South to South Cross Learning Hub

Learning Package:

Enhancing Sanitation Outcomes Through Robust Data and Monitoring Systems and Innovative Technologies

Learning Lab on

Citywide Inclusive Sanitation Spatial Planning Approach (CWIS SPA)

INSIGHTS DOCUMENT

Index

Context

Given the work that has been undertaken in the last few years with respect to inclusive sanitation across South and Southeast Asia and Africa, there is a need that has emerged to strengthen cross learning efforts which will enable sharing of best practices and learnings, and foster increased knowledge sharing and peer to peer engagement to facilitate collective progress and achievement of outcomes.

To this end, through the South to South Cross Learning Hub, Dasra aims to provide a platform for continuous learning and sharing between sanitation sector stakeholders, and build a narrative around the journey of the region, and the strides made towards inclusive sanitation. In order to achieve these objectives, and facilitate cross learning, the key levers that will be leveraged to engage with stakeholders are learning labs, exposure visits, and codification of knowledge.

To operationalize these efforts, Dasra has curated learning packages basis the insights received from our regional partners across 3 categories; thematic, functional and geographic. Each learning package will span over 6 to 10 months, with the aim of holistically, across stakeholder groups and geographies, covering the topic at hand. The pilot learning packages are as follows:

- Leveraging Inclusive Sanitation Principles to Support Vulnerable Communities
- Enhancing Sanitation Outcomes Through Robust Data and Monitoring Systems and Innovative Technologies
- Building Sustainable and Climate Resilient Cities in Hilly Terrains
- Capacity Building to Enhance Sanitation Service Delivery

The ‘Enhancing Sanitation Outcomes Through Robust Data and Monitoring Systems and Innovative Technologies’ learning package aims to deep dive into various data and monitoring tools and systems that are being leveraged across the region to facilitate improved sanitation service delivery. Additionally, it will also explore different innovative technologies that have been introduced to ensure better sustainability in the sanitation ecosystem, along with last mile service delivery.

As a starting point, we organized the learning lab on ‘Citywide Inclusive Sanitation Spatial Planning Approach (CWIS SPA)’ in partnership with Asian Institute of Technology, Global Water and Sanitation Center (GWSC), Innpact Solutions and Shelter Associates. This session was curated basis the need that emerged from partners on better understanding the sanitation project planning and design process, and how spatial data can be leveraged to do the same.

An Introduction to CWIS SPA Tool

Genesis of the Tool

While there are various sanitation systems and technologies available, there was a requirement for an approach that prioritized financial investments for these systems and technologies. Additionally, in terms of sanitation service delivery, there was a need to ensure that marginalized communities are integrated into the value chain. Across low and middle income countries, 56% of subsidies end up in the pockets of the richest 20%, but only 6% of subsidies reach the poorest 20% of the population.[1] There was a need identified to establish a data driven method for evidence-based decision making, that was less field intensive given the conditions during the pandemic. Therefore, Technical Assistance Hub in collaboration with Innpact Solutions, Consortium for DEWATS Dissemination Society and Innovative Solution Pvt. Ltd. (guided by Ms. Neelima Thota) developed the CWIS SPA during the pandemic, which was designed to address the spatial nature of sanitation problems, leveraging individual as well as hybrid sanitation systems (both sewer and non-sewer), while prioritizing marginalized communities. Currently, this approach is led by Innpact Solutions in collaboration with GWSC.

CWIS SPA is based on geospatial intelligence and open-source data driven framework, employing comprehensive analyses and remote sensing techniques for evidence-based decision making. It encompasses the entire sanitation value chain, with a specific focus on climate and economically vulnerable communities. It has been applied in 31 cities across Bangladesh, India and Nepal, and is on track to be scaled in other South Asian countries as well.

