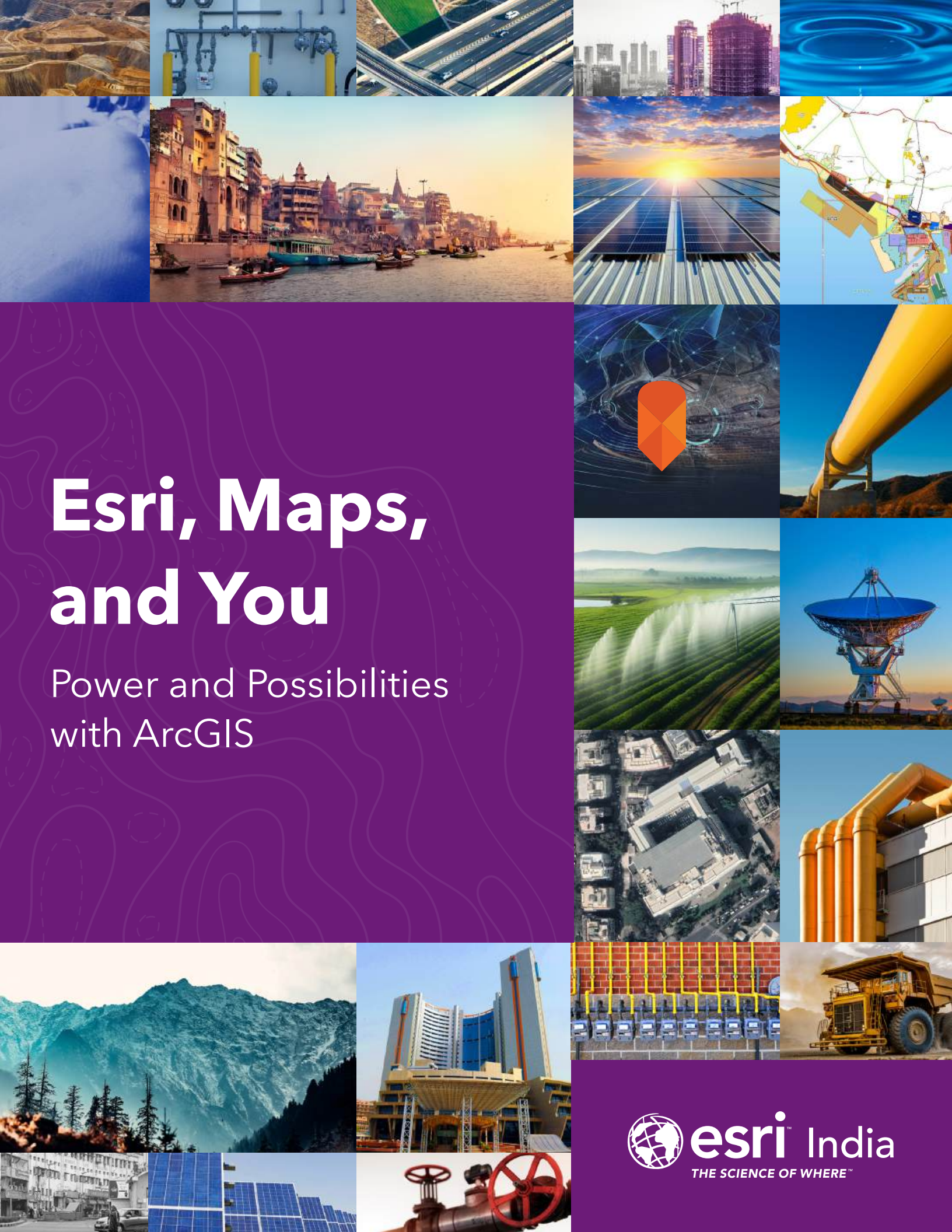

Esri, Maps, and You

Power and Possibilities with ArcGIS

esri India
THE SCIENCE OF WHERE™

Foreword

Geographic Information Systems (GIS) are revolutionizing decision-making across various sectors. By harnessing GIS-generated location intelligence, businesses and governments are optimizing efficiency and fostering development and resilience in India more effectively. Esri's ArcGIS plays a pivotal role in this transformation. The robust GIS software suite empowers organizations to analyze and visualize spatial data, uncover geographic patterns, relationships, and trends, and thereby enhance decision-making processes with deeper insights.

As a leader in the Indian GIS market, Esri India has been working closely with government departments and private organizations across the country, to help deploy GIS solutions to achieve immeasurable benefits.

This booklet is a testimony to the innovative work being done using Esri's ArcGIS System in India. Through the medium of case studies, we have captured for you, information about the GIS solutions that have been implemented by organizations across India and the unmatched edge they are providing these entities.

So, whether you are an existing user of Esri's GIS technology or a newbie about to explore the immense capabilities of spatial intelligence, this booklet will give you ideas about how you can get the best out of GIS technology. We hope you find this compendium of cases informative and insightful and are inspired to embrace GIS within your organization.

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Adani Natural Resources Achieves Comprehensive Decision-Making in Mining with ArcGIS

Client
Adani Natural Resources

Industry
Mining

Organization Profile
The scale of Adani Natural Resources (ANR) business assures a steady availability of coal, extracted in the most responsible way, which promises a constant supply of power to both urban and rural geographies of India. Mining Tech Consultancy Services (MTCS) is a leading consulting company under the umbrella of Adani Natural Resources, providing cost-effective & end to end services for mining & exploration projects in India and also exploring global market. MTCS is responsible for digitizing mining related information and providing GIS solutions for Adani Natural resources.

Website
www.adani.com/businesses/natural-resources

Project
Enterprise-wide geospatial application

Highlights
The GIS System has helped in:

- Contiguous acquisition and tracking of land in areas of interest.
- Suggesting suitable infrastructure areas.
- Monitoring large mining landscapes.
- Exploration planning in undulated topography and tracking exploration progress.
- Monitoring safety and environmental parameters in the mining area.
- Effective evacuation and logistics planning.

Project Summary

Mining entails careful planning and periodic assessment of the area during the entire lifecycle of the project. The Geospatial application developed by Adani Natural Resources is a unique initiative providing information on a single platform and giving deep insights. The GIS system developed can be used for quality decision-making based on land availability, forest details to facilitate infrastructure planning and monitoring environmental impact. The GIS application is a solution for significant challenges like different datasets with different stakeholders, complexities of having multiple mining locations, information in different formats, and datasets in different coordinate systems impacting decision-making. Advanced technology involving drones, 2D & and 3D models, and integrating non-SAP sources brought visibility to land use. The technological prowess is being enhanced as a part of Adani Mining's vision of being the leading mining company with the ethos of a responsible miner.

The objective of the project was to create:

1. Integrated database management for decision-making and query.
2. One enterprise-wide geospatial application and dashboard.
3. To ensure mining is carried out in conformance with the set standards as per the mining plan with the highest safety standards.

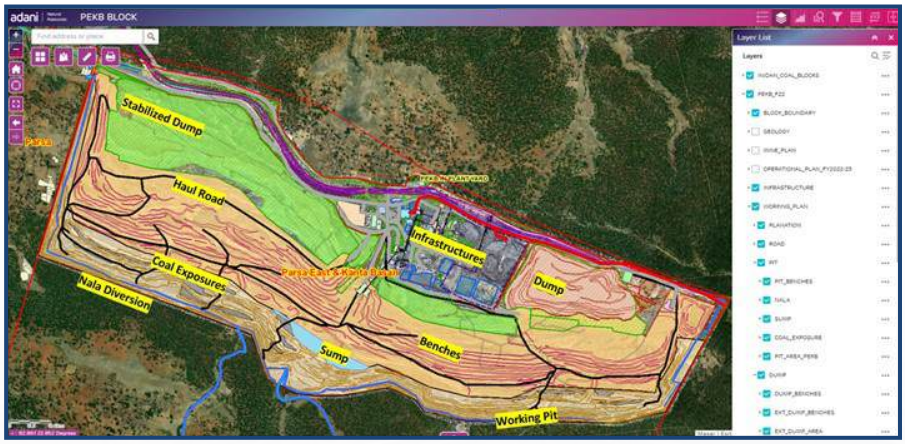
Challenges

Mining decisions and executions are dependent on multiple spatial and non-spatial databases like mine boundaries, surface features, land, forest details, infrastructure planning, geological report mining plans, etc. To mitigate these problems, the need of the hour was to integrate the entire database and provide a platform that could give easy access to different databases to different stakeholders.

- Different datasets are available with different stakeholders.
- Datasets are in a different coordinate system (National Grid, Modified Everest, WGS 84 Datum, local coordinates).
- Information is available in different formats like Satellite Imagery, Drones Data, Reports, Maps, Mine Planning, Mine Operations etc.
- Information does not have a spatial component leading to delays in decision-making.
- Impact on decision, planning and execution.
- Data error gets compounded with many mining sites.

Solution

Esri's ArcGIS Enterprise was deployed on-premises within the organization's service-oriented architecture. ArcGIS Enterprise is a foundational software system for GIS, powering mapping and visualization, analytics, and data management. It is the backbone for running the Esri suite of applications and custom applications. ArcGIS Enterprise is tightly integrated with ArcGIS Desktop and ArcGIS Pro for mapping and authoring and seamlessly connects with ArcGIS Online to share content between systems.



Integrated GIS Database

Adani deployed the following solutions to build a comprehensive GIS database and integrated network.

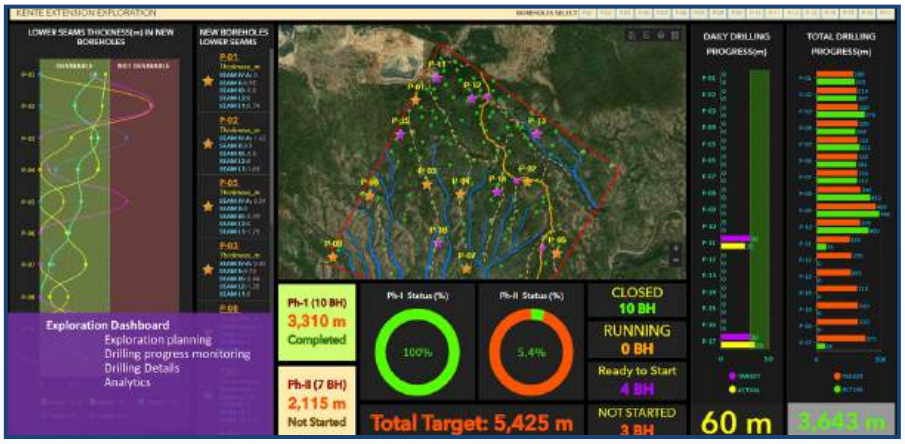
1. **ArcGIS Desktop:** Helped in the digitization of mining-related information to prepare the GIS database.
2. **ArcGIS Enterprises:** Managing a huge volume of GIS database to create organized, user-friendly WebGIS Application (both in 2D & 3D).
3. **ArcGIS Image Server:** Hosting a huge volume of drone database captured monthly for each project.
4. **Operational Dashboard:** Capturing and monitoring real time production details of mining projects, tracking budgeted verses actual production targets as well as land details with compensation status.

Benefits

GIS applications increased project efficiency, enhanced decision-making capability, dynamic planning of activities, and monitoring of mining projects. A single platform with access to multiple spatial and non-spatial databases related to mining projects helped stakeholders interact and collaborate with sharing and updating information. Some of the examples are listed below:

Change Detection

1. Contiguous acquisition and tracking of land in areas of interest demarcated by mine planners designated to certain activities like mining, dumping, or infrastructure areas. Similarly, mine planners continuously upgrade the working plan for every consecutive month/year on the basis of land availability.
2. Infrastructure planning in mining areas is not flexible as it must be in a non-mineralized zone. GIS applications integrate geological model databases, surface features, and existing mining features to suggest suitable infrastructure areas.
3. Monitoring large mining landscapes from drone data and tracking land reclamation details, vegetation planning, vegetation health growth, and mining operations as per DGMS safety guidelines like bench height, slope, haul road gradients, etc.
4. Exploration planning in undulated topography and tracking exploration progress through GIS dashboards and analytics.
5. Monitoring of safety and environmental parameters in the mining area.
6. Effective evacuation and logistics planning.



Exploration Dashboard

WebGIS Application

> Esri's solution has provided a single platform to host, visualize, analyze, track integrated mining related information, thereby increasing effective mining related decision-making process, collaboration with stakeholders and monitoring of mining benchmarks/projects. The GIS platform has become the foundation for our digital transformation projects in mining, thereby opening windows to creative solutions, resolving challenges, ensuring safety standards, and increasing ROI of mining projects.

- Abinash Majhi, Associate General Manager, Adani Enterprises Limited

Adani Group Plans Building India's Largest Commercial All-weather Port with ArcGIS

Client
Adani Enterprises Limited

Industry
Ports

Organization Profile
Adani Enterprises Limited (AEL) is the flagship company of the Adani Group, driven by the philosophy of incubating stellar infrastructural asset catering to underserved sectors of India. Its diversified portfolio is broadly split into 4 sectors like 1) Energy & Utilities, 2) Transportation & Logistics, 3) Consumer Goods and 4) Primary Industry with other emerging businesses. AEL is recognized as India's largest listed business incubator and known for their successful execution of large-scale projects in the energy and infrastructure sectors in India. These businesses are a balanced combination of well-established ventures and emerging enterprises, all dedicated to meeting the evolving needs of India. AEL is presently focused on businesses related to airports, roads, water management, data centres, solar manufacturing, defence and aerospace, edible oils and foods, mining, integrated resource solutions and integrated Agri products.

Project
Land Information System

Website
www.adaniports.com

> "The GIS-based system has helped us to achieve maximum efficiency in decision-making and planning, data distribution and handling, eliminating redundant data, integrating information from many sources, generating new information via complex analysis/queries involving geographical reference data, and updating data quickly and correctly."
>
> **- Rajesh Goswami, Deputy General Manager, Adani Enterprises Limited**

Project Summary

Adani Group has incorporated a major project of Mundra Master Planning and Development using ArcGIS. The project consists of a port and an industrial hub in the gulf of Kutch, which is currently operational. It has vital scope for future development along with an impact on surrounding (Influence zone).

Spatial planning using GIS technology has helped the organization in successful planning of the port and industrial hub operations with feasible future expansions and eventually becoming one of the largest commercial all-weather ports in India with state-of-the-art infrastructure and the largest coal import terminal which provides faster cargo evacuation and minimal turnaround time.

Challenges

Before the implementation of the GIS System, the major challenges for the organization were retrieving necessary information for any concern, and managing incompetent reconciliations as information was scattered with multiple stakeholders, and end users had limited accessibility. To resolve these challenges, the company required a common base. It needed an enterprise level Geographic Information System (GIS) system designed for gathering, storing, processing, analysing, organising, and visualizing location specific information on geographic maps.

Solution & Benefits

GIS technology became an appropriate tool to create a common location-based information system that facilitated data collection, compilation, conversion, development, validation, storage, analyses and visualization. The system enabled integration of data from multiple data sources and stakeholders, leading to enhanced collaboration and informed decision-making.

The following are the major advantages of using GIS in the Mundra Master Plan:

- Visualization and Interaction with dynamic data.
- Support to everyday operations (engineering, planning, land sorting, security, environment, port lease management, and others) with geo-referenced information.
- Visual support to port operations allowing real-time display of ship movement.
- Incorporation of rules and restrictions related to manoeuvres, berthing requests, and infrastructure availability.
- Access to information across the organization and integrate with existing legacy systems.
- Improvement in the effectiveness of existing procedures.

Adani Electricity Mumbai Limited Optimizes Outage Management with ArcGIS

Client
Adani Electricity Mumbai Limited

Industry
Utilities

Organization Profile
Adani Electricity is India's largest private sector power distribution utility, distributing electricity for over nine decades in Mumbai, the commercial capital of India. It is the distribution arm of the Adani Transmission Limited (ATL), formed after the acquisition of Reliance Infrastructure Limited's integrated Generation, Transmission, and Distribution utilities powering the city of Mumbai. A huge customer base and the spread of electricity distribution have made Adani Electricity, a business powerhouse of Mumbai. The Company owns the largest, advanced, and efficient power distribution network which helps in meeting the power demand of 2,000 MW in Mumbai. Additionally, the company offers world-class customer care service through various customer convenience offerings spanning issuing bills in multiple languages, more than 2,000 payment avenues, 24X7 multi-lingual toll-free number, contemporary customer care centers, and a bouquet of other technology-driven and value-added services.

Website
www.adanielectricity.com

Project
GIS-based Outage Management System (OMS)

Highlights
- Quicker & effective response to power outages.
- Minimized average complaint management time.
- No delays and errors in site data capture; having accurate and reliable data.

Project Summary

Quicker & effective response to the customer's power outages in today's ever-changing environment is key to achieving AEML's primary goal of enhanced customer satisfaction. To enable this AEML's Mumbai Distribution Business has implemented an Enterprise GIS solution developed by Esri India. The GIS-based Outage Management System (OMS) has replaced its legacy application, a call-based Complaint Management System (CMS).

The Enterprise GIS solution is aimed to minimize average complaint management time by focusing on network abnormalities rather than customer calls thus improving the overall reliability of the electric system. The system determines the "most probable" location of fault that has taken place in the field on receipt of power outage complaints. With the accurate knowledge of outages & associated up-to-date distribution networks, dispatching outage crew & carrying out the field operations is improved.

Challenges

The Enterprise GIS solution has helped AEML to overcome the following challenges that existed with the previous system.

- Managing assets spread geographically
- Reaching asset locations on-time for timely isolation and restoration
- Work-hour loss due to work duplication & subsequent data entry
- Unnecessary efforts spent on tracking jobs
- Delay in site data capture and knowing real-time progress and variance
- Errors in site data capture and having accurate and reliable data
- Non-availability of network data on demand for analysis and value engineering

Solution & Benefits

The GIS-based OMS provides a number of advantages over the legacy CMS, some of them are:

- With the introduction of OMS, there is a paradigm shift in the overall approach of managing outages. Now, the focus has been shifted to the root cause of the outages (Network Device level fault, in OMS terminology: Incidents) rather than concentrating on the symptoms (individual customer complaints, in CMS terminology: Calls). This will improve the overall outage management efficiency, fewer outages, and better customer satisfaction.

- As a lot of changes are being carried out in the vastly dispersed distribution network, it is vital for the utility personnel in the control centre /outage management centre to know what exactly is happening in the field. The CMS has limitations in providing this critical information since it does not maintain field network snapshots. On the other hand, GIS based OMS provides a common window through which one can visualize & understand network changes & field operations being carried out on near-real time basis without any overhead to operation & maintenance personnel.

- The home-grown legacy CMS provides functionality to attend & handle Customer Outage Calls whereas OMS technology has progressed into determining "where" the actual outage has taken place.

- The dispatcher (Shift Engineers/System Controllers) can quickly view consumer/outage locations within OMS. This has improved the dispatching of crews, provided the utility's customer service representatives with up-to-date outage knowledge, and increased the overall effectiveness of outage restoration personnel.

- Now dispatcher overhead of performing analytical processing to understand all the outages received from a particular area in case of bulk outages is minimized.

- Even in case of bulk area outages, the dispatcher working on CMS has to manage every complaint. But in the case of OMS all complaints received from a particular area, which forms a considerable part of the common feeder/distribution network automatically get attached to a common upstream device (i.e. most probable location identified by in-built heuristic engine). This has immensely benefited in saving outage management time.

- Sometimes during the course of outage management, it is necessary to reassign outage complaints to other crews. This was time-consuming in the earlier system whereas OMS provides an effective way of crew re-assignment.

- Instead of the crew providing the affected area information, now Dispatcher is in the position to guide the crew who are not familiar with the feeder network.

- Considering the geographic nature of Mumbai City, a considerable part of the network is laid through the hutment area. Locating outage consumers & their supply delivery points (Service points) that belong to the slum area has been a herculean task earlier. With the help of the new system now locating outage consumers & their related feeding points is going to be less laborious & efficient.

- Overall reliability of the electric system is going to be improved due to the shorter outages and hence will increase overall customer satisfaction level.

- OMS enforces better adherence to the rules (e.g. defining faults in terms of network equipment). This has brought improvement in overall consumer tagging & network updation errors.

- Since OMS keeps a record of all the outages in terms of network abnormalities; it is crucial information for short-term as well as long-term network planning and improvement.

- The underlying application architecture provides numerous advantages for integration. COM and XML (extensible Markup Language), and other existing standards enable the solution to be deployed along with work management systems, customer information system (CIS), and other technical/business systems without the need for proprietary programming tools or closed interfaces. By using open standards, both deployment and maintenance costs of integrated systems are minimized.

OMS also effectively handles the Planned Outage Process by:

1. **Creating & executing the switching plans for HT network -** Switching orders which include attaching tag-out/lock-out involve isolating specific networks, both electrical and mechanical, from equipment that is to be repaired, inspected, or tested.

2. **Ensuring safety -** The existing permit process is integrated with OMS. Tag-outs are implemented for related maintenance activities and removed for the return of equipment to service in a timely manner. This ensures the safety of operating personnel and equipment during maintenance and also reduces the length of an outage.

3. **Increased Transparency -** The system provides near real-time operational view including outages, permit issued/put-back, & network operations to all concerned stakeholders. This provides transparency at all levels and reduces excessive communication among the stakeholders.

"With the Implementation of GIS, we could achieve a single window concept for viewing assets spread across geographical extents. With the help of COTS functionalities available through the product like Electrical Network Tracing, we could derive Consumers connected to DT/Feeder and vice versa. The software is easy to learn and comes with a whole range of plug-ins for specific needs. Esri India's GIS solution has given us a platform to view all the utility assets in a single screen which is available to all stakeholders. ArcFM gives the user "the power to trace the electrical network" and identify the assets/consumers related to a feeder. Tracing functionality is one of the backbone tools for the utility industry. With this tool, the user can easily visualize, get instant information and make effective decisions. Esri's GIS system has helped us to achieve higher productivity and deeper insights with many such tools."

- Anand Kumar S V, Addl. VP – IT DevSecOps, Adani Electricity Mumbai Limited

AGiSAC Facilitates Effective Governance in Himachal Pradesh with ArcGIS

Client
Aryabhatta Geo-informatics and Space Application Centre (AGiSAC)

Industry
Space

Organization Profile
Aryabhatta Geo-informatics and Space Application Centre (AGiSAC) has been set up under the aegis of the State Council for Science, Technology, and Environment, Himachal Pradesh.

The Centre envisages the development of low-cost software and web-based applications for the various government departments and stakeholders that facilitate administration in tracking, monitoring, and analyzing data.

Website
www.agisac.gov.in

Project
Decision Support System

Highlights
The geo-informatics applications developed by AGiSAC using ArcGIS aid the user departments in planning, monitoring capacity building measures, upkeeping existing infrastructure, and more. Further regional and sub-regional balance in all spheres get measured, monitored, and maintained effectively using these geo-informatics applications. The applications help the user departments to decide on establishing an asset/scheme/project based on geospatial analysis of various variables such as terrain and topography. A gap analysis of existing infrastructure coupled with inputs like user base, routes, etc. helps them to identify ideal locations for developing infrastructure.

Project Summary

AGiSAC works to identify decision-making applications with the help of user departments and provides tailor-made GIS solutions for better decision-making in government departments using ArcGIS. It has developed web, desktop, and mobile applications for various state user departments such as rural development, public works department, irrigation and public health, forest, town and country planning, and environment to ensure efficient, effective, transparent, and accountable governance.

Solution & Benefits

The geo-informatics applications developed aid user departments in human resource management, upkeep of existing infrastructure, visualizing gaps in the existing infrastructure, identifying ideal locations for establishing new facilities like educational and health institutions, fair-price shops, timber and non-timber plantations, finding nearest routes, action plan generation for MNREGA works, check duplicity of works, and measure and monitor distribution of beneficiaries and thereof regional and sub-regional imbalances.

The Decision Support System (DSS) is hosted on a web portal and efficient low-cost data gathering devices like GPS-enabled mobile phones are used for the automatic updating of the databases. The user departments provide validated databases to the Center. As all government departments are enjoined to subscribe to the Center, various databases are used seamlessly, and interdepartmental issues are tackled easily. The inputs used for the development of geospatial information include SOI (Survey of India) toposheets, cadastral maps, high-resolution satellite data, demographic data, departmental data, etc.

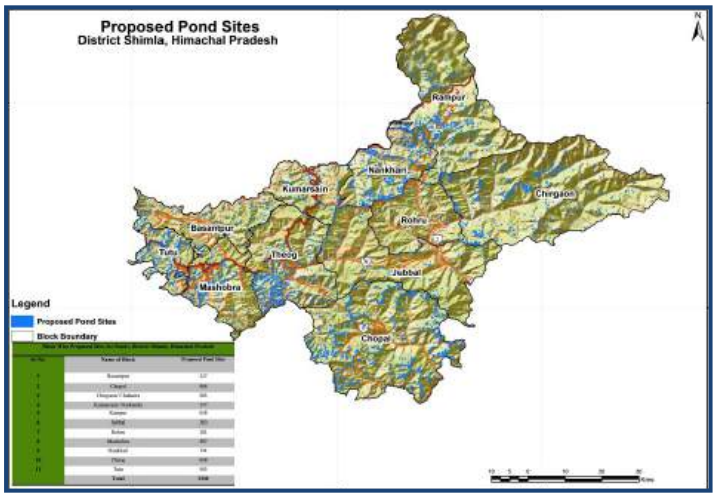
Esri's ArcGIS suite is helping AGiSAC achieve the desired outcomes through these applications. The technology facilitates viewing, editing, creation, and analysis of geospatial datasets. It allows users to explore data within a dataset, symbolize features accordingly, and create maps. By using the technology, AGiSAC could create and manipulate datasets to include a variety of information. The maps produced generally include features such as north arrows, scale bars, titles, legends, neat lines, etc. The ArcGIS suite also allows the users to use extensions such as 3D Analyst, Spatial Analyst, and Network Analyst.

