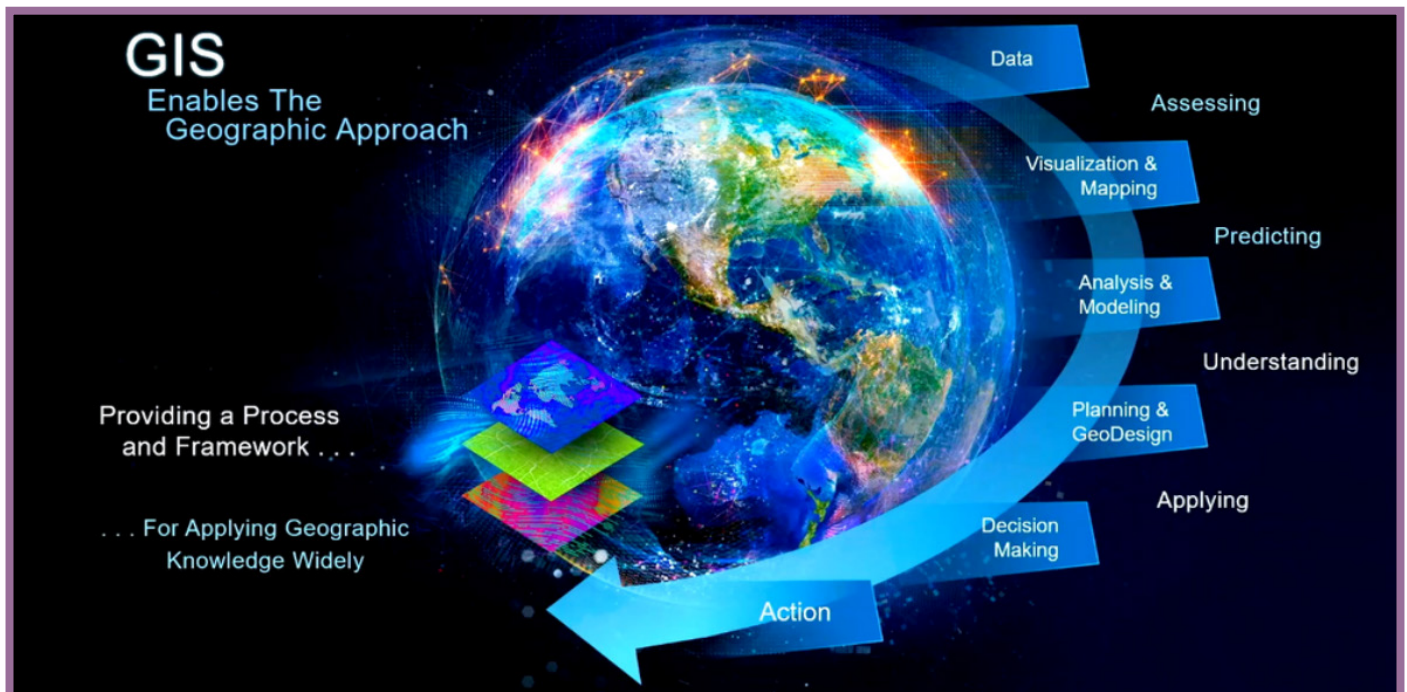


# GIS – Driving Impact Across Sectors

Geographic Information System (GIS) is a crucial technology that has proven its capabilities across multiple domains such as environment conservation, natural resources management, urban planning, disaster and emergency management, agriculture, healthcare, utility management, retail, telecommunications, manufacturing, banking, insurance, etc. It is driving progress in these sectors by offering unique advantages like enhanced information sharing among multi-location teams, improved progress monitoring, superior asset management, increased productivity, and significant time and cost savings.



## Urban Planning

While the population of the world is growing exponentially, the land available to accommodate the same remains limited. It is shrinking in size with every passing day. The need of the hour is not just urbanization but smart urbanization; to plan urban development smartly to accommodate more in less, and that too nicely and efficiently. By using GIS in urban planning, planners can take urbanization to new scales.

The most frequently involved sectors of urban planning include land use, transport, housing, land development, and environment. Each scale of planning involves different stages: the determination of planning objectives; the analysis of existing situations modeling and projection; development of planning options; selection of planning options; plan implementation; and plan evaluation, monitoring, and feedback. The different functions, scales, sectors, and stages of urban planning make different uses of GIS.

## GMDA Achieves Higher Citizen Engagement using ArcGIS

Gurugram Metropolitan Development Authority (GMDA) embarked on an ambitious e-government initiative, aimed at enhancing responsiveness to citizens' needs; increasing operating efficiency and effectiveness; improving financial health, and ensuring greater transparency within various departments. It launched an innovative GIS-integrated Decision Support System named "OneMap Gurugram" in 2019. The data-driven system includes various GIS applications for e-Governance including a mobile app. OneMap went live with a huge amount of data available at a single click. The data is distributed under various heads, including wet and dry infra health, homeland security, planning, land governance, power, citizen-centric services, etc. Initially, there were 12 live applications on OneMap, which soon became available on the mobile app. Currently, more than 25 live applications on the OneMap Portal are helping the government to enhance collaboration and citizen engagement. Projects like 'Crop Survey' and 'Ease of Doing Business', which are part of OneMap Gurugram are enabling the authorities to extend the benefits to the State level.