Importance, Functions, and Outcomes

CWIS SPA answers critical questions that are required for planning and design of sanitation systems, as shown in the diagram below. This includes specific details about beneficiaries and their degrees of vulnerability, allowing for targeted service delivery. It also facilitates understanding on household level information of the beneficiaries, such as existing treatment options and other sanitation systems that can be mapped. This supports in understanding the services and infrastructure that need to be developed, including public toilets, and which type, to ensure optimization of resources. The presence of all this information results in the ability to determine prioritization and planning for the same, along with the estimation of investment required.

[1] https://www.worldbank.org/en/topic/water/publication/smarter-subsidies-for-water-supply-and-sanitation

Whom?	Where?	How?	How much?
Whom to save? Identifying number of beneficiaries for sanitation project: The people without access to sanitation system The marginalized low income communities The community vulnerable to climate induced hazard / environmental risks	Where are the beneficiaries with degree of vulnerability (geolocation)? Where is the treatment plant and other sanitation system located? Where is sewerage and non sewerage zone?	How to provide access to adequate public toilet services to users How to determine suitable toilet technology (contextual) for each of risk typology How to optimize resources? How to prioritize and plan plan investment for safe containment, safe collection and transportation of FS for all?	Resource and Investment estimations and inputs for informed regulatory designs

Further, given the importance of ensuring that sanitation service delivery is inclusive in nature, the approach is aligned with CWIS functions and outcomes, in order to ensure effective planning and design of projects, keeping inclusivity at the center.

Equity	→ Urban Poor → Climate and environment risk
Safety	→ Safety across sanitation value chain → Safe containment
Sustainability	→ Environmentally → Financially
Responsibility	→ Managed through sound regulatory system → Mechanisms for enforcement
Accountability	→ Service level benchmark → Performance monitoring indicator
Resource Planning	→ Smart management → Evidence based planning and management

Utilization of the Approach in Sanitation Projects

This approach can either be utilized as an individual tool, or in combination with other approaches, and has been used as a starting point to project planning. This tool has been leveraged for Investment Identification, Pre-Feasibility Studies, Feasibility Studies, Detail Project Reports, and Master Plans across the South Asia region.

Deep Diving into the Tool

Challenges & Considerations

Mainstreaming CWIS comes with its own set of challenges, such as resource optimization across the sanitation service chain, ensuring equitable services and identifying target beneficiaries, performance and monitoring targets, data-dependent planning, and understanding the correct mix of solutions.

Further, it is important to evaluate the following key considerations, while planning and implementing CWIS:

- **Hard to Reach**
  It is essential to understand that there are settlements which do not have access to sanitation facilities, as they are difficult to reach for the service providers. For example, in such areas, it is challenging for desludging vehicles to reach. In many such settlements, desludging vehicles cannot reach. It therefore becomes important to identify these hard-to-reach settlements, and the type of desludging vehicles which can or cannot access these settlements to ensure access of services to all.

- **Affordability**
  For the CWIS interventions to truly benefit the target beneficiaries, it is important to accurately identify which settlements comprise of urban poor who cannot afford the services. As the government data and surveys undertaken are dated, and also face the risk of manipulation, they do not provide an accurate picture of the ground reality, which makes it difficult to identify the beneficiaries. This further builds the case of open-source data platforms to have micro-level information available.

- **Climate Risks**
  As an aftermath of climate change, countries are at a higher risk of flooding, earthquakes and heatwaves. This often aggravated in context of developing countries, where low-income settlements living in informal housing are disproportionately affected. In such scenarios, access to toilets is comprised along with damage to the sewerage systems which leads to contamination. This further increases the risk of water-borne diseases, making it a public health hazard. Therefore, it becomes crucial to acknowledge the differentiated effect of climate risks and vulnerabilities on sanitation service chain and delivery and to identify the population who are most affected, while working on CWIS.

- **Water Proximity**
  Understanding the city's proximity to water bodies becomes pivotal for preventing contamination of the water bodies. Contaminated or polluted water bodies are a reflection of faulty or inefficient sanitation systems, and these locations can be identified through a GIS-based system.

