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**THEME: Geo-Budget: Enabling Sustainable Growth**

## **Innovative Information and Communication Technology (ICT)**

### **in City Sanitation Planning**

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**Abstract:** The City Sanitation Planning is a complex phenomenon, which requires huge amount of data to support the decision. In the process of planning and management of huge data and maps, Geographical Information System (GIS) based planning tools play a very vital role, since map and data can be stored, manipulated and analyzed for planning and decision making. It facilitates and also eases to assess spatial as well as non-spatial data on a single platform.

As a part of City Sanitation Plan, three such innovative tools were developed. The paper has been put together based on experience of using ICT tools during the development of City Sanitation Plan in four cities of Madhya Pradesh viz. Gwalior, Ashta, Raisen and Khajuraho.

#### **1. INTRODUCTION:**

The sanitation facility is a major concern for the good quality of life in the cities, especially in the low-income settlements, where the sanitation service is not adequate. Access to toilet facilities and the facilities for safe disposal of solid and liquid waste are not adequate. Inadequate sanitation facilities pollute the environment and have a detrimental effect on health and economy.

As per the Government of India's National Urban Sanitation Policy (NUSP) 2008, – '*All Indian cities and towns become totally sanitised, healthy and liveable and ensure and sustain good public health and environmental outcomes for all their citizens with a special focus on hygienic and affordable sanitation facilities for the urban poor and women*'.

The NUSP statement mentioned above aims at providing household level sanitation facilities as well as carrying safe disposal and treatment of solid and liquid waste generated throughout the city. It not only talks about the provision of technical solutions for waste disposal, but also emphasizes on the active participation of communities and citizens in sanitation management.

A sanitation survey commissioned by the Ministry of Urban Development (MoUD) found that no city in India is "healthy and clean" while 40% needs immediate remedial action. The survey revealed that much more needs to be done to improve access to community and public toilets for the urban poor and also most importantly to stop open-defecation. Thus, each city of the country has to develop a city sanitation plan which would encompass and integrate all the aspects related to city level sanitation management.

In the present context, when the population growth of towns/ cities is increasing at an accelerated manner and the settlements are growing haphazardly without any planning of basic infrastructure, the process of city sanitation planning becomes very critical. The local authority requires updated information on available sanitation systems in order to assess the demand – supply gap which will become the base for future planning and rejuvenation of sanitation facilities.

## 2. METHODOLOGY:

In most of the smaller towns, the availability of data (both spatial means maps and non-spatial) on sanitation was a great challenge. Hence, initially a base map of the towns was prepared with the help of consultative process of local people/ agency and based on the data regarding various components of sanitation collected through handheld GPS, various thematic digital maps were developed which acted as a base for planning process.

Major problem of any small Indian city is that they don't have any map data of their city. Hence, with the help of local persons, baseline survey of different locations like major road, minor road, school building, temple, dustbin, hand pump, open pump and other areas of each city was conducted in order to fix the ward boundaries and city limits and identified major landmarks to prepare base-map of that city.

While performing baseline study, all further actual points of interests like all water sources (river, wells, hand pumps etc.), dumping grounds, various treatment plants and waste bins were also located across city limits. After survey, the non spatial data was collected.

For spatial data, team worked on maps of different cities. Map conversion and the non spatial data were attached to this spatial data. Based on the collected data onsite with handheld GPS, all digital maps were developed as a standard document utilized for further process.

The study focused on water supply, drainage and sewage network, sanitation facilities and solid waste management. The data collection methodology is described in Figure 2.