GIS Portal Showcasing Green Corridor of Himachal Pradesh

GIS System Showcasing Panchayat Level Development Plan for Rural Development Department

Annual PMGSY Incentive Progress for Public Works Department

GIS Portal used by Jal Shakti Vibhag



GIS-based Water Conservation Plan and Inventory of Water Bodies for Shimla District under Jal Shakti Abhiyan: "CATCH THE RAIN CAMPAIGN"

> "ArcGIS effectively meets AGiSAC's GIS-based analytical requirements. By facilitating easier management of complex datasets, the technology enables officials to make quick, informed decisions. The DSS enhances collaboration, allows effective analysis of the developmental gaps, and works as an effective tool in spatial planning and decision-making processes."
>
> **- Sh. D.C. Rana, IAS, Director cum Member Secretary, AGiSAC & Sh. Satpal Dhiman, HPFS, Joint Member Secretary, AGiSAC**

GIS Portal used by the Department of Industry

AGiSAC Achieves Excellence in Solar Power Plant Installation with ArcGIS

Client
Aryabhatta Geo-Informatics & Space Application Centre (AGiSAC)

Industry
Space

Organization Profile
Aryabhatta Geo-informatics & Space Application Centre (AGiSAC) is committed to bringing geo-information for the benefit of people and sustainable development to facilitate decentralized planning and decision-making. It helps to facilitate the monitoring and evaluation of government schemes and programs and to set up an integrated natural resources data management system. Along with it, AGiSAC is providing services/consultancy based on specific user needs in the field of Remote Sensing and GIS and wider usage of geospatial applications through simultaneous support systems/ software.

Website
www.agisac.gov.in

Project
Solar Site Identification Using ArcGIS

Highlights
- AGiSAC has used ArcGIS spatial analysis tools to streamline the complex process of running suitability analysis.
- ArcGIS has proved invaluable in the analysis of both raster and vector datasets.
- Use of ArcGIS has significantly reduced the number of hours spent on field surveys and provided high-quality results.

Project Summary

In collaboration with Himachal Pradesh Electricity Regulatory Commission, AGiSAC has carried out a study to identify suitable sites of land for Solar Power plant installation. Disparate datasets such as imagery, DEM, land use, settlement clusters, and locations of existing infrastructure such as roads and electricity sub stations were used in ArcGIS Pro spatial overlay analysis to find suitable sites along with solar power potential calculated in MW. Following the GIS study, field visits were undertaken to verify the optimum locations.

Challenges

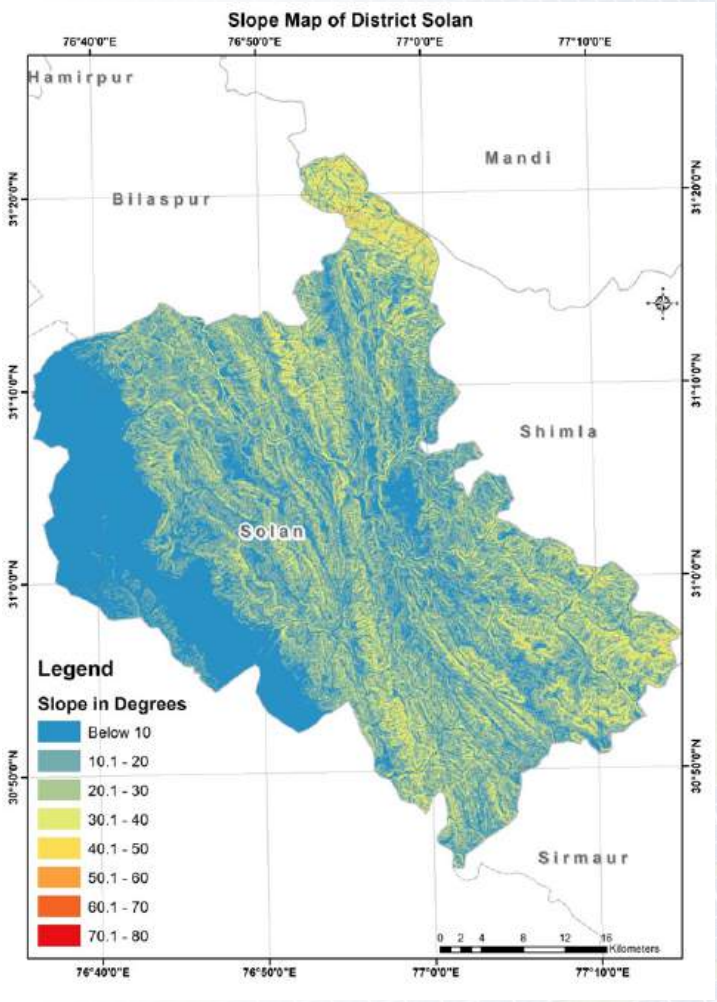
Before the prevalence of remotely sensed data, field surveys had to be carried out by teams of scientists and engineers over a period of several months. Data collection was an expensive and laborious process, especially due to the mountainous terrain of Himachal Pradesh. Large volumes of data collected in disparate forms were difficult to collate and analyze as there was no single platform that could ingest tabular and spatial data simultaneously. Suitability calculations had to be done manually, adding up to thousands of hours across the state.

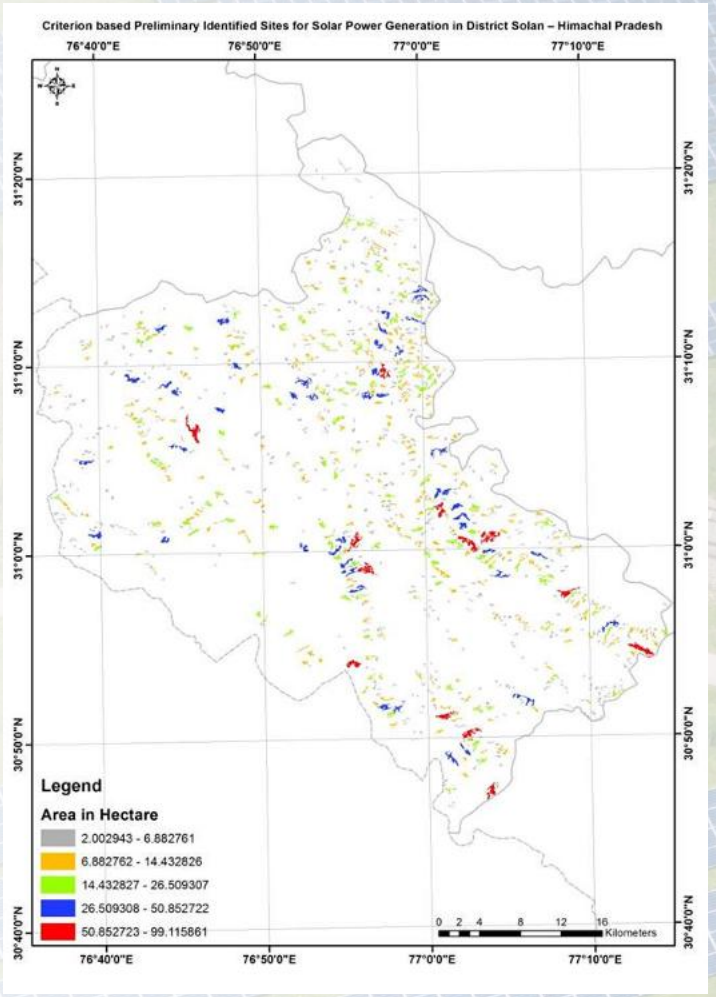
Solution

AGiSAC has used ArcGIS spatial analysis tools to streamline the complex process of running suitability analysis. The ArcGIS Desktop platform provides an interface where raster, vector, and tabular data can be ingested and analyzed. The Suitability Modeler tool allows disparate datasets such as DEM, satellite imagery, LULC maps, as well as vector datasets such as roads and human settlement, to be overlaid to delineate suitable areas according to user-defined thresholds.

ArcGIS has proved invaluable in the analysis of both raster and vector datasets. The user was able to carry out advanced proximity analysis to measure the accessibility of potential Solar Power Plants to existing roads and electric substations. High-resolution land use maps were also created using image classification tools on CARTOSAT-1 imagery. Tracts of barren land extracted from this classification were identified as the most suitable land use type for Solar Power plant installation.

The suitability modeler tool then overlaid all the resultant layers and applied a uniform user-defined index to assess the suitability of each class for the construction of a PV plant. Several zones that best matched each user-defined threshold were then extracted from each district, which was further verified via field survey.





Benefits

ArcGIS provides a single platform capable of analyzing raster and vector data. Several inbuilt tools allow users to perform complex workflows without coding. Users at AGiSAC were able to save time on field data collection, and instead devote resources to analysis. In the traditional methodology, a majority of time is spent on getting approvals for site visits from local bodies and gathering site knowledge from experts and scientists regarding site suitability parameters such as land use, slope, aspect, terrain, etc. Due to the hilly terrain of Himachal, it takes more than a month to cover each district in detail.

Through remote sensing, this data could be easily gathered from satellite data and analyzed in ArcGIS within a matter of hours. More than 80% of optimum locations selected through the Suitability Modeler were verified as suitable through ground truthing.

> “ArcGIS software has significantly reduced the number of hours spent on field surveys. Previously, entire districts had to be inspected to record on-ground conditions. Remote sensing has allowed us to reduce our time in collecting raw data and direct our resources towards analysis. Using inbuilt spatial analysis tools, we were able to conduct proximity analysis to find out the accessibility of potential Solar Power Plants from existing roads and electric substations. The results from spatial overlay analysis have also reduced the number of field visits required to verify a site for suitability – focusing only on those that best meet our requirements as defined in the model thresholds. Overall, the use of ArcGIS has saved us a lot of time and given us high-quality results.”
>
> **- Dr Brijesh Saklani, Sr. Scientific Professional, AGiSAC**

Gujarat Gas Limited Manages Gas Assets Optimally with ArcGIS

Client
Gujarat Gas Limited

Industry
Utilities

Organization Profile
Gujarat Gas Limited (formerly known as GSPC Distribution Networks Limited), is India's largest City Gas Distribution player with its presence spread across 44 Districts in the State of Gujarat, Punjab, Haryana, Madhya Pradesh, Rajasthan and the Union Territory of Dadra & Nagar Haveli making GGL a PAN India Company.

The company has more than 37,000 (Thirty-Seven Thousand) km of gas pipeline network. It has more than 800 CNG stations and distributes approximately 9 mmscmd of natural gas to more than 20.25 lakh households, approximately 3.5 lakh CNG vehicles (serving per day), and to over 4,300 (Four Thousand and Three Hundred) industrial customers.

Website
www.gujaratgas.com

Project
GIS system for City Gas Distribution Networks

Highlights
- Esri India's GIS solution allows GGL to map and manage gas assets efficiently.
- The GIS solution has led to significant cost savings through optimized route planning, efficient project estimating, and streamlined maintenance activities.
- Manpower utilization has improved as a result of enhanced crew monitoring and efficient emergency response.
- Productivity gains are notable in terms of reduced hours spent on planning and increased operational efficiency.
- The GIS system has substantially improved data accuracy, contributing to better decision-making across various operational domains.

Project Summary

Gujarat Gas Limited (GGL), as India's largest City Gas distribution company, has undertaken a comprehensive project to enhance its operational efficiency through the implementation of a Geographic Information System (GIS) on the Esri platform. This project involves mapping all gas assets and associated infrastructure using ArcGIS and ArcFM. The GIS system is instrumental in various aspects of GGL's operations, including commercial activities, engineering and design, construction and projects, maintenance, and emergency response.

Challenges

Before the implementation of the GIS system, GGL faced challenges in terms of data accuracy, operational efficiency, and response time. The lack of a centralized and spatially enabled system made it difficult to conduct feasibility studies, and desktop studies for alternative projects. Route planning, project estimating, network simulation, and maintenance planning were cumbersome processes. The absence of a robust GIS system also hindered quick response to emergencies, efficient complaint handling, and crew monitoring during critical situations.

Solution

Esri India provided a comprehensive GIS solution. This system allows GGL to map and manage gas assets efficiently. The solution enables commercial activities such as feasibility studies, and desktop studies for alternates. In terms of engineering, planning, and design, the GIS system facilitates route planning, project estimating, network simulation, design clearances, and reinforcement and replacement planning. For construction and projects, it aids in construction planning, network identification, route analysis, and risk assessment. Maintenance activities benefit from the system through maintenance planning, patrolling, valve chamber maintenance, shutdown planning, and providing data for root cause analysis. In emergency response, the GIS system ensures quick response, isolation and squeeze-off analysis, efficient complaint handling, and crew monitoring.

> Esri India's GIS solution has revolutionized our operations, providing us with a holistic platform to manage our gas distribution network. The quantifiable benefits in terms of cost savings, manpower use, productivity, and data accuracy are remarkable. This solution has not only resolved our operational challenges but has also positioned us at the forefront of technology in the gas distribution industry. It has empowered us to respond swiftly to customer needs, emergencies, and market dynamics, ensuring the seamless delivery of services to our consumers.
>
> **-Subrata Banerjee, Manager (Technical Services), GGL & Nautam Akbari, Sr. Engineer (Technical Services), GGL**

Benefits

The implementation of Esri India's GIS solution has yielded several quantifiable benefits for GGL. These include significant cost savings through optimized route planning, efficient project estimating, and streamlined maintenance activities. Manpower utilization has improved as a result of enhanced crew monitoring and efficient emergency response. Productivity gains are notable in terms of reduced hours spent on planning and increased operational efficiency. The GIS system has substantially improved data accuracy, contributing to better decision-making across various operational domains.

The GIS system plays a crucial role in maintenance activities by facilitating maintenance planning, patrolling, valve chamber maintenance, and shutdown planning. It provides real-time data for root cause analysis, enabling proactive maintenance measures and minimizing downtime. In emergency response scenarios, the GIS solution enables quick decision-making by providing tools for isolation and squeeze-off analysis. It also supports efficient complaint handling and crew monitoring during critical situations, ensuring a rapid and effective response to emergencies.

The GIS system allows for continuous monitoring of the gas distribution network. It provides real-time data on asset status, performance, and potential issues. This data is analyzed to identify trends, assess network health, and proactively address any emerging challenges.

GIS-Enabled Collaborative Platform boosting GMDA's Intelligent Decision Support System

Client
Gurugram Metropolitan Development Authority

Industry
Urban

Organization Profile
Gurugram Metropolitan Development Authority (GMDA) is responsible for the planned development of the area under the authority. The main function of GMDA is to prepare plans, policies and proposals for guiding GMDA's planned development through the process of Master Plans, Zonal Plans, Layout Plans and Urban Extension Projects etc.

Website
www.onemapcitizens.gmda.gov.in

Project
OneMap Gurugram

Highlights
Esri India helped GMDA by developing:

- One collaborative infrastructure framework for multiple stakeholders across departments
- An evidence-based decision support system

Project Summary

Gurugram Metropolitan Development Authority (GMDA) is responsible for the planned development of the area under the authority. The main function of GMDA is to prepare plans, policies and proposals for guiding GMDA's planned development. To accomplish the mission of GMDA, to be a major support in governance by embedding GIS in all aspects of decision making, planning & management, OneMap Gurugram was developed on Esri platform by GIS division of GMDA.

Challenges

Under GMDA, there are various agencies and multiple stakeholders like Municipal corporations, Gram panchayats, TCPO Haryana, Revenue and Disaster Management department, Haryana Industrial Development Authority, Public works department, Haryana Urban Development Authority, Public Engineering department etc. The challenge was the lack of a common decision which supports system or common decision-making platform, for all these departments, was resulting in lack of a coordination among the different departments and delay in execution of development initiatives as per the plan.

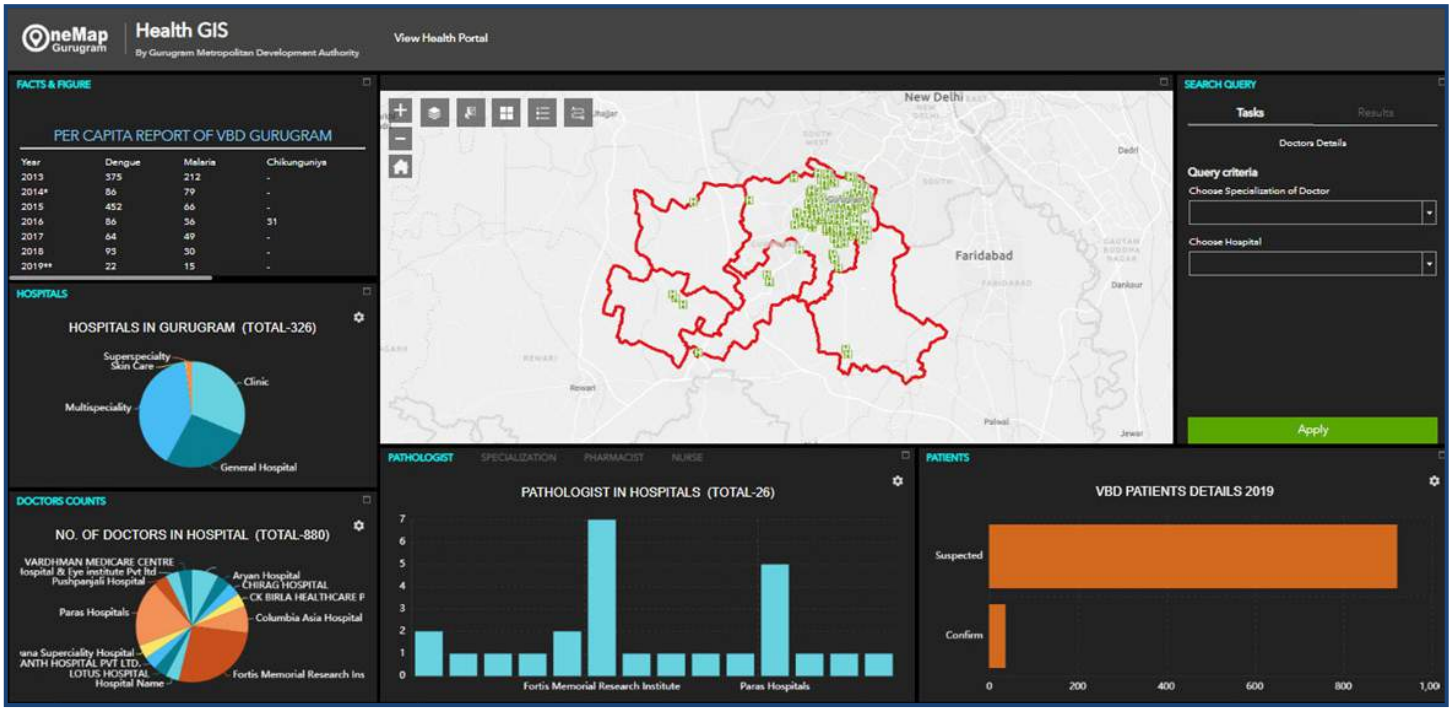
The other challenges while formulating and implementing development schemes were due to the existing data management systems. These were not fully equipped to address the information prerequisites for planning purposes. Since it was an information intensive task, GMDA had to also address:

- Incompatible and non- standard datasets inhibiting integration
- Inefficient inter-sectoral data flow
- Lack of information on quality, completeness and lineage of data

Solution

A modern geospatial based system was established for planning purposes of land, infrastructure, urban amenities and urban environment in the notified area. GMDA created a central and robust GIS integrated Decision Support System with spatial information as well as citizen engagement for GMDA in particular and for other allied departments & district authority of Gurugram.

To reshape the urban governance processes and provide an impetus to infrastructure development OneMap Gurugram, a GIS-integrated support system was developed. The Platform clustered the GIS layers



of information into different applications as per departmental requirements. GMDA decided to go with an Enterprise Wide GIS Portal to facilitate the integration of all departmental work with Enterprise GIS, to bring about Spatial Decision Support System and collaboration of different departments on common base maps.

OneMap Gurugram provides vivid details of various infrastructure in the city through its webGIS portal named “Onemapggm”. The site provides details of dry infrastructure like Rail, Road, Telecom Towers and Metrolines. It also provides wet infrastructure details like Water Distribution Network, Sewage Network, Drainage network and recycled network with Network Asset details and Power infrastructure, Public transportation facilities, Land Governance Layers, health facilities, homeland security, image services and similar other information. OneMap Gurugram is a detailed and accurate geo-enabled intelligent Decision Support System, aligned with objectives of development of the state that increases effectiveness of land acquisition, planning, compensation and providing urban services, etc.

The GMDA has adopted a hub type framework for the collaboration of different departments under the Smart City. The platform clusters GIS layers of information into different applications as per the departmental requirements. The same platform is also being leveraged for integrated Command & Control Centre under mission through various interactive dashboards.

Benefits

OneMap Gurugram is the first of its kind Federated Architecture in GIS to be used by different departments within and outside GMDA. Described as a GIS-integrated support system, OneMap Gurugram is not just a navigation application, but also a data mine, with information from different government departments collated, digitised and accessible at a single point. The key benefits of OneMap Gurugram are:

- A conjunction platform for spatial and non-spatial details about the city, provides all departments with updated dataset on OneMap Gurugram.
- One collaborative platform for different departments to interact with one other and take decisions.
- An evidence-based decision support system.
- Intelligent governance through map-based decision making.
- Visibility of ongoing & upcoming projects.
- Links to different organizational apps.
- Provides Citizen engagement through visibility of their area on OneMap Gurugram.

> “GMDA has leveraged Esri’s ArcGIS beyond being a platform. GIS is utilized to create a centralised services framework for citizens, businesses and various government departments. Onemap Gurugram is the core infrastructure providing various services like map, image, data, webGIS application development, GeoDatabase, Capacity building, and many more services to multiple stakeholders across departments and citizens.”
>
> **- Dr. Sultan Singh, Head (GIS), GMDA & HARSAC**

HARSAC Harvests Success: Groundbreaking Agri Reforms Mapped with ArcGIS

Client
Haryana Space Applications Centre (HARSAC)

Industry
Agriculture

Organization Profile
Haryana Space Applications Centre (HARSAC) is responsible for implementing GIS, Remote Sensing, UAV, and GPS technologies across Haryana State, covering a total of 42,212 sq. km. HARSAC harnesses geospatial technology to benefit the state's citizens and prepares plans, policies, and proposals to guide decision-making authorities in the government of Haryana.

Website
www.hsac.org.in/harsac

Project
Crop Management Solution

Highlights
- Facilitates capture of real-time, ground-truth intelligence on the total crop produced in Haryana.
- Ensures more effective governance in yield management and agricultural income generation.
- Brings more transparency to the lifecycle from seed to market; empowering farmers.
- Leads to substantial financial savings for the state.

Project Summary

Haryana Space Applications Centre (HARSAC) has developed and deployed a Geospatial Technology-based Crop Management Solution to address challenges in agricultural management. This solution empowers farmers, enhances transparency, and strengthens agricultural reforms in Haryana. The solution, which is part of HARSAC's OneMap Gurugram Portal, enables the authority to capture real-time, ground-truth intelligence on the total crop produced in Haryana. It allows the government to precisely record, measure, and analyze agricultural produce, leading to more effective governance in yield management and agricultural income generation. By bringing transparency to the lifecycle from seed to market, farmers feel more empowered. The system has led to significant improvements in yield management, cost reduction, and resource optimization, resulting in substantial financial savings for the state.

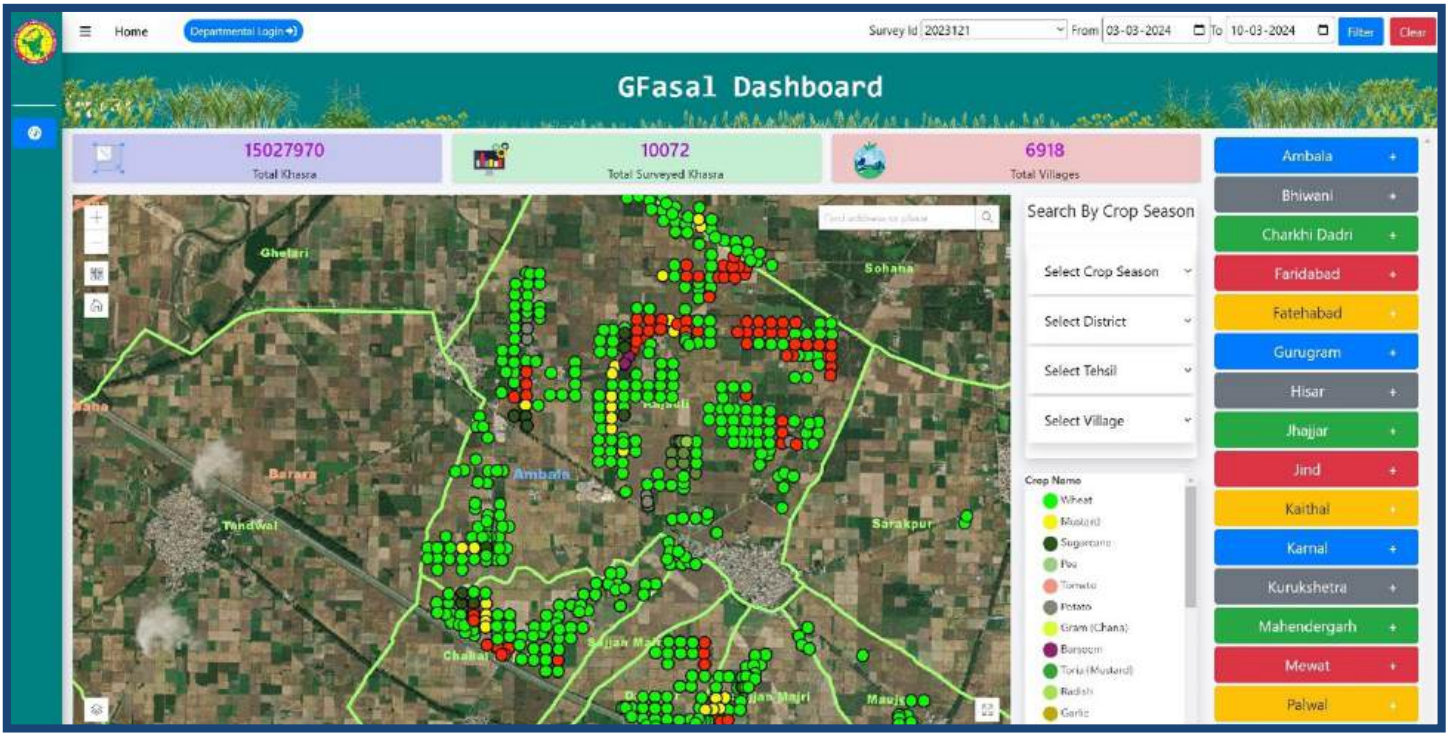
Challenges

Traditional paper-and-pencil surveys in agriculture are prone to errors in measuring farmlands and yields, leading to mismatches in records. Without a digital system, government benefits like subsidies and insurance often do not reach farmers. Additionally, traditional systems struggle with collaboration among different departments.

