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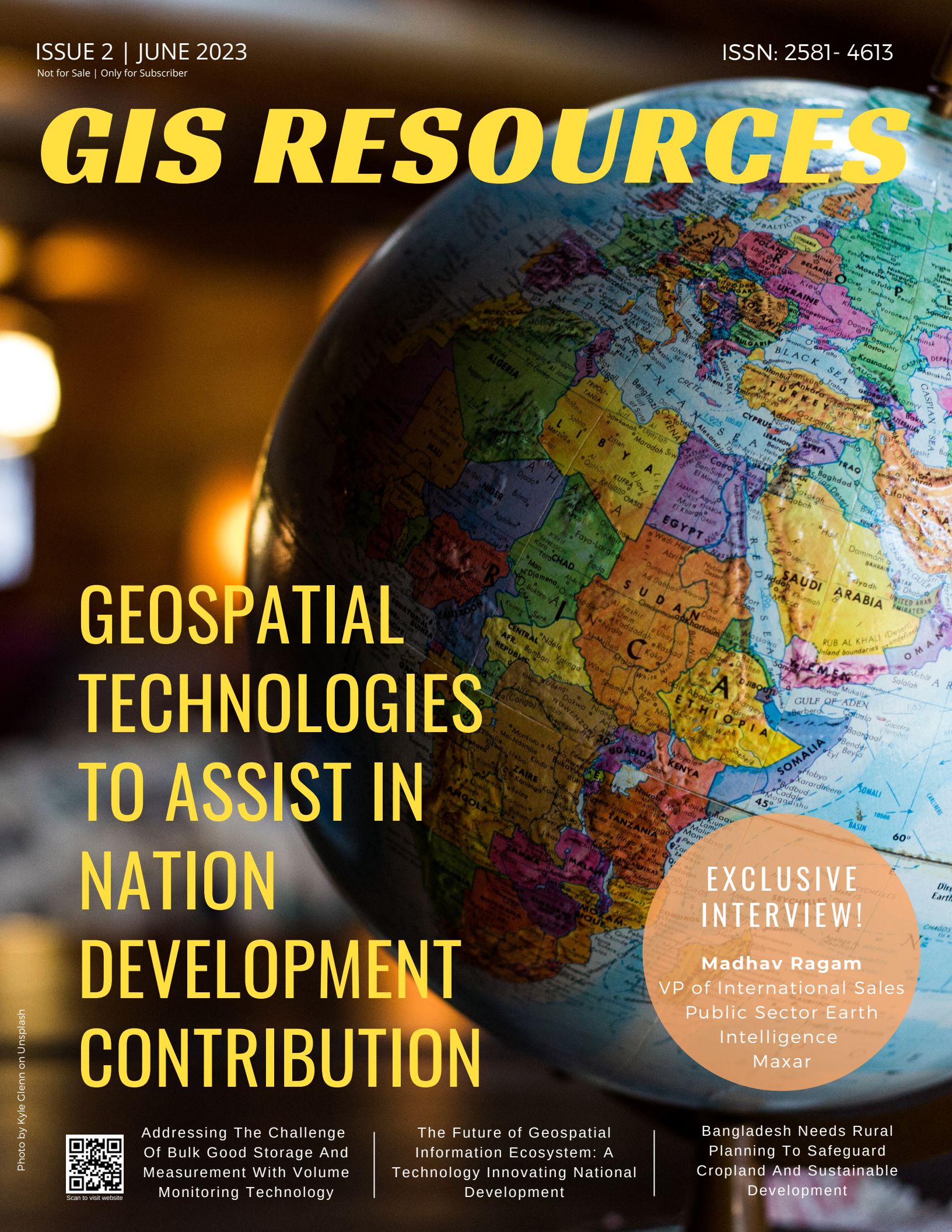
GIS RESOURCES



GEOSPATIAL TECHNOLOGIES TO ASSIST IN NATION DEVELOPMENT CONTRIBUTION

EXCLUSIVE INTERVIEW!

Madhav Ragam
VP of International Sales
Public Sector Earth Intelligence
Maxar

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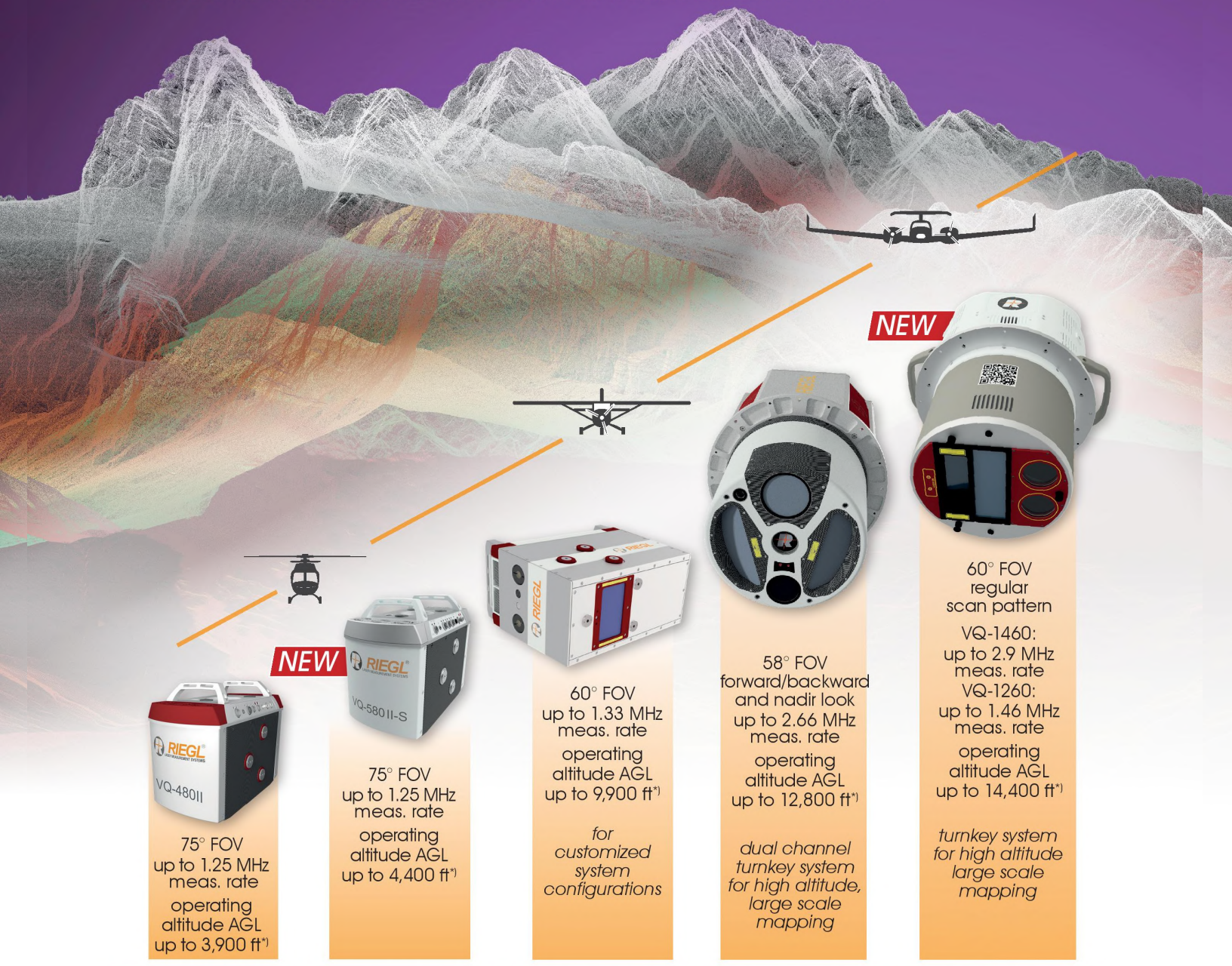

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Regd. Office
GIS Resources
B-24, Jawahar Vihar, Malik Mau Aima,
Rae Bareli, Uttar Pradesh, India - 229010
Phone: +91 852 304 7671
Email: support@gisresources.com
Website: www.gisresources.com

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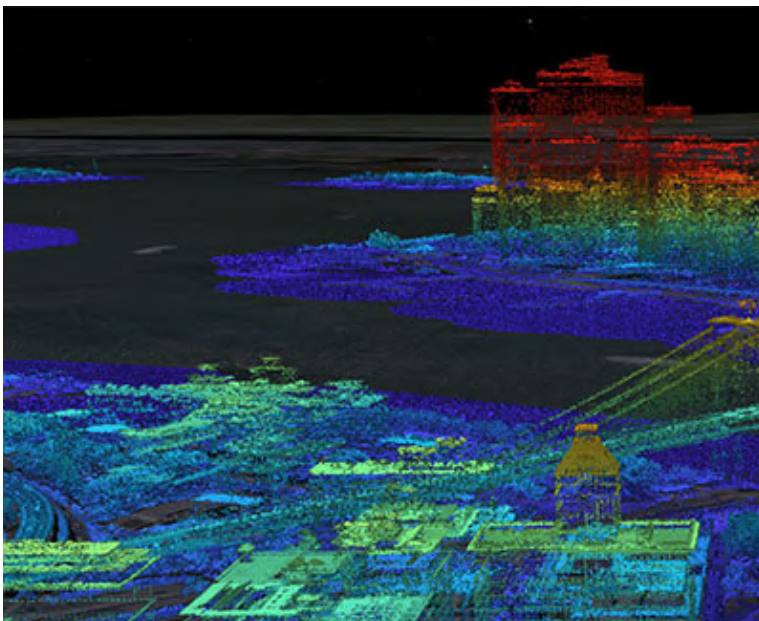
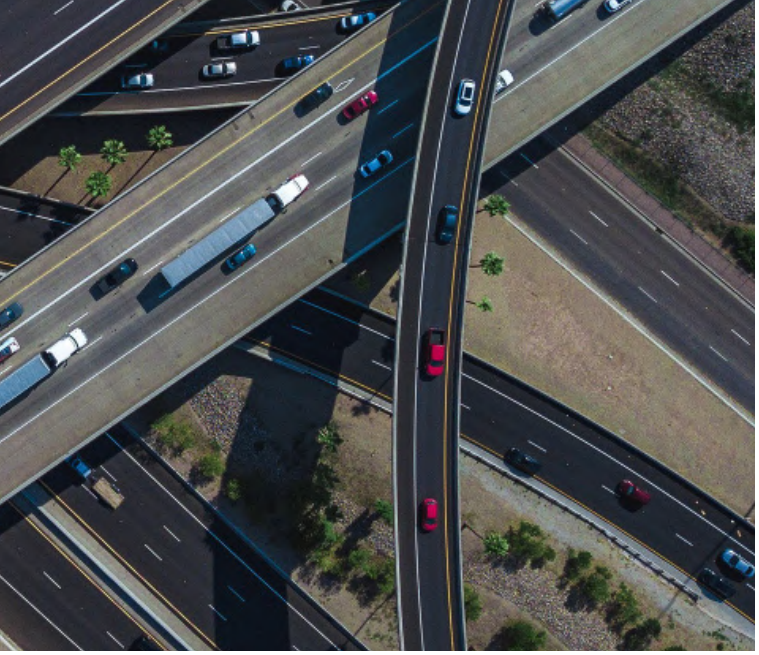
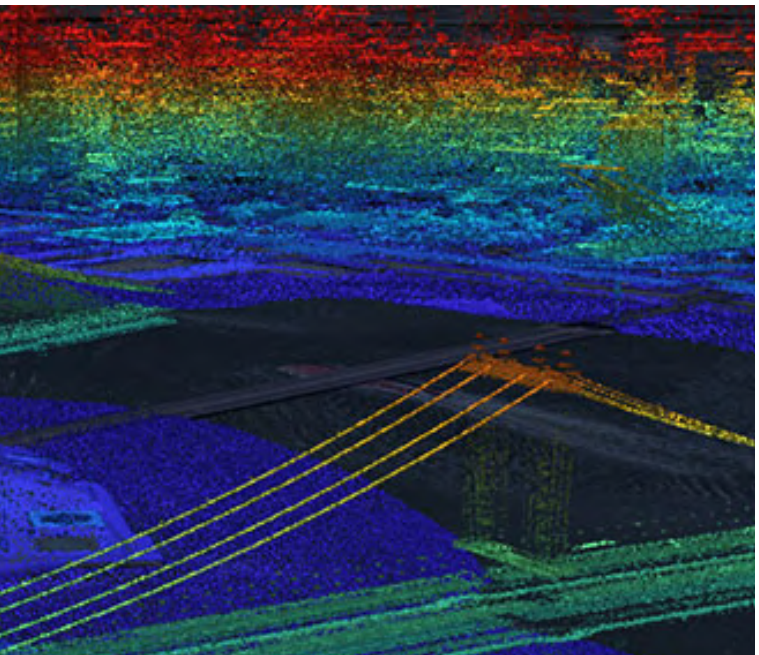






Editor's Note

By Ashok Prim

There is worldwide realisation and acceptance that climate change is affecting lives and livelihoods. This has prompted nations to come together to take decisive action to mitigate climate change. Global temperature rise over pre-industrial era temperatures are sought to be kept within 1.5 degrees by 2030 for any meaningful impact on climate change.

Countries were required to prepare action plans that would chart a course of action for developmental activities in various sectors of the economy and regions of the country in order to reduce the effects of climate change and keep temperature from rising beyond 1.5 degrees.

India submitted its Intended Nationally Determined Contributions (NDC) to the United Nations Framework Convention on Climate Change (UNFCCC) on 2nd October, 2015. In accordance with decision 1/CP.21, paragraph 22, India's Intended NDC is now its first NDC under the Paris Agreement. In August 2022, India communicated an update to its first NDC submitted earlier on October 2, 2015, for the period up to 2030.