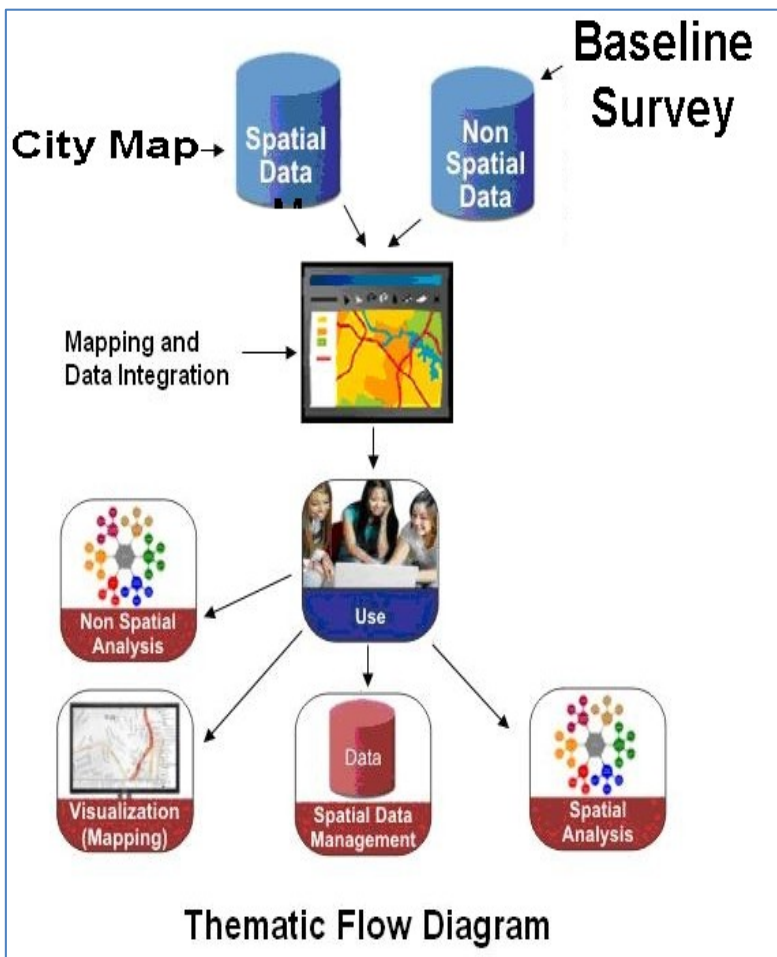


Figure 1: Thematic flow diagram

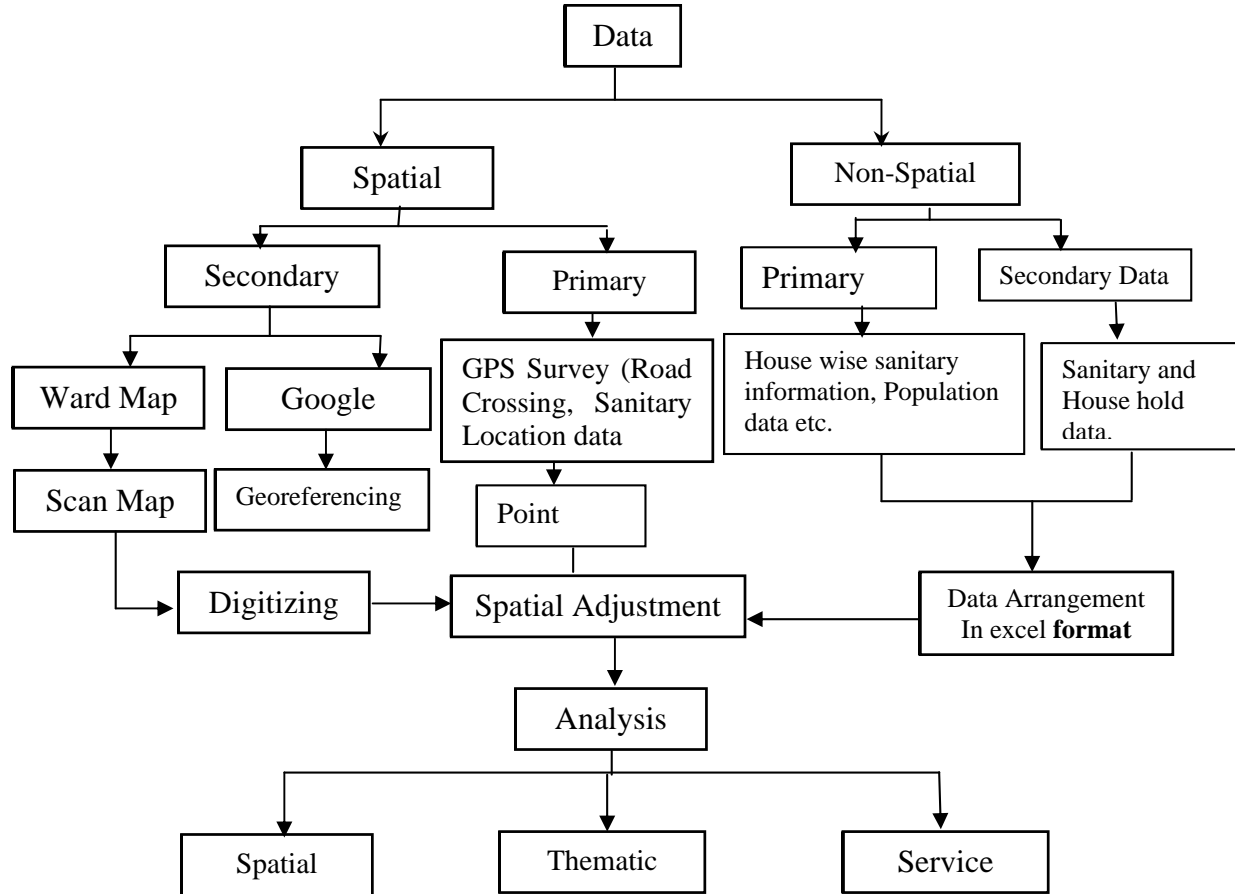


Figure 2: Data collection for three ICT Tools

For data collection, the feature types were decided initially e.g. schools appeared as point feature, entire road network appeared as linear feature and green areas appeared as polygon in map.

The participatory planning involved the community to generate a local map of the ward. All details of ward were digitized precisely and ensured the quality. Simultaneously with this process, all textual data i.e. non-spatial data collected from various departments was managed with