Arghyam
Safe, sustainable water for all

An Approach to Integrated Urban Water Management (IUWM)

The Mulbagal Experience

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Contents

Preface

Arghyam, a charitable foundation set up by Rohini Nilekani, has been working on domestic water and sanitation in India since 2005. As a donor, Arghyam's primary focus has been grant-making to NGOs, research and other institutions in the field of domestic water and sanitation. Apart from that, Arghyam drives several initiatives as action-research projects in emerging or niche areas, where it is difficult to find grantees. They include the India Water Portal (www.indiawaterportal.org) – an online, open platform for sharing information and knowledge among the water community, and A Survey of Household Water and Sanitation (ASHWAS) in rural Karnataka to assess and share citizens perspectives. The focus in the initial years was the rural water sector.

In early 2007, Arghyam decided to venture into the urban water space and initiated a pilot programme on Integrated Urban Water Management (IUWM) in Mulbagal, a town in Kolar district, 100 kms from Bengaluru. From 2008 to 2012, several activities were taken up under this programme with a consortium of partners from government, civil society, academic, and other water sector institutions. There were some successes and failures, many challenges faced, and lessons learnt.

This document tells the story of the IUWM programme and captures the key decisions and outcomes. This document is as much about Arghyam's philosophy and approach in taking up such an initiative as it is to share the field-level complexities of the urban water sector. Hopefully, it will also provide some insights for those planning to embark on similar initiatives.

Using the IUWM programme experience and approach, Arghyam will be focussing on grant-making in the urban water sector. Arghyam is convinced that the IUWM approach offers sustainable answers to many of today's complex water-related problems plaguing our small towns. Far from being a prescriptive solution for all towns, this document articulates an IUWM approach through a set of guidelines and principles. It is an evolving effort. We look forward to refining and strengthening it with the experiences from practitioners across the country.

Arghyam
May 2012

Acknowledgements

Arghyam's effort to put the concept of an IUWM model in Mulbagal into practice has lasted five years. This idea, the realisation of which is still evolving, would not have been possible without the inspiration, hard work and commitment of many individuals and institutions along the way.

The seeds of the concept of IUWM were laid at a conference on urban water in 2007. Arghyam Advisor, S. Vishwanath has played a key role in shaping, developing and refining the IUWM idea over the years. K. Nagasreenivas, Sr. Manager of the programme led it through the initial years, laying the basis of Arghyam's partnership with the Town Municipal Council (TMC), the State Government and all other partners. With valuable advice from Mr. M N Thippeswamy (former Chief Engineer, BWSSB), management guidance of Gopal Kulkarni and the technical work of the team consisting of Mohansundar Radhakrishnan, Rimi Goswami, Revathy Rugmini, Shweta Tripathi and Monica Taparia, the early steps including the studies and investigations were taken.

The implementation phase owes its progress largely to B S Manjunatha Prasad, Head of Arghyam's Urban Initiatives. Under the able guidance of Arghyam Trustee, Anuradha Hegde, he provided the leadership and tenacity of purpose to convert the knowledge, ideas and goodwill into tangible interventions on the ground. Dr. K J Parameshwarappa, Habeeb Noor and Praveena Sridhar contributed to the implementation projects from Bangalore, while the committed K Somaiah, M M Bopaiah and G Lingaraju as members of the Programme Support Unit provided the day-to-day support to the TMC. .

As a partnership project, Arghyam must surely appreciate the work by MYRADA in the organisation of community groups, Professors Sekhar Muddu and Sudhakar Rao and their teams for their pioneering scientific studies and analysis, and Centre of Gravity for their communication work. IRAP, SEI, TTI and Conzerv partnered on the IUWM Framework, WEAP, Water Asset Survey and the Energy Audit respectively.

Senior officers of the Government including Mr. Anjum Parvez and Mr. C G Suprasanna and many others from KUIDFC, KUWSDB, Kolar DC, UDD, Slum Development Board have provided steady support and very valuable advice.

The TMC and Chief Officers led by its President Dr. Rahmatullah Khan have been unstinting in their support throughout the duration of the project.

The citizens of Mulbagal, in whose name this project was carried out, participated in the programme and generously gave their time and trust.

At Arghyam, Madhavi Purohit led the publishing of this document very professionally, managing the design, editing and publishing work. Nivedita Mani and Ayan Biswas ably supported her.

Arghyam Advisor, Ravi Narayanan's wisdom and support kept the team going through many a rough patch. Finally and most importantly, Rohini Nilekani as the Founder and Chair of Arghyam has provided understanding and support throughout the many twists and turns of this quest, helping us keep our faith.

To her, to all those named above and to everyone else who helped Arghyam on its journey, not named but surely acknowledged, my gratitude and admiration.

Sunita Nadhamuni
May, 2012

Executive Summary

Background

Arghyam initiated an action-research programme on Integrated Urban Water Management (IUWM) in the town of Mulbagal, Karnataka, in mid-2008. This initiative was taken up in partnership with the Urban Development Department (UDD), Government of Karnataka, and the Town Municipal Council (TMC) of Mulbagal. MYRADA (a Karnataka based NGO), the Indian Institute of Science (IISc), and other organisations have also supported various aspects of the programme. This document captures the process followed and reflects on the challenges and lessons which may be of use to similar initiatives.

IUWM was conceived as an approach to urban water management based on participatory principles, on integrated, source-to-sink planning, and on inclusive, sustainable interventions. The key hypotheses underlying this initiative were the following:

- By considering all the available local water sources, (ground, surface, rain, and treated wastewater), small towns may better be able to meet their water demand.
- By creating a local support institution with skilled human resources, and strengthening the capacities of the existing staff, the town would be able to improve implementation of its water-related schemes/projects.
- By involving the community in all aspects of water management through appropriately designed structures, increased equity and accountability, and higher performance of assets could be achieved.
- By adopting the principles of change management to guide and involve local stakeholders through small, incremental efforts, the larger goal of IUWM could be achieved in a phased and sustained manner.

Over the course of four years, this multi-phase initiative included first, a Preparatory phase of engaging the local and state government stakeholders and developing the partnerships. This was followed by the Foundation phase which involved a series of studies to identify issues, mobilising the local community, and setting up the Project Support Unit (PSU). Third was the Planning and design phase, during which appropriate interventions were planned, based on the evidence generated and prioritised by the local stakeholders. The fourth phase, Implementation, involved guiding the local actors in implementing a few targeted interventions. The final Operations and Maintenance (O&M) phase involved building local capacities and strengthening institutional or community structures to manage the interventions.

At the outset, it was understood that interventions in a single and sectorally defined area of urban water management might not be able to address all the issues as water shapes, and is shaped by, many intersecting areas – energy, institutions, land, social issues, and the environment. Several of the required interventions were related to legal, policy or structural aspects and were beyond the scope of this programme. It was also accepted that this approach needed a change in mindset of stakeholders at all levels, and was therefore bound to be a long-drawn-out process.

Institutional arrangements and studies

The UDD nominated the Directorate of Municipal Administration (DMA) as the nodal office for this programme. Under the chairmanship of the DMA, a State Level Coordination Committee (SLCC) was set up with representation from all the state level departments related to water management. An agreement was signed between the TMC and Arghyam expressing commitment and interest in this programme. Quarterly meetings of the SLCC were held to share progress and key lessons from the field, get approvals on decisions, explore dovetailing into government schemes, address concerns, and get suggestions. Overall, the state government was very supportive and interested in the outcomes of this experiment, and thought it had good potential to bridge the distance between state level organisations and town citizenry. Similarly, the citizens of Mulbagal were remarkably open to the IUWM experiment. Despite a few frustrations, there was restraint and maturity on all sides, with successive TMC presidents and the councillors sustaining interest.

Community mobilisation involved creating ward level groups *(sanghas)* with the elected councillor as the head. The *sanghas*, several of which were based on existing self-help groups (SHGs) that were themselves not very strong, were not very effective in acting as a platform for citizen participation. To support the TMC in taking up the IUWM programme, Arghyam set up a PSU in the town.

Several engineering, scientific, and social studies were carried out to assess the water situation in the town, including a groundwater study, water quality study, an energy audit, a household survey of water and sanitation assets, and GIS mapping of all toiletless households in the town.

The objective of the groundwater study was to model and understand the feasibility of continued dependence on groundwater for meeting the town's future needs. Over 250 bore-wells were monitored to develop a model that captured the impacts of groundwater recharge and pumping patterns. Along with the groundwater modelling, a study was also conducted to probe into water quality issues. The study involved rigorous testing of water quality in 75 drinking water wells. A total of 28 parameters were tested as recommended by the Bureau of Indian Standards Drinking Water Specifications (IS 10500–1991). Testing was conducted during the pre-monsoon, monsoon, and post-monsoon periods.

The studies showed that groundwater levels were shallow inside the town but the water quality was poor. On the other hand, water levels were deep at the outskirts of the town, but the water quality was good. The water quality study revealed a distinct pattern. The bore-wells inside the town showed high concentration of dissolved salts and nitrates, total coliform and E.coli. Comparatively, the bore-wells located on the periphery or outside town were mostly free of pathogens and nitrates. It was surmised that leachates from the household pit disposal systems had severely impacted the groundwater quality, rendering it non-potable for most parts of the town.

From the town's perspective, there were several implications arising out of these two studies. There was sufficient quantity of groundwater to meet the town's needs. Increased pumping inside the town could increase the recharge and therefore address the issue of poor water quality. Protecting the catchment of the lakes and tanks which recharged the groundwater in the town was essential. To address the issue of water quality, it had to be ensured that all households had toilets and that the toilets were connected to septic tanks or to the underground sewerage system (this was under construction at the time of writing).

An energy audit was conducted to assess the efficiency and performance of the five pumping stations supplying water to the town and evaluate the potential benefits for the TMC. The study showed that the TMC was paying huge penalties (up to 14% of the total expenditure on energy) for not maintaining the power and load factors prescribed by the Karnataka Power Transmission Company Limited (KPTCL). The causes were lower yield from bore-wells, increased water demand, wastage and leaks, and inefficient pumps and motors etc. The implications for the town were that an energy efficient water system could reduce the production cost of water supply by almost Rs. 2 per kilolitre. This would result in saving Rs. 31 lakhs annually with a total investment of Rs. 64 lakhs on the complete set of interventions. As a pilot, a pump was replaced in one pumping station and the performance enhancements and savings are being tracked.

A complete audit of the water supply system (including the pipes, valves, pumps, and all the other assets) was carried out and a GIS map of the entire grid was created. This was the basis for studying the efficiency, losses, coverage, and condition of the water supply system.

An elaborate approach for participatory planning, beginning at the street and ward level and converging into a town level plan using several tools including WEAP (Water Evaluation and Planning), was developed. However, due to insufficient traction on the ground for community participation, and limited interest in this activity shown by the town's stakeholders, the activity was considered premature and was dropped. The programme then adopted the Change Management Approach and decided to take up small focussed activities and build up participation and ownership of the town in an incremental manner.

Interventions

The studies helped to identify five main tracks as areas for intervention – energy efficiency in pumping stations, rainwater harvesting in schools, community toilets, individual toilets under the Government of India (GoI) Integrated Low Cost Sanitation (ILCS) scheme, and solid waste management. These interventions were embedded in existing programmes/schemes, approval and funding for which came from the DMA. These activities were seen as ways to address tangible issues faced by the town's population. The IUWM principles of sustainability, good governance, and empowerment of local government were implicit in the design of each activity.

The success achieved in the five intervention tracks over an eighteen month period is noteworthy. Twelve defunct community toilets were repaired and their ownership was transferred to the TMC by the Slum Board that had originally built them 10 years ago. Four community toilets were brought back to use with a community-managed model. In one of them, a caretaker has been employed by the community and is sustained by the fees paid by the households. A locally customised solid waste management initiative has been designed and is running successfully in 750 households. Wet and dry waste is segregated and collected by a newly formed local group called the *Nirmala Balaga* that takes responsibility for daily collection and disposal of the wet waste. Fees from the households are being regularly collected by the group as of May 2012. Councillors have shown interest to initiate a similar programme in other wards.

A defunct rainwater harvesting structure in a local school was also repaired and made functional. Applications for toilets for 240 households under the ILCS scheme were developed, approved by the local authority, and submitted to the Government of India (GoI). The applications are advancing slowly through the various stages of approval, and are being tracked. Proposals were prepared for pump replacements in two more pumping stations and rainwater harvesting in seven institutions. These proposals were going through a tendering process at the time of writing.

An unplanned bonus was the revival of an ancient temple tank (*kalyani*) in the town. The tank was defunct for the last 40 years, filled with garbage and weeds and infested with snakes and insects. Under the leadership of the local councillor and Arghyam, residents were employed to clean up the *kalyani*. It has generated great interest amongst many, from the community to the District Collector, and is now filling up with good quality water. Inspired by this incident, the management authority of another temple close by is also keen to clean up their *kalyani*.

There has been an increasing ownership and interest from the TMC, which has led to them taking several steps demonstrating their commitment. Land has been allocated for a solid waste treatment plant. A lake has been saved from becoming home to a wastewater treatment plant.

Close engagement with the Karnataka Urban Water Supply and Drainage Board (KUWSDB) led to several important design changes in the ongoing underground drainage system and the planned wastewater treatment plants.

In response to the water quality findings, and the resulting perception that groundwater was not safe for drinking, the TMC took the initiative to launch a project with a private sector entity to set up and run a reverse-osmosis based treatment plant on a commercial basis. Arghyam had mixed reactions to this development. A reverse-osmosis treatment mechanism is not the most environmentally friendly option, and outsourcing it to a private sector entity was outside the originally envisioned IUWM model. Still, it was good that the TMC took initiative to address a critical problem.

Lessons learnt

IUWM promoted sustainable approaches to conjunctive use of water and allowed the citizens to be a part of the planning process. The main thrust of the IUWM programme in Mulbagal was to initiate an institutional model owned and run by the local government. Many lessons were learnt while implementing the programme and they can be grouped into three categories.

The first set of lessons involves the physical water resources in towns. Today, the mainstream thinking considers surface water sources, often exogenous to the town, as the viable, safe, and sustainable option. But the reality is that the majority of the 7,935 urban bodies in India rely on groundwater to a significant extent. Groundwater needs to be studied at a fine granularity inside towns to be able to design for its sustainable use. This is true for all the local water resources like lakes and tanks, rainwater, storm water, and wastewater. Along with this, the physical systems and structures need to be audited for performance and efficiency. Most towns will have easy to address issues that can give quick, tangible returns like pump efficiency improvements, fixing systems losses, getting experts to address design flaws in new schemes etc. Studies and focussed interventions need to be carried out to avail of these opportunities.

The second set of lessons involved acknowledging the structural impediments like political pressures, public finance and bureaucratic practice that create hurdles for IUWM in small towns. At the very outset, water infrastructure decisions are taken mostly at a state level, not keeping the local and contextual realities in mind. Despite the existing mechanism for a bottom-up planning process, towns rarely have the option of charting their own path, and are more often subsumed inside a state level scheme. Government schemes like ILCS are cumbersome and complex, involving long procedures for application, lots of paperwork, and multiple levels of approval at town, district, state, and national level before funds actually reach the town. Councillors are likely to be interested in ward level, tangible, short-term improvements. Stakeholders too are not incentivised to look for long-term sustainable options at the town level. The relationship between the TMC and the state level departments is unequal, and the system is not equipped to support the TMC as a unit of self-governance.

Also, towns are short on staff, both in number and in skills, making it virtually impossible for today's small towns to conceptualise and lead an IUWM effort. The staff is constantly multi-tasking and is pulled in different directions. They work in a reactive mode under political pressure, fire-fighting to address pressing daily demands of citizens. The political culture is largely one of patronage with citizens approaching their representatives for individual services. The ability of citizens to engage for systemic solutions seemed to be severely constrained. Decisions are sometimes not driven by evidence or information, but by political motivations with little transparency in the process. The typical budgeting today provides stronger incentives for capital spending than O&M, without a closer look at lifecycle costs. How the long-term financial viability can be aligned with the short-term political interest is unclear.

The third and final set of lessons came out with the discovery that, under these circumstances, the Change Management Approach offered a rational and feasible way to help small towns move incrementally towards IUWM. It involved connecting with the leadership of the target audience, connecting with key stakeholders, triggering ideas among stakeholders, providing guidance on options to implement the ideas, and facilitating them to execute the ideas through training and mentoring. This brought about an attitudinal change in the stakeholders as they realised the possibilities of improvement. It also resulted in a ripple effect, since suddenly people saw themselves as potential change agents. With guidance and support, the TMC and citizens rose to the occasion, participating enthusiastically in the efforts. This was seen in three projects at least: the solid waste management project which was run by the youth from the area, in the *kalyani* cleanup which inspired another temple community to clean up their tank, and in the smooth functioning of a public toilet run by a caretaker from the community. At all times, Arghyam played the role of a change agent and mentor, not the executor. In fact, Arghyam did not pursue ideas which did not resonate among the stakeholders.

It was also realised that constant guidance was essential for the progress of the programme. If towns are to be more autonomous, they urgently need some enhancement in planning and execution skills in conjunction with access to expert advice. Feedback received from all levels (TMC, DC, DMA) reinforced the importance of technical and strategic guidance to small towns to manage their water.

Due to the complex nature of the IUWM programme (multiple phases, variety of activities, and a large number of stakeholders), several changes were made in the team composition – both internally and externally. Dynamic decisions were made in plans and budgets. Hence analysing the resources required for individual phases is a challenging task, and is beyond the scope of this document.

Way forward

Going forward, Arghyam will adopt a multi-pronged approach to extend the IUWM initiative in other areas.

- First, efforts will be made to deepen the intervention in Mulbagal and facilitate the creation of a town level WatSan council. The role of Arghyam will be to provide direction in strategic issues and facilitate the TMC and citizens to execute the programme. This could also involve replicating this experiment in other towns by building capacity of the TMCs, lightly overseeing the execution, and helping the towns progress on their own initiative. In Mulbagal, Arghyam intends to create a research partnership and observe the town's journey in IUWM.
- Second, Arghyam will make grants in the urban WatSan sector to experiment with different working models of IUWM. It will fund NGOs in multiple towns to develop community-based, decentralised and sustainable water management models following the IUWM principles. These could include community toilets, water and sanitation in schools, rainwater harvesting, water body restoration, special initiatives in slums, and institutional strengthening.
- Third, Arghyam will engage with policy research agencies to explore the structural impediments in IUWM and the impact of policies on the sector, e.g. public finance requirements, incentives, human resources, coordination between departments, and devolution of power. This will form the basis for advocacy efforts at various levels.

An approach which combines all the above could be a practical solution to create impact on the ground. It will help generate field evidence and influence policy-makers. This will also be a major step towards the development of an IUWM framework, especially for smaller towns.

