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ArcIndia News

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CASE STUDY

Kanpur Smart City Limited

GLOBAL VIEW

GIS-Based Study of Water Scarcity in Peru Offers Replicable Model

CUSTOMER SPEAK

Shri Rajiv Ranjan Mishra, National Mission for Clean Ganga (NMCG)

COVER STORY

Securing Water for Future Geospatially

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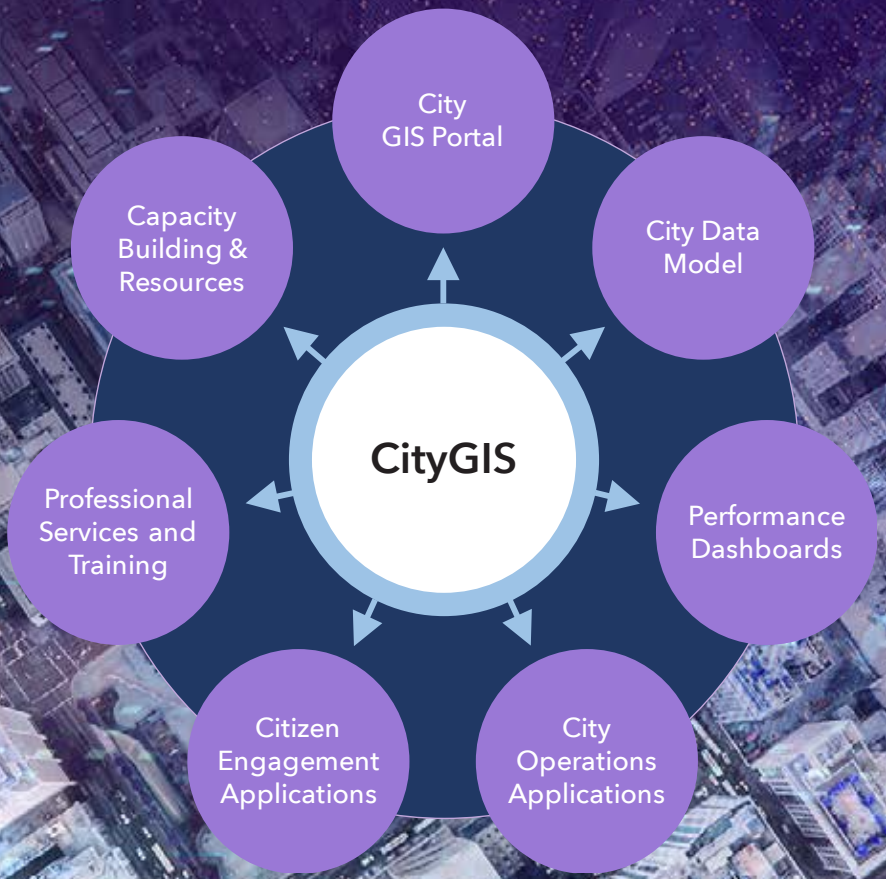

PRESIDENT'S DESK

Agendra Kumar
President, Esri India

Water scarcity is often counted as a rural challenge. However, as urbanization continues to expand, stress on the water supply is getting increasingly acute everywhere. Today, 1 in 3 people across the globe live without safe drinking water. As per the report published by Niti Aayog in June 2018, 600 million people currently face acute water shortage, and almost 200,000 lose their lives from lack of access to safe water in India. The Coronavirus disease (COVID-19) pandemic has aggravated this crisis, as there is a surge in demand for domestic water to maintain hygiene.

Climate change has created patterns of extreme deluge and drought, exacerbating the already fragile conditions. While radical changes in the weather patterns have dwindled average rainfall, areas where freshwater is readily available is either not distributed evenly or much is wasted, polluted, and unsustainably managed. The challenges associated with water scarcity are higher for India as we hold the world's 20% of the population but only 4% of drinking water reserves. Recognizing the multitude of challenges, the government of India has diverted its efforts towards technology engagement in all aspects of water conservation and management.

The formation of the 'Jal Shakti Ministry' in 2019 is a benchmark move by the Government of India dedicated to addressing the mounting water challenges. The ministry also launched Jal Jeevan Mission in August 2019 to ensure 'Har Ghar Jal' to all rural households by 2024. The use of digital technologies can help our nation overcome these challenges and such initiatives should be equally matched by the adoption of smart technologies. Technology, specifically Geographic Information System (GIS) can help us better understand the multidimensional complexities of water ecology, socioeconomic challenges of our communities, water quality, as well as define a long-term view for a sustainable water future.

As part of new water consciousness, the Jal Jeevan Mission – Urban, launched by the government of India aims to create universal coverage of water supply in all 4,378 statutory towns as well as sewage management in 500 AMRUT cities. The Namami Gange program, an integrated conservation mission launched to clean Ganga and its tributaries aims to provide safe drinking water to all. Geospatial technologies are already at the heart of such government initiatives and can play an important role to support the execution of various other programs. Now, with the recent liberalization of policies governing the acquisition and production of geospatial data, it will provide a much-needed boost to the various efforts towards better water management.

Our existence and growth will be determined by the way we use and manage our water resources today and, in the times, to come. The work done by GIS professionals like you is key for our nation to achieve our goals for water security and management. Your knowledge, collaboration, and innovative use of our GIS technology can help in making better decisions to achieve the vision of a more sustainable water future.

Agendra Kumar

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INDIA

We are delighted to share that Esri India is now certified as a "Great Place To Work" organization!

We are passionate about what we do and committed to serve our user community in resolving some of India's biggest challenges through GIS. To achieve this, we foster a culture of equality, flexibility, and transparency for both our team members and users to grow.

We have excelled on the five elements of building a
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Credibility


Respect


Fairness


Pride


Camaraderie

Amrita Vishwa Vidyapeetham Signs MoU with Esri India to set up Centre of Geospatial Excellence

Amrita Vishwa Vidyapeetham, ranked the 4th Best Overall University in India in NIRF 2020, has inked an MoU with Esri India, the market leader in Geospatial Information Systems, to establish a Centre of Geospatial Excellence on Spatial Analysis and Modeling with dedicated facilities for research, development and testing.

The Centre would promote development of specific skills and technical knowhow among academicians, students and the industry around geospatial technologies and latest toolkits like Artificial Intelligence (AI), Machine Learning (ML) and geospatial Big Data Analytics. It would conduct certificate and diploma courses, training programs and workshops, particularly around geospatial technology application areas to strengthen multi-hazard risk reduction and community resilience.

Talking about the MoU, Dr. Maneesha Sudheer, Dean of International Programs and UNESCO Chair on Sustainable Development and Innovation, Amrita Vishwa Vidyapeetham, said: "This partnership aims to enhance research and capacity development in Geoinformatics, Spatial Analytics, and Modelling. The collaborative initiatives will work towards sustainable development to address quality education (SDG 4), gender equality (SDG 5), sustainable communities (SDG 11), and climate action (SDG 13) by engaging faculty, bachelors, masters, and Ph.D. students. They will help enhance the existing curriculum and educational material, as well as develop new educational approaches for effective teaching and learning of sustainability initiatives using spatial geoinformatics."

Added Agendra Kumar, President, Esri India: "Empowering the academic community with necessary tools and technologies needed for future-ready students and capacity building is one of our key priorities. Geospatial infrastructure is the core foundation of disaster-risk reduction, sustainability and resilience initiatives. Our collaboration with Amrita Vishwa Vidyapeetham will support various research initiatives and flagship programs such as Amrita Live-in-Labs for better sustainability and development."

The MoU was inked during the International Symposium on Disaster Risk Reduction & Community Resilience that was jointly hosted by the Ministry of Earth Sciences, the Indian National Centre for Ocean Information Services (ESSO-INCOIS), Govt. of India, Esri India and Amrita Vishwa Vidyapeetham. The event commemorated the 16th anniversary of the 2004 Indian Ocean Tsunami. The participants discussed the challenges faced and lessons learnt since that catastrophic event, and analysed India's current preparedness in community resilience, governance and technological solutions to mitigate any future impact of tsunamis in India.

Dr. Maneesha Sudheer said, "The symposium served as a platform to integrate the last 16 years of advancements in science and technology to improve the rehabilitation and resilience of coastal communities. It stressed on scientific social responsibility to reduce risk and vulnerability factors by understanding the impact of tsunamis on coastal communities, using latest advances in monitoring and modeling of tsunamis, and coming up with a strategic framework to further advance India's disaster preparedness and build sustainable and resilient communities."

Esri Joins Digital Twin Consortium

Esri, the global leader in location intelligence, announced it has joined the Digital Twin Consortium. This authoritative community of users brings together industry, government, and academia to drive consistency in vocabulary, architecture, security, and interoperability of digital twin technology. Esri provides ArcGIS software to organizations across industries, enabling them to connect detailed building information models (BIM) to their natural surroundings, as well as connecting to and collaborating with other networks and systems.

While many organizations have deployed some version of a digital twin to solve a particular challenge, they usually do so on an ad hoc basis without a larger strategy or vision. This has resulted in many siloed models that are fragmented and disconnected from other critical information systems.

"We are excited to join the consortium along with our partners, including Autodesk and Microsoft, to demonstrate how users can benefit from GIS when developing digital twins," said Matt Piper, Esri global industry director for utilities and AEC. "Esri's technology gives customers the ability to visualize, understand, and analyze geographic information at a large scale by connecting and interacting with disparate systems."

The digital twin is a virtual representation of the built and natural world. It allows organizations to capture, model, visualize, simulate, analyze and predict information by interconnecting many information systems to better improve decision making.

"Business requirements are changing, and this change is driving innovation and the adoption of more integrated solutions," continued Piper. "Users may have created a digital twin of a facility or plant structure in the past, but it wouldn't be connected to other systems. Esri's ArcGIS software enables organizations to see digital twins in the context of other information models, like electric and water networks or the environment."

The ArcGIS system is the foundation for digital twins providing reality capture, GIS and BIM integration, real-time IoT, advanced AI, and machine learning.

To learn more about how Esri is bringing the power of location to digital twins, visit go.esri.com/DigitalTwin

Esri Releases Guide Teaching ArcGIS Desktop 10.8

In the latest edition of this long-standing popular choice for classrooms, Getting to Know ArcGIS Desktop 10.8 guides students and professionals alike through the fundamentals of making maps and analyzing data using the latest Esri ArcGIS Desktop software.

This is a comprehensive, hands-on tutorial, moving readers from basic GIS concepts to sophisticated GIS analysis. Along the way, readers gain practical knowledge about ArcGIS Desktop tools and functionality. Exercises address querying map data, making map layouts, symbolizing and labeling maps, setting map projections, creating and sharing web maps, building and editing geodatabases, and analyzing geospatial data.

Data for completing the exercises and a 180-day free trial of ArcGIS are also available for download.

Getting to Know ArcGIS Desktop 10.8 is available as an e-book (ISBN: 9781589485785, US$99.99) from most online retailers worldwide.

Esri Releases New Book on Applying GIS to Resiliency Planning

How do communities deal with unexpected situations on the scale of a global pandemic, for example? How much of the response is planned in advance? How well does that plan protect those most vulnerable and spread resources equitably?

In their book, Resilient Communities across Geographies, authors Sheila and Steven Steinberg examine the theory and application of different communities' abilities to respond to and recover from unexpected, disruptive situations. Examples vary from ecosystem resilience to climate adaptation to urban and cultural resilience.

Although there are many different forms of resilience, they all share some characteristic patterns. These patterns can be revealed and better understood by geographic information system (GIS) technology. The application of GIS yields actionable information culminating in a resilience plan.

In this book for academics and practitioners, readers will be able to discern patterns of theoretical frameworks, analytical methods, and GIS applications that will undoubtedly be relevant to their own fields of interest.

Resilient Communities across Geographies is available in print (ISBN: 9781589484818, 320 pages, US$49.99) and as an e-book (ISBN: 9781589484825, US$49.99). Both editions can be obtained from most online retailers worldwide. The print edition is also available for purchase at esri.com/esripress or by calling 1-800-447-9778. If outside the United States, visit esri.com/esripressorders for complete ordering options, or visit esri.com/distributors to contact your local Esri distributor. Interested retailers can contact Esri Press book distributor Ingram Publisher Services.

Esri India Wins 'Digital City Award for Varanasi Smart City'

Esri India announced as the winner in the "Digital City" category for the work done for Varanasi Smart City at Smart Cities Awards 2021, held at Pragati Maidan, New Delhi. Esri India has been applauded as a winner at the 6th Smart Cities India Expo 2021 which concluded with the Smart City India (SCI) Awards.

