



# Catalyzing Innovation

ANNUAL WORLD BANK CONFERENCE ON LAND AND POVERTY  
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## GIS Based Slum Information Management System

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## Abstract

Slums have constituted an integral part of Mumbai's cityscape for several decades. With its potential to provide employment to a vast multitude, the city attracts a large number of people. Many of them stay in slum colonies for the lack of a better alternative.

Slum-dwellers stay in shanty structures in unhygienic environment, not by choice but by compelling circumstances as they were thrown out of the formal housing sector, the latter being expensive and much beyond their income levels. It is imperative to enhance their standard of living and for which an authorized dwelling unit is a first step in the right direction. This, in turn, will bring about a marked improvement in their hygiene and health as well as raise the level of public hygiene.

With the rapid growth of population in Mumbai and Mumbai Metropolitan Region (MMR), the backlog, current and future needs of housing need to be addressed comprehensively. There is an urgent need to address the lack of consistent and intelligible urban planning strategy, approach and process by using effective decision making tools like GIS, LiDAR etc.

The aim of this paper is to showcase the GIS based Slum Information Management System (SIMS) solution which consists of four components; Topographical Survey of Slum Clusters & Slum Rehabilitation (SR) Schemes, LiDAR Survey of Slum Huts, Mobile Application for gathering slum dwellers information and Web Application with Web-GIS feature for determining the slum dwellers eligibility for free housing under SR Schemes.

SIMS has facilitated Slum Rehabilitation Authority (SRA) in sector-wise micro-planning of slum cluster, speedy implementation of SR schemes, availability of digital data in real-time, easy dissemination of slum information among stakeholders and bringing transparency, and effectiveness in identification of eligible slum dwellers.



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## Key Words:

1. DGPS/ETS (Differential Global Positioning System/ Electronic Total Station)
2. GIS ( Geographical Information System)
3. HRSI (High Resolution Satellite Imagery)
4. LiDAR (Light Detection And Ranging)
5. SIMS ( Slum Information Management System)

## Introduction

Slum Rehabilitation Authority (SRA) is a planning authority, to function as a local authority for the area under its jurisdiction. As per the slum rehabilitation scheme parameters, SRA can declare any area as slum rehabilitation area for the rehabilitation of slums and in certain cases slum areas become slum rehabilitation area by means of deeming provisions. All such slum rehabilitation areas, where slum rehabilitation schemes are proposed and being implemented, come under the jurisdiction of SRA.

SRA has envisaged to implement a single window clearance portal for all types of approvals that are required for the execution Slum Rehabilitation Schemes with the help of ICT and GIS Mapping Technologies.

With these initiatives, SRA's aim is to plan and create environment friendly, model urban settlements with full- fledged physical and social infrastructure to meet residential needs of slum-dwellers.

In view of above, SRA has initiated the implementation of Enterprise GIS project which comprises following components;

Topographical Survey of Slum Clusters and Slum Rehabilitation Schemes (SRS) Using DGPS/ETS, Digitization of City Survey Boundary and Linking of Land Ownership Data for all 24 Administrative Wards of Municipal Corporation of Greater Mumbai (MCGM)

Door-to-Door Slum Hutment Biometric and GIS Enabled Survey Using Mobile Application and Processing of Applications for Determining Slum Dweller's Eligibility for Free Housing.

## Technology Stack

- i. ESRI ArcGIS Desktop Advanced 10.4 Used for Preparing GIS Basemap
- ii. ESRI ArcGIS Server Advanced Enterprise 10.4 Used for Publishing Web GIS Services



