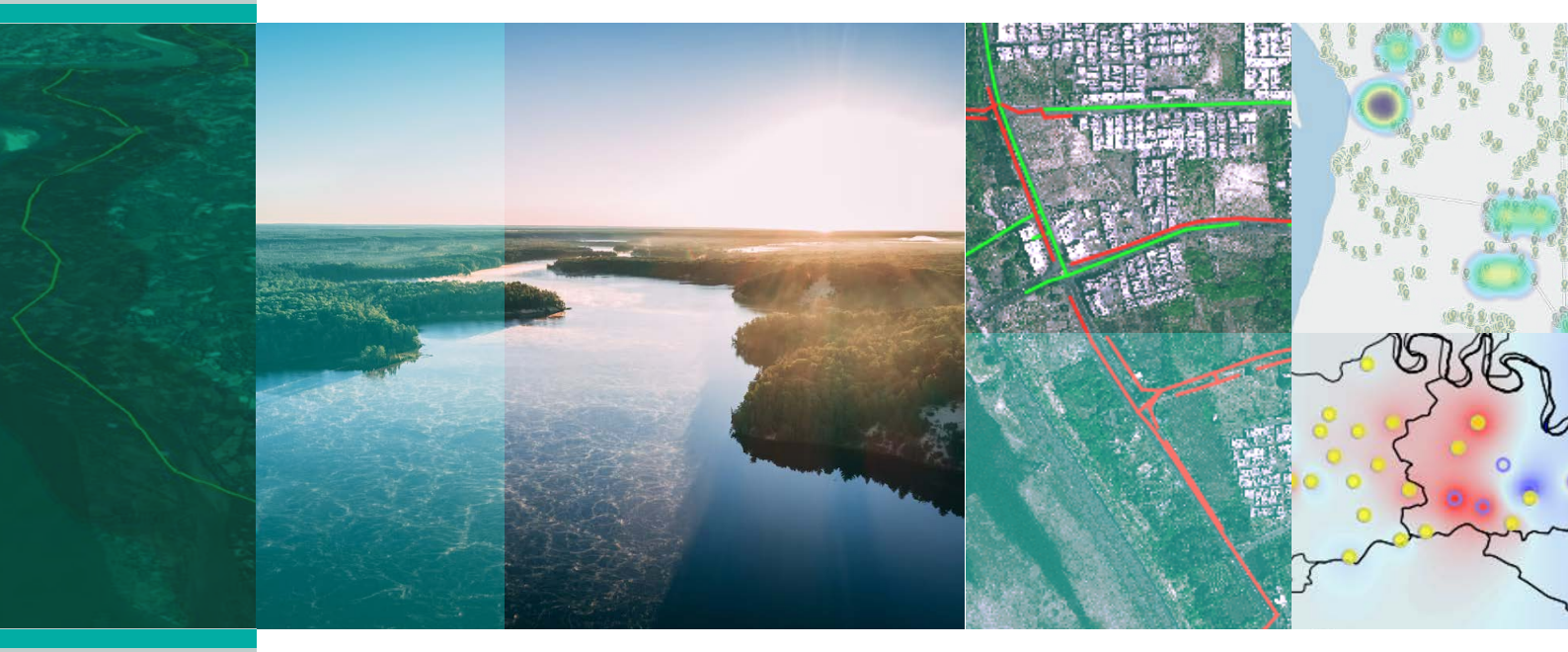
SCANPOINT GEOMATICS LIMITED

River Rejuvenation Programme



White Paper 2023

SCANPOINT GEOMATICS LIMITED

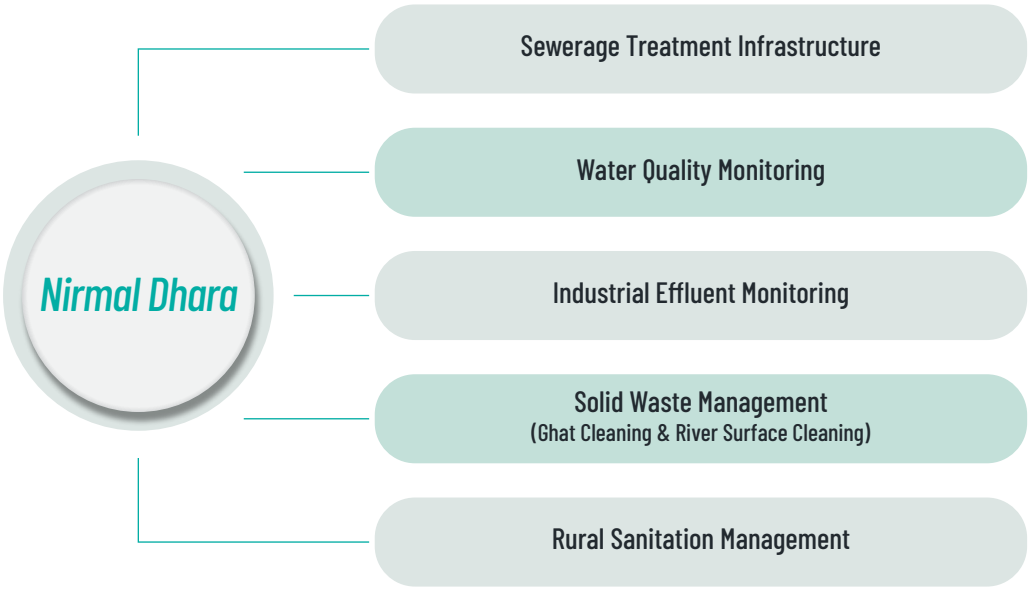
INTRODUCTION

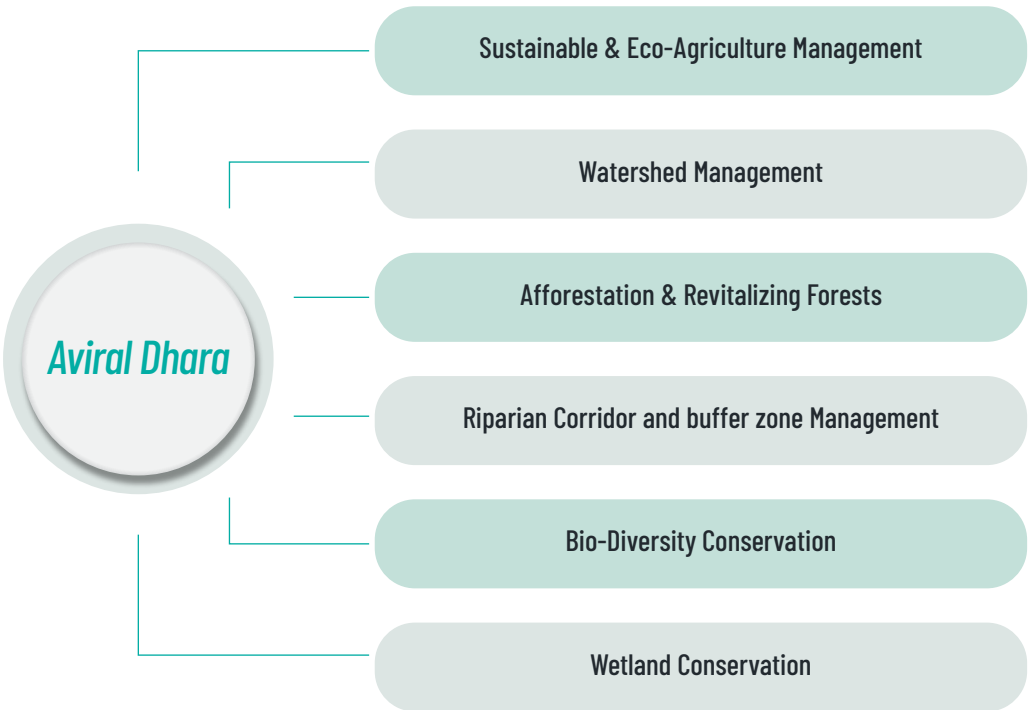
River rejuvenation is the process of reviving or restoring the natural flow and health of a river that has been damaged due to natural activities such as silt deposition as well as human activities such as waste dumping, encroachment, and pollution. The process involves removing pollutants, cleaning up riverbeds, and restoring the natural environment around the river.

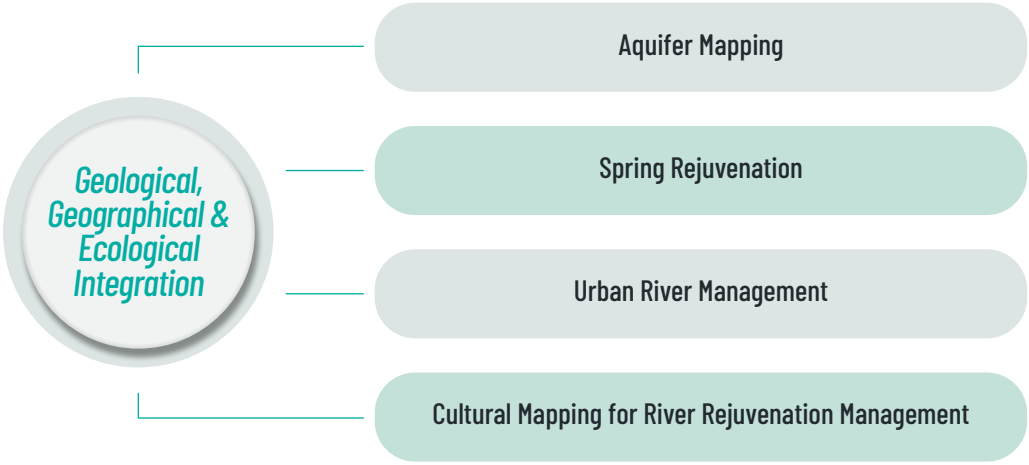
River rejuvenation Programme, is an integrated conservation mission, to restore the natural habitats of plants and animals, promote biodiversity, and provide cleaner water for drinking and irrigation. It can help to control floods and reduce the damage caused by them. Reviving rivers will not only boost the ecological condition but also boost tourism in the region and improve the livelihoods of people who depend on the river for their livelihoods.