- **Remote Locations**
  With settlements located in the outskirts of the cities, there comes in an additional challenge of providing desludging facilities. This increases the time taken to provide services, in turn increasing the cost of operations for the service providers.

- **Optimizing Resources**
  Since developing countries operate with limited resources, it is crucial to plan for optimal usage. In context of sanitation, resources like funds for sanitation services and available infrastructure needs to be used judicially, ensuring that all the community members have access to safe sanitation facilities. Currently, even the most well-planned systems are not able to maximize their efficiency. Therefore, it becomes important to appropriately design for optimal use, or to augment the service are of the infrastructure to enhance productivity of the infrastructure.

- **Selecting the right mix of solutions**
  Whether a sewered system is more efficient over a non-sewered system, is an ongoing debate amongst the sector practitioners, planners, and the municipal representatives. However, it is more crucial to understand the contexts to identify the modalities of treatment (sewered/ non-sewered)

When the participants were asked to vote on which of these considerations were the most pressing, ***settlements at risk of affordability of services, flooding, and polluted water bodies*** emerged as top priorities that need action.

However, to effectively mainstream CWIS planning it is vital that all of these parameters are incorporated.

Understanding the Modules of the Tool

To facilitate this holistic approach to CWIS, contextual GIS-based modules were developed by Innpact Solutions. These modules help in addressing the key considerations or challenges discussed above, and further facilitate robust planning and service delivery.

The table below highlights the six modules, and the key questions or considerations that it helps in addressing, followed by examples of implementation in various cities.

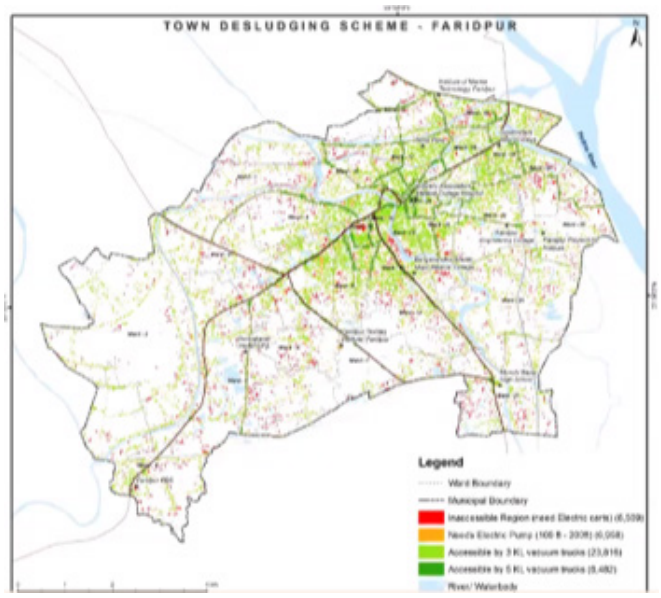
No.	Module	Key Parameters considered to address the challenges	Examples of Implementation
1.	**System Suitability Delineation across Sewered Systems (SS) and Non-Sewered Systems (NSS)**	Watershed, population density, building density, growth patterns, water proximity, bulk waste-water generating areas	Based on the composite marking and analysis of these parameters, the sewerage system in Ranchi (Jharkhand) and Raghoghar (Madhya Pradesh) were decided. Ranchi has 28% non-sewered pockets and 72% sewered areas, while Raghoghar 52% sewered systems and 48% non-sewered areas.
2.	**Safe Containment & Access to all**	Mapping different typologies such as water-logged areas, hard to reach areas, low-income settlements, etc, and evaluating their risk intensities. Based on this mapping, a variety of solutions like raised septic tank, plastic septic tank, twin pits, biogas digestors, etc. is selected.	In Sherpur (Bangladesh) a ward level mapping of these typologies was undertaken to identify the target beneficiaries.
3.	**Safe Collection and Transportation to all**	Based on the type of buildings in the settlement areas, assessing what kind of desludging track can access these regions - eventually identifying what kind of vehicles will be required to eliminate manual desludging. This analysis is compared with the existing desludging fleet, and demand is projected.	
4.	**Used Water Management**	Optimizing infrastructure for both, sewerage and non-sewerage system for grey water management, especially when there is a mix of both systems.	In Ranchi (Jharkhand), the treatment infrastructure for greywater was analysed and clubbed together with minimal infrastructure requirements. Pan-town greywater management system done in 7 towns of Bangladesh.
5.	**Resource Optimization**	Defined emptying zone for service proximity – identifying which part of settlements are located at what distance, identifying the need for a transfer station, evaluating capacity of the FSTPs and the desludging trucks for optimal planning.	In Bahadarbad (Uttarakhand), a resource optimization plan was developed at the block level. This comprised of setting up a treatment plan in the centre and integrating with transfer stations and designing the routes.
6.	**Enabling Environment**	Ensuring clear indicators for monitoring progress – undertaking holistic analysis of the available and possible options to make informed decisions. Helps in identifying intervention type, stakeholders involved, comparison with investment and funds, and identifying implementation priority.	15-year Lifecycle analysis undertaken for OP in the Bahadarbad block in Uttarakhand to ascertain its financial viability.

