets or do not want to use them for the fear of skin disease.

Saving the toilets from theft and vandalism is a challenge in the metro city of Delhi. Plastic fixtures are now used which are less prone to theft. Most toilets need to be monitored 24X7 so as to minimize the risk. Availability of water is one of the major challenges for the proper functioning of a toilet.

Arranging funds for the construction, running, maintenance and renovation is also an issue. The existence of a number of hoardings in unauthorized areas limits agencies from advertising on the panels in exterior toilet walls of toilets. This affects revenue generation from advertisements. Majority of the slums under the NDMC area still lack access to public toilets. Out of 273 conventional toilets, only 33 toilets are located in slum areas and lack proper maintenance and cleanliness. Hence, there is a need to propose such innovative toilets at the slum areas which can be customized as per the user needs. There is a need to create awareness among the slum community on how these



NDMC Toilet, Mandir Marg

smart toilets can be operated and how they are beneficial for health and hygiene.

## Key highlights

The smart public toilets have been quite successful in the NDMC area. It has a unique operational model that has high revenue potential that ensures sustainability. The services knitted around this toilet promotes users towards using them. BOT model further ensures that the facility is finally transferred to a government body. However, a number of challenges need to be resolved with respect to maintenance, cleanliness, mode of revenue generation and customization as per the need of the public (slum area, public zone, etc.). Creative means of revenue generation, utilization of recycled and grey water for the smart toilets are the issues that need to be resolved during the upscaling of this concept.

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# THE SUNIDHI TOILET

*Female Friendly, Hygienic, & Prefabricated Public Toilet*

## Background

In India, using rest rooms in public places is always a challenge for women. Inadequate or poorly maintained toilets often don't address the menstrual hygiene needs of women and adolescent girls. The requirement to change menstrual pads is largely ignored in toilets. Due to the lack of incinerators for scientific disposal of sanitary napkins, they are disposed in an unhygienic manner, sometimes left on the floor in the absence of dustbins, or flushed into the toilets causing pipe choking. These unhygienic practices increase risk of diseases like urinary tract infections. Therefore, most women hesitate or avoid using public toilets. The soiled napkins are collected by cleaners and disposed in municipal bins imposing high health risks to cleaners.

This concern triggered Water, Sanitation and Hygiene Institute (WASH Institute) to come up with a women friendly toilet named 'Sunidhi Toilet'. It is a modular toilet, which are prefabricated using moulds and transported to the required location for easy installation.

## The Innovation

Sunidhi toilets are specially designed for female who have attained menarche. The idea was conceived by WASH institute, a national level NGO that designed, constructed and installed it. This was done in consultation with stakeholders from communities in urban and rural areas. Representatives from the institute interacted with several women from SHG groups, Government organizations, adolescent girls, women labourers, etc. for feedback. The toilet has sanitary napkin vending machines, changing room and an incinerator to dispose sanitary pads, and



Sunidhi Women Friendly Toilet

other facilities required in a public toilet for women. Some of the village women who were first time users were not confident and were hence taught how to use the vending machines. The toilet is self-cleansing and top priority was given to handwashing units as it reduces 45% of sanitation related diseases.

The toilet has been constructed using cost effective ferro-cement technology by skilled and experienced masons. The average installation time is one day. The design can be improvised as per requirements.



- ✓ Women friendly toilets
- ✓ The toilet has sanitary napkin vending machines, changing room and an incinerator to dispose sanitary pads
- ✓ Modular design made from prefabricated moulds
- ✓ Easy to transport, installation, and dismantle
- ✓ Suitable to high footfall areas – festivals, markets, events, etc.

These toilets are located in busy public places like bus stands, parks, temples and market areas that have a high floating population of women. The toilet locations were chosen keeping in mind areas frequently visited by large number of women but deprived of adequate sanitation



A photograph of a large, semi-circular concrete structure, likely a tomb or vault, covered with a green tarp. A blue tarp is visible in the background.