relevant layers in excel. After ensuring quality of map generated, both the map and its relevant excel database was further integrated.

### 3. DESCRIPTION OF THE ICT TOOLS:

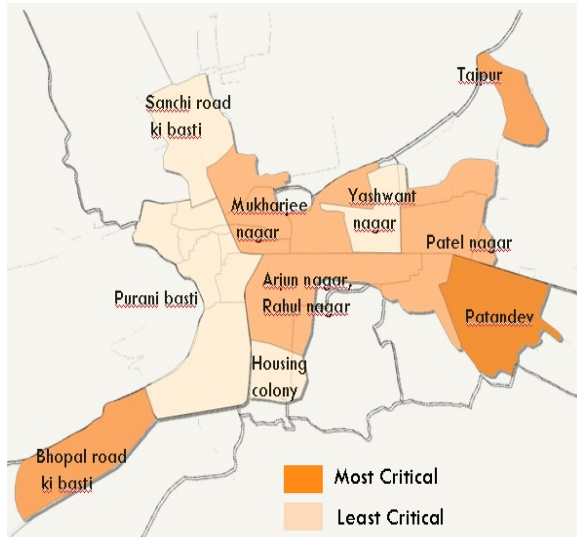
The purpose of developing innovative integrated ICT tools was following:

- SAMS (Sanitation Amenities and Management Systems) - To provide spatial representation of the existing situation of the sanitation facilities to develop a comprehensive GIS based applications for sanitation.
- Mapper for participatory planning within a ward.
- Mobile Application for capturing field based sanitation data with location and pictures.