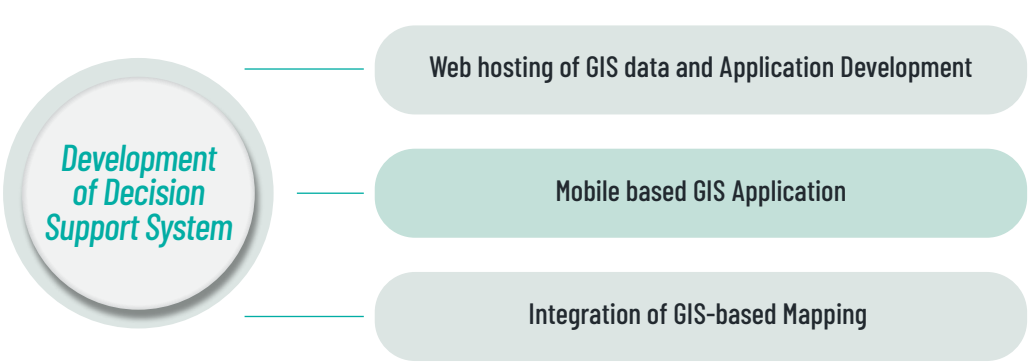
Main pillars of the River Rejuvenation Programme are:-

The Vision for river rejuvenation constitutes restoring the wholesomeness of the river defined in terms of ensuring "Aviral Dhara" (Continuous Flow), "Nirmal Dhara" (Unpolluted Flow"), Geological, Geographical and Ecological Integration.


Nirmal Dhara
Sewerage Treatment Infrastructure
Water Quality Monitoring
Industrial Effluent Monitoring
Solid Waste Management
(Ghat Cleaning & River Surface Cleaning)
Rural Sanitation Management


Aviral Dhara
Sustainable & Eco-Agriculture Management
Watershed Management
Afforestation & Revitalizing Forests
Riparian Corridor and buffer zone Management
Bio-Diversity Conservation
Wetland Conservation


Geological, Geographical & Ecological Integration
Aquifer Mapping
Spring Rejuvenation
Urban River Management
Cultural Mapping for River Rejuvenation Management


Development of Decision Support System
Web hosting of GIS data and Application Development
Mobile based GIS Application
Integration of GIS-based Mapping