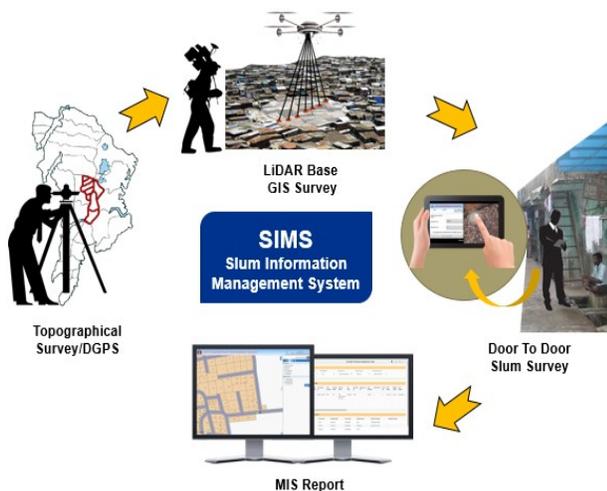
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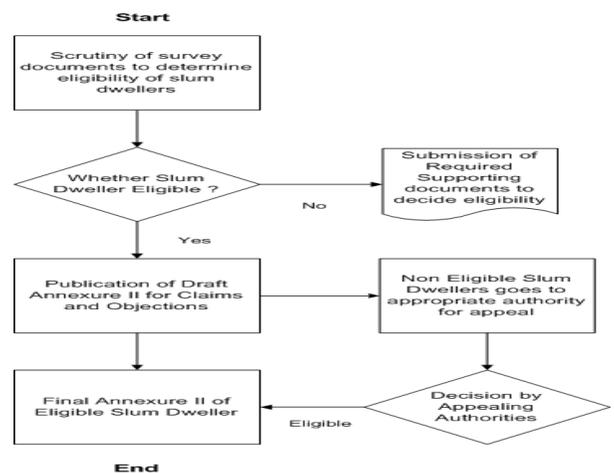


- iii. Microsoft Visual Studio 2013 and .NET Framework 4.0 for Web Application
- iv. Android SDK for Mobile Application Using Eclipse Tool for Front End

M/s KPMG Advisory Services Pvt. Ltd. is appointed by SRA as an e-Governance Consultant to support SRA in implementation of ICT and GIS initiatives.



**Fig: 1 – GIS Enabled Biometric D2D Survey**



**Fig: 2 – High Level Process Flow for determining eligibility**

## Previous Approach for Implementation of Slum Rehabilitation Schemes

70% or more of the eligible hutment-dwellers who show their willingness to join slum rehabilitation scheme (SRS) come together to form a co-operative housing society and elects Chief Promoter. Society may also select developer/architect for implementation of scheme in their area. This selected developer/architecture submits the SRS proposal to SRA for further approvals. Upon acceptance of SRS proposal, the SRA forwards the detailed slum plan and list of slum dwellers to the Competent Authority (CA). CA conducts the door to door biometric survey of each slum dwellers covered under the proposed scheme and collect the necessary documents from them. The collected documents are rigorously scrutinized for determining slum dweller’s eligibility for free housing. This is a part of SRS proposal approval procedure which is known as “Annexure II”.



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In the entire process, GIS or for that matter no technology had role to play and entire process of survey is done manually. Approach for conducting door to door survey was reactive in nature and determining eligibility is time consuming process. Entire process of survey and determining eligibility is manual and hence digitized data of slum dwellers and relevant MIS is also not available.

## **Business Process Re-engineering for Implementation of Slum Rehabilitation Schemes**

With the re-engineered approach, instead of waiting for society/developer/architect to submit their SRS proposal and after that conducting the survey, SRA has proactively started GIS enabled biometric survey of all slum dwellers residing in Municipal Corporation of Greater Mumbai area. SRA has appointed an agencies to conduct the Door-to-Door Biometric Enabled Slum Hutment Survey of all slum dwellers residing within the boundaries of Municipal Corporation of Greater Mumbai (MCGM) and Thane Municipal Corporation (TMC), where latest LiDAR technology is also being used for precise mapping of slum huts. This entire exercise will create a huge GIS and MIS database repository of slum dwellers.

