ASSOCIATION OF GEOSPATIAL INDUSTRIES

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From the President's Desk

A report by NITI Aayog estimates that nearly 40% of India's population will have no access to drinking water by 2030 and 6% of India's GDP will be lost by 2050 due to the water crisis. Approximately 600 million people in India are facing high to severe water stress, marking this as the worst-ever water crisis in human history. Thus, there is an imminent need to deepen our understanding of our water resources, usage and put in place interventions that make our water use efficient and sustainable.

The Government of India realizes this daunting issue and has taken numerous steps to address it, while emphasizing the use of technology for the purpose. In July 2019, the government had formed a new ministry, Jal Sakti, to address all water issues in the country. The ministry also looks at the management of water resources and drinking water supply in a holistic manner. The larger aim is to work with state governments to ensure 'Har Ghar Jal' to all rural households by 2024.

In view of the criticality of the looming water crisis and the untapped potential of Geospatial technologies to better serve this sector, the Association of Geospatial Industries hosted India Geospatial Leadership Summit-2021 as a virtual summit focusing on the theme, "Geospatial Technologies for Water Security" from 16th to 18th February 2021. GIS technology has been a key technology for country's water resource management requirements. Many central government organizations like CWC, CGWB, NRSC/WRIS, NMCG, and state water resource departments have been successfully using GIS for many years in improving the management of water resources.

It is heartening to note that in the budget for 2021-22, Finance Minister Mrs. Nirmala Sitharaman announced significant budgetary provisions for water sector. Geospatial technologies can play an important role to support the execution of Urban Jal Jeevan Mission program for providing water supply to urban households in 4378 ULBS and liquid waste management in 500 AMRUT cities where the government has announced an investment of Rs 2.86 lakh Crores over 5 years and Urban Swachh Bharat and clean air in 42 urban centres with over 1 million population investment of Rs 2217 Cr.

Lastly, let us welcome the new Geospatial Data Guidelines that the Department of Science and Technology released on 15 February 2021. The new guidelines are expected to add a dose of fresh air to the geospatial industry, as it removes the need for permissions and many controls which were hampering the creation, use and sharing of geospatial data.

Hope this issue brings more clarity about the water crisis faced by our country and the role Geospatial technologies can play in addressing it.

Happy reading,
Agendra Kumar

In this Issue

Article

India's Water Scarcity: Challenges and Solution

by: Mahashreveta Choudhary

Water is the foundation of life and an essential resource for flourishing life on Earth. It is critical for all be it households, industries or agriculture sector. No surprise then that the United Nations Sustainable Development Goals holds immense importance to water, with Goals on Clean Water and Sanitation, Industry Innovation and Infrastructure, Sustainable Cities and Communities, Climate Action, Life Below Water and Life on Land all having components related to availability of clean water for success.

Even when 70% of the Earth comprises of water, it is only a small percentage that is usable which leads many countries to battle issues of water scarcity. Highlighting India's water scarcity issue, **G C Pati, Chairman Central Ground Water Board** illustrates, "The growing needs of India's population, urbanization and industrialization have put India under pressure resulting in conflicts related to water." In the country, more than 50% of the population does not have access to safe drinking water and about 2,00,000 people die every year due to this. Over 75% of households do not have access to clean drinking water. In rural India, the situation is more severe, due to water scarcity women and children travel between 200 meters to 5 km daily to access water. UNICEF data says the estimated economic burden of waterborne diseases in India is approximately US$ 600 million.

Per capita water availability in India as compared to other countries is comparatively low and the situation is getting worse by the day. Elaborating on this point, **Rishi Shrivastava, Director Remote Sensing at Central Water Commission** says, "there are nations which have per person water storage infrastructure of more than 5000 cubic meters whereas in India we have 200 cubic meters of storage capacity per person. This is a major concern leading to drought in several parts of the country."

Government Initiatives to Tackle Water-related Problems

The Government of India has taken concrete steps to tackle the challenges related to the water sector, starting with the formation of the Ministry of Jal Shakti, which was created with a mission to achieve optimal sustainable development through efficiently using water resources that can adhere to the need of the growing population. Under this ministry, various projects have been launched. For clean drinking water availability, the government has launched the **Jal Jeevan Mission** that aims to provide safe drinking water to every household through functional tap. Through the Swajal Scheme, the government is enabling communities to manage safe water sources within their habitations by themselves. **State Water and Sanitation Mission and National Rural Drinking Water Program** have also been launched in every state so that the remotest part of the country gets piped drinking water. Accentuating the importance of groundwater, **Atal Bhujal Scheme** was launched in 2019. The plan aims to improve groundwater management through community participation in identified priority areas.

Rivers are the lifeline of India and understanding their importance, various plans have been launched that strive for river rejuvenation, cleaning of river, river basin management and interlinking of rivers, etc. These plans are river specific like the **National Mission for Clean Ganga** that aims to ensure greater equity in the distribution of water by enhancing the availability of water in drought-prone and rain-fed area.

The government has also rolled out **National Hydrology Project** to improve the extent, quality, and accessibility of water resources information. The program is aimed at achieving a decision

support system for floods and basin level resource assessment, planning, and strengthening the capacity of targeted water resources professionals and management institutions in India.

Under the National Action Plan on Climate Change the country established its 8th National Mission as **National Water Mission** with the main objective to conserve and manage water in such a way that no one is left behind. The National Water Mission envisions having a comprehensive water database in public domain so that assessment of climate change and its impact on water resources can be done. This will also allow focusing on the vulnerable areas including areas that have been over-exploited for water generation, promote basin level integrated water resources management and minimize wastage of water to ensure more evenhanded supply throughout the country.

Roadblocks Leading to Water Scarcity in India

India's daunting water security challenge has several reasons acting as a catalyst, including rapid urbanization and industrialization coupled with a poor water management system. **Prof. A K Gosain, Professor Emeritus**, at the Indian Institute of Technology, New Delhi points out that "the country does not have a comprehensive water policy which leads to mismanagement and uneven distribution of water between various sectors."

Severe climate conditions are also one of the reasons adding to the water scarcity. Due to diverse climatic conditions and rainfall distribution across the country, we have both draughts and flood happening at the same time which affects the water conditions. Due to variation in climate the average monsoon rainfall of the country reduced to 22 days from earlier 45 days, has deteriorated the water level of rivers. On the other hand, an increase in industrialization and weak waste management is resulting in river pollution.

Technology for Water Security

The government of India understands the importance of technology and thus stresses upon its use in various schemes designed to make India a water secure country. In its recent guidelines for acquiring and producing geospatial data and geospatial data services, the Government of India acknowledged that the availability of comprehensive geospatial data can enhance and benefit diverse sectors of the Indian economy. Emphasizing the usefulness of new Geospatial Policy Guidelines, **Dr. K J Ramesh former Director General Indian Meteorological Department** articulates, "New Geospatial Policy Guidelines is a huge step in the liberalization of geospatial data production, and will prove beneficial in the water sector."

Geospatial technology coupled with other cutting-edge technologies have a tremendous contribution in the assessment of environmental flows, flood forecasting, inundation mapping, river morphology, reservoir sediments assessment, water resource management and irrigation planning. For water as a utility, geospatial technology combined with Internet of Things (IoT) and sensors can be an effective tool for decision makers in the distribution and movement of water. It can help in efficient water distribution, identify leakages, and manage adequate water pressure. Let us have a closer look at how geospatial data and technology is adding value to India's dream of becoming water secure nation.

