



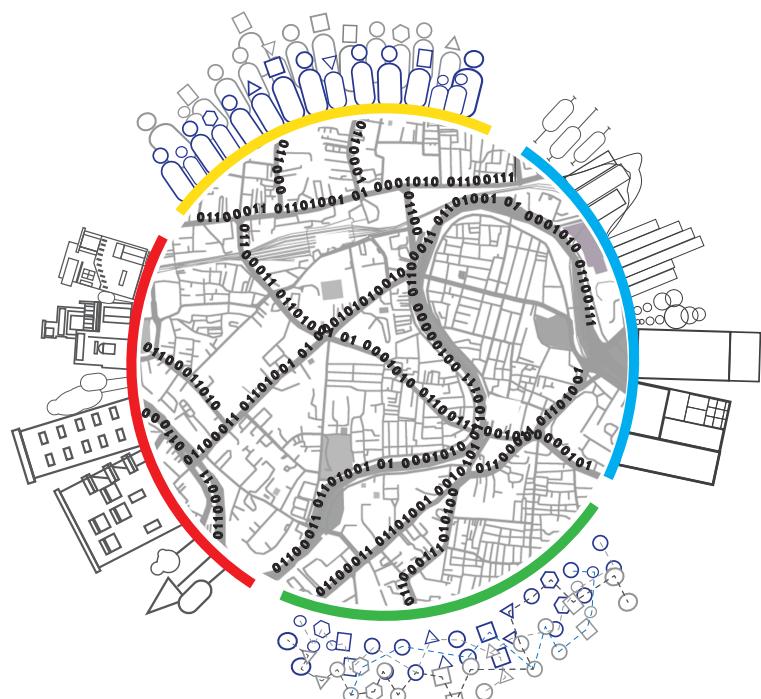
Ministry of Housing and Urban Affairs
Government of India



Developing Resilience Scenarios and Strategies through Participatory Simulations

Case of Metropolitan Chennai

CASE STUDY 3 | JULY 2019



POWERED BY

TATA TRUSTS

Data Driven Governance

URBAN
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ABOUT TATA TRUSTS

Tata Trusts are amongst India's oldest, non-sectarian philanthropic organisations. Since its inception, Tata Trusts have played a pioneering role in transforming traditional ideas of charity and introducing the concept of philanthropy to make a real difference to communities. Through grant-making, direct implementation and co-partnership strategies, the Trusts support and drive innovation in the areas of healthcare and nutrition; water and sanitation; energy; education; rural livelihoods; natural resource management; urban poverty alleviation; enhancing civil society and governance; media, arts, crafts and culture; and diversified employment. The Trusts engage with competent individuals and government bodies, international agencies and like-minded private sector organisations to nurture a self-sustaining eco-system that collectively works across all these areas.

ABOUT DATA DRIVEN GOVERNANCE

The Data Driven Governance (DDG) Initiative of the Tata Trusts works with rural and urban decision making systems to enable inculcation of data as a way of life in the planning and delivery of government schemes – thereby creating significant impact for underserved and marginalized communities. This has been demonstrated through deployment of inclusive data and technology processes at district and city levels, through large scale partnerships with governments, central planning entities, foundations and philanthropies such as the Niti Aayog, Ministry of Housing and Urban Affairs and Tata Steel Rural Development Society.

The Urban Engagements under the DDG Initiative of the Tata Trusts provides directed technology and capacity building support to urban administrations at central and city levels through effective fore-grounding of city data policies, data standardization models, implementation of inclusive open data portals, improved civic engagement and skill building of municipal officials in data and technology practices

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TATA TRUSTS

PROJECT PARTNERS

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The Tata Trusts are among India's oldest philanthropic organizations. The Trusts own two-thirds of the stock holding of Tata Sons, the apex company of the Tata group of companies. The wealth that accrues from this asset has enabled the Trusts to play a pioneering role in transforming traditional ideas of charity and introducing the concept of philanthropy to make a real difference to communities.

Through grant-making, direct implementation and co-partnership strategies, Tata Trusts support and drive innovation in the areas of natural resources management; education; healthcare and nutrition; rural livelihoods; enhancing civil society and governance; media, arts, crafts and culture; and diversified employment. The Trusts engage with competent individuals and government bodies, international agencies and like-minded private-sector organizations to nurture a self-sustaining ecosystem that collectively works across all these areas.