To store and keep a tight control over data generated from above initiatives, SRA Mumbai has decided to setting up a Data Center in its premises, which is being under the final implementation stage. To access entire digital slum survey hutment data, “Slum Information Management System” (SIMS) a web application is being developed by SRA which will be hosted at SRA Data Center. In future, SIMS application shall be made available to the Society/Architect/Developer for identifying eligible slum dwellers by overlaying their proposed SR Scheme boundary. This will help to drastically reduce the time taken for preparation of Annexure II and Issuing Letter of Intent for the implementation of SR Scheme.

The following steps are adopted by SRA, Mumbai for conducting Slum Hutment Survey;

- i. GIS based Slum Cluster boundary is created by conducting topographical survey using GPS & ETS machines
- ii. Upon finalization of slum cluster boundary, GIS - MIS survey work is allocated to agencies for slum hutment survey.
- iii. Agency conducts LiDAR (Light Detection & Ranging)/DGPS/ETS survey to create GIS based slum hutment boundary and captures panoramic images of the slum huts.
- iv. Upon completion of GIS based survey, agency initiates MIS survey to collect slum dwellers information using mobile application in the tablet.



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- v. Slum hutment map is being accessed by field survey team in the mobile application during slum hutment survey which enables them to easily locate the slum hut structure in the particular slum cluster.
- vi. Field survey team initiates the MIS survey by capturing Aadhaar number (eKYC) of the survey respondent. During survey process, agency captures other details and digital copies of documents required for the deciding the eligibility of the slum dwellers and stores real-time data on the server. Survey team also collects the hardcopies of documents and prepare a separate file of the same.
- vii. After completing the slum hutment survey, agency submits the survey files to respective Competent Authority for the scrutiny to determine eligible slum dwellers for free housing.

## Approach Adopted for the Project

### 1. Acquisition and Procurement of Data:

SRA procured High Resolution Satellite Imagery (30 cm) of year 2015 from NRSC, Hyderabad for better visualization of slum hutments and slum clusters, and also procured a separate Satellite Imagery for year 2000 for performing change detection analysis. Baseline date for deciding eligibility for free home is 1st Jan 2000 as Govt. of Maharashtra Government Resolution. SRA has also acquired GIS basemap database of entire Mumbai City and Suburban from Utility

Mapping Division of National Informatics Center, New Delhi and Development Plan (1991) from MCGM, Mumbai



**Fig: 3 - NIC Basemap on Satellite Image**



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2. **GIS Data Creation:** With the help of appointed GIS Survey Agencies, SRA has created following GIS layers by using DGPS/ETS/LiDAR surveying instruments;

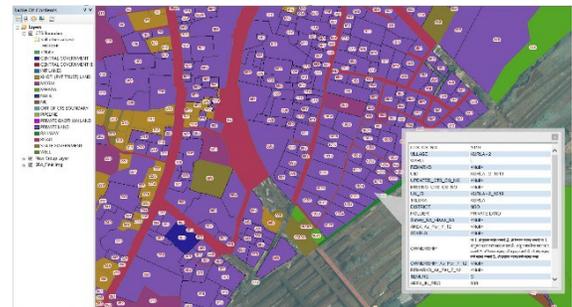
- Slum Cluster Boundary
- Slum Rehabilitation Scheme Boundary
- Slum Hutment Boundary
- City Survey Boundary
- Slum Declaration Boundary (3C)
- Geo-referenced Panoramic Images of Slum Areas



**Fig: 4 - Slum Cluster Boundary**



**Fig: 5 - SR Scheme and Hutment Boundary**



**Fig: 6 - CTS Boundary and Land Ownership**

3. **Door-to-Door Slum Hutment Biometric and GIS Enabled Survey Using Mobile Application:** Upon completion of GIS data creation related activities, the appointed agencies conducts Door-to-Door- Slum Hutment Survey.