The robust GIS-integrated Decision Support System (DSS) developed using Esri's ArcGIS technology has taken collaboration between different departments and citizen engagement to new levels. The System provides updated data about the various aspects of the city on a unified platform leading to better governance, higher vigilance, improved citizen-centric services, and higher citizen engagement.

GIS provides planners, surveyors, and engineers with the tools they need to design and map their neighborhoods and cities. Using **ArcGIS Urban**, administrators can analyze, visualize, and evaluate the demographic needs of the community, and planners can design and measure the impact of multiple housing scenarios. The technology enables planners and design professionals to collaborate across teams with a web-based 3D application that supports scenario planning and impact assessment. By incorporating ArcGIS Urban into a comprehensive planning process, planners can more easily assess land-use changes to meet future demand.

GIS helps to store, manipulate, and analyze the physical, social, and economic data of a city. It aids in monitoring an area or conducting the feasibility study of a location for a specific purpose, for instance ascertaining the suitability of a location for the construction of a bridge or dam. It also helps in identifying changes in geographical features or behavior of a land over a specified time. Such information enables professionals to make informed decisions about the development condition of an area and plan accordingly.

Planners make use of GIS also to smooth the progress of citizen participation and community input as they develop a vision for the community that enhances the quality of life for all citizens. Citizens are the life and blood of any city and first-hand input from them as to what can be done to make their city smarter can aid in crafting amazingly productive methods/means for urban planning. Smart community planning prioritizes the human element in designing the communities. Esri provides the technology to make it happen. Esri's smart city technology helps planning professionals determine how, where, and when their designs can have the greatest impact on improving the quality of life.

Esri India has worked with more than 45 Smart Cities, enabling the stakeholders to accomplish the objective of 'providing exceptional citizen experiences.' These cities have established GIS platforms or Geo-Hubs with Esri's ArcGIS technology, which has helped them to achieve excellence in urban planning and administration.



# Infrastructure Development

Today's smart infrastructure projects necessarily warrant the usage of advanced technologies such as GIS, BIM, Digital Twins, etc. In large infrastructure projects, the cost overruns are usually in the 20% to 60% range. By using GIS and associated BIM technology, an average of 13% in terms of cost savings can be realized. GIS plays a crucial role in assisting project teams in site selection and evaluation based on geographical, resource, and environmental factors. It enables building professionals to visualize the landscape, strategically plan structure placements, and harmonize the built environment with nature. This location-based approach proves valuable in planning roadways, railways, and airports, allowing planners to assess terrain and environmental variables along proposed routes for optimal and environmentally conscious decisions. Esri's ArcGIS portfolio supports the end-to-end Architecture, Engineering, and Construction (AEC) value chain.

Esri solutions are conceptualized and developed embracing Findable, Accessible, Interoperable, and Reusable (FAIR) principles. Supported by intelligent mapping and data capture tools for Geodesign, intuitive visualization for enhanced situational awareness, advanced geospatial analytics for operational intelligence that is actionable, and multi-mode dissemination for sharing and collaboration among stakeholders, **ArcGIS AEC solutions** foster transparency, efficiency, and cost optimization across the value chain.

Esri's **ArcGIS GeoBIM** enables organizations to provide rich geospatial context to architecture, engineering, construction, and facility management projects. By bringing GIS and BIM data together, ArcGIS GeoBIM allows users to incorporate and use data from multiple systems, access project data from a common experience, explore GIS and BIM data side by side, collaborate and share information with stakeholders, and minimize costly data conversions. Using AEC Project Delivery, users can extend internal GIS content and context to resources outside of the organization. This allows them to collaborate and share information directly with stakeholders.

AEC firms are also increasingly leveraging the idea of integrating GIS and digital twins for abstracting and modeling everything to enhance business processes, mitigate risk, optimize operational efficiencies, and boost decision-making. ArcGIS Reality helps in building geo-referenced Digital Twins of Urban areas to address issues like better utility management, urban flooding, safety and security, etc.

## Varanasi Smart City Excels in City Management with ArcGIS

Varanasi Smart City Limited (VSCL) used Esri's ArcGIS to create an **enterprise-wide integrated City GIS** to address the four major problems of the city: solid waste management, environmental monitoring, traffic management, and integration with smart streetlights. In the process, multiple data sources and data levels became available for analysis, including information on administrative boundaries, public services, religious places, education and health, tourism and recreation, transportation, water bodies, and locations of infrastructure related to water, sewerage and drainage systems in the city.