Innovative Toilet Concepts For Urban India | 45



5. Slab curing for doors



6 Joining slab mould and doors at platform

facilities. The other considerations were availability of space, water and possibility of underground drainage connection.

### Costing and Financial aspects

The approximate construction cost of one unit is INR 85,000, which includes fabrication material (INR 20,000); fabrication and installation charges (INR 20,000); charges for incinerator, vending machine and plumbing materials (INR 45,000). The operation and maintenance (O&M) cost includes a caretaker, water used for flushing and cleaning and electricity charges are minimum. The cost of underground drainage connection depends on the distance of disposal point.

The user fees is generally INR 5 per user. Each toilet facility has a caretaker, who is paid about INR 5000 per month. INR 5 is charged for a new sanitary napkin. However, this was also not affordable to users (vendors

from Mattuthavani Vegetable market) and request were made to the authority to reduce the user charges.

### Challenges

Even though the toilet is easy to assemble, handling the weight of the pre-cast toilet during installation was a key challenge. Initially some women from rural areas found it difficult to use the vending machine and incinerator. This was sorted out through IEC, pictorial user instructions and educating the users by the caretaker.

### Key highlights

The toilet is designed considering the female gender requirement. It maintains the hygiene aspect by scientifically disposing sanitary pads. The present toilet design can be further modified for a square structure so that it can be installed in small spaces. Since Sunidhi toilets are easy to install and dismantle, it can be installed during festivals and events too.

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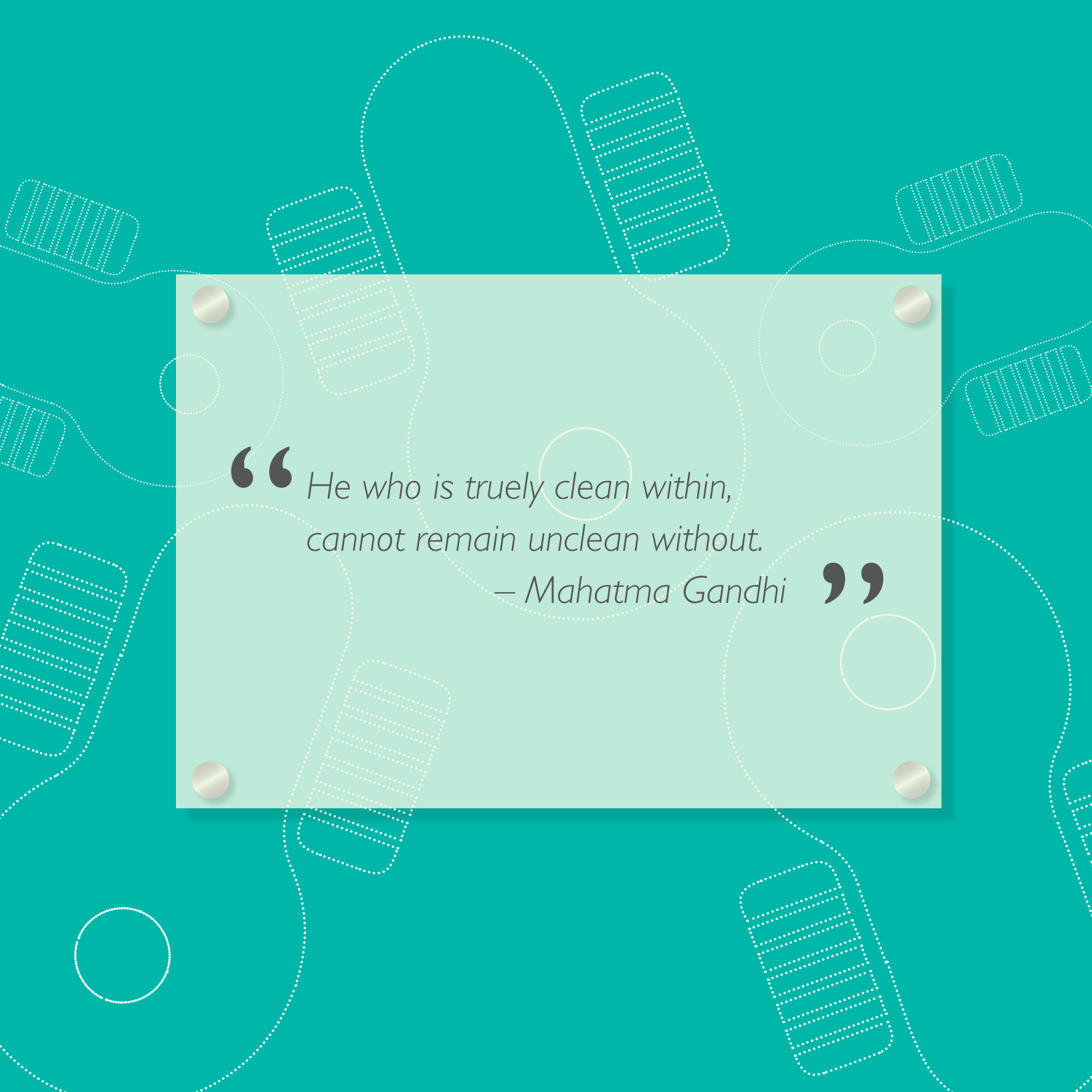
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*“ He who is truly clean within,  
cannot remain unclean without.  
— Mahatma Gandhi ”*