List of Figures

Acronyms and Abbreviations

AIILSG	All India Institute of Local Self Government
ASHWAS	A Survey of Household Water and Sanitation
CGWB	Central Ground Water Board
DC	District Collector
DLCC	District Level Coordination Committee
DMA	Directorate of Municipal Administration
DSP	Deputy Superintendent of Police
DSS	Decision Support System
DUDC	District Urban Development Cell
E.coli	Escherichia Coli
GIS	Geographic Information System
GLR	Ground Level Reservoir
GoI	Government of India
GoK	Government of Karnataka
GPS	Global Positioning System
GRWB	Geo Rain Water Board
HUDCO	Housing and Urban Development Corporation
IEC	Information Education and Communication
IISc	Indian Institute of Science
ILCS	Integrated Low Cost Sanitation
IRAP	Institute for Resource Analysis and Policy
ITS	Inner Town Series
IUWM	Integrated Urban Water Management
KPTCL	Karnataka Power Transmission Corporation Limited
KUIDFC	Karnataka Urban Infrastructure Development and Finance Corporation
KUWSDB	Karnataka Urban Water Supply and Drainage Board
LDA	Lake Development Authority
Lpcd	Litres Per Capita per Day
LT	Low Tension
MDWS	Ministry of Drinking Water and Sanitation
MLD	Million Litres per Day
NGO	Non Government Organisation
NSS	National Sample Survey
O&M	Operation and Maintenance

Acronyms and Abbreviations

OHT	Overhead Tank
OTS	Outer Town Series
PS	Pumping Station
PSU	Project Support Unit
SEB	State Electricity Board
SEI	Stockholm Environmental Institute
SHG	Self-Help Group
SLCC	State Level Coordination Committee
STP	Sewage Treatment Plant
SWM	Solid Waste Management
TDS	Total Dissolved Solids
TLWG	Town Level Working Group
TMC	Town Municipal Council
UDD	Urban Development Department
UIDSSMT	Urban Infrastructure Development Scheme for Small and Medium Towns
ULB	Urban Local Body
WatSan	Water and Sanitation
WEAP	Water Evaluation and Planning
WNNS	Ward *Neeru Mathu Nairmalya Sanghas*
WSP-SA	Water and Sanitation Programme – South Asia

Glossary

Anganwadi	A government sponsored day care centre for children in the 0-6 age group
Kalyani	Temple tank
Sangha	Group
Nirmal Bharat Abhiyan	A government programme aimed at providing basic toilet facilities to the urban poor at a minimum cost
Kabadivalas	Scrap/junk dealer
Nirmala Balaga	The SHG for collecting segregated solid waste in the pilot area of Mulbagal
Pourakarmikas	Municipal sanitary workers
Shramdaan	Voluntary contribution through physical labour
Jala Jagruthi	Programme name for IUWM in Mulbagal

1

The urban water situation in India

There are 7,935 towns (as per Census 2011) in India and the number is rising with many big villages emerging as towns. According to the Census 2011 (provisional), the urban population of India is 377 million, representing nearly 31% of the total population.[1] However, the growth in urbanisation has not been matched with development of infrastructure. A large number of Indian cities and towns have a pressing need for adequate infrastructure facilities, especially in the areas of water supply and sewerage systems, solid waste management systems, roads, transportation, and housing.

The water situation in urban India looks bleak. Performance indicators on varying aspects, from the status of municipal water assets and systems, to the quality of water and sanitation related services in terms of coverage and reliability, and the environmental condition of water resources within and outside the town, all show that towns perform poorly with respect to water management. Various studies done across the country on each of these areas provide evidence on this.

In India, 64% of the urban population is covered by stand-posts and individual connections.[2] The duration of water supply is between an hour to six hours in most cities. Metering of water connections is low in Indian cities. 70% of water leakages are from pipes for consumer connection and due to malfunctioning of water meters.[3] According to the 65th round of the National Sample Survey (NSS),[4] about 74% of urban households were served by piped water supply. The rest were covered by other sources such as tube wells and hand pumps. About 11% of urban households had no latrines. 8% were using pit latrines and 77% of urban households were using either septic tanks or flush latrines. Monitoring of water quality in Indian cities is haphazard and water supply is of questionable quality as indicated by several reports and surveys.[5]

The historical experience of urban water governance in India is limited. It will be safe to conclude that, in general, most municipalities and town councils are underfunded and poorly governed. Consequently, standards of basic urban services – including water and sanitation – are appalling.

The underlying causes for these problems range from poor implementation of policies and programmes and lack of suitable technologies to poor governance and weak capacities on the ground. Water is managed in silos with multiple institutions having responsibility for different aspects of water. For example, groundwater, water quality, lakes, storm water drains – all impact each other, but each is managed by a separate government department. There is a thriving informal sector filling the gaps in access or quality like water tankers, bore-well diggers, or bottled water providers that are not included in the overall planning. In addition, with close to 30% of

1 http://censusindia.gov.in/2011-prov-results/paper2/data_files/india/paper2_at_a_glance.pdf
2 Report on Indian urban infrastructure and services, 2011, High-powered Expert Committee for Estimating Investment Requirements, Ministry of Urban Development, Government of India. http://niua.org/projects/hpec/FinalReport-hpec.pdf
3 Ibid
4 National Sample Survey, 65th Round (2008-09), Ministry of Statistics & Programme Implementation, Government of India.
5 McKenzie, D and Ray, I. 2009, Urban water supply in India: status, reform options and possible lessons, Water Policy, Vol. 11, No. 4, pp 442–460

urban India living in slums, equity in water service delivery is a big challenge and a priority.

There are insufficient models to handle the trickier problems of sustainability – financial models for tariffs, cost recovery, subsidies, lifeline water for the poor, environmental models that include decentralised, small-scale and community-based systems, technical models to handle ageing/poor infrastructure, weak O&M capabilities, and lack of good data to drive decisions, and institutional models designed to address fragmented responsibilities, weak local capacities, lack of community participation, and low system efficiencies. There is an absence of plans for issues and externalities like conflicts, disasters, climate change, growth, migration, and pollution.

Urban water is currently being managed under a certain institutional paradigm. There are state level water utilities or departments with the mandate for urban water supply and sewerage. Financing flows from central government schemes, development banks, state governments etc. Thus, currently planning for small towns is done at the state level, with little room for accommodating the individual town's needs and constraints, or for building the town's own capacities or resources. There tends to be a supply-side, engineering focus to addressing water demand, which often leads to over-allocation and scarcity.[6] With the exception of large cities and metros, urban local bodies run and maintain these systems with their meagre funds and capacities. Regulatory systems are non-existent or weak, and there is little transparency in decision-making or the financials. Given the opaque nature of the existing model, citizens play no role at all in the whole process.

6 Coping with water scarcity: Challenge of the twenty-first century, UN-Water, 2007, http://www.fao.org/nr/water/docs/escarcity.pdf

2

The IUWM approach

2.1 The case for IUWM

Evidence shows that in a diverse country like India, solutions have to be designed for the local context in order to be effective. A 'one-size-fits-all' approach does not work. Secondly, when the powers, responsibility, and resources for implementing solutions are devolved to the local government, as per the 74th Constitutional Amendment, the ownership is higher, the accountability is greater, and solutions are more likely to sustain over time. This twinning of power with responsibility is what will make administration effective. Thirdly, given the increasing pressure and competition for natural resources like water, small towns do not have either the financial power or the influence to wrest external water resources from surrounding rural areas, let alone other larger cities and industries. Negotiation for water is more difficult for smaller urban centres that have lesser say on the water stored at distant reservoirs.[7] Hence, it is prudent for small towns to plan largely around their local resources.

Finally, the flow of water doesn't follow departmental or administrative boundaries. When wastewater from the home is let out into a storm water drain and then into a lake, it automatically becomes the concern of multiple agencies. When groundwater is over-exploited for agricultural purposes, and the drinking water is also extracted from the same aquifer, it may lead to contaminated water, making it a cross-departmental and competing use issue. Hence the need for an IUWM approach addressing the social, technical, institutional, financial, and environmental aspects while looking at the rural, peri-urban, and urban water continuum.

2.2 What is IUWM?

It is in the above context that Arghyam's IUWM programme was conceptualised. It is to respond to the question, 'how would an urban local body assure reliable access to water for all its citizens and manage its water resources in the most effective way?'

Internationally, IUWM approach broadly means managing freshwater, wastewater, and storm water as components of a basin-wide plan in an urban area. For developing countries like India, issues of universal access to water, assured water quality, safe sanitation, and strong governance gain prominence.

2.3 IUWM principles

The IUWM approach is based on three core principles as the basis for a sustainable and equitable urban water model. These are:

7 Patel, A. and S. Krishnan (2008). Groundwater situation in urban India: Overview, Opportunities and Challenges. Urban Water Supply and Sanitation: A Management Perspective. M. J. Iyer. Hyderabad, ICFAI University Press

1. Sustainability
   - Closing the urban water loop and integrating all aspects of water from source to sink.
2. Good governance
   - Balancing the demand, supply, and resource availability.
   - People's participation in all stages.
   - Universal access to water and sanitation facilities.
3. Empowering local government
   - Subsidiarity, i.e. decisions are made at the lowest appropriate level – giving priority to managing water resources locally.
   - Empowering, strengthening, and building local institutions to be able to carry out these functions.

These principles have been derived from the work of Arghyam's NGO partners in the rural areas, who have decades of experience in sustainable water management as well as from Arghyam's own experience.

The key hypotheses underlying this initiative were the following:

- By considering all available local water sources, ground, surface, rain, and treated wastewater, small towns may be able to meet their water demand.
- By creating a local support institution with the necessary skilled human resources and strengthening the capacities of the existing staff, the town would be able to improve implementation of its water-related schemes/projects.
- By involving the community in all aspects of water management through appropriately designed structures, increased equity, accountability, and higher performance of assets could be achieved.
- By adopting the principles of change management to guide and involve local stakeholders through small, incremental efforts, the larger goal of IUWM can be achieved and sustained in a phased manner.

2.4
In practice

In practical terms, IUWM is the local government making informed decisions about the kind of schemes it needs and the kind of finances that will be required. It is promoting conjunctive use of local water sources – surface and groundwater along with recycled wastewater and storm water – instead of reliance on a single, external source. It is making spaces for citizens, especially the poor, to participate in the decision-making and getting their issues redressed. It proposes that the urban local body (ULB) renovate existing systems and augment supply through alternative sources instead of new, infrastructure-heavy solutions.

3

The IUWM process

The high level process of the IUWM approach consists of five phases.

The **Preparatory** phase involves setting up the partnerships with the town, state level government departments, NGOs and other key expert partners for the scientific and engineering studies. In the **Foundation** phase, scientific studies are carried out to understand the water situation in the town. The community is mobilised, ward level groups are formed, and capacities of local municipal staff and the council are strengthened. In the next **Planning and design** phase, a participatory plan is developed by the people and the local government for water management in the town. The plan, based on the results of the studies of the previous phase, reflects the actual needs of the people as well as the unique situation of water in that town. It is guided by IUWM principles of sustainability. Interventions are chosen from best practices tried elsewhere or locally evolved. Given the complexity and challenges on the ground, this is not envisioned as a one-shot process. Small steps must be taken in each year's plan to build upon the previous year's interventions.

In the **Implementation** phase, this plan is then presented by the TMC to the state level bodies for funding and implementation. Ward level groups are trained to play a role in the solution being implemented. Financing for the interventions is arranged by the local government through their own funds, from different schemes available to them, or as grants from the state government.

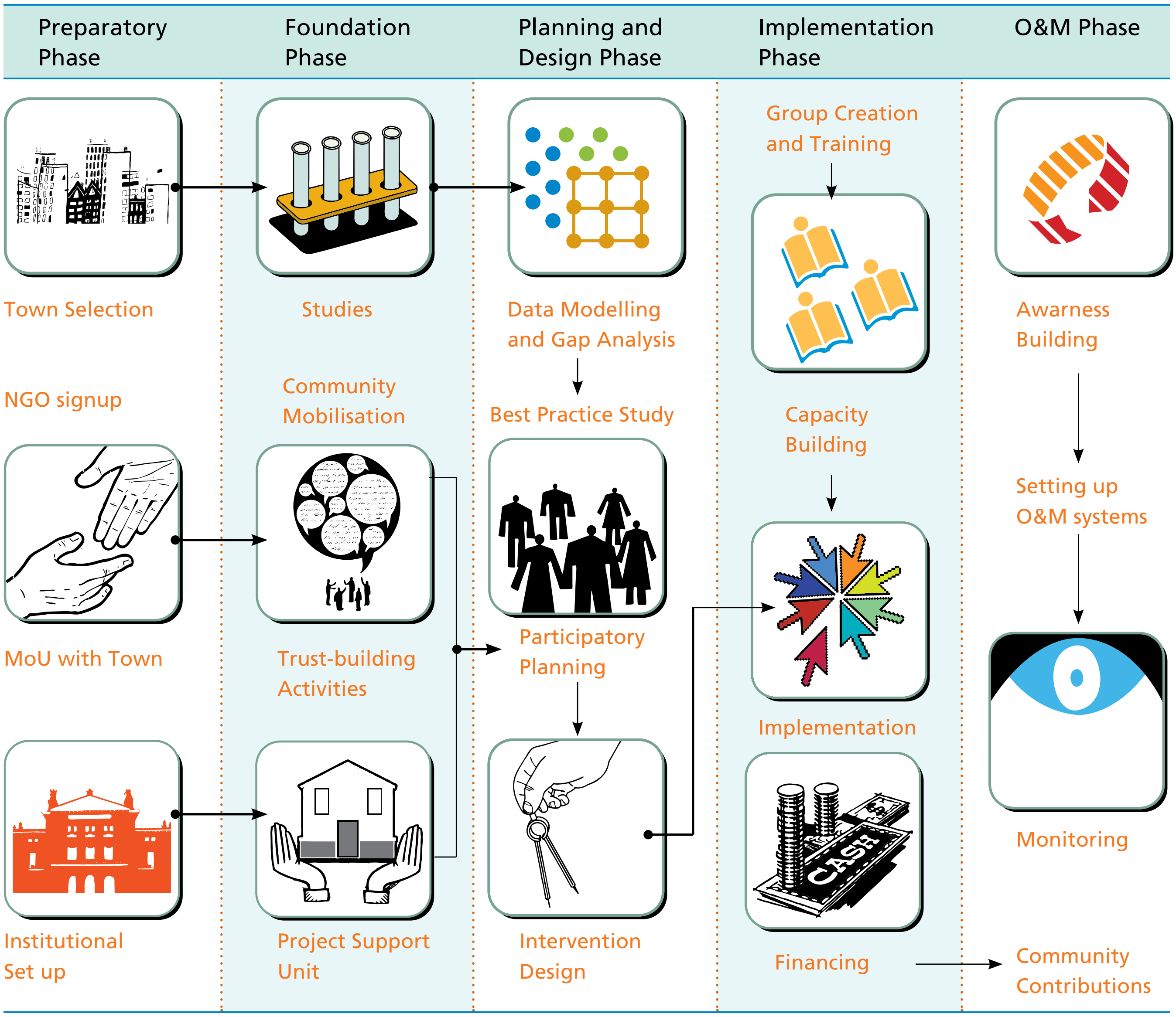
In the final **Operations and Maintenance** phase, systems are set up for effective operational and financial functioning. The town council and ward groups will stay involved in the operations and maintenance thereafter. This entire process is repeated every year, making incremental progress towards IUWM. A detailed timeline of the programme as it rolled out in Mulbagal is given as Annexure.

At the outset, it was understood that interventions in a single, sectorally defined area of urban water management would not be able to address all the issues, since water shapes, and is shaped by, so many other intersecting areas, such as energy, institutions, land, social issues, and the environment. Several of the interventions needed could be legal, policy-related or structural and therefore, beyond the scope of this programme. It was also accepted that this approach needed a change in mindset of stakeholders at all levels, and consequently was bound to be a long-drawn-out process.

What this document does not cover is an analysis of the financial and human resources as well as the time taken for the different phases in the programme. This was a complex action-research programme with multiple phases and activities, with a large number of diverse stakeholders and partners driving these activities. There were many changes in the internal and external team composition over the five years, and dynamic planning and budgeting decisions were made to accommodate the lessons from the field. Hence this analysis will be a challenging exercise that has not been undertaken yet.

The sections that follow briefly describe the process, activities and Arghyam's experience from the IUWM pilot programme in Mulbagal town. While the process flowchart given below represents the conceptual phases that an IUWM approach would involve, some of the ideas could not be implemented owing to practical constraints and the field realities.

Figure 1: Five phases of the IUWM process



4

Preparatory phase

4.1
Town selection

The first step was identifying the town based on several criteria. It had to be small enough (under 100,000 in population), be located in Karnataka and preferably close to Bengaluru, be representative of other small towns in the country, have credible local partners for Arghyam to work with, and be politically uncomplicated to manoeuvre. Most importantly, the town and its elected representatives would have to be keen to take up this programme and come forward. It could not be thrust upon them by an external organisation. Discussions were held simultaneously with the state level government departments responsible for administration of these towns.

From the 220 ULBs in Karnataka, 16 were shortlisted based on secondary data and this was further narrowed to five – Doddaballapur, Chikaballapur, Tiptur, Harihara and Mulbagal. All five towns were visited, questionnaires were filled, and data related to the selection criteria was collected. Interactions with the president, councillors, commissioner, engineers, and accounts officers were held to gauge their interest in the programme.

At the end of this six-month process, Mulbagal was selected as it best met the above criteria. An MoU with its TMC was signed with the approval of the UDD, Government of Karnataka (GoK).

A brief profile of Mulbagal

Mulbagal is a Class III town according to the Census data of 2011, meaning that it has a population between 20,000-49,999. It is located in the Kolar district of Karnataka, spread over a geographical area of 9.8 square kilometres. The town population was close to 50,000 in 2008 when the project was initiated and consisted of about 14,000 households. About 31% of the total population resides in 16 slums (14 registered and 2 unregistered). The TMC is administratively divided into 27 wards with a population ranging from 600 to 4,350 people per ward. The TMC has a 27 member council, headed by the president.

The annual rainfall of the town varied between 570-875 mm. Mulbagal lies in an over-exploited zone as classified by the Central Ground Water Board (CGWB) and the Department of Mines and Geology, Karnataka. The subsequent groundwater study showed that the depth of groundwater inside the town ranged from 4 to 14 metres. With absence of viable surface water sources, Mulbagal's water supply is totally dependent on groundwater drawn through bore-wells in and around the town. The town water supply system consists of 114 municipal bore-wells (all 114 wells are not operational all the time due to various reasons), five pumping stations, and one ground level reservoir (GLR) which supply water to different parts of the town. The town also has a few lakes and tanks. The water supply to the population is through 3,841 domestic connections and 741 public taps which do not have any metering system. The town does not have an underground drainage system. Waste disposal is mostly through septic tanks but waste from those defecating in the open enters the storm water drainage system.