The team at VSCL created the **Kashi Integrated Command and Control Centre (ICCC)** to visualize and address the problems in real-time. The ICCC uses location-based technology to manage traffic safety and city security. The ICCC has also proved to be a versatile mechanism for rapid emergency response.

### Varanasi 3D

Esri India has also created a 3D GIS for Varanasi City. The portal shows the entire Varanasi City land use in 3D, which helps in understanding the building scape of the city, and how it has grown over the years through density aspects. There is a set of analytical themes, and each one represents a 3D thematic map of a particular aspect or problem of the city. The 3D themes, when incorporated in dashboards, help in understanding the data in a better way. The portal also enables the planning of buildings, street lights, or cameras in the city.

## Utility Management

Utilities are an integral part of any city. GIS has proved to be an irreplaceable tool for demystifying utility data and providing location-rich “contextualized” insights. For addressing the complex challenges utilities are faced with, the “Geo-Enabled Smart Utility Management” approach provides a bird’s eye view of the utility infrastructure with the ability to narrow it down to individual assets and consumers.

Along with tools for analysis, visualization, modeling, and collaboration - GIS amplifies the digital utility operations multifold by enhancing situational awareness along with actionable intelligence for informed decisions both at regional and local levels.

ArcGIS Utility solutions are making access to contextualized information easier than ever, helping utility CXOs address their priorities better than before. They are helping organizations to stay agile in the changing times and drive innovation. By augmenting existing frameworks with **ArcGIS Utility Network**, utility CXOs can enhance their business value delivery while optimizing operations for improved efficiencies and increased customer satisfaction, paramount for a sustainable future.

**Power utility companies** like Sterlite Power, BSES, and AEML, are leveraging ArcGIS to improve their operational efficiencies and provide enhanced services to their consumers. In the **oil and gas** sector, IOCL, Gujarat Gas Limited, Mahanagar Gas Limited, and many others have been leveraging ArcGIS to achieve excellence in their operations and asset management.

Built using ArcGIS, IndiaWRIS is a one-of-its-kind comprehensive Water Resources Information System (WRIS) that provides authoritative, and consistent data and information on **India’s water** resources and allied themes. This information enables the stakeholders to achieve highly effective outcomes in the planning, development, and management of water resources in the country.

## Telecommunications

The two major telecom service providers (TSPs) in India, Reliance Jio and Airtel have harnessed the various capabilities of ArcGIS to achieve the most effective outcomes in network planning to management. ArcGIS enables them to map their network assets along with their coverage capacities.

The technology allows the teams to collaborate, share, and perform a variety of spatial analyses such as identifying coverage blind spots, hotspot analysis, and network route planning.

## Managing Gas Assets Optimally using Esri’s ArcGIS System

A comprehensive GIS solution built using ArcGIS allows Gujarat Gas Limited (GGL) to map and manage gas assets efficiently.

In terms of engineering, planning, and design, the GIS system facilitates route planning, project estimating, network simulation, design clearances, and reinforcement and replacement planning.

For construction and projects, it aids in construction planning, network identification, route analysis, and risk assessment. Maintenance activities benefit from the system through maintenance planning, patrolling, valve chamber maintenance, shutdown planning, and providing data for root cause analysis.

In emergency response, the GIS system ensures quick response, isolation and squeeze-off analysis, efficient complaint handling, and crew monitoring.

The GIS solution has yielded several quantifiable benefits for GGL. These include significant cost savings through optimized route planning, efficient project estimating, and streamlined maintenance activities.

Manpower utilization has improved as a result of enhanced crew monitoring and efficient emergency response. Productivity gains are notable in terms of reduced hours spent on planning and increased operational efficiency. The GIS system has substantially improved data accuracy, contributing to better decision-making across various operational domains.

As the telcos transition from 4G to 5G, they rely on 3D geodata to accurately predict their 5G network coverage and deliver the quality of service the customers expect. 5G networks demand a more sophisticated approach to network planning due to their reliance on millimeter-wave frequencies, which are highly sensitive to environmental factors such as building structures, vegetation, and terrain variations. As traditional 2D maps fail to capture the intricate details necessary to accurately assess signal strength and quality, 3D mapping techniques have become a necessity in 5G network planning.

Esri's geospatial capabilities leverage 3D maps, LiDAR, drone-based surveys, and GIS coverage analysis to help telcos in site identification network planning and designing. ArcGIS Pro enables the creation of detailed 3D models at any scale - from individual sites to entire cities and regional geographies - which serve as the foundation for digital twins. Along with asserting its leadership in 5G, India aspires to connect over 20 crore rural and urban households with broadband services by 2030. To increase broadband penetration from the existing 13% to 80%, we are looking at a huge deployment of digital connectivity infrastructure-fibre, mobile towers, data centers, satellite broadband, wi-fi, etc. GIS will be a crucial enabler here as well, enabling stakeholders to achieve unmatched precision and cost and time efficiency in the projects. GIS-powered digital twins will

enable the stakeholders to achieve excellence in network planning, coverage, maintenance, and management.