Solution

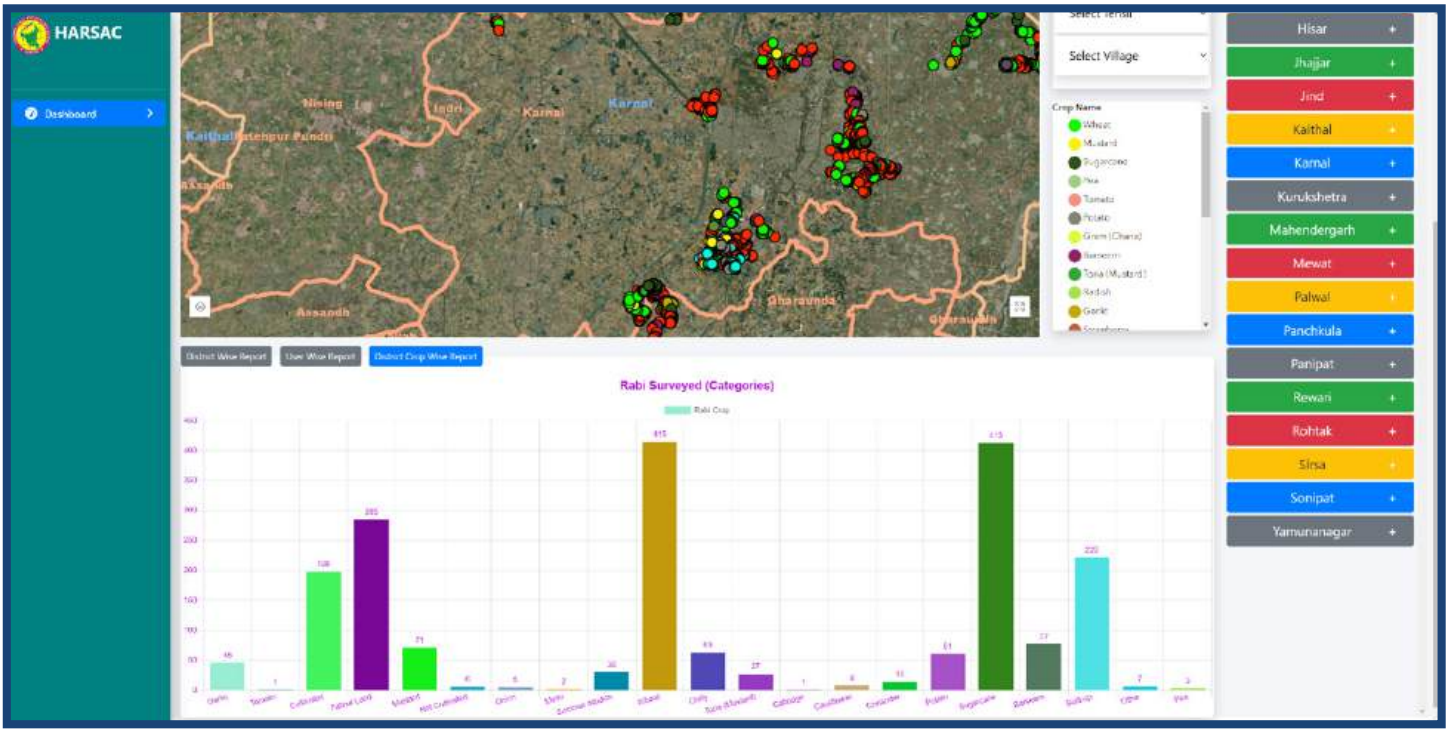
The Crop Management Solution, built using Esri's Geospatial Technology, enables complete data collection of crop types and conditions across Haryana. It performs precise measurements of farmland size in each district, helping HARSAC manage farmlands and crops more effectively, reduce labor costs, and minimize resource waste. The accurate, up-to-date data allows for the formulation of feasible funding and agricultural development plans.

The system encourages farmers to register on a common portal, promoting transparency. **Currently, about 1.2 million farmers are registered.** This registration facilitates complete knowledge of farmland, easing crop monitoring and management. Farmers receive updated market rates and can schedule appointments to sell produce at government-approved centers, saving time and effort.



Overview of the GFasal Dashboard

GFASAL: Geospatial Governance revolutionizing Farming Activities through Spatial Analysis and Learning, The GIS system allows HARSAC to visualize and analyze field data easily, ensuring integrated agricultural data can be updated and managed through an enterprise geodatabase. The system also serves as a platform for data synchronization, management, and sharing, enhancing collaboration among departments and leading to informed decision-making.



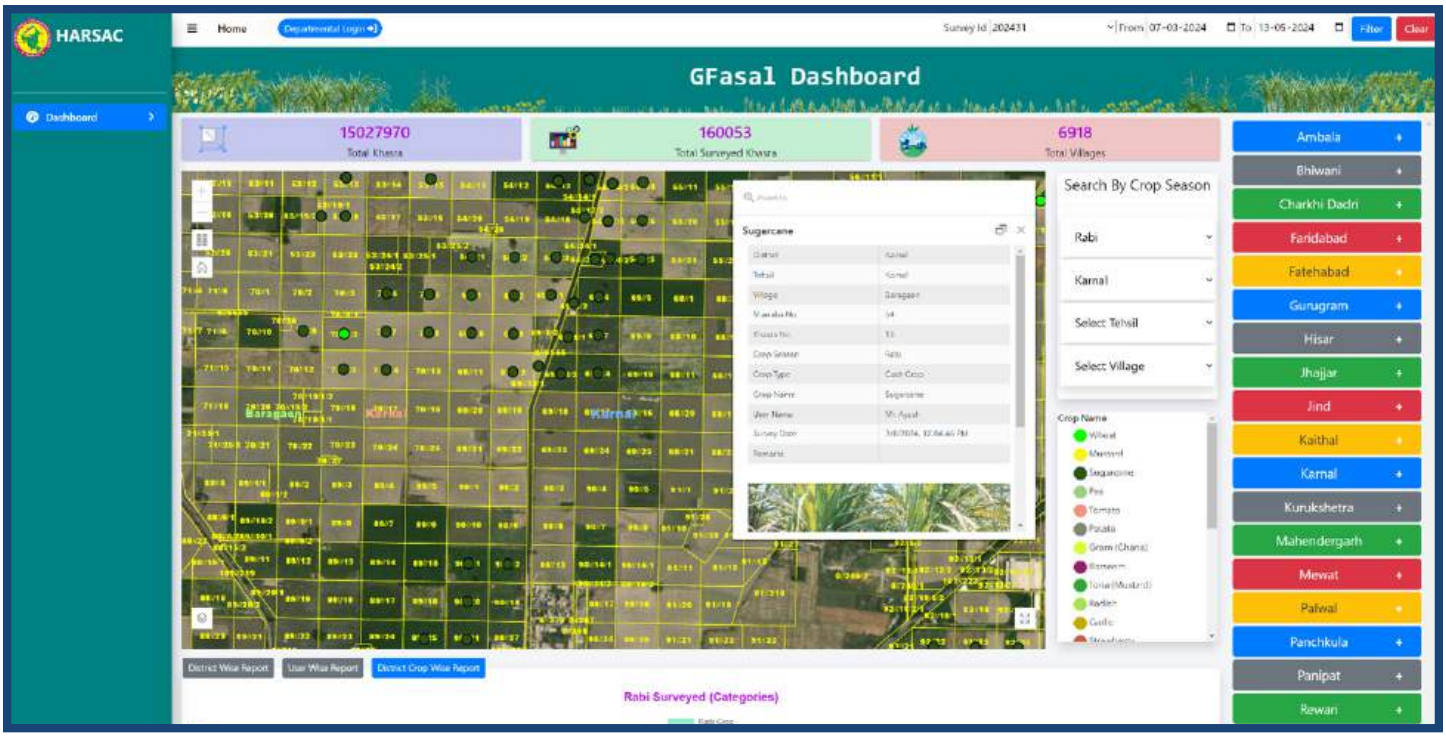
Major Crop Classification in Karnal District

A mobile application enables surveyors to measure farmland areas, add attributes, and take pictures of crops using integrated GIS and GPS technologies, ensuring real-time data upload.

The GFasal Dashboard provides district-wise crop details, allowing users to see information on crops surveyed, crop types, and village-level data, promoting transparency from seed to market.

This robust GIS-facilitated system ensures genuine farmers are identified, bogus beneficiaries are excluded, and registration anomalies are reduced. The state's income from agricultural produce is optimized, and government benefits reach the real farmers.

Field surveys, carried out by students, involve using the mobile app. This experience imparts geospatial data knowledge and GIS skills, contributing to future capacity building and making students more employment-ready.

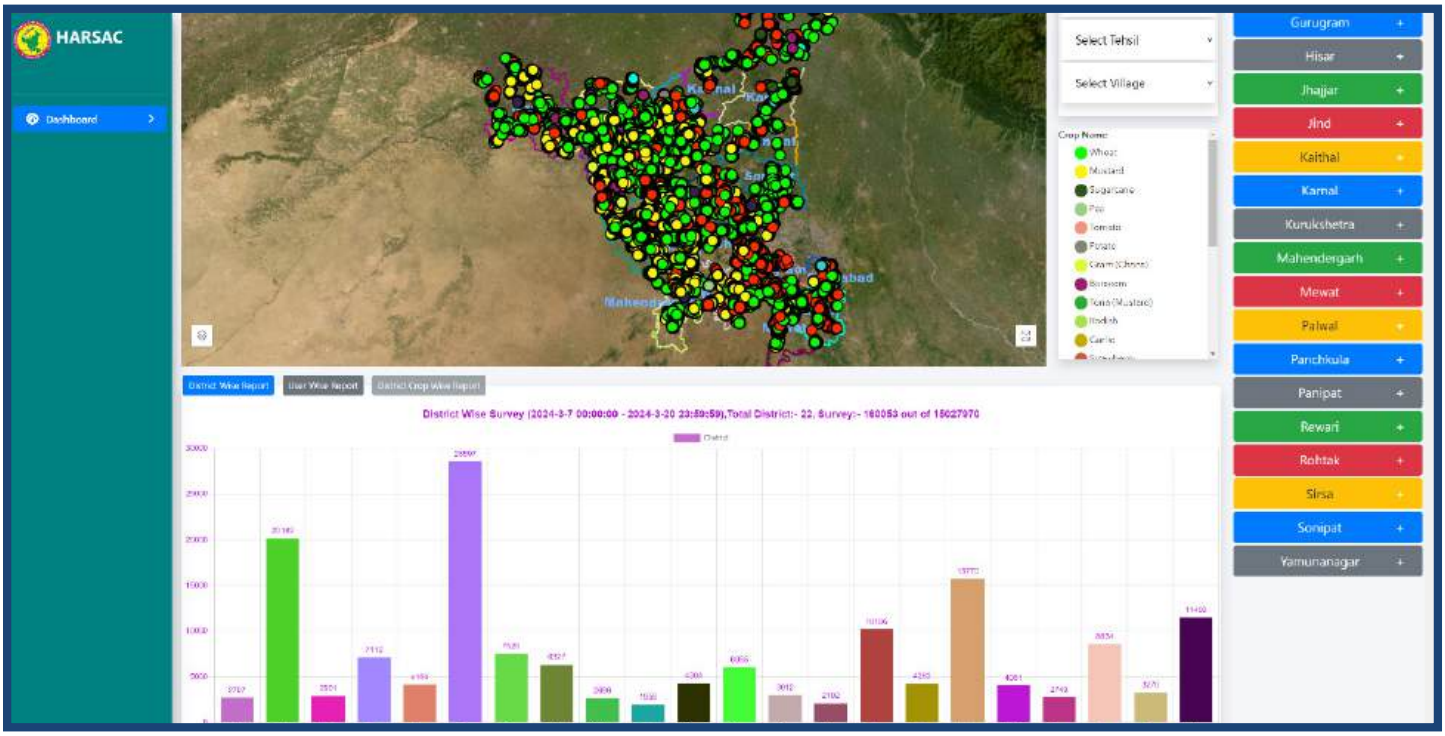


Area 54//13 in Karnal: Sugarcane, Sown on 8th March 2024, with Geotagged Photo Attached

Methodology

The Crop Management Solution employs the following GIS tools and techniques:

1. **Data Collection:** Using mobile applications integrated with GIS and GPS, surveyors collect data on crop types, farmland size, and conditions.
2. **Real-time Data Upload:** Collected data is uploaded in real time to an enterprise geodatabase, ensuring accuracy and timeliness.
3. **Data Visualization:** The GFasal Dashboard provides a visual representation of crop data, enabling easy analysis and decision-making.
4. **Collaboration:** The system facilitates data sharing and synchronization across departments, enhancing collaboration and informed decision-making.
5. **Farmer Portal:** Farmers register on a common portal, where they can access information on market rates, selling outlets, and schedule appointments for selling produce.



District-wise Crop Survey Count across Haryana: Mapping Agricultural Abundance for Sustainable Growth

Benefits

The implementation of the Crop Management Solution has led to significant improvements:

1. **Yield Management:** Accurate measurement and analysis of farmlands and yields.
2. **Cost Reduction:** Reduced labor costs and minimized resource waste.
3. **Transparency:** Enhanced transparency in the agricultural supply chain.
4. **Financial Savings:** The state has saved approximately 300-400 crores.
5. **Farmer Empowerment:** Farmers receive support throughout the crop lifecycle, from production to market.
6. **Social Enforcement/Assessment Impact:** Strengthened social enforcement mechanisms and enhanced assessment capabilities, fostering greater accountability and compliance within the agricultural sector.

The integration of Geographic Information Systems (GIS) in agriculture is transforming traditional farming practices. GIS technology enables precise data collection, a nalysis, and visualization, which are crucial for effective decision-making and resource management. Agriculture plays a vital role in the economy, and efficient crop management is essential to support the livelihoods of millions of farmers. HARSAC, recognizing the need for modernizing agricultural practices, implemented a Geospatial Technology-based Crop Management Solution to overcome the limitations of traditional methods and enhance agricultural productivity and governance. The Crop Management Solution by HARSAC is a pioneering step towards modernizing agriculture in Haryana. By leveraging Geospatial Technology, the state has achieved significant improvements in yield management, transparency, and financial savings.

> The Crop Management Solution developed using Esri's Geospatial Technology is enabling HARSAC to effectively govern the full lifecycle of agricultural production in the State of Haryana. By removing demand-supply gaps and minimizing errors in yield estimations and procurement predictions, it fosters a culture of sustainable agriculture, bringing about 300-400 crores worth of savings to the State.
>
> **- Dr. Sultan Singh, Head (GIS), HARSAC**

L&T WET Revolutionizes Irrigation Pipeline Design with ArcGIS

Client
L&T Construction's Water & Effluent Treatment IC

Industry
AEC

Organization Profile
L&T Construction's Water & Effluent Treatment business vertical provides state-of-the-art design, detailed engineering, procurement, project management, project execution, commissioning and operation & maintenance for: Water Transmission, Treatment; Distribution and Management; Municipal Used Water Collection Treatment and Reuse; Industrial Water Treatment to achieve Ultra-Pure Water; Industrial Effluent Treatment and Zero Liquid Discharge / Recycle; Desalination Plants - Sea Water / Brackish Water; "Unaccounted for Water" Projects to Monitor the Water Loss; Lift Irrigation Projects; Refurbishments of Treatment Plants; Canal Relining projects. With a fiscally sound approach to projects, proven project management skills, country wide operational presence, and an experience & expertise that spans over 40 years, L&T is recognized as the leader in developing and providing water infrastructure in the country.

Website
www.lntecc.com

Project
Irrigation Pipeline Design

Highlights
The use of GIS in the Irrigation Pipeline Design Project ensured:

- A more streamlined and effective project execution.
- Development of a well-designed irrigation system.
- Optimized cost savings and operational efficiency.
- About 50% of time saving in chak planning process with minimal manual errors.
- Real-time or near-real-time insights, empowering users to make well-informed decisions based on the latest information.

Project Summary

In recent times, lift irrigation projects have emerged as a popular solution for supplying water to agricultural lands at elevations higher than the source of water. The integration of GIS into irrigation projects has revolutionized the way these projects are planned, designed, and managed in India. The technology can also be used to automate various processes and tasks in the lift irrigation project lifecycle. The successful implementation of ArcGIS products in the Lower Suktel Irrigation project serves as a case study showcasing the potential of GIS in such endeavors. The case study highlights how GIS facilitated the design and execution of the project, offering insights into how this technology streamlined the process and contributed to the project's success. By leveraging GIS technology, the project was able to achieve a more streamlined and effective execution, ensuring that the irrigation system is not only well-designed but also optimized for cost savings and operational efficiency. The ability to cater to a large cultivable area and incorporate micro irrigation compatibility underscores the scalability and versatility of GIS in irrigation projects.

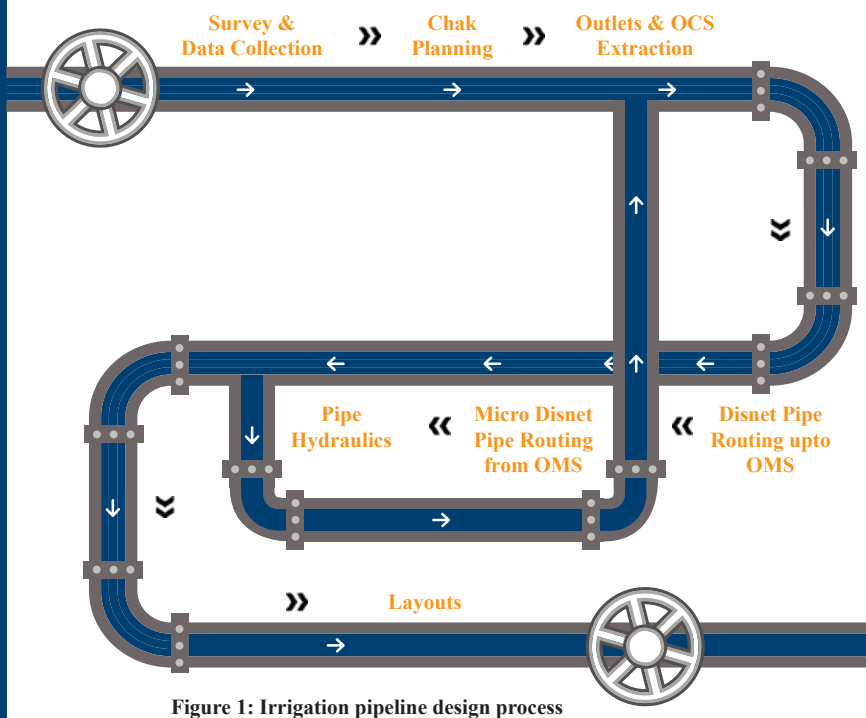


Figure 1: Irrigation pipeline design process

The Lower Suktel Irrigation project in Odisha, with a distribution network of up to 1 ha sub chak compatible with micro irrigation for 27000 hectares of cultivable area, is the subject of this case study, which describes the use of GIS in irrigation pipeline design.

Solution

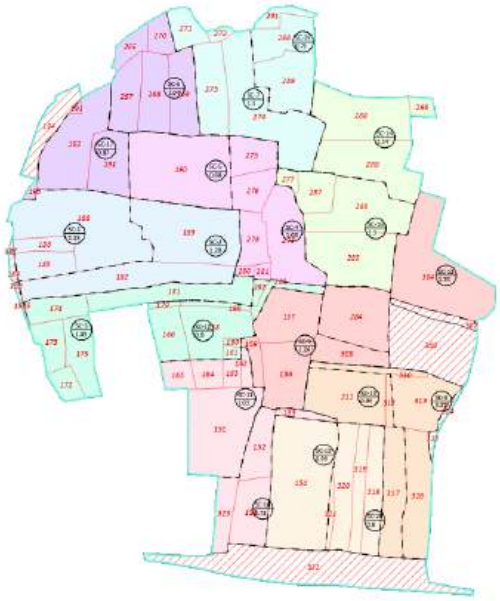
Chak Planning

The process of chak planning in irrigation management is undeniably foundational and traditionally labor-intensive. The establishment of layouts for chaks, which serve as basic units within the command of a channel, has conventionally involved significant manual effort using tools like AutoCAD and Excel. This process typically requires merging land records manually, which can be time-consuming and prone to human errors.

The adoption of GIS, particularly through customized tools developed using ArcGIS Model Builder, has proven to be a game-changer in this aspect of irrigation planning. About 50% of time saving is attained in chak planning process using ArcGIS with minimal manual errors.

Land Records (ROR) Overlay

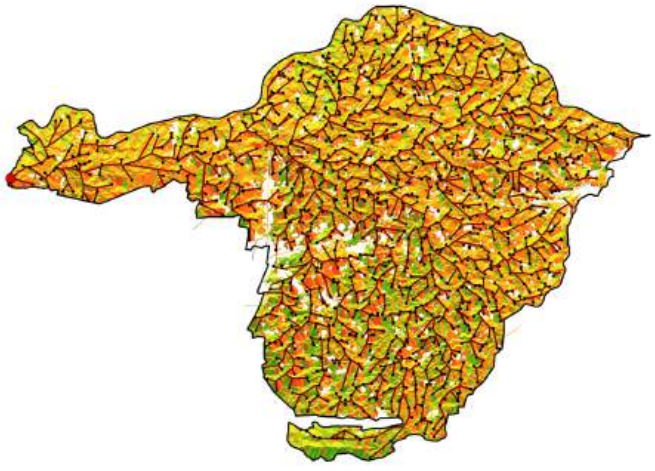
Cultivable & Non - Cultivable Making



Sub - Chak Plan

Distribution Network routing

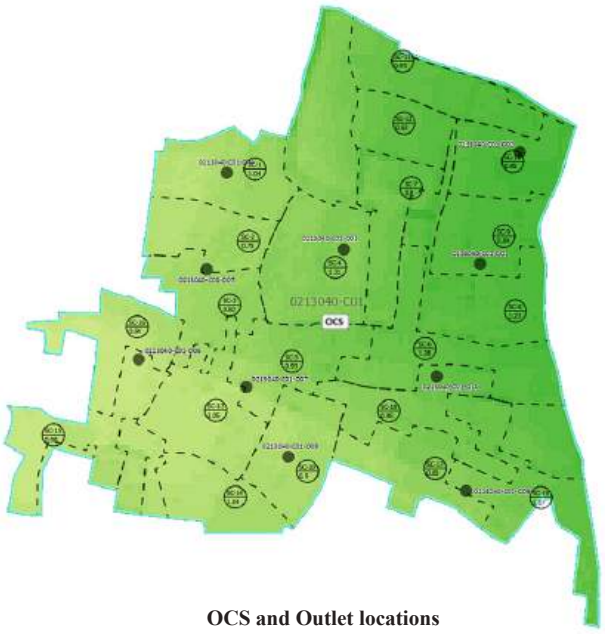
Assured and timely irrigation water supply is indeed crucial for maximizing agricultural production within a command area. The efficiency of a water delivery system significantly impacts the ability to meet these needs. Designing and constructing a well-planned water delivery system is essential to ensure the efficient functioning of the irrigation network. The implementation of the least cost path analysis (LCPA) as an automated tool for generating a preliminary distribution pipeline network is a significant advancement in the field of pipeline distribution design. LCPA allows for the creation of an optimized distribution pipeline network, ensuring that water is delivered using the most efficient and cost-effective routes. The toolset based on LCPA aids in identifying the least costly path for laying down pipelines, minimizing construction expenses while ensuring a well-connected network. The use of an automated tool for this purpose streamlines the pipeline network design process, reducing manual effort and time while also potentially reducing errors.



Distribution Network

OCS and Outlet Locations

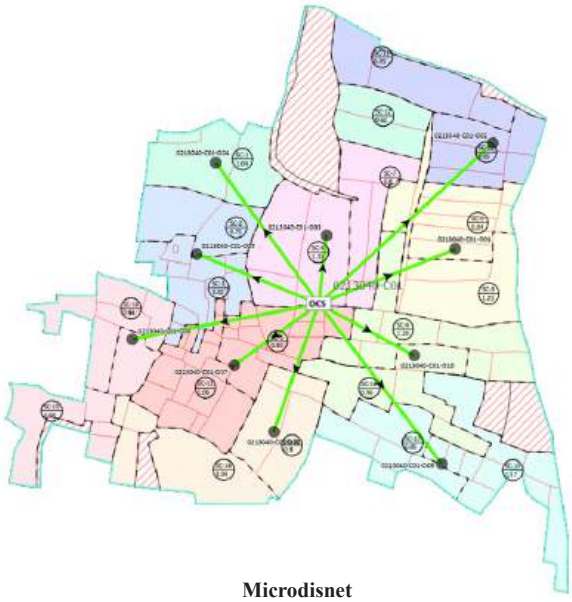
The utilization of the zonal statistics tool within ArcGIS Pro to develop an in-house automated toolset is a smart approach for irrigation planning and management. This process not only optimizes the placement of sub-chak outlets but also aids in efficiently locating the Outlet Management System (OMS) or Outlet Control System (OCS). By using the zonal statistics tool, the toolset can identify the highest elevation point within a chak. Placing sub-chak outlets at this point ensures efficient water distribution, leveraging gravity to distribute water effectively.