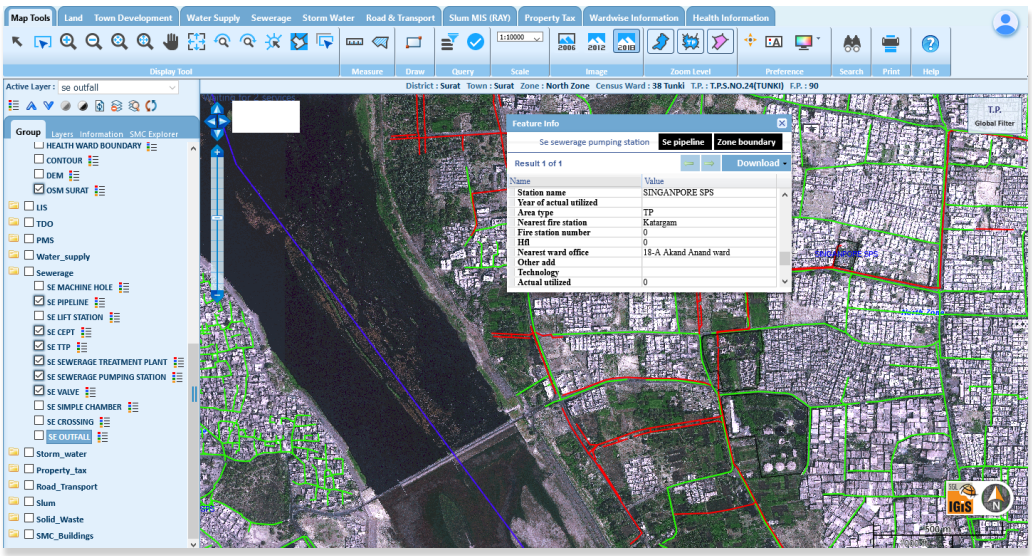
Nirmal Dhara

"Nirmal Dhara" is a term used in river rejuvenation efforts that focuses on ensuring clean or unpolluted flow of water in rivers. The goal of achieving Nirmal Dhara is to improve and maintain the water quality of rivers by reducing pollution, preventing the discharge of untreated wastewater, and implementing effective water treatment measures. Following are some efforts that are made under Nirmal Dhara, to ensure the aforementioned objectives:

Sewerage Treatment Infrastructure

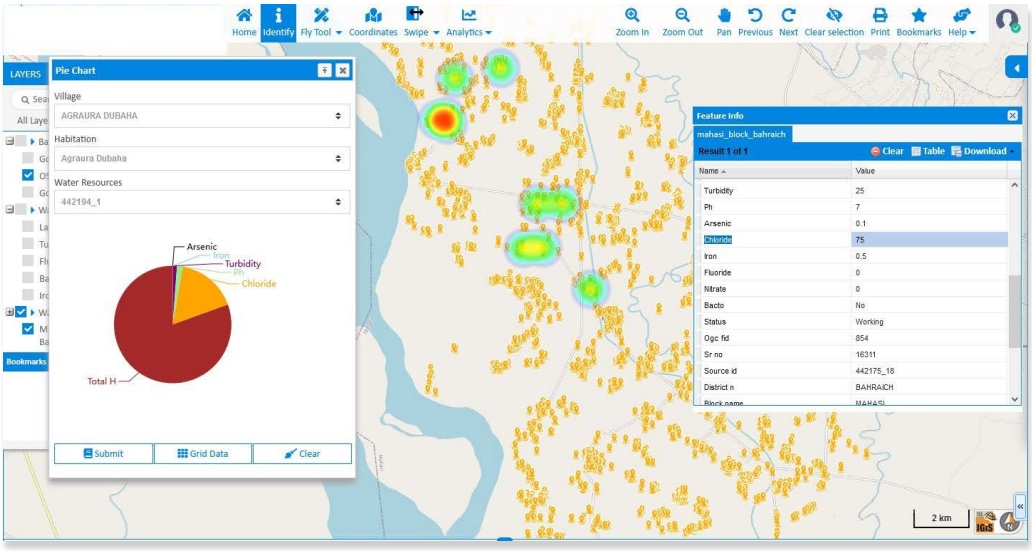
The fast-growing population, raised living standards, and rapid industrialization and urbanization have led to the degradation of water resources and rivers in different ways.

Any city/town needs to have the facility of the sewerage treatment for treating the contaminated water and make water apt to be re-used. GIS plays a major role in keeping record of all the information related with sewerage system & treatment over a single platform like site suitability for sewerage treatment plant (STP), Effluent Treatment Plants (ETP), Common and Combined Effluent Treatment Plants (CETP), sewerage pipelines, Manhole & Node, tracking of the contaminated water flow in the river etc. To optimize the planning, monitoring, and management of sewerage treatment systems, IGiS can be effectively utilized. IGiS technical solutions can help stakeholders with site selection & suitability for treatment plant construction. Additionally, it helps to maintain Asset inventory, assess environmental impacts & in emergency system deployment in case of sewerage system failure.



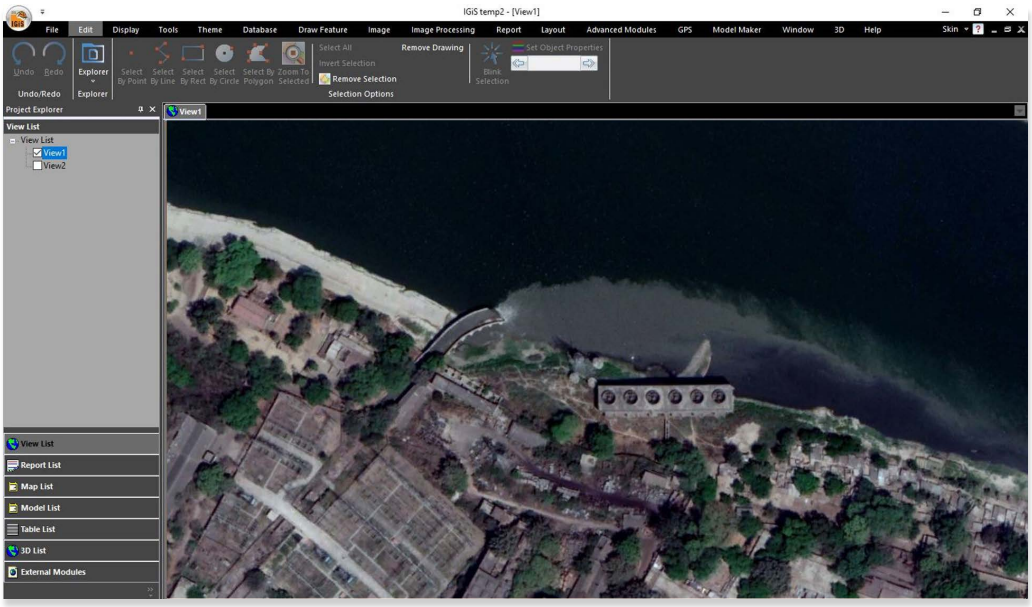
Water Quality Monitoring

Monitoring water quality is recognized as the first step towards understanding the characteristics of water pollution and devising effective mitigation strategies for river rejuvenation. Monitoring and assessment of various water quality parameters require sampling from widely distributed locations. IGiS helps in identifying pollution sources, track water contamination patterns, and guide decision-making for targeted interventions, ultimately facilitating effective management and protection of water resources. Real time water quality monitoring station (RTWQMS) network along the main stream of river is developed and water quality parameter data is collected in real time. Integrating with RestAPI's, user can easily analyse the water quality over web-portal using IGiS based enterprise solution by assessing the station location & geotagged photograph associated with the location.