SCI Awards is a unique platform designed to felicitate, recognize, and encourage individuals, policy makers, companies, municipalities, government bodies, and associations to illuminate the work done across both urban and rural sectors. It is a well-recognized industry platform with 800+ submissions reviewed by an eminent jury comprising industry veterans.

Varanasi Smart City SPV leveraged Esri ArcGIS platform to integrate the city's locational data and IoT sensor data over GIS Base Maps and derive real-time analytics enabling efficient decision-making on city management and its operations. Beyond improving the urban environment, GIS has now equipped the city with options to minimize air pollution, improve water management, create safer public areas, and respond intelligently to emergencies. The technology is steadily ensuring that this potpourri of culture maintains its rich heritage while assuring Varanasi's denizens the benefits of new Indian urbanism.

Esri Releases ArcGIS Velocity for Analysis of Real-Time IoT Data

Esri, the global leader in location intelligence, announced the release of ArcGIS Velocity. Previously known as ArcGIS Analytics for IoT, Velocity is a new cloud-native capability for ingestion, processing, visualization, and analysis of real-time and high-volume geospatial data on the fly. It complements existing systems with geographic information system (GIS) technology by spatially enabling Internet of Things (IoT) data from current providers and simplifying real-time data analysis.

Velocity enables users to capture information from sensors, moving objects, or anything that changes over time, and then automatically flag patterns, trends, and anomalies. This will allow deployed personnel to access time-critical information the moment they need it.

"This new capability will help organizations take advantage of the insights made possible by the Internet of Things with up-to-the-second data and improved situational awareness," said Jack Dangermond, Esri founder and president. "Organizations will now be able to easily connect to the increasingly real-time world."

ArcGIS Velocity is also now available in two additional license levels—Standard and Advanced. These new licenses offer different storage and compute capabilities and will make Velocity more accessible for customers across industries such as commercial, natural resources, utilities, transportation, national government, water and wastewater, and public safety.

"Being able to have real-time insight into vehicle travel across the state has always seemed like a pipe-dream, but ArcGIS Velocity makes it not only a reality, but an easy-to-achieve reality," said Roger Cleaves, GIS Specialist, California Department of Toxic Substances Control. "Since it's all hosted on the cloud, setup couldn't have been easier, allowing us to start answering important questions regarding hazardous waste instantaneously. The potential is endless, from real-time notifications to capacity planning, and even environmental impact modeling."

Organizations across industries can improve their operations by better leveraging IoT data produced by devices and sensors. Remote monitoring of assets, predictive maintenance, and process optimization are a few of the benefits that can be gained from IoT data. ArcGIS Velocity lets users incorporate geospatial analysis into their decision-making as well as share results in the form of a map, feature, or stream service that can be used in other ArcGIS applications.

Via a simple drag-and-drop interface, users can create dynamic processing pipelines that combine functions from a rich library of fast spatial operations. These include geofencing, buffering, pattern detection, spatial aggregation, spatial enrichment, and proximity alerting. ArcGIS Velocity results can then be pushed as alerts or directly published as GIS maps and data services for use across the enterprise by any application for additional data fusion, mapmaking, or analysis.

To learn more about how ArcGIS Velocity can help industries access the power of location in the IoT, visit go.esri.com/arcgis-velocity.

CASE STUDY

Kanpur transforms into an inclusive, vibrant city of opportunities with efficient urban services using Esri ArcGIS

Kanpur Smart City aspires to leverage its culture and heritage by investing in inclusive and transformative solutions that enhance the quality of life for its citizens. As per the Government of India's guidelines, Kanpur Municipal Corporation has formed a separate Special Purpose Vehicle (SPV) as Kanpur Smart City Limited for the implementation of projects under the smart city mission for the city of Kanpur. Since its establishment, KSCL has managed to bring all the verticals, assets and boundaries coming under Kanpur smart city jurisdiction under one GIS roof and made optimal use of Geospatial technology for managing and continuously improving their operations and infrastructure development and management.

Project Summary

Kanpur metropolitan sprawling over an area of 260 Sq. Kms. is the biggest city and main centre of commercial, industrial and educational activities in the State of Uttar Pradesh.

Kanpur's proposal envisions to retrofit 1475 Acres adjacent to the south bank of Ganga to a vibrant 24x7 destination. As a signature intervention reflecting the city's image, the area needs to be:

> "GIS Technology is of immense importance for smart city planning, development, operations and management.
>
> The GIS portal developed on Esri platform has provided us with the spatial data and tools essential for the smart decision making for smart cities."

Ashanvi Dubey
GIS Expert,
Kanpur Smart City Project

- 'Sampann': An economic engine providing a pro-business environment and supporting the region's knowledge industry.
- 'Sachal': A walkable, well-connected mixed-use area with public realm investments visible in its streets, public spaces and buildings.
- 'Sakriya': A model for achieving social equity by planning with 'citizen first' city governance.
- 'Satat': A model of sustainable infrastructure development for future proofing.

- 'Swasth': Creating a low-impact carbon neutral model for a healthy environment.

Challenges

Gathering authenticated data form Kanpur Municipal Corporation, designing a geodatabase for KSCL with the available spatial data has been a formidable challenge for the city. Another challenge was to provide the GIS solution access based on hierarchical roles. Given the rapid growth of Kanpur city in terms of population and economy and accompanying demand for infrastructure, use of technology for managing all aspects of smart city was imperative. Therefore, the need was to have a GIS Solution for smart city that showcases various aspects of the city including verticals with respect to citizen amenities, educational institutions, emergency facilities, travel and transportation, healthcare facilities, smart parking, various boundaries associated with city management, help citizen to find the optimal route. The visualization and analysis for timely decision making was the main challenge faced by the KSCL.

Solution

Esri India together with 6Simplex Software Solutions Pvt. Ltd. started their geospatial initiative and provided ArcGIS platform to meet above challenges by setting up KSCL's enterprise GIS portal. The new geodatabase helped capture spatial data related to mapping of various components in the smart city like different administrative boundaries, drains and water supply infrastructure, emergency services, building footprints and local points, civic, education & transportation facilities etc. During COVID-19 pandemic, the GIS solution was used to map the affected areas and residents which helped city administration to have a clear view of the situation and thus helped in taking timely action to manage the spread.

The enterprise GIS provides the following:

1. Enterprise Geodatabase
2. Identity management, authentication and authorization for KSCL
3. ArcGIS Server based service-oriented architecture to power the map, feature and non-spatial REST based services.
4. ArcGIS network analyst service for helping end user to find the optimal routing solution for commuting within the city.
5. Secure ArcGIS JavaScript API based web application for Data viewing and querying, advanced spatial data editing including split/merge of features, map printing, dynamic report generation, Providing a bird's eye view of all ongoing data collection activities and providing near real time view of the collected data.
6. Secure ArcGIS JavaScript API based web application for, field data collection in online mode only, advanced spatial data editing including split/merge, logging field activities, geofence based data viewing and collection for robust data management and better performance.

GIS tools and functionalities

The various GIS tools and functionalities included in KSCL GIS solution are:

1. Basemap selection - Users can select from the variety of available ArcGIS basemaps.
2. Layer selection module - Users can search and select from more than 60 layers, where the layers are grouped for better user experience and visualization. Users can view the data in the attribute table, zoom to layer extent or scale.
3. Admin users can customize layer visualization properties, export layer attribute tables.

4. Map module - Various standard functionalities such as zoom-in, zoom-out, map orientation, zoom to full extent, next and previous extents, reset and refresh maps, single select, multi-select, rubber banding, on feature click HTML pop-ups, etc. are enabled to facilitate better user experience.
5. Users can customize their map coordinates unit to specific standards such as DMS, LatLong, Meters.
6. Users can also change the map scale by typing the desired scale in the change map scale tool.
7. Tools module
   a. Information panel - Users can click on features to view the detailed information.
   b. Bookmarks - Users can create and save their favourite areas as bookmarks and later choose from available bookmarks.
   c. Search
      i. Attribute search - One can search various smart components by simply typing in the parameter or perform an advanced attribute query.
      ii. Spatial search – This tool facilitates the use of spatial relations and expressions such as crosses, intersects, within, etc. The data layers can be queried based on such spatial relations.
   d. Places search – It uses Esri's geocode service to find any place entered in the search box.
   e. Measurement tool - Users can measure area, distance and location of the object of interest using this tool.
   f. Go To XY tool - This tool allows the user to enter valid latitude and longitude and a map navigates to that location.
   g. Routing - An important tool to help Kanpur citizens to find the best suitable route between the locations of their interest. Routing tools use Esri's network analyst service at the back end.
   h. Redlining and Annotations - Users can mark or annotate the map areas of interest. Users can draw shapes, type comments, etc. using this tool.
   i. Map Print - Only admin users can export map prints in various ISO formats.
   j. Import shapefile - This functionality is exposed only to admin users. An admin user can choose a shapefile (.shp) to be shown on map.
7. The GIS editor application enables role-based feature editing for admin users. Such users can use add, edit or delete features. In addition to this advanced editing functionalities such as merge, split and move features are also available.

Benefits

As a result of deploying the initial Desktop GIS, KSCL can:

- Gather various smart city assets inclusive of citizen amenities, education, emergency facilities, travel and transport, healthcare facilities, smart parking and create a geodatabase which serves as the backbone of the KSCL GIS solution.
- In future KSCL may opt to add more data layers to the geodatabase to make it more scalable.
- Provide secure, Single Sign On (SSO) based web access to all its spatial and non-spatial data and services.
- View all their verticals such as visual sign boards, traffic cameras, number plate detectors, location of educational institutions, hospitals, etc.
- Help citizens to view locations of multimodal transport facilities within the city.
- The solution facilitates the use of routing services where users can find the optimized route to their favorite location.
- Edit spatial data with their data modification policies and data validation rules enforced.
- Export web maps in various available formats.
- Perform spatial and attribute search.

6simplex
Software Solutions Pvt Ltd

Water Utility GIS Solution by 6Simplex

Increasing public awareness, stricter measures, and promulgation of new laws in water resources have made the use of advanced technologies indispensable. Geographic Information Systems (GIS) are an effective tool for storing, managing, and displaying spatial data often encountered in water resources management. To stress the importance of GIS in water resources management, applications related to this area are addressed and evaluated for efficient future research and development.

Solution

6Simplex Software Solutions, a Nagpur based Geospatial Products & Services company collaborated with Esri India to develop a GIS-based Water Utilities Management solution. The solution uses Esri ArcGIS API for Javascript 3.x, ArcGIS 10.2 along with ArcFM 10.2 and underlying Oracle database servers which enables water utility companies to manage on field water assets, maintain consumers database and enables executive to visualise on field data collection, billing, and tracing water network manifold. This helps them to deeply understand their water distribution network along with consumer complaint redressal.

Features

Dashboard and Reports:

Water utility Web GIS application provides an excellent GIS map-based analysis which helps executives to understand water distribution in the respective area. Users can export reports based on custom queries as well as the Map print in single and multi-page PDFs.

Map Printing:

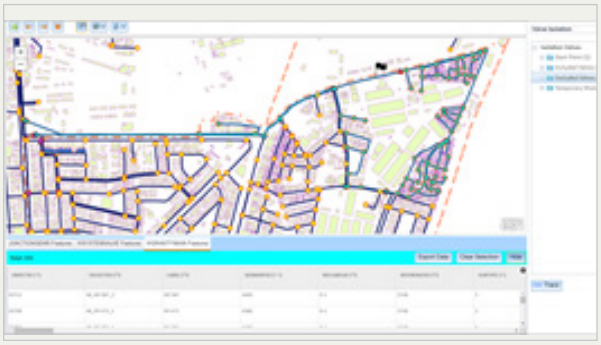
Exporting single page and multi-page PDF reports.

Field asset and customer data mapping:

Water Utility Mobile GIS application helps in capturing real time data on field. New connections can be faster realized in GIS systems as soon as the request for a new connection is made by O&M teams on the field. Using the mobile application, the O&M team has better understanding of leakages and component faults on field.

Water Facility Management:

It allows users to trace water distribution network connectivity as well as inspect water distribution outages. Also acts as a bridge between Zone OEM works and GIS team.



Security Management:

This provides functionality to help the admin user manage users and roles within the organization helping role based editing to GIS data.

Benefits

- A comprehensive GIS based analytics & reporting solution to address payment status, volume of water billed, and other reports based on customised advanced queries to GIS data.
- Exporting single page and multi-page PDF reports.
- Optimized access to the water network using facility management extensions.
- Registering consumers on GIS database.
- Smooth coordination between different teams such as, Billing, customer handling, complaint redressal, and management.
- Reduced cost of managing the water asset monitoring and field operations.
- Easy user creation and assignment of roles.
- Water tracing allows us to analyse various workflows related to water distribution management.