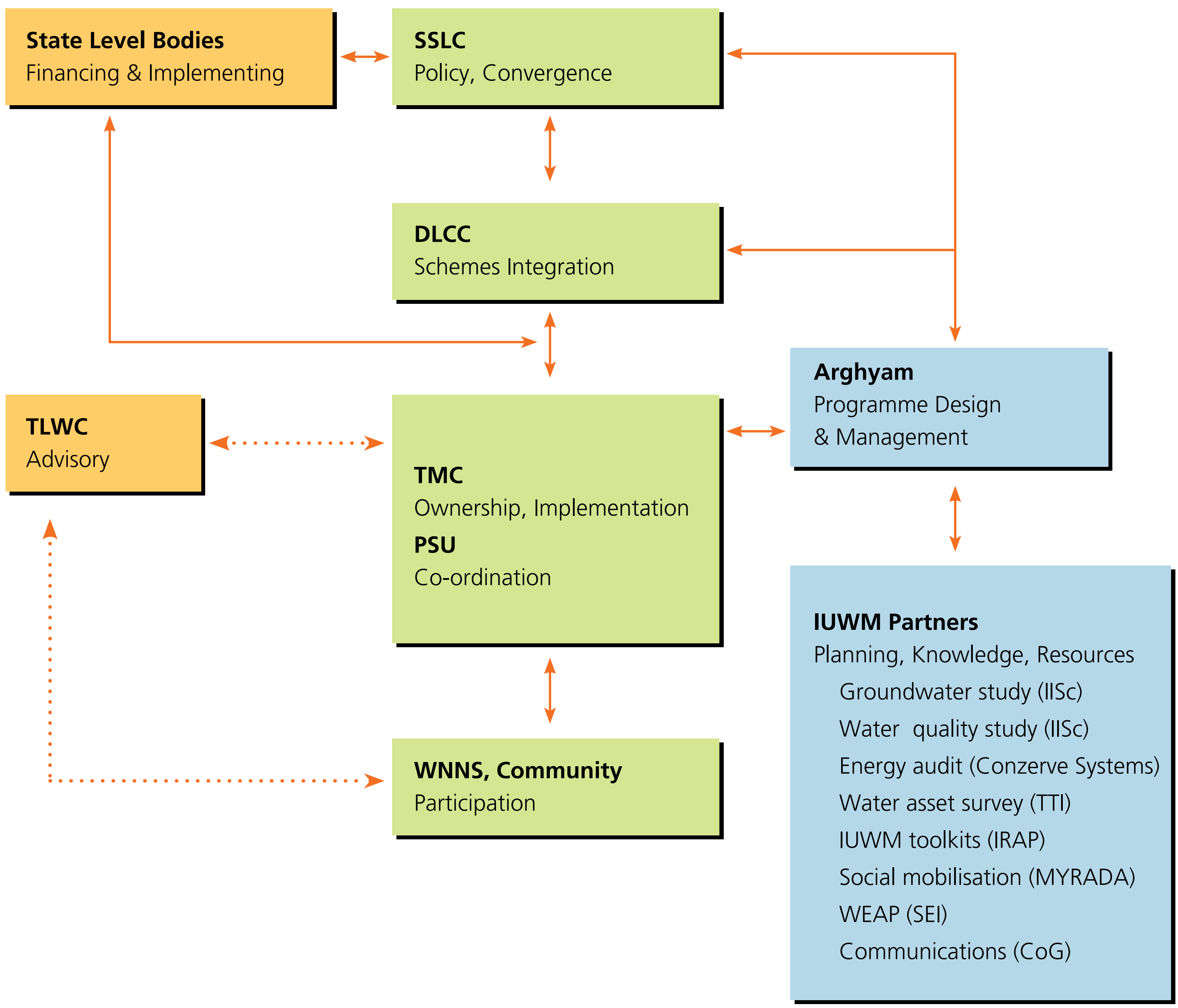
4.2
Building partnerships

At the state level, a State Level Coordination Committee (SLCC) with the Commissioner, DMA as the nodal officer was created. The SLCC had representation from the UDD, Karnataka Urban Infrastructure Development Finance Corporation (KUIDFC), Karnataka Urban Water Supply and Sewerage Board (KUWSDB), Mines and Geology Department, Lake Development Authority (LDA) etc. This was important because a key pillar in the IUWM approach was the integration between various government agencies responsible for water and the SLCC was a space to facilitate such integration. From the beginning, the state government was very supportive and interested in the outcomes of this experiment, and thought it showed potential as a sustainable model for urban water management. The DMA Commissioner chaired the SLCC meetings and proactively offered suggestions in various phases of the programme. The funding for various activities was approved by him.

An attempt to create a similar body at the district level – District Level Coordination Committee (DLCC) with the district level officials of the above departments – was not successful, partly because Arghyam could not follow through. In the final year of the programme, the current District Collector (DC) showed much interest in the work done in Mulbagal, ensuring more funding and helping to clear administrative hurdles. Given the sparse staffing at the TMC, a Project Support Unit (PSU) was created in Mulbagal to support the TMC, at Arghyam's cost. The PSU with three members having engineering, social mobilisation, and coordination skills was based in Mulbagal and served as a secretariat to the TMC on all IUWM activities. It had the responsibility to coordinate between local and external partners, and carry out the town level activities in conjunction with the TMC staff. The Town Level Working Group (TLWG), an advisory group of town leaders and respected heads of local institutions, was never formed due to time and resource constraints. The town stakeholders were remarkably open to the IUWM experiment, and despite a few frustrations, there was restraint and maturity shown by all sides, with successive TMC presidents sustaining interest along with the councillors.

Discussions were held and partnerships initiated with two departments of IISc to undertake scientific studies in the town. Vendors were engaged for technical studies. MYRADA, a reputed grassroots NGO was signed up as a partner for the community mobilisation work. This included the setting up of ward level citizen groups or Ward *Neeru Mathu Nairmalya Sangha* (WNNS) to represent the ward on water and sanitation issues and engage with ongoing activities. 27 *sanghas* were created and existing SHGs have been brought into these *sanghas*.

Figure 2: Institutional structure and roles for IUWM in Mulbagal



5

Foundation phase

This phase included the studies of the water resources and systems in the town, the community mobilisation activities, and the PSU formation.

There were six studies that were carried out in total. They included the groundwater study, the water quality study, the energy audit, the household water and sanitation survey, the water asset survey and the toiletless household mapping.

5.1
Urban groundwater behaviour study

5.1.1
Background

Groundwater acts as a decentralised source to provide 'safe drinking water' for millions in rural and urban areas. It accounts for nearly 85% of rural domestic water needs and 50% of urban water needs (Kumar and Shah, 2004).[8] As urbanisation increases, towns and cities become more dependent on groundwater, formally or informally, to meet their growing water demand. Urbanisation modifies the groundwater cycle impacting well yields, deteriorating the quality and reducing the base flow. Hence it is important to scientifically understand the behaviour of urban groundwater systems for planning water supply and sanitation systems for a town.

5.1.2
Objectives

A three year study (2008–2011) of Mulbagal's groundwater was carried out by Dr. Sekhar Muddu, Associate Professor, Department of Civil Engineering, IISc, Bengaluru. The objective was to develop a hydro-geological model which could guide the town in decision-making, simulate the groundwater system under future scenarios, and provide inputs into policy formulation.

5.1.3
Process

Mulbagal depends entirely on the groundwater pumped (~ 5 million litres per day, MLD) from within, and in the neighbourhood of the town by the municipality through 100 plus wells. A minor fraction is pumped privately by the residents. The existing baseline data of Mulbagal's groundwater comes from the CGWB which has been monitoring a single well near the town, three times a year between 1978 and 1996. In 2000, an additional observation well inside the town was added. This granularity is insufficient since the entire town would not have the same behaviour with respect to groundwater use and aquifer response. For this study therefore, an extensive and innovative groundwater level monitoring network covering 250 bore-wells was set up.

Activities under the study included analyses of spatio-temporal behaviour of groundwater levels, spatial variations in recharge and bore-well yields with respect to rainfall variations, calculating the groundwater balance at the scale of an administrative ward as well as for key pumping stations in the town. Models were developed to estimate the fraction of groundwater recharge from rainfall and that due to leakage from water and wastewater utilities. The groundwater model was calibrated and used for simulations and future scenarios. It was validated over the years 2008–2011.

8 Groundwater Pollution and Contamination in India: The Emerging Challenge; M. DInesh Kumar and Tushaar Shah, International Water Management Institute (IWMI); 2004

5.1.4
Key findings

The bore-wells supplying the town can be categorised into a set of Inner Town Series (ITS) bore-wells that are mostly located inside the town and Outer Town Series (OTS) or Pumping Station (PS) bore-wells that are located outside or at the periphery of the town.

The study found that the groundwater levels are quite stable across the three years of the study period at various locations in the town. The groundwater level fluctuation between wet and dry months for the ITS wells is relatively small when compared to the PS wells.

The recharge due to leakage of wastewater was estimated to be 50% of the pumping value from the municipal wells.

The study showed higher than average pumping in the PS wells, lesser for the ITS wells and average pumping in the rural agricultural area. On an average, estimated pumping in the PS wells varied between 4.5-5.5 MLD and in the ITS wells varied between 0.5-0.75 MLD.

The groundwater level inside the town, which is at a higher topographic level, is shallow. Outside the town, towards the valleys, the groundwater level is relatively deeper. This is a non-classical hydrological behaviour and may have resulted from the higher pumping in the shallow topographical regions outside the town, bringing of this pumped water to the town, and causing a daily recharge by the generated wastewater within the town and leakages from the water supply system. There is also an underground dyke running alongside the edge of the town that may be an influencing factor in the groundwater levels.

The pumping stations also showed higher recharge, while there was average recharge over the town and rural areas. The higher daily extraction at the pumping station areas lead to higher decline of groundwater levels, which in turn facilitated better recharge.

The scenarios modelled and their impacts were:

1. Scenario A – Impact of future decade of low rainfall on the groundwater levels.
2. Scenario B – Impact of low rainfall on groundwater recharge by lakes and tanks when they do not fill up to their full capacity.
3. Scenario C – TMC decides to augment the town's water supply by digging more wells at the pumping stations, or increasing the hours of pumping, or using higher capacity pumps.
4. Scenario D – Impact of lowering groundwater levels due to a functioning underground sewerage system. Currently, shallower groundwater levels inside the town are attributed to leakage of sewage from septic tanks and pits.
5. Scenario E – Combination of scenarios B and D, i.e. reduction in recharge due to lakes and tanks not filling up and a functioning underground sewerage system.
6. Scenario F – Combination of scenarios B, C, and D. This is a realistic scenario operating in the town in the near future.