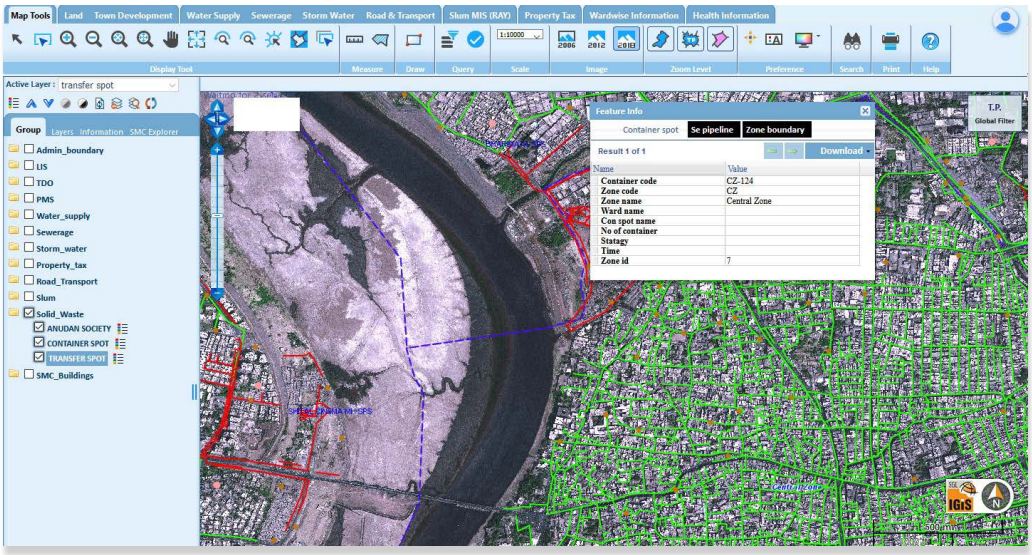
Industrial Effluents Management

Pollution situation of river stretches in urban India is exponentially worse due to presence of clusters of industries. The effluent treatment plants, established in the industrial sectors like Pharmaceuticals, Chemicals, Leather industry and tanneries, are used in the removal of high amount of organics, debris, dirt, grit, pollution, toxic, non-toxic materials, polymers etc. Real time monitoring of such treatment plants with live data of industrial effluents over the GIS based web portal through API integration provides the detailed situations spatially. It will help stakeholders with synoptic view to understand the effluent discharge in river stretches



Solid Waste Management

Solid waste Management is complete process of collecting, treating and disposing of solid wastes. GIS is an excellent tool as it is used in the planning and management of technical elements. In past few decades, some measures have been taken to shorten the distance between landfills and waste collection stations. GIS can be useful in collection of wastes by geotagging the bins. This will help in saving time and resources by finding best/alternative path to for transportation of solid waste from waste bin to disposal site. Additionally, GIS helps in identifying the suitable disposal sites aiding in environmental & human safety. Reports can be generated for every assets, every Ghats of different zone/ward for the ease of understanding and decision making for the departmental staffs

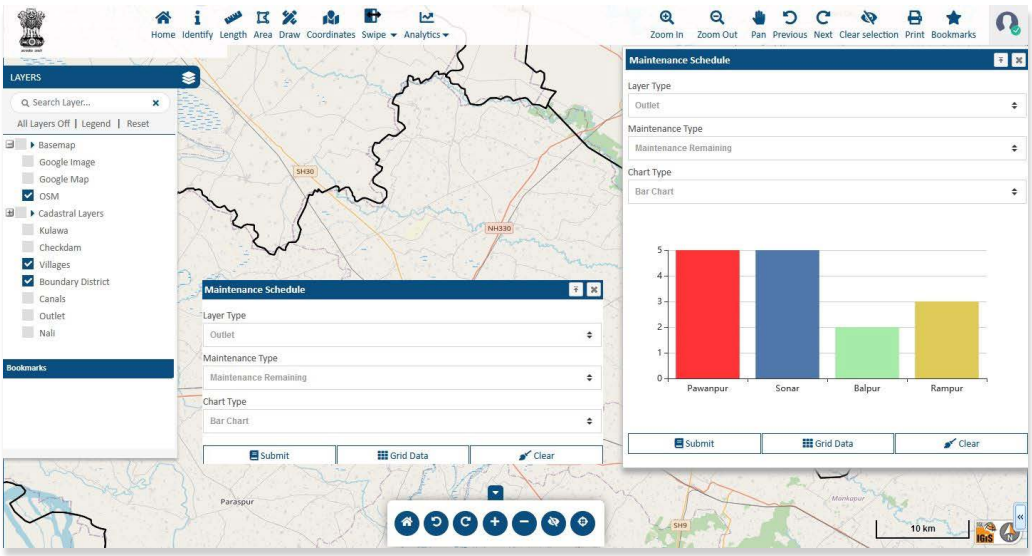


River Surface & Ghat Cleaning

Efforts to clean the surface of rivers involve systematic actions to remove pollutants, debris, and floating waste from the water. GIS aids in mapping and analysing pollution sources, monitor water quality, and plans for clean-up activities in Ghats. GIS enables efficient resource allocation, tracking of pollution hotspots, and evaluating the impact of clean-up initiatives, contributing to Effective River and Ghat cleaning process. This conservation step leads to improved sanitation outcomes and public health along the riversides.

Rural Sanitation Management

Rural sanitation aims to provide clean and safe sanitation facilities in rural areas. Poor rural sanitation practices, such as open defecation and inadequate waste management, can lead to the contamination of rivers and water bodies, posing health risks and ecological harm. IGiS plays a significant role by enabling effective planning, monitoring, and management of sanitation projects. It helps identify areas lacking proper facilities, assess sanitation needs, target interventions, and track progress, leading to improved sanitation outcomes and public health in rural communities. IGiS web based GIS solution can help various government bodies like, MGNREGA, for seamless accessibility in Government to Government (G2G) and Government to Citizens (G2C) domain. They can form an asset repository system by geotagging using survey based Mobile application. It will help them analyse all the existing assets, repairs required, maintenance stage, socio-economic situations etc.