GIS-based digital twins extend beyond 3D models by incorporating temporal dimensions, showcasing historical, present, and projected future states. This temporal aspect enables users to track changes over time, facilitating better decision-making and planning. By integrating real-time data and predictive analytics, GIS-based digital twins provide a comprehensive understanding of dynamic environments, allowing stakeholders to anticipate trends, mitigate risks, and optimize strategies.

Recognizing the immense capabilities of digital twins in solving challenges across industries, the Government of India is also investing in unique digital twin initiatives. The initiatives aim to carve out a position of leadership for India in digital infrastructure and innovation by combining the prowess of 5G, IoT, AI, AR/VR, 6G, Digital Twin, and next-gen computational technologies. Esri's ArcGIS technology aims to become a crucial enabler here by facilitating enhanced data capture and integration, better real-time visualization, advanced analysis and automation of future predictions, and information sharing and collaboration. Using ArcGIS, the stakeholders can achieve unparalleled context and high-resolution data integration for better business decisions.

## Disaster and Emergency Management

Disaster Management is an ongoing process along with the development plans of a region, including cities. Be it modeling through early warning systems or using decision support systems to understand which disaster is going to affect or is affecting which region the most, GIS can help mitigate the risks of a disaster to a great extent. Using GIS, preparations can be better, efforts can be more directed, and responses can be faster. GIS enables the response teams to gain situational awareness, engage with the public, and understand the impact of the event. As GIS leads to better identification of the affected areas and people, recovery becomes easier and faster.

ArcGIS provides powerful capabilities that aid in identifying, assessing, and understanding risks that cause disasters and emergencies. With its advanced capabilities for mapping,



imagery, and remote sensing, ArcGIS enables users to visualize, analyze, and manage data in 2D, 3D, and 4D to gain new insights for prevention, mitigation, and informed decisions.

**Prevention:** Using multidisciplinary factors and historical data, ArcGIS tools aid in improving predictions regarding subjects that will be impacted. Such localized evaluation helps in proactive measures to deal with the impact of the disruptions. By integrating real-time data from sensors/IoT devices and social media on maps and big data capabilities, agencies can identify temporal patterns and extract actionable location intelligence. By analyzing dependent factors, agencies can have a bird's eye view as well as the ability to drill down to details to assess accurate situations on the ground and plan remedial actions.

**Response:** Situational awareness along with actionable intelligence being the key factor, it is important that all responders are armed with updated information as situations dynamically evolve and data-driven decisions are taken. Be it evacuation routes, rehabilitation shelters, or other services that are key to successful response operations, it is updated information presented in a spatial context that makes the difference and helps stay ahead. The GIS-enabled mobile apps support field operations, community and citizen engagement by bridging the gap between teams on the ground and command-control reducing response times and maximizing resource utilization.

**Rehabilitation and Recovery:** The aftermath of disasters warrants a methodical recovery. While Post Disaster Needs Assessment (PDNA) is the first step toward a holistic recovery, it is important to recognize that the disaster recovery process goes beyond the PDNA and aids in identifying a criteria-based prioritization, planning, and implementation of the recovery agenda. GIS plays a critical role in ensuring that disaster recovery processes are prioritized and embrace inclusiveness, resilience, and sustainability. Situation analysis using dashboards, impact analysis tools, and workforce management tools helps in providing prioritized relief to affected citizens and their needs in the shortest time. This enables the affected communities to build back in a more adaptive way. The information and knowledge shared during the process supports in building actionable agendas for strategic planning, disaster risk reduction, and policy decisions to strengthen resilience.

**Esri India's Indo ArcGIS** offers specially curated solution products for disaster management. This Indo ArcGIS Solution provides automated alerts and live feeds for active hazards and possible disasters. It helps in locating available resources for efficient disaster response and mitigation and assessing

population and area under disaster impact. It also provides simple-to-use apps for effective decision support in the middle of a crisis.

The Volunteer Registration Solution provides an interface to the public for registering as a volunteer in case of disasters with location details. It enables disaster managers to check location-wise volunteers' status, helping them to plan actions as per the availability of the resources.



### Healthcare

“Good health and well-being” are essential for achieving sustainable living conditions for the citizens of any region. GIS is the core foundation of all the key public health functions - assessment, policy development, assurance, and operational awareness. To devise effective healthcare strategies for communities, agencies need to be able to respond to questions such as:

- What are the key health challenges our communities are facing?
- Which are the immediate interventions needed?
- Where are these interventions needed?

GIS provides answers to these, enabling public health agencies to take larger steps in addressing national healthcare needs. It stands out as a game-changing technology for health systems focused on delivering personalized care. By providing a nuanced approach to understanding and communicating with various patients and communities, GIS opens doors to modernized outreach, tailored messaging, and informed decision-making.