Para 4 of India's updated NDC requires it 'To achieve about 50 percent cumulative electric power installed capacity from non-fossil fuel-based energy resources by 2030'. In Para 6 of India's updated NDC, sectors and regions of the country have been identified that need 'To better adapt to climate change by enhancing investments in development programmes in sectors vulnerable to climate change, particularly agriculture, water resources, Himalayan region, coastal regions, health and disaster management.'

Geospatial Technologies are the tools that will enable complex terrain, sub-surface, bathymetric, socio-economic and temporal data driven analysis towards sustainable and environment friendly development practices in all sectors of the economy. Geospatial Technologies combined with Big Data analysis, Machine Learning and Visualisation will enable decision makers to plan ahead to meet the climate challenge. The clock is ticking but we have no other choice except to save our planet.

The BLK247 VolumeMonitor delivers visual and volume monitoring.

Addressing The Challenge Of Bulk Good Storage And Measurement With Volume Monitoring Technology

By Jon Allemand,
Senior Product Manager
Hexagon AB

Volume estimates are integral to the smooth running of any operation that uses bulk goods, such as grain, wood chips, chemicals and other precious resources. If these estimates are incorrect it can result in over or under-valuing stock, which in turn can disrupt automated asset management processes.

In order to free up human resources for other tasks, frequent accurate scanning of bulk good piles needs to be automated and reliable. Incorporating the use of technology that can create a 3D point cloud of the goods, partnered with software that can calculate point cloud volume from the scan, enables a timely and accurate solution to volume monitoring that can be tailored to specific storage locations.

The benefits of digital adoption for improved bulk goods storage aren't limited to volume monitoring. Visual monitoring and sensors ensure optimum storage conditions are maintained, minimizing the risk of losing or damaging stock and alerting when an intruder is too close.

Challenges To Monitor, Measure And Manage Bulk Goods

Companies whose operations depend on handling bulk goods face numerous challenges. A critical one is the determination of their on-stock volume. Imprecise measurements can negatively impact the business's upstream and downstream processes. This could mean that they need to pay more attention to current stock, have higher than necessary carrying costs and that sub-optimal operating decisions are being made.

Laser scanning technologies operated by trained personnel

have been shown to provide accurate volume information. But for high precision, current processes still require manual human resources, which can interrupt the operation of the plant and expose personnel to a hazardous environment. Importantly, these processes are costly in time and labour, creating a need for automated solutions.

One such company needing a system for their bulk goods is Axpo Tegra AG, a leader in the renewable energy sector in Switzerland. The company is active in the biomass sector within the areas of fermentation, composition and wood energy. Its CO2-neutral biomass power plant is a leader in producing renewable energy in Switzerland, requiring precise and timely volume information to ensure continuous operation.

To do this, it deploys Hexagon's Leica BLK247 VolumeMonitor laser scanner. With a fully automatic measurement process, it speeds up and simplifies measurement workflows and is an ideal solution for companies dealing with bulk goods like grain, wood chips, chemicals, cement, and other finished goods.

Automatic Survey-Grade Volumes Delivered In Near Real-Time

Historically, the problem with survey-grade measurements via laser scanning was the significantly manual process, both in data acquisition and the data processing stages. Of course, the volumes were reliable, but the time consuming and costly process could not be justified for daily measurements.

Often, they would only be performed for monthly reporting requirements. Because of the demand for this information by their production, Axpo Tegra AG sought out a different solution.

Daniel Kressig, Head of Biomass Power Plant, Axpo Tegra AG: "It was great to use the simple and intuitive interface of the BLK247 VolumeMonitor solution. We now have easy access to reliable volume information and value the visual monitoring the BLK247 provides in addition."

Some technologies already exist for continuous observation and automated volume measurements. For example, single-point laser or radar/echo systems, but these systems provide less accurate volumes. Especially, when the stockpile and site have irregular shapes.

By using Hexagon's Leica VolumeMonitor solution and installing the Leica BLK247 directly above the center of the stockpile, Axpo Tegra AG automatically achieves survey-grade volume precision. Most importantly, these on-demand measurements are delivered at a frequency far beyond that of other laser-scanning workflows.

To achieve this, a dense point cloud is captured from the BLK247's fixed installation, continuous LiDAR sensor. The VolumeMonitor software then creates a precise 3D digital twin of the stockpile's surface – even while the silo is being filled. Finally, the volume is computed by comparing the stockpile's 3D surface against an existing 3D model of the empty site.

Using precise 3D models is important as other solutions lose accuracy by representing the site through geometric primitives to simplify computation. By using 3D digital twins of the site and stockpile, companies like Axpo Tegra AG can maintain high accuracy. Another strength of this solution is that it can be adapted to fit all different shaped storage areas at the same time.

Most importantly, though, the whole measurement and computation process is performed in a matter of seconds, fully automatically. The BLK247 VolumeMonitor solution then makes this volume data or 3D intelligence immediately accessible to all internal stakeholders. For Axpo Tegra AG, this means reliable volume information is available whenever their decision-makers require it. With the 3D digital twin of the

Figure 1: The BLK247 VolumeMonitor measures the volume of the grain silo even while the silo is being filled.

stockpile, they can validate all measurements and have absolute confidence in the size of their silo's stockpile.

Sensor Fusion Delivers Simultaneous Visual Monitoring

In addition to their ability to measure the volume of bulk goods, sensor-fusion devices also provide real-time visual monitoring of the site and reports on changes in storage environment. Using these solutions enable companies to track if the temperature exceeds a user-defined threshold or if it detects temperature abnormalities. Simultaneously, live video can be streamed directly to a 3rd party video management system (VMS), for example, the site's control room and 3D zones can also be defined to generate an alarm if an intruder is detected. The BLK247VolumeMonitor is an IoT device, and a simple network cable will link it to the control system and network of the factory. As an edge computing device, it does not need any extra processing capabilities for many of its features and functionalities. Additionally the technology enables a visual inspection of the quality of the material delivered and can help identify any foreign materials that may impact the downstream operations of the wood-fire power plant.

3D Intelligence Delivered Effortlessly And Directly To Internal Stakeholders

Inventory managers are usually confronted with the challenge that volume records are often documented with a lengthy paper trail. Volume monitoring solutions change this by delivering high-frequency, high-accuracy volume measurements multiple stakeholders.

By having precise and highly temporal data, these stakeholders can take a data-driven approach to their decision making which can benefit both their upstream and downstream processes. Whether based on the current levels or historical data, it is easily accessible within the BLK247 VolumeMonitor's web interface.

For Axpo Tegra AG, just one example is that their purchasing manager now has absolute confidence in the quantity and distribution of stock within the silo. This allows them to optimize their procurement of wood chips, particularly in extraordinary situations when there are significant fluctuations in market prices.

"With the BLK247 VolumeMonitor, we can better plan extraordinary operations around the automated, frequent and reliable measurements of our silo."

Daniel Kressig
Head of Biomass Power Plant

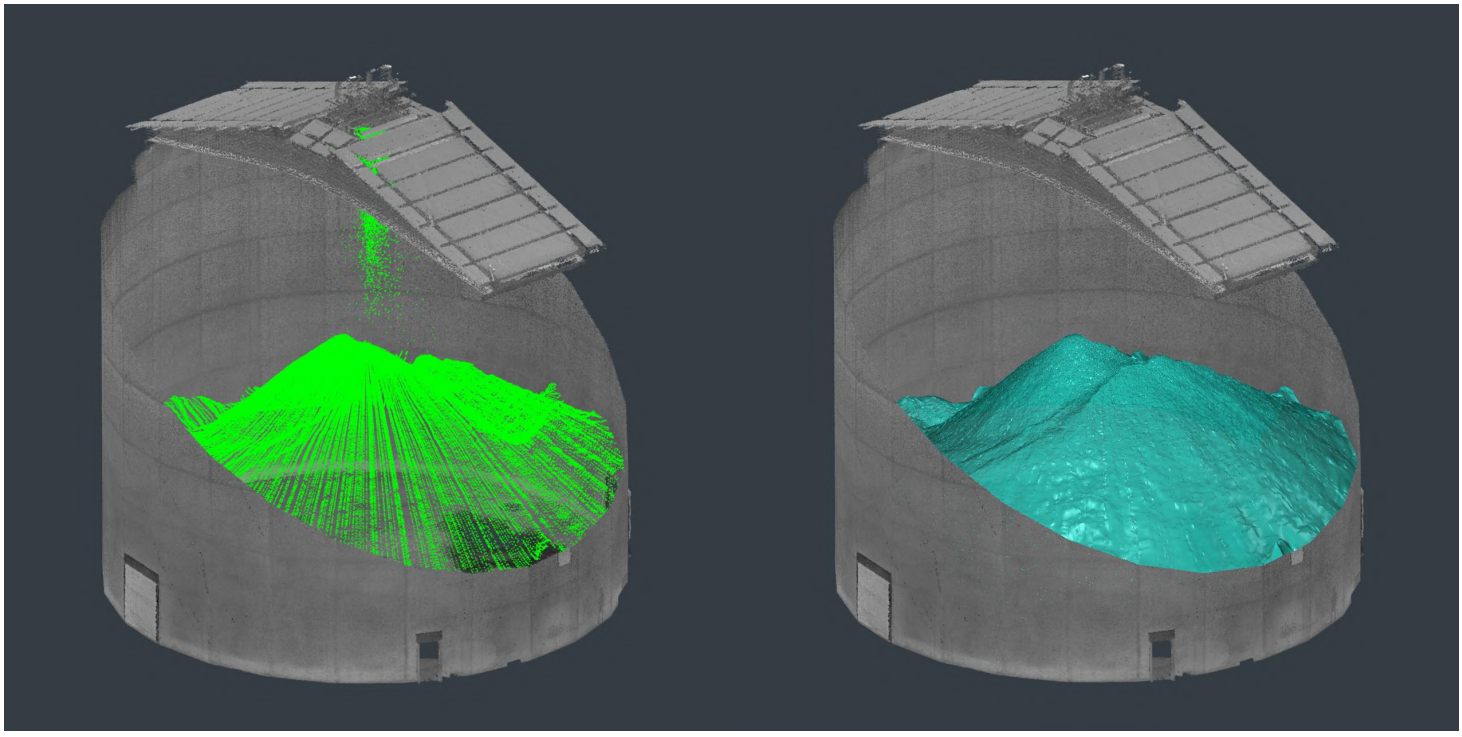
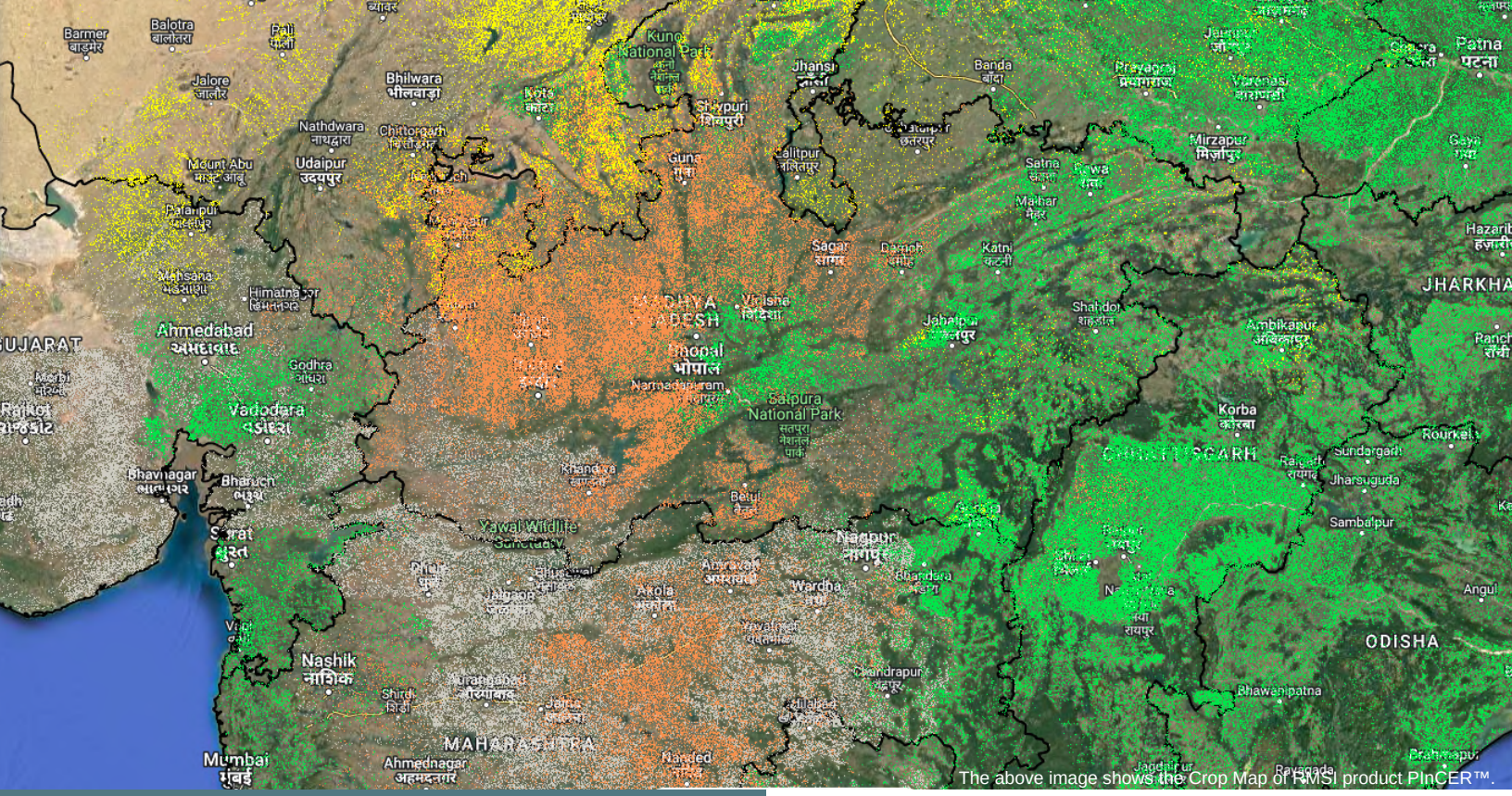


Figure 2: The Leica BLK247 VolumeMonitor solution creates a digital twin of the stockpile as shown here. Original point cloud on the left and final surface model on the right.