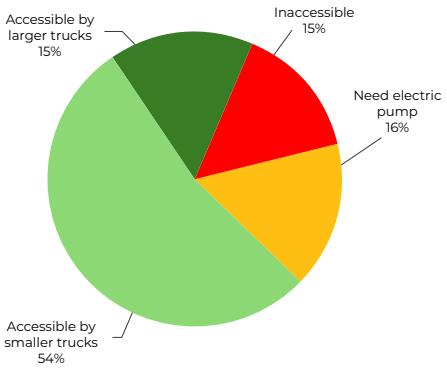
How the Tool functions

The tool leverages open-source data maps and allows for an array of geospatial analyses such as hard-to-reach assessment, waterlogging and flood risk mapping, greywater management, FSTP proximity, public toilet assessment, economic vulnerability assessment, and water proximity assessment. Theses assessments are done through layers of data sources that are relevant. A few examples of the data layers for the assessments are discussed in the table below:

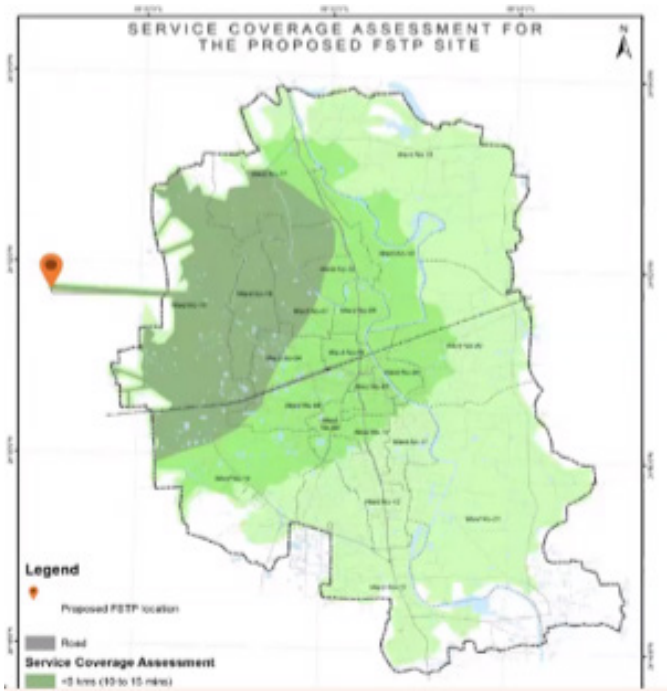
No.	Type of Assessment	Key Stakeholders and their Roles	Key Enablers
1.	**Hard to Reach Assessment**	▸ Road network with typology (Open Street Maps) ▸ Building data (Google Open Buildings) ▸ In-accessible settlements (Geospatial assessment using road networks)	▸ Assessment for road linkages type of buildings in **Faridpur, Bangladesh using open street maps and Google Open Buildings,** to understand the type of desludging vehicles that are required to ensure access
2.	**Waterlogging or Flood Risk Assessment**	▸ Elevation profile (Shuttle Radar Topography Mission) ▸ Natural drainage density (Hydrological assessment using DEM) ▸ Highest flood level of nearby river (Flood monitoring stations) ▸ Past flood/waterlogging intensity and duration (Sentinel-I SAR)	▸ Delineating streams through **open DEM for natural drainage** and for identifying watershed regions in **Birendranagar, Nepal** ▸ Using **remote sensing** to identify waterlogged regions in **Bangladesh**
3.	**Greywater Management**	▸ Digital elevation model ▸ Watershed Boundaries (Hydrological assessment in GIS) ▸ Major outfall locations (Geospatial Mapping)	▸ Using geospatial locations to identify outfall points in Ranchi, Jharkhand, using real settlement data
4.	**FSTP Proximity Analysis**	▸ Road network with categories (Open Street maps) ▸ Location of FSTP /STP (Secondary data) ▸ Geospatial network analysis by assessing travel time	▸ Travel time analysis to understand the proximity to FSTP in Ranchi, Jharkhand