# CONCEPT OF SMART SANITATION FACILITY

Public toilets and community toilets are important sanitation facilities. Public toilets serve this purpose in markets, railway station and bus stand, public places like zoo, garden whereas, community toilet serves poor communities where individual household toilets are not available due to space constraint or non-affordable to urban poor. Public toilets, caters floating population. As a

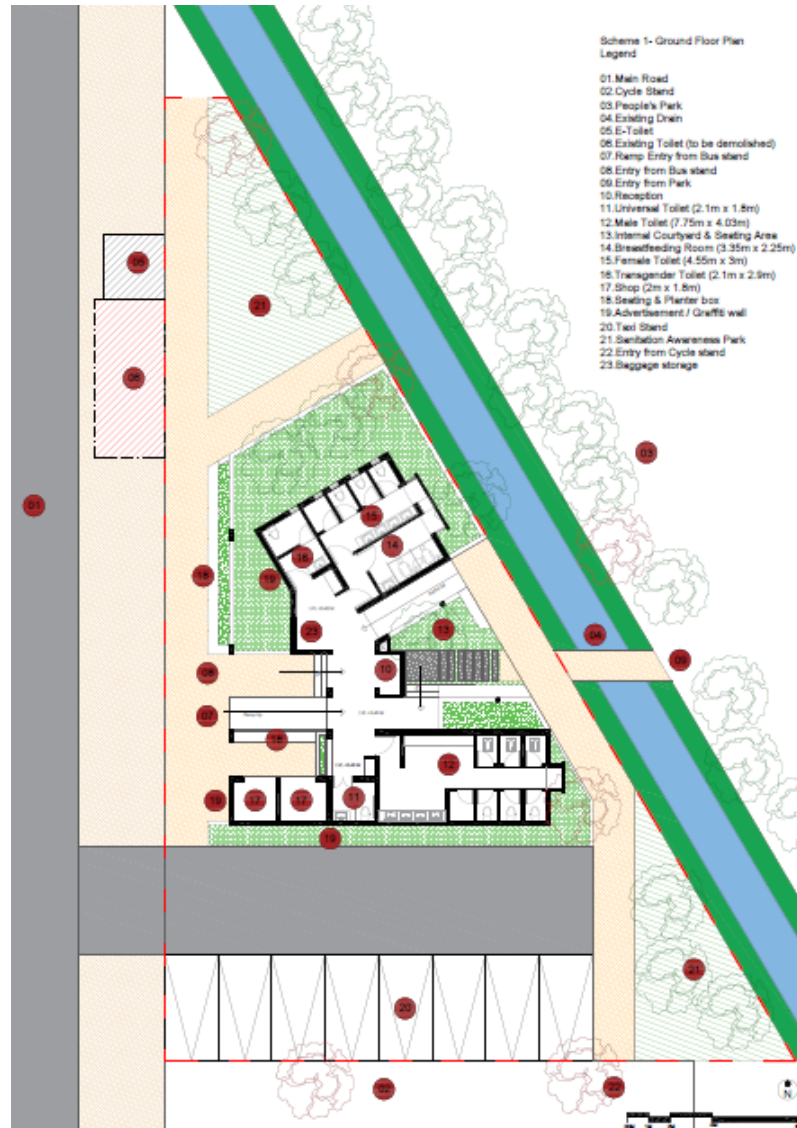
thumb rule, 5 % of total urban population is considered as floating population.