Under the Data Driven Governance Initiative of the Trusts, which provides directed technology, strategy and policy support to rural and urban decision making systems to enable improved governance and decision making, the Trusts have supported Fields of View, OKAPI and CUBE, IIT Madras to bring the Transformative Scenario Planning initiative to fruition in the Chennai Metropolitan Region.

Fields of View (FoV)

Fields of View is a Bangalore-based non-profit organization that uses simulations and games as visual representations to engage specific groups or diverse stakeholders on a wide range of issues that range from framing and defining vague but pressing policies to solving "wicked problems." Tools such as Agent Based Models enable policymakers to explore multidimensional implications of their decisions prior to implementation.

The visualization process broadly functions as a means to deepen participation in social, economic, and environmental problems that require solutions through involving multiple actors including the general public. The interdisciplinary team works with academia, civil society, and the government around complex public policy problems ranging from urban poverty to waste management.

Okapi Research and Advisory (Okapi)

Okapi is an IIT-Madras incubated research and consulting group focused on strategies for addressing the institutional voids that handicap collaboration and innovation in delivering sustainable development. It works with government, corporate, philanthropic, and community-based clients, primarily but not exclusively in India, to help them reach environmental and human development goals.

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Its current work focuses largely on infrastructure and service governance, in sectors ranging from energy to urban infrastructure and at scales from social enterprise development to national policy. It also has a growing portfolio of projects focused on developing scenarios as a tool for anticipating, preparing for, and influencing the future; including adoption of new technologies and science-based approaches across sectors.

Center for Urbanization, Buildings, and Environment (CUBE) at IIT Madras

IIT Madras is one of the leading institutes in higher technological education, basic and applied research. CUBE is in the process of being constituted within the Building Science Department and will function as a research hub that offers technical expertise on various topics around the built environment.

USING SIMULATIONS FOR RESPONSIVE SCENARIO PLANNING

The Challenge

Coastal cities in India and across the world are being impacted by climate change in the form of heavy rains, cyclones and rising sea levels. Chennai, as we know, faced unprecedented flooding in 2015 and parts of the city were declared under drought in 2016. The challenges posed by climate change are compounded by the inter-connected and resource-based challenges that governance of urban areas brings with it, such as the need for drinking water, management of solid and wet waste, and land-use planning for an increasing population, demand and changing use pattern.

The need to respond to these challenges is clear and policymakers have access to large amounts of data for their planning processes. There are difficulties in aggregating and making such data actionable as policymakers also operate within existing institutional frameworks that are often fragmented, limiting the interaction across institutions and thereby impacting the nature and efficacy of decisions made.

The consequences of policymakers' decisions assume criticality given that they are responsible for performing essential public functions such as the supply of drinking water, maintenance of drainage systems, etc. Combined with specific challenges such as planning for a large and diverse set of stakeholders, the unprecedented speed of urban growth and corresponding effects on climate and the environment, a lack of support can harm lives and livelihoods of people.

Therefore, there is a need to develop tools that help policymakers plan and react to on-the-ground challenges in a timely manner.

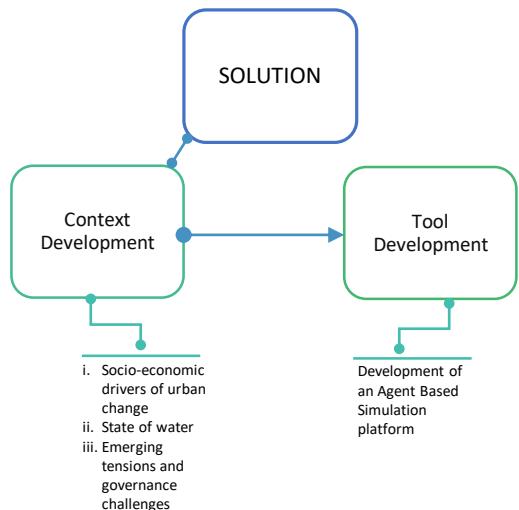


Figure 1: Implementation Steps – Development of Simologue

The Solution

A. Developing an Agent Based Simulation Platform

This approach is a combination of in-depth analysis of existing data, extensive field research to gather data and consultation to facilitate the use of a simulation platform to understand systems-level impacts of various strategies for balancing the environment, specifically water-related vulnerabilities, and development aspirations. The overall exercise was envisioned to support and guide public, private, and community stakeholders in advancing a more sustainable and resilient future for the Chennai Metropolitan Area (CMA).