The above image shows the Crop Map of RMSI product PInCER™.

The Future of Geospatial Information Ecosystem: A Technology Innovating National Development

By Pushpendra Johari
Senior Vice President, Sustainability
RMSI

The world is rapidly advancing, with technological innovations continuing to drive this change and disrupting traditional data generation, delivery, and dissemination methods on the way. Further, a lot of technological innovations in geographic information systems (GIS) have enabled location intelligence in a big way. As a result, GIS has become essential for businesses, governments, and individuals alike, helping in better decision-making, from where to build a control center to how to mitigate the effects of climate change. Better decision-making leads to growth in individual organizations that aggregates into national development.

Current Trends in GIS Data Capture & Its Application

GIS provides valuable spatial data analysis and visualization capabilities. From a nation's development perspective, it is getting increasingly utilized in various application areas, including disaster management (including preparedness, response & recovery), impact forecasting of NatCat events, monitoring and managing natural resources, urban planning, infrastructure development, environmental conservation and strengthening the defense mechanism of the country, to name a few. The technology's versatility and ability to integrate various data sources make it a valuable tool for decision-makers in these sectors.

There has also been tremendous advancement in GIS data capture, helping to boost GIS applications. Advanced remote sensing and high-resolution satellite imagery are now available at a daily vintage, providing detailed and up-to-date information about the Earth's surface, including land cover,

vegetation, and changes over time. UAVs, or drones, equipped with cameras and sensors, have revolutionized GIS data capture.

Further, Mobile Mapping Systems mounted on vehicles or carried by individuals are being used for efficient and accurate data capture. These systems typically include GPS, LiDAR (Light Detection and Ranging), and imaging sensors to collect geospatial data while on the move. Mobile mapping is useful for road inventory, asset management, and infrastructure planning applications. Crowdsourcing platforms and citizen science initiatives also enable the public to contribute to GIS data capture and enhance official datasets.

The proliferation of IoT devices, such as sensors and smart devices, also generates a vast amount of geospatial data. These devices collect real-time information about environmental conditions, traffic patterns, infrastructure usage, and more. Integrating IoT data with GIS allows for dynamic and comprehensive data capture, enabling real-time decision-making and analysis at the location level.

GIS data capture increasingly focuses on integrating and analyzing large and diverse datasets. Big Data technologies and advanced analytics are facilitating the processing and analysis of massive amounts of geospatial information, enabling insights and patterns that were previously challenging to uncover.

AR and VR technologies are also being integrated into GIS data capture workflows, allowing users to visualize and interact with spatial data in immersive and realistic ways. For example, field workers can overlay GIS data onto their real-world view using AR, enhancing data collection and analysis in the field.

These trends reflect the ongoing technological advancements, enabling more efficient, accurate, and versatile GIS data capture methods. The boost in the availability of high-quality location data provides opportunities for enhanced decision-making, planning, and analysis in various industries and sectors.

New Geospatial Policy - A Harbinger of Change

Every national initiative linked to India's development needs significant use of geospatial data and high-level analysis to enhance decision-making at the country level and transform the economy.

The Indian government has significantly changed its geospatial policy, recognizing the need for change. It is a landmark announcement that liberalized the rules for acquiring and producing geospatial data services. As per the new rules, the globally available geospatial data should no longer be restricted in India. The new guidelines have removed the barriers and allowed easy data sharing between public and private organizations. The new policy indicates that the government also realizes the importance of making the geospatial data sets available and how it is linked to the country's National Growth.

Ready access to geospatial data will offer a level playing field to private entities, offering to take ahead scientific and

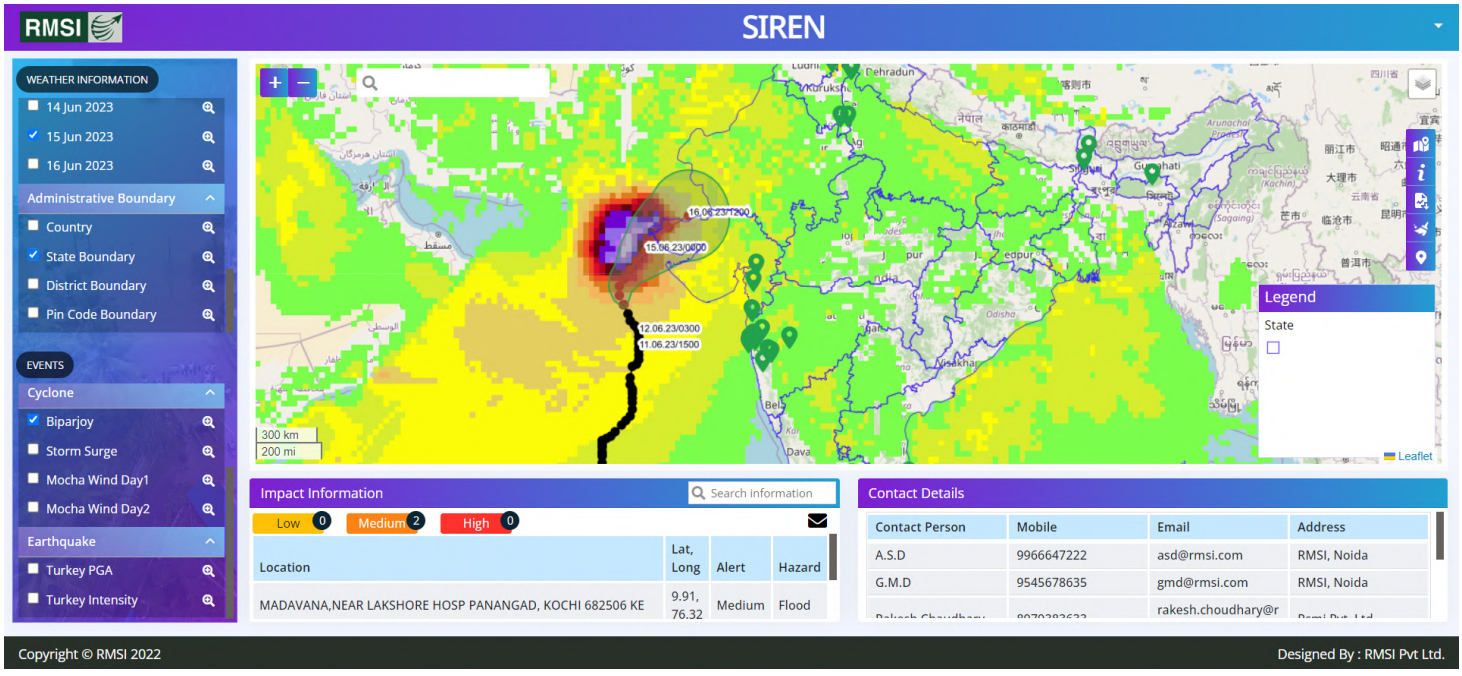


Figure 1: RMSI's Impact Forecasting Platform is a comprehensive solution that helps you visualize and analyze the impact of upcoming NAT CAT events for specific locations of your interest to maximize your decision space and take appropriate measures. The above image shows the live tracking of cyclone Biparjoy with potential windspeeds and flood depth at various locations.

developmental research to build high-quality solutions and maps. And, hence, enabling the private sector to contribute more and more to national development.

Contribution of GIS to the National Development Agenda (Solving Real-World problems)

A country's national development is evaluated based on addressing some of the most pressing challenges, such as connectivity (land-based and telecom), urban development, climate change, food security, disaster management, and self-reliance in every walk of life.

Geospatial technology today play's a key role in infrastructural development, the safety of cities, the growth of agriculture production, monitoring border security, and more. Moreover, geospatial technology has facilitated India in becoming self-sufficient in food production and exporting it to other countries.

Sustainable Infrastructure

Geospatial technology can improve sustainable infrastructure planning, design, and construction.

Infrastructure development is a critical element of a nation's development. GIS as a technology offers a unique advantage in planning, designing, and monitoring infrastructure development. It helps identify the most suitable location for infrastructure development by identifying a host of location-specific information from soil type, hazard risk levels, and current development around the area of interest. It can also play a crucial role in establishing and maintaining green belts, which are essential for the environment. The geospatial analysis also allows for identifying and assessing the environmental impact of infrastructure projects, tracking the condition of assets, monitoring the performance over time, and planning to replace aging infrastructure. This information can help planners and designers make informed decisions about where to build infrastructure and how to design it to be as sustainable as possible.

The Gati Shakti plan launched by PM Modi is slated to be a game changer for infra projects in India and is expected to prevent delays in infrastructure projects. Interestingly, the project's backbone spans technologies from geospatial mapping to analytics. **A core feature of Gati Shakti is a GIS platform that provides spatial planning tools.** The integrated portal will give visibility to various departments under the 16 ministries, showcasing over 200 layers of large-scale databases superimposed by the departmental data sets over a geo-coded map. Such GIS-enabled projects have massive potential for cost savings, bringing down delays and enhancing the effectiveness of key infra projects. Starting as a niche technology, GIS is core to many such initiatives in India. It indicates that the government reflects on this technology's importance in India's overall developmental agenda.

RMSI has built software for several international infrastructure projects. We feel that using GIS can substantially reduce project costs, especially by avoiding reruns and delays in interdepartmental processes. For instance, in the US, we recently built a software platform to monitor well pads, and eventually, the system delivered cost savings of 30-40 percent for our client.

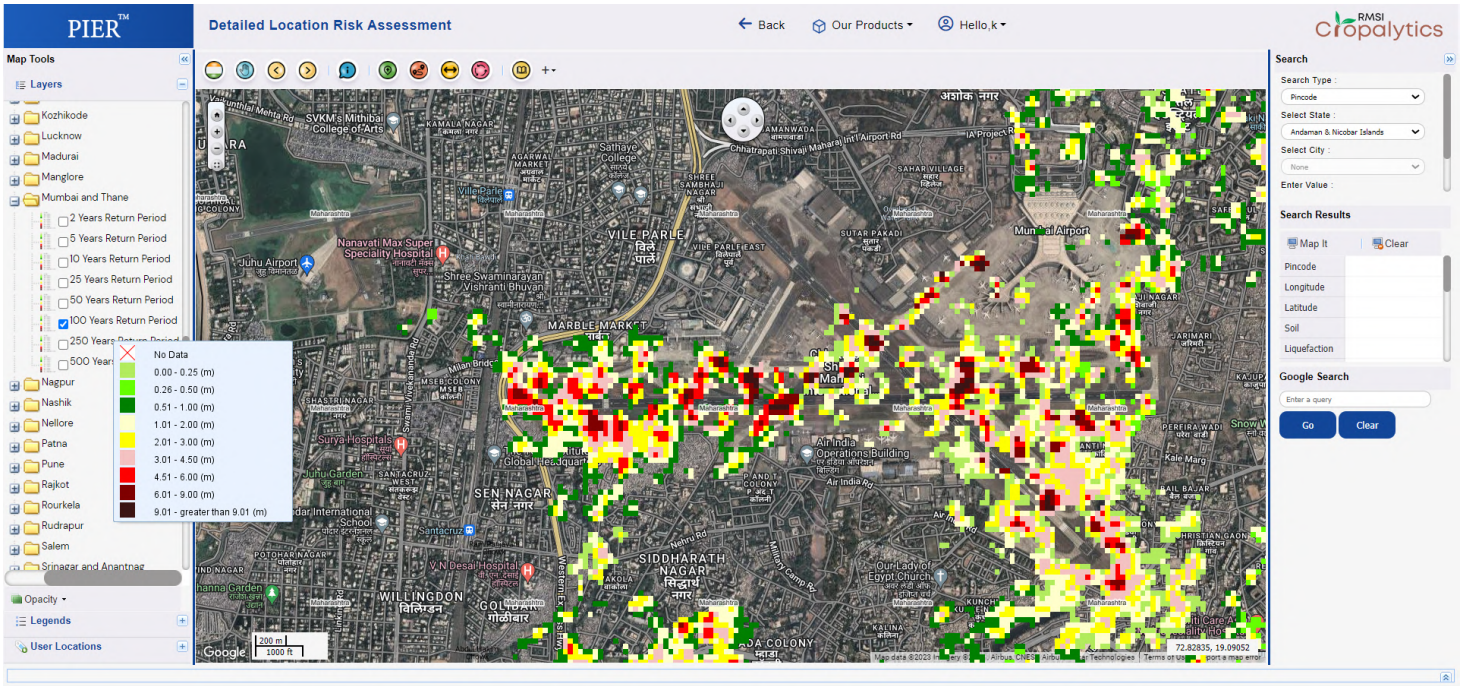


Figure 2: The above image shows a flood map of 100 year return period in Mumbai City on the PIER's (Profiler for Insurance Exposure & Risk) detailed Location Risk Assessment tool.

We have also developed an impact forecasting platform that provides early updates 2-3 days in advance to help organizations and industries identify potential business interruptions, supply chain disruptions, and other indirect losses that could arise due to natural catastrophe events. An early impact forecast helps them to take measures to protect their assets, employees, and customers and minimize the impact of these events. The alert feature can ensure preventive maintenance of critical components at the exposed locations.

Creating Better National-Level Strategies For Disaster Management

A sound disaster management strategy is also crucial to the overall sustainable development of a nation. Disasters are spatial in nature. They strike at a specific location and influence a particular area. Thus, location intelligence plays a critical role in disaster management.

GIS, coupled with remote sensing, provides a basic framework that helps in all disaster management stages, from preparedness to response and recovery. Through advanced wireless technologies and web-based GIS applications, disaster management by governments and other agencies is being revolutionized. It enhances the coordination of response efforts and planning for disaster risk reduction. GIS decision support systems for disasters have been applied in several parts of the world for effective management.