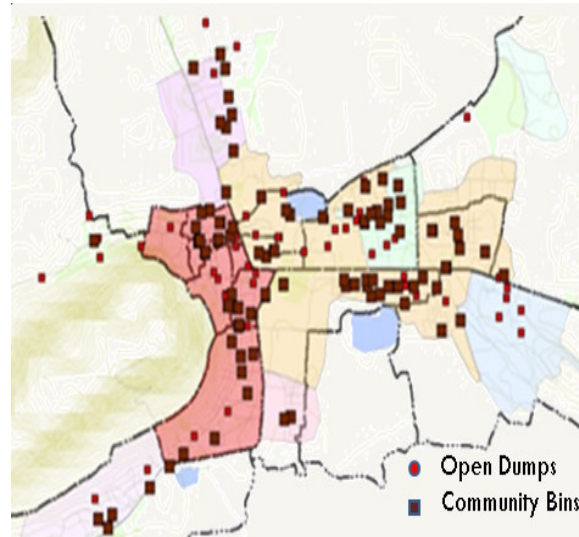
#### 3.1. SAMS (Sanitation Amenities Management System)

Sanitation Amenities Management System (SAMS) is a powerful user friendly web application designed to assist activities related to CSP where user can visualize all relevant information spatially and assess the present status.

Major advantage of this application is that administrative officers can find out the service level, efficiency and comparative analysis through generating various maps (thematic and gradation), bar and pie charts. Since the application is web based, user can access information irrespective of his location across globe. Through SAMS, user can view and analyze data and make decision making and planning accurately. This application can help in query generation analysis and getting different reports and existing status of sanitation and water supply in the city which can give a clear idea to the concerned authorities about the current status of the city/ward and take corrective decisions.



**Figure 3: Showing Sanitation facility**



**Figure 4: Showing bins and dumps**

In order to understand present situation of sanitation ward wise, thematic map can be generated as required on various parameters. Figure 3 shows present scenario of sanitation facility ward wise and legend below describes the criticalness of the issue.

### 3.1.1. Key Features:

- User friendly which doesn't require training to operate. Common citizen can also use it to get information.
- User can get clear idea of socio economic and housing characteristic conditions of the city.
- Focused areas of CSP are kept in different layers like water supply, drainage and sewage, sanitation and solid waste management.
- The data collected through survey is stored and displayed in various layers.
- In each layer, user can view baseline study, technical study and GIS map analysis and through photo gallery, get clear idea of present condition of sanitation, water supply in the city or ward.
- Spatial data is managed in such a manner that user can easily navigate necessary information and get the results interactively.
- User can choose the specific layer to view details, ongoing schemes, existing status and key issues.
- Support of spatial data for analyzing existing situation within the city limits and its utility in crucial decision making process.
- Using SAMS, city level and ward level activities of CSP can be viewed at one click.
- This integrated data then can be viewed and analysis is possible in SAMS easily.
- The authorities can get visual details, compare different data and take corrective actions accordingly.

### **3.1.2. Technology:**

Main technology used for SAMS is Java. Backend/Database is MySQL with spatial extension. For GIS shape files are used. JVM – Java Virtual Machine is required for SAMS but even if it is not available on user's computer, it has been provided on SAMS website.

## **3.2. Mobile Application**

While preparing CSP, the necessity of information flow at various levels has to be addressed so that the suggested plan would be implemented effectively and its benefits would pass to common man of the society. In order to monitor and evaluate CSP, mobile application is used which is easy to use and useful for decision making purposes. This application is used to update identified indicators, and accordingly it will update spatially so that further decision making process will become easy. User would need to enter master and detail entry from mobile application. This data is further uploaded to web based database and this updated information is further utilized for various report generation through SAMS.

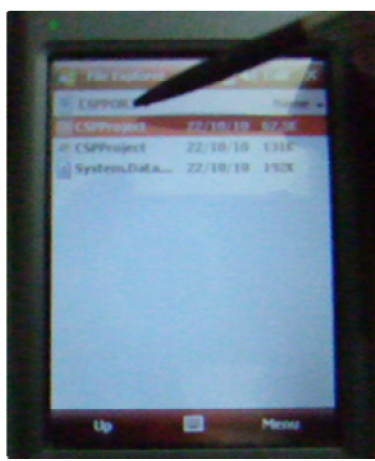
### **3.2.1. The role of mobile application in CSP:**

- Real time data transfers to and from the field with mobile connectivity.
- Includes location information through GPS (Global Positioning System).
- Visualizes data on map.
- SMS (Short Message Service) alert from server to predefined locations.
- Provides both GPRS (General Packet Radio Service) & GSM (Global System for Mobile Communications) facility for transferring data.
- Report generation based on requirement.
- Cost effective service.
- Secure and reliable data transfer.
- Both GPRS and GSM technologies are enabled.