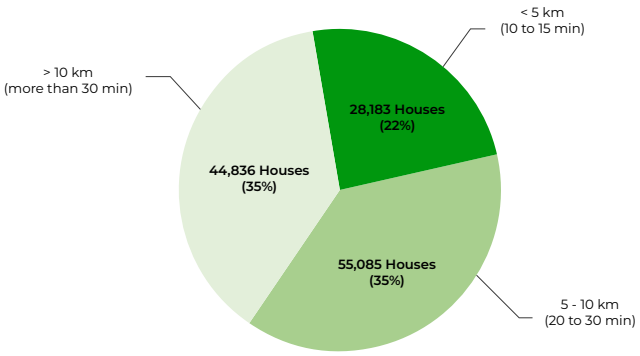
Hard to Reach Assessment - Faridpur, Bangladesh





FSTP Proimity Analysis





- Assess service coverage time and cost
- Helps in locating treatment plant
- Based on actual truck travel time

Leveraging Data to Reach the Most Marginalized

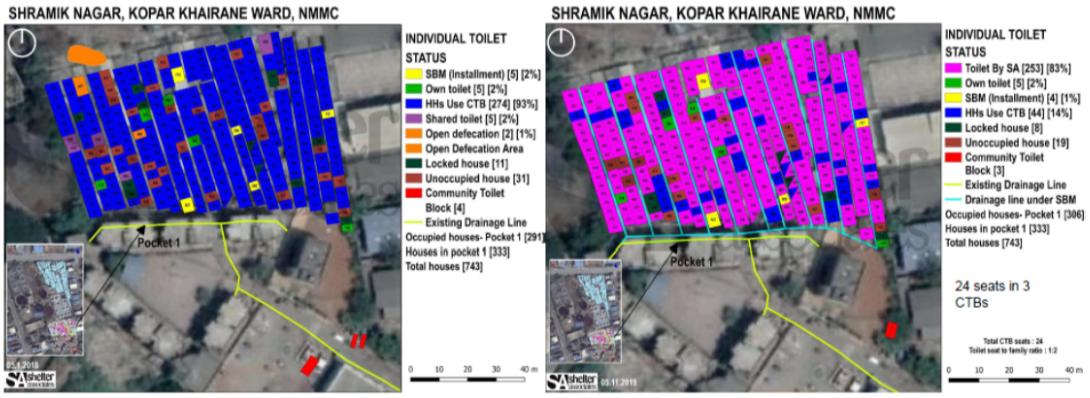
The Need for Data

Shelter Associates has kept data at the forefront, leveraging GIS and Google Earth to create spatial data. Spatial data has been identified as a crucial mechanism to map poverty and identify the most vulnerable, while facilitating planning with both a micro and macro perspective, and subsequent monitoring of projects post implementation. This data also allows for dialogue between various stakeholders, which results in sustainable solutions across the value chain, and enhances transparency and efficiency of resource allocation across processes. In order to foster collaboration, and avoid the need to reinvent the wheel, Shelter Associates has brought data into the public domain, to allow for greater access amongst stakeholders.