Watershed Management and Water Conservation

For India to achieve sustainable water resource management it requires better knowledge of linkages between various watershed components along with knowledge of useful indicators of water resource conditions and quantitative method to assess land use and watershed management practices that can yield better understanding of risks and uncertainty for better decision-making.

Mr. Srivastava gives a very comprehensive analysis illustrating differences in results while assessing water resources with and without geospatial technologies. He explains, "Central Water Commission did an assessment of water resources of the country in 1993 where geospatial technologies were not used. The data that was derived from the survey was not accurate resulting in various assumptions related to groundwater data, surface water data, and water utilization by medium projects and micro-projects. In 2019 the assessment was done again using space technology which helped us tackle many challenges."

The Project Mission Water Conservation under MGNREGS mapped 1,520 Gram Panchayats in 88 blocks covering 5 districts of Andhra Pradesh using geospatial technology. This study provided 32,000 locations of water conservation sites in 1521 GPs. The project also yielded state, district, block, village, and cluster-level capacity building and intuitional arrangements and developed a Web Portal WEBGIS.

With the help of aerial photography and satellite imagery water resources like lakes, rivers, ponds, and potential groundwater zones can be identified. The technology can help create terrain modeling, flow modeling, and debris flow probability to understand the condition of watersheds. It also helps create a Digital Elevation Model (DEM) of watersheds to represent delineation and drainage patterns which are used to study parameters like its flow direction, drainage network, and slopes.

Availability of Clean and Safe Drinking Water

Geospatial technology can help in the entire supply chain of drinking water availability and distribution. In conjunction with various cutting-edge technologies, it helps maintain up-to-date data for effective decision making and streamline essential processes providing improved insight that results in better operations, planning, and water distribution. It can help in household mapping, identifying available sources of drinking water and areas that need more attention.

Agreeing upon the usefulness of the technology, **Rajesh Kalra, Director Operations and Maintenance at the Orange City Water** says, "remote sensing technologies helps to build hydraulic modeling that is useful in analyzing the available resources and plan distribution accordingly. However, providing drinking water and providing clean drinking water are two different things" adds Mr. Kalra. "Water system is getting polluted, and its consumption can be harmful. Geospatial technology can be helpful in identifying the health of water and examine if the water can be used for drinking purposes or not" adds **Debpriya Dutta** who is Head /Scientist G - Science for Equity, Empowerment and Development (SEED) and National Geospatial Programme Division at the Department of Science and Technology.

"Mapping underground assets are also very crucial to reduce water wastage. These are hidden treasures and cannot be analyzed offline." says Mr. Kalra.

Geospatial technology has helped Orange City Water in mapping underground utilities like, pipes, valves, water meter, etc. that helped Orange City Water in eliminating non-revenue water.

Groundwater Conservation and Use

India is among the top 10 countries in groundwater abstraction. It is the most preferred source as extraction of groundwater is low in terms of cost and there is independence in its operation, which means anyone can extract it. The situation has led to its critical shortage. G.C Pati explains "that 17 percent of the groundwater resources in our country are over-exploited and 20 percent of them are either in critical or semi-critical condition. In northern states, the groundwater extraction is more than 100 percent."

Remote sensing technology can help in preparing an extensive 3D map of potential groundwater zones and then further dividing it into different categories depending upon the water level like extremely low, low, moderate, high, and extremely high. The technology can also help define the surface water bodies, **estimate meteorological variables such as temperature and precipitation, assess hydrological state variables like soil moisture and land surface characteristics. It can also help to estimate fluxes like evapotranspiration,** which in simple terms is the sum of water evaporation and transpiration from a surface area.

"Nevertheless, all the groundwater that is available is not suitable for drinking. It is affected by arsenic, fluoride, salinity iron, calcium, etc. depending upon its geography," says Rishi Srivastava. Thus, it is critical to understand the health of the groundwater and decide whether it is appropriate for drinking or not.

River Rejuvenation Programs

It is important to understand the dynamics of river and its riverine ecosystem before initiating river rejuvenation project as rivers have multi-directional movements. They are also an interplay of atmosphere, hydrosphere, and lithosphere.

"To understand rivers in a holistic way geospatial technology can help in understanding the hydrological process of the river that makes the job easy in detecting changes like delineation in river movement and disturbed ecology around it," explains **Lingaraju Yale** who is designated as **National Director River Rejuvenation Projects of Art of Living.**

Rajiv Ranjan Mishra, Director General of **National Mission** for **Clean Ganga** too advocates the use of geospatial technology in reviving rivers. Mr. Mishra says, "NMCG has a special place for the use of hi-end technology including geospatial technology. We have initiated a very path-breaking project along with Survey of India (SoI) on generation of high-resolution DEM and GIS ready database for part of river Ganga using LiDAR mapping." DEM models will provide valuable information for use not only in making urban river plans but also for identifying the baseline of river flood plains and regulating them for their restoration and preservation.

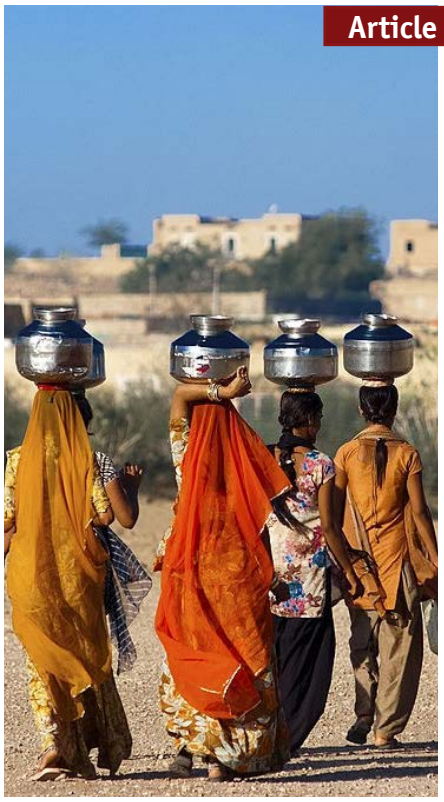
To maintain flow of rivers and distribute water evenly across the nation to avoid situations like flood and drought, the Government of India has initiated a project called **Interlinking of Rivers**. National Water Development Agency (NWDA) that aims to maintain the ecology and sustainability of rivers is using geospatial technology to understand the characteristic of rivers during monsoon and non-monsoon season to prepare Detailed Project Reports of various interstate and intrastate river links projects.

"We have prepared water balance study reports and analyzed 137 basins and sub-basins and 71 diversion points where we can divert river water during monsoon seasons to water short areas and store at appropriate locations. Remote Sensing technology helped us understand 16 links projects under peninsular components and 14 Himalayan components." says **Jancy Vijayan**, Director (Multi-Disciplinary Unit) of NWDA.

Construction of Large Hydrological Projects

For continuous strengthening of dam safety activities together with the World Bank, the government of India has launched **Dam Rehabilitation and Improvement Project (DRIP).** Under this project, approximately 225 large dam projects in Madhya Pradesh, Orissa, Kerala, and Tamil Nadu will be rehabilitated.