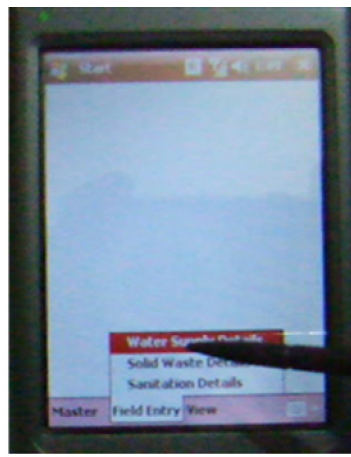
The entered data is sent as an SMS to SAMS and is integrated in the main system.

### **3.2.2. Suggested indicators of mobile application**

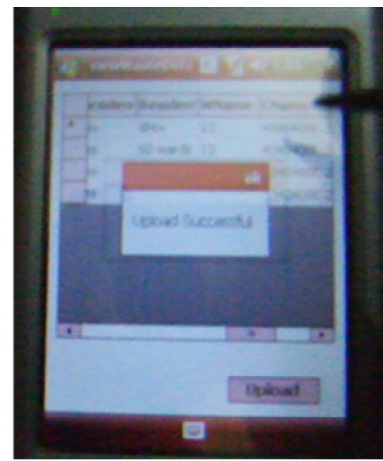
- Whether the solid waste is cleared from bins? (Y/N) (Daily update)
- Major drains (Flowing / not flowing)
- Any water logging in each ward? (As required)
- Is there any waste lying on the streets? (Daily update)
- Any hand pump / public stand post need cleaning or repair work?



**Project Menu**



**Field Entry**



**Data Uploading**

Figure 5: Mobile based application to upgrade the real time data

### 3.3. Mapper

GIS Mapper is a simple user friendly desktop application for ward level information collection, storing, data updating, planning and decision making purpose. Mapper is a tool, which allows users to create, edit and analyze spatial information in combination with connected non-spatial information; make maps and analyze spatial information in combination with connected socio-economic information, and is therefore an ideal basis for planning and decision making as well.

The application is in local regional language and can be easily used for participatory mapping by local stakeholder and local authorities in partnership with NGOs and community-based organizations. In short it is easy to handle, useful for quick planning and decision making, and also helps in generating information required for analysis purpose.