GIS enables health systems to capture, analyze, and present data in impactful ways such as calculating access to care for patients, examining the health impacts of a community context through the social determinants of health model, and implementing service reconfigurations that align with local needs. GIS not only makes a healthcare agency’s data more valuable, whether it comes from an electronic health record system, claims, and billing systems, or other data warehouses, but also makes it easy to source and use additional reliable platforms such as the Indian edition of ArcGIS Living Atlas.

Every day the technology ecosystem is evolving rapidly. Health agencies are collecting more and more data for analysis to build further efficiencies and effectiveness in their decision-making, operations, and processes. Integration of AI, ML, big data, and data science methods and tools with spatial analysis enables more accurate, efficient, and productive insights with potential applications across several disciplines within public health, precision medicine, and

the Internet of Things-powered smart healthy cities. These can help in predictive modeling to identify populations at high risk for disease, in healthcare delivery of telemedicine/ mobile health to the masses or even integrating social media feeds for syndromic surveillance. GIS will continue to be the core foundation to support the health tech revolution we are witnessing.



## Business Growth

Businesses are core to the development of cities, livelihood, and services to urban populations. GIS empowers businesses to make better-informed decisions by providing actionable insights derived from spatial data analysis. By leveraging GIS technology, businesses can gain a competitive edge, optimize their operations, and achieve their strategic objectives more effectively.

GIS can help them get answers to key questions including, where are markets shifting? Where are the best customers? Where are operations at risk? Where are products and services delivered? In a constantly changing world, GIS technology provides greater business intelligence for more successful, resilient organizations that can withstand the most severe disruptions and thrive to better serve their stakeholders.

### Retail

As retailers strive to engage customers more effectively and build market share, unlocking the insights hidden in location data is key to understanding customers. GIS enables retailers to garner holistic customer insights that support engagement across the customer's journey: before, during, and after engagement. Before engagement, GIS helps firms decide where to open new stores and generate new leads. During the critical moments of engagement, the technology drives sales through contextual marketing and location-based experiences, and after engagement GIS allows firms to identify and deliver the next best experience and segment customers to derive even more insight.

**ArcGIS Business Analyst** is a Location Intelligence solution suite designed to aid organizations in making data-driven decisions. ArcGIS Business Analyst is a unique solution comprising data, maps, workflows, and infographics that will enable businesses to make smarter decisions. Using ArcGIS Business Analyst, businesses can gain invaluable insight into changing populations, housing, demographics, consumer spending, competition, etc., and thus make more informed decisions for market planning, site selection, territory management, and customer analysis. Such in-depth analysis will help them gain a competitive edge and improve operational efficiency.

Logistics is the lifeblood of every retail business. GIS enables retailers to visualize all parts of their supply chain—inventory, transportation assets, warehouses, and stores. It empowers supply chain professionals to make data-driven decisions regarding optimal site selection for warehouses, distribution centers, and manufacturing plants. By integrating various datasets such as demographic information, transportation networks, and customer locations, GIS helps identify strategic locations that minimize transportation costs, reduce delivery lead times, and maximize customer reach. This proactive approach enables businesses to stay ahead of the competition and gain a competitive edge. Leveraging location intelligence can also significantly enhance fleet management efficiency. Using GIS, retailers can optimize routes, minimize backtracking, and increase the probability of timely deliveries, thereby ensuring customer satisfaction. Additionally, it enables managers to proactively identify issues and provide drivers with instructions to circumvent them, further streamlining operations.

Advertising success also depends on precise, accurate information about target audiences. Location intelligence provided by GIS makes it possible to target a specific audience based on the places they visit in the real world. For example, by using precision or proximity audiences, retailers can increase the relevance of their ads to consumers based on the commercial places of interest they visit. With precise demographic, consumer spending, and behavioral data, they can confidently reach specific customer types where they live, work, and play. GIS helps gain a deeper understanding of the target audience and improve the return on investment (ROI).

### Manufacturing

GIS plays a vital role in manufacturing as well. Manufacturers need agility and new insights to deliver good customer experiences. Data-driven insights, automation, and coordinated planning across the value chain enable more informed decision-making and thereby more effective outcomes. Esri's location intelligence solutions help in reducing operational costs, minimizing disruptions, and mitigating risks in the supply network. Esri offers a comprehensive suite of products and services tailored to meet the diverse needs of the manufacturing industry with an extensive portfolio that includes cutting-edge products such



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as ArcGIS Business Analyst and ArcGIS Knowledge. These advanced tools empower manufacturing professionals to drive innovation in market analysis, customer service, sales territory optimization, field service operations, supply chain visualization and analysis, asset management, and more.