OCS and Outlet locations

Microdisnet Routing

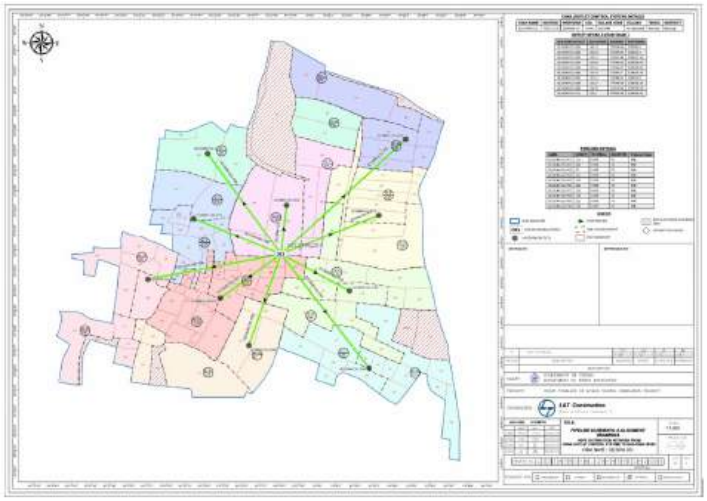
Microdisnet is the pipeline routing from OCS to the outlet of each chak. Leveraging the attribute data, an in-house toolset has been developed to route pipelines from OCS to sub-chak outlets for all the chaks.



Microdisnet

GIS Layouts for Approvals

Map Series in ArcGIS enables the automated generation and updating of layouts for command maps, index maps, and schematic maps. The layout preparation in ArcGIS is object based and any changes in the design can be seamlessly updated to the entire database. With Map Series, maintaining consistency in layouts across multiple maps becomes efficient.



GIS Layouts

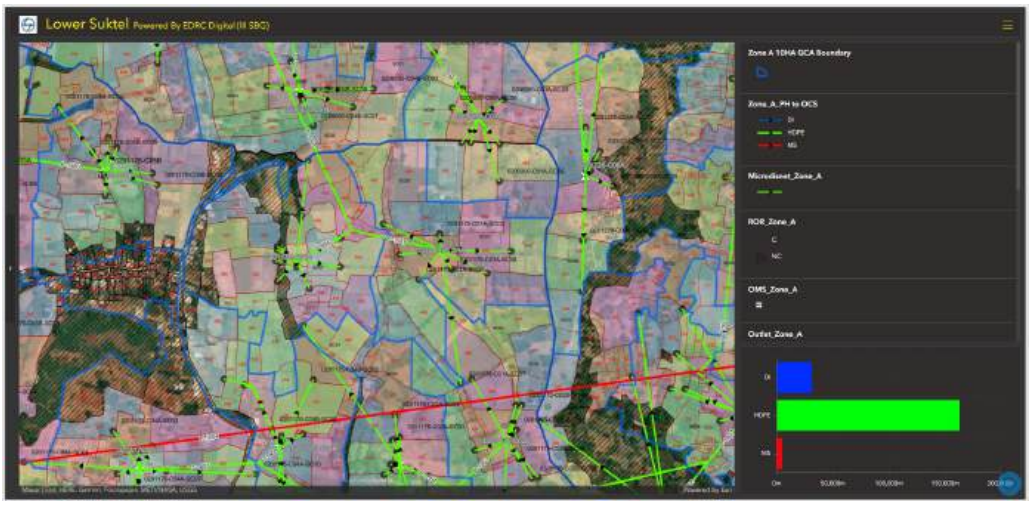
Digital Execution

The development of a dashboard using ArcGIS Online involves publishing all design data, including pipeline details, fittings, OMS (Outage Management System), and outlets on the web for streamlined execution. This approach allows site engineers to easily visualize both the data and associated design details directly from the dashboard, enhancing the efficiency of execution.

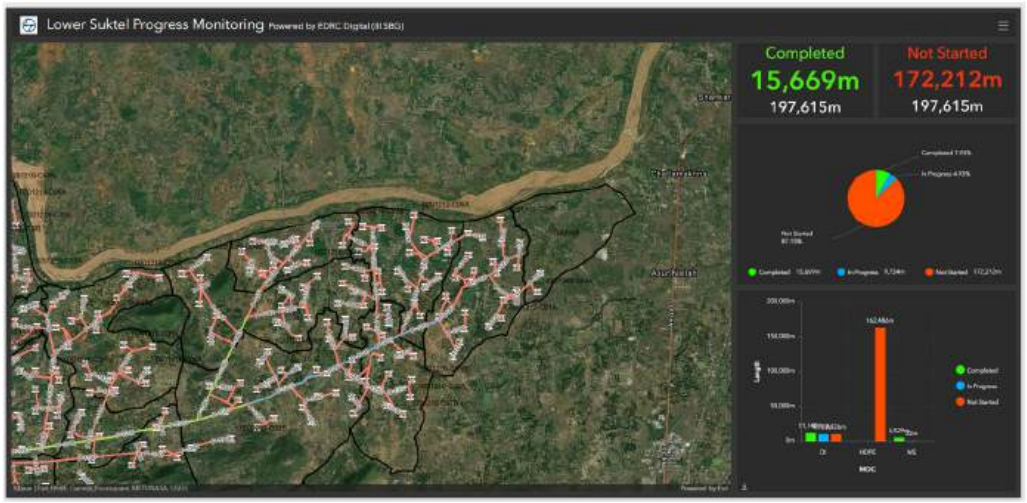
Progress Monitoring

Monitoring progress via GIS dashboards represents a potent method for visually tracking and analyzing diverse data types across geographical locations. These dashboards provide real-time or near-real-time insights, empowering users to make well-informed decisions based on the latest information.

Overall, the integration of GIS technology in lift irrigation projects has been a game-changer, revolutionizing the way these projects are approached, designed, and managed. The Lower Suktel Irrigation project stands as a testament to the potential of GIS in transforming agricultural irrigation systems.



ArcGIS Dashboard Enabling Easy Visualization of Data & Design Details



ArcGIS Dashboard for Monitoring the Progress of the Project

"ArcGIS empowers the qualitative design of irrigation pipelines by seamlessly integrating spatial data, enabling precise planning and analysis for optimal infrastructure development, ensuring efficient water distribution, supporting sustainable agricultural practices through informed decision-making and resource management."

– Dr Rajesh Kumar, HEAD - EDRC (DIGITAL), III SBG - WET IC, L&T Construction

L&T Achieves Excellence in Irrigation Infrastructure Construction with ArcGIS

Client
L&T Construction

Industry
AEC

Organization Profile
L&T Construction is a division of Larsen & Toubro (L&T) a major Indian technology, engineering, construction, manufacturing and financial services conglomerate, with global operations. L&T addresses critical needs in key sectors - Hydrocarbon, Infrastructure, Power, Process Industries and Defense - for customers in over 30 countries around the world. L&T is engaged in core high impact sectors of the economy and integrated capabilities span the entire spectrum of 'design to deliver'. With over 8 decades of a strong, customer focused approach and a continuous quest for world-class quality, L&T have unmatched expertise across Technology, Engineering, Construction, Infrastructure Projects and Manufacturing.

Website
www.lntecc.com

Project
GIS-based Progress Monitoring of Irrigation Infrastructure

Highlights
- Esri's GIS system provides up to 90% improved visualization of pipe laying activity and its execution progress.
- GIS-enabled real-time mapping of project advancements helps to identify areas of challenges.
- The GIS system fosters collaboration and transparency among stakeholders.
- End–to–end digital tracking of material tracking from factory to site commissioning.
- More than 95% material utilization.
- Savings of up to 10% of pipe material cost during procurement.

Project Summary

L&T secured orders from the Government of Madhya Pradesh Micro Lift Irrigation Schemes. The intent of the project is to provide water for micro-irrigation to 1 lakh hectares of farmland in the districts of Madhya Pradesh, by lifting 32.04 cusecs of water from Indira Sagar Project reservoir. The scope of work includes survey, design, procurement, construction and installation of pumping systems, transmission and distribution of pipeline networks, electrical power transmission line and automation system by SCADA. For a massive project like this, assessment of construction progress and comparison with the planned progress play a vital role in project management. Effective and timely progress monitoring enables the project team to take effective actions against delays and discrepancies. Esri's Enterprise GIS system is helping to achieve that. Since the construction itself is carried out in some geographic location, adding a location dimension for monitoring progress increases its effectiveness phenomenally. Spatially representing progress information on a map facilitates clear communication and enables efficient decision-making.

Challenges

Construction planners lack a comprehensive spatial understanding of the terrain, making it difficult to identify optimal locations for irrigation infrastructure. This can lead to suboptimal project designs and inefficient water distribution. Without digital and GIS technology, data collection becomes a time-consuming and error-prone process, hindering the accuracy of project assessments.

The lack of GIS hampers effective monitoring and evaluation, impeding the ability to track progress and identify potential issues in a timely manner. Without GIS solutions, communication and coordination among project stakeholders become cumbersome, leading to potential delays and mismanagement. Additionally, the absence of GIS limits the ability to analyze historical data and predict future water requirements accurately. Furthermore, the manual handling of vast amounts of information without digital support increases the risk of errors and inefficiencies in decision-making. Finally, the lack of GIS inhibits the integration of various data sources, hindering a holistic understanding of the complex factors influencing irrigation project success. In essence, the absence of GIS and digital solutions in irrigation projects undermines efficiency, accuracy, and overall project effectiveness.

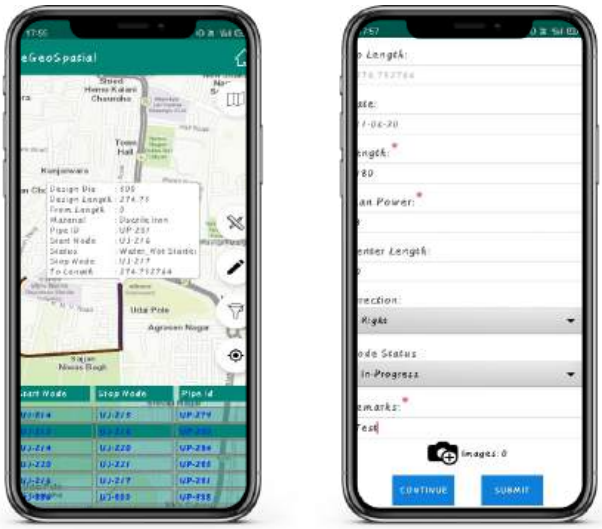
Solution

Progress monitoring using Esri's Enterprise GIS solution encompasses monitoring and viewing the status of construction progress in map-based web portals. This type of browser-based web portal gives L&T Construction an

advantage in customizing the way the progress needs to be shown. Since all the progress information is displayed on the map from a properly structured geodatabase, additional attribute information regarding the progress can also be obtained from the database. This information, if required, can be depicted as charts or percentages. Depending upon the type of structure or feature, the way of representing the progress differs.

Progress update via mobile app

Enterprise GIS solutions are flexible enough to be integrated with almost any system. Data acquired from a mobile app is displayed on the map in real time. The status and progress of the field construction are updated in a mobile app by the field engineer. That data is received as a map service and shown on the portal. Apart from displaying just numbers and colors, additional statistical information can also be calculated and shown if required. This will enable the office personnel to track the progress in real time. Besides, the progress of the features is shown on top of satellite and drone photos. This gives the user a real-world feel of the structure status.

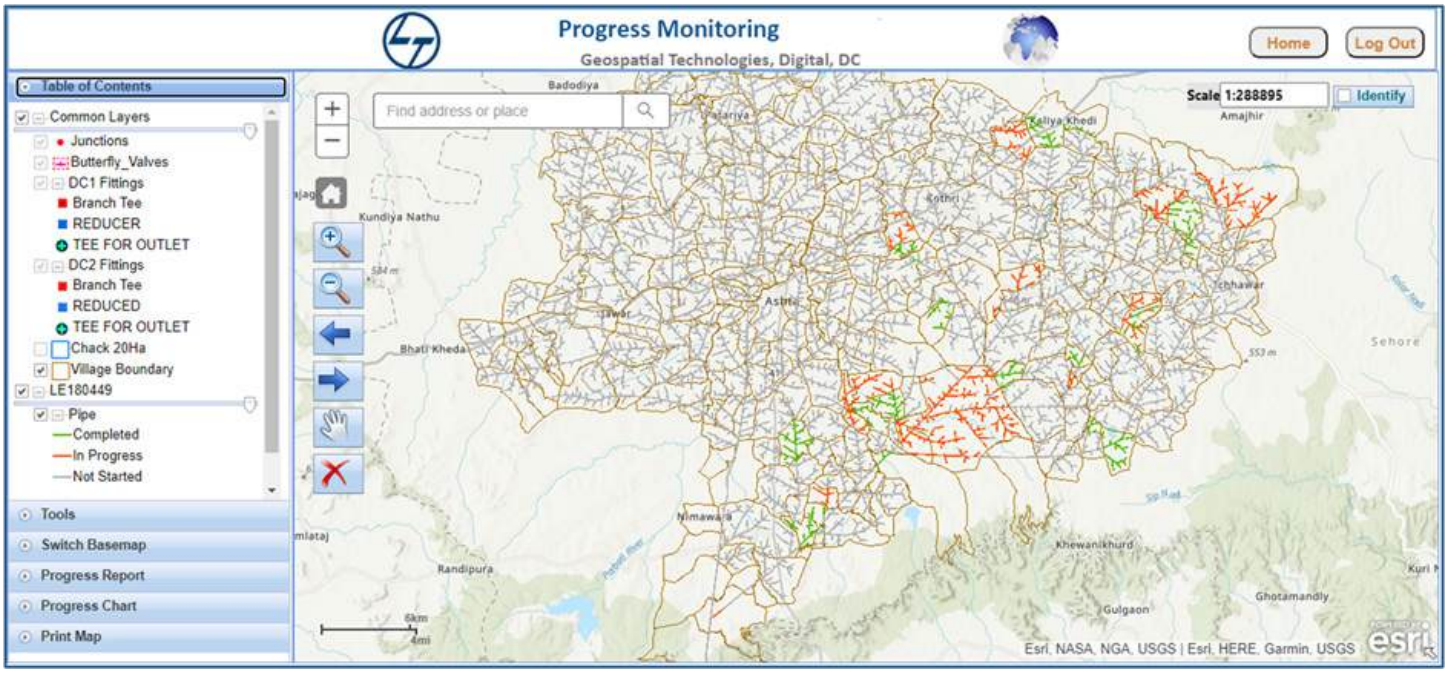


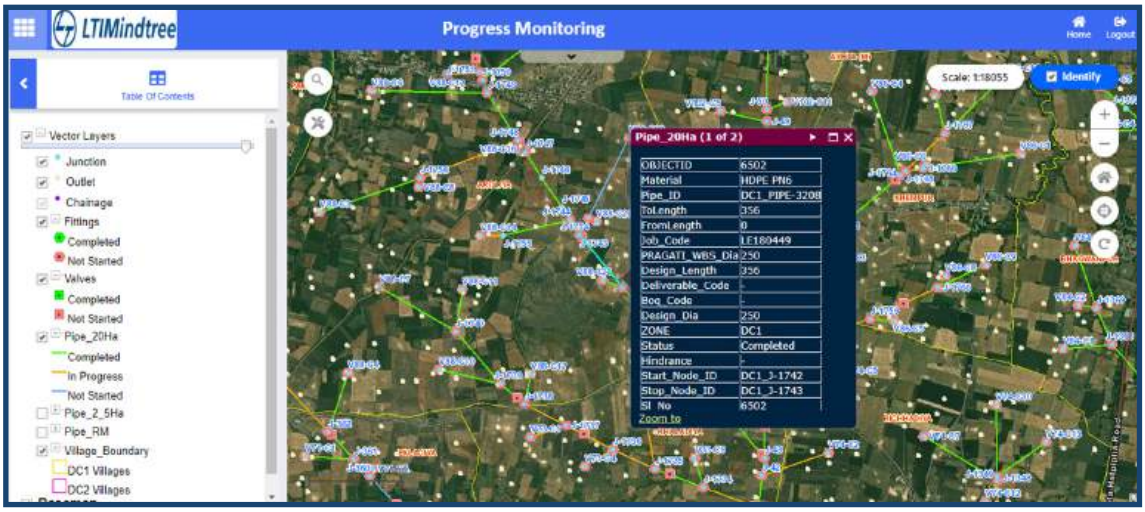
Progress update via web portal

Design progress can be updated directly in the browser-based web portal. The user can view the progress results on the map right away. Forms are given in the web portal where the user selects and enters a few projects related information based on which the design progress is monitored. Then these details are updated on the map. Since the features on the map are published as a service from our own server, along with the feature, the corresponding attribute table also gets updated. This is a major advantage of maintaining feature and design information as geodatabase.

Progress Visualization

The construction progress of the laying pipes is shown on the map below. The green features represent the completed and the red ones show the work in progress. The progress statistics can also be seen. There is a provision to view the progress via charts.

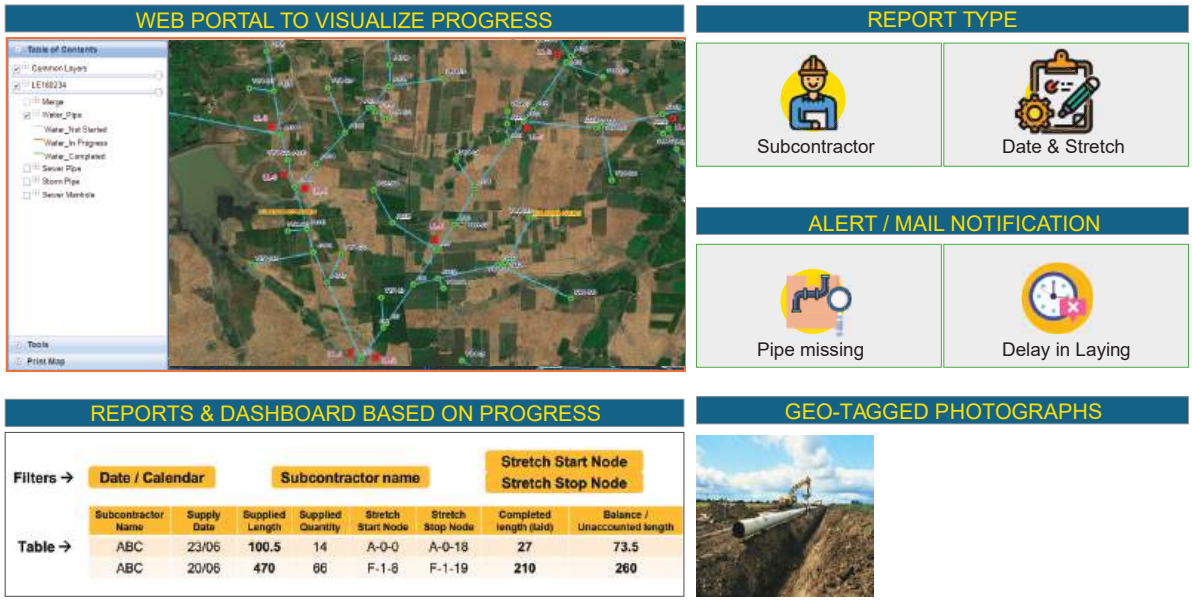




SPRINT – Spatial solution for Pipe Reconciliation & Inventory Tracking

The primary objective of this module is to first identify instances of pipe theft at the node level, ensuring a granular approach to detecting and addressing this issue. Additionally, the focus extends to pinpointing the location-wise unused inventory, allowing for more efficient management and utilization of resources. Another crucial aspect involves reconciling the pipe inventory with the actual pipe issuance, aiming to streamline the tracking process and reduce discrepancies in the supply chain. To enhance operational transparency, the initiative incorporates the use of mobile technology to monitor and report progress in pipe laying activities. The mobile-based approach facilitates real-time updates, ensuring accurate and timely information on the execution progress of pipe laying tasks. Altogether, these objectives collectively contribute to a comprehensive strategy for improving efficiency, minimizing losses due to theft, optimizing inventory usage, and enhancing the overall progress monitoring of pipe laying activities.

Esri's GIS-based mobile application has been implemented to streamline data collection processes at unloading sites and monitor pipe progress, allowing for efficient tracking and management. The application supports bulk uploading of progress data, facilitating a seamless and time-effective method for inputting information. GeoAI, blend of Artificial Intelligence with Geospatial metrics is employed to accurately count pipes at unloading locations, enhancing precision and reducing the likelihood of errors in inventory tracking. The web application complements these efforts, offering validation reports and a progress dashboard for a comprehensive overview of operations. Additionally, the system incorporates alert notifications via email and provides reports in Excel and PDF formats, ensuring stakeholders are promptly informed and have access to detailed insights for effective decision-making.



Office Admin Web - Web Bashboard

Benefits

- Esri's GIS system plays a crucial role in the progress monitoring of water projects, offering a powerful tool for data integration, analysis, and visualization. It provides up to 90% improved visualization of pipe laying activity and its execution progress.
- Through GIS, stakeholders can efficiently track and manage various aspects of water projects, including the location of water sources, distribution networks, and infrastructure. The system has saved 10 to 15% of planning engineers' time.
- GIS-enabled real-time mapping of project advancements helps to identify areas of challenges.
- GIS-enhanced communication among project teams, government agencies, and communities fosters collaboration and transparency. Overall, the integration of GIS in water project monitoring has not only streamlined the management process but also enhanced the overall effectiveness and sustainability of water initiatives.
- The GIS system enables end–to–end digital tracking of material tracking from factory to Site commissioning.
- The system enables more than 95% material utilization.
- Since precise information is available to the project team, exact quantifications of material are estimated which results in bulk procurement and cost savings. Up to 10% of pipe material cost during procurement has been saved.

> "Esri provides extensive support throughout the project lifecycle, covering everything from tendering to O&M. Its powerful ArcGIS 3D capabilities not only boost our chances of winning projects but also streamline our workflow."
>
> **– Dr. Pari, Associate Vice President, Geospatial, LTIMindtree**

ArcGIS Enhances Efficiency of MGL's City Gas Distribution (CGD) Network

Client
Mahanagar Gas Limited

Industry
Utilities

Organization Profile
Mahanagar Gas Ltd. (MGL) stands as a prominent natural gas distribution company in India, primarily serving the bustling metropolis of Mumbai and its surrounding regions. MGL prides itself on its City Gas Distribution (CGD) network, meticulously designed, maintained, and operated by its in-house team of skilled professionals, adhering to globally recognized technical and safety standards. The CGD Assets are mapped to their geographic coordinates and are an integral part of various departments' day-to-day activities.

Project
Cloud GIS system for City Gas Distribution Networks

Website
www.mahanagargas.com

Project Summary

The Enterprise implementation that was taken up had several facets right from migrating from on-premises GIS to cloud GIS system. Evolving business needs have been addressed by implementing a comprehensive GIS system that fosters collaboration and connectivity across different teams. The system offers a wide range of advanced features and functionalities that go beyond basic mapping capabilities. This includes advanced spatial analysis tools, providing users with more powerful tools to extract meaningful insights from spatial data. The Enterprise system provides seamless connectivity across different platforms and devices for different user segments.

Challenges

The old system was quite outdated and didn't have the scalability for multiple departments' usage. The application was built on a standard COTS product which lacked customization options based on the emerging needs of the GIS users at MGL. The process had a two-way migration engine which was used to import and export data through a scheduled process, which took several hours to complete daily. Moreover, the old web and mobile GIS application was no longer supported by the original OEM. These problems led to the decision to migrate from the on-premise GIS System to the Cloud GIS System.

The major challenges faced by the old system included:

Lack of Interoperability: The older GIS systems did not support modern data formats and standards, making it challenging to integrate them with other systems. This lack of interoperability hindered collaboration and data sharing between different organizations and departments.

Limited Spatial Analysis Capabilities: Advancements in spatial analysis techniques and algorithms were not supported by the older GIS system. This limitation affected the system's ability to perform complex analyses and extract meaningful insights from spatial data.

Scalability Issues: As the need for GIS functionality grew, the old systems struggled to scale up to meet increased demands. This limited the system's ability to handle larger datasets, more users, and additional functionalities.

Cost of Maintenance: The cost of maintaining and supporting the older GIS system increased over time. Finding replacement parts, supporting legacy software, and addressing compatibility issues became more challenging and expensive as the system aged.

Solution

The new web application, powered by ArcGIS, is set to empower MGL's organization-wide GIS users by allowing them to access and visualize the MGL pipeline network and its assets from both office and field locations. This enhanced accessibility will equip users with valuable insights, enabling them to make informed decisions in the performance of their duties.

Furthermore, MGL is actively engaged in the development of a Corrosion Protection (CP) module within ArcGIS. This module will serve as a valuable tool for recording TLP readings, conducting in-depth analyses based on these readings, and generating comprehensive reports within the software, thereby supporting the CP team's operational efficiency. Similarly, the valve chamber cleaning process flow is streamlined in order to manage the effectiveness of cleaning activities through intuitive mobile applications using Survey123 forms.

The integration of Survey123, ArcGIS JS API, and Dashboards creates a comprehensive GIS solution that caters to the diverse needs of departmental stakeholders, from field data collection to visualization and analysis. ArcGIS Dashboards provide a way to create data visualizations and present key indicators, charts and visual elements (attachments) captured from the field in a dashboard format. The GIS ecosystem also helps in reducing data silos and enabling different teams or departments to work with a unified dataset. This promotes collaboration and avoids duplication of efforts in maintaining separate datasets.