Figure 3: Simulations of rainfall, 2008-2021

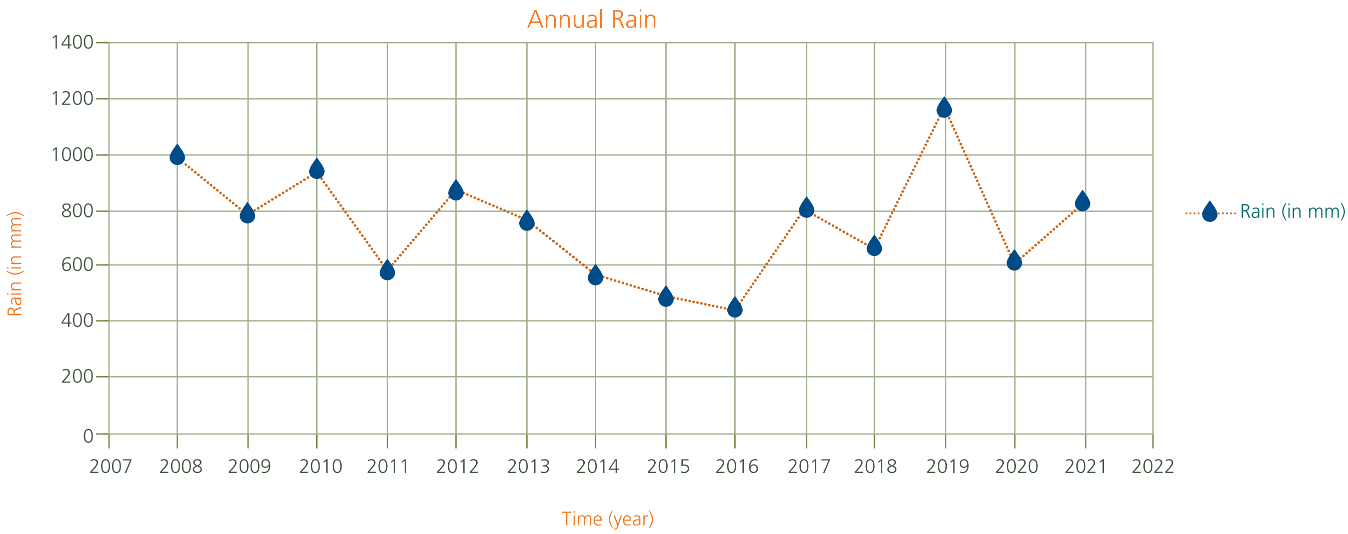


Figure 4: Observed Groundwater Levels, May 2009

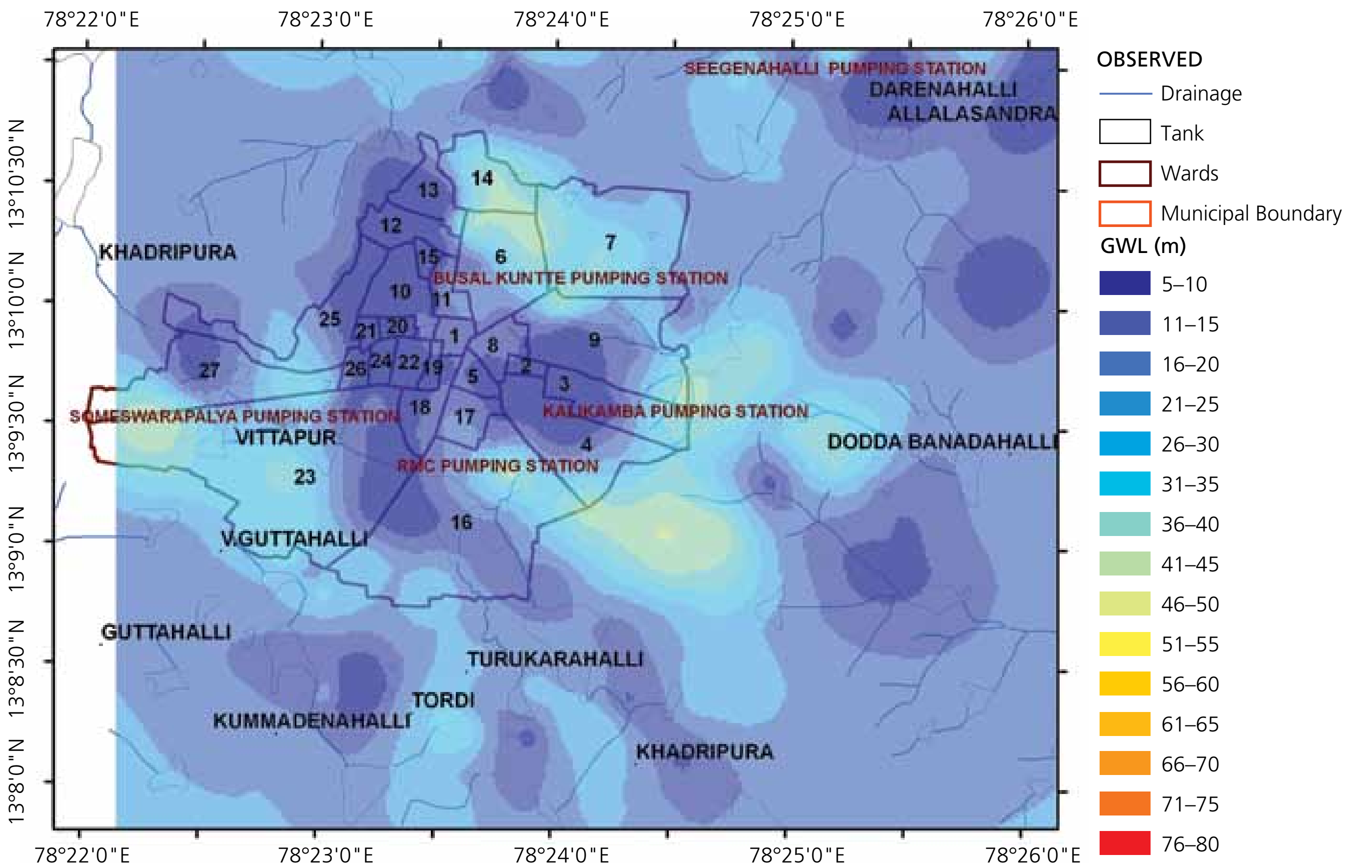


Figure 5: Groundwater Levels – Case B, May 2017

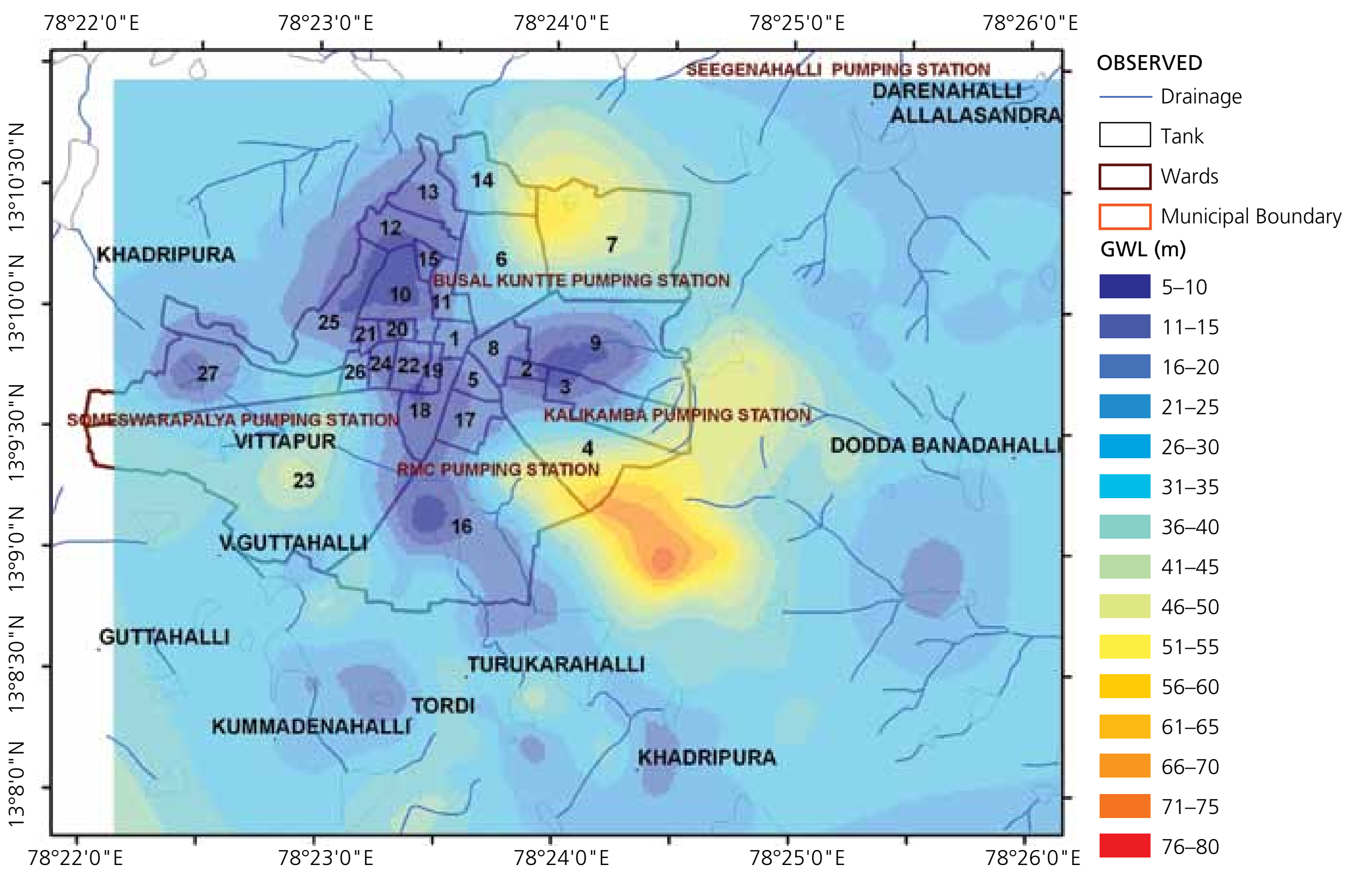


Figure 6: Groundwater levels – Case D, May 2017

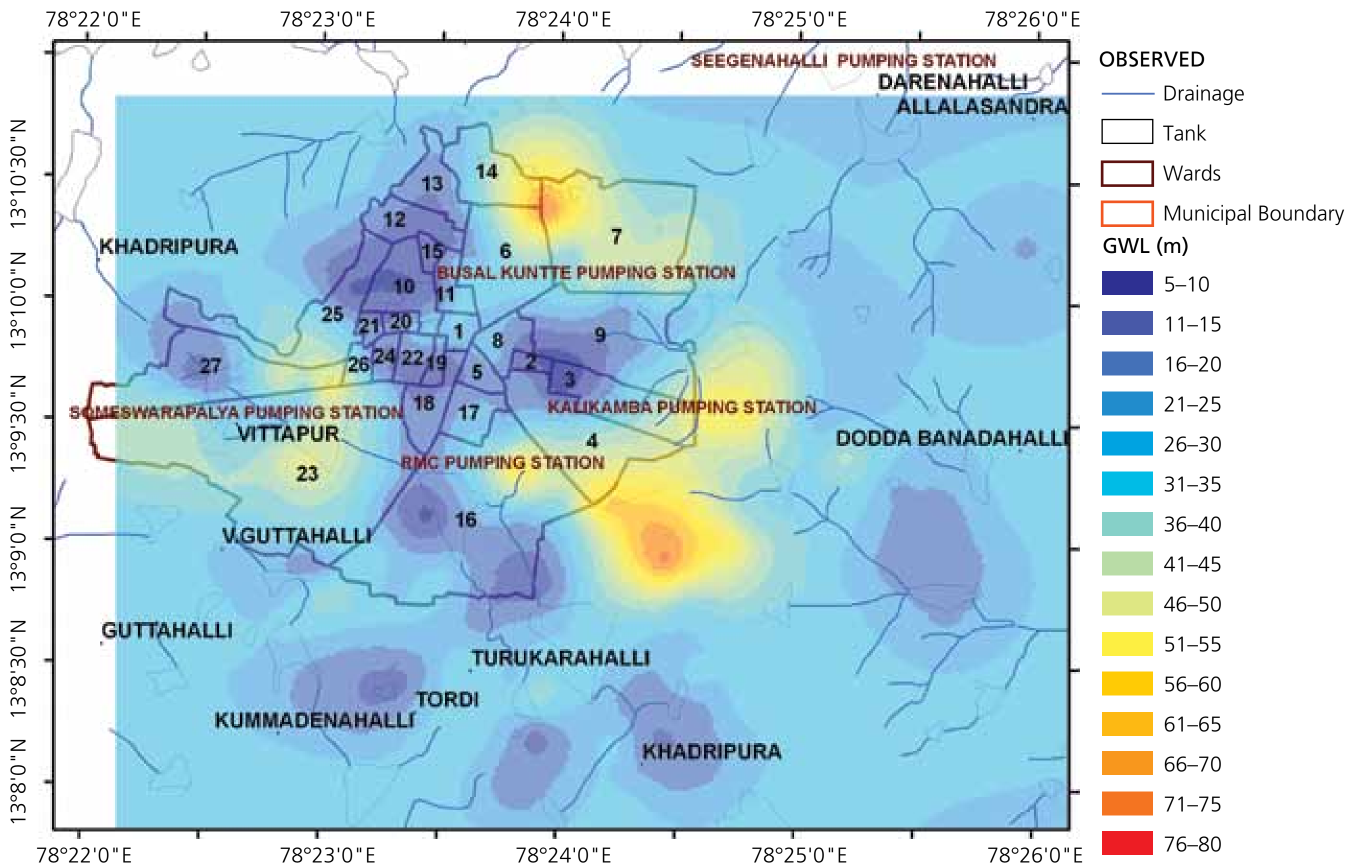


Figure 7: Groundwater levels – Case E, May 2017

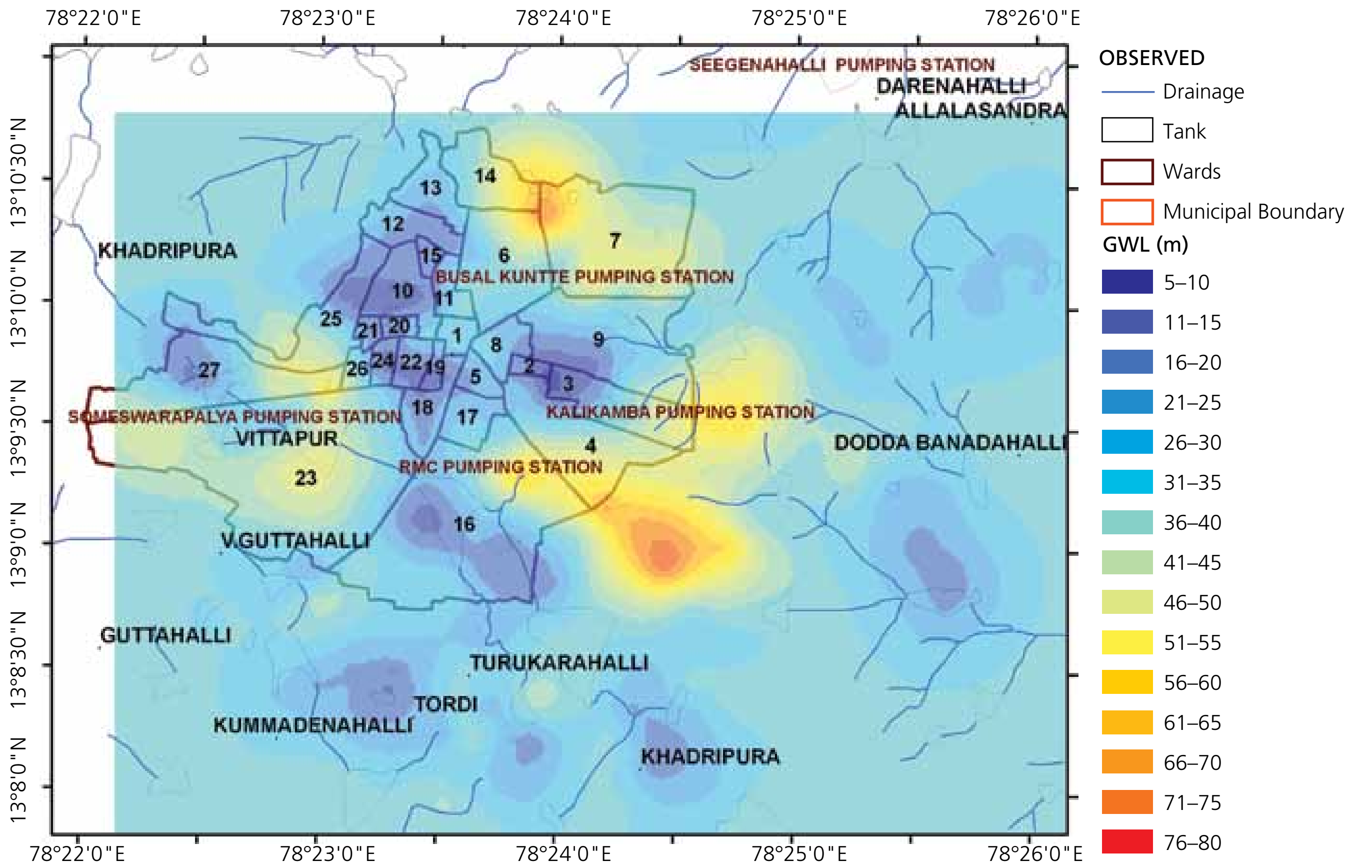
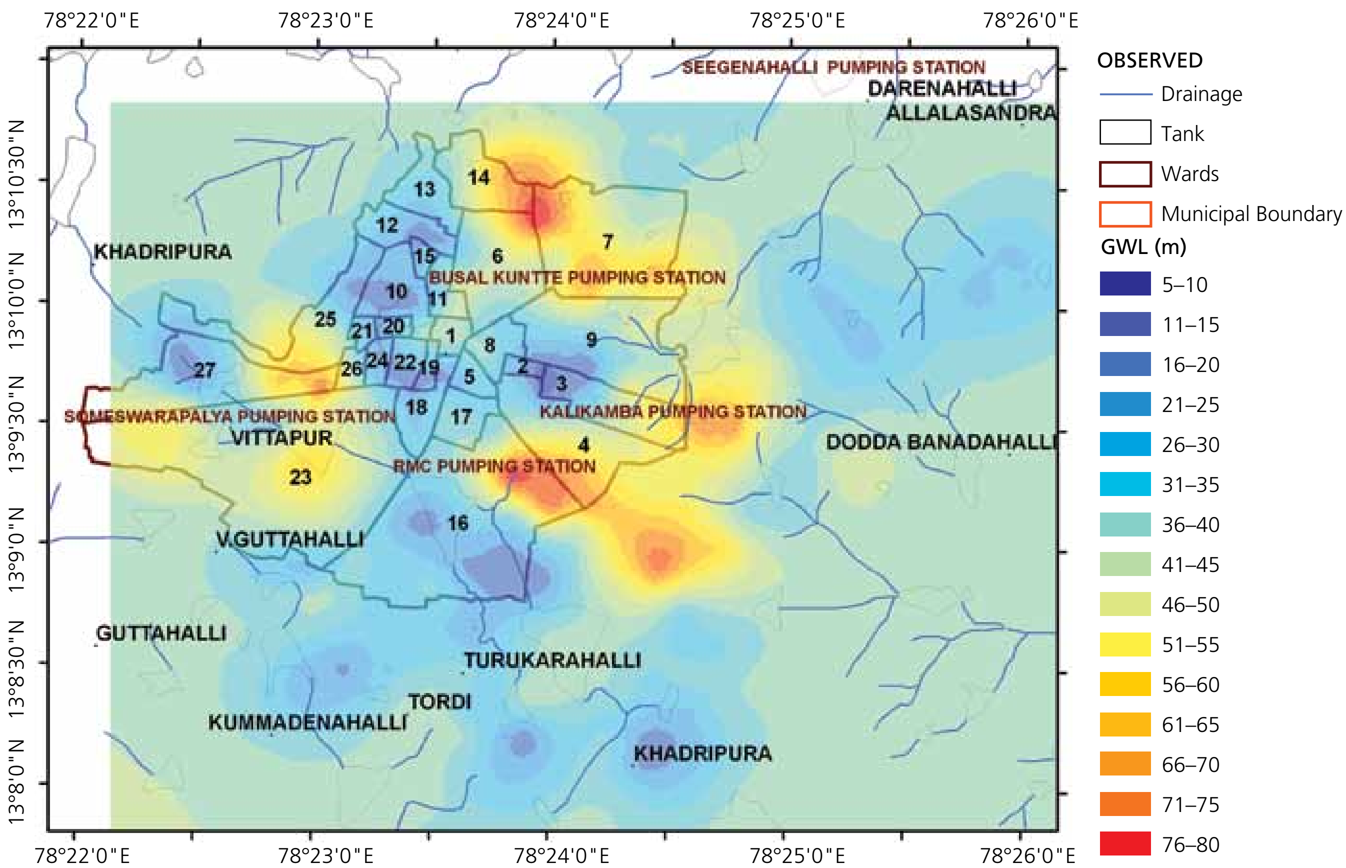


Figure 8: Groundwater levels – Case F, May 2017



The models revealed that the groundwater levels inside the town significantly are reduced in the future for Cases B, D and F when compared with that of the current levels of May 2011. Case F shows the deepest groundwater levels inside the town among the cases. Case D shows more decline in the levels inside the town than for Case B. Case D corresponds to reduced leakage of wastewater, which mainly affects the levels inside the town while Case B is of reduced recharge from lakes and mainly affects the levels outside the town in the PS locations. Case E behaviour inside the town is very similar to Case D as expected, though the levels in the PS areas show higher decline due to lower recharge from lakes plus the reduced flow from inside the town. The groundwater levels inside the town are least affected by Case B as this corresponds to reduced recharge in lakes and hence the effect is only observed in PS regions while there is no effect in the groundwater levels inside the town.

5.1.5
Implications

Implications for Mulbagal

The implications for the town are several. The relatively shallow groundwater levels within the town are not desirable from the groundwater quality perspective. There is lesser assimilation of wastewater leaking from soak pits and the shallow groundwater medium could connect the water supply pipelines and wastewater drainage systems, leading to a contamination of the water supply. To lower the groundwater levels, an option to consider would be pumping out the groundwater within the town and utilising it through a suitable water treatment system. This would also result in higher rainfall recharge in the town than the current levels.

The groundwater utilisation from the PS wells, especially outside the town, is relatively higher than the other wells, as the water quality is superior. These wells are aided by recharge from the tanks and lakes in the vicinity. Hence it is critical that the runoff water to these tanks and lakes is sustained and, if possible, augmented. This will, in turn, sustain the wells in these locations. Moreover, quality of the water in the lakes and tanks needs to be good since good fraction of water storage is recharged to the PS wells in the vicinity. On an average, estimated recharge to the PS wells is 75mm/year through tanks and lakes and 50-75 mm/year through rainfall.

Broader implications

The broader implications of this study are understanding groundwater behaviour in an urban context, its linkages to the groundwater quality, and the drivers of sustainability of the municipal wells supplying the town. It also helped in understanding efficient well design and optimal water production by taking into account the energy-water nexus. There were two tangible outputs from this study. The first was a simplified framework for understanding urban groundwater behaviour. This can fit within the national groundwater estimation methodology of the Ministry of Water Resources, GoI which is currently designed for rural groundwater and does not have an urban variant. The framework based on this pilot can be refined going forward. The second output is a template for monitoring groundwater for towns of similar lithology. This contains the guidelines on the granularity and spatial frequency with which urban groundwater needs to be monitored given the very different characteristics of pumping and recharge that apply to it.

5.2 Water quality study

5.2.1 Background

Due to its low cost and generally high quality, groundwater has been a preferred source for public water supply for private domestic use in many urban towns and cities. According to the Ministry of Drinking Water and Sanitation (MDWS), one of the key issues affecting sustainable groundwater management is the declining quality of water sources. Urban sanitation coverage is at 63%, but of this 53% have no sewer connections.[9] Open defecation and improper disposal of waste is widespread in both rural and urban areas and is one of the important causes for contamination of water sources.

5.2.2 Objectives

Dr. Sudhakar Rao, Professor, Department of Civil Engineering and Chairman, Centre for Sustainable Technologies, IISc, Bengaluru, led the research project to monitor the water quality in Mulbagal starting April 2009.

The objectives of this study were to:

- Uncover and establish the nexus between groundwater quality and sanitation practices.
- Develop a template for a Water Safety Plan that would enable towns to sustainably manage and protect the quality of their water resources.

5.2.3 Process

Mulbagal depends on groundwater for its potable water requirement and simple on-site pit disposal systems for human waste disposal. The study involved rigorous testing of the water quality of 75 drinking water wells for 28 parameters in Bureau of Indian Standards Drinking Water Specifications (IS 10500–1991) in the pre-monsoon, monsoon and post-monsoon periods.

9 Technology Options for Urban Sanitation in India, A Guide to Decision-making, 2008, Water & Sanitation Programme – South Asia (WSP-SA), The World Bank and the Government of India

5.2.4
Key findings

The monitoring threw up a distinct pattern. The bore-wells inside the town (ITS) showed high dissolved salts, nitrates, total coliform, and E.coli presence. Comparatively, the bore-wells located on the periphery or outside town (OTS) were mostly free of pathogens and nitrates. It was surmised that leachates from on-site pit disposal systems for wastewater had severely impacted the groundwater quality rendering them non-potable. As can be seen from the graphs below, the majority of the OTS well contaminant readings are clustered around the desirable limit and the majority of the ITS well contaminant readings are clustered around the permissible limit.

- The TDS levels in the ITS bore-wells were in excess of the desirable limit (500 mg/L) for drinking water and most values ranged between 800 and 1500 mg/L. This implies that the community would find this water unpalatable and 'salty'. Comparatively, the TDS levels in OTS bore-wells mostly ranged between 500 and 850 mg/L.
- The total hardness levels of water samples from ITS bore-wells ranged from 400 to 800 mg/L classifying the water as 'hard'. The hardness levels of water samples from OTS bore-wells were lower and ranged between 150 and 500 mg/L.
- The nitrate levels in the ITS bore-wells were in excess of the permissible limit (45 mg/L) for drinking water and most values ranged between 50 and 300 mg/L exposing the community to health risks associated with nitrate contamination. Nitrate levels in OTS bore-wells were mostly below the permissible level of 45 mg/L.