Mostly, dam site selection is done by traditional methods or according to political interests. However, remote sensing and geographic information systems (GIS) techniques are recently emerging as some of the most appropriate approaches to understand dam sites. Stressing upon the use of technology in dam construction, **Nikhil Kumar**, **Vice President AGI** and **Head Strategic for South East Asia and India** for **HERE Technologies** explains online GIS tools help in identifying



the areas for the construction of dams and monitor their progress. The technology is useful in reducing the costs by one-third and ensures that the project is going in the right direction. The technology has a lot to offer in the monitoring of dams as they themselves are one of the vulnerable points of collapse that can lead to disasters like floods. A number of new age technologies like optical sensors, GNSS and hydrological Sensors help in assessing the risks involved in managing and monitoring dams.

Conclusion

Water availability has been a major concern for India where many cities and states are dealing with the problem of water shortage. To achieve a better outcome in efforts toward water security, the Government of India has come up with several projects where geospatial content and technology are adding value. Integrated water management is important for sustainable social and economic development where geospatial analytics can help in optimizing the availability, access, and use of water resources in every sector that will help in the longer run.

NOTE: *Inputs for the story were taken from the proceedings of* **India Geospatial Leadership Summit** *organized by Association of Geospatial Industries on the theme* **"Geospatial Technologies for Water Security."**

Geospatial Technology Would be a Key Enabler in Overcoming Water Challenges

Geospatial technology will help in real-time accurate 2D-3D data acquisition, quick processing and creation of an integrated geospatial water platform with spatial database says **Pramod Kaushik**, President, Hexagon India and Senior Vice President, AGI India in an exclusive interview with the Association of Geospatial Industries.

Q. How does Hexagon perceive India market? Tell us about some initiatives by Hexagon that helped India fight COVID-19 battle ?

India has always been a focus for Hexagon. It has been consistently growing both in terms of technology adoption and socio-economic development, and we see a great potential to contribute to this growth story through our technology in helping and serving the Government, private enterprises, farmers and the citizens of our country. For decades we have been serving and supporting our customers in defense and security, law enforcement, mapping organisations, oil and gas, industrial manufacturing, mining, forest and agriculture, automobile industries, transportation, urban transformation, etc.

Hexagon has developed a series of simulations intended to help governmental authorities, healthcare organizations, and the general public to better understand guidance on social distancing and protective coverings and combat the spread of COVID 19. We have deployed POC of Hexagon COVID 19 quarantine patient tracking system with Rajasthan Government. Our mobile alert-based crowd sourcing application has been deployed on NIC India cloud, which would enable the citizens to report any Geo-tagged incidents. Additionally, our customers now have remote access to their software license agreement without additional paperwork with the free license support to Work-From-Home (WFH).

Q. Hexagon has a bold vision for an autonomous future where business, industry and humanity sustainably thrive. How is the organization working to build India's autonomous future?

We are leading a revolution in which autonomy can be achieved for any task, work process, entire operation or industry. This shift from automation to autonomy is monumental, so critical to our collective future. Simple notion of putting data to work is our key focus at Hexagon.

Hexagon's Smart Solutions portfolios (Smart Manufacturing, Smart Industrial Facilities, Smart Mines, Smart Farms, Smart Autonomous Mobility, Smart Buildings and Infrastructure and Smart Cities and Nations) purposefully empower an autonomous future — where data is fully leveraged so that business, industry and humanity sustainably thrive.

We are excited and hopeful that the Government would adopt our innovation in industrial automation, location intelligence, machine automation, machine learning, deep learning and artificial intelligence in their mainstream initiatives like Digital India and Aatamnirbhar Bharat (self-reliant India).

Q. What are the upcoming technology innovations from Hexagon that we can look forward to? How will these impact India?

In geospatial space, there are many upcoming technology innovations from Hexagon, for example the Geo-Design in Digital Reality. Today all architecture designs, be it land scaping or building infrastructure, are made in computer aided design software. These designs need to be examined and analyzed with a geospatial context. Our enhancement in Luciad portfolio that delivers immersive 3D experiences

with 360° panoramic imagery supports visualization in digital reality. This bridges the gap of planning and as-built. Our other innovations in Machine Learning and AI will also disrupt India market.

Q. Access to safe drinking water has been a grave problem for India, especially in rural areas where lack of usable water has resulted in decades old sanitation and health problems. How does solutions offered by Hexagon help our country to address this pertinent issue?

Hexagon offers a range of solutions. Our solution designed for the water sector can help rural water supply departments and metropolitan water, sewerage, and sanitation departments to maintain enterprise level comprehensiveness, accurate, and up-to-date location based inventory of their network assets and make that information readily accessible throughout the department. Hexagon water solutions enable extensive use of data and capabilities to streamline vital processes and provide enhanced insight to inform operations, planning, and customer services. These solutions will help reduce wastage, reduce non-revenue water and transmission and distribution losses.

Key components of our water solution include:

1. Network design and documentation that efficiently designs, documents, and manage water networks.
2. Operation that connects the enterprise to enhance data flows and better target resources.
3. Enterprise Integration to maximize data use and cut integration costs.
4. Customer services to ensure customer satisfaction.

Our Command Control Centre helps to monitor assets and resources through camera integration, outage management, mobile workforce management and Supervisory Control and Data Acquisition (SCADA) integration. We also have hydraulic modelling for detecting leakages and demand forecast models and solutions for Water Pressure Management to plan water distribution suitably.

Q. What role do you foresee for geospatial technologies that can help India overcome our water challenge?

Geospatial technology would be a key enabler in overcoming water challenge. GIS will help in real-time accurate 2D-3D data acquisition, quick processing and creation of an integrated geospatial water platform with spatial database on rainfall, extreme weather, soil characteristics, catchment areas, water bodies, land use and land cover, agricultural practices, irrigation demand, distribution network, transmission network, storage capacity, urban water demand, etc. On top of the platform spatial analysis, predictive modelling, Artificial Intelligence and Machine Learning tools will further enable science based planning and management of natural resources by policy makers, government departments, research organizations and citizens.

Q. Hexagon is a global conglomerate serving over 50 countries around the world. Water is a critical issue for most countries. Can you share some examples of solutions that Hexagon has rolled out in an international setting? How has that experience been different from the Indian one?

Hexagon has worked for various water resources or utility management companies. Some of these are Anglian Water Resources and Infrastructure in England and Wales and Perusahaan Daerah Air Minum that supplies drinking water to Banjarmasin, Indonesia.

Anglian Water partnered with Hexagon's Safety and Infrastructure division to create an advanced utility GIS that would provide a single, modern IT environment for the utility providers. Powered by Hexagon's utility GIS solutions, Anglian Water operates an advanced water and wastewater infrastructure management system that features a highly accurate network model of all the distribution assets of the system, including water mains and sewers, storage reservoirs, pumps, pipelines, valves and meters, and more. Our solution helped to streamline incident and outage management and seamlessly connected operations teams and field crews. According to Anglian Water's annual performance reports, the program is working properly satisfying more than 94% of its customers.