A study conducted by Shelter Associates showcased that Faecal Sludge Treatment Plants (FSTPs) were being highly underutilized. One key reason for this was the absence of door to door data of the municipality to understand the coverage of septic tanks. There is therefore a strong need to have granular data at a household level when planning for projects, to enable efficient and optimal systems operating on the ground. Having data for every family will then facilitate scheduled desludging, and allow for monitoring across the sanitation value chain.

A Community Centric Approach

The data utilized by Shelter Associates is co-created, while ensuring a community centric approach. Community mobilization consists of communities gathering their own data, which enhances trust, ensures reliability, and gives them perspective on availability of services in their settlement. Post this, there is a need for the government to validate this data, which builds their confidence to then use it for planning. This data is leveraged to create maps with household level information, to enable detailed tracking and delivery of interventions, providing a clear before and after comparison. Through this, toilets have been built through a cost sharing model, with Corporate Social Responsibility (CSR) funding for provision of raw materials, Urban Local Bodies (ULBs) laying drainage networks using the data and maps created, and the community completing construction at their own cost.



Shramik Nagar NMMC	Before	After
Drainage coverage	0%	98 %
Household Toilet	2%	86 %
Toilet seat to person ratio	1:65	1:10
OD status	OD slum	ODF +

Post implementation, the data is also leveraged to highlight progress made to donors for enhanced transparency, and identify and track the most vulnerable across slums through digital addressing to ensure social welfare schemes reach them. Data driven planning also allows for slum dwellers that may currently get excluded from existing sewerage networks to be included better in service delivery, and gain access to household toilets. This mapping has been taken one step further through digital addressing, providing unique IDs for households.

Impact Created

In Maharashtra, Shelter Associates has mapped and surveyed over 3,00,000 slum households, and generated plus codes for digital addresses for over 90,000 households. Through their slum rehabilitation efforts, over 9,000 individuals have been impacted, with the facilitation of construction of over 27,170 toilets in slum households, and an overall impact on over 15,00,000 people.

Kolhapur Case Study

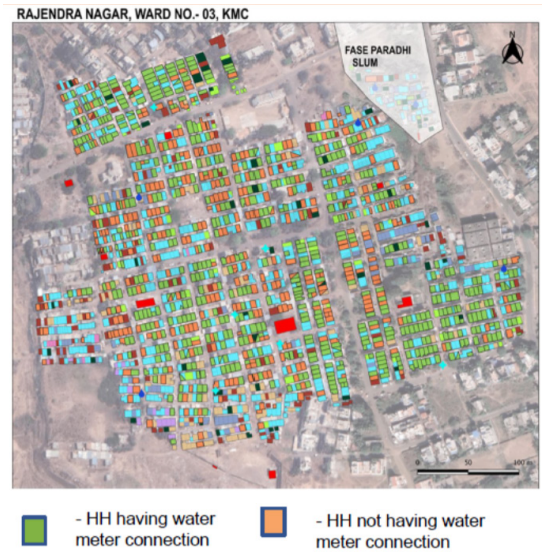
Kolhapur has a total of 56 slums, with 18,020 households, and a slum population of 72,628 people, which is 9% of the total city population. The initiatives undertaken by Shelter Associates have resulted in a citywide impact, with an increase in coverage of both drainage and home and shared toilets. This mapping also identified slums which are on reservation land, and will therefore be relocated soon, to ensure maximum efficiency of interventions.