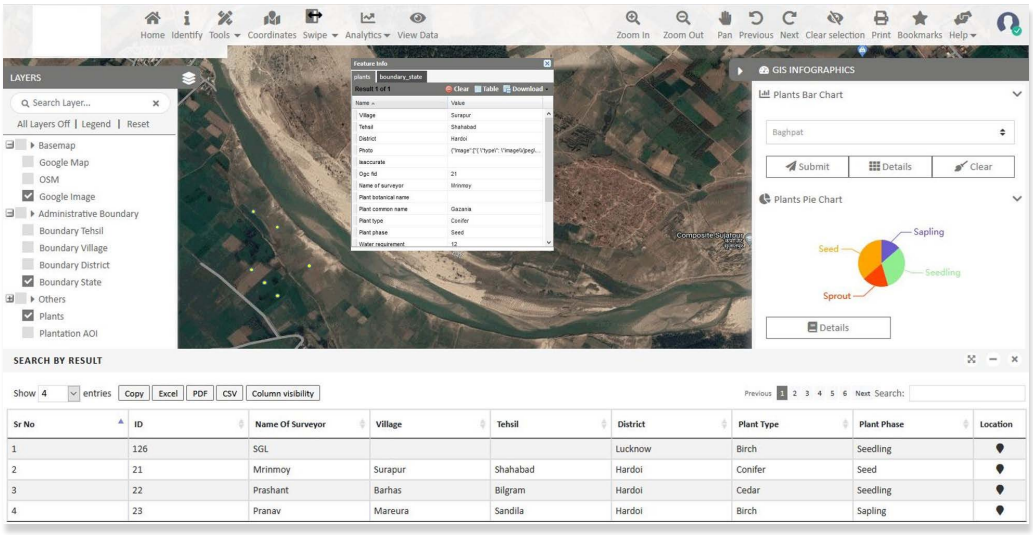


Aviral Dhara

"Aviral Dhara" aims to balance human water needs while ensuring that adequate water is available to maintain the flow in the river and sustain the associated ecosystems. Aviral Dhara emphasizes the importance of maintaining a minimum continuous flow in rivers, even during dry seasons or in areas with water scarcity. Following are some efforts that are made under Aviral Dhara, to ensure the aforementioned objectives:

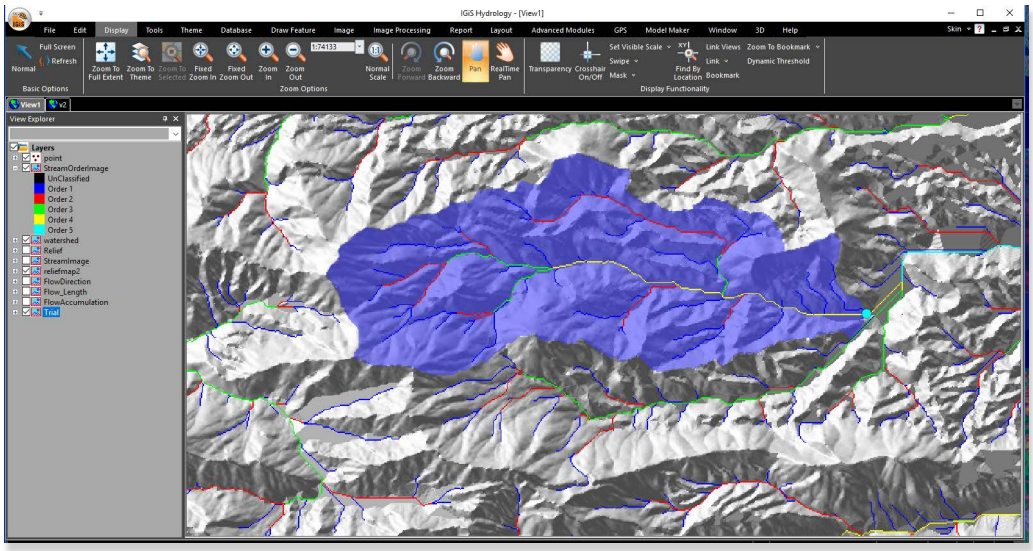
Sustainable & Eco-Agriculture Management

Sustainable and Eco-Agriculture Management is important for river rejuvenation in ensuring Nirmalta as well as Aviralta. The rivers along with their tributaries are proposed for sustainable and ecological interventions, as river-scape, under different landscapes namely natural landscape (Grassland, Wildlife Diversity etc.), agricultural landscape (Agroforestry, Fodder Plantation etc.) and urban landscape (Riverfront Development, Eco Park etc.). The different models of plantations including timber species, medicinal plants, grasses, shrubs and fuel fodder and fruit trees are aimed to augment water, ground water recharge and contain erosion. IGiS provides mobile application to maintain inventory & monitor agricultural areas form to time. IGiS web-based solution also provide interactive dashboard for stakeholders to understand the impact analysis over the period of time.



Watershed Management

Watershed management planning involves creating a blueprint or a plan that outlines the most effective strategies to protect and enhance water quality and other natural resources within a specific watershed boundary. Additionally, it helps regulate water flow during heavy rainfall, reducing the risk of flooding. Preserving the natural features of the watershed promotes biodiversity, contributing to the overall rejuvenation of the river ecosystem. IGiS offers a separate hydrology module that have functionalities to delineate watershed boundary. It encompasses all the essential tools like, flow accumulation, flow direction, stream generation, stream order, micro & macro basin delineation, runoff patterns analysis etc. These tools finally aid in the effectual management and understanding of watersheds for environmental planning and decision-making.