The Innovation Hub for urban Water, Sanitation and Hygiene Solutions (IHUWASH) project is implemented in three project cities Mysuru, Udaipur and Faridabad. IHUWASH project is supporting the city administrations



3D representation of layout plan for Option-I

Option I –  
Total Built-up Area = 1,150 sqft.  
Total Landscape Area = 2,350 sqft  
Setback area – 3m



Site Plan – Option I



3D representation of layout plan for Option-2

to demonstrate the innovative public sanitation facilities. IHUWASH has proposed these facility that is not only providing access to safe sanitation to people, but also integrate different elements of the facility that do not leave the space to be merely the public / community toilet.

Considering Mysuru city population which is about 1 million, nearly 50,000 is the floating population. In view of a need to increase the public sanitation facility in the city, Mysuru City Corporation (MCC) has felt need to increase the public sanitation facilities. IHUWASH is supporting MCC to develop smart sanitation facility at the proposed site near bus stand.

Post launch of Swachh Bharat Mission programme by Honorable Prime Minister, awareness about the smart toilets has increased among urban local bodies across India. In many cities including Mysuru, smart public toilets have been demonstrated. One of the striking feature of such toilets is using non-conventional construction material like stainless steel, pre-fabricated fiber super structures. Water efficient features like auto flushing, interactive mode, solar panel on rooftop etc. are now

commonly part of public toilet.

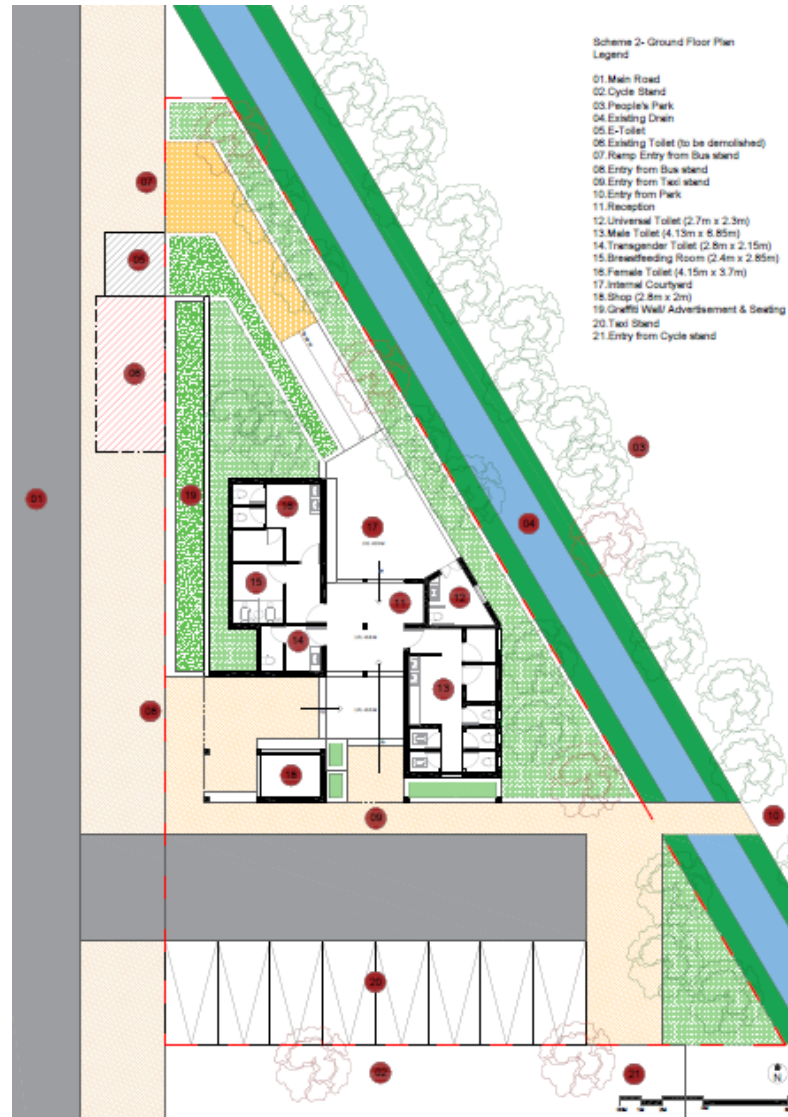
The purpose of the smart toilet is to provide innovative solutions that not only provide basic sanitation facility, but also encourage people to use toilet, and therefore prevent urination in public places. In addition, new revenue models to sustain Operation and Maintenance (O&M) are inbuilt.