### Banking and Financial Services

We have seen increased adoption of GIS in the Banking and Financial Services sector as well. GIS is helping the sector in enhancing sales and marketing, regulatory compliance, business continuity planning, and service location evaluation. By leveraging geospatial visualization, banks can gather and

interpret information more effectively than traditional tables and charts allow. Mapping market statistics helps evaluate and determine optimal locations for bank branches.

As financial services and banking navigate unique challenges and opportunities, especially with the expansion into emerging markets, there is a growing demand for sophisticated geospatial and data analytics. The shift towards decentralized business models further necessitates advanced analytical tools. To address these trends and globalization pressures, banks are elevating their banking analytics capabilities. GIS plays a crucial role in this evolution, transforming geographic data into actionable insights that finance professionals can use for targeted banking analytics projects.

## Sustainable Development

GIS has become integral to sustainability efforts worldwide. The unified platforms, powered by GIS, aid in integrating and visualizing a wide range of environmental data, enabling stakeholders to make informed decisions. With

GIS, information on land use, biodiversity, water resources, and energy consumption can be overlaid on infrastructure assets and analyzed to identify patterns and areas for improvement.



A primary application of GIS in sustainability lies in analyzing land cover data. By leveraging GIS, organizations can pinpoint areas suitable for conservation or restoration efforts. This

facilitates the preservation and restoration of ecosystems, promotes biodiversity, and safeguards natural resources while planning and managing networks. Additionally, GIS aids in

monitoring and managing protected areas, ensuring their long-term sustainability. By integrating data on protected areas, land use, and ecological factors, GIS enables effective planning and decision-making to uphold the integrity of these vital areas.

In essence, GIS serves as a powerful tool for comprehending and managing sustainability factors. By harnessing its capabilities, stakeholders can glean valuable insights, identify improvement opportunities, and make informed decisions to foster a more sustainable future.

## GIS and UN SDGs

Leave no one behind (LNOB) is the central, transformative promise of the 2030 Agenda for Sustainable Development and its Sustainable Development Goals (SDGs). The ability to disaggregate SDG indicators where relevant, into thematic areas related to age, gender, economic status, and income is a key tenet of the “leave no one behind” philosophy. “Disaggregation of subjects by geographic location” is critical to ensure that no one is left behind. With economic development being highly contextual and spatially explicit, the context of geography (place) attains higher significance with people and the environment.

Each of the 17 UN SDGs is dependent on the understanding of geographic location, inter-relationships, and inter-linkages. Use of geospatial information, earth observations and other forms of location-based data becomes critical for situational awareness and decision support. Geospatial technologies play a central role in disaggregation contextualized to national, sub-national and local levels.

The SDGs Geospatial Roadmap is a living resource that helps communicate, guide and enhance the awareness of geospatial information, Earth observations, and related data sources, products, and enabling tools and methods, to inform and support the implementation of the SDGs, according to national circumstances.

### Agriculture

Using GIS farmers can achieve increased production and reduced costs by enabling better management of land resources. The risk of marginalization and vulnerability of small and marginal farmers, who constitute about 85% of farmers globally, also gets reduced using GIS. Agricultural Geographic Information Systems enable farmers to map and project current and future fluctuations in precipitation, temperature, crop output, etc.

Agricultural mapping is day by day becoming crucial for monitoring and management of soil and irrigation of farmlands. It is facilitating agricultural development and rural development. Accurate mapping of geographic and geologic features of farmlands is enabling scientists and farmers to create more effective and efficient farming techniques. As farmers are able to take more corrective actions in the form of better utilization of fertilizers, treating pests and weed infestations, protecting natural resources,

etc., we are bestowed with more and higher quality food production.

GIS holds the key to viable solutions for agriculture. ArcGIS facilitates stakeholders to collect, maintain, analyze, and share the agriculture data and make better in-season decisions. ArcGIS allows integration of earth observation, imagery, field data, and real-time data streams to improve efficiency, profitability, and sustainability.

### Environment Conservation & Climate Change

Perhaps the most important concern for all of us today is protecting the environment we live and breathe in. Climate change issues are creating havoc with erratic weather patterns affecting everything from crop production to the untimely melting of ice glaciers. There is a lot to worry about and immediate action is required. It's not that the world has not geared up to take corrective actions, but we need to do more, and GIS can help us achieve that.