ArcGIS Field Maps

ArcGIS Field Maps is a new mobile app solution that allows you to streamline field workflows and take maps anywhere. You can use Field Maps to explore the maps you make in ArcGIS, collect and update your authoritative data, and record where you've gone, all within a single location-aware app. Field Maps includes a companion web app that allows you to configure the maps mobile workers use in the field.

You can do the following with ArcGIS Field Maps:

- Replace paper processes and disparate tools to bring efficiency to fieldwork with a single app that can be configured for the specific workflows of your field workforce.
- ArcGIS Field Maps provides fieldworkers with secure, 24/7 access to your organization's ArcGIS maps on their mobile devices.
- Location tracking analysis can be used to verify when, where, and by whom work was done.

As an all-in-one field app, one download supports many capabilities and means greater efficiency for your fieldworkers and IT associates.

ArcGIS Field Maps Mobile App

The Field Maps mobile app streamlines field workflows by bringing together the following capabilities into one app:

- Simple map viewing and mark-up.
- High accuracy field data collection and inspection.
- New smart form capabilities.
- Battery-optimized location tracking.
- Start tracking for a specific duration.
- Start and stop tracking from a link, Google Assistant, or the companion Apple Watch app.
- Dark Mode support on iOS.

ArcGIS Field Maps Web app

The Field Maps web app simplifies the configuration and deployment of maps with the following capabilities:

- Author smart forms for data collection.
- Enable web maps for offline use.
- Manage feature templates.
- Configure sharing settings.
- Hide maps from the Field Maps mobile app.

The major highlights of ArcGIS Field Maps are as below:

1. Smart Forms

Smart forms are now a part of your maps.

- Set a required property for a field in your form using the Field Maps web app. Now you don't have to set it at the schema level. This provides greater flexibility and is one of the topmost requested data collection features.
- Qualify input types for certain fields. For example, only capture the date and not the date and time. Further constrain that to a date range.
- Choose if an individual field should be read-only. This is extremely powerful when workflows involve updating the attributes of an existing feature and there are certain fields you need the mobile worker to see, but not be able to edit.

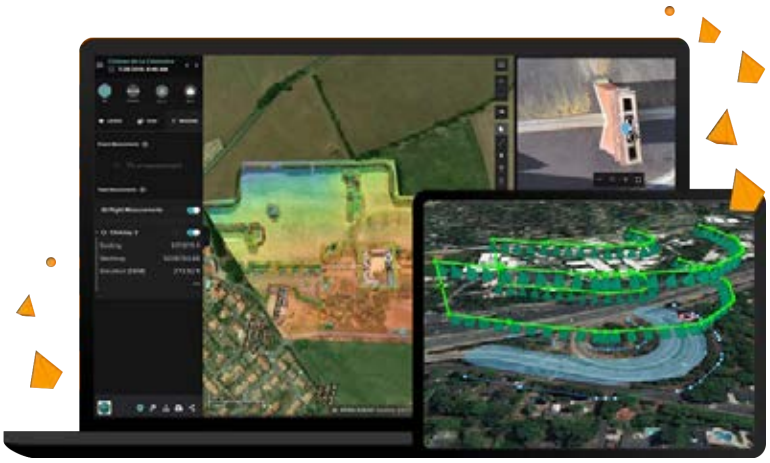
2. Location Tracking

- Integrating location tracking into Field Maps means you can record and share your location while you work.
- When you turn tracking on, you can choose how long you want to be tracked. When you have reached that duration of time, tracking will be turned off automatically.

3. Dark Mode

- Dark Mode provides a great viewing experience in low-light environments. You can turn on Dark Mode on your iOS devices from Control Center. Dark Mode provides additional contrast in sunlight conditions as well.
- If you plan to use Dark Mode, consider choosing a basemap like *Imagery Hybrid* or *Streets (Night)* to provide similar contrast.

Site Scan for ArcGIS



Site Scan for ArcGIS is an end-to-end cloud-based drone mapping software designed to revolutionize imagery collection, processing, and analysis. It maintains a complete picture of your drone inventory and flight history with automatic fleet management. It helps to stay up to date with accurate imagery when needed with repeatable flight plans that ensure high quality data capture when flying your drones. Site Scan securely process imagery in a scalable cloud environment to create high-quality 2D and 3D imagery products that can be quickly shared throughout your organization on any device. It also saves time by using the measurement and analysis tools to get the answers you need from your data.

What does Site Scan for ArcGIS do?

Site Scan for ArcGIS provides drone flight planning, fleet management, image processing, and analysis capabilities as Software as a Service (SaaS). Site Scan delivers a complete end-to-end solution for drone imaging projects.

With Site Scan, drone operators can:

- Plan and execute drone flights and manage flight data and metadata to support project requirements.
- Manage their drone fleet to run safe and efficient drone operations.
- Generate 2D and 3D mapping and analytics products from drone imagery.
- Publish drone mapping products to ArcGIS Online, ArcGIS Enterprise, and Autodesk BIM 360.

Is Site Scan for ArcGIS an app, an ArcGIS Desktop extension, or something else?

Site Scan for ArcGIS consists of two applications:

- Site Scan Flight Planning is a flight planning and control application for drone operators that runs on iOS (iPad). The app is integrated with ArcGIS platform and allows users to plan automated flights in 2D or 3D, and allows the user to control the drone in flight.
- Site Scan Manager is a web-based application for processing, managing, and performing analysis on drone imagery. The app also includes an administrative dashboard for managing users and project permissions, available to users with administrator privileges.

How does it make things easier?

Autonomous drone flights

- Increase efficiency by creating and sharing advanced 3D flight plans between your pilots.
- Overlay 2D and 3D data from ArcGIS Online and ArcGIS Enterprise for enhanced flight safety and data capture quality.
- Manage your data in the field and upload it to the cloud.

Process and analyze in the cloud

- Unlimited amounts of drone flight data is processed into 2D and 3D outputs through a scalable cloud environment.

- High accuracy is ensured through automatic ground control point detection.
- Easily visualize and analyze results directly in a web browser.

Quickly share drone and project data

- Share information with your stakeholders in formats they understand, whether in a 3D view or as a report or map within ArcGIS Online or ArcGIS Enterprise
- Collect and process files using reality capture technology within Autodesk BIM 360; or export in common file formats.

Drone fleet management

- Fleet management keeps track of flights, drone hardware, and pilot flight history—all in one place.
- Drone program managers can create custom preflight checklists for their teams and store responses within the cloud.

What types of imagery can I process with Site Scan Manager?

Images must be geotagged JPEG files. You can process thermal and multispectral imagery. Video cannot be processed into maps and models, but can be used in conjunction with geospatial video logs recorded on the flight planning app to be used with FMV tools in ArcMap and ArcGIS Pro.

How it Works with ArcGIS?

Site Scan for ArcGIS is a comprehensive drone software solution that you can use with your ArcGIS Online or ArcGIS Enterprise data.

ArcGIS Online and ArcGIS Enterprise

Import your organization's saved GIS data and share your data with your ArcGIS Online organization and ArcGIS Enterprise for further analysis and collaboration.

ArcGIS QuickCapture

Use ArcGIS QuickCapture together with Site Scan for ArcGIS to capture features remotely using the drone's location.

ArcGIS Drone2Map

If working in an offline environment, use the Site Scan for ArcGIS Limited Edition iOS app to connect with ArcGIS Drone2Map and process, analyze, and export your drone data.

How do Site Scan for ArcGIS licenses work?

There are currently three license types:

- **Viewer license:** These users can see project data in Site Scan Manager and use the measurement tools but can't make any edits or changes.
- **Access license:** These users can use the full functionality of Site Scan Manager in their assigned projects, including creating and persisting measurements, processing existing data and downloading processed outputs. They can also create a drone flight plan in Site Scan Manager but aren't able to fly a drone with Site Scan Flight Planning. Administrator functions, such as User Management and Fleet Management, require this license type.
- **Operator license:** In addition to the capabilities of an Access license, these users can fly a drone using Site Scan Flight Planning and upload images for processing.

SECURING WATER FOR FUTURE GEOSPATIALLY

Water is undoubtedly one of the vital elements for existence of life on the earth. But today this very lifeline is under serious threat due to human activities of the past. With about 4% of worlds water resources and 18% of world population, India has a bigger problem on its hands.

India receives a good rainfall during monsoon season, but changing economic, demographic, and climatic conditions are reshaping the water situation rapidly. According to the World Resources Institute's report, India ranks 13 out of 17 countries facing extremely high water stress. In an average year, agriculture, industry, and municipalities are consuming 80 percent of the available surface and groundwater. Reuters reports that more than a third of India's population

lives in water-stressed areas and this number is set to grow due to depleting groundwater and rising urbanisation. As per the 2030 Water Resources Group, if we continue to consume water at the

current rate, India will have only half the water it needs by 2030. A potential crisis that's only few years from now.

Recognizing the gravity of the situation, water has been at the top of governance agenda in recent years. Government of India's National Water Mission (NWM) (2009) advocates conservation of water, water wastage, equitable distribution through integrated water resources development and management. Jal Shakti Abhiyan, Swajal scheme, Atal Mission for Rejuvenation and Urban Transformation (AMRUT) and Pradhan Mantri Krishi Sinchai Yojana are some of the other initiatives from central government with a thrust on sustainable water management. Water being a state subject, state governments too have been proactive and have rolled out initiatives to address the water related challenges in their respective states.

However, water challenges are intricately related with the hydrologic cycle and related processes and cannot be addressed in isolation. They are multi-disciplinary and involve interactions between the hydrosphere, atmosphere, lithosphere, and biosphere; and have local, regional, national, and global dimensions. Physical, biological, economic, and social processes too have a strong bearing on the water ecosystems which unless addressed in totality will not help in addressing the problem holistically. Spatial and temporal diversity of all these factors brings to the fore importance of a) knowledge of the linkages among the components (rivers, wetlands, groundwater, uplands, urban/rural water supplies, industries, consumption patterns, etc), b) understanding of the processes operating at different spatial and temporal scales and c) availability of actionable intelligence for taking informed decisions.

While an Integrated Water Resources Management (IWRM) approach is need of the hour, India continues to battle with a) Non-confirming administrative and basin/catchment boundaries, b) Inadequate per capita storage to tide over spatial and temporal variations in water availability, c) Inadequate cross sectoral cooperation and integrated approach, d) Poor data and information exchange between stakeholders, and e) Lack of human capacities in monitoring water use and water quality as per National Water Academy. Time has come to work collectively to overcome these constraints.

An Integrated Water Resource Management (IWRM) approach promotes coordinated development and management of water from "source to tap" while taking into consideration all the processes for maximising economic and social welfare in an equitable manner without compromising the sustainability of vital ecosystems and the environment. "Science of Where" becomes important more than ever for understanding these constraints and managing linkages and processes.

By harnessing geographic context, GIS technologies provide unmatched capabilities to discover insights from within data and transform how governments and communities see, think and act towards integrated water resource management. While conventional GIS offers powerful tools for the collection, storage, management, and intuitive visualization of data from multiple disparate sources, advanced GIS capabilities like spatial modelling and predictive analysis using artificial intelligence, machine learning and big data provide enhanced situational awareness for accurate forecast of likely water scenarios to mitigate, plan and respond, including the impact of changing economic, demographic and climatic conditions.

Simulation models provide decision-makers with interactive tools for understanding the physical system and judging how actions on the ground can affect the overall ecosystems. Mobile GIS tools play a vital role in democratizing geo-information and empowering stakeholders with real-time information for informed decisions and risk mitigation. With powerful collaboration capabilities, geospatial infrastructure promotes collective problem-solving and perhaps most critical of all, building robust water resilience based on data and insights.

Given the complex multidisciplinary nature of the processes, geospatial infrastructure offers unmatched capabilities for revealing deeper insight in relationships and patterns, answer complex questions, and informed decisions for fostering sustainable water resource management from "source to tap" including water ecosystems, water supply, water quality and water resilience.

Protecting & Restoring Water Ecosystems

Water ecosystems are critical to the global water security and resilience. While India has a wealth of water ecosystems that have been lifeline for economic development for centuries, these are under tremendous stress today due to rapid urbanization, industrialization and agricultural intensification, manifested by the shrinkage in their areal extent, and decline in the hydrological, economic and ecological functions they perform.