Some of the key smart features that such toilets have are,

- Maintain cleanliness and hygienic conditions by controlled automatic flushing operations
- Conserve resource (water and energy) by using waterless urinals, solar panels, LED lights etc.
- Inclusive to needs of women, children with emphasis on safety and user friendly for differently abled people. Has durability with innovative construction material to prevent theft and vandalism, reduce time and cost in construction
- To make the operation and maintenance self-sustainable with additional revenue sources by provide space for advertisement, commercial space etc. To create employment opportunities



Option 2 –  
 Total Built-up Area = 1,100 sqft.  
 Total Landscape Area = 3,365 sqft  
 Set back area – front 3m and back 2m



Site Plan – Option 2



Considering requirement of MCC for the site, design of proposed smart public sanitation facility requires integration of smart technologies and user requirements. Following features are suggested for current site.

#### Essential Features

- ✓ Separate blocks for urinals and toilet (both for men and women)
- ✓ Bathing facility (Men and Women)
- ✓ Universal toilet ( friendly for differently abled ). Signage for blind people in brail language
- ✓ Provision to keep baggage in cloak room facility for commuters
- ✓ A breast feeding room
- ✓ Provision of Sanitary vending machines, incinerator for disposal of sanitary waste, child care facility
- ✓ Digital display system which indicates toilet occupancy
- ✓ Durability with innovative construction material/ reduced construction time
- ✓ Public Awareness/Advertisement with dedicated space

#### Additional Features

- ✓ Water ATM and Water conservation (rainwater harvesting)
- ✓ Safe disposal of waste (preferably in UGD /onsite treatment systems)
- ✓ Safety
- ✓ Smart technology (use of cards for entry, monitoring users automatically)
- ✓ Innovative landscaping to make it public sanitation facility than merely a toilet
- ✓ Revenue generation for financial sustainability

Current footfall at the existing toilet at the site is max. 100/day. The site is located nearby bus stand so footfall

is going to increase. Moreover, public urination is quite common, due to insufficient capacity and maintenance issues of existing facility outside KSRTC. The site has taxi stand and very busy market area.

Considering the commercial area, bus stand and taxi stand following is recommended for the site

#### Primary Requirements:-

Male	2/3 WC, Indian	Innovative Indian toilet pan design for reducing knee pain can be adopted. IHUWASH can facilitate this.
	3 WC, Western	As per requirement
	2, Bathroom	
Female	2/3-WC, Western	1 Indian 2 western
	1- Bathroom	Provision of Sanitary napkin vending machine
	1, Breast feeding room	
Transgender	1-WC	As required can be Indian
Urinals - male	5	Water less urinals OR Conventional with water sensor OR Pee Wall
	2, Handwashing stations	Separate for male/female with 4 basins

Two design options (one with multiple entry) are provided by showing above mentioned primary requirements. The designs can be modified as per the feedback/requirements suggested by the MCC. The nearby toilet despite of non-functionality has shown footfall of 100. Fully functional toilet at this high footfall location will require above mentioned toilet seats.