Benefits

The GIS implementation is leading to the following key benefits:

- **Enhanced Performance:** The GIS system allows users to work with larger datasets and perform complex spatial analyses more efficiently. It also enables better performance in terms of data processing, analysis, and visualization.
- **Advanced Workflows and Functionalities:** The GIS system offers a wide range of advanced features and functionalities that go beyond basic mapping capabilities. This includes advanced spatial analysis tools, providing users with more powerful tools to extract meaningful insights from spatial data. The Enterprise system provides seamless connectivity across different platforms and devices for different user segments. ArcGIS Dashboards provide a much-needed snapshot view of the assets under regional territories.
- **Seamless Integration:** Interoperability has been a key challenge addressed by the GIS system, as it seamlessly integrates with other systems and technologies. This fosters collaboration and data sharing across different departments and organizations.
- **User-Friendly Interfaces:** The user-friendly interface of the GIS system contributes to increased productivity, catering to both experienced GIS professionals and new users, thus reducing the learning curve.
- **Scalability:** Scalability is a critical advantage, allowing MGL to expand its GIS capabilities to meet growing needs. The mobile access provided by ArcGIS systems enables field personnel to interact with spatial data using smartphones or tablets, enhancing field data collection, asset management, and decision-making processes. The implementation also ensures cost efficiency in the long run, with improved performance, reduced downtime, and enhanced productivity contributing to overall savings. Additionally, specific modules, such as the Corrosion Protection (CP) module and streamlined Valve chamber cleaning processes, demonstrate the system's adaptability to diverse operational needs, further enhancing MGL's operational efficiency.
- **Mobile Access:** ArcGIS systems come with mobile capabilities, enabling users to access and interact with spatial data in the field using smartphones or tablets. This enhances field data collection, asset management, and decision-making processes.
- **Cost Savings:** Upgrading to a new cloud GIS system leads to cost savings in terms of reduced hardware maintenance and support expenses. Newer systems are often more efficient, reducing the need for frequent hardware upgrades and maintenance.
- **Manpower Efficiency:** A more user-friendly interface and improved processing speeds lead to time savings for GIS professionals. Tasks that took longer in the old system get completed more quickly, leading to increased efficiency. A lot of tasks are automated minimizing GIS teams' interference to routine activities.
- **Reduced Downtime:** Improved system reliability and reduced maintenance requirements result in fewer instances of system downtime. This translates directly into hours saved that would have otherwise been spent on troubleshooting and resolving issues.
- **Faster Decision-Making:** The ability to perform complex spatial analyses more quickly enables faster decision-making processes, saving hours or even days in critical situations.
- **Real-Time Updates:** The GIS system supports real-time data updates, ensuring that the information available is current and accurate. This can be particularly important in scenarios where decision-makers rely on the latest data for planning and response.
- **Higher Data Accuracy:** Advanced data management tools in the GIS system contribute to better data quality control, reducing errors and inaccuracies that may have occurred in older systems.

> The implementation of Esri's ArcGIS Enterprise solution at Mahanagar Gas Ltd. (MGL) marks a transformative milestone for the organization, bringing about a variety of benefits. Firstly, the new GIS system enhances overall performance, leveraging cloud implementation of the software for more efficient data processing, analysis, and visualization. This allows MGL to handle larger datasets and perform complex spatial analyses with greater ease. The advanced workflows and functionalities offered by Esri's GIS platforms, including ArcGIS Dashboards, provide a comprehensive view of assets under regional territories, empowering users to make informed decisions.
>
> **– Viraj Kulkarni, Ch. Manager - GIS, MGL**

MahaBHUMI: GIS Based Digital Basemap on 1:4k for Integrated Planning - Maharashtra State

Client
Maharashtra Remote Sensing Application Centre (MRSAC)

Organization Profile
Maharashtra Remote Sensing Application Centre (MRSAC) was established in January 1988, as an autonomous body under the Department of Planning, Govt. of Maharashtra. It is a premier institution, dedicatedly involved in serving the state of Maharashtra through use of geospatial technology like remote sensing, geographic information system (GIS), global positioning system (GPS), mobile technology, photogrammetry, drone (UAV) and LiDAR for 3-D mapping.

Project
MahaBHUMI Geo-Portal.

Website
www.mrsac.gov.in/MRSAC

Highlights
The aim of designing an integrated information system - MahaBHUMI Geo-Portal is multi-fold:

- To develop a system that shall depict the basemaps prepared from very high resolution satellite data on 1:4k with details of transport system, water resources, irrigation, urban areas and landuse. The Contours generated under the MahaBHUMI project are at 2m interval and are also shown in the topomaps collated at 1:10K scale.
- To integrate data generated in MRSAC from high resolution satellite images & geotagged information on water supply schemes, forest boundaries (upto beat level), orchards, mining lease boundaries, historical monuments, etc. with topomaps.
- To create a central repository of departmental data & assets in GIS.
- To create Web services of various databases so that these could be consumed by various departments in their own applications.

Project Summary

In order to make effective use of the very high-resolution satellite database and to achieve the e-governance objective of Maharashtra State, MRSAC has designed an integrated information system/unified geo-portal called MahaBHUMI. The aim of designing MahaBHUMI Geo-Portal is to acquire high-resolution satellite data and provide as services, the value-added processed satellite image data, under a common base of coordinate and projection system. The value-added base maps are generated by the process of abstraction of the visible features distributed into various base themes. The integration of the base themes generates the base map with various assets and topographic information. This can aid in creating a central repository of base information in a GIS environment. The project employs database standards with a standard schema for the generation of base geodatabase using very high-resolution ortho-corrected satellite data.

Challenges

For any kind of planning, a strong and robust database forms the backbone. This is the first of its kind in the country and therefore involved setting new benchmark in satellite data ortho-rectification to designing Geodatabse standards to meet the large scale mapping needs of different departments involved. The present initiative of standardization and feature extraction from very high-resolution satellite imagery, for planning, implementing, monitoring, and management of various government schemes is therefore taken up. The aim of such standardization is to enable individual state level partner institutions (Line Departments) to create, update, and carry out capacity building and disseminate the information up to grassroot (Gram Panchayat) level. In other words, the whole effort is for designing, creating, updating and disseminating the resource information under the ownership of individual stakeholder departments. The outcome of creating and organizing information is to establish and enable the information system comprising spatial natural resources and non-spatial data (MIS) towards supporting the decentralized planning at various levels in the Govt. The GIS database is customized to meet the requirements of the Government departments based on their problems/priority/developmental programs at the Cadastral/ Village/Block/Taluka/District level.

Solution

The base maps and the geo-portal that are generated under the MahaBHUMI project would lay the foundation for efficient infrastructure planning, monitoring

and management. Monitoring is a continuous process that involves data collection and analysis. The findings from monitoring and evaluation form the basis for establishing key goals and targets, adjusting strategies and making them effective and efficient. The information generated under MahaBHUMI will help in the integration and coordination of various databases in all state and local agencies involved in ensuring the success of the implementation of the various state development programs. MRSAC's systematic approach for base map preparation ensures accuracy and precision which can be effectively utilized for any/all planning purposes of various line departments of Maharashtra.

Objectives

1. Feature extraction and interpretation on 1:4K scale using high-resolution ortho-rectified and geocoded stereo satellite data of 50 cm resolution. The activity is carried out for the following base layer themes based on the standard document and schema provided:

   URBAN Bag containing settlement, buildings, habitation, industries, mining areas, historical monuments, etc.

   TRANSPORT Bag containing all transportation layers including roads, railways, airports, helipads, waterways, metros, mono rails, road land use, etc.

   WATER Bag Water Resources layers and irrigation layers with canals, hydro structures, etc.

   LUSE MASK Bag: Creation of land use/land cover integrated mask using the features extracted from the above-defined three themes along with FOREST, WASTELAND, and AGRICULTURE base themes. Reserved/Protected Forest boundaries for the state are used as a reference for Reserved Forest interpretation.

2. The activity is processed on 10K sheet based on the NSF OSM grid.

3. The database is generated as per the ArcGIS geodatabase scheme.

4. Integration is performed to generate a seamless mosaic of all theme data with respect to the adjacent grid data.

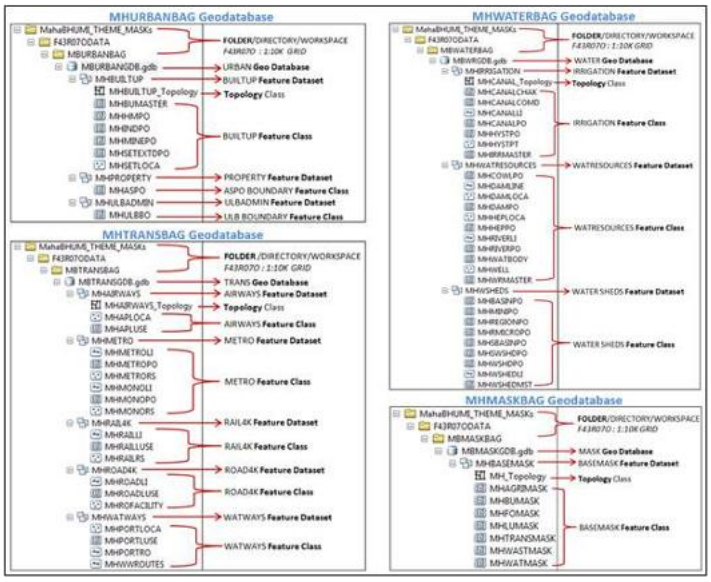
Methodology

Spatial distribution of Earth's surface features, both natural and man-made, represented in the form of a map is the best tool available to catalogue and view the arrangement and distribution. For the preparation of thematic maps, the base map becomes a pre-requisite, and many times this base map itself serves as an excellent tool for various application purposes- both for planning and implementation. With the very high spatial resolution satellite images available these days, it is possible to prepare a very accurate base map on a larger than 1:2000 scale. The base layers generated should be so accurate to lay the foundation for efficient infrastructure planning, monitoring, and management of natural and man-made resources of Maharashtra. MRSAC employed a very systematic approach for base map preparation under the MahaBHUMI project. The stereo and tri stereo data of World view-2 and Pleiades data on 50 and 30 cm was used to generate orthomosaic using dedicated DGPS points classified as Iconic, Primary and Secondary. The data so prepared is used for the generation of DEM and 2 m contour. A comprehensive schema and data standard is prepared for the project with proper nomenclature, domains and data types.

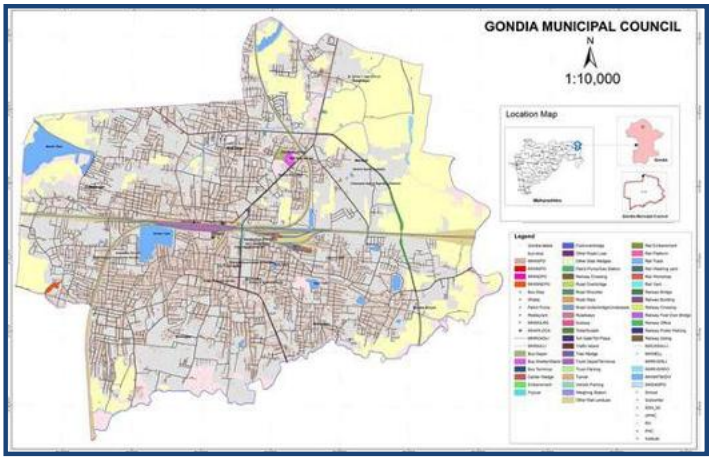
The following base layers are generated under MahaBHUMI with full theme details along with their attribute information. A complete metadata standard is generated along with the data using the metadata software generated by MRSAC. The base layers are contained in the following Data "BAGs":

Directory Nomenclature
MBIMAGEBAG (MahaBHUMI Satellite Images Bag)
MBGRIDBAG (MahaBHUMI OSM GRID Layers Bag)
MBTOPOBAG (MahaBHUMI topographic Layers Bag)
MBURBANBAG (MahaBHUMI Settlement/Urban Layers Bag)
MBTRANSBAG (MahaBHUMI Transport Layers Bag)
MBWATERBAG (MahaBHUMI Water Resource Layers Bag)
MBMASKBAG (MahaBHUMI Land Use/Land Cover Bag)

Thematic interpretation is done using very high-resolution ortho-rectified and geocoded satellite data of 50 cm resolution. The data is generated on 10K sheet wise with scale of interpretation of 1:2000. The various theme features, which need to be abstracted/interpreted, are based on Geodatabase Standard which facilitates generating the databases, organizing them, and integrating them in a better way to achieve various goals of the MahaBHUMI project. The features that need to be abstracted/interpreted in each bag are described separately in separate sections of the Standard document. The description is comprehensive information about the minimum content of the base data, and in the future other information can be generated and augmented to these data through attribute object tables.



MahaBHUMI Database Schema

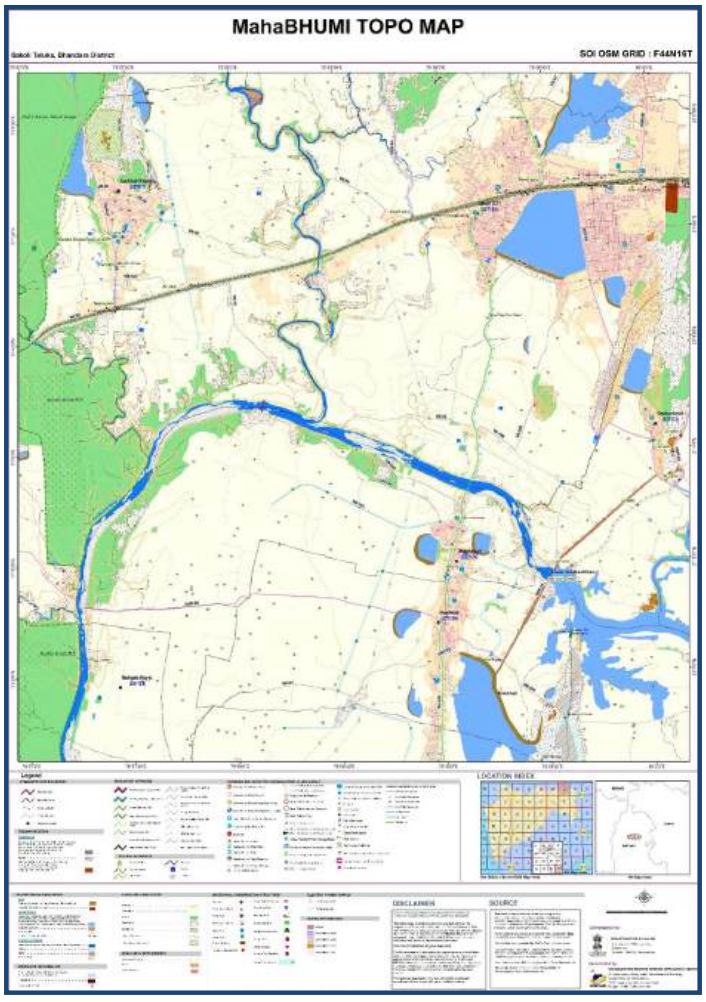


Gondia Municipal Council Map as per MahaBHUMI Standards

Output

Interpretation under various themes is being done for 11,109 grids of 10K of SOI for Maharashtra State. Feature extraction for the 10K SHEET is done using high-resolution ortho-rectified and geocoded satellite data of 50 cm resolution stored in the IMAGEBAG for URBAN (Settlement, Habitation & other urban layers), TRANSPORT (Transportation layers), WATER (Water Resources & Irrigation layers) and MASK themes as per the Geo-Database Standards . In the MBMASKGDB, the MASK feature class is initially interpreted for three classes only viz. FOREST, WASTELAND, and AGRICULTURE level-1 base themes. For interpreting the Forest theme, under MASKBAG, Reserved/Protected Forest boundaries generated using HR satellite data are used as reference. Data interpretation is carried out for all the Point, Line and Polygon features designed for the specified themes under the GDBs in their respective feature datasets (FD) and feature classes (FC). Topology is created in the individual FDs for each theme. The interpreted/abstracted polygon master database of URBAN, TRANSPORT, and WATER is integrated with the MASK using union command for final integrated LUMASK.

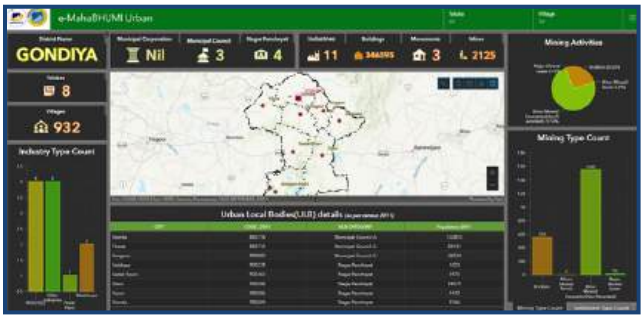
The project is intended to enable user departments with necessary applications using the data created under MahaBHUMI to be served on internet. Sample applications are configured for one district for the feasibility of applications and workflows for the project implementation.



MahaBHUMI 1:10K TOPOMAP

MahaBHUMI Water Resources Sample Dashboard – for Gondia District

MahaBHUMI Transportation Theme Sample Dashboard



MahaBHUMI Urban Theme Sample Dashboard

MahaBHUMI Land use/Landcover Theme Sample Dashboard

MahaBHUMI Sample Geoportal

> Base maps generated under MAHABHUMI Project on 1:4K scale and its integration with Cadastral maps, MIS data of various Govt Depts and also the data from location based services shall change the way planning, implementation and monitoring are carried out for citizen centric services in the state. Geospatial services of this data through decision support system for each department will be a game changer in the state, setting a new benchmark in the e-Governance.
>
> **- Dr Ashok Kumar Joshi, Director, MRSAC**

Dr. Ashok Kumar Joshi (Director, MRSAC, Nagpur) - Technical and Administrative Support, Overall Guidance, Management and Monitoring of the Project.

Shri. D. M. Kolte, (Former Director, MRSAC) and Senior Resources Scientist for Overall Monitoring and Management of the project.

PROJECT TEAM

Dr. Tutu Sengupta, Associate Scientist & Project Manager-MahaBHUMI Basemap & Project Coordinator- Water Resources, MRSAC, Nagpur

Mrs. Sapna Deotale, Head, MRSAC Mumbai Branch Office & Associate Scientist (Former Project Coordinator-Urban Team)

Dr. Sanjeev Verma, Associate Scientist (Project Coordinator- Transport, Industries)

Mrs. Archana Kolhe, Scientific Associate (Project Coordinator-Land use, Database & Archival)

Shri. Sanjay Balamwar, Associate Scientist (Project Coordinator-Ortho-Image & Urban)

Dr. Indal Ramteke, Scientific Associate (Project Coordinator-Urban)

TEAM MEMBERS

A) DATABASE MEMBERS

Dr. Ajay Deshpande, Associate Scientist (Project In-charge -Mining and Historical Monument)

Dr. Vivek Kale, Scientific Associate (Land Use-Wasteland)

B) HARDWARE/ SOFTWARE MEMBERS

Mrs. Sangita Rajankar, Associate Scientist (Software Development)

Shri. Srinivas Khandare, Associate Scientist (Hardware)

Shri. Rajkumar Fulzele, Technical Assistant (Hardware & Software)

DATABASE AND ARCHIVAL COORDINATOR

Dr. G.S. Rao, Scientific Associate (Coordinator- Database & Archival)

FORMER PROJECT MEMBERS

Mrs. Neelima Shrivastava, Associate Scientist (Retd.) and Former Manager-MBBM

Dr. Arvind Hadap, Documentation Officer (Retd.) and Coordinator- Database & Archival

Project team extends gratitude to Dr. S. N. Das (Former Director, MRSAC, Nagpur) for conceptualization and formulation along with Senior Scientists of MRSAC, Nagpur

MCD Achieves Effective Governance with ArcGIS

Client
Municipal Corporation of Delhi

Industry
Urban

Organization Profile
The three existing civic bodies, East Delhi Municipal Corporation (EDMC), North Delhi Municipal Corporation (NDMC), and South Delhi Municipal Corporation (SDMC) are re-unified into a single entity as Municipal Corporation of Delhi. The Municipal Corporation of Delhi is one of the largest municipal bodies in the world providing civic services to approximately 20 million citizens of Delhi. It occupies an area of 1397.3 sq. km. which is sub-divided into 12 Zones i.e. Centre, South, West, Najafgarh, Rohini, Civil Lines, Karol Bagh, SP-City, Keshavpuram, Narela, Shahdara North & Shahdara South.

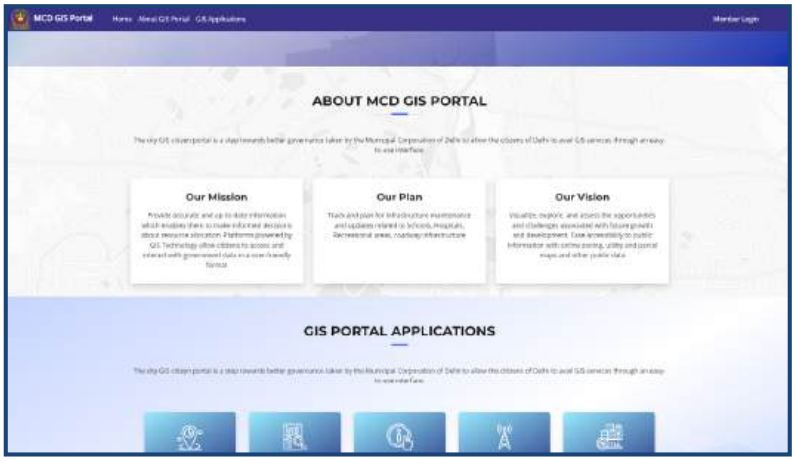
Website
www.mcdonline.nic.in

Project
GIS Citizen Portal

Highlights
- Effective visualization of MCD assets and properties
- Real-time visualization, ensuring transparency and streamlined workflow.
- Simplified information management
- Enhanced communication and decision-making
- Streamlined resource management leading to improved operational efficacy and resource optimization.

Project Summary

The MCD GIS citizen portal is a step towards better governance taken by the Municipal Corporation of Delhi to allow the citizens of Delhi to avail various services through an easy-to-use interface along with geo-referential data. The main purpose of this project is to provide a planning tool and updated information for departmental officers to design their projects/ schemes that help in delivering hassle free, transparent and efficient services to its citizens. The services include public outreach, tower location analysis, property tax, tax comparison, factory and general trade licenses, health and veterinary trade licenses, Tehbazari, birth & death registration, swatchta karamchari attendance, seasonal mosquito control monitoring, etc.



Challenges

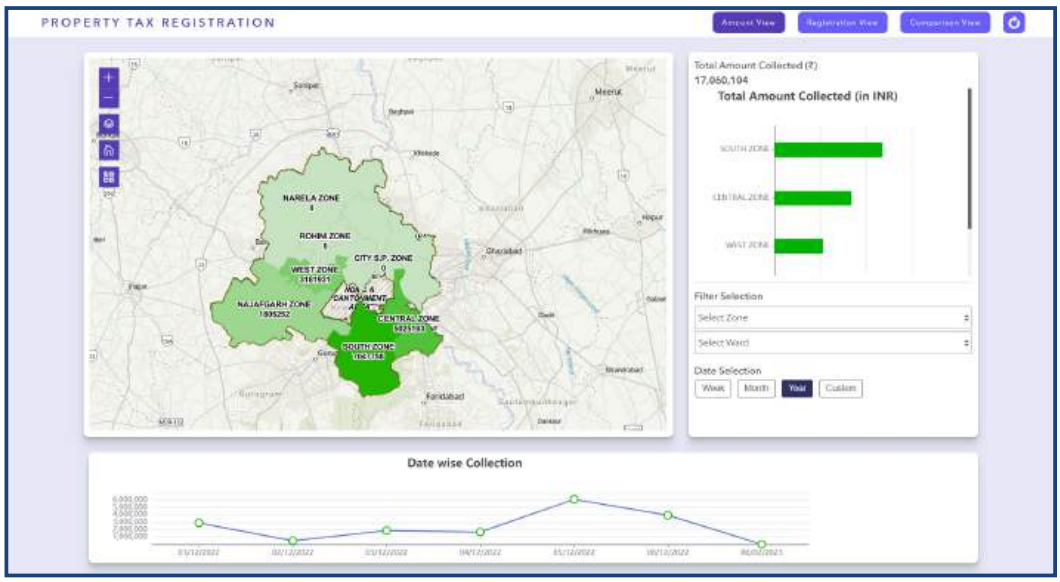
Under the conventional system, the Municipal Corporation of Delhi (MCD) faced numerous challenges in effectively managing its widely dispersed resources and assets. Access to critical data was restrained within specific zones and wards jurisdictions, relying primarily on different computer systems, Excel files, and paper-based workflows. The absence of an efficient and consolidated monitoring mechanism contributed to an uneven distribution of resources and a fragmented understanding of the overall area. Consequently, budget allocations for the improvement of MCD's jurisdiction exhibited inconsistency, obstructing the seamless implementation of targeted developmental initiatives. Furthermore, the decision-making process suffered from siloed information and the unavailability of a structured visualization tool, resulting in limited analytical insights and hindrances in strategic planning. The constraints of the conventional system were a significant challenge to MCD's capacity to efficiently manage resources and make well-informed decisions.

Solution

Esri India's holistic solution has efficiently resolved the challenges faced by MCD through a single window-enabled GIS portal. The following measures have been taken to address the challenges:

Data Model Design: Implementation of a robust data model for structured data management and seamless integration equipped with GPL and Postgres.

Existing Data Migration: Smooth transition of existing data from the conventional system to the GIS platform, preserving critical historical records and information.

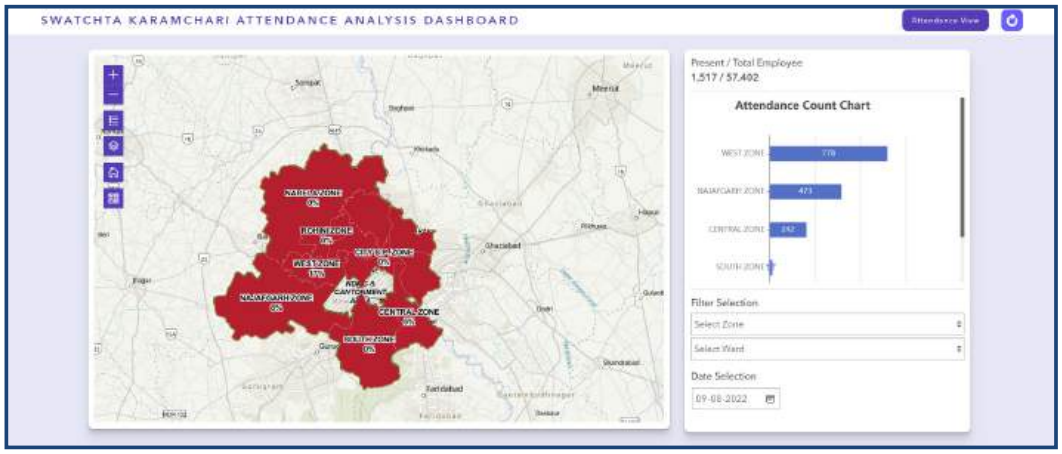


Data Preparation/Publishing: Facilitation of accurate data preparation and publishing, ensuring data reliability within the GIS framework. Web Application Development: Creation of intuitive web applications for simplified access and visualization of geospatial data, streamlining asset monitoring and management.