Figure 9: Comparison of TDS levels of inside town and outside town wells

Figure 10: Comparison of total hardness levels of inside town and outside town wells

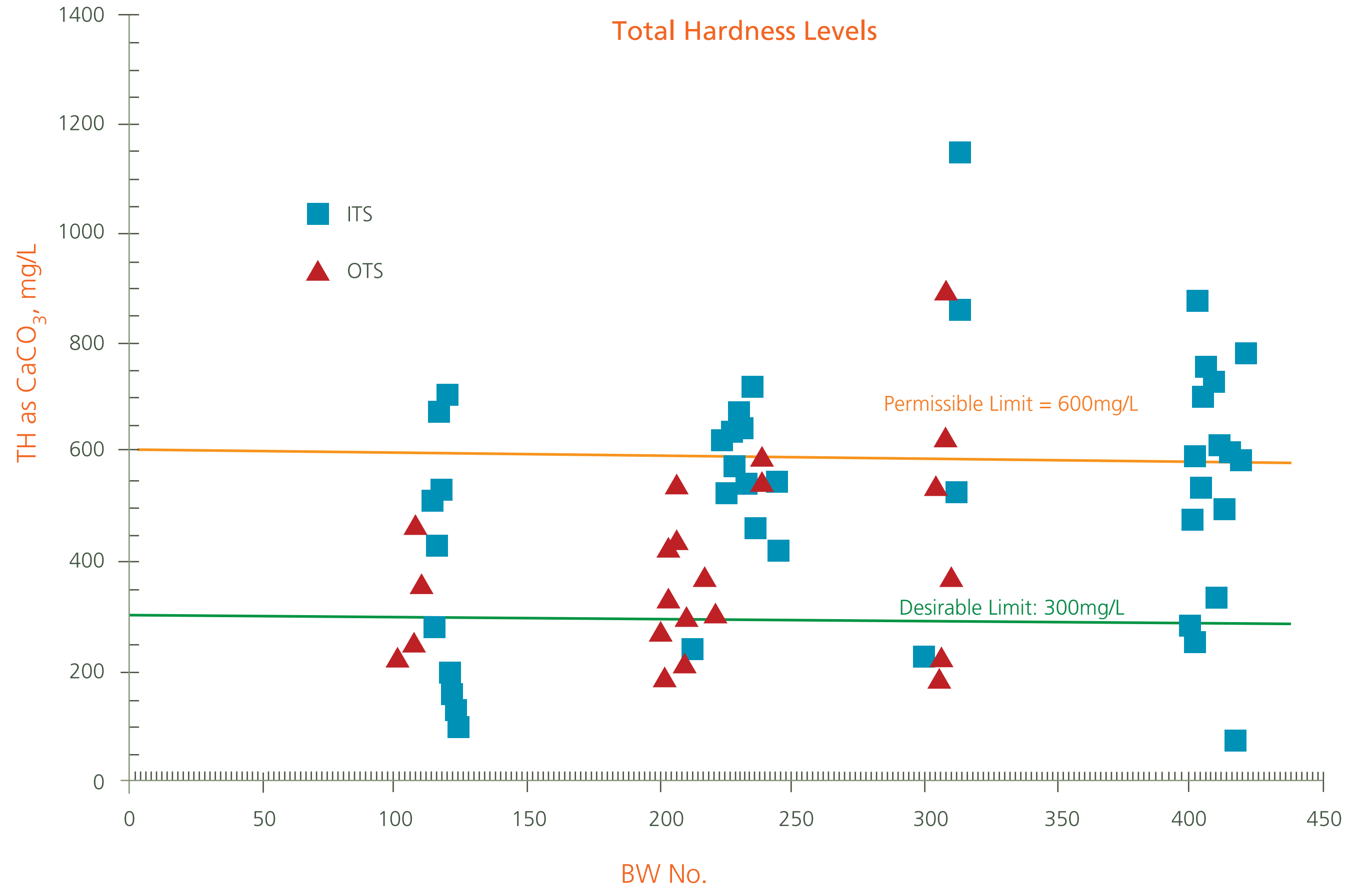


Figure 11: Comparison of nitrate levels of inside town and outside town wells

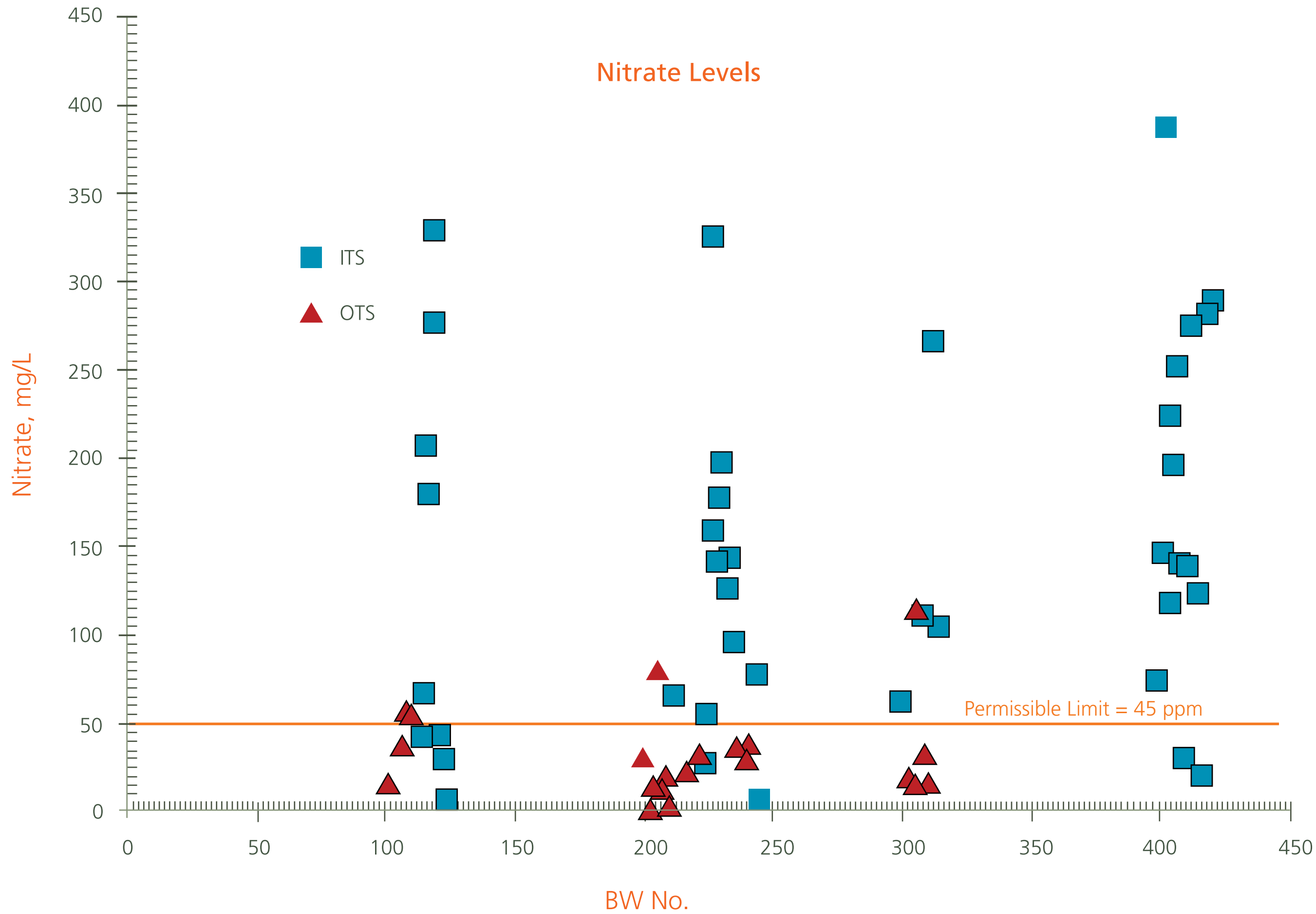
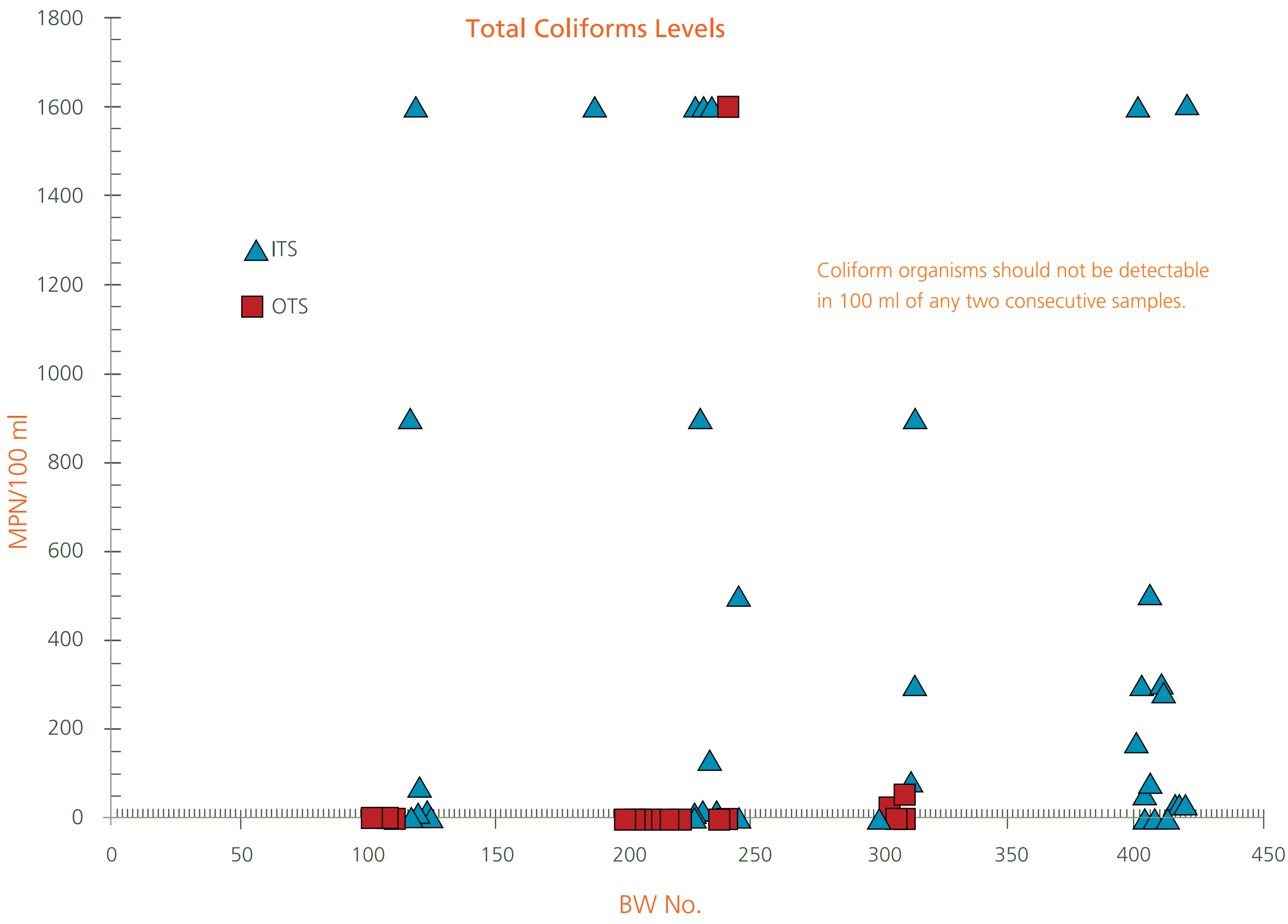


Figure 12: Comparison of total coliform levels of inside town and outside town wells

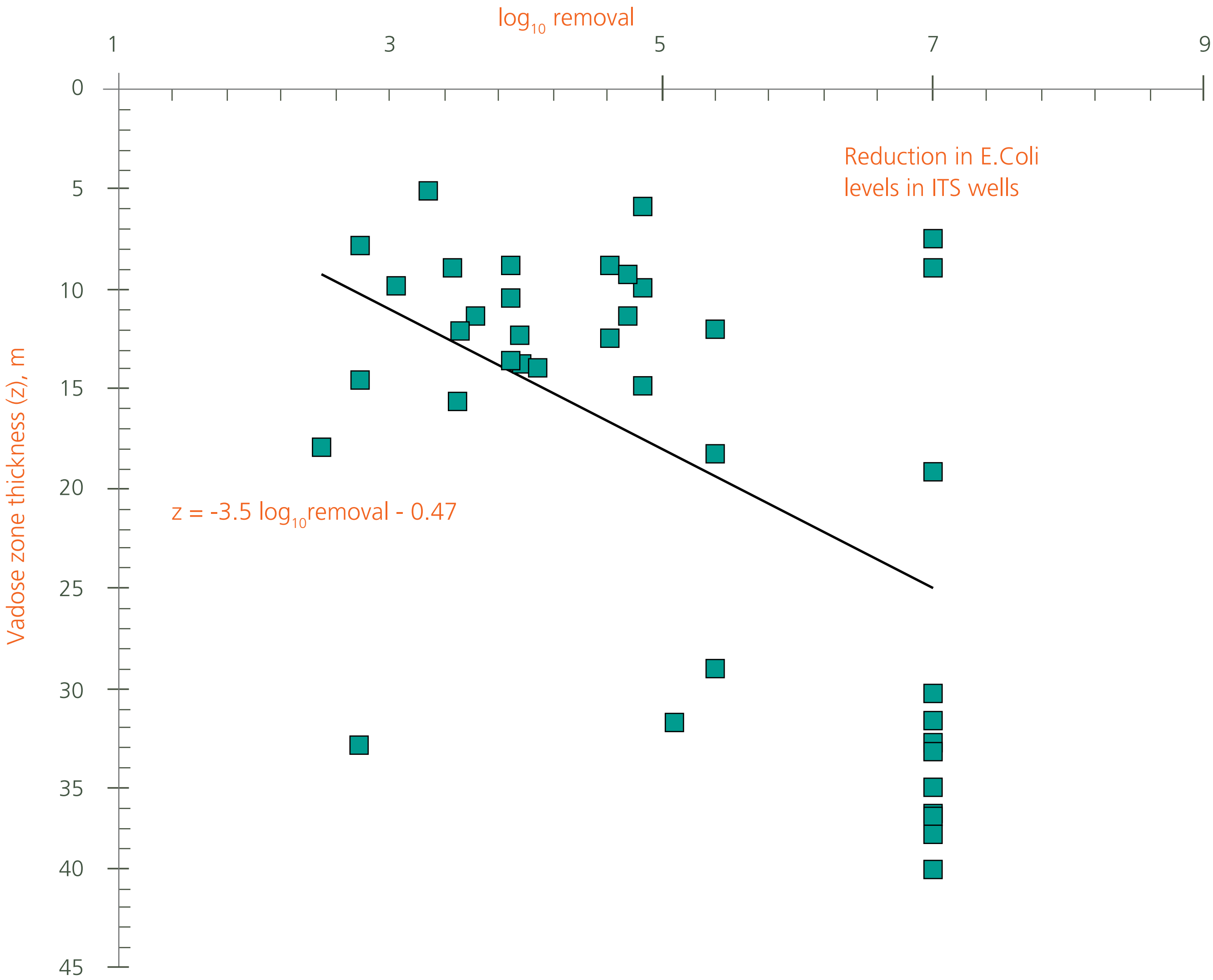


- Most bore-wells belonging to ITS series showed presence of total coliform and E.coli, while the reverse was true of OTS bore-wells. This implied faecal contamination from sewage infiltration and put the community at risk of contacting waterborne diseases.

One of the key outcomes of the analysis was on pathogen movement and removal by the soil. Bacteria and pathogens travel in the ground, and have varying survival times in anaerobic groundwater environments. The average for coliform bacteria is 5.5 days.[10] It was also found that an unsaturated or vadose zone (the zone above the water table) is the best line of defence against faecal pollution as it is less permeable. Based on this, it will be possible to calculate the size of the zone required to protect drinking water sources from bacteria, and similarly from nitrates and other contaminants. This finding corroborates the British Geological Survey (2001) report that smaller the size of unsaturated zone, greater is the chance of faecal contamination. The Mulbagal study showed that faecal bacteria are less mobile in dry soil, and therefore thicker vadose zones or lower groundwater levels are beneficial in preventing faecal contamination as seen in figure 13. (A logarithmic scale is used in order to capture the dramatic reduction of E.coli from millions to thousands to almost nil with increasing thickness of the vadose zone). In contrast, contamination by chemicals like fluoride, arsenic, iron and salinity can be reduced by increasing recharge and dilution.

10 Rao S.M., 2011, Sustainable water management- nexus between groundwater quality and sanitation practice, Indian Institute of Science, Bengaluru

Figure 13: Reduction of E.coli in water with increase in vadose zone



The water quality findings and the associated risks were shared with the TMC. Sanitary seals were constructed by Arghyam for a few bore-wells to reduce contamination risks. In response to the water quality findings, and the resulting perception that groundwater was not safe for drinking, the TMC took the initiative to launch a project with a private sector entity to set up and run a treatment plant on a commercial basis. Arghyam had mixed reactions to this development. Going with a reverse-osmosis treatment mechanism, which is not the most environmentally friendly option, and outsourcing it to a private sector entity was outside the model of IUWM that was envisioned. Still, it was good that the TMC took initiative on a problem that was critical.

5.2.5 Implications

It has been estimated that 80% of children of India suffer from waterborne diseases and, of these, 700,000 die each year.[11] Contamination by pathogens is real and groundwater quality testing must include testing of E.coli and total coliform before it is declared as a 'safe' source. The findings and intervention measures adopted by Mulbagal town would be relevant for other towns too.

11 Ibid

On-site sewage disposal system is a reality in the country and cannot be easily replaced with more expensive off-site systems. Also, a large percentage of the country depends on groundwater for its drinking water needs. Keeping the two realities in mind, it is necessary to explore modifications to the on-site sewage disposal systems so that they are able to capture the generated nitrates and not release them into the groundwater.

5.3
Energy audit

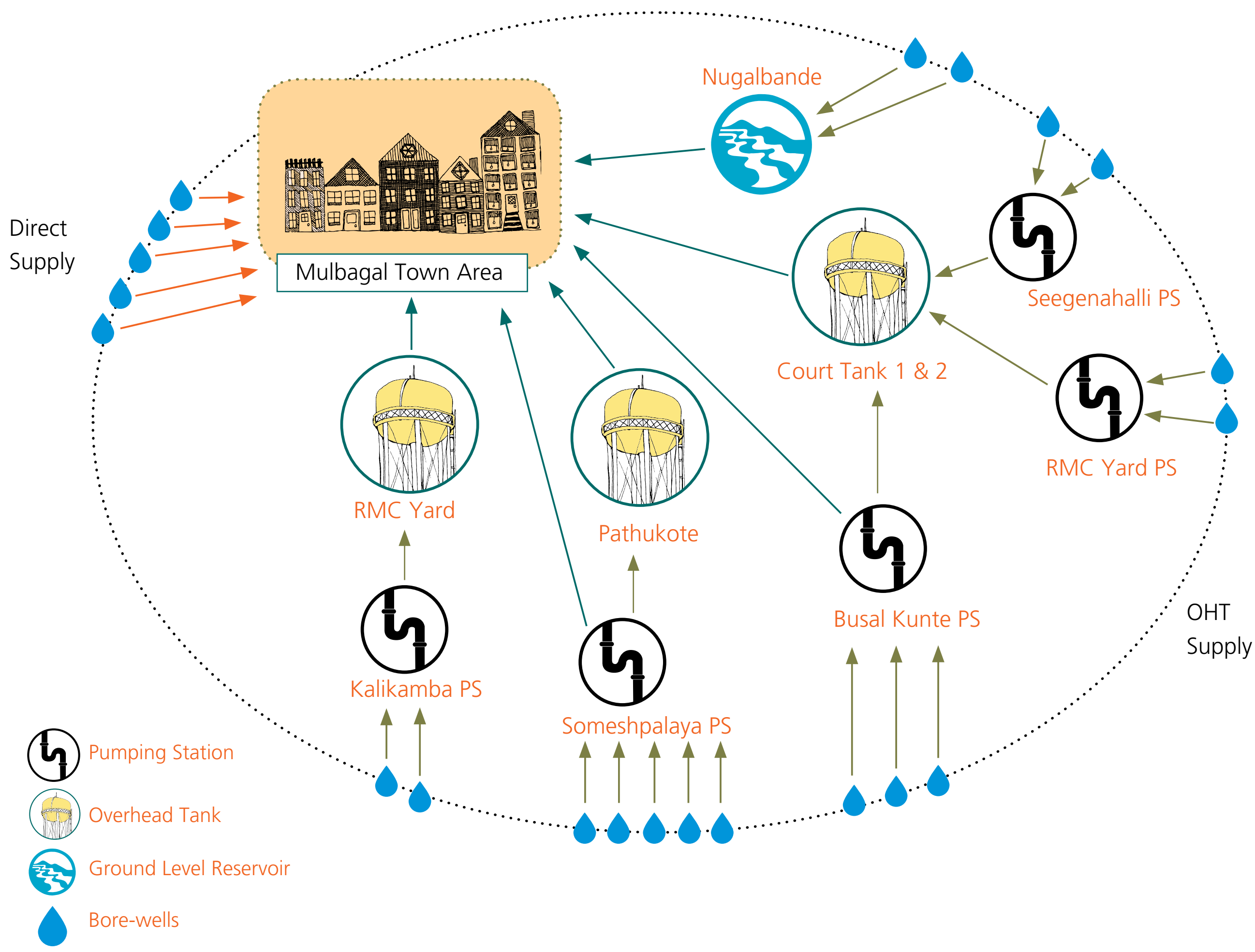
5.3.1
Background

Water supply systems are big consumers of power. The transport of water, from above or below the ground, to human settlements often involves high use of energy. Water treatment processes in the water supply systems are often dependent on energy intensive systems. This often results in huge production costs. In this sector, research shows a close relationship between water and energy and advocates for significant savings (energy, water and monetary) through technical and managerial interventions. Energy audits in India have determined that energy costs account for 40 to 60% of the operating expense of supplying water. The key to understanding this improved and efficient system would be through unbundling the lifecycle costs of various components.