## ESSENTIALS IN A PUBLIC TOILET:

- ✓ Adequate signage for locating a public toilet
- ✓ Seperate entrances for men and women.
- ✓ Male and female caretakers for safety and security.
- ✓ Door and latches and hooks in working condition.
  - ✓ Adequate lighting and ventilation
  - ✓ Continous supply of electricity and water.
  - ✓ Easy access for all, including differentlyabled
    - ✓ Toilet for children.
  - ✓ Toilet paper /Water for anal cleansing
    - ✓ Soap
  - ✓ Sanitary Napkins in women's toilet
    - ✓ Dustbin with lid
  - ✓ Clean sink and fittings
    - ✓ Clear Mirror
  - ✓ Clean and Dry floors.

## About IHUWASH Project

The IHUWASH project aims to improve performance of the urban WASH sector in India by following a process of agglomeration (compilation of best practices), incubation (supporting innovative solutions) and acceleration (giving momentum to innovations). IHUWASH is a collaborative initiative of the National Institute of Urban Affairs (NIUA), lead partner; and TARU Leading Edge Private Limited, IRC and Ennovent.

## ABOUT STUDY CITIES

Three cities, Faridabad, Mysore and Udaipur from the states of Haryana, Karnataka and Rajasthan, respectively, have been selected. The aim is to improve performance of the urban WASH sector in these cities through innovative solutions. The project duration is for three years beginning 2016.

### Faridabad

The city is located in the state of Haryana and is about 32 kms to the south of the state of Delhi. According to Census 2011, Faridabad was the most populous city in Haryana with a population of 1.4 million. The Ministry of Urban Development (MoUD) ranked Faridabad's sanitation status - 33.25. It has been awarded 'Fastest Mover Big City' by Swachh Survekshan 2017, conducted by the MoUD. It achieved a rank of 88 amongst the 434 cities surveyed across India. Faridabad has been selected under the Smart Cities Mission, Atal Mission for Rejuvenation and Urban Transformation (AMRUT) and Swachh Bharat Mission (SBM): the three missions launched by MoUD.

**Project potential:** Faridabad is ranked ninth amongst the largest industrial estates in Asia and is still growing. Out of a total of 11,665 registered working factories in Haryana, 2,499 were in Faridabad. Its strategic location within the Delhi-NCR region will allow access to support from numerous government agencies and academic institutions in terms of technical and capacity building. The Smart City Mission, AMRUT and SBM are being implemented in the city. All these factors offer tremendous potential for public-private partnerships (PPPs).