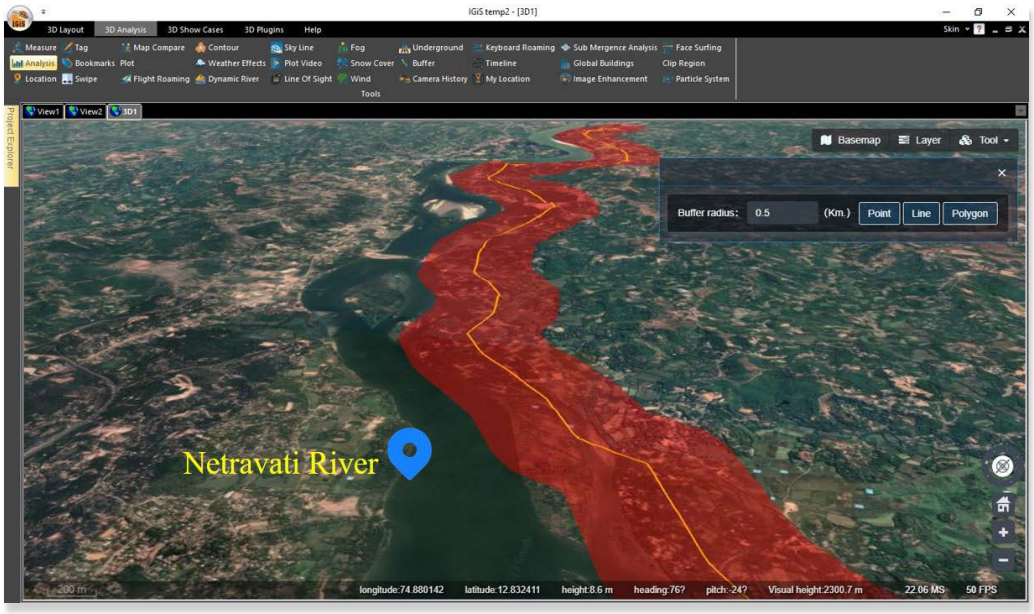


Afforestation & Revitalizing Forests

Afforestation is the process of establishing forests in areas where they did not previously exist or have been significantly depleted. It is crucial to restore forest ecology near rivers and its tributaries that has been lost over the period of time. This practice has numerous benefits, including preventing soil erosion, improving water quality, enhancing biodiversity, and providing habitat for aquatic and terrestrial species. One of the key tools, for river scape, that can greatly assist in the planning, monitoring, and evaluation of afforestation projects is remote sensing & GIS. IGiS helps to achieve all the aforementioned objectives and also assists in pre-assessment of site suitability, Tree species plantations with specific site selection, evaluates benefits & impact assessment of afforestation. IGiS web-solution supports decision-making processes for stakeholders, who can achieve better outcomes in their afforestation endeavours.

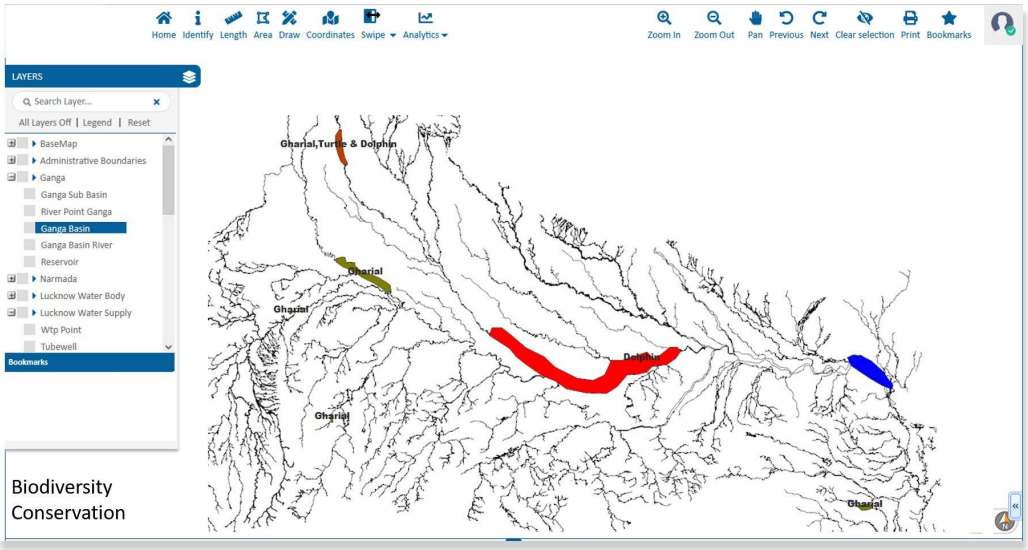
Riparian Corridor and buffer zone Management

Riparian zones are highly valuable ecosystems that play a critical role in enhancing the health of rivers. They act as ecological engineers, performing various essential functions to support river ecosystems. These functions include stabilizing stream banks, buffering pollutants and sediment, regulating temperature, providing energy for food webs and communities, recharging groundwater, and serving as corridors and habitats for wildlife. However, riparian zones are currently facing significant threats due to agricultural practices, urbanization, alterations in river flow, excessive exploitation, climate change, pollution, and the introduction of invasive species. These threats are jeopardizing the health and integrity of riparian zones & overall river health. Given the ongoing decline in river health and the global environmental changes that lie ahead, there is an urgent need for an integrated approach to manage riparian zones effectively with Remote Sensing & GIS. Using satellite data & indices based derived product, buffer structure of riparian vegetation is examined regularly. IGiS in-built tools supports designing and managing buffer zones around riparian corridors. These zones act as protective barriers, filtering pollutants, and preventing encroachment. By analysing spatial data, such as land use pattern, slope, flora & fauna density and soil characteristics, IGiS can assist in determining the optimal width and configuration of buffer zones based on ecological requirements and land use compatibility. It helps stakeholders with the status of the riparian corridor that should be managed by the retention of existing plants or replanting (if disturb) with appropriate native species.