To realize this objective, the first step was 'context development', wherein there was a close analysis of pressures emerging from conflicts between the city's land-use, environmental and water-related limitations and socio-economic and developmental direction.

Once the background context was developed and data on the availability and use of resources, collected, the next step was to develop an agent-based simulation platform called Simologue. The tool was designed as a platform for integrated governance through a facilitated dialogue between various stakeholders involved with governing Chennai. The dialogue was based on various future scenarios developed by each stakeholder and, through the same, were able to negotiate with their peers.

A future-based approach helps to improve decision-making by *(i)* facilitating the integration of diverse public institutions and collaboration between stakeholders by defining specific goals and evaluation parameters by stakeholders themselves, and *(ii)* incorporating intangible data with regards to their interaction and decision-making into the decision support system.

Through workshops and outcomes of the simulation platform, actionable strategies were to be developed by the stakeholders themselves that would help them work towards certain future scenarios and overall systemic sustainability.

B. How was it implemented

Context Development – The phase of context development was one that involves evidence gathering and mobilization to refine the problem statement.

A conscious decision was taken to rely on existing literature and studies that presented good quality information which needed streamlining for better understanding of the city's water management network and process. However, certain unexplained links or gaps in the existing literature were identified through the course of data compilation and analysis that were investigated through primary research. The evidence gathered was divided into three areas of interests:

i. Socio-economic drivers of urban change:

This involved primary and secondary research efforts to identify the region's key drivers of urban expansion and transformation. The work included review of planning and development documents, interviews with relevant urban stakeholders to gain granular insights into decision making processes, longer term aspirations and concerns, and analysis of related socio-economic data influencing the metropolitan area's growth patterns.

This was done using a stakeholder analysis approach that could explain who drives development trends and how. Stakeholder analysis covered the following three steps:

1. Identifying stakeholders
2. Differentiating and categorizing stakeholders
3. Investigating stakeholders' relations

First, all relevant actors were identified by drawing on existing literature, semi-structured interviews with key public departments, Chennai's urban development, water and waste-related policy making, along with representatives from CMA's business community and civil society organizations.

The interview data was supplemented by four hands-on workshops where government officials representing relevant agencies like Chennai Metropolitan Development Authority (CMDA), Public Works Department (PWD) etc. were asked to reflect on their priorities, visions for the city's future, opportunities and challenges related to their work, inter-departmental relations etc.

Next, these stakeholders were differentiated primarily based on their goals and visions for the city's future development. Such vision data was also collected through secondary research of literature, policy documents and master plans in combination with primary work through interviews and workshop engagement. Finally, the analysis was carried out, which led to an understanding of which of the identified stakeholder groups and their visions predominated action/policy-making. This was done through a trend analysis of public budget allocations, the nature of permitted land use development through mapping land reclassification, and examination of policies on economic development.

ii. State of water:

This involved aggregation and analysis of data around Chennai's current state of water, land-use, and waste. Focal points of the study included assessment of trends in ground and surface water use, waste water, and solid waste.

This included a compilation of data on rainfall patterns, river flows, water production at desalination plants, extent of water recycling, ground water levels and extraction from private wells, storage capacities of rivers and tanks and inter-state allocations. This also included available information from published and unpublished documents to illustrate the need for more integrated actions across the identified multiple sectors for Chennai's sustainable future.

For instance, the clearances granted by the State Environment Impact Assessment Authority (SEIAA) were matched with water (and wastewater) requirements and demand projections made by the Chennai Metropolitan Water Supply and Sewerage Board (CMWSSB) for a randomly selected sample year. This helped to determine if the agency in charge of water provision for the city - Chennai Metro Water - was prepared to meet future demand for water.

Data was obtained on current and future water supply and demand and the process of future projections through interviews with key persons at Chennai Metro Water.