5.3.2
Objectives

Arghyam commissioned Schneider Electric Conzerv India Pvt. Ltd to undertake the energy audit of all pumping stations, and measure the efficiencies and performance levels. It also included evaluating the revenue savings possible and supervising the implementation of energy saving measures on a pilot basis.

Figure 14: Schematic of the water supply system in Mulbagal



5.3.3
Process

Mulbagal town supplies drinking water to the entire town in two ways (see figure on previous page).

- Through five pumping stations and overhead tanks (OHTs). These, in turn, get water from the bore-wells drilled at different places – inside and outside the town.
- Directly through bore-wells. Here, the bore-wells pump water directly into distribution system.

Both these processes are highly energy intensive and there was a growing concern over the mounting energy consumption for pumping water. In addition, the TMC reported that it was paying huge penalties for not maintaining the power factor and load factors prescribed by the KPTCL.

5.3.4
Study findings

The study found that annually, 14% of expenditure on power was towards penalties. The overall efficiency measured during the audit process ranged between 28 to 43%. This is far below the pump efficiencies of 70% that are available today. The reasons for the high energy consumption included internal factors like the decline in yield of the bore-wells, increase in the number of bore-wells in operation, increased demand, increased wastages including leaks, and inefficient pumps and motors. External factors like power outages and voltage fluctuations also escalate the costs of energy utilised for water supply. The pumping system performance at an individual pumping station is presented in Table1.

The average increase in unit rate for electricity by 10% would increase the overall electricity expenditure by 15%, warranting attention to the energy efficiency issue. Both Busal Kunte and RMC Yard pumping stations are within the town and have LT (low tension) connections. They therefore get clean power and are not subject to penalties of demand or power factor; hence the NA in the table below.

5.3.5
Implications

The recommendations from the study for an energy efficient water system included improving power factor, installing energy efficient pumps in three pumping stations, replacing bore-well pumps, implementing automation in the pumping stations and revamping the present electrical distribution in the system. These were expected to reduce the cost of water supply by almost Rs. 2 per kilolitre. With an overall investment of Rs. 64 lakhs for a complete set of interventions, there could be a saving of Rs. 31 lakhs annually.

A set of recommendations applicable at the municipal and at the state level have been developed. They include regular analyses of the electricity bill, awareness and capacity building for municipal staff, regular monitoring and maintenance of the electrical system for high efficiency, periodic audits of all ULBs, energy efficiency cells at the state level to assist municipalities, and benchmarks on energy efficiency in water and on power supply service levels by electricity companies.

Table 1: System performance of five pumping stations at Mulbagal

Pumping station	Demand excess (in %)	Power factor	Penalty paid (as % of total monthly bill)	Pump efficiency (in %)
Seegenahalli	46	0.61–0.83	13	43
Kalikamba Temple	29	0.79–0.90	15	30
Busal Kunte	NA	NA	NA	28
RMC Yard	NA	NA	NA	32
Someshpalaya	59	0.7–0.82	15	30

5.3.6 Intervention

Based on the above recommendations, the Mulbagal TMC and Arghyam decided to undertake some corrective measures as a pilot in the Seegenahalli PS. Rs. 9.6 lakhs were spent on civil, electrical, and mechanical improvements which included a multi-stage high efficiency (77%) pump, demand and PF controllers, and monitoring systems. The findings showed that penalties were reduced from around 15% of the monthly energy bills down to zero. Owing to increased hours of use of the new pump, there was a 25 to 35% increase in water drawn from the well as monitored until April 2011. The tail-end of the system is prone to voltage fluctuations requiring the municipality to use both the old and the new pumps, since the new pump does not function optimally at very low voltages. This requires working with the State Electricity Board (SEB) for provisioning of clean power at the pumping stations. More wells were also in operation for more hours between the months of June 2010 and February 2011 when the study was conducted. All the combined interventions resulted in a decrease in the electricity billing by around 13 to 15% till June 2011; this was despite a 10% increase in the unit rates of energy in the state. This intervention provided an opportunity for savings in energy costs across all pumping stations.

5.4 Household water and sanitation survey

MYRADA, the partner NGO, planned a baseline survey to understand the demographics, service levels, and citizen viewpoints. A 20% sample size was chosen with six to seven samples per street in every ward, with households depending on public and private water supplies equally represented in the sample. Some of the highlights of the survey findings covering 1,845 households (18%) are detailed below.

The average monthly income of households is around Rs. 4,200 with an average household size of 5.62. The water supply across wards varied between 57 to 107 litres per capita daily (lpcd), which is lower than the national standard of 135 lpcd for towns. The water supply service levels were not uniform in all the wards. Only 26% households received water supply daily and that was for a maximum of two hours. 25% of the households water was used for human consumption daily. Only 40% of the households felt that the current water supply levels were adequate. Given the few households covered under daily supply, bins, pots, and buckets were found to be the predominant form of domestic storage. This allowed for storage of about 340 litres, which was less than the daily household requirement at current levels. 37% of the households had household water connections. Only 40% of the households spent money on water supply. The monthly spending ranged from Rs. 7 to Rs. 146, with the average expenditure of around Rs. 45 per month.

Household baseline studies on sanitation indicated that four-fifths of the town had access to either household, community, or public toilets, while the rest defecated in the open. Bathrooms were mostly separate units inside the house. The toilets were mostly Indian style with pour-flush model of usage. While cost of toilet construction was around Rs. 10,000, its monthly maintenance was around Rs. 105. Open defecation was observed in 23 of 27 wards, often near a water body or on open ground. Septic tanks and soak pits constituted 77% of major on-site wastewater disposal system from the toilets. Drains carried domestic wastewater from kitchens and bathrooms in 63% households, while 88% dumped solid waste on the streets. The critical parameters for households in deciding service satisfaction level were quantity, quality, and supply period. Nearly all of them were either unaware or uninvolved in any water and sanitation projects. The councillor and valve-men were the key personnel sought for redress.

5.5 Other studies

A water asset survey was carried out by TTI Consulting Engineers (India) in 2009. This resulted in mapping of the entire distribution network in the town, and studying its performance. The total length of the water supply network is 92 km. This included transmission, feeder, and distribution mains. At the time of the survey there were 3,841 domestic and 18 commercial connections, and 741 public taps. Very rough estimates indicate that on an average nearly 30% of water is being lost from the system due to leaks, breakdown, and theft.

The water asset survey database and maps have been used by the ULB as part of their regular reporting mechanisms to the State subsequently. The maps/ databases created were also used to verify ground status prior to proposing projects under various schemes by the Municipal Engineer, including those proposals made for financial support from the DMA in 2010.

As with most advanced data management systems, the issue of updating the databases and maps was also evident here. An attempt at data-based decision making though initiated, required consistent hand holding. The reasons for this include – absence or low capacities of manpower, absence of state-driven protocols for reporting, inability of the Municipality to procure expensive GIS software and no precedence of the decisions taken using data/ maps among elected repsentatives in small towns.

In 2010, a survey to check the presence of toilets in households was carried out. A GIS map of all the 1,375 toiletless households was created. This served as a planning tool for prioritising work on community toilets during the Implementation phase.

5.6
Overall findings of the studies

Overall, the studies and surveys revealed that the issues are highly interconnected. Without proper collection and treatment of sewage, the lakes would continue to deteriorate. The health of the lakes and the sewage disposal impacts the quality of the groundwater which is the source of water for the people. Drains are clogged with sewage and solid waste. Without a proper solid waste management system, the drains cannot do their job of carrying clean storm water to the lakes and tanks. The *kalyanis* inside the town are silted and dysfunctional, leaving the town without sufficient storage of good quality water. There aren't enough sanitary workers to clean the drains and collect the garbage, no environmental engineer to oversee the daily operations and maintenance. There was just an overburdened chief officer and engineer to run the entire town.

In particular, the studies on groundwater behaviour and quality endorsed the need for more granular data. Mulbagal lies in the Kolar district which is categorised as an over-exploited zone. Therefore, it was expected to have problems of deep groundwater levels and depleting resources. The studies however indicated shallow levels and water quality problems, which seem to be largely caused by human interventions. All put together, the studies helped to get a much finer and accurate understanding of the situation in the town.

6

Planning and design phase

Since the IUWM approach is an integrated, holistic one, several activities were considered necessary in the Planning and design phase to make the subsequent implementation more effective. They were:

- Entry-point activities
- Community mobilisation
- Urban planning with WEAP
- Participatory planning
- Institutional strengthening
- Infrastructure improvement
- IUWM framework
- Communication

Since 2007, these activities were experimented with in Mulbagal and resulted in varying degrees of success. Several of them also had to be dropped. This was due to various factors like lack of relevance or unsuitability of the approach, difficulties in implementation and feedback from the field, the team or external experts. Lack of capacities and resources to drive the activities, pressure (for or against) from the key stakeholders, and limited understanding of the complexities involved were other factors.

6.1
Entry-point activities

The objectives of entry-point activities were to demonstrate best practices in water management, demonstrate Arghyam's commitment to the town, and keep the stakeholders interested and engaged with the idea of IUWM. A rainwater harvesting system was set up in a government school that was facing water shortage problems. Leaky taps in public areas were identified and 250 of them were replaced. Sanitary seals were constructed for 15 bore-wells to demonstrate how to prevent contamination of the water. A week-long sanitation drive involving citywide cleaning up of streets, drains, minor repairs to drains, transport and disposal of collected waste in the municipal landfill was taken up.

A few of the above did generate desirable outcomes but overall, their contribution in earning the goodwill or sustaining the interest of the town was not substantial. Our assessment is that this could be because of the lack of an overarching communications campaign to take these efforts to citizens, lack of careful planning involving all the stakeholders, and the activities being too few and spread out to create a visible impact.

6.2
Community mobilisation

Ward *Neeru Mathu Nairmalya Sanghas* (WNNS) were built by MYRADA on top of the existing SHG network. There are 148 SHGs in Mulbagal formed by the Women and Child Development Department. These SHGs are not very strong, and as a result, neither were the WNNS that were based on them. Although people's involvement was

slow to start with, it rose gradually as they were made aware of the need for better sanitation and cleanliness. But as the system wasn't responsive to most of the issues, the frustration of the community rose. MYRADA's experience was that the community had to place a stronger demand on the administration in such situations. The lack of a clear engagement plan with outcomes for the WNNS led to a lack of focus and some disillusionment. Also, MYRADA's people participation model may have been successful at the village level, but this approach may not be sufficient to find solutions for the interconnected and complex problems of a town.

6.3
Water Evaluation and Planning

WEAP is an open-source tool developed by the Stockholm Environmental Institute. It is a widely used planning and policy-oriented Decision Support System (DSS) specifically designed for modelling water resources and evaluating alternative management scenarios. It was decided to develop a WEAP model for Mulbagal and use it as a tool for the participatory planning process. The model would represent all the aspects of IUWM – household needs, socio-economic situation, groundwater and surface water sources, the different demands, water supply and wastewater distribution systems, and financial elements. The WEAP Mulbagal model could be used to evaluate future demand-supply scenarios by posing 'what if' questions with stakeholders. The larger objective of such an exercise was to develop a water planning tool that could be used for urban areas across the country.

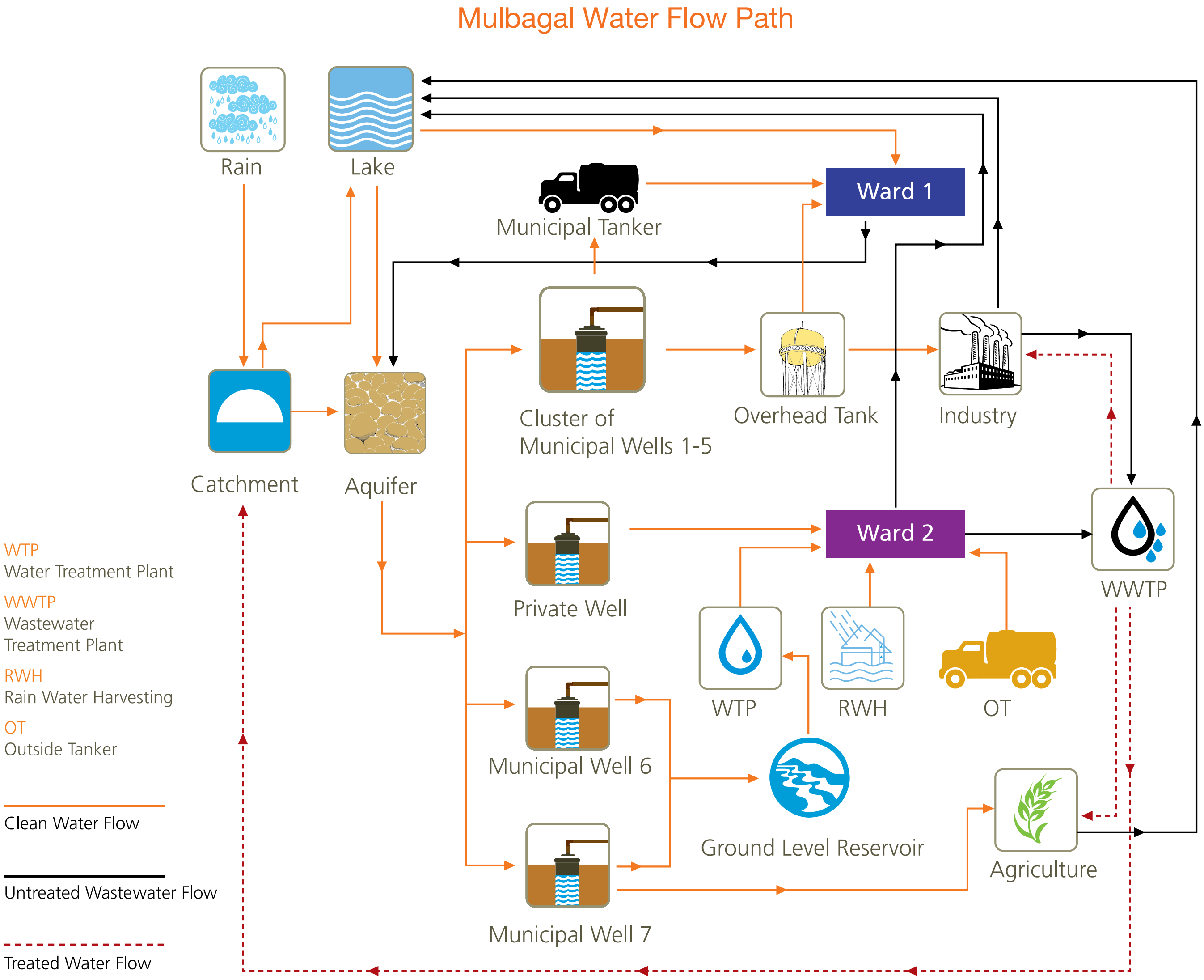
Substantive effort went into this from the WEAP team, Arghyam and the IISc team. The outputs of all the studies were incorporated into the model. Some basic scenarios were created and tested. There were some technical hurdles with modelling the groundwater and the model could not be completed. There were also the previously expressed issues of aligning the more immediate interests of town stakeholders with the sustainable future model that WEAP promised. The highly technical nature of the tool and the limited technical capacities of the town's decision-makers made communication a big challenge. Arghyam's vision was to apply scientific tools to diagnose the problems facing the town and develop a needs-based action plan, while the TMC was accustomed to preparing a more generic plan to avail of funds available to it. While WEAP is a powerful idea with a lot of potential, it appears that the capability and culture of using such decision-support tools did not exist in the town yet.

6.4
Participatory planning

This was a central component in the IUWM approach. The idea was that there should be a space for citizens to participate in the planning process with their elected representatives, and that the town plan should be built up from ward level micro-plans. WNNS with the ward councillor at the head were created for this purpose. The effort was to begin with sub-ward level exercises aimed at identifying individual and street level issues. This would then feed into the discussions held at the ward level. The outputs from the ward level discussions would be collated and, from these, town level needs would be distilled. These would form the basis of a visioning exercise to draw a 25 to 30 year plan for water and sanitation for the town.

The process was to be facilitated by MYRADA and Arghyam, with the active participation of the TMC. The *sanghas* were to use the outputs from the studies to

Figure 15: Schematic of the minimum elements of a Mulbagal IUWM Model



help them understand both the nature and extent of the problems in their areas.

A significant amount of time (refer to Annexure on Timeline of IUWM programme) and resources went into developing the participatory planning process. However, it could not be carried out due to several reasons, the primary one being that the stakeholders wanted their immediate problems to be fixed and showed little interest in developing a model for the long-term sustainability of water. It was very challenging to mobilise and get the *sanghas* to engage in this process. The studies, especially the scientific ones, were too complex to be communicated effectively to the stakeholders. The conclusion reached was that such a comprehensive participatory planning approach was premature and the idea would have to be revisited and modified.

6.5
Institutional strengthening

Early on in the programme, UN-Habitat, a potential partner provided an opportunity for one of the councillors from Mulbagal to attend an international conference in China. This generated a lot of interest among the other councillors. Some exposure visits were arranged for them to the towns of Udupi and Kundapur.

In 2008, Arghyam organised a 2-day training on municipal governance for all the town councillors. The training covering their roles and responsibilities was conducted by the All India Institute of Local Self Government (AIILSG) at Mulbagal.

To increase involvement and ownership of councillors in the IUWM programme and create a space for decentralised planning and decision-making, an untied-fund scheme was explored. The idea was to give untied funds of Rs. 1 lakh each to the WNNS, led by the councillor, to be used for high-priority micro-improvement works in their respective wards. Guidelines were developed to ensure this would be used and monitored effectively. This idea was however not implemented due to political risks and fear of furthering a culture of patronage.