Traditionally, use of GIS for water related ecosystems has been limited to localized mapping restricted at large by the administrative boundaries. More needs to be done to safeguard these transboundary natural resources. With geography knowing no boundaries, it is imperative to visualize and understand the water ecosystems holistically including their interconnections and interdependencies at a national, regional, and local levels. Decision support for such complex scenarios mandates scientific knowledge of resources information including precipitation, runoff, geology, soil, topography, climate, sediment yield and many other factors.

Playing a central role, a GIS based Water Management platform brings together all the processes and sub-systems of the water related ecosystems on a unified platform. It aids to monitor, plan, implement and improve various processes from "source to tap". By virtue of their capabilities to present relationship between the spatial and hydrological processes of the watershed in an efficient manner, GIS based hydrological models are valuable tools for surface-water and ground-water management at an ecosystem scale. With multiple stakeholders responsible for the overall success of water-ecosystem management, real-time insights and collaboration become very crucial.

GIS offers unmatched capabilities to effectively and efficiently plan, design and manage protection and restoration of water ecosystems including a) Watershed development and strengthening of distribution network from source to the tap b) Improvement in water management and distribution system for water bodies c) Diversion of water from high-

India-WRIS

A well-developed information system, for water related data in its entirety is a prime requisite for sustainable water resource management of a nation.

Powered by ArcGIS, the generation of a database and the implementation of a web enabled Water Resources Information System popularly known as India-WRIS was conceived as a single window solution for all water resources data and information in a standardized national GIS framework. Developed jointly by Central Water Commission (CWC) and the Indian Space Research Organization (ISRO), this centralised platform is now India's national repository of water resources and associated data with administrative granularity. This data includes hydrological, hydro-meteorological real time information and data acquired using public funds available for legitimate use, enabling better decision making and meeting society's needs.

India-WRIS allows users to Search, Access, 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). It has four key elements:

(1) Data input/entry/collection system

(2) Data storage, analysis, and transformation into 'user friendly' information

(3) Interactive system for geo-visualization and temporal analysis and

(4) Information dissemination system in public domain, processing tools and data downloads

Providing holistic information on the state of water resources, India-WRIS platform aids in decision support for water resource planning and management strategy. By creating public awareness about the crucial issues related with water and attract wider participation in water resource management, India-WRIS aims to strengthen India's water resilience in times to come.

Managed by the National Water Informatics Centre (NWIC), India-WRIS also provides value added products and services to all stakeholders for its management and sustainable development.

available sources to deficient water scarce areas d) Water conservation and rainwater harvesting e) Renovation of traditional and other water bodies/ tanks and f) Intensive afforestation.

Increasing water-use efficiency & ensuring freshwater supplies

Nearly 80% of India's freshwater is used in agriculture and over half of India's cultivated land is under water-intensive crops. India draws nearly 25 percent of the world's groundwater and Indian agriculture relies heavily on groundwater (60% of the irrigated area in the country). India uses at least twice the amount of water to grow one unit of food versus comparable countries. This is a cause of concern which needs immediate attention.

With depleting water resources, the focus needs to shift on the water-use efficiency for a sustainable future. Improving water efficiencies becomes critical more than ever and geospatial technologies have a critical role to play. Use of GIS for agricultural and water conservation interventions aid in identification of causes for inefficiencies and support in optimizing the water utilization, while improving crop yields and efficiencies.

With agriculture being major water consumer, right information on suitability of a crop, inputs, land conditions, weather conditions, market conditions, etc. in right time can optimize the irrigation and thus utilization of water. By integrating location intelligent IOT based devices, and farm infrastructure, precision agriculture offers transformative potential for sustainable water-smart-agriculture, while improving crop yields and minimizing risks for the farmers.

Government of India's initiatives for improving water use efficiency 'More crop per drop' can be benefitted greatly by use of GIS technologies for source creation, distribution, management, field application and extension activities. GIS based farmer decision support systems can facilitate better choice of the crops to the farmers keeping in view the water availability and future challenges. Precision water application devices like drips, sprinklers, pivots, rain-guns can be deployed judiciously with a better understanding of the context and local conditions.

With heavy reliance on natural resources for water especially in rural parts, water conservation efforts will be the lifeline for future sustainability. 3D Village Contour Maps serve as very effective tools for planning interventions. GIS technologies can assist the stakeholders in various interventions viz. a) Water harvesting, ridge area treatment, b) Water conservation plans c) Soil and moisture conservation d) Rainfall management e) Minor Irrigation (both surface and ground water) and micro irrigation and f) Agronomic measures to maximise use of water while minimising irrigation requirement.

Achieving safe & affordable drinking water

Depleting water ecosystems have been constantly adding pressure on the urban and rural water supply systems. This clubbed with the increasing population and economic activity have been adding to the water demand keeping the governments and agencies on their toes.

As per the National Statistical Office (NSO), Ministry of Statistics and Programme Implementation, about 57.5% in the urban areas and 48.6% of the households in the rural have exclusive access to principal source of drinking water. Further about 94.5% of households in rural and about 97.4% in urban areas used 'improved source of drinking water' viz. bottled water, piped water into dwelling, piped water to yard/plot, piped water from neighbour, public tap/standpipe, tube well, hand pump, protected well, public tanker truck, private tanker truck, protected spring and

rainwater collection. Along with the hardships, this also implicates a huge economic cost to the nation. Not a desired situation after 70+ years of independence.

In urban environments, with open systems still prevalent, water utilities are seldom in a position to accurately assess the non-revenue water (NRW) which in turn introduces redundancy and impacts their operational efficiencies. Lack of proper maintenance of existing infrastructure causes further losses of almost 40 per cent of piped water in urban areas. In rural environment sustainability of water availability and supply, drop in ground water tables, and water contamination continue to be major challenges. Many villages in rural India continue to depend on the traditional sources of drinking water viz. community managed open wells, private wells, ponds, river, lake, and irrigation reservoirs.

GIS technologies have wide applicability in ensuring safe and affordable drinking water supply in urban and rural environments. Leveraging the context of location GIS aids in design, model, planning and maintenance of water distribution networks helping the utilities to optimize costs and improve turnaround times. A geo-enabled water supply platform supports asset management, outage management, leakage / pilferage management, and emergency response management across the water distribution life cycle.

GIS platform integrated with IoT, SCADA and other components of the distribution systems by leveraging machine learning and artificial intelligence offer numerous opportunities for automation and operational improvement. Efficient systems and seamless flow of data and

Data Driven decision support for ensuring uninterrupted water supply

With more than 50% of non-revenue water and other operational problems, Thrissur municipality decided to challenge the status quo and take the bull by its horns. Water Efficient Thrissur (WET) initiative was conceived on ArcGIS Enterprise platform to address these problems by enhancing the situational awareness of the water utility network and assets and arm the administration with real-time actionable intelligence and decision support.

Designed and built on an authoritative spatial repository integrated with non-spatial data and sensors (Smart meters and IoT devices), Esri's geo-enabled decision support platform has taken the centre-stage in delivering data driven insights and rapid decision support to all the WET stakeholders. Some of the benefits reaped by Thrissur municipality being:

- Reduction of water losses, pilferages, and leakages
- Geo-enabling of billing systems and customer feedback for advanced analytics
- Reduction in response time to citizen grievances / disruptions through outage management and workforce management system
- Real-time dashboards with map-based interfaces and real-time statistics for decision support
- Hydraulic modelling and simulation of water network for predictive demand and supply studies

Given the water scarcity challenges cities are staring, WET strengthens Thrissur's water governance and resilience by helping them to prepare strategically, respond rapidly and recover methodically in the event of any disasters or disruptions.

information from sensors and smart devices enables utilities to respond faster to operational contingencies. Be it regulating water supply, identifying drop in pressure and leakages, maintenance and repair of pipelines and revenue planning and recognition, with enhanced situational awareness and actionable intelligence on finger tips, GIS enables the utilities to provide improved water services, while improving the operational efficiencies. Real time data delivered via easy to understand maps and apps create transparency and understanding improving citizen engagement and citizen services.

District Metered Area (DMA) is an effective tool to manage water supply and NRW Management. GIS driven DMA approach aids in better management of the water distribution systems by bringing together all the relevant subjects together on a single platform enhancing the situational awareness while providing actionable intelligence for improving operations. These can benefit in reduction of non-revenue water, improvement of water quality, optimize energy consumption, mitigate leakages, pilferages, and contaminations.

Improving water quality, wastewater & safe reuse

One of the major factors contributing to water stress in India is water pollution. Almost 70% of India's surface water resources and an increasing percentage of groundwater reserves are contaminated by biological, toxic, organic, and inorganic pollutants. Many of these sources have become unsafe for human consumption, irrigation and industrial needs. Excessive withdrawal of ground water in coastal regions is resulting in intrusion of salt water into freshwater bodies thus rendering them unsuitable for consumption. According to NITI Ayog as much as 70% of water being contaminated, lack of access to safe water causes staggering 2 lakh deaths every year. This challenge clubbed with the depletion of the water resources poses a huge challenge to the development agenda and needs addressing on war footing.

Traditional methods of water sample collection and testing are expensive and time consuming and in turn delaying the remedial efforts. Geospatial technologies play a vital role in rapid water quality assessment and monitoring. Using remote sensing and geospatial modelling, water quality indicators such as chlorophyll, algae bloom, turbidity, suspended sediments, and mineral content in water bodies can be assessed and monitored with greater accuracy. Integration of water quality indices (WQI) in a geospatial environment offers multiple advantages including evaluation of the impact, planning for water quality interventions and decision support. Using advance techniques, simulation and modelling of the water ecosystems using these WQI aid in generating predictive scenarios of potential pollution and water quality deterioration and thus helping in arresting the problems before they manifest.

Sewerage and industrial waste are one of the big contributors to the water quality deterioration. In a country like India with unorganized waste management, this is a huge challenge. In the absence of geographical context, understanding of interrelations and interdependencies it is impossible for agencies to address these problems and implement sustainable solutions. With its power to bring together multiples disparate subjects, Geospatial technologies can be force-multiplier in wastewater and sewerage management including planning design and management of a) Networked sewerage systems and sewage treatment plants b) Water recycling, removal of contaminants and reuse / release wastewater and c) Storm water drainage to regulate water flows.

Improving water related disaster management and strengthening resilience

India has been highly vulnerable to water related disasters including floods, droughts, and cyclones over last many decades. Increasing temperatures, shifting rainfall patterns and resultant water related extremes (disasters) are some of the most visible impacts of the climate change. With a large network of rivers, a good part of Indian subcontinent is flood prone. Every event of flood result in huge losses of life and property. In recent years urban flooding has become a very common phenomenon, paralyzing cities in no

time. Contrastingly, about 42% of India's land area is facing drought, while tropical cyclones continue to ravage the coastal regions of India very frequently.

More than one extreme can occur together, triggering simultaneous shocks and stresses across the water ecosystems. Water related disasters have a significant impact the water availability for human consumption, industrial production, and social wellbeing. To strengthen resilience and adaptability of nation and its communities, there

is a compelling need to explore and understand these interconnections, contextualize location, and analyse the interdependencies spatially and temporally. Geospatial technologies are vital to governments, non-profits, and businesses to prepare strategically, respond rapidly and recover methodically respond to such extremes.

For ensuring water security, building water resilience is an important step so that governments, and communities can a) anticipate risk, b) prepare to adjust c) share and learn d) integrate, coordinate and collaborate and e) ensure inclusiveness. With its unique ability to integrate data about everything—and, at the same time, ability to provide a platform for intuitively understanding data and knowledge as an integrated whole, GIS becomes an essential and irreplaceable tool for strengthening water resilience. GIS not only helps with a better understanding of the evolving situations, but also provides a platform for collective problem-solving, decision-making, and collaboration.

Spatial modelling and predictive analysis using artificial intelligence, machine learning and big

India Water Tool

Water can only be sustainably managed if data with an appropriate level of granularity is made available publicly in a format easily accessible and usable to all stakeholders. India Water Tool Version 3 (IWT 3.0) is a comprehensive, high-resolution, user-friendly tool that helps companies and other users evaluate, assess and plan their water management interventions.

With ArcGIS at its core, India Water Tool is a decision-support tool for organizations to measure and map water risks associated with their businesses and operations. Targeted at companies and investors who need to understand the water risks for their operations, supply chains, investments and plan their water management interventions. Communities can use the tool to plan collective recharge and conservation efforts.