Perusahaan Daerah Air Minum supplies drinking water to Banjarmasin, Indonesia and uses Intergraph G/ Technology from Hexagon Safety and Infrastructure division to analyze and maintain asset data model based on the daily maintenance operations within the organization. Intergraph G/Technology enables PDAM to maintain the location based asset data needed to inform and coordinate the planning, construction, and operation of their network fulfilling the regulatory requirements and creating a readily accessible, definitive source of information. This ensures record are current, consistent, and accurate.

For long, India has been using remote sensing, GIS and other Geospatial technologies supported by ISRO, State Space Application Center and center ministries for planning and development. While Geospatial data availability has improved, the real challenge still lies in generating a reliable geospatial data that is up-to-date and contextual. Also, these data sets are owned by multiple departments that work in silos, having different update frequency, data model, scale and lot of redundancy. The challenge for users in India is having a quality geospatial data, so that the analysis leads to a right actionable information.

Hexagon understands this challenge and provides a powerful, flexible GIS management platform that lets Indian customers aggregate data from a variety of sources and analyze them in unison to extract clear, actionable information. Indian customer can perform sophisticated analysis to extract information from data stored in multiple databases on different platforms and a variety of different files, all at once. It also enables you to create queries of unlimited intricacy, creating and concatenating queries together so that the results of one query feed into another query dynamically.

NMCG is Expecting Advance Technology Based End Solutions for River Rejuvenation

NMCG is leveraging the digital advancements by establishing a strong digital and geospatial data infrastructure like LiDAR data and other geospatial data of river rejuvenation, says **Rajiv Ranjan Mishra**, Director General, National Mission For Clean Ganga in an exclusive interview with Association of Geospatial Industries.

Q. What are the key highlights of the Namami Gange flagship programme?

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. NMCG has initiated a comprehensive approach to champion the challenges posed to Ganga through different sectors, namely, wastewater management, solid waste management, industrial pollution, riverfront development, biodiversity conservation, afforestation, river management planning, and wetland conservation. Pollution abatement measures comprehensively tackle all sources of pollution such as municipal sewage, industrial effluents, municipal solid waste, non-point sources of pollution such as agricultural runoff, open defecation, un-burnt bodies etc. Interventions for ecological restoration, and including scientific afforestation, catchment area treatment, biodiversity conservation, determination and implementation of environmental flow, demand-side management to reduce abstraction of water with sustainable agriculture, wetland and spring rejuvenation, improving groundwater through aquifer recharge, flood plain protection, etc, also forms a part of the overall rejuvenation process.

Namami Gange Programme is an initiative of NMCG and its state counterparts—State Programme Management Group. A total of 326 projects have been sanctioned under this programme at a cost of Rs. 29186.58 crores. 137 projects have been completed and the remaining are in progress. Pace of execution and consequently the expenditure has increased many folds with the expenditure for FY 2019-20 being Rs. 2673.09 crores as compared to Rs. 170.99 crores in FY 2014-15. Environmental Awareness through campaigns like Ganga Run, Ganga Amantran, Ganga Utsav, Ganga Quest, community engagement through IEC activities are fostered for maintaining the cleanliness of river and its conservation.

Q. What are the main challenges that you are coming across in this project?

1. **Maximum utilisation of sewage treatment capacity**: Sewage treatment plants (STP) have been at the centre of Ganga pollution abatement. Land acquisition and other related activities were taking a lot of time. The issue is just not with the construction or rehabilitation of STPs but also their performance with reference to maximum utilisation of sewage treatment capacity.

2. **Restoring the flow**: For the first time, notification for ecological flow was issued for River Ganga, formally establishing the right of river over its own water which has far reaching implications for ensuring river health in the long term. Scientific plan for afforestation along Ganga with the help of FRI is under implementation. Biodiversity conservation for Ganga has been taken up with WII mapping the biodiversity for the entire length and scientific improvement of habitat, species and community participation. Similarly, program for fisheries resource and their conservation has been taken up in association with CIFRI. A river is a self-purifying system only when water flows through it. So, it's not just about unclean Ganga. It is

about the existence of Ganga. If the flow in the river is maintained it can solve the problem of 60-80 per cent of organic pollutants.

3. **Faecal Sludge Control**: A staggering 99.93 per cent villages lying on the banks of Ganga, also known as Ganga Grams, have been declared open defecation free (ODF) by the government under the Swachh Bharat Mission (SBM). As per SBM data, more than 1.19 million toilets have been constructed in over 4,465 villages till December 23, 2020. The whole objective of making villages lying in the Ganga basin to be ODF was to reduce the faecal coliform levels in the Ganga. What should causes bigger concern is that faecal sludge is a bigger pollutant than sewerage, and if proper faecal sludge management is not in place, it would invariably pollute the Ganga. Plus, the pollution from the cities flows through a network of small and progressively larger open drains, which eventually flow into the Ganga. None of the cities have a scheme for management of solid waste, most of which is dumped in the streets, clogging open drains and adding to the pollution load. Only a fraction of this waste is collected by the Nagar Palika Parishads and dumped at the city limits without treatment or recycling.

4. **Cost overruns**: Cleaning up the massive stretch of 2,525 km that the Ganga traverses is a programme where regulating the finances is a big issue.

5. **Governance limitations**: The cleaning of the Ganga requires seamless coordination between the agencies responsible for carrying out different tasks. This calls for vision and a clear-cut governance strategy. Several attempts have been made to clean the river Ganga since 1986 with a long history of programs, schemes and ministries. There has been a long pending demand and aspiration to see a clean Ganga in a time bound manner. This demand was acknowledged while announcing an integrated programme – Namami Gange –and several new policy decisions were taken to address them. But only after an integrated programme was launched in 2014, with a dedicated budget of Rs. 20,000 crores for a period of 5 years (2015-2020), and strengthening the administrative structure of NMCG and an institutional mechanism linking management at National level to the District level, the project started showing desired results.

Q. How are you using geospatial technologies in your projects?

NMCG is executing a number of research projects based on Geospatial technology. NMCG is a comprehensive organisation with high priority for research and evidence based decision making and has special place for hte use of hi-end technology including geospatial technology. Geospatial technology is widely used in river basin management. NMCG is executing number of research projects based on Remote Sensing and GIS technology. NMCG is also using geospatial technology in outreach programme as online story mapping for students, citizen centric bhuvan ganga mobile app to get information of ground zero and GIS based dashboard to monitor real time information.

Q. Who is responsible for executing geospatial solutions for your projects?

GIS cell is responsible for executing GIS in various projects of NMCG. The organization is equipped with advance GIS desktop software, GIS server with portal, image processing software and surveying equipment. NMCG has sanctioned a number of GIS based projects to executing agency. It has also initiated a very path breaking project along with Survey of India (SoI) on "Generation of high-resolution DEM and GIS ready database for part of River Ganga" using LiDAR Mapping. These models will provide valuable information for use not only in making urban river plans, but also for identifying the baseline of river flood plains and regulating them for their restoration and preservation. This technology enables identification of entire topography of an area making it easy for policy makers to analyse the available data and improve decision-making process. Critical pollution hotspots are also easily identified

through this technology. Mapping area is 43,084 km^2 along the 10 Km buffer of river. During summer 2020, field season, data acquisition over around 5000 sq Km area in Western Uttar Pradesh has been completed. Acquired data has been processed to generate Digital Elevation Model and Ortho-rectified imageries of said areas.