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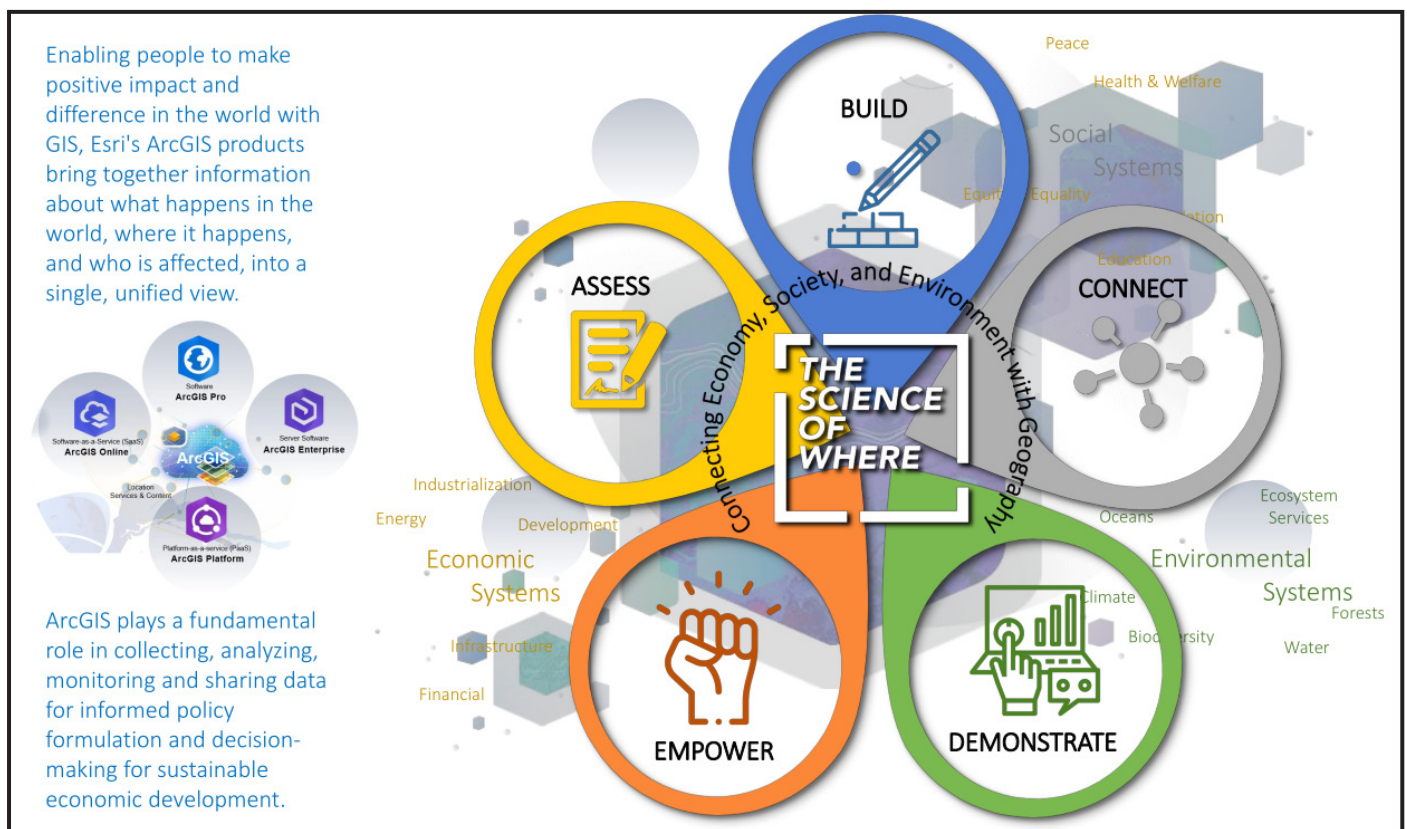
GIS can be used most effectively for environmental data analysis and planning. It allows better viewing and understanding of physical features and the relationships that influence a given critical environmental condition. Factors, such as the steepness of slopes, aspects, and vegetation, can be viewed and overlaid to determine various environmental parameters and impact analysis.

GIS can also display and analyze aerial photographs. Digital information can be overlaid on photographs to provide environmental data analysts with more familiar views of landscapes and associated data. GIS can provide a quick, comparative view of hazards (highly prone areas), risks (areas of high risk that may occur) and areas to be safeguarded.

On completion of data analysis, GIS can help in effective planning and managing environmental hazards and risks. In order to plan and monitor environmental problems, the

assessment of hazards and risks becomes the foundation for planning decisions and mitigation activities. GIS supports activities in environmental assessment, monitoring, and mitigation and can also be used for generating environmental models.

Esri's ArcGIS technology serves as a powerful integrative tool, consolidating data on global phenomena, their locations, and their impacts into a unified platform. This technology is pivotal in compiling and disseminating data related to Sustainable Development Goals (SDGs), informing policy decisions, and facilitating sustainable development initiatives. Through collaborations with governmental bodies, non-profit organizations, and authoritative data providers, Esri India is actively creating solution products, interactive dashboards, and other informational resources to help advance sustainable development efforts.



### Natural Resource Management

Being a ubiquitous technology, GIS integrates seamlessly with disparate data sources such as satellite imagery, LiDAR (Light Detection and Ranging), aerial photography, and GPS. This helps in providing valuable information for natural resource management. GIS-based modeling techniques enable the

simulation of various scenarios related to natural resource management, such as the impact of climate change, urban expansion, or deforestation on ecosystems. These predictive models assist in identifying potential future challenges and devising proactive measures to mitigate them.