Data on environmental clearances granted as well as water requirements for each project were gathered from the SEIAA website. Care was taken to ensure that the right numbers were compared. Chennai Metro Water's projections were made for existing as well as new projects. Therefore, yearly incremental increase in water demand was compared to water requirements of new projects that obtained Environmental Impact Assessment (EIA) clearance for 2016.

iii. Emerging Tensions and Governance Challenges:

The findings from the first two sections were critically analyzed to understand how the socio-economic and developmental trajectories conflicted, interacted, and coexisted with the environmental realities in the Chennai metropolitan context. This part of the study was meant to help prioritize problems in a way that set the stage for strategic thinking towards integrated urban governance in the subsequent parts of this initiative.

Socio-Institutional Network Mapping unpacks the relationship amongst varied stakeholders, specifically the government agencies that remain key to planning and policy-making processes in CMA. This was done by using a qualitative Social Network Analysis (SNA) approach that provided a means to unpack the complex socio-institutional landscape by mapping the institutional actors (organizations, individuals, interest groups etc.) and their linkages or networks (socio-institutional relationships).

For the case study in Chennai, qualitative data was collected through primary sources such as interviews and workshops. In order to accurately model the institutional structure and develop the simulation platform, some qualitative data was also collected through secondary sources where primary data was unavailable.

Through the SNA, different relationships could be analyzed. For instance, financial flows mark the flow of funding between agencies that they themselves perceive as important. Similarly, functional flows mark the linkages that represent agencies' dependency or influence on others for proper functioning. Data or knowledge flows mark the pathways of communication of data or sharing of knowledge between actors (e.g. CMDA gathering data from multiple agencies like Greater Chennai Corporation (GCC), PWD and other departments to prepare the Master Plan.)

Fields of View conducted workshops to gather qualitative information from decision-making departments involved in this context. This information captured the effective interactions between public departments, delays in decision-making, the flow of information, and the practical constraints under which they operate.

Tool Development – This entailed developing an agent-based simulation platform. Agent based models (ABM) are simulations of how specific individual motivations, constraints, and actions aggregated up into city-level outcomes.

They allow users to understand the connection between the city's social micro-foundations (behavior of particular stakeholders, or "agents") and macro-level outcomes such as changes in land use, density, water use, etc.

Both qualitative and quantitative data were employed to create the simulation model. The set of quantitative data on water, waste, and land-use was collected from Chennai River Basin Reports, CMWSSB), Municipal Administration and Water Supply Department of Tamil Nadu Government, Tamil Nadu Water Supply and Drainage Board (TWAD), and Water Resources Organization of PWD. The data collection process was followed by the data cleaning process for the collected data.

For qualitative data, an analysis of the city's institutional environment was undertaken by relying on interviews of government officials and other stakeholders, review of planning and development documents and other secondary research material and stakeholder mapping workshops conducted with policy-level and on-the-ground govt. officials in Chennai.

Once the model was developed, it was used to generate various what-if decision-making scenarios. An agent-based approach was used where various stakeholders are modeled as individual autonomous agents, with their own respective objectives and functions. This simulation tool models the behavior of public institution stakeholders as separate agents to capture the specifics of their operation.

Using the data, the simulation generates multiple future scenarios that can be explored by policymakers in order to come up with a multitude of plans for the future.

C. Hindrances in Implementation

Collection of qualitative data

Qualitative data required a space where the stakeholders could provide data about their operations based on their experiences and daily interactions. There are delays and differences in decision-making processes due to real-time and on-the-ground changes. Such changes and events need to be accounted for during the planning phase.

Decision-making processes are also affected by the influence stakeholders exert and existing institutional relationships and interactions. This data is completely invisible and is not captured by traditional methods. In order to collect qualitative data, a new data-collection methodology was designed and administered in a structured workshop format.

This method requires representatives from stakeholder organizations (or stakeholders themselves) to participate in a five-stage approach to formulate organizational goals while interacting with their peers. These interactions are carefully documented to create a structured format of institutional interactions while tackling a specific planning or implementation problem.

This document then provides a cross-sectional view of the specific decision-making process and thus, document intangible and qualitative parameters.

Availability of quantitative data

Secondary data available from different sources required multiple rounds of cleaning up to ensure that the data is uniform in terms of time periods, geographical scope, and units/values. Where data was not available, proxy data had to be used to estimate the actual data required for modelling.