Bio-Diversity Conservation

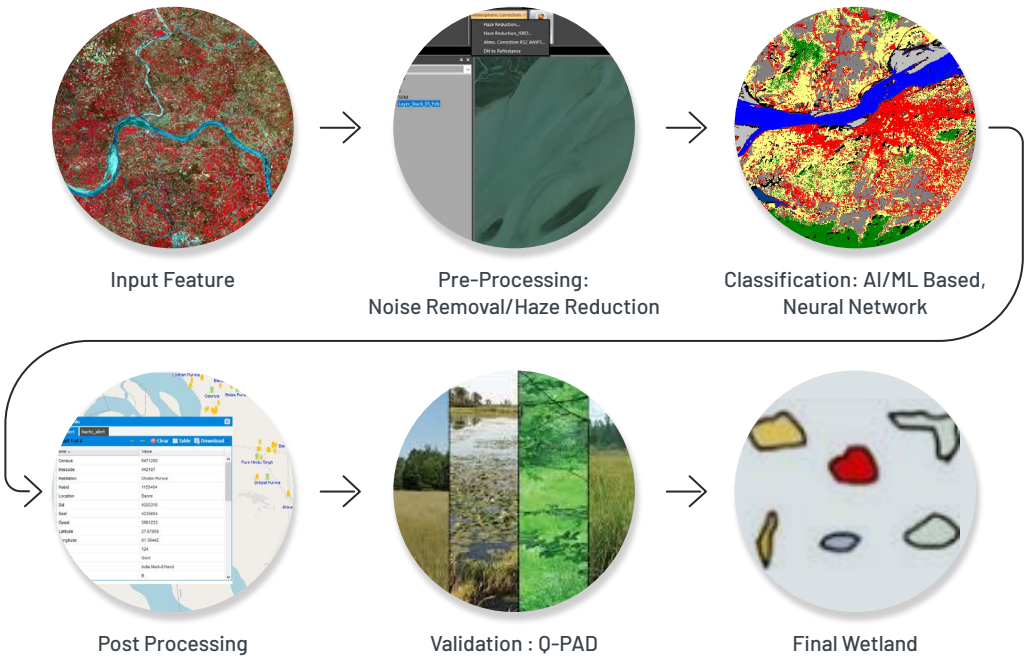
Bio–Diversity conservation practice restores viable populations of all endemic and endangered biodiversity of the river, so that they occupy their full historical range and fulfil their role in maintaining the integrity of the river ecosystems. Remote sensing & GIS plays integral role in mapping and protecting large and remote areas. High biodiversity areas can be identified & mapped along the river stretches. It can help to regulate the elements responsible for structural changes in the river & reduced flow regime. It can help to monitor the impacts occurs due to migration barriers for aquatic species, bank alteration, unsustainable resource extraction, river bed and bank agriculture, sand mining, change in water quality due to pollution. In order to maintain the ecological integrity of the river, IGiS can help stakeholders with effective decisions making process, formulation of mitigation practices & policies, & devising stretch specific conservation strategies.



Biodiversity Conservation

Wetland Management

Wetland Management refers to the planning, conservation, and sustainable use of wetland ecosystems. It involves activities aimed at protecting, restoring, and enhancing the ecological integrity of wetlands (distinct ecosystem characterized by the presence of water, either permanently or seasonally) while considering the needs and benefits for both human communities and the environment. It encompasses various practices aimed at minimizing the impact of waste on human health, the environment, and society as a whole. IGiS facilitates wetland mapping through its comprehensive GIS tools. With IGiS, wetland mapping involves data integration from various sources, including satellite imagery, aerial photographs, and ground observations. The software enables the interpretation of wetland features, delineation of wetland boundaries, and analysis of wetland characteristics such as vegetation type and hydrological patterns. IGiS offers automatic water indices generation like NDWI, NDMI, NDSI, and more and also offer spatial analysis tools, attribute assignment capabilities, and visualization options to generate thematic maps of wetlands. This aids in understanding wetland distribution, ecological importance, and supports decision-making for wetland conservation and management.



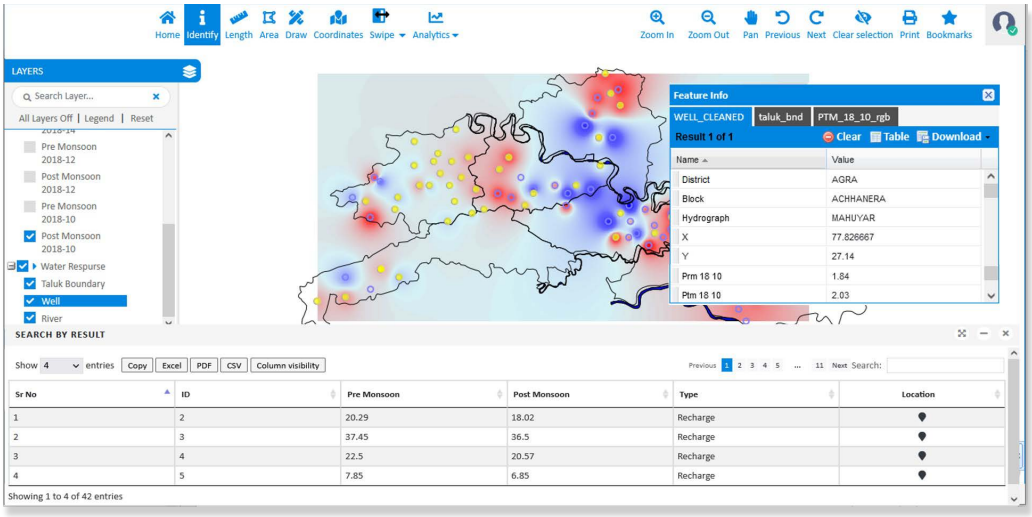
Geological, Geographical & Ecological Integration

Geographical, geological, and ecological systems play significant roles in the process of river rejuvenation and can have various effects on the overall outcomes. Some key effects that influence river rejuvenation are, topography that affects the flow patterns and water dynamics within a river system. It exhibits varied slopes which can lead to increased erosion and sediment transport, impacting water quality and the stability of riverbanks. Another important key is the Soil Composition that affect water infiltration rates, groundwater recharge, and nutrient retention.

Certain geological Formations like rocks, hills, or cliffs can influence the natural channel morphology and flow patterns of a river. These formations can impact water velocity, sediment transport, and the formation of river pools, riffles, or rapids. Stakeholders also considers ecological aspects during conservation techniques. These ecological keys health depends on maintaining ecological connectivity. River rejuvenation should consider factors such as fish migration, nutrient cycling, and the exchange of species between the river and surrounding habitats. Preserving or restoring connectivity supports the overall functioning and resilience of the ecosystem. Some of these aspects are discussed below that can be achieved using IGiS:

Aquifer Management

An aquifer is an underground layer of permeable rock, sediment, or soil that contains and transmits groundwater. Aquifer Management refers to the sustainable and responsible management of underground water resources stored within aquifers. Aquifer management utilizing GIS technology analyze, and visualize data related to underground water resources. GIS enables the integration of various datasets, such as hydrogeological parameters, water quality information, land use patterns, and groundwater monitoring data, into a spatial framework. This allows for comprehensive mapping of aquifer boundaries, identification of recharge areas, assessment of water availability, and analysis of potential impacts from land use activities or pollution sources. By utilizing IGiS technology, aquifer managers can make informed decisions, develop sustainable water resource plans, and implement effective strategies to protect and manage aquifers for long-term use. IGiS also facilitates the communication and sharing of information with stakeholders, enhancing collaboration and engagement in aquifer management efforts.