GIS project on "Reconstructing the Ganga of the past from Corona archival imagery" has been executed by IIT Kanpur. Deliverables of Corona project are the atlas of the Ganga river showing a comparison between 1960s and present, establish the reference condition of the Ganga and quantify the changes in morphological characteristics and land use/land cover within the Ganga valley, and propose a policy document on 'desirable' land use within the Ganga valley.

Bhuvan Ganga Geoportal provides platforms to manage, access, visualize, share and analyze geo spatial data, and non-spatial data products and services towards spatial mashups to support NMCG objectives of environmental and ecological improvement within the Ganga River basin.

Aquifers in the Ganga Yamuna doab play an important role in sustaining the flows in these rivers. Aquifer mapping project is being executed by NGRI, Hyderabad by geophysical mapping with focus on Palaeo-channels in parts of Ganga Yamuna doab from Kaushambi to Kanpur stretch. This project will be helpful for development of a plan for managing aquifer recharge which may help in increasing the flow of river Ganga during lean season.

Namami Gange is executing two spring rejuvenation projects, one is the schematic mapping of Tehri Garhwal district for inventory of springs using LiDAR technology, Hydro-geomorphic and liniment studies for identification of different type of springs and their recharge zones and implementation of spring rejuvenation by constructing rainwater harvesting and artificial structures. Another project is Rejuvenation of dying springs in Tokoli Gad Catchment of Tehri Garhwal District using Geo-chemical and Geo-physical techniques'. The project will assess the impact of land use land cover change or impact of natural or anthropogenic precipitation variability and also will strengthen the local water governance and participatory spring shed management approach.

Namami Gange has commissioned two projects with NEERI, one is assessment of water quality and sediment analysis to understand the special property of Ganga River and another one is "GIS-based mapping of Microbial Diversity across the Ganges for Ecosystem Services".

NMCG is working with IIT Delhi to map out high resolution climate scenarios for basin-scale water resources management. One of the major outcomes of this project will be improved understanding and scientifically rigorous estimates of climate change and its impact on water resources in the Indo-Gangetic Plain.

Large number of smaller tributaries have been mapped along with their catchment area/ watershed and water bodies. A GIS based inventory of small rivers is also being created with additional component in the form of district wise list of small rivers. NMCG in partnership with INTACH is carrying out the cultural mapping of the main stem of the Ganga from origin to Ganga Sagar documenting the rich natural, built and intangible heritage.

GIS cell, Ganga Knowledge Centre, NMCG has developed a prototype "Ganga River Water Quality decision support system based on web GIS". This dashboard will be very useful in decision making of compliance and non-compliance status of STP.

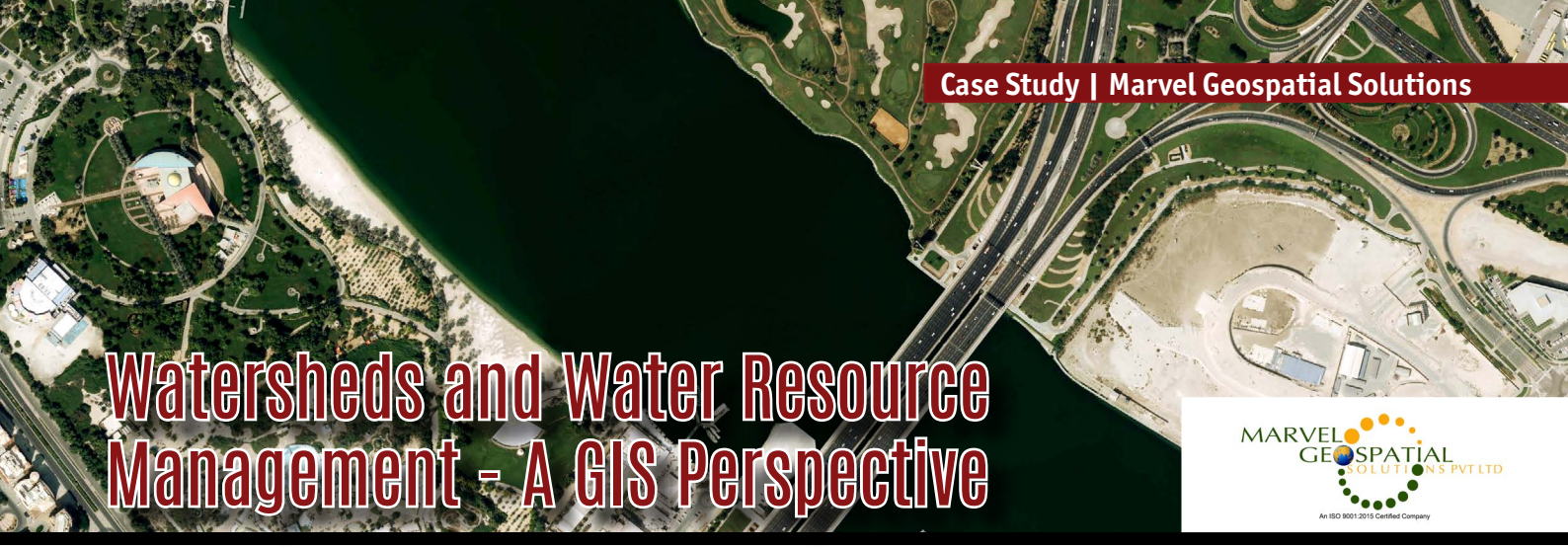
Q. What kind of challenges do you experience while using the technology?

Geospatial data collection and dissemination from stakeholder and state agency is the main challenge. NMCG is expecting advance technology based end solutions of river rejuvenation. Geospatial applications require spatial data for which there are five sources – satellite imagery, aerial imagery, topographic maps, positioning data from GNSS and crowdsourced data. NMCG needs accurate and high resolution data. Aerial acquisition takes too much time and resources.

Q. What are your expectations from the geospatial industry?

The geospatial industry is one of the fastest growing sectors globally. Remote Sensing and IoT will be critical components in integrated decision support systems. These systems will be used for hydrological and hydro dynamically modelling and monitoring water resources and to better understand fish habitats, sedimentation, and temperature changes. NMCG needs to manage and inspect large geographically distributed sewerage infrastructure. This combination of technologies can be applied to inspect and monitor. This next generation of Remote Sensing technologies will help achieve the goal of moving from calendar-based schedules to condition-based schedules. As new tools, like remote sensing combined with IoT, increase the frequency of acquisition, there will be greater demand for insights from the geospatial data collected for river water quality trend analysis. The past several years have borne witness to some amazing advancements in the geospatial sector, yet this is just the beginning.

NMCG is leveraging the digital advancements by establishing a strong digital and geospatial data infrastructure like LiDAR data and other geospatial data of river rejuvenation. 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 for accelerating the economic growth of the country. The geospatial industry is shifting from a 'top-down' to a 'bottom-up' driven industry as the dynamics of investment in geospatial data collection and application data becomes increasingly driven by digital governance and citizen services management.



Watersheds and Water Resource Management - A GIS Perspective

Geospatial Information System (GIS) is a powerful technology in spatial modeling, analysis which helps not only in visualization of the water and Utilities but much more.