- Numbering on hutments
- LiDAR/DGPS/ETS Survey to capture hutment boundaries
- Capturing 360° panoramic images of hutments and linking with respective hut structure
- Collecting slum dwellers demographic information and supporting documents
- Conducting Aadhaar enabled eKYC of slum hutment owner/respondent
- Capturing images and videos of supporting documents, slum hut structures and self-declaration.
- Preparation and submission of hutment wise supporting document files to competent Authority for determining slum dwellers eligibility for free housing



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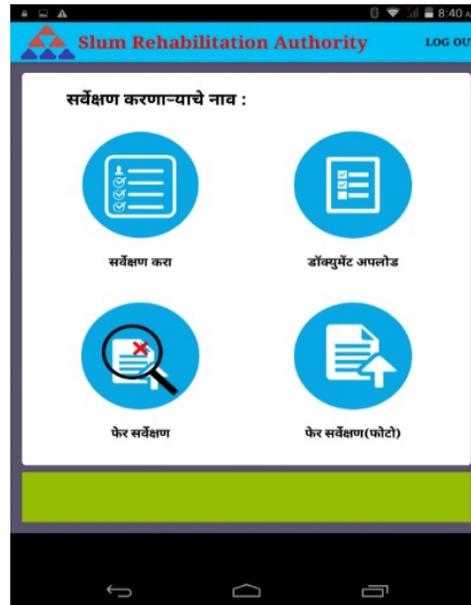


Fig: 7 - Mobile Application for Survey

#### 4. Assessment of Slum Hutment Survey

**Data:** A GIS enabled web application is implemented for monitoring slum hutment survey progress and determining the slum dwellers eligibility for free housing under SR Schemes. The application has following major features:

- i. Dashboard for MIS
- ii. Workflow for Work Allocation
- iii. Tracking of Survey Progress
- iv. QA & QC of Survey Data
- v. Thematic Mapping
- vi. Time Series Analysis
- vii. Panoramic Visualization
- viii. Reporting Tools



Fig: 8 – SIMS Application-GIS Maps

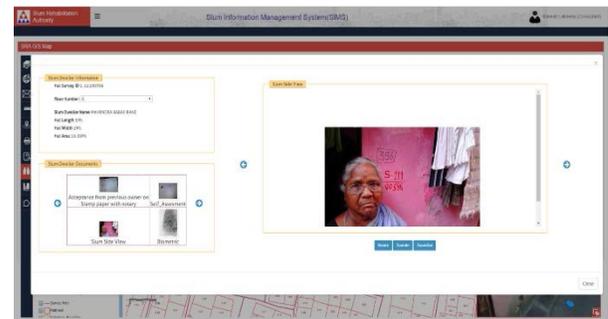


Fig: 9 – SIMS Application-Documents collected

#### Challenges in implementation of Project:

- i. Resistance from slum dwellers to conduct the survey
- ii. Non-availability of GPS signals in narrow slum lanes
- iii. Restriction in movement of person with LiDAR Backpack due to narrow lanes



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- iv. Resistance within the department for adoption of new process
- v. Lack of skills to accept the change

## **Benefits:**

- i. Proactive approach towards in sector-wise micro-planning of slum cluster
- ii. Speedy implementation of SRA schemes
- iii. Removal of bogus and duplicate beneficiaries
- iv. Availability of digital data in real-time
- v. Easy dissemination of slum information among stakeholders
- vi. Transparency, Efficiency, Effectiveness in identification of eligible slum dwellers
- vii. Well Integrated and centralized slum information management system
- viii. Higher Process Visibility

## **Future Plans**

This GIS data ...

- i. Will be shared with concern department of MMR region for their planning purpose
- ii. Of eligible/non-eligible slum dwellers available in public domain will help society/developer/architect to ascertain feasibility of proposed rehabilitation scheme. This data will also be helpful for department to issue LOI within minimum period.
- iii. Will be used as a decision making tool to identify available open lands in the City where Rental Housing Scheme, Pradhan Mantri Awas Yojana and other Central and State Government Housing Schemes can be proposed.
- iv. Of Slum Rehabilitation Scheme's boundaries will be put up in a public domain. This will help society/developer/architect to demarcate their own scheme boundary.
- v. Of Land Ownership will be used for land acquisition and thereby reducing the time taken for implementation of SR Scheme.
- vi. Will play a vital role In a Single Window approval system, at every stages of SR Schemes approval process.