6.6
Infrastructure improvement

A key component in IUWM is the water infrastructure which is the mandate of the Government. The strategy was to work with existing Government schemes on infrastructure and improve their effectiveness on the ground through advisory support.

In 2007, KUWSDB had prepared the designs for the underground drainage system in Mulbagal under the Urban Infrastructure Development Scheme for Small and Medium Towns (UIDSSMT). The proposed design consisted of a single sewage treatment plant (STP) of 9.9 MLD capacity outside the town along with three intermediate wet wells. The design was based on the topography such that the sewage flowed by gravity to the wet wells and, from there, it would be pumped to the STP.

In April 2009, KUWSDB approached Arghyam for advice on the proposed plan and innovative wastewater recycling technologies. Following visits to the STP and wet well sites, Arghyam suggested the establishment of decentralised wastewater treatment systems instead of the wet wells. These are suited for low volumes of sewage flows, are more environment friendly and less expensive than traditional treatment plants. The expenditure involved in pumping of sewage to the centralised STP would be avoided. The problems of bad odour and inconvenience to the habitations in the vicinity would also be addressed. This suggestion was accepted by the state agency, which has agreed to explore appropriate decentralised technologies for deployment.

Another area of infrastructure improvement was the water distribution system. Under the present system, water is distributed from an overhead tank (OHT) to the town through a main pipeline. As the need for water increased, a few of the influential councillors tapped directly into this main distribution pipeline resulting in several illegal connections. This affected the service for the people further down the distribution line, with lowered quantity and pressure. Rather than take on this difficult political issue head-on, the TMC staff decided to use the provision under the proposed highway-widening project to refurbish the water supply system. This would allow them to create a new section of the distribution system replacing the old one. At the time of writing, the highway-widening project has not begun and there has been no work on the distribution pipeline.

A water audit study, if carried out at this juncture, can provide factual information and map the exact flow of water from source to users and the volume of water received in different parts of the town. In fact, Arghyam had considered extending the water asset mapping to a water audit study, but this did not materialise. A water audit will be able to provide important insights for revamping the distribution system and for initiatives such as opting for a dual supply system (providing treated water for potable use and untreated water for domestic and other uses) and appropriate water treatment systems.

6.7
IUWM framework

Arghyam engaged an agency, Institute for Resource Analysis and Policy (IRAP), Hyderabad to develop an IUWM framework and toolkit in parallel with the field programme in Mulbagal. The two-year effort involved compiling water management practices under different urban contexts and documenting the entire IUWM process as a guide for interested towns. The immediate value to the IUWM programme was limited. This was primarily because it was not possible to incorporate the field lessons and challenges into the framework and to align them closely. The framework, however, is comprehensive, covering all aspects of the IUWM cycle from scientific and financial models to engineering and community mobilisation best practices. It is a valuable toolkit now available for use by Arghyam and other urban water practitioners.

6.8
Communications

The interactions with local leaders, authorities, and citizens revealed a mismatch of expectations and responsibilities regarding various aspects of IUWM. Also IUWM is not the most user-friendly name for a programme that seeks to involve the average citizenry of a small Indian town.

An external partner, Centre of Gravity, which specialises in communication design, was hired. As a first step they conducted interviews with multiple stakeholders in Mulbagal as well as focus group discussions in some of the neighbourhoods where activities had been going on.

Their findings confirmed the need for clarity, synergy, and a resetting of expectations. A few highlights of those findings are:

- The name recall of the programme was low. It was variously mentioned as Arghyam programme, water programme, Arghyam scheme etc.
- IUWM was not associated with water but an overall town development initiative which could include

anything – roads, education, garbage etc. At that time, an underwater drainage system was being constructed as part of a scheme from the Government of India. It had resulted in large parts of the town being dug up and some citizens attributed that to the Arghyam programme. The citizen awareness about the IUWM initiative was low.

- The programme was seen as a scheme from Arghyam in which substantial sums would be spent by Arghyam for town improvement activities. The nature of the contract between TMC and Arghyam was completely misunderstood.
- There was a lot of impatience with the pace at which the programme was going and Arghyam was being blamed for the delays.
- A number of preparatory activities carried out by Arghyam were going completely unnoticed.
- Water was an important concern for a lot of areas, but it was not the most important one when compared to employment or the overall condition of the town.

In the light of these findings, a communications architecture was developed, which included:

- Renaming IUWM as *Jala Jagruthi*, a much more accessible and simple-to-understand name that also establishes a direct connection with the central focus of the programme i.e. water. Also, *Jala Jagruthi* was articulated as a town-pledge that the leaders and the citizens of Mulbagal needed to commit to, as opposed to its perception as an Arghyam scheme or an Arghyam programme.
- Creative ideas at three levels – first, developing pictograms for individual initiatives like rainwater harvesting, community toilet revamp, solid waste management, upgradation of pumping technology etc. Second, consistently presenting various facets of *Jala Jagruthi* and third, presenting all of this as a part of an overall initiative to transform Mulbagal into a model town with citizen's participation.

This new communication architecture was rolled out during a launch event in February 2012, across various parts of the town where individual initiatives had taken a tangible shape and form. This will help citizens experience the work across its multiple dimensions.

Figure 16: *Jala Jagruthi* logo and pictograms developed as a part of communications strategy

7

Implementation phase

The interactions with the TMC and community during the planning phase brought to light some of the significant demands of an integrated approach. It was realised that to address multiple aspects of IUWM, such as citizens' participation, urban planning, subsidiarity, environmental sustainability etc., the town would require a different level of organisational skills, capacities and some structural changes. These would take much longer to develop and, in some cases, require external actors to drive the changes. To a certain extent Arghyam did not take into account the town's framework of reference and assumed that the TMC and the community would naturally take to the idea of IUWM.

Arghyam decided that a change in strategy was needed. To address the more fundamental issues identified above, it seemed appropriate to adopt principles of organisational change management. The key ideas included were incremental movement towards clearly achievable, realistic and measurable goals, along with a gradual build up of interest and capacity of stakeholders. The initiative itself would take on a more tactical approach and transition to specific field projects. This would hold the interest of the councillors and create opportunities to try out some of the principles of IUWM.

A meeting with the DMA presented an opportunity for leveraging the annual budget for specific activities. The TMC, with Arghyam's support, prepared a proposal for a set of water-related projects based on the studies and submitted it to the DMA in 2010. Five projects amounting to Rs. 35 lakhs were approved. They included energy efficiency in pumping stations, rainwater harvesting in schools, community toilets, individual toilets under the Government of India's ILCS scheme and solid waste management. This marked a clear transition of the programme to direct implementation of projects.

In keeping with this transition, the role of Arghyam and programme partners also changed to providing support and advisory services. It involved capacity building of TMC staff, strengthening of people's groups, building awareness and ownership amongst councillors, bringing in best practices, and advising in the design and implementation of these projects. This transition and the associated change in Arghyam's role was discussed with TMC. All the departments at the state, district and town level offered tremendous cooperation and support to this initiative, recognising the potential of this approach.

The positives of this approach were that the TMC and stakeholders saw a lot of relevance for these projects. It was possible to rally the team, the stakeholders, and partners around the activities as these were addressing actual problems being faced by people.

The five implementation projects are detailed in the sections below.

7.1

Energy efficiency in pumping stations

On the recommendations of the energy audit, improvements at the Seegenahalli PS were taken as a pilot in the early part of the programme. Based on the success of that pilot, the DMA proposal in 2010 sought funds for two more pumping stations and, in response, Rs. 8 lakhs was released by the DMA.

7.1.1

Objective

- To maximise water transfer from pumping stations to OHTs/reservoirs with optimal consumption of energy. This would be achieved by replacing low-efficiency equipment and installing electrical equipment to facilitate clean power availability.

7.1.2

Activities

Site visits were carried out by the consultants and technical specifications for the pumping and electrical machinery at the pumping stations were developed. The procurement procedure required an approval by the TMC, and subsequent technical and administrative approvals by the DMA and DC respectively. Arghyam facilitated this process and provided the necessary technical support at the DMA office. Based on these approvals, the TMC invited vendors for providing the requisite services (supply of equipment, installation and post-installation services). No vendors bid for the tender the first time, and the tendering process was deemed void. A few months later, the call for tenders was issued again, but due to Karnataka by-elections, the procurement process was stalled until May 2011. Technical evaluation of the bids took place after that but were treated as void since requisite documentation was not adhered to. Finally, the tenders were called again. At the time of this writing, the tenders have not been closed yet and have to be taken forward by the TMC.

The project was repeatedly stalled at various points and required push from Arghyam's end as well as intense handholding to make it through each step. The effort required once again highlighted the inertia in the system and reinforced the need for local interest to drive it. Without a strong leader from the town or from the external support agencies, projects such as this will be subject to delays, changes and partial fulfilment of goals. It should be noted that this was a project where the pilot successfully demonstrated financial and water savings to the town, and the TMC had the incentive to proactively drive this forward in other pumping stations. The puzzle remains why this straightforward activity could not be satisfactorily concluded.

7.2

Rooftop rainwater harvesting

After the pilot rainwater harvesting project in two schools, the DMA proposal sought funding for rainwater harvesting structures and sanitation improvements in 10 other educational institutions (schools, colleges or hostels), and Rs. 10 lakhs were approved. At the TMC's request, Arghyam supported them in surveying 25 institutions in Mulbagal. Detailed estimates were prepared for the 11 institutions short-listed through field-visits. This number was further reduced to 7 due to budget and resource constraints.

7.2.1
Objectives

- To create rainwater harvesting structures in educational institutions to meet non-potable water requirements.
- To thus save the treated municipal water for other higher priority uses.

7.2.2
Activities

Detailed analysis on the water flows, location of sumps/ tanks, volume of tanks required, sanitation improvements and other site specific requirements were undertaken. Accordingly, school-wise costs were estimated and handed over to the TMC. After obtaining the requisite approvals, the TMC issued a call for tenders, which was delayed for a few months due to elections. After tender evaluation and technical approvals, the work order was issued to the contractor but work has not yet been initiated as the security deposits (part of the Karnataka Transparency and Procurement procedures) have not been paid yet.

Simultaneously, discussions were initiated with Mr. Devaraj Reddy of Geo Rain Water Board (GRWB) on providing software support to ensure that awareness and ownership amongst the beneficiaries is built up. This was necessary for proper usage and maintenance of the structures.

This project has had a similar experience as in the energy efficiency project. The pilot was taken up in two schools. The pipes were broken down by children playing in the grounds after school hours and the structure was rebuilt to be more robust. But overall, there was little ownership from the TMC to avail the funds for other schools and implement the project. Arghyam and its partners were also unable to spend the required time and effort to build up ownership in the community.

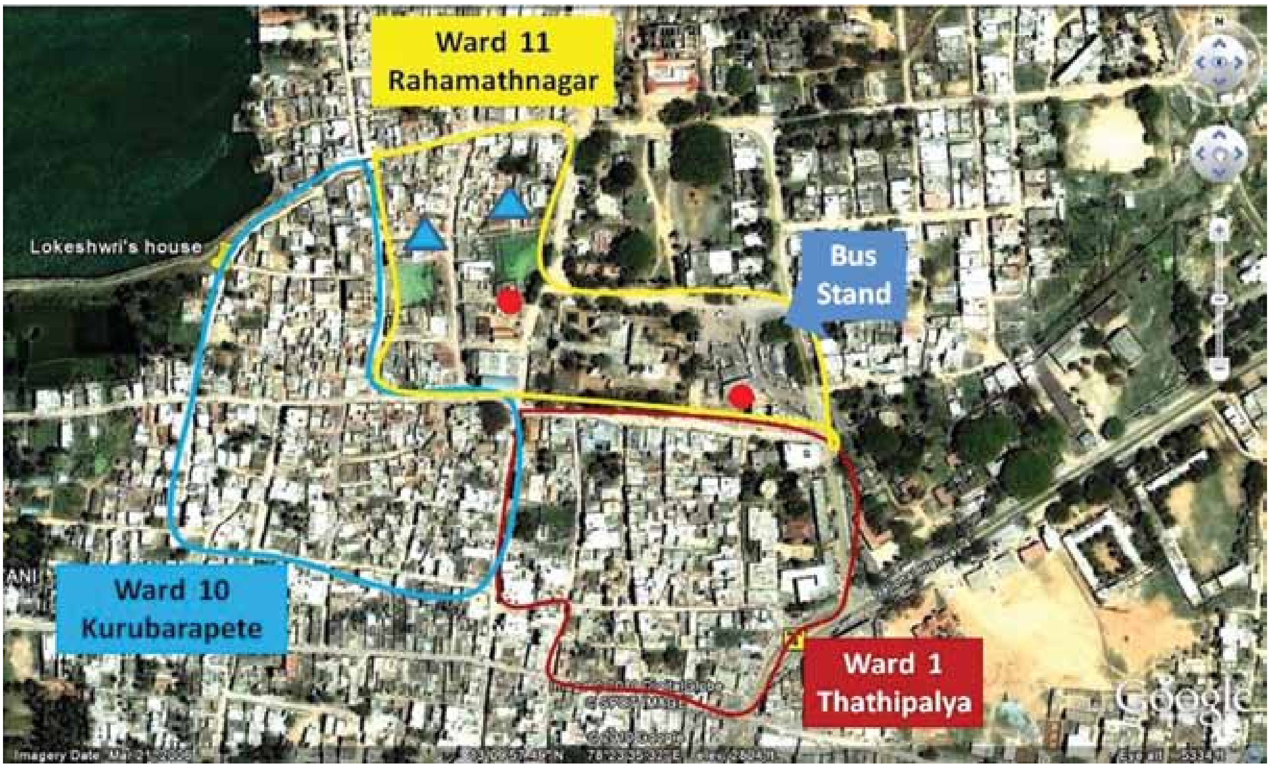
7.3
Community toilets

As indicated in a previous section on water quality studies, the groundwater inside Mulbagal town was found to be heavily contaminated by nitrates and bacteria. A primary attribution was the practice of open defecation by 1,375 households, as well as inadequate treatment of sewage from existing toilets.

- To set up a sustainable mechanism for maintenance of the repaired community toilets with the involvement of citizens and the TMC.

At the TMC's request, the Slum Board cancelled the contract of O&M for the dysfunctional toilets, repaired the toilets and handed it over to the TMC. The TMC restored water and electricity connections.

Figure 17: Map of community toilets in Mulbagal



▲ *Kalyani* ● Community Toilet

Working with the TMC, Arghyam's survey found 10 community toilets constructed by the Karnataka Slum Board in 2003. These were lying in disuse due to reasons such as no doors, no water, broken pipes and inaccessibility.

7.3.1
Objectives

- To repair and revive community toilets built under the 2003 *Nirmal Bharat Abhiyan* scheme, which were in a state of neglect and disuse.

Arghyam's partner, Gramalaya was engaged as an expert in urban sanitation. A new decentralised technology for treatment of sewage was taken up in one of the toilets.

7.3.2
Setting up a sustainable O&M mechanism

The next step was to set up a sustainable O&M mechanism for the maintenance of the toilets. The PSU/TMC conducted a meeting with the beneficiaries and suggested several options to them. With the help of the TMC, PSU, Arghyam, and an Anganwadi teacher, the beneficiaries developed a management mechanism for one of the community toilets where a local resident was appointed as the caretaker. She resides in the existing caretaker room on the community toilet site and is paid Rs. 50 per month by each of the 35 families. She was given training for manufacturing detergents, cleaning liquids, and growing vegetables in the vacant land of the site. The TMC has agreed to pay for the water and power.

A lot of emphasis was placed on Information, Education and Communication (IEC) to ensure that the toilets would be fully and properly used. Numerous discussions were held with the community to sensitise them for participation.

7.3.3
Outcomes

Some very clear outcomes have been seen in the five months since this was initiated. About 200 people started using this facility regularly and there is no more open defecation in that area. The caretaker and teacher are the local champions, and the caretaker has made a livelihood out of this. A defunct public asset has been restored and is in use. After the completion of the first toilet, three more have been repaired and are now in use. Issues like shortage of water have cropped up and sustainability may require continued support.

7.3.4
Implications

The effort required the strong leadership and drive provided by Arghyam to fight the inertia and vested interests in the system. Developing the management model took substantial time since it required ownership by the community, and the demand was initially very low. In sanitation projects, it is better to provide the financial and other support for launching the project, since the demand from the community will develop only after they have a positive experience using a functional toilet. Before opening the toilet for use, it is essential to design a suitable management mechanism.

7.4
Individual toilets

When Arghyam entered Mulbagal, there was no information on how many households had access to toilets, either community toilets or individual toilets. In 2010, a GPS survey was conducted revealing that 1,375 of 14,500 households were without toilets.

7.4.1
Activities

The Government of India’s ILCS scheme offers a subsidy of Rs. 9,000 to build individual toilets for households below the poverty line under the condition that they must have the:

a. Necessary space to construct the toilet.
b. Valid documents to prove ownership of the land.
c. Latest tax paid certificate.

Together with MYRADA, the TMC assisted households in applying for the ILCS scheme, distributing application forms to 1,375 households through the respective councillors. The filled-in forms and their attachments were collected by MYRADA and verified through site visits. It was concluded that 240 households were best suited to qualify for the scheme. These were reviewed once again by bill collectors, the health inspector, and the chief officer through site visits. A report was prepared by the TMC based on the GoI guidelines, and a model design was prepared for the individual toilets along with estimates and drawings. The TMC resolved to submit the report to the District Urban Development Cell (DUDC) Kolar for approval and, once verified, it was passed onto the DC for approval. Upon approval by the DC, it was passed to the DMA. The report was then sent to the regional office of Housing and Urban Development Corporation Limited (HUDCO) in Bengaluru after the approval from a state level committee. The proposal was reviewed in Bengaluru and is now with HUDCO, New Delhi, awaiting approval.

7.4.2
Implications

The process of getting individual toilets under the ILCS scheme has been a long-drawn effort and approval has not yet been received.

It may be worth examining the approval process in detail to assess ways in which to reduce the application time and cost of this activity. One option is to explore the possibility of applying the 74th Constitutional Amendment to give local authorities the mandate to make approvals.

7.5
Solid waste management (SWM)

As per the survey conducted by Arghyam and IISc, the quality of ground and surface water in Mulbagal is deteriorating by the day and is mostly unusable. This is largely attributed to the rampant practice of open defecation and of dumping garbage on the roads and in the drains.

7.5.1
Objectives

- To set up a system of door-to-door collection of garbage, segregated at source. This would contribute to reduction in the contamination of groundwater, improvement in general hygiene and town aesthetics.
- To explore options for setting up an equitable and sustainable economic model in solid waste management.

The model of solid waste management proposed for the pilot wards involves collection of segregated waste at the doorstep with the wet waste being transported to the landfill and the dry waste sent to the local *kabadivalas* for recycling. A special working group was to be created for carrying out door-to-door collection of waste.