Presented as intuitive maps, ITW 3.0, includes datasets from key Indian government agencies and other organizations, real-time satellite data of surface water availability from NASA and U.S. Geological Survey (USGS) and Water stress models developed by the World Resources Institute (WRI) and Columbia Water Center (CWC). IWT 3.0 provides access to:

- Comprehensive data on water availability, quality, and water stress,
- Watershed-level water-balance studies providing watershed health information and demand-side management.
- Aids in measuring and map water risk and prioritize locations for further analysis and site-specific water-management improvements

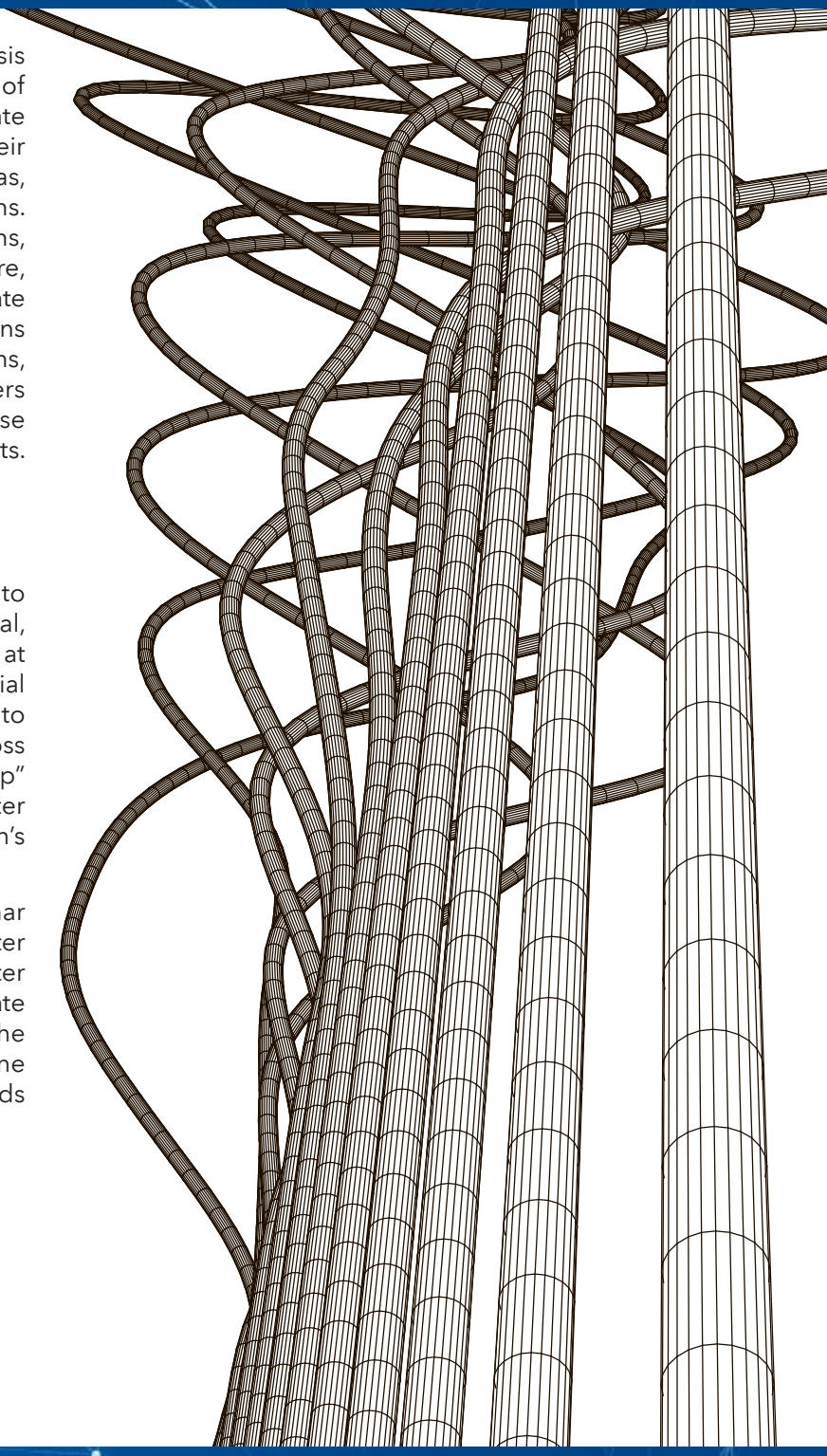
Organizations can use IWT 3.0 to generate reports with key water indicators mandated by corporate disclosure initiatives (GRI, CDP Water, DJSI, Bloomberg and UN CEO Water Mandate).

data can provide enhanced situational analysis and comprehensive impact assessments of water scenarios, thereby helping with accurate assessment of likely impact of the disasters, their geographic spread, hot spots, priority areas, appropriateness and efficacies of interventions. Advanced capabilities for intuitive visualizations, sharing and collaboration and anywhere, anytime access to required information, facilitate seamless intra and inter sectorial interactions between central, state, district administrations, NGO's, and other stakeholders. While this fosters inclusiveness it also promotes multi-fold increase in the efficacy of prevention and mitigation efforts.

In closing

As the geospatial infrastructure continues to play a vital role in integrating physical, social, institutional, and economic infrastructure at national, state and local levels, geospatial thinking offers numerous opportunities to accelerate digital transformation initiatives across the water sector holistically from "source to tap" and rapidly move towards integrated water resource management and strengthen nation's water resilience.

For India to achieve its vision of "Atmanirbhar Bharat (Self-Reliant India)" nations water resilience holds the key. Building a robust water resilience by leveraging strengths to anticipate future trends, prepare, manage, and mitigate the challenges effectively and efficiently, will be one of the critical success factors in our march towards being a US$5 trillion economy.



In Conversation with...

Shri Rajiv Ranjan Mishra,

Director General, National Mission for Clean Ganga (NMCG)

Q. Can you share how the National Mission for Clean Ganga has been progressing?

Namami Gange is a flagship programme of the Government of India for the rejuvenation of Ganga and its tributaries. National Mission for Clean Ganga (NMCG) is the implementing authority of this program. Authority constituted under the provisions of the Environment Protection Act (EPA), 1986, and is a part of the Ministry of Jal Shakti. Vision is to restore the wholesomeness of river Ganga in terms of Aviral Dhara (continuous flow) and Nirmal Dhara (unpolluted flow) along with preserving its ecological and geological identity.

The NMCG, backed by Ganga River Basin Management Plan by a consortium of seven IITs, has a holistic multi-sectoral, multi-agency and multi-level approach in four broad categories: Pollution Abatement (Nirmal Ganga); Improving flow and ecology (Aviral Ganga); Strengthening People, River connect (Jan Ganga) and Research, knowledge management (Gyan Ganga). Unlike previous efforts, it is not limited to cleaning or piecemeal selected city interventions but follows river centric, basin based approach for comprehensive rejuvenation. It is based on learnings from the past and also from some of the global best practices for river rejuvenation. Namami Gange's major components include the creation of sewerage infrastructure, solid waste management, industrial pollution abatement, rural sanitation and water quality monitoring, environmental flow, river front development, afforestation and biodiversity conservation, sustainable agriculture, public participation and policies, research & innovation.

Shri Rajiv Ranjan Mishra,
Director General,
National Mission for Clean Ganga (NMCG)

Q. How has GIS technology intervention helped augment the National Mission for Clean Ganga?

Technology is an integral part of Namami Gange's vision for clean Ganga. Namami Gange programme has high priority for research and evidence based decision making and has a special place for the use of new technology including geospatial technology. NMCG Authority order of Oct' 2016 states that the pollution in River Ganga and its tributaries shall be monitored by use of satellite imagery and other remote sensing technologies. One of the bottlenecks for a comprehensive planning for a river rejuvenation was the lack of scientific data, which requires detailed research studies based on geospatial technology. To overcome these issues, NMCG has sanctioned different GIS based research projects touching different aspects of river rejuvenation to use geospatial data in a wide

variety of areas, including legislative and policy development, the allocation and management of water resources, river system spatial planning, monitoring & basin management. NMCG is also using geospatial technology in outreach programme as online story mapping for students, citizen centric bhuvan ganga mobile app to get information from ground zero, GIS based dashboard to monitor NMCG interventions & water quality, river corridor mapping by LiDAR technology, mapping, biodiversity mapping, fisheries resource mapping, wetland mapping, water bodies mapping by UAV, microbial diversity mapping, cultural mapping, rivulet mapping, urban river mapping, aquifer mapping, high resolution climate scenarios for basin scale and spring rejuvenation mapping, etc. NMCG is leveraging the digital advancements by establishing a strong digital and geospatial data infrastructure like LiDAR data & other geospatial data of river rejuvenation. Significance of GIS framework had brought a paradigm shift in visualization of all crucial spatial and non-spatial information of Ganga basin to adopt accurate & transparent decision. Namami Gange has been recognized as India's leading programme in using geospatial technologies towards river basin management and regulating the proposed protected and regulatory zones along the banks of the river.

Q. Can you brief on the key challenges faced during project implementation and how the GIS technology addressed them?

During the course of River Ganga's journey from the Himalayas to the Bay of Bengal, municipal sewage from urban centres along its banks, effluents from industries, municipal solid wastes and polluting waste from several other non-point sources including agriculture get discharged into the river resulting in its pollution. Large scale abstraction of water from river Ganga for different purposes, most substantial being for agricultural use, leads to depletion of flow in certain stretches. Challenges in the accurate information system is another area where Namami Gange has been working. We have been trying to build an integrated and composite database of multiple sectors of Namami Gange including sewerage infrastructure, water quality monitoring, etc. But with multiple organisations in play, data validation takes time and resources. NMCG is expecting technology based decision making end solutions tools & technology for river rejuvenation.

Q. Forecasting the relevance of prevention & control of environmental pollution in the river with the fundamentals of next-generation society. How do you vision geospatial infrastructure and technological tools link in this journey?

As the NMCG authority order mandates the use of geospatial information and technology in river rejuvenation, there lies an opportunity for the technology solution providers and decision- makers to tap on to the true potential of geospatial information and technologies. Geospatial infrastructure and technological tools will support river rejuvenation journey. Geospatial infrastructure is enabling a whole new era of maps and language of understanding. Data science and location intelligence are playing an important role in data quality. Data quality will be the differentiator. Remote sensing and IoT will be critical components in integrated decision support systems. It will increase the frequency of acquisition, there will be greater demand for insights from the geospatial data collected for river water quality trend analysis. These systems will be used for hydrological & hydro dynamically modelling and monitoring water resources to better understand riverine ecosystem. Next generation of remote sensing & GIS technology will help to achieve the goal of river rejuvenation. Geospatial sector need to transform from a data-based paradigm to a solutions-based paradigm. Space assets provide vital information and services that will positively contribute this journey.

AMRITA VISHWA VIDYAPEETHAM
DEEMED TO BE UNIVERSITY

ADVANCING SUSTAINABLE DEVELOPMENT IN INDIA WITH GIS

Development and data are highly interdependent, and both are necessary for mankind to make sustainable progress. GIS brings a whole new dimension to this duo, called precision. It is a ground-breaking technology that has made it possible for us to revisit and interpret data in different ways.

Amrita's initiative to inculcate GIS in its curriculum has led to a cooperative partnership with Esri India. This partnership will leverage GIS applications for various research initiatives at Amrita. A Center of Excellence in the area of "Geoinformatics and Spatial Analytics & Modelling" will be established at Amrita with dedicated Research, Development and Test facilities. The center will focus on capacity building for geospatial research in several domains. As a part of capacity building technical webinars, workshops, hackathon, short certificate courses and GIS-based academic programs will be offered by the Centre in partnership with Esri India.

Amrita Centre for Wireless Networks and Applications offers a dedicated Mtech program in Geo Informatics and Earth Observation that aims to provide the students with an opportunity to acquire detailed systematic knowledge and critical understanding of spatial environment related processes. The program also introduces state of the art technologies for data collection and analysis, as well as the ability to independently develop innovative solutions to complex problems in the areas of natural and man-made environments.

There is growing evidence that GIS helps professionals from any field in making decisions with greater confidence and efficiency. GIS is also about great savings. With GIS, one not only saves on cost and effort, but also indispensable resources of time and energy. Amrita's strategic partnership with Esri India foresees the launch of well-trained and highly capable manpower who can work towards solving real world problems, thereby contributing to the United Nation's 2030 Agenda on Sustainable Development. Application of GIS technology in the curriculum will help Amrita deliver more impactful research outcomes.

GIS professionals have the edge of becoming leaders in any field. Whether adding value to a business or diversifying research or giving better direction to policy and decision makers, a GIS professional has it all.