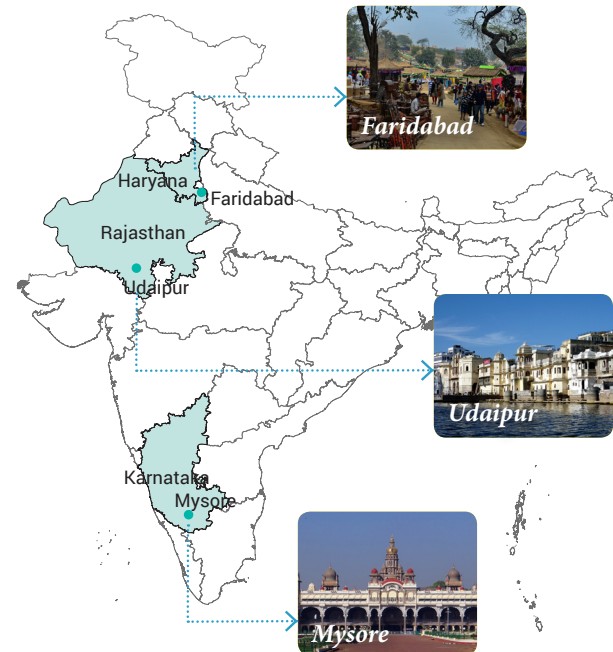
### Udaipur

Located within the State of Rajasthan, Udaipur is famous for its palaces, lakes (Pichola, Rang Sagar, Fateh Sagar, Swaroop Sagar, Badi Talab, Madar and Udai Sagar) and gardens. It is located about 430 km to the south of the state capital, Jaipur, and about 670 km to the south of Delhi. It is the sixth largest city in the state and has been selected under the Smart City Mission. In the context of sanitation the city scored only 31.95 marks out of 100, in 2009. This places it in the red category where immediate attention to public health and the environment is indicated. In the latest Swachh Survekshan 2016 conducted by the MoUD for 73 cities, Udaipur was not included. However, in Swachh Survekshan 2017, the city is ranked to 310 out of 434 cities. The city has now prepared its City Sanitation Plan (CSP) under the National Urban Sanitation Policy (NUSP). The city has also been selected under SBM and AMRUT.

**Project potential:** Udaipur has a high influx of tourists. This floating population poses a challenge to the city administration in terms of toilets, solid waste management and water supply. The Udaipur Chamber of Commerce and Industry (UCCI), a not-for-profit, industry led and industry-managed organization has supported

development of an environment park covering 100,000 sqft in the city. Apart from UCCI, there is a marble industry association and many other private industries, which can support implementation of innovative sanitation solutions. Udaipur has been identified as a smart city based on a competitive proposal submitted to the MoUD and, therefore, has demonstrated willingness to increase the existing infrastructure in the city.

## Project Sites



### Mysore (Mysuru)

The city is the second largest in the state of Karnataka, and an educational, commercial and administrative hub. It is an important tourist and heritage centre located only about 135 km from the state capital, Bengaluru. It is located in the foothills of the Chamundi Hills and stretches over 128.42 sqkm. Census 2011 reports a population of 893,062 living in 209,527 households in the city. Mysore (Mysuru) was ranked first in Swachh Survekshan 2016, however, it was downgraded to number five in Swachh Survekshan 2017. The city is not included in the Smart City Mission but is part of AMRUT and SBM.

**Project potential:** Mysore (Mysuru) had a ranking in Swachh Survekshan 2016 that indicated satisfactory sanitation services. The city leads in sanitation management and can be a model for other cities. As it has already reached an advanced stage in providing basic services, there is scope to pilot other innovative sanitation models, establish a WASH park, set up WASH laboratories, under the city administration.





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#### **Lead Implementing Partner:**

➔ **NIUA** is a premier institute for research, capacity building and dissemination of knowledge of the urban sector in India and the lead implementing organisation of this initiative. It conducts research on urbanisation – urban policy and planning; municipal finance and governance; land economics; transit-oriented development; urban livelihoods; environment, climate change; and smart cities.

[www.niua.org](http://www.niua.org)



#### **Consortium Implementing Partners:**

➔ **Ennovent** is a business innovations catalyst for sustainability. We believe sustainable solutions for low-income markets can create long-term business value. We partner with the private, public and third sectors to take novel business ideas to these markets in developing countries.

[www.ennovent.com](http://www.ennovent.com)



**Faridabad** is an important industrial hub, the most populated city in Haryana and part of the National Capital Region (NCR). It is being developed under the Smart Cities Mission, Swachh Bharat Mission and the Atal Mission for Rejuvenation and Urban Transformation (AMRUT).



**Mysore** is the second largest city in Karnataka and an important educational, commercial and administrative hub. Since the city is a tourist and heritage centre, it is covered under Swachh Bharat Mission and the AMRUT.



**Udaipur**, 'The City of Lakes' in the state of Rajasthan and is known for its picturesque surroundings and royal past. Its rich architectural heritage and beautiful lakes fascinate tourists worldwide and encourage them to visit the historic city. It is being developed under the Smart Cities Mission, Swachh Bharat Mission and AMRUT.

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