RMSI has implemented Decision Support Systems (DSS) for the Government of Puducherry and the National Disaster Management Authority for cyclone impact forecasting to support preparedness and response for all the coastal states of India. Also, from a disaster risk reduction (DRR) perspective, we are working with various state/union territory governments, such as J&K, Andhra Pradesh, Assam, UP, and Meghalaya in India, for detailed Hazard, Vulnerability, and Risk Assessment (HVRA), hydro-meteorological hazard forecasting, and long-term mitigation planning.

Transforming the Food Security Problem

Geo-assisted agricultural practices enable countries to become more self-reliant on food. Technology has made significant advancements in the agriculture sector by developing innovative solutions around key industry pain points. AI/ML-based technologies enable crop identification and health monitoring to improve crop quality and help mitigate the impact of adverse weather and climate change. Geospatial technology is a valuable tool in transforming the agri-value chain with predictive and data-based insights for the traceability of seeds, monitoring pest and disease outbreaks, and expected yields.

This technology helps the entire agri-value chain by providing information and analytics to solve the challenges of the Indian Agri-sector and assist decision-makers in government, crop insurance, agriculture input sector, banks, commodity buyers, and the social sector.

For India, RMSI Cropalytics, an affiliate of RMSI, has developed an agri-market platform bringing in all the players in the ecosystem on a single platform to improve the overall

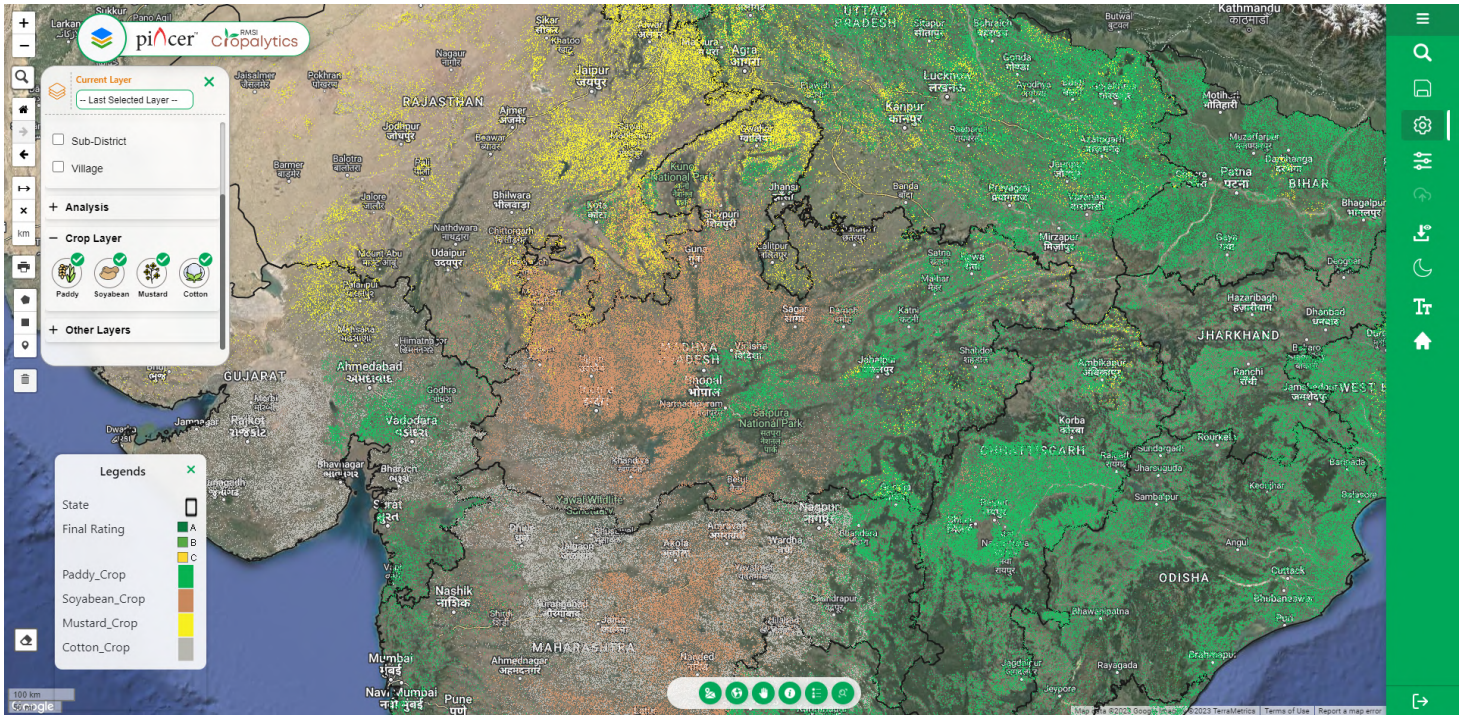


Figure 3: The above image shows the Crop Map of our product PInCER™. Crop Map helps the industry uncover insights, sync data in real-time, and ensure their business is future-ready. The map covers major crops such as paddy, soybean, maize, sugarcane, and wheat, amongst others & shows the geo-location of sown acreage of the current cropping season in high resolution.

efficiency of the entire value chain. RMSI Cropalytics has developed the capability of generating crop maps across India for all major crops and estimating the crop risk profile for every farm in India.

Urban Development

The Indian Government's Smart City Mission aims to provide citizens with a high quality of life while promoting sustainable environments by implementing smart solutions. While the government is developing various online services, location intelligence is the backbone behind these services. It allows for location-based citizen services where individuals tag locations with their requests that trigger the complete service request completion cycle; this also helps citizens to convey risk situations via a mobile application that can alert the rescue teams to combat the risk by tracking the location by the app.

RMSI recently worked on a prestigious project in Saudi Arabia involving the construction of a one of its kind, 170 km vertical city. The project had a large volume of geospatial data that is maintained & managed under the ArcGIS enterprise environment. Regular field surveys were conducted to enhance and update the existing geospatial information. In addition, the recorded data was to be managed, improved, and made accessible to various sectors for decision-making.

Geospatial information also empowers the service industry by creating high-quality last-mile delivery data offering quick and accurate route planning, package tracking, and timely delivery, resulting in more efficient and reliable services for citizens reliant on online deliveries and shopping. Besides, Last Mile data helps emergency responders reach impacted locations faster. Additionally, high-quality maps make it easier for businesses and residents to find what they are looking for and improve their quality of life.

Recently, RMSI undertook a pilot in the city of Gurgaon (Delhi NCR) to prepare a highly detailed last-mile map. There were significant gaps in existing last mile maps as many road networks are mapped incorrectly, also not covering details like road blockages and gate timings.

Conlusions

Geospatial technology has proven to be a critical component in developing nations, revolutionizing how we approach complex challenges and opening up an entirely new realm of possibilities. From providing crucial insights for policymakers to supporting various industries, including agriculture, transportation, and urban planning, geospatial technology has firmly cemented itself as a vital tool in the vertical integration of complex systems.

It empowers informed decisions, enhances citizens' lives, and provides a holistic view of progress and prosperity. Geospatial technology is crucial to our present and future success as a civilization, leaving an indelible mark on modern life.

In short, geospatial technology's role in national development cannot be underestimated, as it remains critical to our current and future success as a civilization.

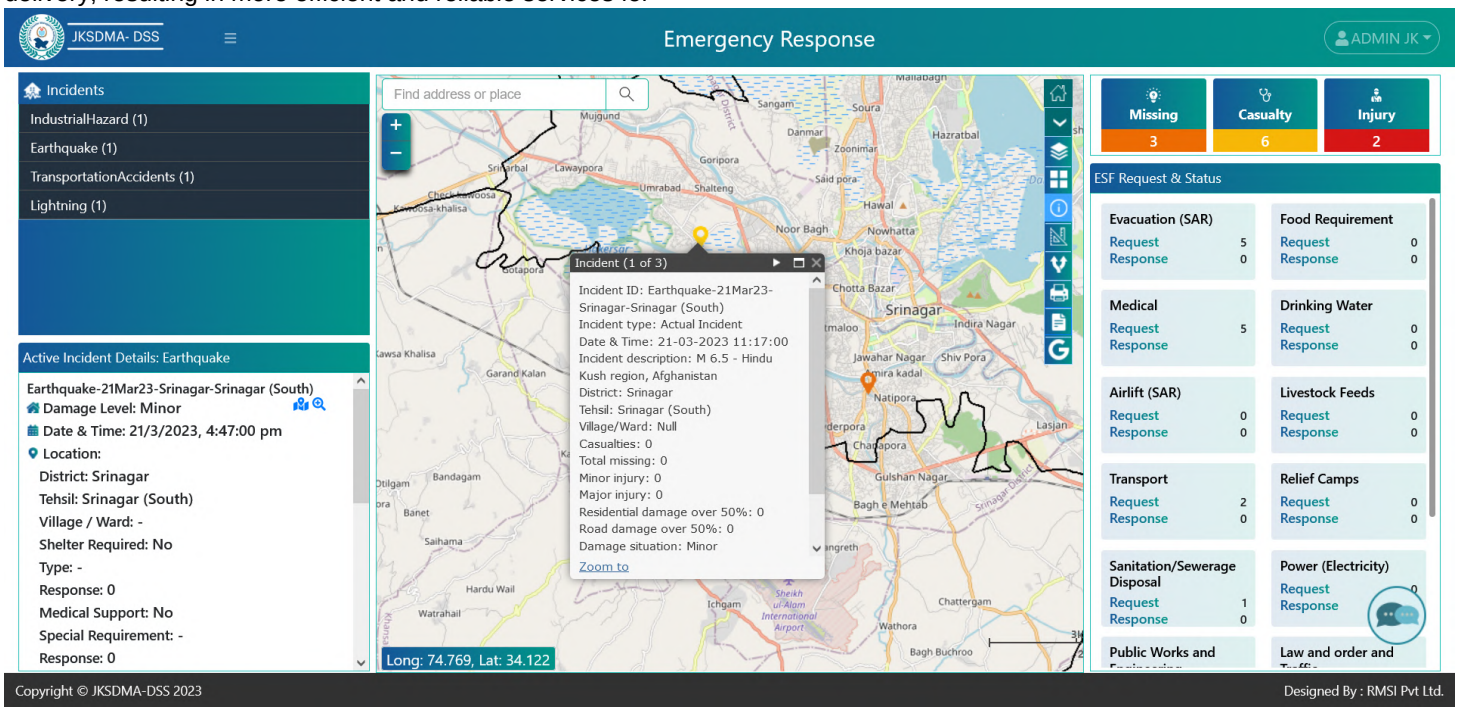


Figure 4: The above image shows a flood map of 100 year return period in Mumbai City on the PIER's (Profiler for Insurance Exposure & Risk) detailed Location Risk Assessment tool.

Farmonaut Technologies aims to collaborate with various stakeholders in the agricultural sector, including governments, FMCG companies, suppliers, warehouse companies, exporters, importers, and direct consuming companies.

Farmonaut Technologies Revolutionizing National Development Through Geospatial Advancements

By Shivani Dudhatra
Technical Writer & Digital Content Creator
Farmonaut

Geospatial technologies have emerged as powerful tools in assisting national development efforts across various sectors, and Farmonaut Technologies stand at the forefront of utilizing these technologies to revolutionize agriculture. With their comprehensive range of services, including crop health monitoring, blockchain-based traceability, crop area and yield estimation, fleet management, personalized AI advisory, and more, Farmonaut Technologies is making significant contributions to national development through geospatial technologies.

In this era of rapid technological advancements, the integration of geospatial technologies has become increasingly crucial in driving sustainable progress. Farmonaut Technologies exemplifies the transformative potential of these technologies in the agricultural sector. Their innovative use of remote sensing, artificial intelligence, and blockchain is reshaping the way farmers operate, optimizing resource utilization, minimizing risks, and promoting sustainable practices are being utilized worldwide.

This article delves into the various geospatial technologies offered by Farmonaut Technologies and explores how they contribute to national development. From ensuring sustainable agriculture through crop health monitoring to fostering transparency and safety with blockchain-based traceability, Farmonaut Technologies is empowering farmers, policymakers, and stakeholders to make informed decisions, drive productivity, and enhance economic growth.

By harnessing the power of geospatial technologies, Farmonaut Technologies not only addresses immediate

challenges in the agricultural sector but also lays the foundation for long-term national development objectives. Their services not only enhance the productivity and profitability of individual farmers but also contribute to food security, environmental sustainability, and economic resilience at a national level.

By adopting Farmonaut's cutting-edge technology and intelligence, various stakeholders can enhance their performance and operational capabilities across the agricultural value chain. Currently, the adoption of geospatial technologies in developing countries is relatively low, presenting an opportunity for stakeholders to partner with companies like Farmonaut.

One of the challenges in the agricultural sector is achieving scale and reach while minimizing investments. Geospatial technologies provide a solution by offering scalability and wider reach through scientific methodologies and cost-effective implementation. As technology continues to improve and AI integration enhances accuracy and timely delivery, more complex problems within the agriculture value chain can be addressed. By gaining greater insights through geospatial technologies, stakeholders can make better-informed decisions, achieve cost savings, optimize resource utilization, streamline supply chains, reduce field and post-harvest losses, and ensure better price realization for farmers while delivering high-quality products to consumers.

Farmonaut Technologies is poised to lead these transformative changes in the future, paving the way for advancements in the agriculture sector. The continued progress of geospatial technologies and AI integration will drive adoption, ultimately benefiting all stakeholders involved. As the agriculture value chain becomes more efficient and sustainable, the agricultural sector will play a vital role in national development efforts, driving economic growth, ensuring food security, and promoting environmental sustainability. Farmonaut Technologies is at the forefront of this transformation, and it is crucial for stakeholders to embrace these advancements to stay ahead in the evolving agricultural landscape.