7.5.2
Activities

The project started by understanding the current solid waste management situation in the town in terms of existing human, financial, and systemic resources. Best practices of solid waste management from around the country, like Udupi, Kundapur, Vellore, and Pune were studied through visits and discussions. The Mulbagal model was developed picking some elements from the other models like segregation and waste treatment but with unique aspects like the formation of the *'Nirmala Balaga'* group to run the solid waste management programme. A workshop to debate this model was conducted. This was followed by formal resolutions passed by the TMC to select the pilot areas, create the *Nirmala Balaga* group, approve the tariff and bylaws, release funds for the auto-tippers (vehicles for waste-collection), and banning plastic bags less than 40 microns thick.

With this, the formal programme was underway and trainings were carried out for the TMC staff, the *pourakarmikas* and the citizens on their roles and responsibilities. In one of the pilot areas, a Police Colony, the local Deputy Superintendent of Police (DSP) emerged as a strong champion of the effort. Three auto-tippers were purchased with contribution from Arghyam and the pilot area was slowly expanded.

7.5.3
Outputs

The pilot areas are visibly better with cleaner drains, less odour, and fewer stray animals or mosquitoes compared to other wards. Other wards have come forward demanding a similar service, and another police colony has taken it up on its own. Seven people have received employment, and the TMC allocated Rs. 3.6 lakhs from their budget for this programme. Composting of the wet waste was initiated but discontinued, and segregation is functioning at about 60% effeciency.

7.5.4 Implications

With the many challenges on the ground, the success of the SWM project depends on total cooperation and concerted effort of all stakeholders. It is important to consider all aspects of the project like finances, staff, institutional support, and citizen responsibilities while designing the system.

The project required strong leadership and project management from Arghyam. The intellectual work in bringing together experts and best practices, designing the model and troubleshooting to get the pilot going, could not have fructified without the external push from Arghyam and partners.

7.6 Revival of a *kalyani*

This effort was outside the purview of the five implementation projects approved under the DMA proposal. It began as an offshoot of the solid waste management project. For over 40 years, this ancient tank was filled with solid waste, sewage, and was infested with snakes. It underwent a remarkable revival through the efforts of the TMC, political representatives, Arghyam, and citizens.

7.6.1 Objectives

- To clean up and bring to life an ancient temple tank which was in a state of neglect and disuse.
- To investigate the source, quantity, and quality of water in the tank.

7.6.2 Activities

The inspiration for this came from the DC of Kolar and the activity started as *shramdaan* or service-offering by the TMC staff, solid waste management staff and *pourakarmikas*. It was soon realised that the scope and complexity of the task required professional help and hence contractors were hired. The tank had to be first de-weeded and drained to assess the extent of the damage to the tank. The next challenge was to de-silt about a kiloton of sludge accumulated over the years, along with glass pieces, stones, plastic covers, garbage and debris. The effort was agonisingly slow and fraught with danger. The labourers had to stand inside the silt which was slushy and filled with sharp objects. Under the leadership of the local councillor and support of Rs. 1.3 lakh from Arghyam, a crane was hired and the job was completed.

7.6.3 Outputs

A beautiful, ancient structure has been revived and has generated awe and pride amongst the citizens. Some rare artefacts were uncovered during the cleanup process. Initial testing showed that the water quality was good. The structure has to be studied further to understand its role as a water resource for the town. Beneficial side-effects of cleaning up the *kalyani* include reduced groundwater contamination, reduced mosquito breeding and possibly waterborne diseases. The *kalyani* triggered interest within and outside the town for reviving other structures.

The TMC has entrusted the responsibility of maintaining this *kalyani* with the *Nirmala Balaga* – a special working group formed for solid waste management.

7.6.4 Implications

In Mulbagal TMC there are 26 *kalyanis* which are in various stages of disuse. By revitalising these tanks, there is an opportunity for improving the groundwater potential, both in quantity and quality. This model can be adopted for reviving tanks across South India.

This project was an example where the local councillor showed great drive and leadership in ensuring the success of the project. Though there still was strong support and handholding from Arghyam, it was more collaborative when compared to the other projects. When the intervention chosen is aligned with the interest of the local stakeholder, the chances of it being driven by the local champion are much higher.

8

Moving ahead

The urban dialogue on governance, public delivery systems and urban behaviour is only beginning. Much more work will have to be done to evolve appropriate models at the town level. A similar situation prevailed in the rural areas after independence. It took concerted effort of the government and hundreds of NGOs over decades to establish practices and norms of participation, development, and governance for rural development. And yet, progress remains uneven.

8.1

Lessons learnt

For Arghyam, the lesson learnt was that an idea externally conceived, however robust and sound theoretically and however relevant it seems to be for the town, is still one that is externally imposed. It requires time and effort to be internalised and owned by the town. The translation of the idea of IUWM into an actual town experience assumed a certain neatness in the idea of bringing citizens action, science, and governance together, aided by a PSU, to develop an approach that combined efficiency with fairness. The reality of five years of endeavour has shown how challenging this can be. The idea of embedding an externally imposed model of social cohesion backed by good science and institutional clarity and integrity, requires time. We have understood the challenges in trying to change ways of of thinking which have historically been based on a culture of patronage.

The main thrust of the IUWM programme in Mulbagal was to initiate an institutional model where the local government promotes sustainable approaches to water resource management with participation of the people, especially the poor. There were many lessons learnt in implementing this initiative and they can be grouped into three categories.

The first set is to do with the physical water resources in towns. Today, the mainstream thinking considers surface water sources, often external to the town, as viable, safe and sustainable options. But the reality is that the majority of the 7,935 urban bodies in India rely on groundwater to a great extent, if not exclusively. Groundwater needs to be studied at a finer granularity inside towns as urbanisation modifies groundwater behaviour. Mulbagal has only one official monitoring station which is insufficient to design groundwater management systems for the entire town. This is true for all the local water resources like lakes and tanks, rainwater, storm water, and wastewater. Along with this, the physical systems and structures also need to be audited for performance and efficiency. As in Mulbagal, most towns lack this data. Neither do they have the wherewithal to carry out such studies. Again, as in Mulbagal, most towns will have easy to address issues that can give quick, tangible returns like pump efficiency improvements, fixing losses in the systems, getting experts to address design flaws in new schemes etc.

Studies and focussed interventions need to be carried out to avail of these opportunities. In Mulbagal, while it took some time for the town to absorb the implications of the findings of the studies, they started using that knowledge in a piecemeal manner. When the town decided to go for a water treatment system, the negotiations with the provider and the location etc. were decided based on the results of the water quality study.

The second set of lessons are in acknowledging the structural impediments like political pressures, public finance, bureaucratic practice, and other aspects of the urban structure that create hurdles for integrated urban water management in small towns.

At the very outset, water infrastructure decisions are taken mostly at the state level, not keeping local, contextual realities in mind. Mulbagal's geological distinction of having an underground dyke outside the town which prevented the groundwater from flowing out warranted a different strategy from other towns. Despite the existing mechanism for a bottom-up planning process, towns rarely have the option of forging their own path, and are most often subsumed inside a state level scheme. Government schemes like ILCS are cumbersome and complex, involving long procedures for application, lots of paperwork, and multiple levels of approval at town, district, state, and national levels before funds actually reach the town. It took over a year and 1,500 pages of application forms and documents to get through most of the project preparation and approval stage; but at the time of writing, the first approval is yet to be received.

Councillors are likely to be interested in ward level, visible, short-term improvements and there are no stakeholders who are incentivised to look at town level, long-term sustainable options. In Mulbagal, there were repeated requests from the councillors for the solid waste management programme or a community toilet revival, but never for a long-term, sustainable water management plan.

The relationship between the TMC and the state level departments is unequal, and the system is not functioning to support the TMC as a unit of self-governance. Often, in the state level meetings, the town representatives would not even speak. Also, towns are short on staff, both in number and in skills, making it virtually impossible for today's small town to conceptualise and lead an IUWM effort. In this town, there are three posts directly relevant to the IUWM effort: a chief officer, a junior engineer, and an environmental engineer post. The latter position was not filled during the course of this project, and the first two have had transfers mid-project. The staff is constantly multi-tasking and is pulled in different directions. The PSU staff would find it very difficult to get the time and attention of the chief officer on a daily basis as he struggled to respond to citizen demands.

Running an effective municipality has other practical issues. Inefficiencies in management and financial practices affect the delivery of basic services. All members do not participate equally in the municipal decision-making processes. A high percentage of municipal members are ignorant of the provisions of the Municipal Act. This prevents them from performing and participating effectively, and allows vested interests to take advantage. There is a strong political culture of patronage with citizens approaching their representatives for services for themselves.

The ability of citizens to engage for systemic solutions seemed to be severely constrained. The extreme forbearance and helplessness of citizens was remarkable. For example, some women shared with us how the roads outside their homes became open sewers in the monsoons forcing them to shut their windows against the stench. Yet they seemed helpless in finding the answers. Even the councillors often reflected this sense of helplessness. Decisions are not driven by evidence or information, but often by power and politics with little transparency in the process.

Budgeting today is typically geared more towards capital spending than O&M, without a closer look at lifecycle costs. For instance, a chlorinator in the Seegenahalli pumping station was purchased a few years ago to improve the water quality but during the entire four years of this programme, it was never connected and never used.

While the journey would have arguably been much smoother if Arghyam was a field NGO based in Mulbagal, there are still limitations as to how much could have been achieved in a short span of four years. The external agents, including management, environmental, scientific, engineering, and social change experts, each played a role in catalysing change, and providing the information and foundational support for further action to be taken. But many of the changes required are structural and the constraints remain regardless of the animator.

The third and final set of lessons came out with the discovery that under these circumstances, the Change Management Approach offers a rational, feasible way to help small towns move incrementally towards IUWM. The Implementation phase of the initiative demonstrated good change management with Arghyam playing the role of a change agent. It involved connecting with the leadership of the target audience, connecting with key stakeholders, and triggering ideas among them. For example, the solid waste management programme that was introduced in Mulbagal soon garnered interest from the councillors. The TMC's quick involvement in identifying local youth as community facilitators, help in building the *Nirmala Balaga* group, and the emergence of local champions like the DSP and school teachers etc., reflects this leadership. Several of the council resolutions passed during the course of this programme were unanimous.

The change management approach involved providing guidance to stakeholders on options to implement the ideas, facilitating them to execute the ideas through training and mentoring, and finally, assisting them in consolidating the gains. The interest triggered in the TMC in the solid waste management programme was enough for them to allocate land and funds for it. It also resulted in a ripple effect, since suddenly, people saw themselves as being able to affect change. Citizens of the participating wards also began to make payments for the waste collection.

Given guidance and support, the TMC and citizens rose to the occasion and cooperated enthusiastically in the projects. This was seen at least in three projects: in the solid waste management project which was run by the youth from the area, in the temple tank clean up which inspired another temple community to clean up their tank and in the smooth functioning of a public toilet run by a caretaker from the community. At all times, Arghyam played the role of a change agent and mentor – never the chief executor. When ideas were suggested and did not find resonance, Arghyam did not pursue it further.
If towns are to be more autonomous, they urgently need some enhancement in planning and execution skills,

in conjunction with access to expert advice. The need for advice on strategic as well as technical matters is reinforced by the feedback from all levels (TMC, DC, DMA).

8.2
Way forward

There are several questions that lie unanswered at the end of this exercise.

- It is unclear how to create incentives at the appropriate geographic and administrative scale to manage water. This is an important question because of the fragmentation at the different administrative levels and lack of understanding about the varying scale of water management.
- The issue of community participation sometimes implies the involvement of individuals and families (especially the marginal ones) in almost every aspect of a development project – from demand articulation to implementation and monitoring. This is the obverse of the patronage driven development. In Mulbagal, we have found that local champions, although certainly local are often also patrons (e.g. the police officer in the solid waste management project, the councillors etc). Is this inevitable if we privilege the quicker change management approach over a more evolutionary democratic approach? Is the latter even feasible in our towns today?
- Devolution is accepted as a more desirable approach for good governance. With the reality of local sectional interests and the absence of a culture of service (as in the case of Mulbagal), political will is likely to be applied from more distant parts i.e. from district or state levels. If we are looking for tangible wins should we look for directives from these sources? Should we suggest such an approach for the state government in towns like Mulbagal and, if so, unconditionally or with some minimum criteria?
- After planning a comprehensive five-phase approach, we progressed to a more expedient and incremental change management approach. This, as demonstrated at Mulbagal, has certainly released energy, but is there a significant risk that it could lead to more visible projects (e.g. *kalyani*) sucking up the available enthusiasm at the expense of slower and longer lasting change? And are these incremental steps necessarily consistent with the IUWM approach as articulated in the four hypotheses (see Section 2.3: IUWM principles).

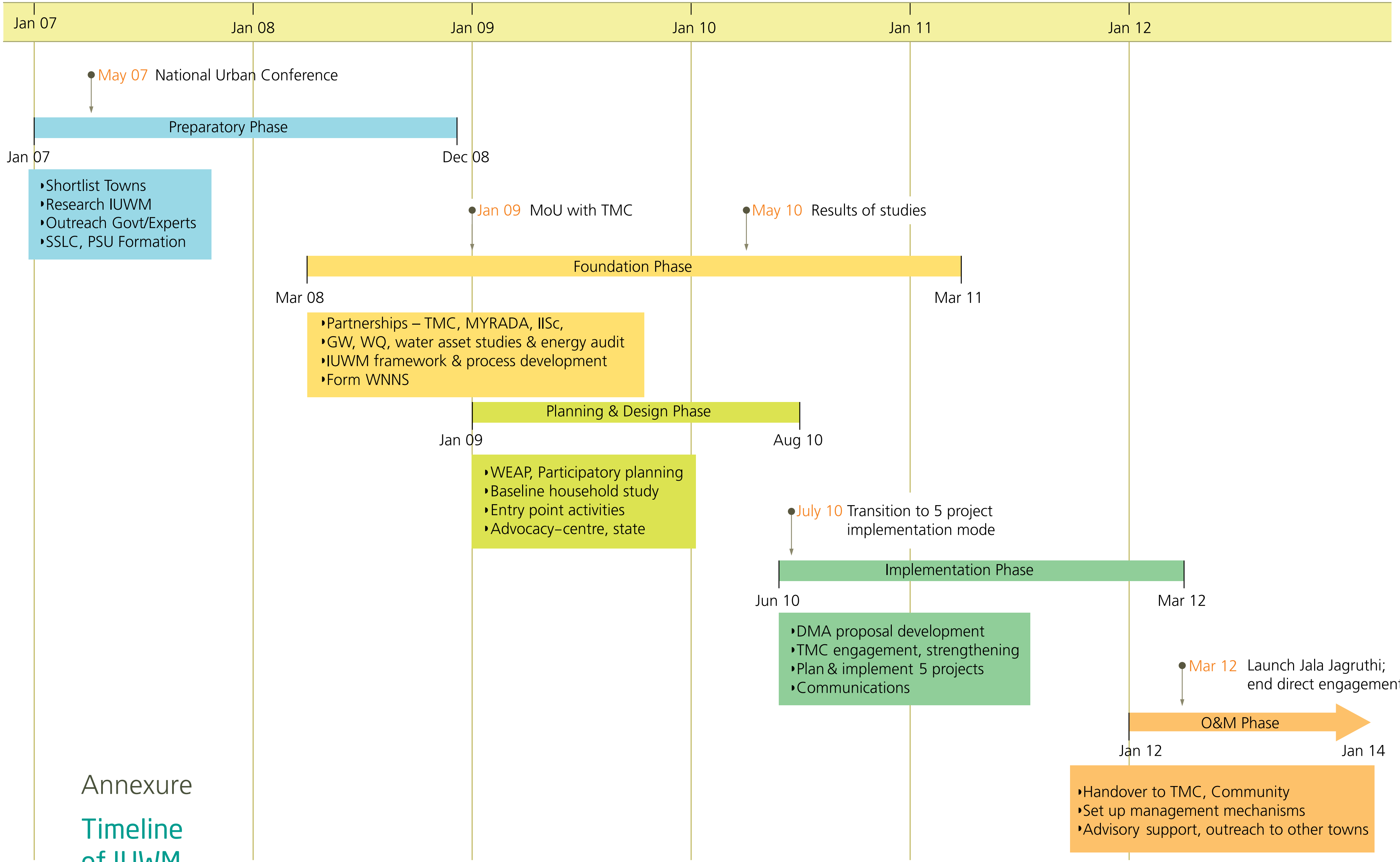
To deepen the understanding on these questions and broaden the experimentation space, Arghyam has made a commitment to expand its urban initiative going forward. Arghyam will adopt a multi-pronged approach through specialised groups to extend the initiative into other areas:

- First, efforts will be made to deepen the intervention in Mulbagal and facilitate the creation of a town level WatSan council. The role of Arghyam will be to provide direction in strategic issues and facilitate the TMC and citizens to execute the programmes. This could also involve replicating this experiment in other towns by building capacity of the TMCs, overseeing the execution with low engagement, and help the towns progress on their own initiative. In Mulbagal, Arghyam intends to create a research partnership and observe the town's journey in IUWM.
- Second, Arghyam will make grants in the urban WatSan sector to experiment with different working models of IUWM. It will fund NGOs in multiple towns to develop community-based, decentralised and sustainable water management models following the IUWM principles. These could include community toilets, water and sanitation in schools, rainwater harvesting, water body restoration, special initiatives in slums, and institutional strengthening.
- Third, Arghyam will engage with policy research agencies to explore the structural impediments in IUWM and the impact of policies on the sector, e.g. public finance requirements, incentives, human resources, coordination between departments, and devolution of power. This will form the basis for advocacy efforts at various levels.

An approach which combines all the above could be a practical solution to create impact on the ground. It will help generate field evidence and influence policy-makers. This will also be a major step towards the development of an IUWM framework, especially for smaller towns.

Annexure

Timeline of IUWM programme



Arghyam
A Profile

Arghyam is an Indian public charitable foundation setup with an endowment from Rohini Nilekani, and working in the water and sanitation sector since 2005. 'Arghyam' is a Sanskrit word meaning 'offering'. Our vision is "safe, sustainable water for all".

As a funding agency, Arghyam works primarily through partnerships – with government, NGOs and various types of institutions – for impact and scale. The emphasis of all of Arghyam's work is on equity and sustainability. Addressing the issues of the poor and vulnerable in accessing water for their basic daily needs is a priority for us. If the outcome of any intervention is to be effective over time, environmental sustainability is important. We believe that the key to achieving this is in better water management which requires effective governance.

Specifically, projects supported by Arghyam strive to understand and address issues of quantity, quality and access to domestic water in communities across the country. Some of the key principles which guide these efforts include community participation and ownership, an integrated approach to managing water from source to sink, an emphasis on subsidiarity (which means managing water locally) and effective use of technology as an enabler.

We work through a combination of project grants to grassroots organisations, knowledge building and sharing through the India Water Portal, promoting new models of water science, technology and system design, participatory action research and advocacy.

Arghyam has collaborated with a diverse range of actors across 20 states in India through 90 projects. Rigorous engagement with people and institutions has helped in deepening the internal debate and keeping Arghyam closely connected to the ground.

For more information, please visit:
www.arghyam.org
www.indiawaterportal.org
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