Mobile App for Property Tax Survey: Integration of a mobile application for property tax surveys, enabling efficient data collection and real-time updates for accurate property tax assessments.

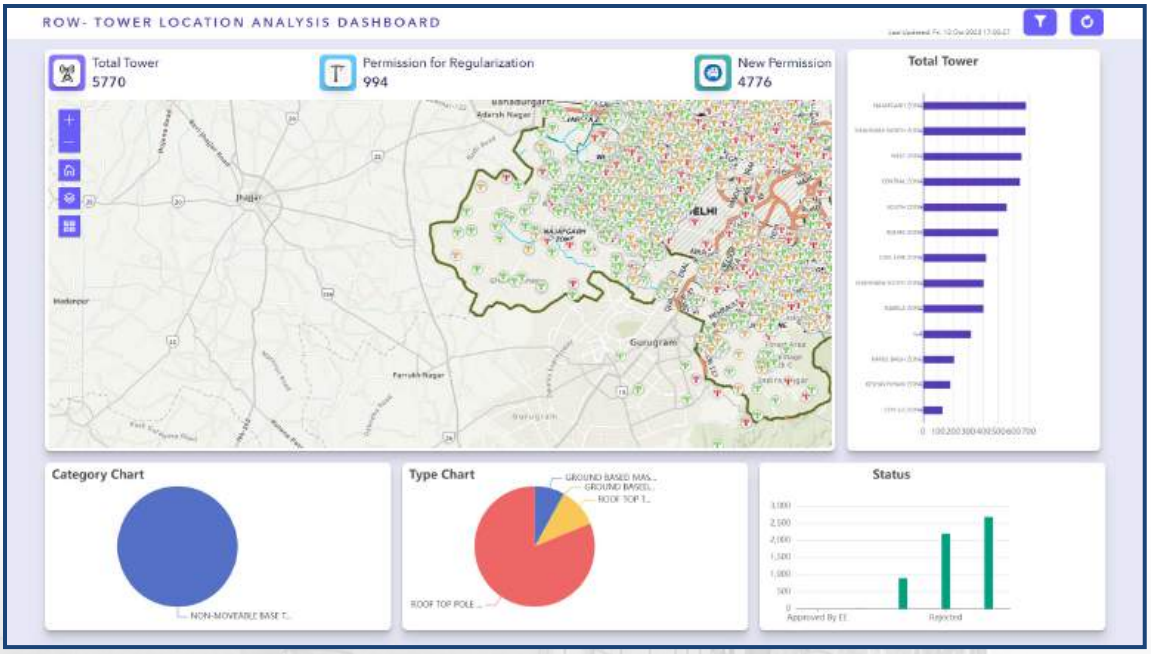
Capital Project Plan App: Implementation of a dedicated application for the planning and monitoring of infrastructure development projects, optimizing resource allocation, and enhancing project management efficiency.

Dashboards: Development of interactive dashboards offering stakeholders comprehensive insights and real-time updates on various operational aspects, fostering data-driven decision-making.

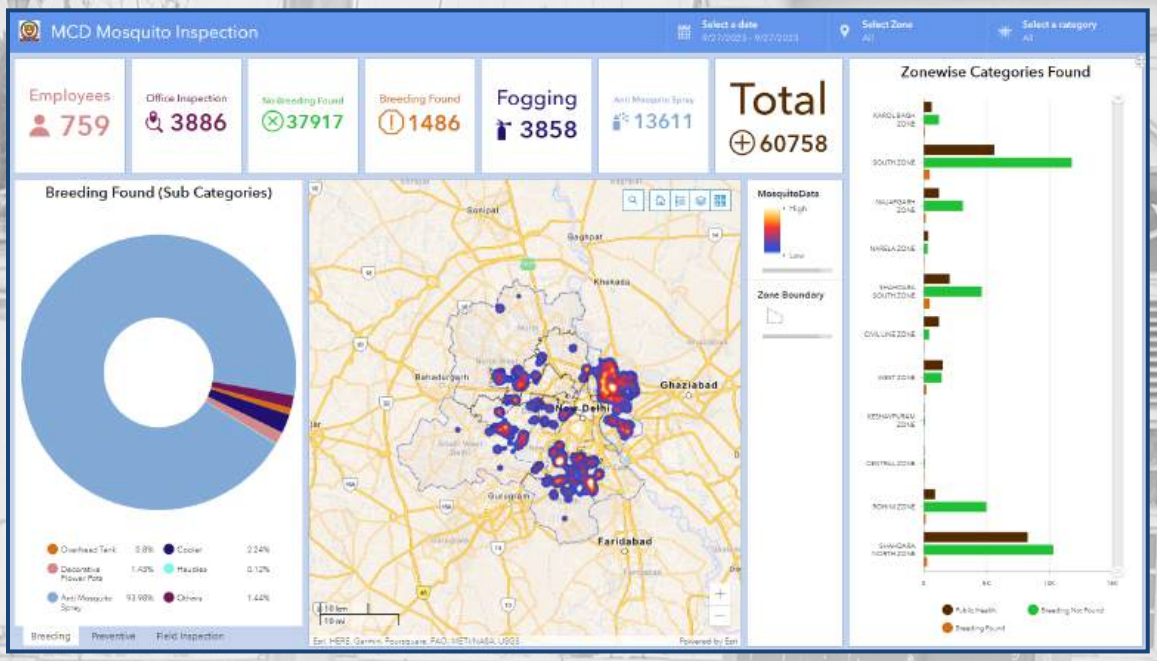


Scripts: Deployment of customized scripts automating complex processes, streamlining tasks, and enhancing operational efficiency within the MCD's framework. This includes the integration of various APIs through which the department is enabled to embed the data on real-time basis for quick and correct decisions.

User-Level Training on Developed Applications: Conducting comprehensive training sessions for users to ensure proficiency in utilizing the newly developed applications, fostering self-sufficiency, and promoting the widespread adoption of the GIS platform within the organization. The solution's suite of web applications has brought about a host of additional benefits, including expanded public outreach capabilities, comprehensive analysis of tower locations, streamlined management of property tax records along with geo-tagged properties, insightful tax comparison functionalities, efficient oversight of factory and general trade licenses, improved administration of health and veterinary trade licenses, simplified processes for managing Tehbazari activities, seamless handling of birth and death registrations, enhanced monitoring of Swatchta Karamchari attendance, and effective oversight of seasonal mosquito control activities.



These web applications have collectively contributed to the overall efficiency and transparency of the Municipal Corporation of Delhi's operations, promoting enhanced service delivery and streamlined administrative processes.



Benefits

Visualization of MCD Assets and Properties: The GIS solution enables the visualization of MCD assets and properties with metadata on a comprehensive GIS map, incorporating essential geodata for enhanced spatial analysis and informed decision-making.

Integration with Online Applications: The system's integration with various online applications enables the display of real-time visualization of thematic maps, providing updated status information for tower permission applications, property tax, licenses, and other relevant processes, ensuring transparency and streamlined workflow.

Simplified Information Management: The GIS tool simplifies the overall process of compiling, handling, manipulating, interpreting, and distributing information for the department, fostering improved data management and operational efficiency.

Enhanced Communication and Decision-Making: The strengthened communication and decision-making systems facilitated by the GIS solution promote better collaboration among stakeholders, leading to more informed and effective decision-making processes within the MCD.

Streamlined Resource Management: The sourced information through the GIS platform significantly eases day-to-day resource management, providing valuable insights for efficient resource allocation and utilization, thereby improving operational efficacy and resource optimization.

> “After implementing the new GIS solution, MCD as an organization has been able to take a leap in their service delivery. All the existing raw data integrated into the new system has enabled us to use it in various departmental activities, planning and visualization. The near real-time data integration provides daily base data updates along with analysis and comparisons on map as well as analytical charts, which further ease the monitoring capabilities of the officers. Moreover, Heat Maps generated with the help of the GIS System, are useful in identifying more prone areas falling under any schemes to provide more thrust-by-field functionalities. This system will surely reflect in the ROI outcome to MCD in the coming years.”
>
> **- Mr. Durgesh Kumar, Consultant (IT), Municipal Corporation of Delhi**

OneMCGM A collaborative GIS initiative for municipal governance

Client
Municipal Corporation of Greater Mumbai (MCGM)

Industry
Urban

Organization Profile
The Municipal Corporation of Greater Mumbai (MCGM) is the primary civic body responsible for urban governance in Greater Mumbai. The Development Plan Department of the MCGM works with NGOs and citizen organizations in the fields of education, public health, creation of urban amenities, art and culture, heritage conservation etc.

Website
www.mcgm.gov.in

Project
OneMCGM

Highlights
- Significant savings in cost & time
- Faster action and decision making
- Improved citizen services
- Common application platform for citizens and staff

Project Summary

The Municipal corporation of Greater Mumbai also known as Brihan Mumbai Municipal Corporation is the governing civic body of Mumbai. Their vision is to integrate multiple information and communication technologies to manage city assets and operations. The goal is to improve the quality of life and to improve the efficiency of services that meet the citizen's requirement. City municipal administration is instrumental in conceptualizing, designing and finalizing the City plan along with citizen engagement. It is planning to develop the areas under its jurisdiction under the city initiative of the Govt. of India.

Challenges

The Municipal Corporation of Greater Mumbai covers a total area of 454 sq. km. and caters to a population of 12.5 million. There are 24 wards under the corporation and more than 75 departments to provide various services to citizens of Mumbai.

Being the largest City of India, with a high density of population, the major challenge is to meet the increasing demands of governance and service delivery for the citizens.

To maintain the sustainability of service delivery, MCGM embarked on an ambitious e-Government initiative, aimed at enhancing responsiveness to citizens' needs; increasing operating efficiency and effectiveness; improving financial health and ensuring greater transparency within various departments like Sewerage Operations, Strom Water Drains, Roads & Traffic, Hydraulic Engineering, Development Plan and Disaster Management Unit. The two main challenges addressed initially were:

1. Citizen Services through a GIS portal
2. Inter-Departmental / Intra-departmental collaboration

Solution

GIS provides a common communication language to the different stakeholders of a city and to its citizens to interact with the government. These two are major aspects of the sustainability of a city.

Landbase of Greater Mumbai was created from aerial photographs in 2004/05 duration by digitizing Tikka and Town Planning scheme images. Land parcels and roads were digitized, followed by scanning and digitizing of 6,000+ images

to capture different features of the city incorporating the development plan for 20 years duration. All major utilities, revenue elements and social infrastructure were planned to have an integrated database for better planning, management and sustainable development of the city.

MCGM GIS Integrater was launched in 2009 envisaging to bring all MCGM data into a centralized database and deploy GIS web applications. Ten departments were identified to be the potential torchbearers of GIS in MCGM. These departments were Roads, Sewage Operations, Hydraulic Engineering, Estate, Disaster Management Unit, Property tax, Storm water Drainage, Garden, Education and Licenses. The primary objective of this project was to design, migrate / implement & maintain department-wise GIS data and web applications for end-to-end asset management.

Desktop GIS applications were deployed in 2008 for generating Development Plan remarks for department users. In lines with EoDB and MCGM's latest business process, Esri India further helped the MCGM Development Plan Department to launch an OneMCGM Portal which is used by the MCGM internal users. The Portal host all the GIS data of different departments and web applications that are shared across the user base. 200+ layers of GIS information have been created in the OneMCGM portal for catering to the requirements of various MCGM departments. GIS applications have been already built and deployed for 20+ departments. As part of the OneMCGM initiative, a Mobile Application for citizens was developed for viewing the various DP reservations. Esri also supported in creating a SRDP1991 online DP remarks portal which was launched in 2015 by DP department which is using Esri GIS based online remarks to interested land developers/ citizens to know about reservations/demarcations etc. on required CTS number (Plot).

Citizens can obtain these remarks by online payment, which is generated instantly. This GIS portal has reduced the substantial time of citizens as well as MCGM DP officials. OneMCGM is integrated with different applications running in MCGM to create spatial reports:

- Integration with Capital Value System (CVS)
- Integration with Auto DCR system Building Construction Approval Management System (BCAMS) under EODB Initiative
- Integration with SAP (PS) System for real-time project monitoring
- Integration with SAP (RE) System for the real estate department

This e-Government initiative is helping citizens to request for services in an easier and faster manner, thus resulting in significant savings in cost and time. The municipality is consequently in a better position to service its citizens, better monitor and control its activities and introduce Customer Relationship Management (CRM) concepts; resulting in a tangible and visible increase in the quality of services for every citizen. The 'OneMCGM GIS' portal displays the latest information about various departments of the civic body, which could be mainly utilized by its officials and workers with an aim to speed up decision-making and coordination. Through this application and website, people can get better services.

OneMCGM brought all the applications to ArcGIS Esri platform. Esri ArcGIS platform also helped in the following:

1. Enterprise Geo-Database of MCGM
2. Institutionalization in spatial data management
3. Survey guidelines
4. Standard procedures for GIS data creation, usage, cleaning and auditing
5. Enterprise GIS web applications
6. GIS integrations with other applications

The earlier arrangement required citizens to visit local ward offices of MCGM in order to seek the information of DP reservations, city survey number. With the launch of mobile application, citizens now can download the app on their mobile phone and using GPS location, can view all details of the plot/DP reservations. It has also become a common application platform.

OneMCGM is an integrated online geospatial platform that provides reliable, timely, and accurate location-based information and services to the public. It is helping us to be in a better position to service citizens, better monitor and control our operations, and introduce Customer Relationship Management (CRM) concepts, resulting in a tangible and visible increase in the quality of services for every citizen. The GIS portal, powered by Esri's ArcGIS, displays the latest information about various departments of the civic body, which could be mainly utilized by the officials and workers to speed up decision-making and coordination.

NMCG Empowered to Clean River Ganga and Its Tributaries with PRAYAG using ArcGIS

Client
National Mission for Clean Ganga (NMCG), Ministry of Jal Shakti

Industry
Water Resources

Organization Profile
The Namami Gange program was launched in 2014-15 to integrate previous and currently ongoing initiatives in a holistic manner with a basin approach. It was approved as a Central Sector Scheme in 2015 and includes a diverse set of interventions such as pollution abatement measures to tackle different sources of pollution such as municipal sewage, industrial effluents, municipal solid waste, non-point sources of pollution, and interventions for improving ecological flows, biodiversity conservation, afforestation, improving amenities and sanitation at riverbanks, capacity building, research & monitoring, public awareness. To speed up and scale up the interventions required for Ganga Rejuvenation through the Namami Gange mission, the Government decided to bring in a long-term perspective with a proper institutional framework, and the National Mission for Clean Ganga (NMCG) was notified as an Authority under The Environment Protection Act on 7th October 2016 empowering it with regulatory powers along with administrative strengthening and delegating higher financial and administrative powers.

Website
www.nmcg.nic.in

Project
GIS-based Water Quality Management System

Highlights
- ArcGIS provides powerful tools for visualizing complex geospatial data.
- ArcGIS supports real-time data integration, enabling monitoring of key parameters of the Ganga River in realtime.
- ArcGIS facilitates increased collaboration and communication among stakeholders.

Project Summary
Namami Gange is running PRAYAG (Platform for Real-time Analysis of Yamuna, Ganga & their Tributaries) for Monitoring, review, and accountability measures. PRAYAG is a collaborative Platform to access Information, Data Maps, Apps & Dashboards for Ganga Basin. The significance of PRAYAG had brought a paradigm shift in the visualization of all crucial spatial and non-spatial information of Ganga basin to adopt accurate & transparent decisions.

The various interventions under Namami Gange have resulted in significant improvements in the water quality of river Ganga. As a result of multi-sectoral interventions, the comparison of median data of water quality parameters viz. Dissolved Oxygen (DO), Biochemical Oxygen Demand (BOD) and Fecal Coliforms (FC) of years 2014 and 2023 (Jan to Sept), DO median has improved at 32 locations, BOD median has improved at 43 locations and the FC median has improved at 25 locations respectively. The stretch of River Ganga from origin up till Haridwar has reached Class A, i.e. highest standard of water quality. Based on the water quality assessment by CPCB in 5 Ganga main stem states in 2023 (January to September), the observed water quality indicates that the median value of Dissolved Oxygen which is an indicator of river health has been found to be above the minimum acceptable limits notified for primary bathing water quality criteria and satisfactory to support the ecosystem of river for almost entire stretch of River Ganga. The median value of Biochemical Oxygen Demand (BOD) has been found less than the maximum acceptable limits of 3mg/L except a marginal exceedance (BOD: 3.2 to 4.5 mg/L) in 2 locations.

The GIS-based Web Centric Water Quality dashboard helps in visualizing the status of River Ganga Water Quality by means of "Monitoring Station wise Water quality Indicator" dashboard. It shows the water quality as reported through monitoring stations at various locations along the river Ganga. This dashboard, as its first phase; is an attempt to create a web-centric GIS-based scientific Water Quality Application by using 7 years' data (2014 to 2021) with 4 parameters DO, BOD, FC, and pH. The data from seven years were processed in a percentile-based method (90, 50 and 10 Percentile) and compliance criteria applied for individual parameters separately. The data can be filtered on the basis of States, Districts, Monitoring Stations, Station Codes, Years, etc. The portal allows users to extrapolate and make sense of trends to better identify decisions in "Nirmal Ganga".

Challenges
Before adopting Esri's technology for water quality monitoring by the National Mission for Clean Ganga (NMCG), several challenges were encountered in decision-making. These challenges include:

Data Integration: Consolidating diverse datasets from various sources and formats to create a unified and comprehensive water quality database can be a significant challenge.

Spatial Variability: Water quality parameters can vary spatially, and capturing this variability accurately requires sophisticated spatial analysis tools to ensure reliable monitoring results.

Real-time Monitoring: Implementing real-time monitoring systems for water quality can be complex, requiring robust infrastructure and technologies to collect, process, and analyze data in near real-time.

Data Accuracy and Precision: Ensuring the accuracy and precision of collected data is crucial. Challenges may arise from the reliability of monitoring equipment, calibration procedures, and the need for standardized measurement protocols.

Capacity Building: Adequate training and skill development are essential for personnel involved in water quality monitoring decision-making using the dashboard & app.

Organizational Collaboration: Coordinating efforts and data sharing among various stakeholders, including government agencies, NGOs, and local communities, is crucial for a holistic approach to water quality management.

Infrastructure and Connectivity: Remote or inaccessible areas may lack the necessary infrastructure and connectivity for seamless data transmission, posing challenges in integrating data from these regions into a centralized monitoring system.

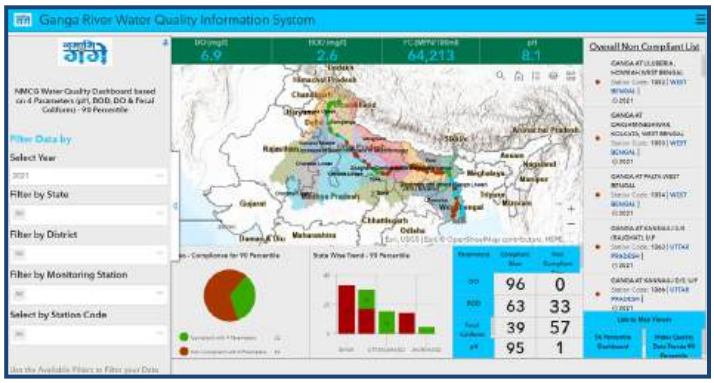
Policy and Regulatory Framework: Aligning water quality monitoring practices with existing policies and regulations can be challenging. Ensuring that the monitoring system adheres to regulatory standards is essential for meaningful data interpretation. Esri's technology can enhance the efficiency and effectiveness of water quality monitoring efforts by NMCG, providing a robust platform for data visualization, analysis, and informed decision-making.

Solution & Benefits

Esri is known for its Geographic Information System (GIS) solutions, which can be applied to various domains, including environmental management. In the context of NMCG, GIS technology could potentially be utilized for spatial analysis, data visualization, and decision support to address challenges related to the Ganga River rejuvenation.

The GIS system allows NMCG to assess the current state of the Ganga River, identify pollution sources, and plan effective conservation strategies. It helps in:

Data Visualization: ArcGIS provides powerful tools for visualizing complex geospatial data. NMCG can use these capabilities to create interactive maps, dashboards, and other visualizations that make it easier to communicate information and insights to stakeholders.



Ganga River Water System Quality Information

Real-time Monitoring: ArcGIS supports real-time data integration, enabling NMCG to monitor key parameters of the Ganga River in real-time. This can help in the early detection of pollution events, enabling prompt response measures.

Collaboration and Communication: ArcGIS Online facilitates collaboration among different stakeholders by providing a cloud-based platform for sharing maps, data, and analyses. This can enhance communication and coordination among NMCG, government agencies, and other partners involved in Ganga River conservation.

Mobile Data Collection: With ArcGIS mobile applications, field teams can collect and update data in the field using mobile devices. This can streamline data collection processes for monitoring water quality, biodiversity, and other environmental factors along the Ganga River.

Decision Support: The analytical capabilities of ArcGIS assist NMCG in making informed decisions. By integrating various datasets, the system can help identify priority areas for intervention, assess the impact of different conservation measures, and optimize resource allocation.

Scalability: ArcGIS solutions can scale to accommodate the varying needs of NMCG. Whether it's a small-scale pilot project or a large-scale regional initiative, the flexibility of ArcGIS can support the scaling of geospatial applications.

Compliance and Reporting: ArcGIS can assist NMCG in meeting regulatory requirements and reporting standards by providing a platform for managing and analyzing environmental data, which is crucial for compliance monitoring and reporting.

> Esri's Manual & Real Time water Quality Information dashboard, which is embedded in "PRAYAG" had brought a paradigm shift in the visualization of all crucial spatial and non-spatial water quality related information of Ganga basin to adopt accurate and transparent decisions in Namami Gange flagship program.
>
> **– Mr. Peeyush Gupta, Real Time Information Specialist, National Mission for Clean Ganga, Ministry of Jal Shakti**

ORSAC Efficiently Sanitizing Irrigation Data with the help of ArcGIS

Client
Odisha Space Applications Centre (ORSAC)

Industry
Water Resources

Organization Profile
Odisha Space Applications Centre (ORSAC) is the nodal agency of the State in providing Remote Sensing, GIS, GPS, and SATCOM applications solutions to all Government Departments, Offices, and Agencies of Odisha. The Centre is involved in the development of geodatabase creation for natural resources, photogrammetry solutions, map making, land use management, and mobile & web GIS application development. ORSAC has indigenously developed more than 30 applications across various domains such as tourism, agriculture, urban, mining, forestry, climate change, etc.

Website
www.odishairrigation.gov.in

Project
Odisha Irrigation Information System (ODIiS)

Highlights
- Odisha Irrigation Information System (ODIiS) is a web GIS portal used for sanitizing the data on cultivated and irrigated areas of the State on the backdrop of cadastral information.
- The unified GIS system provides a common platform for the exchange of information between different departments, thereby enhancing collaboration between different stakeholders.
- The System facilitates more informed decision-making.

Project Summary

With the intent to establish a common and effective system for cultivated and irrigated area data collection, collation, storage, and dissemination, the Department of Water Resources, Government of Odisha decided to develop the Odisha Irrigation Information System (ODIiS). ODliS is a web GIS portal used for sanitizing data on cultivated and irrigated areas of the State and hosted on WebGIS Platform of Esri India.

Challenges

Traditionally, there were physical paper copies of all geographical data regarding irrigated areas and irrigation networks in the state prepared during different periods by various departments/organizations like Water Resources, Panchayati Raj, Agriculture, SC & ST department, etc. These datasets were not accurate and mostly with outdated information. There was no interdepartmental coordination. A general lack of adequate data collection, collation, standardization, storage, and dissemination persisted across different departments, leading to the creation of incorrect reports and statistics.

Solution

To overcome the above challenges, ORSAC decided to generate a common standard database of cultivated and irrigated areas by using Remote Sensing and GIS technologies. Using Esri India's Platform, ORSAC developed the Odisha Irrigation Information System (ODIiS), which is a web GIS portal used for sanitizing the data on cultivated and irrigated areas of the State on the backdrop of cadastral information.

The project was divided into two phases:

Phase I – Data Sanitization and Web Portal Development

Phase II – Asset Database of canal networks and major/medium/minor projects

The project was completed within 3 months, including deployment of the portal for official use by the Department.

ODliS includes data from several departments, namely:

- Department of Water Resources, (Irrigation Department-Major, Medium, Minor, Creek; Watershed Mission, OLIC and Mega Lift)
- Department of Agriculture (Jalanidhi - I, OAIC Jalanidhi-II, Horticulture)

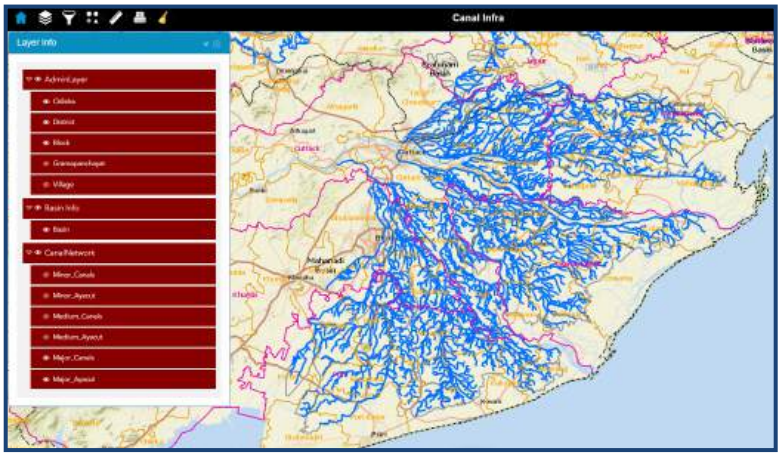
- Department of SC/ST (ITDA)
- Department of Panchayati Raj (DRDA /Block)

Data from these departments are collected and hosted on a single GIS database.