As we delve deeper into the article, we will explore how Farmonaut Technologies' geospatial technologies, such as accurate crop area and yield estimation, efficient fleet management, personalized AI advisory, and more, assist in national development and unlock the full potential of agriculture in driving inclusive and sustainable growth.

Crop Health Monitoring: Ensuring Sustainable Agriculture

Sustainable agriculture lies at the heart of national development, and crop health monitoring is a fundamental aspect of achieving this goal. Farmonaut Technologies

employs remote sensing techniques to monitor the health of crops from a vantage point in space. By analysing satellite imagery and utilizing advanced algorithms, Farmonaut's Crop Health Monitoring service provides farmers with real-time insights into their crop conditions. Early detection of diseases, pests, nutrient deficiencies, and water stress empowers farmers to take prompt action, minimizing yield losses and reducing the need for excessive use of pesticides or fertilizers. This promotes sustainable agricultural practices while enhancing food security, a crucial component of national development.

Furthermore, the aggregated crop health data obtained through Farmonaut's Crop Health Monitoring service holds immense value for policymakers and researchers. By understanding trends in crop health and disease prevalence, governments can devise effective agricultural policies, allocate resources efficiently, and promote sustainable farming practices at a national level. The ability to monitor crop health on a large scale contributes to the resilience and productivity of the agricultural sector, thus driving overall national development. Farmonaut has achieved a milestone of processing 2.2 Million+ Farm level satellite images in just 31 days.

Blockchain-based Traceability: Fostering Transparency and Safety

In an era where consumers demand safe and traceable food products, Farmonaut Technologies addresses this needs through its block chain-based traceability system.

By integrating geospatial data and blockchain technology, Farmonaut empowers farmers to track their produce from farm to fork, ensuring transparency and safety throughout the supply chain.

The implementation of a blockchain-based traceability system by Farmonaut enables the recording and verification of each step in the production, processing, and distribution of agricultural products. Information such as origin, cultivation practices, handling, and transportation is securely stored in a decentralized and immutable ledger. This level of transparency builds consumer trust and confidence, while also helping identify inefficiencies in the supply chain, reducing food waste, and enhancing overall food security. Furthermore, the blockchain-based traceability system facilitates market access for farmers. By providing verifiable information about the production process, farmers can demonstrate compliance with quality and safety standards, opening up opportunities for export and access to premium markets. This not only enhances the reputation of the agricultural sector but also contributes to economic growth and national development.

Accurate Crop Area and Yield Estimation: Empowering Decision-making

Accurate estimation of crop area and yield is critical for effective planning, resource allocation, and decision-making. Farmonaut Technologies leverages remote sensing and machine learning techniques to provide precise crop area and yield estimates. By harnessing high-resolution satellite imagery and advanced data analytics, farmers and policymakers can make informed choices, optimize resource utilization, and improve overall agricultural productivity.

Reliable crop area and yield estimation enable policymakers to assess the production potential of different regions and plan interventions accordingly. This information aids in ensuring food security, managing price stability, and identifying areas where additional investment is required to enhance agricultural productivity. By understanding the spatial distribution of crops and their yields, governments can allocate resources strategically, promote balanced regional development, and contribute to national economic growth.

Moreover, accurate crop area and yield estimation support effective risk management and insurance schemes. By providing reliable information, farmers and insurance providers can assess the level of risk and develop appropriate insurance policies. This encourages farmers to adopt innovative practices and technologies, as they have a safety net in case of adverse weather conditions or other unforeseen events. The availability of crop insurance not only protects farmers' livelihoods but also ensures stability in the agricultural sector, contributing to national development.

Figure 1: Farmonaut Technologies is poised to lead these transformative changes in the future, paving the way for advancements in the agriculture sector.

Efficient Fleet Management: Ensuring Timely Operations

Efficient fleet management plays a vital role in minimizing logistical challenges and ensuring timely operations in the agriculture sector. Farmonaut Technologies' fleet management system integrates geospatial data, GPS technology, and advanced analytics to optimize vehicle routes, monitor fuel consumption, and track transportation logistics. This results in cost savings, reduced carbon emissions, and improved overall operational efficiency.

By leveraging geospatial data and advanced analytics, Farmonaut's fleet management system enables farmers to plan and execute transportation operations more effectively. Optimal route planning helps reduce travel time, fuel consumption, and carbon emissions, resulting in cost savings and environmental benefits. Timely delivery of inputs such as seeds, fertilizers, and pesticides ensure that farmers can carry out their agricultural activities efficiently, leading to increased productivity and higher yields.

Moreover, the efficient management of transportation logistics contributes to the overall resilience of the agricultural supply chain. Timely delivery of agricultural produce to markets minimizes post-harvest losses, ensures freshness, and

maintains market competitiveness. By streamlining transportation, Farmonaut Technologies contributes to the smooth functioning of agricultural supply chains, enabling farmers to reach markets efficiently and boosting the overall economy.

JEEVN AI: Personalized AI Advisory for Farmers

Access to expert advice and personalized recommendations is crucial for farmers to make informed decisions and optimize their practices. Farmonaut Technologies' JEEVN AI, powered by artificial intelligence and machine learning, provides farmers with personalized advisory services. By analyzing farm-specific data, weather patterns, crop health information, and market trends, JEEVN AI offers actionable insights tailored to the unique needs of each farmer. This empowers farmers to optimize their practices, maximize yields, and improve profitability.

The personalized AI advisory services offered by Farmonaut Technologies contribute to national development in several ways. First, by empowering individual farmers with information and recommendations, the overall productivity of the agricultural sector increases. As farmers adopt more efficient practices and optimize resource utilization, the national agricultural output improves, contributing to food security and economic growth.

Second, JEEVN AI's advisory services help bridge the knowledge gap between experienced and inexperienced farmers. By providing access to expert advice and best practices, farmers can overcome challenges and adopt innovative techniques, enhancing their productivity and contributing to the overall development of the agricultural sector.

Carbon Foot Printing: Promoting Sustainable Practices

Farmonaut Technologies also offers carbon footprinting services, enabling farmers to assess and reduce their greenhouse gas emissions. By utilizing geospatial data and advanced analytics, Farmonaut helps farmers understand their environmental impact and adopt sustainable practices. This supports national development goals related to climate change mitigation and environmental conservation.

Accurate carbon footprint data allows policymakers to develop targeted strategies and incentives for sustainable agriculture. Moreover, farmers who reduce their carbon footprint can meet consumer demands for sustainable products, access premium markets, and contribute to economic growth. Farmonaut's carbon footprinting services exemplify their commitment to promoting sustainability, supporting farmers in making informed decisions, and

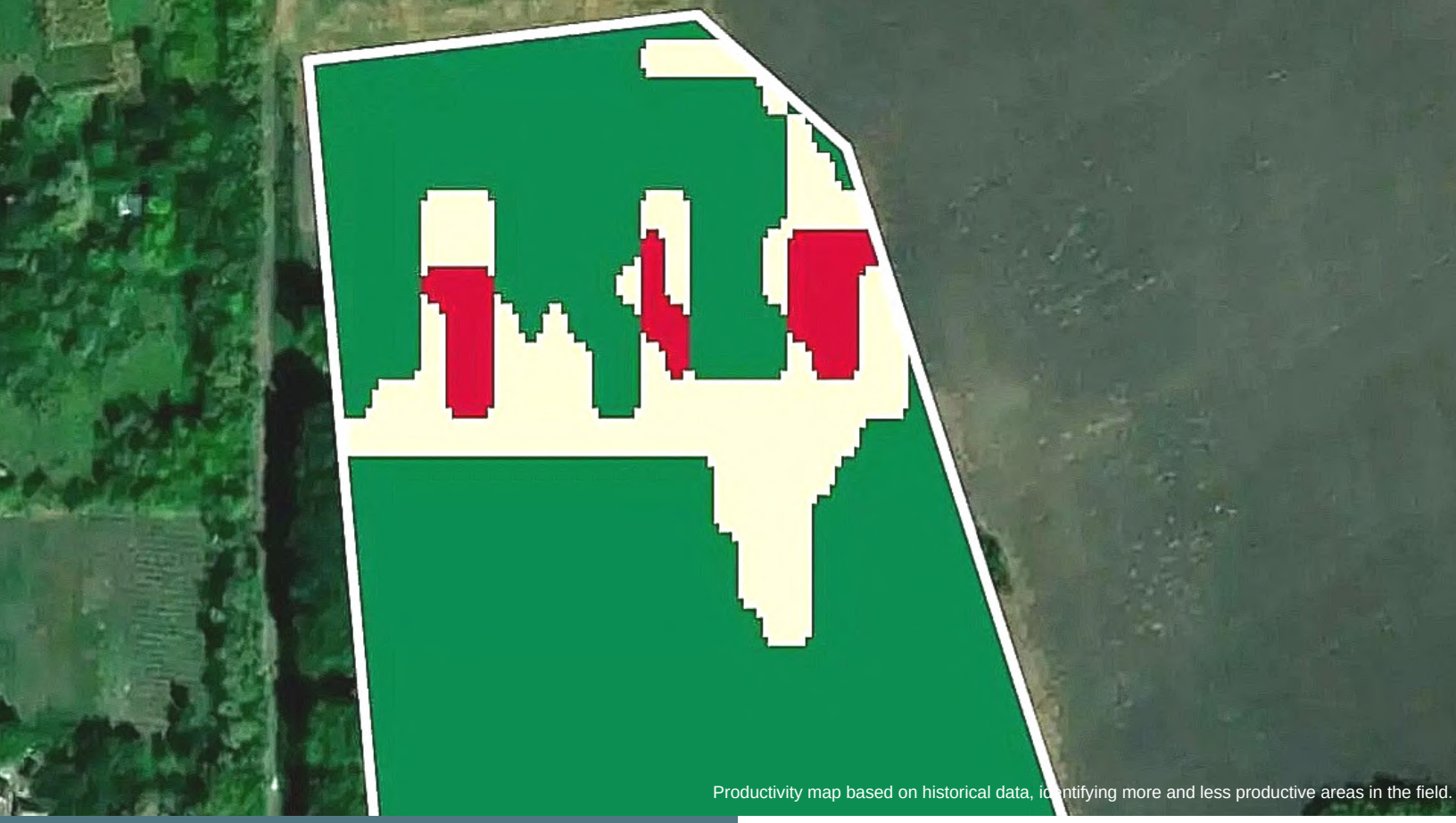
positioning the agricultural sector as an environmental steward.

Lastly, the use of artificial intelligence and machine learning in agricultural advisory services generates valuable data that can be leveraged for research and policymaking. Analyzing the aggregated data from various farms and regions provides insights into patterns, trends, and challenges in agriculture. This information assists policymakers in formulating evidence-based policies, allocating resources effectively, and promoting sustainable agricultural practices at a national level.

Conclusion

In conclusion, Farmonaut Technologies is at the forefront of utilizing geospatial technologies to revolutionize agriculture and contribute to national development. By offering a comprehensive range of services, such as crop health monitoring, blockchain-based traceability, crop area and yield estimation, fleet management, personalized AI advisory, and more, Farmonaut Technologies is empowering farmers, policymakers, and stakeholders to make informed decisions, drive productivity, and enhance economic growth.

Overall, Farmonaut Technologies' contributions to national development demonstrate the transformative power of geospatial technologies in the agricultural sector and highlight their significance in driving inclusive growth, environmental sustainability, and economic resilience.



Productivity map based on historical data, identifying more and less productive areas in the field.

Geospatial Technologies For Progress: Empowering National Development

By Elena Ivanova
EOS Data Analytics

A geographic information system (GIS) is a huge database of digital data converted into a digital format. It consists of detailed layers united by geography and tied to a certain coordinate system. Any events taking place can be successfully tracked using such a database. In addition, it can be used to find almost any point on the globe and track the movement of almost any object.

GIS databases can perform different tasks. You can enter up-to-date data into the database, and in most cases this is done automatically with a scanner. You can manipulate the data, scale it as you see fit, and collect the information you need to solve a particular problem. Like conventional databases, a GIS system can be managed. This is done through a range of integrated applications.

The large amount of data contained in the database provides a wide range of opportunities for analysis of various parameters. You can find vacant lots for building a house, optimally form traffic flows, analyze the proximity of various objects (for example, to determine the number of people who live within walking distance of your store), overlay various indicators and analyze the resulting picture. More so, farming businesses can even perform crop yield forecasting using satellite-derived data through GIS.

The last task that GIS allows you to perform is the visualization of data. You can get maps, graphs, tables, and even pictures of the area of interest. This data is very

important for scientific research as well as for the work of individual companies and organizations.

GIS And National Development

Land, and more precisely its area and associated resources, is the basis for the well-being of nations. The effective management of territory and space is largely responsible for the present and future prosperity of countries, individual regions, or particular areas of large cities.

Information is the very first thing needed for management. In fact, most of the information that people encounter in their daily activities has a territorial connection. Information itself, while potentially existing, needs to be retrieved. For this purpose, methods and technologies are constantly being improved, thanks to which humankind draws the necessary information from space.

Just a few decades ago images of Earth from space were used only by a small circle of specialists. Modern technical means make it possible to receive images from artificial satellites to a personal computer, and the latest software allows quick processing of this data.

Application of space imagery in terms of getting up-to-date information about terrestrial space knows no limits — geology, geography, ecology, economy, nature management, production management, logistics, agriculture, forestry, land management, industry, energy, construction, tourism and transport, as well as many other branches and areas of human activity. In addition to space imagery and geographic information systems, so-called satellite positioning systems (GPS) are very closely involved in the collection of information about the Earth surface.

The need to manage land according to the level of modern technology arises when the state develops, when authorities at all levels feel the need, understand the possibilities of technology, and realize its value with their daily routine.

GIS In Urbanization And Infrastructure Development Monitoring

Urbanization and infrastructure growth are two of the most important aspects of development in the world today. As cities continue to expand, it is becoming increasingly important for governments and businesses to track these changes. Satellite technology is an invaluable tool for achieving this goal, offering a wide range of benefits that can help improve urban planning, economic development and environmental protection.