Experiential Learning at Amrita: Breaking the classroom barriers

Amrita has launched a new school- School for Sustainable Development to further its sustainable development research initiatives. Under this school, the Live-in-Labs® academic program, a fully funded E4LIFE International Ph.D. Fellowship Program and several other Ph.D. and Minor programs are being offered that aim to develop SDG Champions. These programs utilize a multi-dimensional framework that facilitates the development and effective implementation of customized, scalable, and sustainable technological solutions to foster rural development. With over 150 projects in 21 states across India, Amrita Live-in-Labs® participants have touched the lives of approximately 60,000 rural residents during the past several years. With participation from over 40 institutions around the world and nearly 50 departments, schools, and centers at Amrita, students and faculty have clocked in a monumental 200,000+ hours in the field working towards sustainable development in rural communities.

About Amrita Vishwa Vidyapeetham:

Amrita is ranked as the no. 1 Private University in India by the Times Higher Education World University Rankings 2020 and is 4th best in the country. It has been recently awarded the Institution of Eminence status by the Government of India. Amrita holds two prestigious UNESCO Chairs, one on Experiential Learning for Sustainable Innovation and Development and the other on Women's Empowerment and Gender Equality.

RESEARCH PAPER

Hydrological modelling for rainfall-runoff estimate

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Introduction

Climate change is becoming one of the biggest challenges to mankind. Unusual occurrences of flood, drought, tsunami, cyclone etc. are posing serious threats to life and property. These natural hazards could be viewed as the manifestations of global climate change and call for immediate attention. Centre for Research on Epidemiology of Disasters (CRED) broadly classified disasters based on origin as hydrometeorological, geological and biological. Reports released by CRED show that, on a global scale, the percentage of increase in disaster events between two decades 1900-99 and 2000-2009 is more than 67%. Hydrometeorological origin (atmosphere, hydrological, and oceanic) in general claims for the maximum disaster to humans intelligently.

Water crisis that ultimately leads to drought is treated as a natural hazard of hydrometeorological origin. Sometimes it has a considerable temporal longevity that gradually leads to forced displacement, desertification and even loss of life. Across the world, many major cities are facing acute shortage of water during the lean periods making life much difficult. Despite great technological advancements, scarcity of freshwater still remains a serious issue.

In India also, repercussions are very much evident. India being a country of large geographical expanse with diverse bio-geo-physical and socio-economic characteristics with very high population density is vulnerable to many natural hazards of which many are accelerated by faulty human interventions. In any case, the frequency and type of natural hazards that hit the country has increased manifold. Data on multi-year droughts in India clearly reveals that frequency of the event in recent decades have increased alarmingly especially over central and peninsular India. There is also an increase in geographical area hit by moderate droughts.

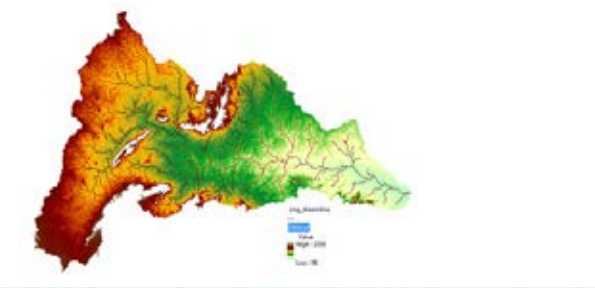
This paper attempts to estimate rainfall runoff relations using GIS and Hydrologic modeling. HCM methods are gaining popularity and

regarded as one of the best solutions for addressing hydrological issues. The river Ong and its associated basin area, (sub-basin of Mahanadi) of Peninsular India has been selected for this case study.

Study Area

The Ong basin, one of the right bank sub watersheds of the river Mahanadi has been selected for the present study. The basin area spreads over the administrative realm of two states namely Odisha and Chhattisgarh. Geographically the basin lies between the north latitudes 20o39'31" and 21o 28' 42" and East longitudes 82o 33' 13" and 82o50' 39". The total basin area is around 5128sq.km.

Odisha and Chhattisgarh states are frequently in news for the scanty rainfall and scarcity of fresh water for drinking and other domestic needs. Agriculture sectors of these states are also under stress due to lack of sufficient water in the reservoirs. Sometimes water level in many reservoirs goes below dead water level due to low rainfall. Keeping the above aspects in mind it was decided to take-up the present study with the core objective of understanding the rainfall-runoff estimate based on hydrological approach.



Physical and Hydrometeorological characteristics of the basin

The topography of the basin is highly rugged. The general relief varies from nearly 96m to more than 1000m with a general slope towards east. Abrupt variations in relief reflect the strong ruggedness and steep slopes in landscape. It determines many other properties of the basin such as drainage, water retention, vegetation, soil etc.

The area receives an average annual rainfall of 1300mm. The eastern region receives more rainfall (1600mm) than the western parts (900mm). Maximum rainfall occurs during the monsoon months i.e., June to September.

The soil types of Ong river basin are classified into four Hydrological Soil Classes A, B, C and D mainly based upon the infiltration rate and other characteristics. The general land-use has been identified as agriculture, forest and built up intervened with few water bodies. Drainage system is dendritic and the streams include both perennial and non-perennial.

Materials used and Methodology

For the present study, the materials used are ASTER DEM (30m resolution), Soil maps, Land-use Land-cover of Global land use/and cover data, maps etc. collected from different sources. Rainfall data used in this study was for the year 2009.

Terrain characteristics is one of the important parameters in hydrologic projects. In the present study, ASTER DEM of 30 m resolution is used to extract the terrain features. Terrain processing was carried out on DEM data using Arc Hydro tools. Base information on land-use and soil were adopted from maps of National Atlas and Thematic Mapping Organisation and National Bureau of Soil Survey and Land-use Planning, respectively.

ArcGIS Tools for Data Processing and Modelling

There are various methods in use for hydrological modeling. The present study is performed based on SCS-CN method with the help of GIS and Remote Sensing tools of ArcGIS. Specific tools such as Arc Hydro tools and HEC-Geo HMS tools of Arc GIS software were used extensively in preparing various data required for developing the hydrological model which included -

1. Processing various Raster and Vector Data in a sequential manner, aimed at Terrain Processing, the results of which were used to create input files for the hydrological model.
2. CN grid generation using Land cover data and

Soil Map of the basin.

3. Developing HMS Model using Arc Geo-HMS tools by 'extracting basin characteristics'
4. And finally making the model compatible and exportable to be used in HEC-HMS software for simulation and validation of the model, using the HEC-Geo-HMS tools.
5. After completion of the above process using ArcGIS tools, simulation of the hydrological model is done using the required tools of HEC-HMS software.

Pre-Preparations for Hydrologic Modelling Using ArcGIS:

The whole Pre-preparation processes include both raster data and vector data in a sequential manner as below.

Raster data processing include1. Raw DEM, 2. Hydro-DEM (DEM after reconditioning and filling sinks), 3. Flow Direction Grid, 4. Flow Accumulation Grid, 5. Stream Grid, 6. Stream Link Grid, 7. Catchment Grid, 8. Slope Grid

Vector Data processing include1. Catchment Polygons, 2. Drainage Line Polygons, 3. Adjoint Catchment Polygons

DEM reconditioning involves modifying the elevation data to be more consistent with the input vector stream network. This implies an assumption that the stream network data are more reliable than the DEM data. DEM reconditioning increases the degree of agreement between stream networks delineated from the DEM and the input vector stream networks. DEM reconditioning (or Agree DEM) pushes the raw DEM along the stream to create a distinct profile along the streams which otherwise may not exist in the raw DEM.

Extraction of Basin Characteristics

Physical Characteristics of Streams and Sub-Basins are extracted into the attribute tables. The following are the characteristics extracted:

1. River Length (populated in attribute table of River)
2. River Slope (populated in attribute table of River)
3. Basin Slope (populated in Attribute Table of Sub-basin)
4. Longest Flow Path (a new feature class with polyline feature is created)
5. Basin Centroid - This will create a Centroid point feature class to store the centroid of each sub-basin.
6. Basin Centroid Elevation - This will compute the elevation for each centroid point using the underlying DEM. This populates the attribute table of Centroid of Basins.
7. Centroidal Longest Flow Path - This creates a new polyline feature class showing the flowpath for each centroid point along longest flow path.

HMS Model Development Using Geo-HMS

The basic function of HEC geo-HMS tool is to create input files for hydrological modeling with HEC-HMS using the output of terrain processing and CN Grid.

Using the above inputs, a Project Point is generated in geo-HMS environment with Salebhata Gauge station as the outlet point.

HMS Input and Parameters

This study is based on the underlying principle that HMS should use the following functions for transform (rainfall to runoff) and routing (channel routing).

a. River Auto Name - This function assigns names to river segments. The Name field in the input River feature class is populated with names that have "R###" format, where "R" stands for river/reach "###" is an integer.

b. Basin Auto Name - This function assigns names to sub-basins. Like river names, the Name field in the input Sub-basin feature class is populated with names that have "W###" format, where "W" stands for watershed, and "###" is an integer.

c. Sub-basin Parameters - Depending on the method (HMS process) intended to use for HMS model, each sub-basin must have parameters such as SCS curve number for SCS method. So,

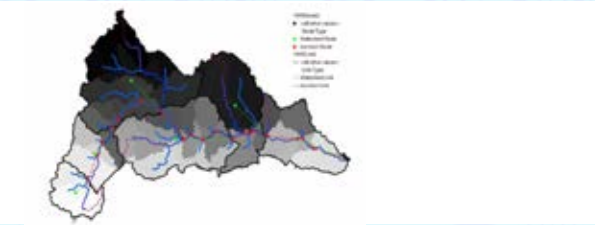
CN Grid is now added to the Project.

d. CN Lag Method- The function computes basin lag in hours (weighted time of concentration or time from the center of mass of excess rainfall hyetograph to the peak of runoff hydrograph) using the NRCS National Engineering Handbook (1972) curve number method.

HMS

a. Map to HMS unit tool converts units using the inputs from Raw DEM, Longest path, Subbasin, Centroidal Longest Path, River and Centroid.

b. Check Data - This tool verifies all the input datasets and the 'Checking Summary' was generated.



c. HMS Schematics - This tool creates a GIS representation of the hydrologic system using a schematic network with basin elements (nodes/links or junctions/edges) and their connectivity. Here two new feature classes HMS Link and HMS-Node are generated and added to the map document.

d. Add Coordinates - This tool attaches geographic coordinates to features in HMS-Link and HMS-Node feature classes. This is useful for exporting the schematic to other models or programs without losing the geospatial information.

e. Prepare Data for Model Export - This function allows preparing sub-basin and river features for export.

Background Shape File

This function captures the geographic information (x,y) of the sub-basin boundaries and stream alignments in a text file that can be read and displayed within HMS. Two shapefiles: one for river and one for sub-basin are created.

Basin Model:

This function will export the information on hydrologic elements (nodes and links), their connectivity and related geographic information to a text file with. basin extension. Following the above steps HEC-HMS project for Ong River Basin has been created successfully.

Opening the HMS model in HEC-HMS

After developing the whole model in Arc Map, it is opened in HEC-HMS to provide Meteorological data and Discharge data for simulation and validation. The final inputs are time series data i.e., the daily Rainfall data from the six Precipitation Gauge and the Discharge Data at the Outlet – Salebhata Gauge Station, for the year 2009.

Simulation of the Model

Finally, the model is prepared with all the required input data and its own structures. A Run is simulated using the input data of 2009 provided.

Conclusion

Hydrological model developed has provided rainfall-runoff estimation of Ong river basin based on 2009 data and the results exhibit satisfactory validation. The model developed could be used for rainfall-runoff estimation for future perspective. GIS and Remote sensing are proved useful tools for hydrological modeling using SCS-CN method which has advanced capabilities of handling large spatial data on soil and land-use. Since the present model is based on land-use and soil types, variation of runoff can always be treated as a function of changes in land-use and soil character. Thus, runoff changes over time can be compared to study the effect of changes in these two components of the physical environment.

GIS-BASED STUDY OF WATER SCARCITY IN PERU OFFERS REPLICABLE MODEL

Even before the Inca empire ruled much of the western coast of South America, indigenous civilizations in and around the Andes mountains farmed familiar crops such as quinoa, chili peppers, and the all-important potato. Today, descendants of those societies continue to farm diverse and globally valued crops.