It is projected that by 2050 around 68% of the world's population shall live in urban areas. In a recent study, an integrated utility management framework is proposed based on the integration of Building Information Modeling (BIM) and GIS, for which a common utility data model representing utility information in five aspects is developed to facilitate the mapping of Industry Foundation Classes (IFC) and City Geography Markup Language (CityGML). Like this many studies proves GIS is a massive tool that helps Utility Management and Sustainable living.

Good data is fundamental to good decision-making. But often, utilities struggle to effectively use the data. Digitalization can help utilities get the most out of their data to improve their decision-making, efficiency, and service. Digital twins - a virtual representation of a physical asset, process, or system, are a very powerful strategy that progressive water utilities are adopting.

GIS in Water Resources and Utilities

Urban water sustainability is a one of the major issues around the world. In regions where outdoor irrigation is the major use of water, land-cover such as lawns, trees, and impervious surface are principle determinants of household water use. Light Detection And Ranging (LiDAR), provides impervious and vegetative cover per household information by generating a vertical profile of land surfaces water use context, LiDAR data enables to differentiate between turf cover, tree canopy, and impervious surface. Thus the land-cover measures informing urban water use models would be best derived from a LiDAR data.

Rainwater Harvesting

LiDAR data can be used to get urban catchment of rooftop surfaces, and commensurate potential for rainwater harvesting and stormwater attenuation. Majority households consume less water than could be potentially harvested. Widespread implementation of rainwater harvesting could substantially reduce supplied water use in urban areas, and are of use to policy makers, planners, engineers and property owners everywhere.

Protect Water Quality

Based on LiDAR- digital terrain attributes, help identify which portions of the landscape would benefit the most from perennial vegetation conservation practices. LiDAR data was used to reduce time and labor to find likely sites of gully erosion. Blue Earth County saved huge amount by doing so.

Forestry Interventions for Water Bodies

The role of forests in relation to the water is often debated. Implementing a riverscape approach included quantification of the spatiotemporal pattern of the riverscape that encompasses upland systems surrounding the river appropriate for management planning. The study will help planners and managers in decision making for the allocation of resources at specific prioritised sites which would help in the treatment of rivers.

Flood Management

GIS and water catchment modelling tools allow flood risks to be examined in catchments. The models make use of precipitation data, overland flows and make assumptions about water management infrastructure. Governments are increasingly using these tools to assess climate risk for communities and to prepare adaptation strategies and community education plans.

Watershed Delineation

Watershed is a region of land within which water flows down into a specified body, such as a river, lake, sea, or ocean; a drainage basin. The word watershed is sometimes used interchangeably with drainage basin or catchment. Ridges and hills that separate two watersheds are called the drainage divide. Topographic maps containing contour lines are used to create watershed boundaries. Watershed analysis is used for the management and planning of natural resources, providing necessary inputs for hydrological modeling as well as providing catchment boundaries with hydrological parameters

Marvel Geospatial Solution

Marvel Geospatial Solutions Pvt. Ltd., [ISO 9001:2015 certified] is headquartered at Hyderabad India, has more than 15 years of experience and is one of the leading Geospatial

Solution and Product Providers in the country. We have global presence with offices in Australia, US and UAE addressing the needs of all private and government sectors. WE bring horizontal and vertical integration of Satellite/Aerial/UAV Photogrammetry/LiDAR.

Our Service includes: Photogrammetric, LiDAR, BIM, UAV Imagery Processing, GIS, Surveying Services, Location Based Services. Marvel Geospatial are the proud partners of NextCore, KAARTA, CADCORP and Here Technologies

Added to all the above, utmost is we have a team of best geospatial experts and professionals in serving the needs of the National and Global markets through focused, innovative, efficient and quality services. A Winner of best MSME and CEO awards Marvel Geospatial Solutions measures its success in terms of the value-proposition it provides its customers to help meet their ROI goals and competitive advantage.

Following are our products that help GIS utilities and are useful for number of GIS/LiDAR/Survey applications.

NexCore RN 50

Built For Simplicity & Tested for Durability!

Ultimate Aerial Mapping LiDAR Solution

A User-friendly System. Accurate to 50mm, Lighting fast processing. The only Drone LiDAR unit available with 2 years warranty.

Special Features:

- Scan up to 50 hectares in a single flight at 10 m/s
- Superior canopy penetration
- 50mm RMSE

NexCore RN100

With upgraded components, the RN100 performed beyond our expectations to deliver 50mm RSMS accurate results at up to 100 meters. It Scans up to 80 Hectares in a single flight at 10 m/s

RN 100

KAARTA's Stencil Pro

Rugged Yet Refined

Stencil Pro is an all-in-one mobile mapping system to scan, process and view capture data in real-time, providing high-definition 4K panoramic imagery and colourised point clouds.

Special Features:

- 360° Colour, Rugged, GEO-Enabled
- High Density and Versatile

Stencil Pro

KAARTA's STENCIL2:

Compact and Versatile Mobile Mapping Solution

Stencil 2 – 16 **Stencil 2 – 32**

Kaarta Stencil 2-16 has a data rate of 300,000 points per second. It can be hand-carried, vehicle-mounted or drone-mounted. Stencil 2-32 with a comparable range of 100 meters and a data rate of 720,000 points per second.

KAARTA's Contour

Special Features:

- Range: 20m / 65.6ft
- Data rate: 43,200 points per second

Contour

Contour is the all-in-one mobile 3D colour-scanning and processing system. There is an ongoing special 25% offer for Contour.

To know more of our Products and Services Reach us out

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Ensuring Water for Everyone

Ceinsys Tech Ltd
Formerly ADCC Infocad Ltd

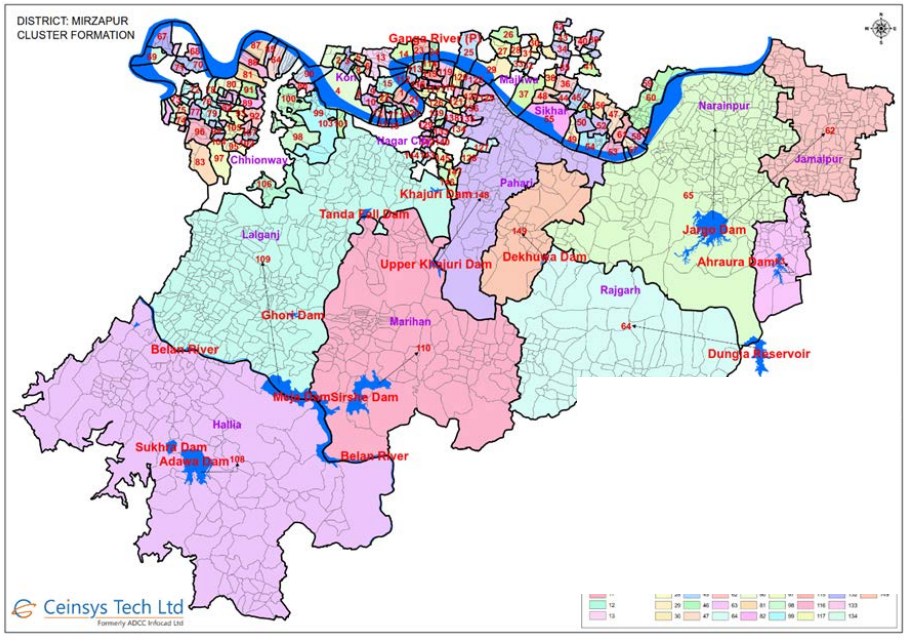
In November 2020, the Prime Minister of India Shri Narendra Modi launched Har Ghar Jal scheme to provide clean and safe drinking water through functional tap in the remotest part of India. This project intends to find out sustainable water sources and provide tapped drinking water to every household through precise planning and hydraulic design by 2021. With the same purview, Uttar Pradesh rolled out Har Ghar Jal Mission in Bundelkhand and Vindhya region so that people can have access to clean drinking water through tap. The project is being implemented by State Water and Sanitation Mission established in Rural Development Department, Government of Uttar Pradesh, for providing overall policy guidance for community led and participatory projects. In Bundelkhand and Vindhya region total 9 districts were selected for the project implementation where Ceinsys Tech Ltd. one of the premier Geospatial solution providers in the country with expertise in water domain and hydraulic modelling was appointed as a consultant for Jhansi District in Bundelkhand region and Mirzapur District in Vindhya region.