Satellite technology provides a comprehensive overview of urbanization and infrastructure growth. Its high-resolution images can be used to track changes in land use, population density, transportation networks and the environment. By combining this data with more traditional methods of analysis, such as ground surveys, a deeper understanding of urban development and its effects can be gained.

Using satellite technology can also help identify potential problems before they become serious. For example, it can be used to detect signs of rapid urbanization, such as deforestation, soil erosion, and air pollution. This information can then be used to inform decision-makers, allowing policymakers and planners to develop strategies to address these problems before they have serious environmental or public health impacts.

Satellite technology can also be used to improve urban planning and economic development. Detailed images can be used to identify opportunities for new developments, such as residential areas or commercial projects. This information can then be used to create more efficient urban planning, leading to increased productivity and economic growth.

Finally, satellite technology can be used to monitor infrastructure growth, allowing for better management of essential services such as electricity, water, and telecommunications. This can help ensure the efficient and cost-effective delivery of these services, contributing to an improved quality of life for citizens and boosting local economies.

In conclusion, satellite technology provides a number of benefits for monitoring urbanization and infrastructure growth. By providing a comprehensive overview of urban development, it can help decision-making and improve urban planning, economic development and environmental protection.

Using Geospatial Tech To Drive Agriculture

The sphere of agriculture in developed countries is characterized by the use of powerful agricultural machinery, a variety of chemicals and innovative agronomic technologies. Nowadays, GIS services have also become relevant for agriculture, due to which its efficiency is increased and the quality of agricultural products is improved.

The main purpose of using GIS-technologies by farmers is to manage the production, storage, marketing and transportation of agricultural products. In addition, in this area it is critically important to take into account numerous and diverse data about the land being exploited. These include:

- climatic, hydrologic, and weather conditions of the area;
- characteristics of soils;
- historical yield data for crop yield prediction;

- distribution of pests and diseases;
- types of environmental pollution and their causes;
- types and timing of previously conducted or planned soil treatments;
- digital terrain modeling.

As advanced computer technologies in agriculture are becoming more and more popular, they simplify the work with information for agrarians, which enables them to efficiently use agricultural land and optimize processes. Examples include the use of specialized programs that help to map how many fertilizers and pesticides to use and where based on remotely collected data.

EOSDA Crop Monitoring As An Example Of Agriculture GIS Software

The modern market offers a huge variety of GIS software depending on the purpose of its use across industries. The same applies to agricultural GIS tools. One such solution out there is the EOSDA Crop Monitoring — a digital precision agriculture platform that offers a comprehensive set of features for full-circle plant development management.

Precision Farming

Precision agriculture GIS software provides detailed maps of vegetation and productivity, helping farmers make informed decisions. They can adjust the application of seeds, nutrients, herbicides, and fertilizers based on varying levels of vegetation. EOSDA Crop Monitoring enables the creation of productivity maps using the previous year's data, identifying and fertilizing unproductive areas to increase productivity.

Mapping

Satellite sensors can analyze soil and crops to create valuable maps for agriculture GIS monitoring. By comparing vegetation in fields on different dates or using various indices, farmers can determine how different factors impact yield. EOSDA Crop Monitoring's Split View feature enables viewing current and historical field data and comparing the performance of various indices.

Monitoring of Plant Health

Remote sensing and GIS technology can help farmers monitor crop health more efficiently. Satellites and aircraft equipped with image sensors can identify crops that need additional care and detect diseases, pest infestations, or dehydration, enabling growers to take timely measures.

Insect And Pest Control

With the help of deep learning algorithms and satellite data, EOSDA Crop Monitoring can efficiently identify pest infestations in large fields. Vegetation indices calculations can help to recognize potential risks. Then, the Scouting feature is used to pinpoint specific areas. Scouts can inspect and report threats via the mobile app.

Irrigation Management

Agriculture GIS technology helps farmers regulate irrigation by using visual patterns to determine each crop's water supply status. The NDMI index in EOSDA Crop Monitoring, ranging from -1 to 1, is commonly used to identify water stress. Negative values near -1 indicate water scarcity, while positive values near 1 suggest waterlogging.

Predicting Yields

Thanks to remote sensing, big data, and AI, predicting crop yield accurately is now possible. EOSDA has developed a method that utilizes historical and current satellite crop data, achieving an impressive accuracy rate of over 90%. Reliable yield estimates are necessary for governments and enterprises to ensure food supply security and accurately predict profits and budgets.

Technology To Boost Farming in Georgia

The economy of Georgia heavily relies on agriculture. For the last few years, this industry has accounted for up to 8% of the country’s GDP and provided jobs for almost 40% of its workforce. Thanks to the country’s farming-friendly climate

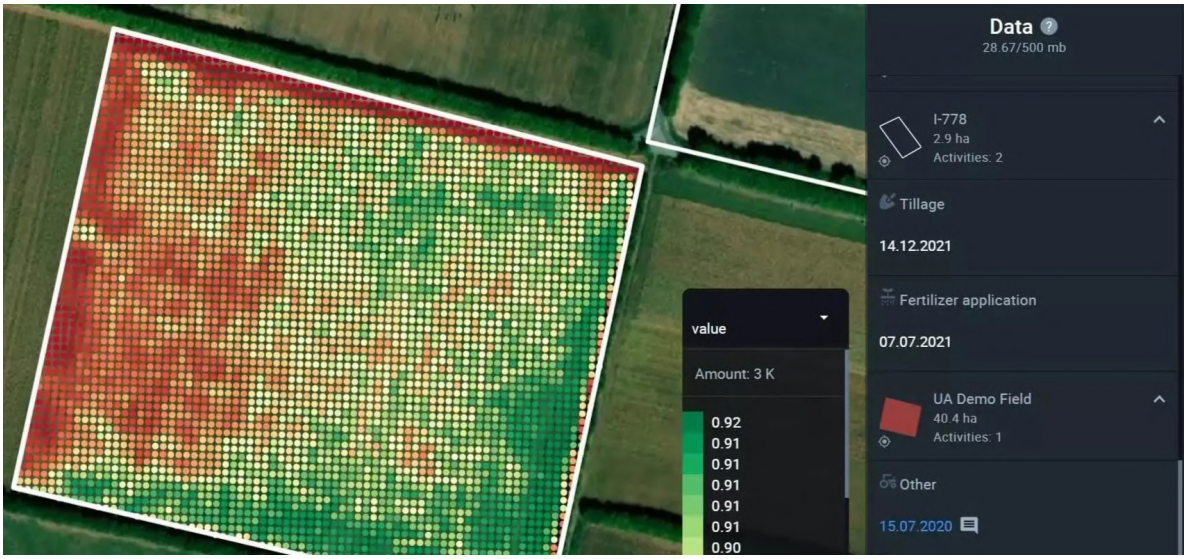


Figure 1: Fertilizer application assessment based on data from field equipment, processed with EOSDA Crop Monitoring.

conditions and fertile soils, local agri producers are able to grow different types of agricultural crops from annual plants like wheat, maze, and barley to subtropical fruits and nuts.

However, despite the sector's growth, it's still dominated by traditional farming approaches, including manual field monitoring, which is very time and labor-consuming, especially when it comes to large territories. To ensure reliable, accurate, and relevant farm data collection, modern agricultural producers need to implement technology. Not only it improves farm productivity and increases profit, but also ensures sustainable business development thanks to precision and data-based decision-making.

Having knowledge of the market specifics, the Georgian Farmers' Association (GFA) works on identifying the challenges farmers encounter and suggests possible solutions. Therefore, the organization has a clear understanding of the most frequent issues that prevent farmers from achieving high yields and profits. These include wrong irrigation management, the use of environmentally unfriendly farming practices, fertilizer overapplication, lack of weather forecasts on a field level and historical farm data for analysis.

Therefore, the GFA needed a way to access current and historical agri data and develop different packages of services and agronomic consultancies. For that, they have adopted the EOSDA Crop Monitoring platform and became its reseller. This means the possibility of creating client subscriptions with specific pricing and the number of hectares available for monitoring. More so, the partner also offers consultancy services and productivity field mapping for an extra price.

Among the most used data for the organization is weather information: daily, historical, and 14-day weather forecasts. Another popular feature is plant condition monitoring based on vegetation indices values throughout all growth stages. This helps to identify any deviations in crop health timely and easily. Some of the most used indices were NDVI (for vegetation's greenness and density measurement), and NDMI (for water stress identification and irrigation management). Historical data is also of great importance since it helps to detect patterns occurring during several years and perform yield prediction, necessary preparations, or crop rotation planning if necessary.

The GFA has noted that adopting the platform and access to such full farm data had a positive impact on its cooperation with organizations and businesses. With EOSDA Crop Monitoring the organization can better coordinate with the private sector, governmental and donor bodies. They also continue promoting the adoption of technologies in farming to achieve sustainability.

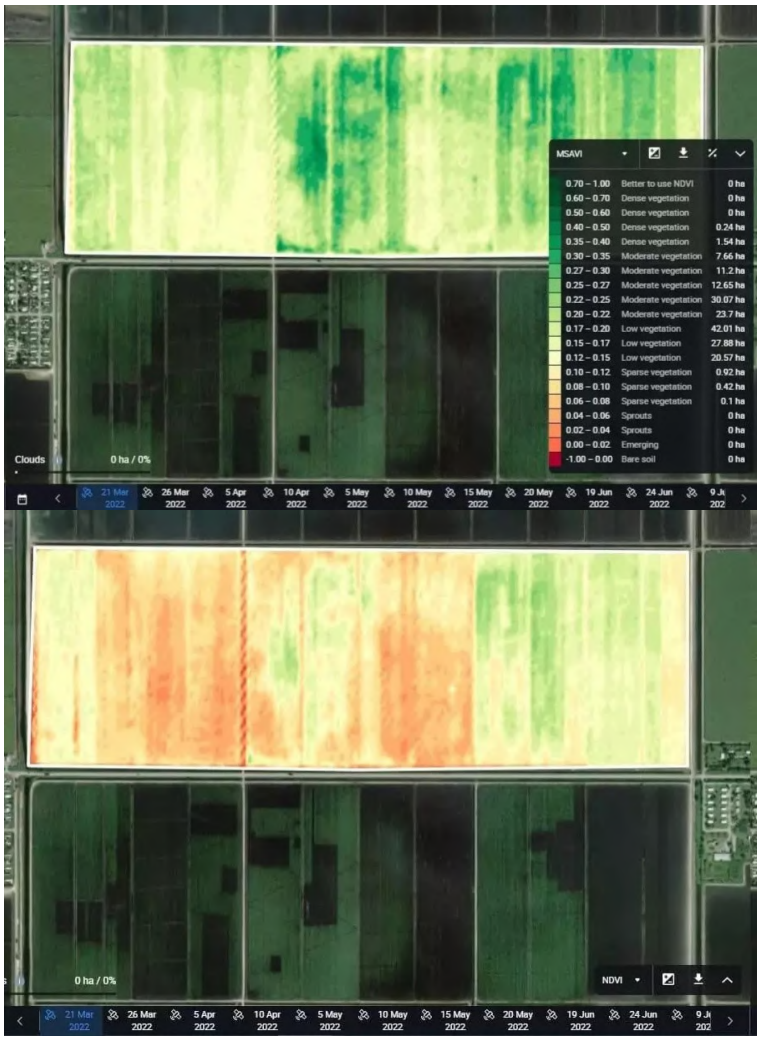


Figure 2: Comparing the NDVI and MSAVI indices to assess vegetation at an early stage of crop development.

For example, the GFA has also altered its way of providing services for mobile laboratories. They perform field productivity mapping to define problem areas for taking test samples right there. That is possible thanks to the precision satellite monitoring provides in terms of field state assessment while also allowing for saving time and costs on field inspection.

GIS In Forestry

Forest mapping was one of the first applications of geographic information systems. Currently, there are studies regarding development of mapping methodology in several areas of forest cover research, such as: forest mapping, mapping of current changes in forests, research of information content of satellite images to solve problems, monitor forest conditions and dynamics, identify forest fires, assess damage to forest plantations from various factors.

One of the main conditions is constant updating of forestry operations, including the data created during forest inventory. Improvement of operability and accuracy of information is practically impossible without modern GIS tools, which allow

to automate methods of constructing maps using stereophotogrammetric interpretation of aerospace images and geodetic measurements, combining them with any cartographic materials.

Application of remote sensing is a condition for adequate assessment of forest fund use efficiency. At the same time the condition of the areas is studied; violations of the requirements under which timber may be harvested are determined; the volumes, areas, and places of illegal logging are determined.

GIS In Healthcare

Health care as a field of human activity is currently undergoing a period of active informatization, which affects a variety of aspects of the industry. This includes the development of electronic medical records (EMR) for patients, the creation of information systems in the area of computerized disease diagnosis, electronic document management and analysis systems for medical statistics, etc.

One important aspect of this process is the analysis of organization of the healthcare system, identifying its shortcomings and advantages, and evaluating the geographical factors of public health.

Therefore, one of the components of the medical state information system should be a medical geographic information system (GIS).

The application of geoinformation technologies and spatial analysis in healthcare relies on different knowledge: medical and socio-economic geography, transport geography and geostatistics, raster image processing and many others. At the same time it is logically conditioned to allocate several main structural and functional subsystems: analysis of public health; analysis and management of medical infrastructure; dispatching of emergency medical aid; space monitoring and analysis of natural factors of diseases; multidimensional data analysis and decision support.

GIS In Telecommunications

Telecommunications service providers use GIS systems as they expand their networks or implement innovative infrastructure. In solving these tasks, the market situation is analyzed based on spatial and demographic data. Decisions are made taking into account the location of network planning services, return on investment, and competition.