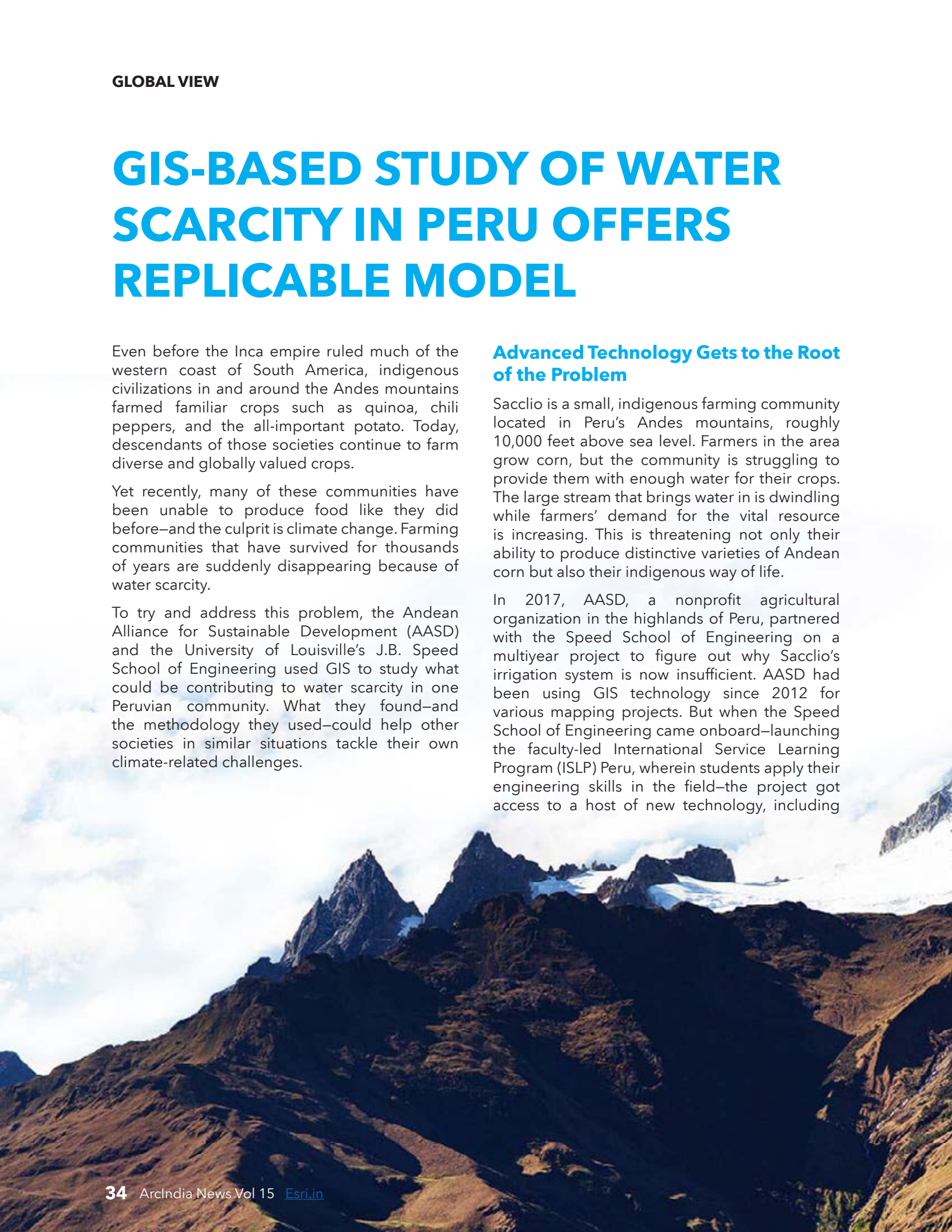
Yet recently, many of these communities have been unable to produce food like they did before—and the culprit is climate change. Farming communities that have survived for thousands of years are suddenly disappearing because of water scarcity.

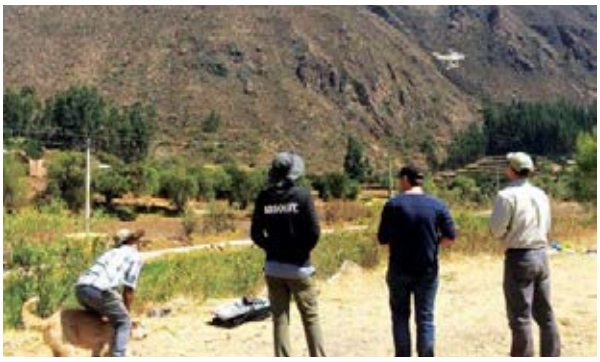
To try and address this problem, the Andean Alliance for Sustainable Development (AASD) and the University of Louisville's J.B. Speed School of Engineering used GIS to study what could be contributing to water scarcity in one Peruvian community. What they found—and the methodology they used—could help other societies in similar situations tackle their own climate-related challenges.

Advanced Technology Gets to the Root of the Problem

Sacclio is a small, indigenous farming community located in Peru's Andes mountains, roughly 10,000 feet above sea level. Farmers in the area grow corn, but the community is struggling to provide them with enough water for their crops. The large stream that brings water in is dwindling while farmers' demand for the vital resource is increasing. This is threatening not only their ability to produce distinctive varieties of Andean corn but also their indigenous way of life.

In 2017, AASD, a nonprofit agricultural organization in the highlands of Peru, partnered with the Speed School of Engineering on a multiyear project to figure out why Sacclio's irrigation system is now insufficient. AASD had been using GIS technology since 2012 for various mapping projects. But when the Speed School of Engineering came onboard—launching the faculty-led International Service Learning Program (ISLP) Peru, wherein students apply their engineering skills in the field—the project got access to a host of new technology, including





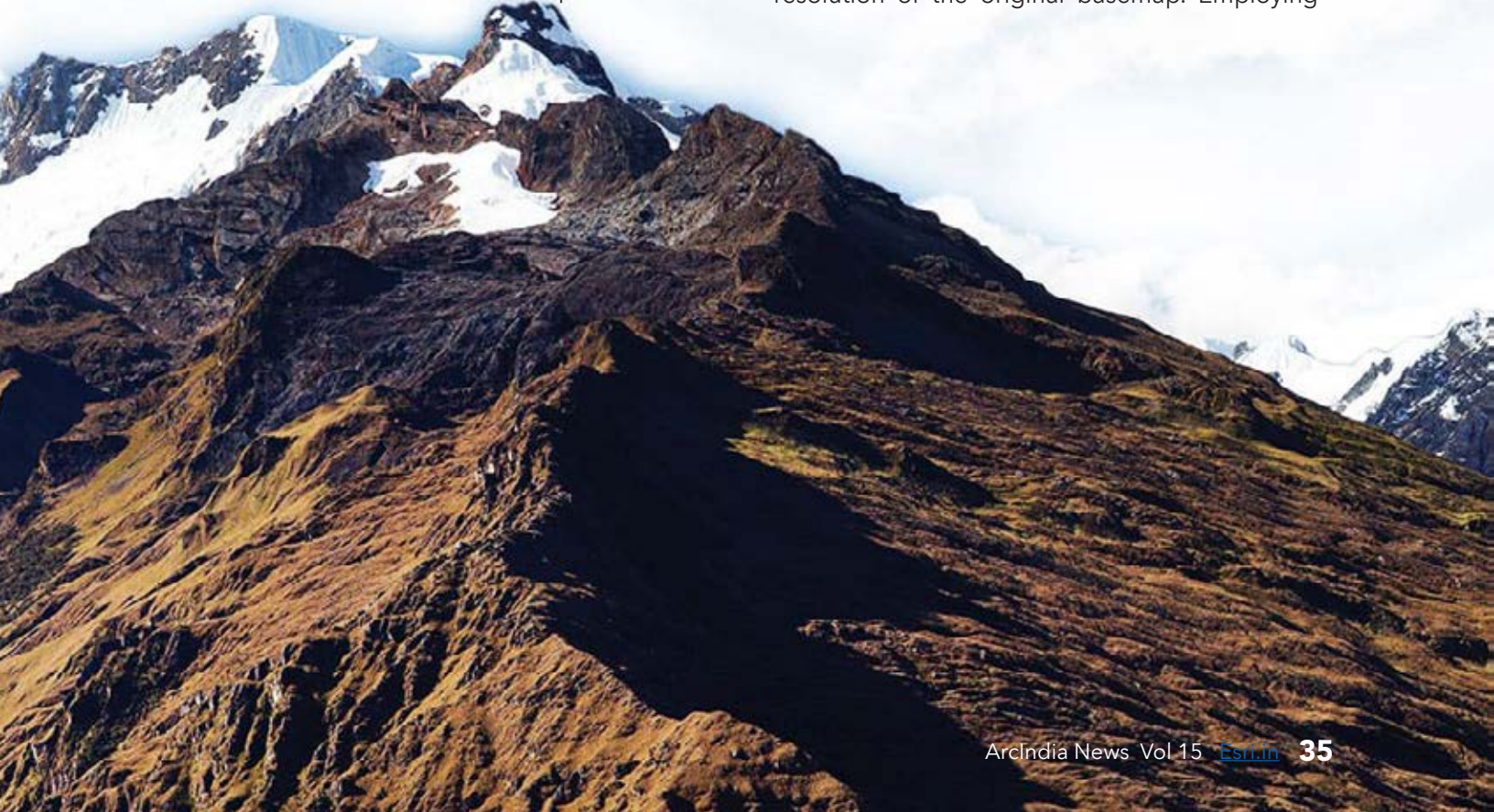
unmanned aerial vehicles (UAVs), Global Navigation Satellite System (GNSS) receivers, and water flow measurement tools.

To begin the joint effort in Sacclio, faculty from the university and staff from AASD used ArcGIS Pro to design the basemap that would depict the area of interest: the canal system that runs through the community. The team also used ArcGIS Pro to build the feature class templates that would be used in ArcGIS Collector to gather data.

In August 2018, a team of students from the Speed School of Engineering used Collector to map all 9 miles (14.4 kilometers) of Sacclio's canal system. This created records of the various materials the canal is made of—including cement, rock, and earth—its hundreds of valves, and any major damage points. After that, faculty members and select students cleaned and processed the data and analyzed it in ArcGIS Pro. This content was then published to ArcGIS Online, which GIS staff members at AASD used to create shareable web maps for further analysis.

The extent of damage to the canal from natural causes such as rockfall, uprooting, and erosion turned out to be so extreme that a team from the Speed School of Engineering returned to Peru the following year to continue the project. Faculty members and students redesigned the survey to capture more details about damage locations and improve its feature accuracy. They also used mapping-grade GNSS receivers from Esri partner Bad Elf in conjunction with Collector to boost location precision.

For the first time, the team also used UAVs to capture high-resolution imagery of the Sacclio canal system, which substantially improved the resolution of the original basemap. Employing



three Phantom 4 Pro quadcopters from DJI, project participants from the Speed School of Engineering and AASD collected thousands of aerial images over approximately 260 hectares of land. University faculty members then processed these images on-site using ArcGIS Drone2Map, which yielded two-inch pixel resolution. GIS staff from AASD then published the high-resolution imagery to the organization's ArcGIS Online account so it could be used as a base layer for all web app products.

In addition, the engineering students used improved technology to measure water flow rates again. Employing a Mariotte bottle (which allows fluid to flow constantly from a container), a Sonde electrical conductivity meter, and EcoWatch Lite software, they measured water loss in the canal by injecting measurable amounts of salt at certain points and seeing how much of it was still in the water at collection points downstream. The students found that Sacclio's canal system was losing up to 50 percent of its total water supply at the time the measurements were taken.

Data Visualizations Offer a Way Forward

With this more accurate data, hosted in its own ArcGIS Online environment, AASD was able to use ArcGIS Web AppBuilder and ArcGIS Configurable Apps templates to create two interactive web apps that make it easier to share critical information about Sacclio's irrigation system.

Each app includes three major data points:

- The percentage of water lost, broken down by canal segment.
- Major damage points along the canal, described by type of damage, the severity, and their locations.
- Overall statistics about the canal, including its width, depth, number of valves, and build material at various locations.

But the two apps serve different purposes and are designed to give users distinct experiences.

The Sacclio Main Irrigation Canals Water Loss Locator, built with the Interactive Legend configurable app template, is data oriented. Users can select, search for, or layer information in various ways to view specific stories about the challenges the Sacclio irrigation system faces. Each data point in this app has a corresponding photo or video that brings users closer to what's happening at various points along the canal.

The Main Irrigation Canals Damage Survey web app, built with the Attachment Viewer configurable app template, shows the depth and breadth of various damage points via photo-based storytelling. The map allows users to scroll through photos and videos of the entire canal and is an efficient and powerful way to communicate the severity of damage.

Having this quantitative data and spatial analysis

available in two easy-to-use web apps makes it easier for the community of Sacclio to convey the gravity of its water scarcity issue to stakeholders who can do something about it. For the past 10 years, the municipal government has consistently denied Sacclio's request for funding to repair its irrigation system. Without any compelling evidence or data, the government body has often deemed the problem not serious enough to warrant investment. But now, with the ability to quickly and efficiently share specific, location-based data with municipal representatives, leaders in Sacclio are confident that the community has a compelling case to receive funding to restore its ailing canal.