Spring Rejuvenation

Freshwater springs are unique aquatic ecosystems that make substantial contributions to local and regional biodiversity due to the diverse range of spring types and habitats they offer. Throughout history, springs have served various purposes for human communities. Despite their typically small size, springs are plentiful and characterized by excellent water quality. Consequently, they provide habitats for numerous species, including endangered organisms and distinctive microbial life forms that are seldom found in other environments due to their vulnerability to human-induced disturbances (such as pristine remnants of least-affected habitats). Remote sensing and GIS can aid in assessing the vulnerability and risks associated with springs. IGiS based web solution can help in implementing appropriate measures to mitigate risks and ensure the long-term sustainability of spring ecosystems. In addition to this, location, extent, and characteristics of springs, can help in their identification, mapping, inventories over the period of time and their assessment to make informed decisions.

Urban River Management

Urban river management involves the planning and implementation of strategies to improve the health, functionality, and sustainability of rivers within urban areas. IGiS can integrate this spatial data like, road networks, population densiry, river network, its width, infrastructure networks and urban planning zones, to create comprehensive river maps for effective management. By analyzing factors such as land use, impervious surfaces, and morphological parameters, stakeholders can assess the impact of urbanization on water quality, flooding, and erosion. This analysis helps in developing targeted management strategies to mitigate negative effects and improve overall watershed health. IGiS-based Enterprise platform and web-portals can facilitate public engagement and education in urban river management. Interactive maps and online platforms can provide information about the state of urban rivers, ongoing projects, and opportunities for community involvement. This promotes public awareness, participation, and collaboration in the sustainable management and restoration of urban river ecosystems.

Development of Decision Support System (DSS)

The development of a Decision Support System (DSS) for river rejuvenation using GIS and remote sensing technologies is a valuable approach to facilitate informed decision-making and effective management strategies. Such a system can provide valuable insights and assist stakeholders in the planning, implementation, and monitoring of river rejuvenation projects. Some of the IGiS based solutions are mentioned below that can enhance the understanding of complex river systems, and facilitates evidence-based decision-making throughout the rejuvenation process:

GIS Integration of Existing Application

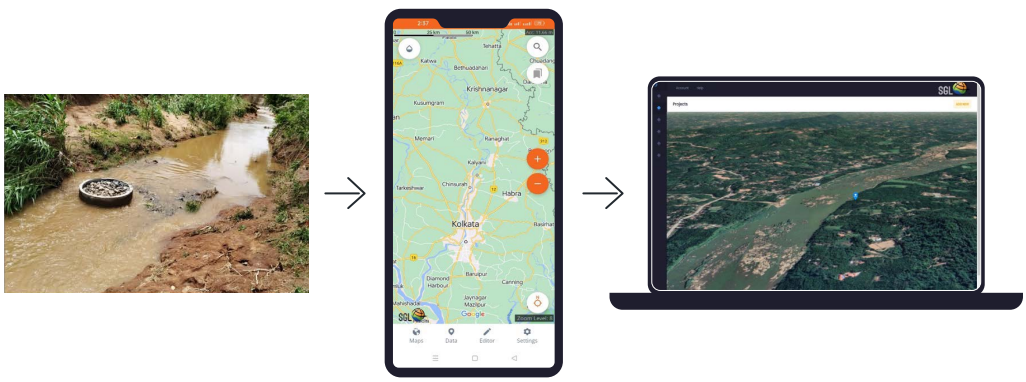
This involves utilizing GIS functionalities and data within the existing application to enhance its spatial analysis, visualization, and decision-making capabilities. This integration enables users to leverage all spatial and non-spatial data within their familiar software environment, without the need for separate GIS software. It enhances the application's ability to work with spatial data, perform spatial queries, display geospatial information on maps, and incorporate geospatial analysis into existing workflows. GIS integration of existing applications can provide significant value by expanding the application's capabilities and allowing for more comprehensive spatial analysis and visualization.

Web Portal and Dashboard Customization

A GIS-based web portal is essential for river rejuvenation as it facilitates data integration, visualization, analysis, and decision support. It provides a comprehensive view of the river system, enabling stakeholders to identify pollution sources, assess land use impacts, and plan targeted restoration efforts. The portal enhances stakeholder engagement, enabling collaboration and information sharing. It serves as a centralized platform for monitoring progress, guiding management strategies, and ensuring effective and sustainable river rejuvenation initiatives. GIS Portal shall be carried out using COTS based Enterprise GIS platform. This web GIS Portal is based on open-ended framework, so that customization/configuration and integration of required functionalities can be easily done in future as per the requirement of department. This portal is capable in integration with smart solution like IoT for real time information/data updation, related to water quality parameter for water resources.

Mobile based GIS Application

Mobile-based GIS app IGiS Q-PAD provide real-time access to geospatial data, enabling field data collection, mapping, and analysis on mobile devices. This enhance data accuracy, improve decision-making, facilitate remote work, and enable efficient resource management, leading to increased productivity and better planning outcomes.



CONCLUSION

River rejuvenation is the process of restoring and revitalizing a river system to enhance its ecological health and functionality. Integrated GIS & Image Processing Software (IGiS) play a crucial role in this endeavour by providing powerful tools for analysing and managing data related to River Rejuvenation. GIS enables efficient mapping of river features, such as stream segments, floodplains, and water quality parameters, aiding in the identification of restoration priorities and also help in mapping the Sewerage Infrastructure, Solid waste management as well as for sustainable & eco agriculture. By integrating various datasets, GIS helps assess the impact of anthropogenic activities on riverbank, identify areas of degradation and design effective strategies for restoration. Ultimately, GIS facilitates informed decision-making and the implementation of sustainable river rejuvenation practices and dashboard provide centralized platform for monitoring progress, guiding management strategies, and ensuring effective and sustainable river rejuvenation initiatives.

ABOUT

Scanpoint Geomatics Limited

Scanpoint Geomatics Ltd. is the leader in the Indian Geomatics Industry. We pioneer the nation's geospatial domain through IGiS. An indigenous technology that brings GIS, Image Processing, and Photogrammetry together on the same platform under the Make in India Initiative. We are proud of our partnership with the Indian Space Research Organisation (ISRO). With an innovative approach and over two decades of rigorous research and development, the duo developed the IGiS platform. Backed by ISRO's domain expertise, we aim to push forth innovation and uplift the global geospatial domain.

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