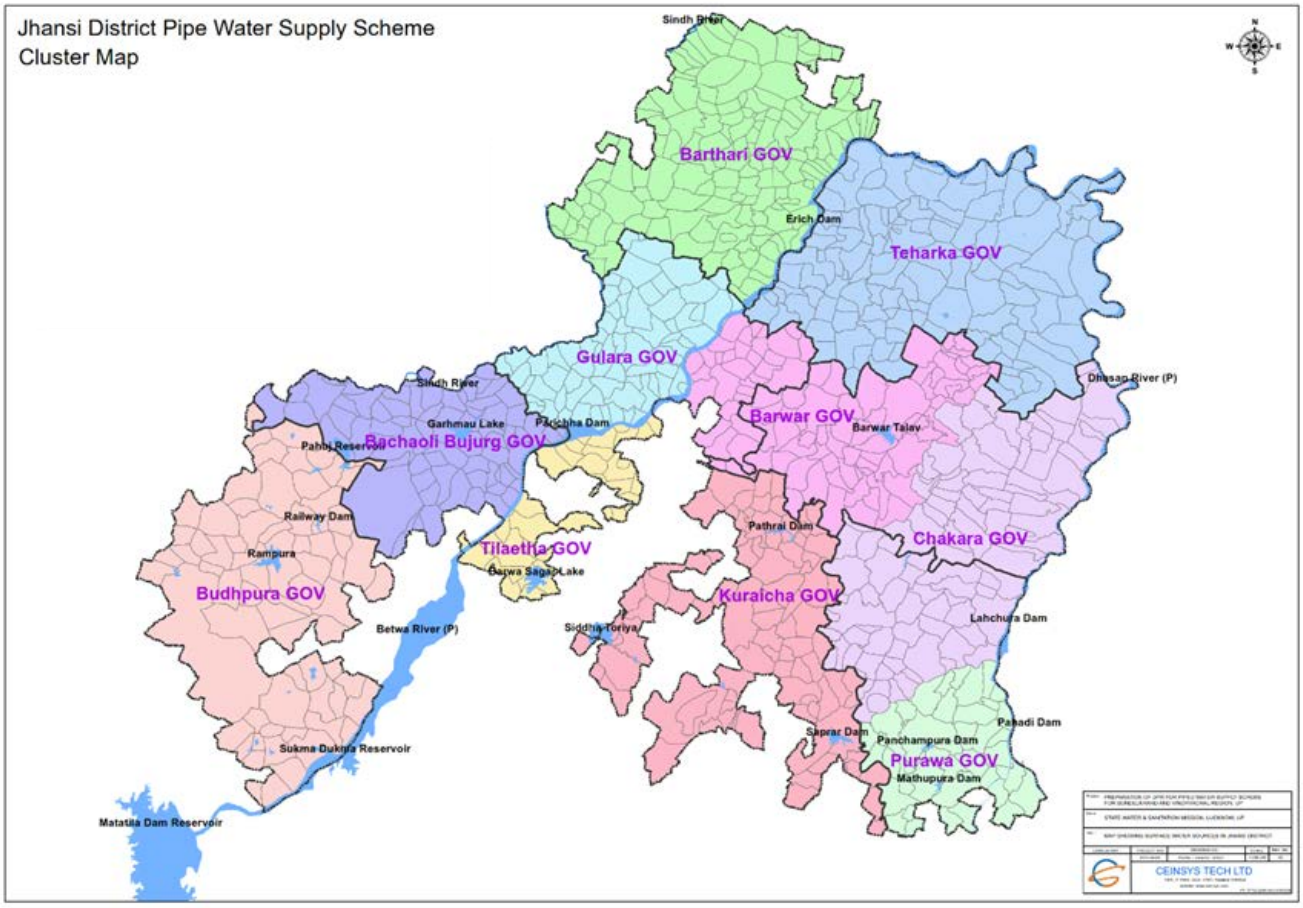
In Jhansi and Mirzapur only 10 percent of the rural population gets piped water supply and rest are forced to walk long distances to get water. There were many challenges in front of the local government in providing tap water connection in every home. Both Mirzapur and Jhansi have different topography. From geographical point of view these two districts are quite different from each other. Jhansi has no active sources of water whereas Mirzapur has river Ganges, but it cannot be used as a source of drinking water due to high level of pollutants in it. Structural instability and shifting trend of river poses another challenge. There was no readily available data on area of interest which made the project more difficult.

Ceinsys Tech provided consultancy services in designing and preparation of Detailed Project Report of drinking water supply schemes in Jhansi district of Bundelkhand and Mirzapur district of Vindhya Region of Uttar Pradesh.

About the Project

Under Har Ghar Jal Mission total 2057 Sq Km (951 Sq Km of Jhansi and 1106 Sq Km of Mirzapur) were to be included. This entire area covers 2252 villages and 5.76 million of population. To cater to such huge geography, Ceinsys Tech initiated GIS based survey to identify every village and hamlet of Jhansi and Mirzapur that were to be covered in the proposed scheme. The survey included total number of houses in Jhansi and Mirzapur, total populations probable sources of water, number of villages to be covered under the scheme and how many villages have already been covered or do not require any action.





Once the GIS survey was complete, demarcation of existing assets of water supply was done on GIS systems with all necessary attributes to give design team an idea to decide whether to use or discard the component. All probable land were also demarcated on GIS which helped design engineer to select from the pool and put forward the best iteration.

Development of Digital Elevation Model using elevation survey data was done to encourage maximum gravity flow to reduce CAPEX and OPEX. The actual design was done on Bentley WaterGEMS platform.

Project Outcomes

Outcome of the design were also ready with actual BoQ and estimation with construction drawings. These drawings can be updated as per actual construction and later used in maintenance. The total cost of the project is INR 40 Billion.

The survey conducted by Ceinsys provided a detailed information to decision makers for the better implementation of the project. It came out with a conclusion that total 160 numbers of water schemes need to be channelized so that 2252 villages of Jhansi and Mirzapur can have tapped drinking water. It also suggested that 19 Water Treatment Plants of 508 MLD Capacity is required for the transmission network of 1800 km (150mm to 800 mm Diameter). In both districts 455 Service Reservoir of 100 Million Liter capacity are required. The DPR prepared by Ceinsys Tech Ltd recommended that the total distribution network is of 11500 RKm. Other major contents of the report included the topographical and geographical details like village boundaries of the block on the GIS based map. The population projected in a span of 15 and 30 years according to the design stages of the project which are the immediate, intermediate, and ultimate design stages.