A Replicable Model Based on GIS

In the Peruvian Andes, indigenous communities face unprecedented environmental challenges that stem from irrigation issues, climate change, and erratic weather patterns. That's why AASD and the Speed School of Engineering plan to implement similar GIS-based programs in other nearby districts. Although GIS is underutilized in the area right now, the technology can be especially helpful to remote communities that need to document and communicate the issues they face. Thus, AASD remains committed to partnering with the University of Louisville—and perhaps other educational institutions—to use GIS to enact positive change in and around the Andes mountains.

What's more, impact-driven collaborations like ISLP Peru can and should be replicated around the globe. There are countless communities like Sacclio facing grave challenges due to changing environmental and climatic conditions. Connecting institutes of higher education with community-based organizations and local leadership is an effective way to use GIS to address complex challenges. This is a replicable model for development and experiential learning, and AASD will continue to refine it in the years to come.

WATER OUTAGE TEMPLATE FOR WATER UTILITY MANAGEMENT

Are you someone working on water utility management? Have you heard about the Water Outage template? If not, you are missing out on some very interesting functionalities.

The Water Outage template enables an organization to deploy a series of maps, apps, and workflows that enable water utilities to investigate leaks and main breaks, understand impacts to water system and customers and manage any service outages.

This template accounts for each step in the lifecycle of a leak or break. These steps are reporting the leak, validating the leak, investigating the leak, running the isolation trace to determine the extent, managing and communicating the outage.

In short, the Utility Isolation Trace template got advanced with more capabilities and became part of the new Water Outage template. The isolation trace included with the Water Outage template has been enhanced to perform a true isolation trace.

If you are familiar with Utility Isolation Trace template, you might be aware that it performed a simplified trace and only returned the valves closest to the leak or break. So, when a break occurred on or near a dead-end water main, the results of the trace could be inaccurate. If you wanted to run a true isolation trace, you had to use ArcMap.

For example, if a break occurred on the main pictured below, the Utility Isolation Trace template would return two isolating valves and only one hydrant out of service. Since the area south of the break is a dead end, the results are incomplete and misleading.

The isolation trace deployed with the Water Outage template can ensure a valid path to a source, which means it will return an accurate result. So, the break on the same main using the new trace returns the correct result of only a single isolating valve and three hydrants out of service.

Now, a Network Trace widget is also available which can be used by the Water Outage template in Web AppBuilder for ArcGIS.

In a nutshell,

- The Water Outage template helps utilities quickly respond to main breaks, reduce water loss, and mitigate the impact to customers.
- Water Outage includes maps and apps that can be used to quickly identify the extent of a break, notify appropriate staff, inform the public, and monitor response activities.
- These apps will be deployed in a dedicated ArcGIS Online organization and provisioned to key users within your utility.
- These maps and apps in ArcGIS Online are complemented by an ArcGIS Enterprise network trace service allowing you to run isolation traces on your network data in a hosted environment.

ARTICLE

New Geospatial Data Guidelines

A golden opportunity for the education sector

By imparting learning, generating knowledge, and fostering innovation, India's education sector has been playing a vital role in shaping India story. Cutting across the disciplines geospatial technologies have always been subject agnostic. Be it sciences, engineering, management, commerce or humanities, geospatial technologies are powerful tools to demystify the learning process for faculty and students alike. By fostering understanding in space and promoting contextual thinking, geospatial sciences have always come to aid of academia in solving complex problems innovatively.

Be it defence, infrastructure, agriculture, transportation, BFSI, retail, supply chain, natural resources, mining, environment, or social sector, each of these sectors rely heavily on geospatial infrastructure for their success. Behind the scenes are geospatial professionals who are instrumental in geo-enabling these sectors. And it is the academia that has been shaping these professionals in the classrooms.

Teaching geospatial has never been about books and classroom, it is spatial thinking and making sense with data in the context of geography that makes it complete. Restrictions on geospatial data have limited this pedagogical component for last many years.

Recently announced guidelines for "liberalisation of acquisition and production of geospatial data and geospatial data services including maps in the country" is a shot in the arm for the education sector. By providing freedom to contextualize location, these reforms clubbed with the new National Education Policy (NEP) offer immense potential to foster spatial thinking in the young minds and play a defining role in achieving India's vision of Atmanirbhar Bharat.

With restrictions and limited access to geospatial data, for long, academia and research have suffered silently and yet tried to deliver their best within the constraints they operated under. According to Dr. A. P. Sastri, Professor & Head, Department of CSE, PSCMR College of Engineering and Technology, Vijayawada "*The major roadblock has been in getting access to geospatial data and this imposed a challenge for the educational institutions to carry out the interdisciplinary analytical projects.*"

Freedom to collect, generate, prepare, disseminate, store, publish, update, and digitize geospatial data sets the stage for long awaited geospatial emergence. According to Prof. B. Srinagesh of Osmania University "*With the New Geospatial Policy, many opportunities have been unleashed. Anyone can create and recreate maps. It gives a lot of employment opportunities; it also helps in developmental activities and better decision making.*"

Prof. B. H. Aithal of IIT, Kharagpur says "*NEP 2020 envisions the technology as aspects of learning and geospatial data is the one tech that can help all other technology to be specialised. Geospatial data would open up more avenues that are challenging and help society in large.*"

With easy access to geospatial data, it is a golden opportunity for the Indian academia to bring a paradigm shift in the society by fostering spatial thinking, further research in geospatial sciences and technology to promote innovation and create new avenues for businesses and employment in coming times. Prof. Aithal adds "*Geospatial learning would become a part of the course*

curriculum so that the data is easily handled and exposure to data handling, data modelling and data sharing would become more open, and it would lead to access and good research."

Mr. Agendra Kumar, Managing Director, Esri India says "*We are delighted with this development. As an organization for last many years, we have focussed on geo-enabling the educational institutions and fostering geospatial thinking as a part of their learning culture. But access to data had always limited our efforts. We are now hoping to have an enhanced engagement with educational institutions in helping them adopt geospatial technologies for their academics and research and bridge the academia-industry gap more effectively.*"

Despite its numerous applications and opportunities, monetizing geo-data has always been challenging because of the restrictions. As a result, research and innovation at scale lacked in this area. With these new guidelines' academia can explore opportunities that data monetization offers in terms of building applications, solutions, and products. Dr. Sastri says, "*This will enable the rise of new technologies & platforms that will drive efficiencies in the domains of healthcare, agriculture, banking, and other allied sectors.*" Academia now has multiple opportunities to incubate start-ups who can leverage location-intelligent data for solving problems faced by business and societies.

Government's digital initiatives have had a limited participation of the academia over last many years. These new guidelines make it possible for the academia to actively contribute through research and innovation. Ar. Prof. S. K. Sharma, Associate Professor, RR School of Architecture And Town Planning, Lucknow says, "*As India is now more focused on the infrastructural development, through this liberalization the research institutes involved in master planning and execution of city, smart city, villages will get more precise and accurate spatial data and be able to meet the international standards.* "

Democratization of geospatial data opens doors for accelerating adoption of geospatial technologies by the Micro, Small and Medium Enterprises (MSMEs) by contextualizing their subjects to improve their operational efficiencies and enhance their offerings and services. There is a large untapped potential for the academia to collaborate and innovate with these sectors.

With a projected demand of 10 lakh geospatial workforce by 2025, academia has a huge challenge on its hand to meet this demand with trained, industry ready professionals. These reforms offer numerous opportunities for the Indian academia to shape the future of world's knowledge based geospatial economy while helping students to lay a strong foundation for their careers and ambitions in decades to come.

Mr. Agendra Kumar of Esri India adds "*To achieve global standards, it is important that a state-of-art geospatial infrastructure is available for the institutions to harness this data. It is our strong desire that every student across the country has access to latest geospatial infrastructure during their education.*" He further adds "*To augment classroom learning, Esri India offers various e-learning options tailored to different levels and their learning objectives. Our Learn ArcGIS program is designed for self-study and available at no-cost with 100+ learning modules. Through Esri Academy and Institutional Agreements (IA), we offer advanced learning experience, and MOOC's covering diverse range of topics. All these are easily accessible to the faculty, researchers, and students with a convenience to unravel the mystique of geospatial technologies, anytime, anywhere.*"

India is faced with complex socio-economic-environmental challenges, which have always intrigued the faculty, researchers, and students alike. By now it is well acknowledged that such challenges are best solved by harnessing "science of where". By thinking out of the box, it is time for academia to harness all the available resources to build a knowledge culture by fostering critical thinking, innovation and contextual problem solving in the classrooms. This will ensure that geo-professionals of tomorrow are well equipped to meet the emerging challenges of digital revolution.

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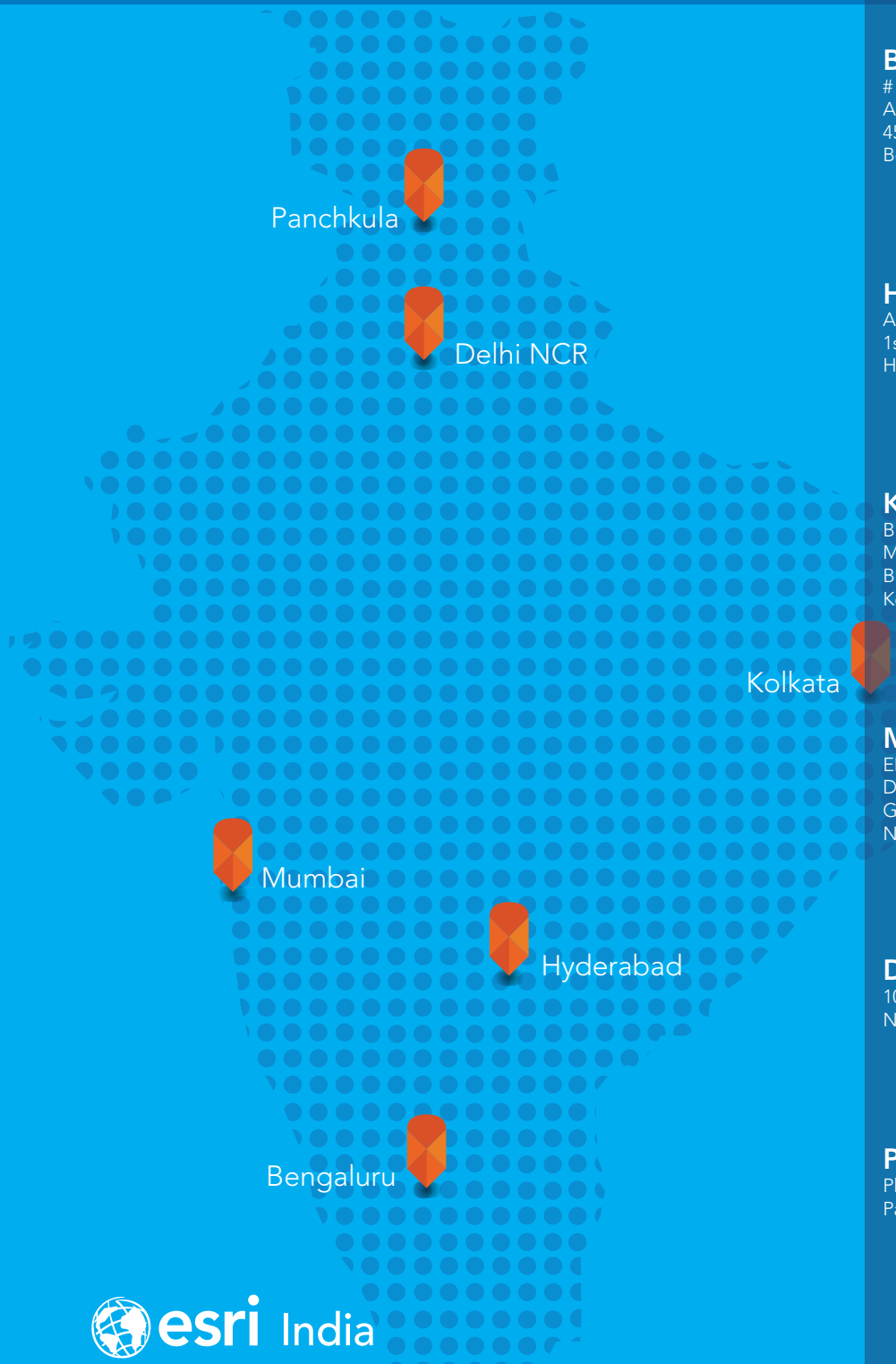

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