	Drainage coverage	Coverage of home toilet + Shared toilet
Before SA intervention	19 %	29 %
After SA intervention	35 %	64 %

SA facilitated 4000+ home toilets

	Number of slums	Coverage of home toilet + Shared toilet
No. of slums with drainage network	22	68%
No. of slums without drainage network	34	59%
Total	**56**	**64 %**

Seeing the work undertaken in the sanitation ecosystem, the Kolhapur Municipal Corporation (KMC) wanted to understand the impact being made by them with reference to metered water connections in slums. Post the mapping that was conducted, KMC has gone on to integrate this data and the digital addresses into their data portal, and has mandated plus codes as a mechanism to track water meters in the city.



Conclusion

It is evident that data and analytics driven planning and implementation of sanitation services help in furthering the CWIS outcomes and functions. Having an accurate picture at the ground level through real-time data facilitates informed and contextual decision making, as reflected in the cities of India, Bangladesh, and Nepal, cited above. Some of the most crucial challenges in providing sanitation services such as access to all, safety, and disaster resilience can be solved by looking at the correct data points. Additionally, with the help of spatial planning, it is possible to develop contextual interventions that address the differentiated problems faced in various regions. It also helps in enhancing service delivery by identifying the underserved communities, and then identifying the specific sanitation challenge across the sanitation service chain. By identifying the root cause, spatial planning helps in addressing and solving challenges at scale efficiently, with minimum investments and infrastructure augmentation.

Therefore, it is essential to build capacities of the decision makers, planners, regulators, and implementers to incorporate spatial planning as an integral aspect of CWIS planning.

Annexure

Speaker Profiles

Ms. Sichu Shrestha

Ms. Sichu has worked in the field of geo-spatial analysis for more than five years. Currently, she is working with GWSC in aspects of data innovation and geospatial approaches for the water and sanitation sector. She is passionate about leveraging spatial data for a positive impact, and is dedicated to working towards resource optimization and enhanced infrastructure planning through strategic GIS approaches.

Mr. Suraj Kumar

Mr. Suraj is the CEO of Innpact Solutions and the Technical Lead for the WASH and Climate verticals. With over a decade of experience in Water-Sanitation, Tourism, and the Blue Economy in South and Southeast Asia, Mr. Suraj has collaborated with leading policy think tanks and numerous donor agencies. He has led the development of the CWIS SPA tool in partnership with GWSC and colleagues. Mr. Suraj is also the co-author of an upcoming IWA publication detailing the tool's applications and insights, which is soon to be released in the public domain.

Mr. Mithun Anand

Mr. Mithun is an Urban Planner and GIS/Data Specialist with over ten years of experience in urban planning, geospatial modelling and remote sensing. He has worked on several planning and GIS projects, such as application of geospatial CWIS planning for over 40 towns, and coastal vulnerability assessments in Odisha. As the co-founder and CTO of Innpact Solutions, Mr. Mithun applies his expertise to develop innovative tools and technologies for development sectors across the South Asia region

Mr. Thusitha K. de Silva

Mr. Thusitha is a Communications Officer at GWSC, and in his role is actively contributing to the strategic development and execution of communication plans that elevate the Center & global impact. Leveraging his strong foundation in digital communication and branding, he develops brand toolkits and designs data-driven communication strategies for narratives that resonate with diverse audiences and drive engagement with GWSC's mission.

Ms. Pratima Joshi

Ms. Pratima Joshi is the Founder-Executive Director of the NGO Shelter Associates, an NGO that designs and implements interventions in Sanitation, Social Housing, and Digital Addressing for urban slum dwellers. After completing her Bachelors in Architecture from Anna University, Chennai, and Masters-in-Architecture from London-based Bartlett School of Architecture and Planning she decided to focus on improving the built-in environment of the urban poor. She has pioneered the use of spatial data for slum development and using concepts like multi-stakeholder consultation and participative governance, she has enhanced the quality of life of 15 lakh urban slum dwellers since 1994. An Ashoka fellow, Google Earth Hero, and TEDx Pune speaker, she is recognized as an eminent social architect by BBC while also being one of the most powerful self-made women on Forbes India's 2021 list.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