The most favorable location of the telecommunications network is selected based on the combined information from planning tools, infrastructure, addresses, GPS coordinates and other data. Accurate coordinates of network components are necessary to identify the relationship between service deficiencies and the constituent network elements. Location information reflects the localization of stations, the presence of multi-storey buildings, and the type of terrain on the site. New facilities, commissioning dates and other network planning data are displayed on accurate maps. Geographic information systems are integrated into corporate databases and provide a functional extension of services.

So what does it have to do with farming? Telecom companies can act as a third party between precision agriculture technologies and farmers, while generating more revenue and improving livelihoods. Since agriculture is the largest employer in the world, giving farmers access to such platforms as EOSDA Crop Monitoring will add value to the telecom company's services, expand its client base and enable building connectivity in the most remote areas of the world. Therefore, for telecom companies it's a way to cover new territories, play a part in ensuring global food security, and tackle climate change.

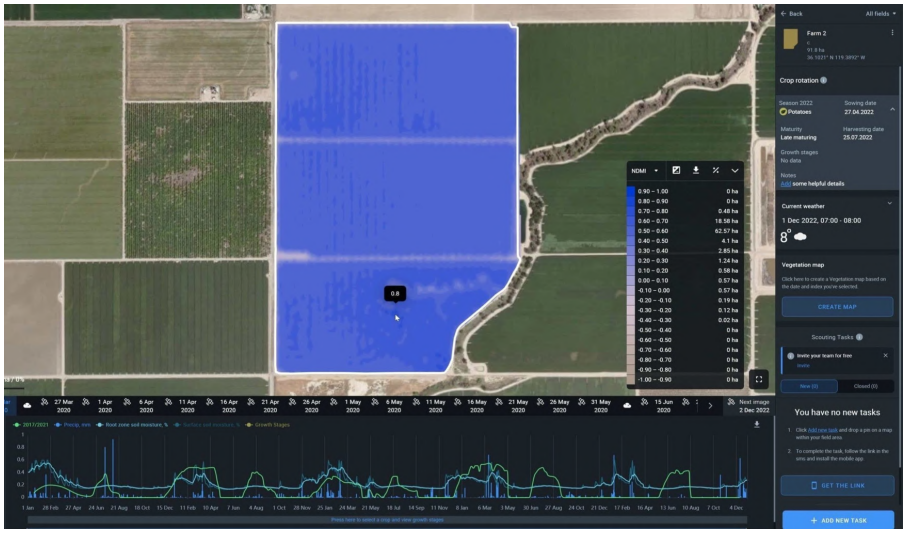


Figure 3: Water deficiency identification with NDMI index on EOSDA Crop Monitoring.

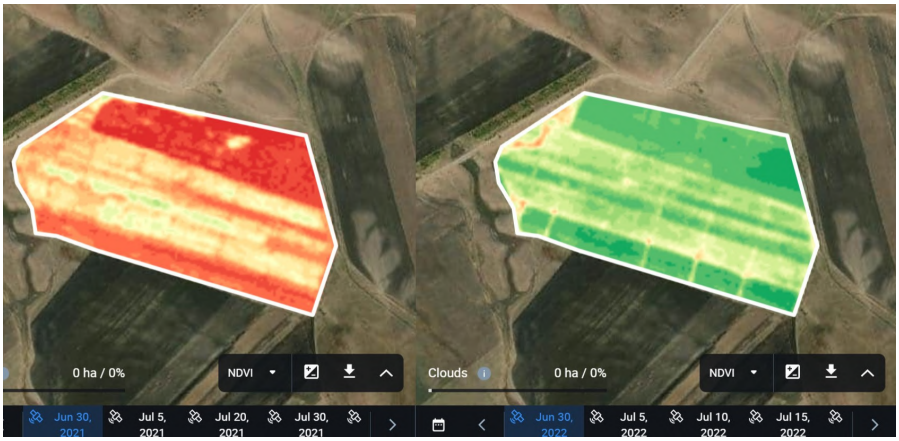


Figure 4: Field NDVI values before (June 30, 2021) and after (June 30, 2022) improved irrigation management. Image Credit: The Georgian Farmers' Association

Bangladesh Needs Rural Planning To Safeguard Cropland And Sustainable Development

By Kabir Uddin
GIS and Remote Sensing Specialist
International Centre for Integrated Mountain Development (ICIMOD)

In Bangladesh, buildings are being propped up along rural roads, as more and more agricultural land is being used for residential and commercial purposes.

In villages across the countryside, long rows of shopfronts on both sides of the road are a common sight. The shutters open right at or a mere couple of meters away from bitumen roads.

Traffic congestion, an issue Dhaka already grapples with, could become a huge problem in other areas as well. Additionally, any future road-widening work would require resettlement and compensation. This conversion is taking place with no planning involved. There is an urgent need to pay due consideration to these eventualities.

The Government of Bangladesh has made significant progress in its road and infrastructure development in the last few decades, with newly built multilane expressways increasing accessibility across the country. While this emphasis on wide, multilane roads and capital and divisional town planning is commendable, rural land use planning remains largely overlooked.

The rural economy of Bangladesh, specifically agriculture, is a powerful driver of poverty reduction in the country. However, as cropland use changes, arable land is becoming a scarce resource. This has major implications for food production. There is a need to invest in optimum agricultural land use and land conservation planning.

Changing Rural Landscapes

It is concerning that houses are being built on fertile agricultural land, a minimal resource, in villages across the country. Once converted to other uses, restoring agricultural land – or forest land for that matter – to a productive former state is extremely difficult.

As rural populations grow, the number of houses being built has multiplied. Such haphazard construction is affecting village ecosystems and disrupting normal functioning. In cases where houses are built on low floodplains or canal banks, residents face significant challenges – stream bank erosion, inundation, and obstruction of water flow, among others.

As buildings and retaining walls are constructed on both sides of the roads, water flow is impeded. During heavy rains, water can accumulate, causing temporary waterlogging and, among other things, causing roads to break down quickly. There is also the effect on the environment – natural habitats and their connectivity are disrupted and crowded built environments contribute to air and noise pollution.

For the government, ensuring road and electricity connections to build houses in scattered places is challenging and expensive. This impacts community facilities and well-being. If construction in rural Bangladesh continues at its current pace, it is likely that some areas will be left without spaces for rest and recreation. Detailed spatial land use planning is, therefore, a must.

Spatial Land Use Planning

Detailed spatial land use planning is the adoption and guidance of an integrated detailed development programme based on the needs and topography of an area. An essential part of any such plan is to ensure equal civil opportunities and privileges for people.

Spatial land use planning is usually done to ensure the proper use of land resources in infrastructure while taking social and environmental development into account. It is often government authorities who formulate, regulate, and implement planning, with local authorities dividing a given area into sub-regions or thematic development areas. This scientific approach can be adopted for all types of development management and supervision of building construction. Zoned thematic development areas provide the basis for legislation and define specific land uses for orderly development, environmental protection, livelihood development, natural resource conservation, and social cohesion while balancing these with economic priorities.

While the initial step of classifying land for optimum use is key, determining the priority of land uses through a consensus-based decision-making approach involving experts and residents is also crucial. With the help of land use planners, local people can decide where to build residential areas in a given village, where to place their markets and schools, and how much land to allocate to roads.

The detailed land-use planning process for Bangladesh's rural areas must be part of an iterative and ongoing process that prioritizes sustainable development. The need for up-to-date information on how much of our finite land has changed to urban landscapes is ever-increasing.

How Geospatial Technologies Help

Information technologies make spatial planning and management of natural resources easier. Geographic information systems (GIS) use earth observation (EO) data to analyse geographically referenced information. These allow complex assessments of situations, providing bases for the adoption of precise and scientifically grounded decisions for land use. They can provide alternative scenarios, model possible future changes, and support risk assessment.

GIS can integrate diverse EO images, spatial data (including land cover maps), and information on how human activities have affected land use over decades. This enables comparison between past and present states of a given stretch of land. GIS makes it possible to project and analyze how anthropogenic changes will affect land use and land cover in the future. It can be used to develop suitability maps by analyzing soil type, slope, water availability, and proximity to infrastructure, which will be essential to inform land use development, natural resource management, and engineering applications.

Bangladesh has been receiving technical support in developing and adopting a national land cover monitoring system to track such land cover change through a joint project of NASA and USAID. The project, SERVIR-HKH, is implemented across the Hindu Kush Himalayan (HKH) region, prioritizing work in Afghanistan, Bangladesh, Myanmar, Nepal, and Pakistan, by the International Centre for Integrated Mountain Development (ICIMOD). The land cover monitoring system makes use of freely available satellite imagery to generate land cover maps on an annual basis using a harmonized and consistent classification system. Such maps and data can be used to supplement information for land use planning.

As one of the world's most flood-prone countries, Bangladesh also needs flood risk and flood shelter suitability maps for different flood scenarios. We have the technology to not just identify suitable sites for the construction of roads and infrastructure, but also for flood shelters. GIS provides decision makers the information they need to choose sites that do not encroach on productive land, are not at risk of being submerged in floodwaters, and are within easy access.

Possible Models

Little attention has been paid to protecting agricultural land that enables long-term food security and provides essential environmental benefits. Still little, if any, consideration seems to have been paid to the fact that villages can be attractive for people to live in. Even in urban settings, houses continue to be built haphazardly, there is a lack of access to many basic services, and planning rules are not followed. Across residential locations in Bangladesh, roads, playgrounds, and civic amenities need appropriate proportioning.

A strategic approach to land use planning could involve selecting specific sub-units of districts (known as upazilas in Bangladesh) for planning as 'model locations'. Learning and experiences from these locations could help future planning in other parts of the country. In addition, they could guide a long-term strategic approach for Bangladesh's rural areas to regulate land use with minimal loss of agricultural land. The Local Government Engineering Department, for instance, may work at the upazila level with the Department of Agriculture and the Bangladesh Forest Department on detailed land use plans and get them approved by the Union Council. These land use plans could then be reviewed and revised occasionally.

Rural land use planning can prevent the country's fertile agricultural land from being converted into unplanned residential areas. It can also control heavy pressure on land. Appropriate and effective planning, implementation, and management can ensure rural development that is sustainable with significantly minimized negative impacts on the environment and on local communities.

Figure 1: Satellite images showing how human activities have affected land use over decades.

Maxar - A Leading Space Technology And Intelligence Company

A Talk with Madhav Ragam, VP of International Sales, Public Sector Earth Intelligence, Maxar

Maxar partners with innovative businesses and more than 50 governments to monitor global change, deliver broadband communications and advance space operations with capabilities in Space Infrastructure and Earth Intelligence. With more than 60 years of experience, Maxar design and manufacture satellites and spacecraft components for communications, Earth observation, exploration and on-orbit servicing and assembly. Maxar capabilities in Earth Intelligence help customers map, detect and predict change across the globe.

We had a great opportunity to have a questionnaire with Madhav Ragam, VP of International Sales, Public Sector Earth Intelligence at Maxar. He has shared interesting insights on developments in the Earth Observation industry and its impact on national development. He also talked about products and services, key trends in the industry and how would Maxar contribute to national mission mode projects.

The questionnaire follows as...

GIS Resources - How has Earth observation, from 1860s aerial photography to 1960s satellites, contributed to science, economy, society, and national development for over 150 years?

Madhav Ragam - Earth observation has always played a critical role in society. For example, after the Second World War, satellite imagery was one of the tools that helped keep the Cold War “cold,” providing global transparency that enabled nations to act based on facts, not fear.

Before the 1990s, however, Earth observation was primarily a government endeavor. The establishment of the commercial remote sensing industry helped push the sector to new heights. In 1993, one of Maxar’s predecessor companies received the United States’ first-ever formal remote sensing license. As the commercial remote sensing industry has grown and globalized, it has had an enormous impact on life as we know it.

For example, highly accurate satellite imagery basemaps enable precision mapping solutions that help billions of people and businesses navigate the real world. Remote sensing data plays a critical role in safeguarding national security and supports disaster response by providing near real-time insights that enable situational awareness and that help users make the best decision possible. Geospatial data is critical to helping monitor global change, from climate change to wildlife populations to urban

Madhav Ragam

VP of International Sales
Public Sector Earth Intelligence
Maxar

footprints. Some of the most important aspects of modern life are enabled by the Earth observation industry, and Maxar is proud to lead from the front.

GIS Resources - How are disruptive technologies reshaping the Earth Observation landscape, and how is Maxar adapting to the rapid technological changes?

Madhav Ragam - There are three big trends that are shaping the future of the geospatial industry—the evolution of multisource intelligence, the adoption of artificial intelligence and machine learning (AI/ML) technologies, and the emergence of 3D digital twins. Maxar is at the forefront of all these trends, pushing the boundaries of what's possible in geospatial intelligence.

Multisource intelligence is focused on the integration of multiple remote sensing data sources, including optical, radio frequency (RF) and synthetic aperture radar (SAR). RF and SAR data has been available for years, but as processing techniques have evolved, they have become increasingly important data sources that complement high-resolution optical imagery. RF data provides critical insight into the location and frequency of communications activity. SAR imagery can be taken at night and through clouds, providing users with 24/7, all-weather monitoring capabilities when paired with optical imagery. Customers increasingly expect geospatial intelligence companies to provide access to multiple data sources—something that Maxar has been providing for a long time.

AI/ML technologies are helping customers gain insights from geospatial data at greater speed and scale, moving from sensing to sense-making. Applied ML algorithms help automate object detection, scene characterization and more—providing critical insights in seconds instead of hours or days. Maxar has been deploying ML algorithms for many years. We're also at the next frontier for AI/ML in space, developing a hosted payload that will enable our satellites to perform on-board processing, including automatic target recognition (ATR) and other functions. On-board processing is exciting and necessary because it will reduce the latency from capture to delivery and decision on the ground and reduce the amount of data that needs to be downlinked.