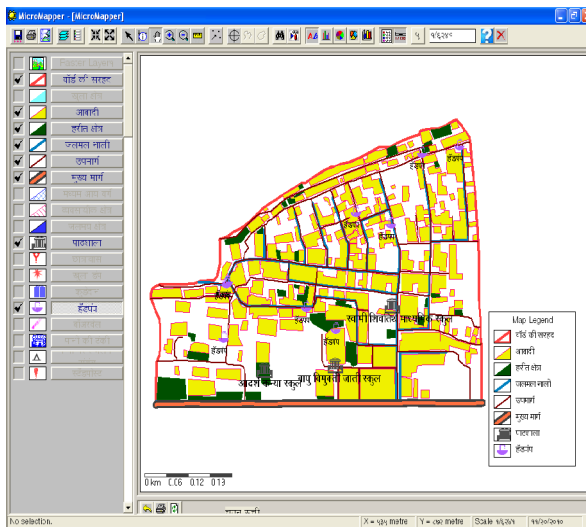


Figure 6: Ward map with sanitation

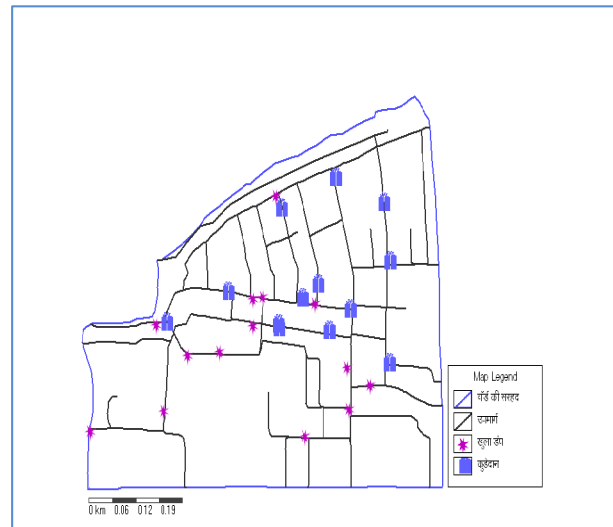


Figure 7: Locations of waste bins and open dumps

Above shown in figure 6 is a digitized map, with features maintained at left pane of top shown image, which covers ward boundary, road network, population, green area, wells, hand pumps, school etc. with respective symbology and color scheme. Figure 7 shows the resource mapping of a ward showing locations of waste bins and open dumps.

### 3.3.1. Features & Utilities:

- Data Management: Mapper provides facility for managing data layer wise for various features. Also provides facility to manage non-spatial data, facility for attribute attachment and viewing attributes of selected features.
- Quick search and Simple Query makes faster to retrieve information as and when needed.
- Bar and Pie charts, Thematic maps can be generated. Output in the form of bitmap (.bmp) format.
- Available in local regional language.
- Display a geographic area in planar form or as a map;
- Accesses information in a database by simply clicking on the map;
- Execute queries to search the base for objects fulfilling one or several criteria;
- Process data thematically to present information graphically
- Add objects to display on maps at specific location as symbols for community users.
- Objects are displayed in the form of specific symbols.
- Create, modify, and enrich the database by adding objects and designing with color;
- Print documents and maps.

### 3.3.2. Uses/Advantages of Mapper in CSP:

- *Easy to handle:* Mapper is a user friendly tool which provides the facility for adding layers for different features, generating the field for attribute data and easy to attach attribute data. It is low cost and can be used for NGO staff and field level workers as well as community members in the wards and slums.
- *Useful for quick planning and decision making:* Mapper is a smart tool which can do analysis in one click. One can retrieve information pertaining to any layer by using query analyzer. The rapid search option can search the object. The bar chart, pie charts and the thematic reports are one of the key features of Mapper. These charts are very useful in planning and decision making.
- *Useful for generating information:* Mapper is a perfect tool for generating layers of information related to water supply and sanitation, socio-economic level through participatory mapping at the ward level. Once all the maps of the wards within the city limits are ready, they can be integrated in the SAMS.

## 4. CONCLUSIONS:

Using the advanced technology like GIS, the existing information is easily recorded, documented and represented in both forms spatially as well as non-spatially, which helps in enhancing decision making process. GIS, Mobile and web based tools for Information, Communication and Technology are now available for decision makers. The ICT tools provide services in order to 'leapfrog' several stages of CSP development and implementation through a participatory approach. The tools have been applied in various stages of the planning process and it is envisaged to provide real time assistance in the implementation of the plan and prove a valuable tool in the management of the sanitation of the city.

The tools will help city sanitation planning and implementation because of:

- Multisectoral, multispatial nature of data
- Size of databank
- Need for continual updation
- Data mining and use of relevant data
- Increasing data readability and understanding
- Easy accessibility to all stakeholders
- Use of data in ensuring awareness and participation
- Monitoring and evaluation of performance transparently.

The ICT tools mainly focus on: handling the multi-sectoral and multi-spatial data, helps in continual updation of data, data mining and use of relevant data, increasing data readability and understanding, easy accessibility to all stakeholders, use of data in ensuring awareness and public participation, and monitoring and evaluation of performance in sanitation.

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