With the help of the solution, ORSAC was able to establish the State's first centralized site for all irrigation-related data and applications.

ODIiS constitutes several modules:

- **Ayacut Info Service** enables the user to query information about Ayacuts of any department or organization by district/ block-wise, river basin wise, and as per department ownership. All ayacut and scheme implemented info of 11 agencies of 5 departments are hosted in the web portal in query-based modules.
- **Land use Info Service** provides information about land utilization in Ayacuts and the extension of cultivable lands. The GIS portal also provides information on the extent of cultivable land for all 314 blocks as interpreted from high-resolution satellite data.
- **Canal Info Service** provides Georeferenced canal network map as interpreted from high-resolution image along with all its attribute information. The portal is designed to provide information on the extent of the canal up to the tail end and coverage of revenue plots.



Benefits

11 organizations across 5 different departments provided 2.3 lakh maps along with Excel data for digitization. Using ArcGIS, this data was scanned, coded, converted to digital format, and integrated with orthorectified image-based revenue cadastral maps. 20GB of cadastral maps were produced at a 1:4000 scale.

The unified GIS system provides a common platform for the exchange of information between different departments, thereby enhancing collaboration between different stakeholders. This also leads to more informed decision-making.

> ORSAC is one of the leading organizations and Nodal Centre for GIS mapping for the State of Odisha. In line with our reputation for using cutting-edge technologies in e-Governance, we converted our extensive paper maps and land data to digital records. Being seasoned users for the past 25 years of ArcGIS software, we knew it was the best option to not only speed up the process of digitizing and georeferencing our massive map collections but also turn this data into useful apps that all stakeholders could access via our GIS portal. The launch of our portal was expedited significantly by the highly customizable and user-friendly web development environment and the ease of connectivity between ArcGIS desktop software, mobile data collection and integration, and web solutions.
>
> **- Mr. Manoj Kumar Sanabada, Scientist 'E', ORSAC**

RSAC-UP Actively Moves Toward Solar Power Generation with ArcGIS

Client

Remote Sensing Applications Centre, Uttar Pradesh (RSAC-UP)

Industry

Renewable Energy

Organization Profile

Uttar Pradesh is the first and foremost state in the country to establish the first state Remote Sensing Applications Centre, Uttar Pradesh (RSAC-UP) in May 1982 at Lucknow. RSAC-UP has been utilizing the geospatial technologies of satellite remote sensing, Image Processing, GIS, GPS, LiDAR, Bathymetry, customized software development using AI, ML, DL, and AL methods in conjunction with geophysical surveys, soil and water testing techniques for assessment, monitoring, utilization, and management of various natural resources of the state with a view to achieving sustainable development.

Website

www.rsac.up.gov.in

Project

Geo-statistical Estimation of Solar Power Generation

Highlights

- Incorporating ArcGIS technology into RSAC-UP's operations has helped the organization overcome challenges like lack of functionality for advanced spatial analysis, interoperability issues with data sharing, and inefficiencies in resource management.
- ArcGIS' array of tools for spatial analysis has brought a whole new dimension to RSAC-UP's assessments of natural resources, infrastructure, and disaster scenarios.
- The System's knack for handling different data formats ensures smooth collaboration and data sharing, a game-changer for the organization.

Project Summary

Solar panels, also known as photovoltaic (PV) panels, are devices that convert sunlight into electricity. The basic principle behind solar panels is the photovoltaic effect, where certain materials can generate an electric current when exposed to sunlight. Solar insolation is converted into electric power by PV cells. With continued advancements in technology, manufacturing processes, and recycling techniques, the overall environmental footprint of solar panels can be further reduced, making them an essential component of a sustainable energy future.

RSAC-UP carried out a study for geostatistical estimation of solar power generation in Orai city, district Jalaun of Uttar Pradesh. The calculations done with the help of ArcGIS demonstrate the potential for mitigating environmental pollution through solar and clean energy. The goal of this research is to assess available and suitable rooftop areas using different GIS and RS techniques for installing PVs and estimating solar power generation in district Jalaun.

Solution & Benefits

For energy generation, researchers have assumed that a 1.7-meter square area produces 0.33 kW of energy per solar panel and 1 kg of coal generates approx. 8 kWh electricity. If coal has 66% carbon, then 1 kg of coal produces 2.42 kg of carbon dioxide. Solar panels have emerged as a key player in the transition to clean and renewable energy sources. Their environmental impact, when evaluated throughout their lifecycle, is significantly less detrimental compared to fossil fuel-based energy production. The goal is to develop eco-friendly and efficient methods that minimize resource consumption, reduce emissions, and improve the overall lifecycle environmental performance of solar panels.

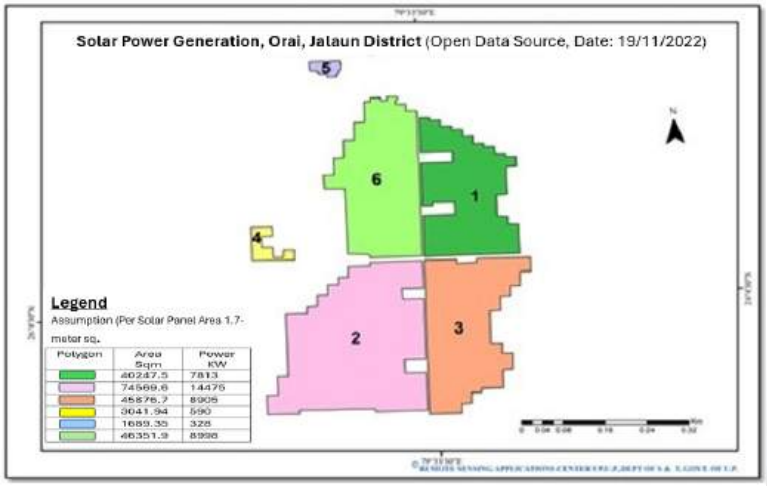
For this study, researchers selected a part of the solar power plant of the Orai district which is part of the Jalaun Solar Power Project. It is a solar photo-voltaic power generation station, spanning two villages -Kuhana and Shajahanpur in the Jalaun district of Uttar Pradesh. The researchers located the site using Esri's ArcGIS and calculated the total energy generation by this power plant.

The most used solar panels are 72 cells and 60 cells, which have a size of 2m x 1m & and 1.6m x 1m respectively. The solar panels will produce between 170 to 350 watts every hour. But this depends on the direct sunlight and weather conditions. It averages about 0.17 kWh to 0.35 kWh per solar panel. Group panel 1 has an area of 40247.5 m2 which produces energy of 7813 kW. Panel 2 has an area of 74569.6m2 with an energy generation of 14475 kW. Panel 3 has an area of 45876.7m2 with an energy generation of 8905 kW. Panel 4 has an area of 3041.94 m2 with a power generation of 590kW. Group panel 5 has an area of 1689.35m2 with a power generation of 328 kW. Panel 6 has an area of 46351.9m2 with a power generation of 8998 kW. The gross solar

power generation by the plant is approximately 41.109 MW. It has saved 12.435 tonnes of carbon dioxide production.

Additionally, incorporating ArcGIS technology into RSAC-UP's operations has helped the organization overcome some of the challenges it faced. The organization faced challenges like lack of functionality for advanced spatial analysis, interoperability issues with data sharing, and inefficiencies in resource management. Additionally, the lack of advanced mapping capabilities and seamless integration with AI, ML, DL, and AL methods posed challenges in producing visually compelling maps and leveraging cutting-edge analytics for decision-making.

ArcGIS array of tools for spatial analysis has brought a whole new dimension to RSAC-UP's assessments of natural resources, infrastructure, and disaster scenarios. The system's knack for handling different data formats ensures smooth collaboration and data sharing, a game-changer for the organization.



"Empowering RSAC-UP with ArcGIS technology is not just an upgrade—it's a strategic leap forward. From unravelling the intricacies of spatial analysis to seamlessly sharing data, ArcGIS is the compass guiding us towards precision, efficiency, and a future where geospatial innovation meets the pressing challenges of sustainable development."

– Project Team, RSAC-UP

Project Team Members:
1. Mr. Sushil Chandra, Scientist, SF & Head of CIP & DM Division
2. Miss Ekta Chauhan, Project Scientist
3. Miss Fariha Fatima, Project Scientist
4. Mr. Vinamra Kaushik, Project Scientist

RSAC-UP Optimizes Green Organ Corridor Route with ArcGIS

Client
Remote Sensing Applications Centre, Uttar Pradesh (RSAC-UP)

Industry
Healthcare

Organization Profile
Uttar Pradesh was the first and foremost state in the country to establish the first state Remote Sensing Applications Centre, Uttar Pradesh (RSAC-UP) in May 1982 at Lucknow. RSAC-UP has been utilizing the geospatial technologies of satellite remote sensing, Image Processing, GIS, GPS, LiDAR, Bathymetry, customized software development using AI, ML, DL, and AL methods in conjunction with geophysical surveys, soil and water testing techniques for assessment, monitoring, utilization, and management of various natural resources of the state to achieve sustainable development.

Project
GIS-based Route Network Analysis for Developing Green Organ Corridor

Website
www.rsac.up.gov.in

Project Summary

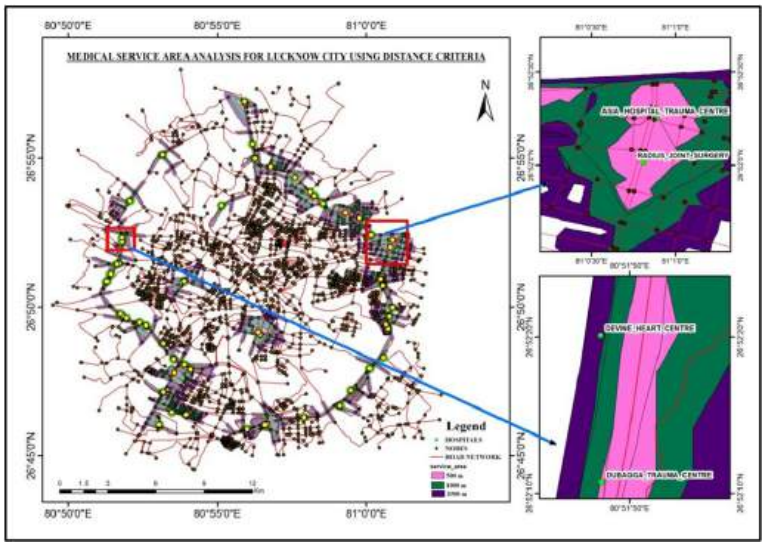
Green organ corridors are demarcated, cleared-out special road routes created so that the organs arrive at their specified destination within the shortest possible time. Traffic congestion can defeat the cause. With the help of ArcGIS, RSAC-UP discovered the best route for developing a green organ corridor between CDRI, Jankipuram, and Amausi Airport in the city of Lucknow.

The Road Network Analysis helped in finding the best route to healthcare facilities among the four possible routes. Network connectivity can explain significant variance in the spatial pattern of the network structure. Analysis reveals that transport network services are directly varying with respect to connectivity indices and coverage of the study area.

Solution & Benefits

In this study, an enhanced road network analysis was done using ArcGIS. A geodatabase was created to store the prepared data. After preparing point and line data for the study area, i.e. base map, road network data, and healthcare service data, network datasets were created. After that, the network analysis process was applied to the road network of Lucknow city to find the best route and service area for the organ corridor. Connectivity indices like Alpha, Beta, and Gamma were calculated for selected routes. The indices were used to find the best route for the green organ donation corridor between the selected points. It is imperative for the transportation of organ donation; minimum time is needed to save patients' lives.

The use of the ArcGIS Network Analysis tool in the route optimization study provided the following benefits to RSAC-UP:



Identifying the best new route among healthcare facilities: Utilizing network analysis methods, the optimal new route between CDRI, Jankipuram, and Amausi Airport, Lucknow was developed from a list of four possible routes. This route is more effective in terms of the minimal distance required for hospital connectivity. The best-new-route analysis identifies the network path with the lowest cumulative impedance between nodes. It is possible for the route to connect from origin to destination or to make stops at particular hospitals along the way.

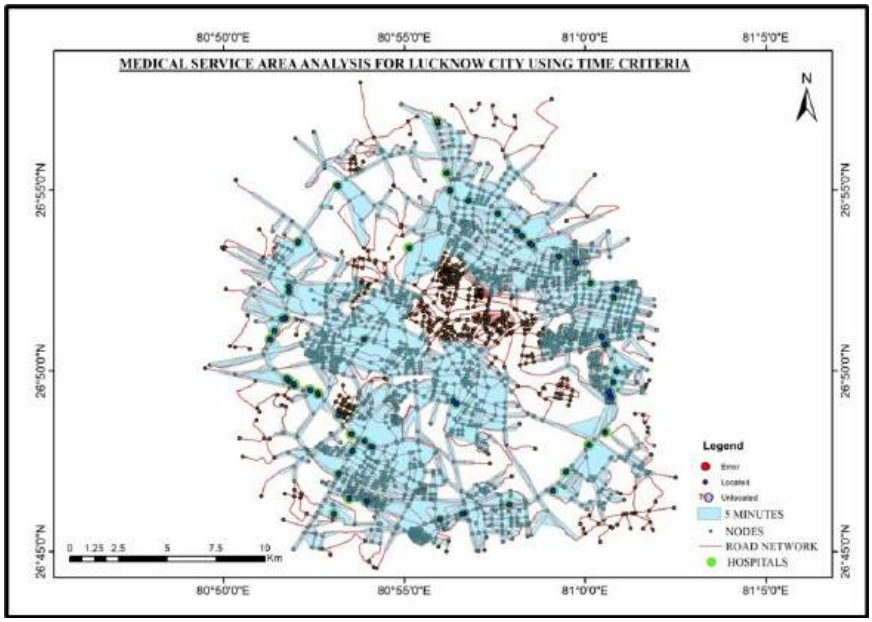
Defining service areas based on distance and time for healthcare facilities: The region known as the network service area is made up of all the accessible routes, or routes with a certain impedance. By this analysis, the actual service area of different facilities can be analyzed, and it can be determined whether these facilities are enough for that area,

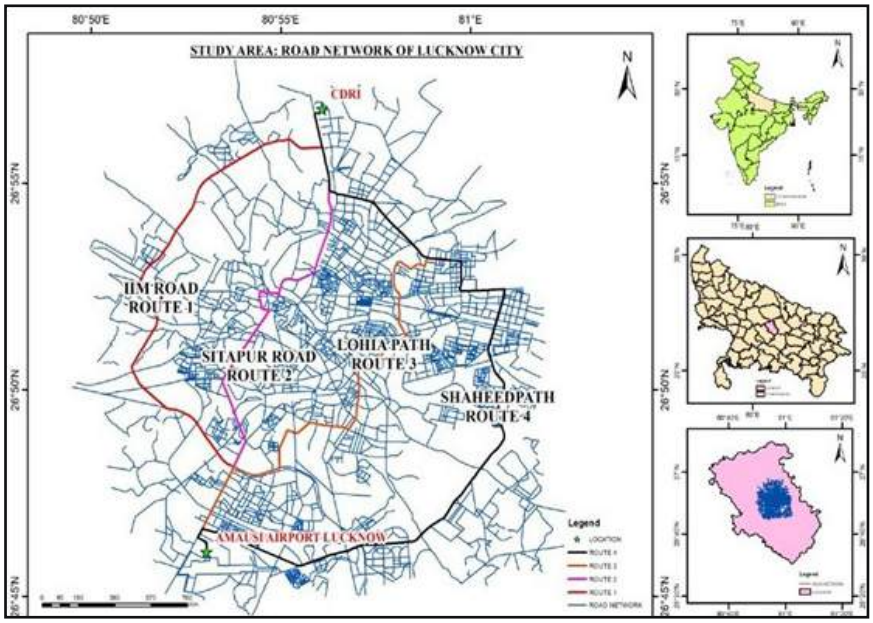
if not then how much is required. This is also called service allocation analysis. The primary goal of a spatial allocation study is to evaluate the effectiveness of the services in terms of time and distance. For the present study, services such as hospitals were chosen for analysis purposes, and their service areas were defined based on time and distance.

The service area map of hospitals with multiple buffers is based on distance intervals of 500 meters, 1000 meters, and 1500 meters showing the actual service area with efficiency.

Connectivity of Road Segments: The most basic characteristics of a transport network are measured by the Alpha Index, Beta Index, and Gamma Index. The network (line) and junction (node) are required to obtain the connectivity index. These indices are useful for system and traffic analyses to detect changes in network structure. The Beta index (β) is used to determine the level of road connectivity. The Alpha index (α) is the ratio of the actual number of circuits in a network to the maximum possible number of circuits in that network. The Gamma index (γ) is a measure of the ratio of the number of edges in a network to the maximum number possible in a planar network.

382 edges and 252 nodes were found in the buffer zone of 1 km in Route 1, 772 edges and 497 nodes were found in the buffer zone of 1 km in Route 2, 949 edges and 567 nodes were found in Route 3, and 1335 edges and 847 nodes were revealed in route 4 through the road network analysis using ArcGIS.





Following a thorough analysis of all four routes, it was noticed that Route 3 has the highest network connectivity, resulting in a low rate of accidents involving pedestrians and bicyclists. It was also observed that higher connectivity levels are associated with fewer accidents involving non-motorized users. Nodes around Route 3 also displayed a good level of accessibility.

> Unlocking the power of ArcGIS technology, we delved into the intricate web of road connectivity, seamlessly mapping and analyzing the intricate network of routes. By employing sophisticated service allocation analysis, we redefined healthcare accessibility, determining optimal service areas based on both time and distance. ArcGIS not only helped us in visualizing the efficiency of hospital service areas with precision but also pioneered the discovery of the best new routes, minimizing distances for vital connectivity. In the realm of road segments, ArcGIS becomes a compass, guiding us through the Alpha, Beta, and Gamma indices, revealing insights into network structure changes, and fostering safer, more connected communities. In the language of maps and indices, ArcGIS emerges as a transformative tool, reshaping our understanding of spatial dynamics and promoting a future where connectivity enhances both efficiency and safety.
>
> **– Project Team, RSAC-UP**

Project Team Members:

1. Mr. Sushil Chandra, Scientist, SF & Head of CIP & DM Division
2. Miss Ekta Chauhan, Project Scientist
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4. Mr. Vinamra Kaushik, Project Scientist

Sterlite Power Generates Optimal Powerline Routes with ArcGIS

Client
Sterlite Power

Industry
Utilities

Organization Profile
Sterlite Power is a leading private sector power transmission infrastructure developer and solutions provider with projects covering approximately 13,700 circuit km of transmission lines across India and Brazil. The Company has a portfolio of high-performance power conductors, extra high voltage (EHV) cables, and optical ground wires (OPGW). It provides bespoke solutions for the upgrade, uprate and fiberization of existing transmission infrastructure projects.

Website
www.sterlitepower.com

Project
GIS System for Powerline Route Planning and Finalization

Highlights
Key Benefits with GIS Integration

1. Better accuracy reduces project changes, cost impact by 1 to 1.5% Rs~ 2.3 Cr for a 100km 756kV line. Transmission projects are linear projects running long distances. For a 1000 km project, the project cost savings is at least 23 Cr.
2. 50%-time reduction in route finalization from 60 days to 30 days
3. Over 95% accuracy in route generation
4. Data confidentiality; enterprise grade secure and multi-tenant platform
5. Reducing competitive threat by 100%. Reliability of field survey improved to 100%

Project Summary

A key trend in the power sector is the revision of the time schedule for the development of transmission projects. Due to the shorter gestation periods of renewable energy projects, the time schedule has been reduced from 36 months to 18 months. This is expected to be reduced further in times to come. While thermal power projects take about five years for commissioning, renewable projects come online in just 18-24 months.

Sterlite Power, which is a leading global developer of power transmission infrastructure with about 25 projects spanning ~13,700 circuit kms in India and Brazil recognized this need to expedite the development of transmission projects to evacuate power from renewable energy projects and focused on developing solutions that could help it achieve the same.

To maintain its track record of commissioning power transmission projects ahead of schedule, addressing the key constraints of time and cost, Sterlite Power collaborated with Esri India to develop a first-of-its-kind integrated GIS Ecosystem for powerline route planning and finalization.

Challenges

The process of power line route finalization is broken down into two stages, namely, route generation and in-field route survey. The old manual methods of carrying out these activities led to delays and inaccuracy due to information gaps. The major problems that the manual systems caused were as follows:

1. **Delayed route generation:** The manual route generation methodology used by Sterlite Power required the survey team to perform an in-field survey and collect relevant data on forests, roads, railways, existing transmission lines, etc. from multiple sources. This was a time-consuming activity. As the desktop route generation process could happen only after this collected data was combed manually, the route generation process was delayed.

2. **Lack of data security and confidentiality:** As part of its Global Infrastructure Business, Sterlite Power bids, designs, constructs, owns and operates power transmission assets across multiple geographies. All bid-related data are highly confidential and the lack of proper access and usage controls pose a major risk to the business. Thus, to support an iterative process involving the continuous back and forth of data, automated versioning concepts and controls were required to simplify the process for the user and maintain data sanctity.

3. **Poor connectivity in remote areas:** In areas with poor or negligible network coverage, the conventional applications did not work effectively due to a lack of offline-mode support.

4. Historical Field Survey and associated studies data (Soil/Hydrology etc.) are not easily accessible and hence not used for current bids.

A more robust digital approach to route finalization and survey was needed to overcome all these challenges and deliver better outcomes. A huge transformation from the conventional manual survey methodology has to be brought, and the integrated GIS system implemented with the help of Esri India provided the perfect solution.

Benefits

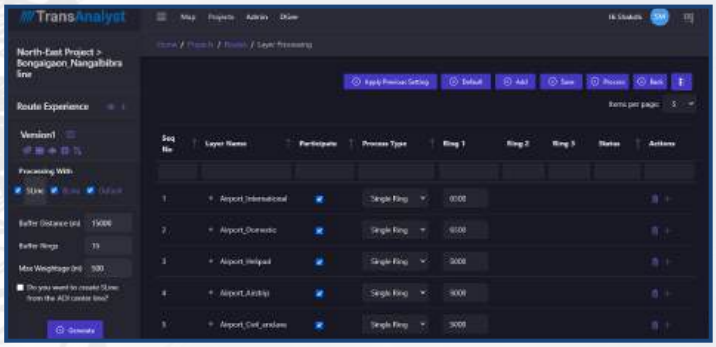
Improved data accuracy: The routes generated by TransAnalyst are based completely on pre-approved data. This, coupled with a lesser number of iterations, gives over 95% accuracy in route generation. The new automated process significantly improves the confidence level in the data and impacts the ROI of the project positively.

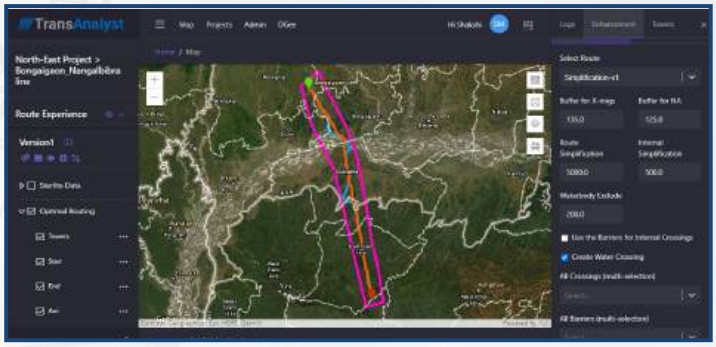
Near real-time data capture: From survey to route generation and feasibility reporting, the automation and digitization have led to in-sync, real-time operation (field team and D&E can look at the same data instantly and make necessary changes). This allows for the right route generation at the very first attempt, thereby leading to more timely decisions.

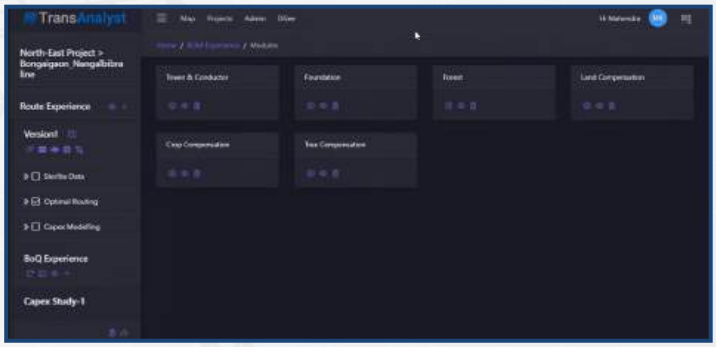
Lesser time required for project completion: The solution for route generation not only delivers an accurate route but does that in less than one hour for a 200 km route while adhering to all the business rules. Additionally, the process of data generation takes a maximum of 1-2 hours. Manually, the route generation process itself would take 2-3 days with 6-8 days for the data creation process, prior to that. The integrated GIS ecosystem allows Sterlite Power to save on an average 2-4 months in a project. Each month saved (early competition) is equivalent to revenue for that month for the project which is a huge saving.

TransAnalyst helps the company to plan multiple route options between two substations in a few minutes by changing weightages of different layers. TransAnalyst reduces 2-3 days effort for creating any one route option, also modify the route based on survey feedback on near to real time basis. Users can analyze the BoM/BoQ of different route options by using its capex model where the tool calculates Steel Tonnage, Conductor cost, RoW cost in terms of Land, Crop, tree, etc., and identify the best route option for bid.