Esri's ArcGIS System empowers decision-makers to manage natural resources more effectively. For instance, through our forest management solutions, we have made it easier for stakeholders to monitor forest health, create inventories of forestry data, and also analyze ecological parameters. Forest departments are now looking at scaling up their existing technology infrastructure to set up GeoHubs for a more coordinated approach to sustainable forest management as well as driving inclusive participation with larger stakeholder communities including citizens.

Esri India's Indo ArcGIS offers specially curated solutions for solving some of the most pressing challenges of natural resource management in India. These unique solutions for burnt area assessment, forest fire management, water resource management, forest plantation management, disaster management, land management, etc. are paving the way for sustainable natural resource management in India. These solutions are supported by 900+ layers of data through the Indian edition of ArcGIS Living Atlas.

Many state government departments have already been using GIS technology for forest management practices such as wildlife management, joint forest management, plantation/afforestation activities, forest fire management, protected area management, commercial forestry, and more. MP Forest is using ArcGIS for a central dashboard for forest monitoring, mapping entire forest boundaries and correcting them vis-a-vis revenue boundaries, utilizing mobile-based GIS for data collection, incident management, and tracking beat guard movement. This is largely helping in sustainable forest management.

Esri's ArcGIS is also playing a crucial role in the conservation efforts of the Ganga River. The GIS-based 'Web Centric Water Quality Dashboard', used by the National Mission for Clean Ganga (NMCG) authority aids in effectively assessing the current state of the Ganga River, identifying pollution sources, and planning conservation strategies.

Esri India's solution is also helping the National Water Informatics Centre (NWIC) to foster both environmental conservation and economic development. Powered by ArcGIS, the India-Water Resource Information System ensures the provision of reliable, timely data and insights for comprehensive future water projections. The System supports informatics-based sustainable development in water resource management, delivering value-added products and services to all stakeholders.

## ArcGIS Facilitates Comprehensive Decision-making in Mining

Adani Natural Resources is using Esri's ArcGIS to make informed decisions in mining.

The System is helping in:

- Contiguous acquisition and tracking of land in areas of interest demarcated by mine planners designated to certain activities like mining, dumping, or infrastructure areas.
- Infrastructure planning. GIS applications integrate geological model databases, surface features, and existing mining features to suggest suitable infrastructure areas.
- Monitoring large mining landscapes from drone data and tracking land reclamation details, vegetation planning, vegetation health growth, and mining operations.
- Exploration planning in undulated topography and tracking exploration progress through GIS dashboards and analytics.
- Monitoring of safety and environmental parameters in the mining area.
- Effective evacuation and logistics planning.



### Conclusion

The applications of GIS go much beyond the scope of this story. GIS serves a diverse community ranging from citizens to administrators, business leaders, scientists, social workers, and many others. It caters to the requirements of individuals, governments, businesses, entire enterprises, and civil society. With geospatial data becoming increasingly ubiquitous, contextualized geo-intelligence has taken a center-stage. Its economic value and benefits across the spectrum, sector-agnostically, are well acknowledged. In the past, GIS was confined to desktop computers, offering only a handful of features, and requiring specialized expertise to operate within office settings. In the present day, with versatile functionalities that are tailored and customized, GIS has become easily accessible from any location at any time, empowering individuals from all walks of life to utilize its capabilities. The recognition of GIS as a valuable decision-making tool has led to its integration into various sectors, extending their reach and impact. By providing valuable insights, improving efficiency, facilitating collaboration, and supporting innovation in various sectors, GIS is reshaping the way governments, businesses, and communities collaborate and interact with spatial data. Harnessing the potential of GIS is critical for sustainable, inclusive, and equitable growth.



### ArcGIS enables CRIDA to objectively review watershed projects and assess India's vulnerability to climate change

Central Research Institute for Dryland Agriculture used Esri's ArcGIS to deal with its vast geographic data for scores of applications in agriculture viz. land use planning, watershed management, agricultural sustainability and vulnerability studies, agrometeorology. Remote sensing, GIS, and GPS were used for precision agriculture to optimize the application of inputs for plot and crop identification, crop monitoring, etc. to estimate and maximize yield. The solutions were aimed at providing farmers with the best possible outcomes for themselves, their families, and investors and indirectly for their customers and the environment.

The ArcGIS solution enabled officials in different domains to make better and quicker decisions. It helped them in:

- Managing risks by assessing the nutrition retention capability of soil organic matter
- Bridging yield gaps by determining local natural resource availability and local model development for risk assessment
- Dealing with concerns related to nutritional security such as rise in demand, cereal production and growth in GDP
- Determining environmental footprints of changing demand profiles
- Managing water resources
- Maintaining soil health and productivity
- Evaluating climate change and climate variability