ABMs and exploratory simulations

These are relatively new tools for decision-makers. To demonstrate the value of the tool, multiple meetings, presentations and workshops had to be conducted to build the capacity of government officials at all levels. These sessions helped to demonstrate the development of the tool and provide a hands-on experience for the officials to play with and explore the tool. Their feedback and suggestions were incorporated to finally develop a tool that they would like to use.

D. Solution Enablers

- i. Partnership with public institutions is necessary, given that the need for data is to use it for applications in improving public policy.
- ii. Regular consultation with stakeholders and modifying project methods and outcomes is a must so as to ensure the relevance of the tools being developed and their use by the intended stakeholders.

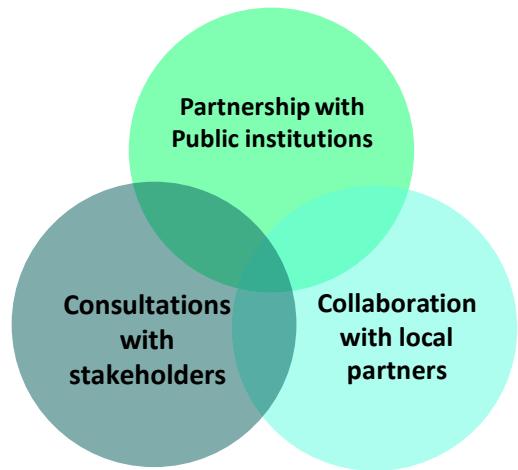


Figure 2: Solution enablers

- iii. Regularly consulting stakeholders and formally partnering with public institutions that are focused on the project focus areas helps to respond to administrative as well as substantive challenges such as the availability of stakeholders, specific data requirements, etc.
- iv. Local partners, who understand on-the-ground context and challenges, must be a part of any efforts under the project.

The Impact

Simulation models, such as the one developed in this project, have been shown to be useful reference points for helping disparate stakeholders:

- i. Understand the larger systems that they are trying to influence
- ii. Test and refine their own theories of change and impact

- iii. Identify synergies and conflicts between their own efforts and others' initiatives.

By using this tool, stakeholders can develop actionable strategies, for the short and long term, that help them achieve their desired futures. The process of data collection for institutional interactions and processes provides an end-to-end research platform which brings all stakeholders together to make possible what-if scenarios.

Simulation based models influencing public policy making are far and few in India. Such models, as has been outlined in this case, are extremely beneficial to administrators setting out to resolve complex developmental issues, by giving them access and exposure to the outcomes of different theories of change without carrying out resource intensive, often irreversible processes of implementing unsuccessful on ground initiatives.

A platform such as Simologue has a high degree of replicability in other Indian cities in different domains such as disaster management, climate change, water management and resilience planning.

Lessons Learned

Workshops as a method for building trust with stakeholders - Over the entire project, six workshops were conducted with government, civil society, and

industry stakeholders to discuss the developments under the project and inform them of the progress of the project. These workshops enabled trust-building between the facilitators and stakeholders, as well as between the diverse govt. stakeholders who come together to participate in these workshops.

An integrated platform that engages both quantitative and qualitative analysis - An integrated platform to engage both quantitative and qualitative analysis by creating a simulation tool brings more value to those attempting to make data actionable in the public policy context. Provided with data on qualitative and quantitative aspects, this model can be extended for other geographical areas and domains. Partnership with public institutions is necessary given that the need for data is to use it for applications in improving public policy.

Regular consultation with stakeholders - Regular consultation with stakeholders and modifying project methods and outcomes is a must so as to ensure the relevance of the tools being developed and their use by the intended stakeholders. Such regular consultation also helps to ensure that stakeholders are invested in the outcomes of the project and develop a sense of ownership towards the tool. Local partners, who understand on-the-ground context and challenges, must be a part of any efforts under the project.

Abbreviations

ABM	Agent based models
CMA	Chennai Metropolitan Area
CMDA	Chennai Metropolitan Development Authority
CMWSSB	Chennai Metropolitan Water Supply and Sewerage Board
EIA	Environmental Impact Assessment
GCC	Greater Chennai Corporation
PWD	Public Works Department
SEIAA	State Environment Impact Assessment Authority
SNA	Social Network Analysis
TWAD	Tamil Nadu Water Supply and Drainage Board

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