With CanvasR, the time required to have updated information from the in-field surveys is reduced to minutes. The surveyors are now able to provide real-time inputs through mobile apps which get updated in desktop systems in the office in real-time. This reduces the risk of continued visits to the field and thus leads to huge savings in terms of time and cost. The tools, Trans Analyst + CanvasR allow Sterlite Power to save on average a month in each Transmission Line to finalize bid proposal. Each day saved increases the probability equivalent to revenue in terms of identifying risk and deriving the accurate cost to build the transmission line. In-field surveys usually take about 10-15 days to complete when done manually.Mr.







> The solution has been helping us gain a significant advantage in winning bids and delivering unmatched outcomes in powerline route finalization projects. With Trans Analyst + CanvasR, the route optimization process takes not more than 3-4 days while providing better accuracy using continuous feed from the field. With these tools in place, we are looking at about 1-2% savings in costs in each project. The reason we chose ESRI as a partner for establishing this GIS ecosystem for powerline route optimization is due to the extensive support the company provides. The availability of resources, flexibility, and the in-depth knowledge base are other factors that made the choice easier.
>
> **- Mr. Trilok Chouhan, AVP, GIS - Corporate IT, Sterlite Power**

NWIC Delivers Nationwide Water Information through a Single Window with ArcGIS

Client
The National Water Informatics Centre (NWIC)

Organization Profile
The National Water Informatics Centre (NWIC) is a subordinate office under the Ministry of Jal Shakti, Department of Water Resources, RD & GR with a mandate for timely and reliable water resources data acquisition, storage, collation & management and to provide tools for informed decision making for management of water resources of the country.

Project
Web based Water Geo-Hub on ArcGIS Server and ArcGIS Platforms.

Highlights
Esri India helped NWIC to achieve the following objectives:

- Build a comprehensive "Water Resources Information System" (WRIS) in the public domain towards making it easily available to users.
- Provide authoritative, and consistent data and information on India's water resources and allied themes for planning, development, and management of water resources in the country.
- Development of a decision support system for informed decision making and strengthening the capacity of targeted water resources professionals and management institutions in India.
- Facilitate seamless collaboration with national/ international research institutes and other agencies.

Website
www.indiawris.gov.in

Project Summary

The management of water resources is a highly complex and tedious task that involves the expertise of multidisciplinary domains and depends on reliable data and information which is accessible to all the stakeholders. Considering the challenges involved in the water resources sector, the Government of India took an initiative for developing a centralized platform to act as a repository of water resources and related data at the national level with administrative granularity up to the smaller units of governance at the state level as well as hydrological levels such as basin and sub basins. The first initiative towards the development of a centralized Water Resources information system under the project titled 'Generation of database and implementation of web enabled water resources information system of India' short named as India-WRIS WebGIS was undertaken in 2008 through collaborative effort of Central Water Commission (CWC) and National Remote Sensing Centre (NRSC). This was a standalone information system built on ArcGIS.

During 2016-17, the Government of India, through Department of Water Resources, River Development and Ganga Rejuvenation, Ministry of Jal Shakti (erstwhile Ministry of Water Resources, RD & GR) embarked upon a World Bank supported flagship program named National Hydrology Project with the objective of improving the extent, quality, and accessibility of water resources information, decision, basin level resource assessment/planning, development of decision support system and to strengthen the capacity of targeted water resources professionals and management institutions in India. On this foundation, India WRIS was revamped on the latest version of ArcGIS by integrating with the existing Water Information management System (WIMS) on a nationwide centralized database. A revamped and up-scaled India - WRIS was launched on 30th July 2019.

Esri India offered NWIC a Water Geo-Hub solution that encompassed software, application development, training, handholding, and support services. The solution provides nationwide water information to users through a "single window", promoting a free exchange of data among various central and state agencies, while delivering reliable and timely data and insights for comprehensive projections of future water, and facilitating informatics based sustainable development of water resource management along with value added products and services to all stakeholders.

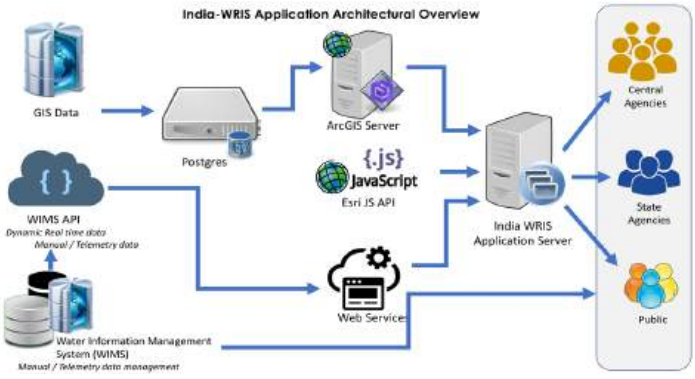
NWIC Mandate

Cutting across demand and supply, water challenges are becoming complex every passing day due to population growth, urbanization, excess withdrawals, and losses, while climate change, extreme weather events, deforestation, and pollution are worsening the situation further. India-WRIS is an important element to address these challenges, bringing all relevant water data on one nationwide platform, making information available to users and creating the basis for better management of our water resources. India-WRIS addresses the following challenges:

- Collection of available data from varied sources, generate new database, organize in standardized GIS format and provide scalable web enabled information system.
- Provision of standardized tools to create value added maps by way of multi-layer stacking of GIS database so as to provide an integrated view of the water resources scenarios.
- Facilitate easier, faster access, sharing of nationally consistent and authentic water resources data through a centralized database and application server to all water resources departments/ organizations.
- Build a foundation for advanced modeling and Spatial Decision Support Systems (SDSS) including an automated data collection system.

Solution

India Water Resource Information System (India-WRIS) is a web GIS-based application on the ArcGIS Server for scientific assessment of the water resources, development of analytical tools and Decision Support System (DSS) for informed decision making.



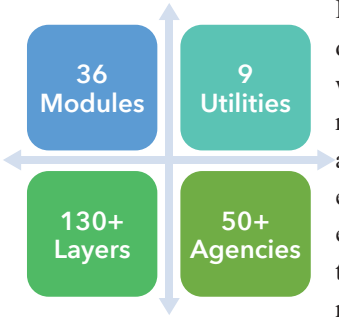
As a national Water Geo-Hub, India-WRIS maps the common ground for sustainable water resource management in the country. By providing nationwide water information to users through a "single window", promoting free exchange of data among various central and state agencies, while delivering reliable and timely data and insights for comprehensive projections of future water, India-WRIS facilities informatics based sustainable development of water resource management along with value added products and services to all stakeholders.

The current version of India-WRIS is in process to be integrated with the Water Information management System (WIMS). With addition of new modules wherein data from automated data acquisition systems established by CWC and CGWB is disseminated along with improvement in the previously existing modules, data through WIMS is fetched in real-time in a handshake mode to disseminate current data in the portal.

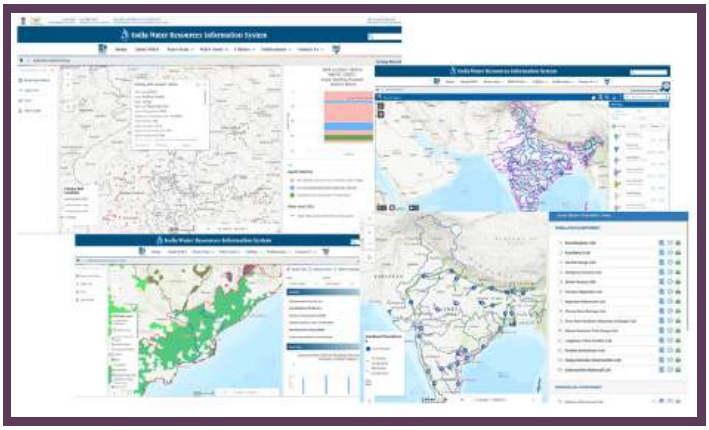
India-WRIS provides access to diverse multiyear datasets (5-100 years) along with a large number of attributes and temporal data sets of various inhouse/agency/archive and allows users to Search, Access, Analyze, Visualize, Understand and Analyse comprehensive and contextual water data for the assessment, monitoring, planning and development of water resources for Integrated Water Resources Management (IWRM).

Water Data

India-WRIS provides comprehensive water data including rainfall, snowfall, geo-morphology, climate, geology, surface water, ground water, water quality, ecology, water extraction and use, irrigated area, glaciers, etc., allied themes along with project information, fostering and promoting an integrated approach to Water Resources Management. Extending geospatial infrastructure capabilities for publishing, Jal IITIHAS is an innovative story telling tool powered by ArcGIS for capturing heritage and cultural references of water structures for increasing public awareness.



In addition to being a repository and dissemination platform of nation's water data, India WRIS also facilitates real time data ingestion and processing along with historical data along with easy to use tools that enhance user experience. Dynamically coupled temporal and spatial information, model linked analytical products such as evapotranspiration and soil moisture at district level and analytical tools on water budgeting, etc. add to the versatility of India-WRIS decision support capabilities.

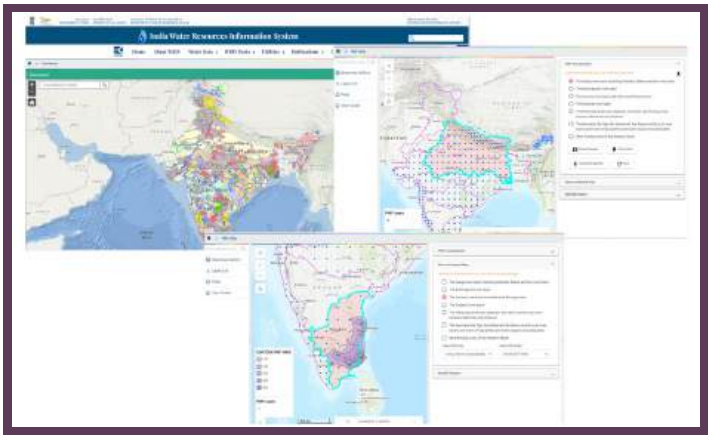


WRIS Tools

Ready to use WRIS tools strengthen collaboration and participatory management of water resources. “Online Feature Editor” enables states to update irrigation projects through secure access to the ArcGIS portal. The “ARS - Editor module” enables states, and central agencies to update and ingest the attribute data related to artificial recharge structures (ARS) under various schemes directly into the India WRIS database while consolidating the nationwide conservation/augmentation efforts made by different agencies at a single location.

Water Utilities

Water Utilities provide users information regarding Data Availability along with dashboards and tools for data/report download, district snapshots and meta data created through ArcCatalog as an XML. Powered by commonly used spatial queries Geo Viewer and PMP Atlas provide intuitive user-friendly visualization of the data sets and analytics.



Dynamic Modules

- Rainfall (mm)
- Reservoir (Level)
- River Points (Level & Discharge)
- Ground Water Level (BGL Meter)
- Water Quality - Groundwater
- Water Quality - Surface water
- Water Audit
- Evapotranspiration (mm)
- Soil Moisture (%)
- Minor Irrigation Tanks
- Coastal Informative System

Semi Dynamic Modules

- Groundwater Resources
- Snow Glacial Lake
- Water Resources Project
- Minor Irrigation Census
- Inland Navigation Waterways
- Inter Basin Transfer Links
- District at a glance
- LULC
- Wasteland
- Wet Land
- Water Tourism

Utilities and Tool

- Data / Report Download (Tabular)
- Data Availability
- Feedback
- GEO Viewer
- Artificial Recharge Structure
- PMP Atlas Data Entry
- WRIS WIKI
- Meta Data
- Mobile App
- Online Editor

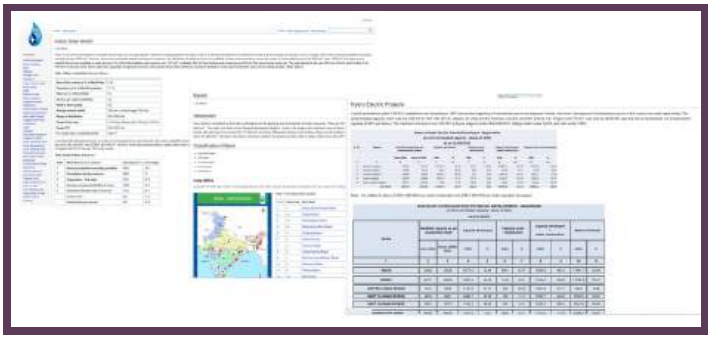
Static Modules

- Litholog
- Aquifer
- Probable Maximum Precipitation Atlas
- Reservoir Sedimentation studies
- Surface Water Bodies
- River Basin System
- Socio Economic Census
- Extreme Events Flood Inundation / Drought Prone Area Program / Earthquake
- Groundwater Prospects
- Region Agro Climatic / Agro Ecological
- Soil
- Land Degradation
- Water Logging & Soil Salinity

Modules of India-WRIS

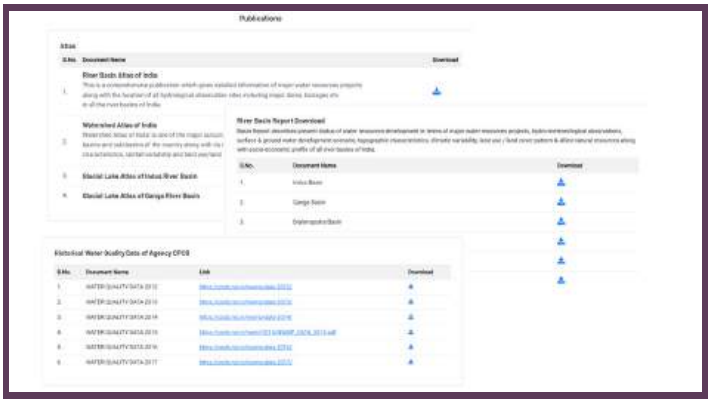
Collaborative Knowledge Platform

As a Collaborative Knowledge Platform sharing updated information regarding the various aspects of the water resources of the nation, WRS Wiki customized on wiki framework provides access to comprehensive water information and knowledge.



Publications

Publications section brings together all the water related literature and publications including Atlas, Basin Reports, Compendium, Groundwater, Pre-generated Maps, Project Documents, Wasteland Distribution Atlas, Waterlogging and Salinity Assessment, NWMP Data of CPCB (2012-2017). A library of various publications of organisations under Ministry of Jal Shakti is displayed under Research and Development section of Publications.



Benefits

As a one-stop solution for contextualized water resource information management and decision support, India-WRIS provides capabilities for data management, mapping and visualization, analysis, and discovery with automation tools for creating, analysis, managing and sharing of water resource information. India-WRIS acts as a force multiplier to strengthen India's water security and resilience by:

- Acting as a single window information source for decision makers, water managers, experts and the public.
- Mapping a common ground for a common understanding and positive action.
- Providing deeper contextualization of all the factors responsible for understanding the relationships and linkages spatially and temporally.
- Bridging the gaps by connecting data and science to the decision-makers.
- Ensuring collective problems solving by fostering participative management and collaboration.
- Creating public awareness about the crucial issues related to water and attract wider participation in water resource management.

> "Esri India presented National Water Informatics Centre (NWIC) with a comprehensive Water Geo-Hub solution that includes software, application development, training, handholding, and support services. This solution offers users nationwide access to water information through a single window, promoting the free exchange of data among various central and state agencies., while delivering reliable and timely data and insights for comprehensive projections of future water, and facilitating informatics based sustainable development of water resource management along with value added products and services to all stakeholders. Esri India played a crucial role in assisting NWIC in achieving its objectives. Additionally, Esri India facilitated seamless collaboration with national and international research institutes and other agencies. Thanks to the efforts of Esri India, NWIC was able to achieve its objectives and establish a robust water resources information system that would benefit the country's water management efforts."
>
> **- Mr. Goutam Bhati, Team Lead (GIS development), NWIC**

Inspired by the stories?

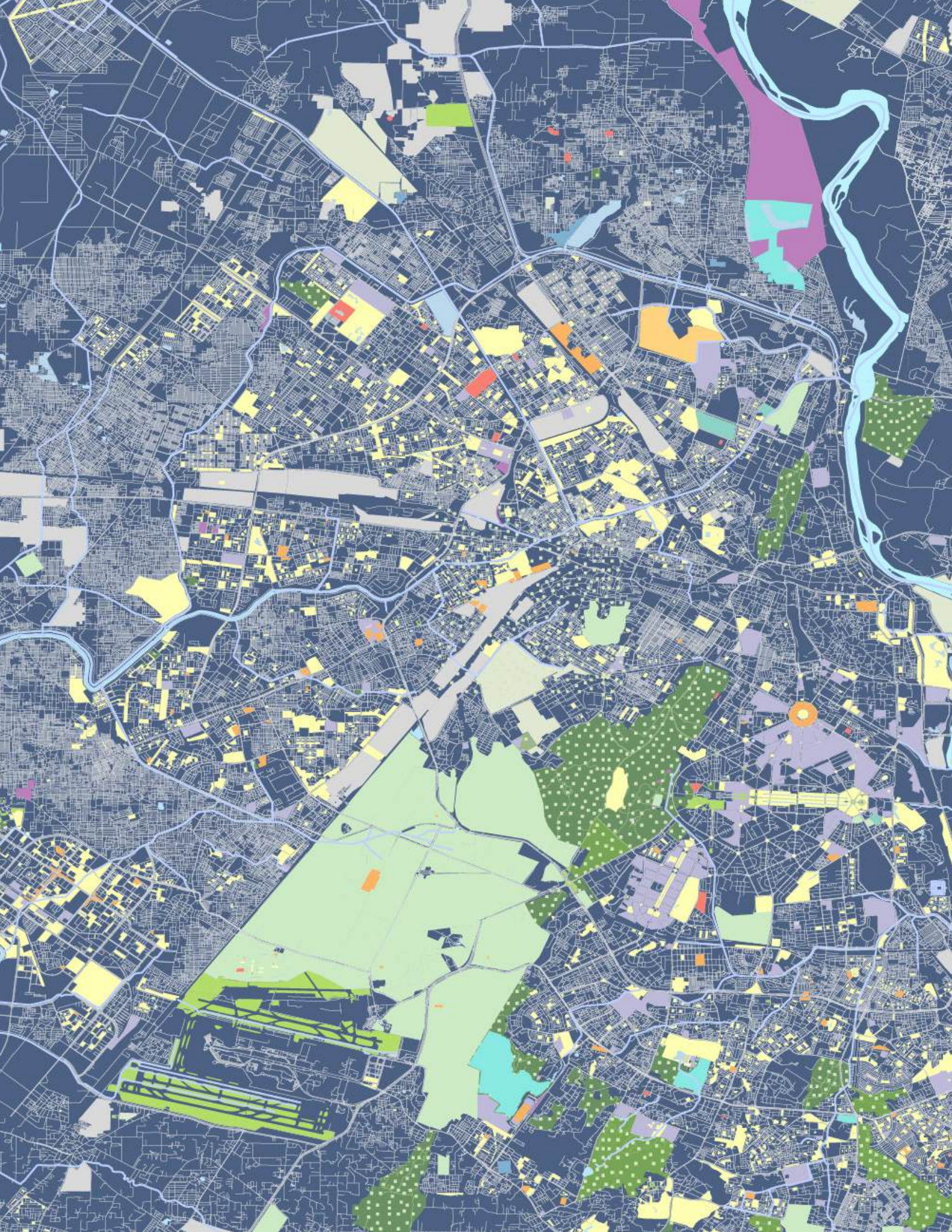
We would love to feature your work using ArcGIS.

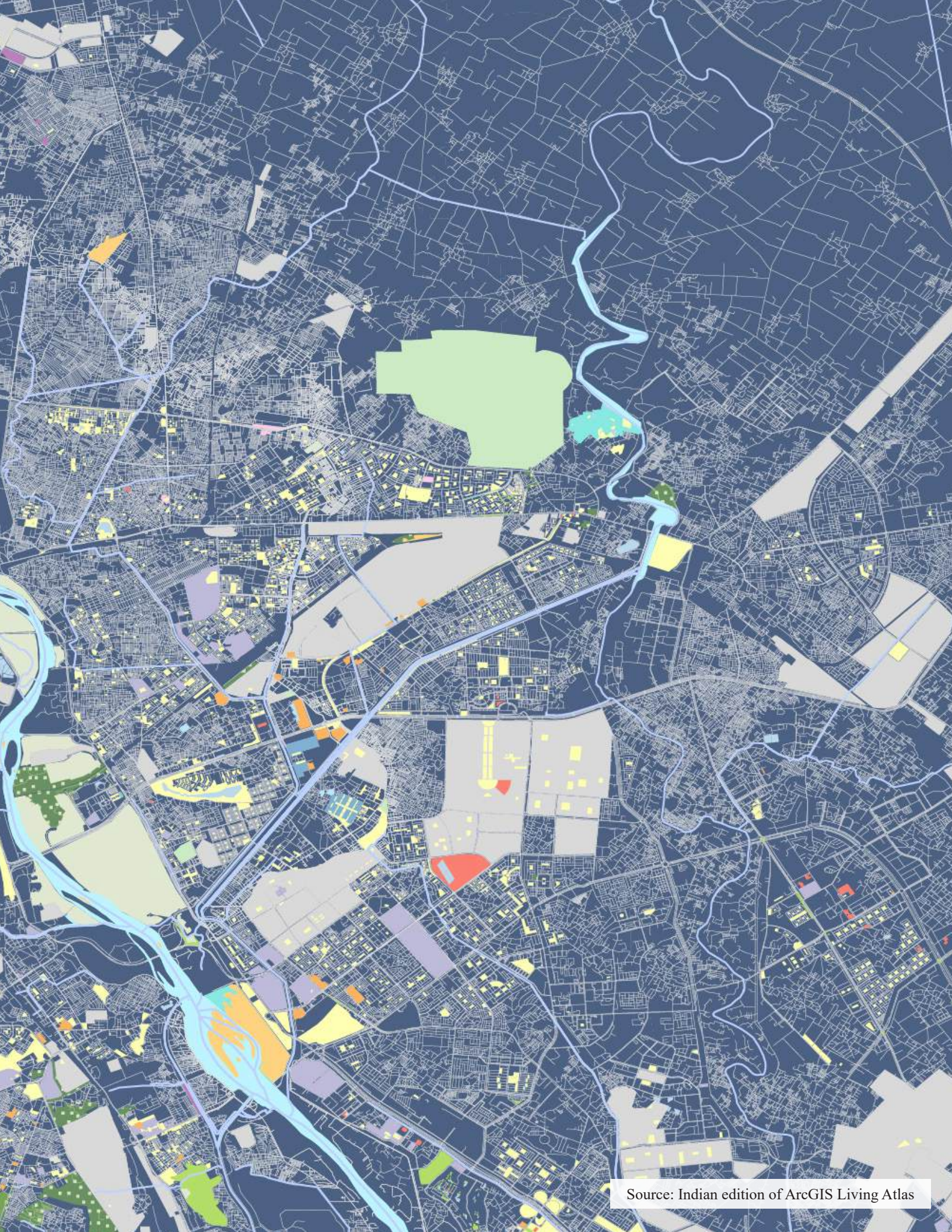
Share it today at **marketing@esri.in** for an evaluation.

About Esri India

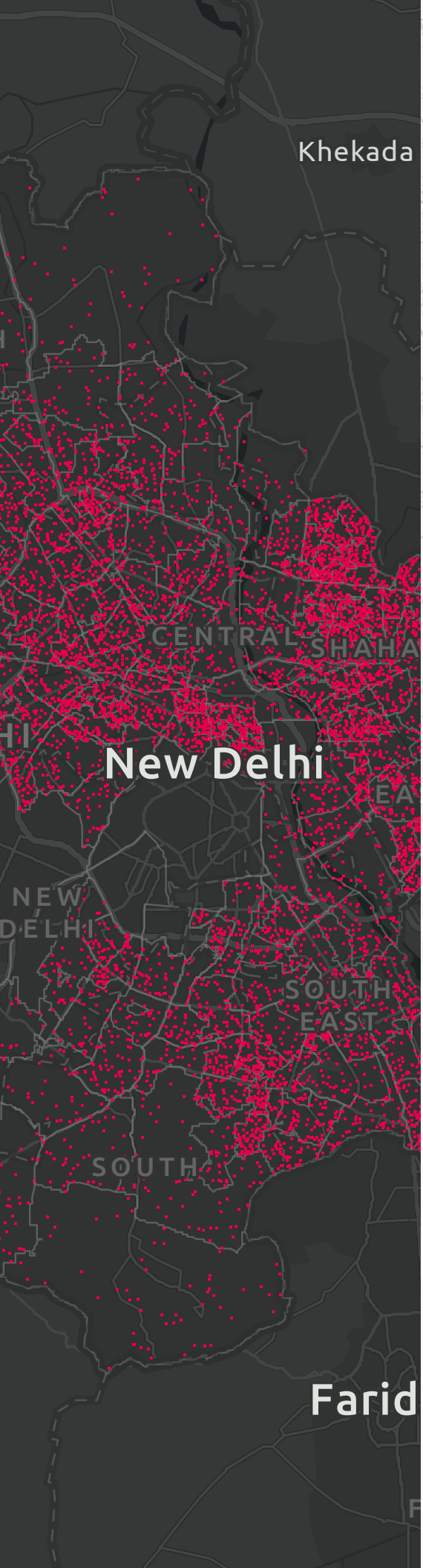
Established in 1996, Esri India Technologies Pvt. Ltd. (Esri India), the market leader in geographic information system (GIS) software, location intelligence, and mapping solutions in India, helps customers unlock the maximum potential of their data to improve operational and business decisions. It has delivered pioneering enterprise GIS technology, powered by ArcGIS, to more than 6,500 organizations in government, private sector, academia, and non-profit sectors. The company has also introduced 'Indo ArcGIS', a unique GIS solution & data offering suited for government organizations. Esri India collaborates with a rich ecosystem of partner organizations to deliver GIS and location intelligence-based solutions. Headquartered in Noida (Delhi NCR), the company has about 1 million users in the country. It got Great Place to Work Certified® in 2021, 2022, and 2023.

For more information visit **www.esri.in.**





Source: Indian edition of ArcGIS Living Atlas



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