How Will The Project Benefit

The proposed water supply schemes will have several benefits. The foremost benefit of the water supply system is that there will be access to tapped water to the people of the villages. Other benefits include improved water quality leading to improved health conditions, sufficient water quantity and better standards of living of the people. The scheme will also generate local employment and increase the revenue of the block. The quality and quantity of the water supply will also improve as scheme has been designed for 70 LPCD and all the underground sources shall be proposed to be discarded. The main benefit will be reduction of water borne diseases due to contaminated water supply. Coverage of water supply is targeted to be 100%. Block level governance will also be improved through the proposed water supply scheme. Suggested water supply scheme will increase growth opportunities thereby help in increasing employment among the villagers. It will also improve service delivery.

AGI India Water Awards Recognizes Exemplary Work in Water Sector

On the sidelines of India Geospatial Leadership Summit 2021, the Association of Geospatial Industries, India announced the AGI Water Awards on February 16, 2021. The awards were conferred for exemplary work done for Irrigation Management, Urban Water Management, Capacity Development and Water Conservation. The objective of the award was to felicitate and encourage the use and adoption of innovative geospatial technologies for making India a water secure country.

AGI India received 27 nominations from across the country under various categories and covering different fields and perspectives. These nominations were evaluated on the basis of technology innovation, innovative methodology, project sustainability and scalability and capacity development and outreach. The nominations were assessed by a distinguished and independent jury, headed by Dr Shailesh Nayak, Director, NIAS and former secretory, Ministry of Earth Sciences, along with Dr V. K. Dadhwal, Director IIST and former Director NRSC and Shri Vishnu Chandra, Deputy Director General, National Informatics Centre.

On the occasion, Mr. Agendra Kumar, President of Association of Geospatial Industries said, "Innovative use of Geospatial technology to build solutions and applications for solving real-world challenges, especially related to water scarcity, water resource management, irrigation management has seen a rise in the past few years. With the intention to showcase some of these advancements and to encourage more user organizations to adopt technology in their area work, aiding national development agenda, AGI India introduced the AGI India Water Awards. We hope that by highlighting these outstanding use cases and application of technology in different categories, more users will begin to take advantage of the available data, resources, and technology that our industry has to offer. I congratulate the winners and applaud their efforts on using technology to improve the sustainability and ecological systems of their areas".

Here's the award categories and list of winners:

Mission Bhagirath for Capacity Development

Mission Bhagirath is a massive project with an outlay of Rs 45,028 Crores and is targeted to be completed in a record time of 3 years. It covers 2.72 crore people and 65.29 lakh households. The project was started in 2015 and covers rural habitations of Telangana State. The project was investigated, designed and estimated by the Mission Bhagirath Department, that ensures 98% of transmission and distribution systems function by gravity. The highlight of the project is that it integrates all existing water supply schemes and ongoing drinking water projects in the state. The project is developing capacities of the state by building a SMART GRID with Optic Fiber Network provided along the pipeline. The project is using modern survey equipment like DGPS and hydraulic modelling software. It is also leveraging IT enabled Monitoring Systems – Smart Project with Automated Systems.

ODIIS (Odisha Irrigation Information System) for Irrigation Management

Started in the year 2017, Odisha Irrigation Information System (ODIIS) aims to ensure geospatial aided agricultural information system for Odisha. With the help of technology, the project aims to provide accurate agricultural information to help develop an understanding of the agricultural development process and food security and an application to provide insights about the agricultural land, cultivated areas, crop health, crop diversity and cropping system. Other objectives include multiple on-time information to empower authorities for decision making on policy, pricing, procurement, etc., cadastral/village/GP based crop monitoring, fertilizer distribution advisory, land suitability for crop cultivation, irrigation infrastructure mapping. The project has successfully built an application of geographical database of the irrigation network, its asset and functioning status with accurate agricultural information which helps in understanding sustainable agricultural development process and food security.

West Bengal Accelerated Development of Minor Irrigation (WBADMI) Project for Irrigation Management

WBADMI Project with the World Bank support is an innovative project that reached out to the small and marginal farmers particularly tribal and women. The project was started in year 2012 and covers entire state of West Bengal. It is unique in the sense that it is for the first time that an integrated effort was made wherein Irrigation facilities combined agriculture, horticulture, and fishery activities in the created command area. Using various geospatial data and technology, the project has been able to hand over almost 2000 minor irrigation schemes (both surface and sub surface) to the farmers based on Water Users Association (WUA). There has been a change in cropping intensity from 122% to 192%. Almost 60% targeted of 75000 ha unirrigated area has been converted into irrigated land, and there has been a 282% change in value of produce. The project has successfully implemented remote-sensing and GIS based soil moisture monitoring technique for optimum utilization of irrigation water. It leveraged a web GIS based technology for site suitability study for setting up surface and subsurface water schemes, as well as using a post scheme implementation impact assessment study based on web GIS techniques.

Water Efficient Thrissur for Urban Water Management

Thrissur Municipal Corporation was facing many challenges in water distribution. City administrators have had difficulty grappling the problem because of the hidden and underground nature of water assets. It needed a solution which could equip public water supply, especially within the old municipal area of Thrissur, with the most modern systems.

To tackle the problem a solution using Esri ArcGIS software was designed that helped users discover, create, use, and share location-based insights, on any device to reduce public water loss by bringing Non Revenue Water below 15%.

The project was started in March 2020 and was completed in August 2020, and mapped asset data such as pipes, valves, hydrants, meters, and other network features, as well as operational data such as pressure zones, work routes, main breaks, and inspection locations. It provided authorities with the tools to visualize and assess where they stand, in terms of water supply infrastructure. It gave citizens an interactive platform to air their grievances, simple graphics and processes make the platform accessible to everyone, sans barriers of age or ability. It also allows authorities to take charge of their assets and respond to how their city is growing.

Preparation of Soil and Water Conservation Action Plans for Water Conservation

The Project Mission Water Conservation under MGNREGS covers 1,521 GPs in 88 blocks covering 5 districts located in Rayalaseema and Prakasam in Andhra Pradesh, which are highly drought prone areas. The main objective of the study is to provide Natural Resources Maps (NRM) to 1,520 Gram Panchayat in 88 blocks covered in 5 districts of Andhra Pradesh using geospatial technology. APSAC technical teams facilitated scientific planning and management of soil and water conservation action plans through ridge to valley approach. Under this project APSAC identified and provided 32,000 water conservation locations in 1521 GPs for water conservation management. About 50,000 farmers have used the scientific results and the GIS maps for implementation of conservation measures. The project also yielded state, district, block, village and cluster level Capacity Building and Intuitional Arrangements and developed Web Portal WEBGIS.

We value your feedback

AGI seeks to explore various avenues to enhance the quantum of interaction between geospatial industry units, academia, government and various other geospatial players. Therefore, we keenly look forward to your feedback and suggestions on various issues that can help meet our objectives. Write to: mahashreveta.choudhary@agiindia.com