The third big trend is the shift from 2D geospatial data to 3D data. Maxar is developing a scalable digital twin of the Earth to help customers explore and experience our world in 3D. Leveraging the industry's highest resolution 2D geospatial foundation and our unique 3D production capabilities, we're able to build virtual real-world environments with incredible detail and accuracy. The potential use cases for 3D geospatial products are virtually endless, but some existing use cases include military simulation and operational planning, enabling GPS-denied and autonomous navigation for vehicles, and enabling game developers to build immersive environments quickly.

GIS Resources - In what ways would Maxar contribute to national mission mode projects, specifically in city management, infrastructure development, mobility, supply chain, energy sectors, mining, and precision applications?

Madhav Ragam - For the past 30 years, Maxar has supported a wide range of government and commercial missions that have helped enable sustainable development and provided socioeconomic opportunities.

Precision mapping is critical in helping decisionmakers make decisions about everything from land use planning to infrastructure development to supply chain optimization. Maxar has the most extensive, high resolution satellite imagery archive in the industry—we recently announced the completion of the first global, satellite imagery basemap at 30 cm high-definition (HD) resolution. Our data is the foundation for Esri's "Living Atlas of the World", the foremost collection of geographic information, and has been used to help mapmaking company TomTom quickly and accurately update its map layers to help its customers improve navigation.

Our data is also critical to sustainable economic development. In Africa, for example, our satellite imagery is used to enable human population and agriculture census mapping from space, offering a far cheaper alternative to manual efforts and critical in enabling effective policy development as populations grow. Some of our geospatial products, such as Maxar's Crow's Nest solution, help monitor illegal trafficking or fishing activity around the world, as well as monitoring offshore assets such as oil platforms to ensure compliance with local regulations. We also help countries protect their natural resources, supporting wildlife population mapping, monitoring for illegal mining or logging and more.

Finally, our solutions play a critical role in enabling security, which is fundamental to societal development. This includes not only monitoring borders and areas of conflict, but also helping provide insights of the impact of natural disasters to aid in disaster response and recovery. Most recently, our Open Data Program supported recovery and aid efforts in Turkey and Syria after the

February earthquake in that region.

GIS Resources - What key factors and trends are fueling the growth and driving the expansion of the thriving space economy, which is projected to generate over $1.1 trillion in revenue by 2040?

Madhav Ragam - There are three big trends that are shaping the future of the geospatial industry—the evolution of multisource intelligence, the adoption of artificial intelligence and machine learning (AI/ML) technologies, and the emergence of 3D digital twins. Maxar is at the forefront of all these trends, pushing the boundaries of what's possible in geospatial intelligence.

Multisource intelligence is focused on the integration of multiple remote sensing data sources, including optical, radio frequency (RF) and synthetic aperture radar (SAR). RF and SAR data has been available for years, but as processing techniques have evolved, they have become increasingly important data sources that complement high-resolution optical imagery. RF data provides critical insight into the location and frequency of communications activity. SAR imagery can be taken at night and through clouds, providing users with 24/7, all-weather monitoring capabilities when paired with optical imagery. Customers increasingly expect geospatial intelligence companies to provide access to multiple data sources—something that Maxar has been providing for a long time.

AI/ML technologies are helping customers gain insights from geospatial data at greater speed and scale, moving from sensing to sense-making. Applied ML algorithms help automate object detection, scene characterization and more—providing critical insights in seconds instead of hours or days. Maxar has been deploying ML algorithms for many years. We're also at the next frontier for AI/ML in space, developing a hosted payload that will enable our satellites to perform on-board processing, including automatic target recognition (ATR) and other functions. On-board processing is exciting and necessary because it will reduce the latency from capture to delivery and decision on the ground and reduce the amount of data that needs to be downlinked.

The third big trend is the shift from 2D geospatial data to 3D data. Maxar is developing a scalable digital twin of the Earth to help customers explore and experience our world in 3D. Leveraging the industry's highest resolution 2D geospatial foundation and our unique 3D production capabilities, we're able to build virtual real-world environments with incredible detail and accuracy.

The potential use cases for 3D geospatial products are virtually endless, but some existing use cases include military simulation and operational planning, enabling GPS-denied and autonomous navigation for vehicles, and enabling game developers to build immersive environments quickly.

GIS Resources - In what ways would Maxar contribute to national mission mode projects, specifically in city management, infrastructure development, mobility, supply chain, energy sectors, mining, and precision applications?

Madhav Ragam - The growth of space-based data and technology innovation have allowed for faster, more cost-effective satellite production and deployment.

Space-based data is more available and accessible than ever before. In addition to companies like Maxar, which have been providing space-based data for decades, there are countless startups launching satellites designed for specific use cases. Customers have realized that this data, which is far more scalable and cost-effective than most terrestrial or aerial data sources, can help solve a range of complex problems. One highly relevant example is methane emissions. Maxar recently developed a methane detection algorithm, which can help organizations identify and locate the source of methane emissions from assets such as oil and gas infrastructure within a 10-meter radius. This solution can save organizations countless hours and cost when compared to more traditional methods.

A second major factor is the shift toward smaller spacecraft, primarily for low Earth orbit (LEO) constellations. Smaller spacecraft are faster and more cost-effective to build, allowing companies to launch assets onto orbit more quickly. Maxar—which also builds spacecraft for government and commercial customers—has a flexible family of spacecraft platforms that includes the Maxar 300 series designed for high-rate production, rapid constellation deployment and mission-level reliability.

GIS Resources - Given the evolving global security scenario and the intensifying space race, how do you envision the role of Maxar, considering its technology and solutions? Furthermore, what kind of future do you foresee for Maxar in this dynamic landscape?

Madhav Ragam - Maxar has a critical role to play in the future of geospatial intelligence. The commercial remote sensing industry is now a critical partner to governments

in their national security missions, and that collaboration will only grow and deepen in the years to come. Maxar can provide vast amounts of unclassified data at scale. Moreover, we can provide that data—as well as data from other providers—in a streamlined manner that shortens sensor-to-decision timelines and makes it easy to extract the insights they need. Moreover, Maxar is enabling international allied collaboration. Some U.S. partners have access to Maxar data through U.S. government platforms, while others work with us directly. It's clear that commercial geospatial intelligence is vital for maintaining global security, and Maxar is well positioned to support our partners long into the future.

GIS Resources - With the rapid increase in space utilization, the issue of space sustainability has become a pressing concern. How do you comment or share your thoughts on the topic, considering the growing number of satellites, space debris, and other activities in orbit, and the importance of maintaining a sustainable space environment?

Madhav Ragam - All nations and people benefit from the responsible use of space. It is critical that all space operators use the space environment responsibly by following best practices for space traffic management and advocating for sound policies. Maxar aims to be a leader in responsible space operations, including by promoting flight safety and helping mitigate the risks of space debris.

As a responsible operator, we build and develop satellites that can maneuver in space to avoid colliding with space debris and other satellites. We are also developing new technology to support on-orbit servicing, including as a partner in NASA's OSAM-1 mission, which will deploy the first spacecraft to demonstrate on-orbit servicing and manufacturing. From an industry and policy perspective, we regularly collaborate with members of the space community to promote sustainable operations.

We also offer specific technology capabilities on our Earth observation satellites that can help with space domain awareness. Our satellites, including our next-generation WorldView Legion satellites, have a non-Earth imaging (NEI) capability. We can take images of space objects in low Earth orbit (LEO) at resolutions of less than six inches and we can support tracking of objects across a much wider volume of space. This capability can help operators better protect and maintain their assets in space. For example, when our WorldView-2 imaging satellite was hit by a non-tracked piece of debris in 2016, we used this capability to determine that the damage was minimal. It's an exciting capability that nicely complements other tracking solutions that support space sustainability.

GIS Resources - In the last, what are the biggest opportunities for the industry and the biggest challenges facing the industry today?

Madhav Ragam - In terms of value creation opportunities, multisource intelligence is giving users far more insight into what's happening on the ground, and AI/ML technologies are increasing the speed and scale of drawing insights from that data. The emergence of 3D terrain data is a gamechanger for many use cases. There is also an opportunity to bring these solutions to more customers across the globe. While commercial remote sensing data has been broadly used by customers in certain markets for a long time, there's opportunity to make these solutions more accessible and affordable for customers in markets across Asia, Latin America and Africa. Maxar is seeing good momentum in these geographies, thanks in part to the scalable, cost-effective solutions that we provide, and we're excited to see how that helps drive positive outcomes across the world.

GEO NEWS

March 16, 2023 - June 15, 2023

Bentley Systems Announces iTwin Activate: IoT

Bentley Systems has recently announced the launch of iTwin Activate, a 20 week co-development program designed to accelerate early-stage startups in infrastructure engineering software. The program, which is organized in cohorts aligned to industry sectors, is managed by Bentley iTwin Ventures, a $100 million corporate venture capital fund that fosters innovation by co-investing in startups and emerging companies.

Trimble Advances Reality Capture with the New X9 3D Laser Scanner

Trimble has recently announced the Trimble® X9 3D laser scanning system, a new versatile reality capture solution for surveying, construction and engineering professionals. The X9 is built on Trimble's proven laser scanning technologies, engineered to enhance performance in more environments while leveraging innovations such as Trimble X-Drive technology for automatic instrument calibration, survey-grade self-leveling and laser pointer for georeferencing.

Maptitude 2023 Released: The Ultimate Tool for Business Development

Maptitude 2023, the latest version of the powerful business mapping and geographic analysis software, is available now. Maptitude 2023 provides an easy-to-use, affordable solution for businesses to visualize their data and gain valuable insights that drive success. Maptitude 2023 is the most comprehensive mapping software available today. It provides businesses with the tools they need to make informed decisions, streamline operations, and increase profitability.

RIEGL Expands Test Aircraft Fleet with a New DA62 SurveyStar

RIEGL Laser Measurement Systems GmbH, a global leader in the development and production of laser scanners and systems for applications in surveying, and in cooperation with Diamond Aircraft Austria since day one of their Special Mission Aircraft business, acquires a new test and calibration aircraft, a DA62 SurveyStar. After successfully operating one of the very first DA42 GeoStar aircraft for nearly 15 years, *RIEGL* is becoming the first Austrian operator of its groundbreaking successor, the DA62 SurveyStar.

Kenya Teams Up with SpaceX to Launch Earth Observation Satellite Taifa-1

Kenya has made a history by launching its first-ever Earth observation satellite Taifa-1 in collaboration with SpaceX. The East African country has been making significant strides in its space program in recent years, and this milestone achievement is a testament to its commitment to exploring and utilizing space technology for the benefit of its citizens.

Geospatial Imagery Analytics Market is Expected to Reach USD 50 Bn By 2032

The Geospatial Imagery Analytics Market is set to grow from its current market value of more than $6 billion to over $50 billion by 2032; as reported in by Global Market Insights, Inc. Geospatial Imagery Analytics Market is expected to showcase massive growth through 2032, owing to the rising traction of location-based applications. In addition, the leading location-based service providers are collaborating with tech companies to augment the analytical capabilities of their location-based solutions, which will add to the market growth over the coming years.

GEO EVENTS

June 27 - 28, 2023
GIS Tech 2023
Beijing, China
http://www.gistc.com/en/

July 10 - 14, 2023
ESRI User Conference
San Diego, CA, USA
https://www.esri.com/en-us/about/events/uc/overview

August 13 - 18, 2023
International Cartographic Conference
Cape Town, South Africa
https://uc2023.qgis.nl/

September 5 -7, 2023
Commercial UAV Expo
Las Vegas, NV USA
https://www.expouav.com/

October 15 - 18, 2023
Fall Northeast Arc Users Group (NEARC)
Omni New Haven, CT, USA
https://www.northeastarc.org/spring-nearc.html

October 16 - 19, 2023
GIS-Pro 2023
Columbus, OH, USA
https://www.urisa.org/gis-pro

Octopber 16-19, 2023
GeoSmart India 2023
Hyderabad, India
https://www.geospatialworld.net/event/geosmart-india-2023/

November 27 - December 1, 2023
2023 Pacific GIS & Remote Sensing User Conference
Suva, Fiji
https://www.pgrsc.org/

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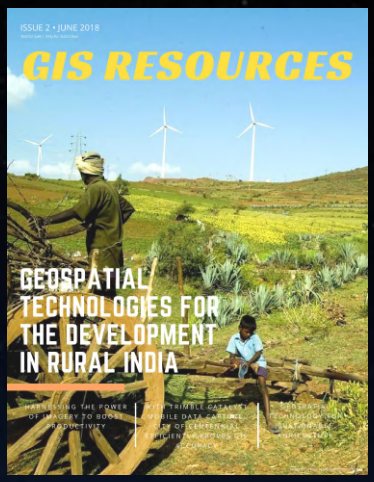

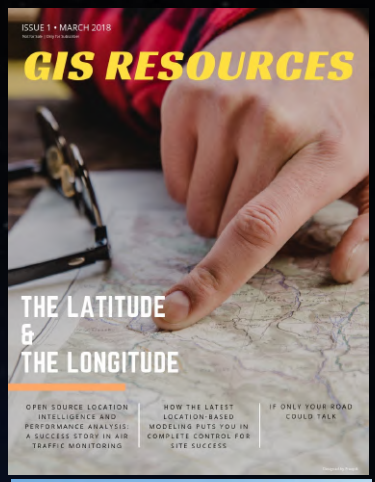

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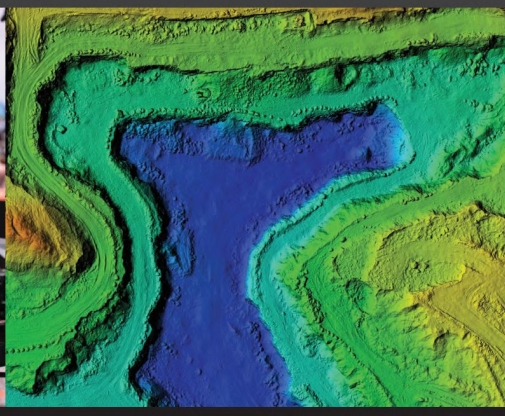

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