ArcNews

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India: A Vision for National GIS

India has long adopted modern remote-sensing and GIS technologies for various development projects. Today, it recognizes that empowering its citizens and modernizing governance are urgently needed for future nation building. In support of this national goal, India is set to establish a next-generation GIS—a National GIS—that empowers its citizens, enhances efficiency in governance, and supports an inclusive social and economic order. Dovetailed into this larger vision of National GIS, the state of Karnataka has envisioned its statewide GIS subplatform. India is looking at innovative GI policies by which such authoritative and updated GIS data and a wide range of applications would become possible. (*See pages 16 through 21 for a preview of the future.)*

GIS: Transforming Our World

By Jack Dangermond

Our world is facing serious challenges.

To everyone who attended the 2013 Esri International User Conference, I want to thank you for helping to make this year's conference such a great success. For those who could not attend, let me take a few minutes to give you an overview of the opening remarks from Monday morning. Also, if you would like to view the Monday Plenary Session, it is available at esri.com/uc.

The theme of this year's conference was "GIS: Transforming Our World." The word *transformation* can refer to two types of change: physical change, as well as change in how we perceive things. GIS is relevant to both.

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Completely Integrating ArcGIS for Server, Portal for ArcGIS, and ArcGIS Online

Implementing Web GIS

Web GIS is a new pattern for delivering GIS capabilities and is at the center of Esri's strategic direction for implementing GIS as a platform. Maps on the web provide a new paradigm for how people everywhere access and use geographic information. They use GIS maps on their desktops, the web,

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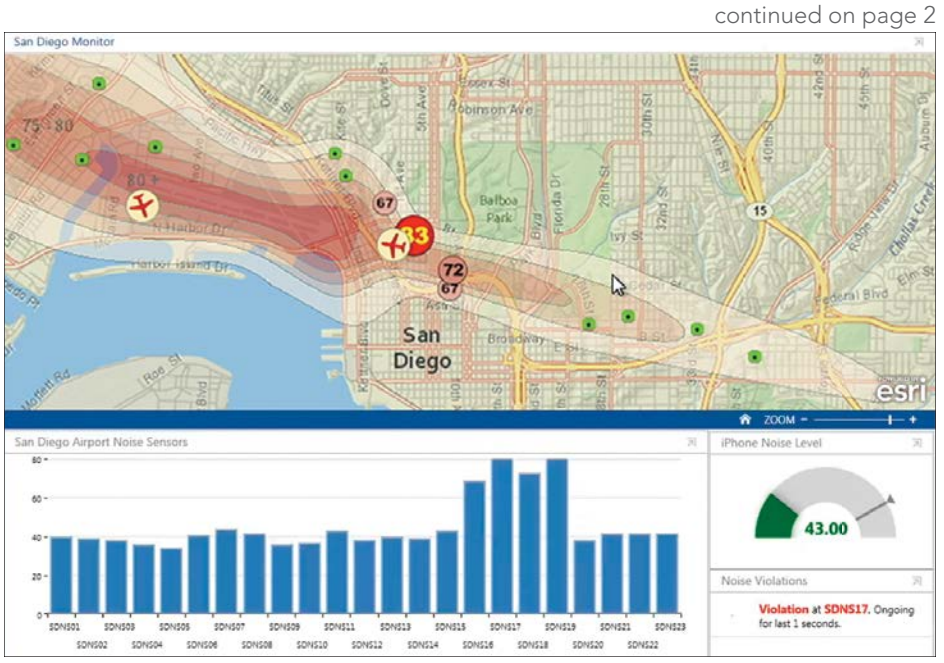
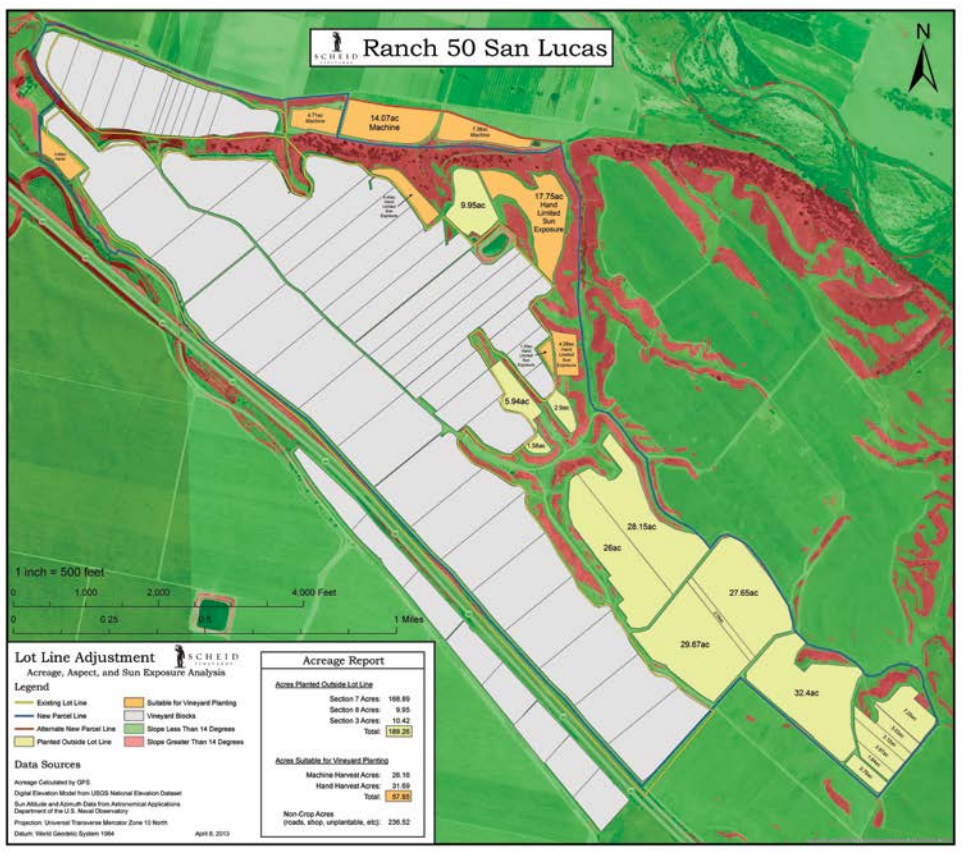


Web GIS supports real-time visualization and analysis. It also provides a flexible and agile framework for implementing GIS as a platform.

Scheid Is at the Cutting Edge of Geospatial Agricultural Management

World-Class Vineyard Uses GIS to Fine-Tune All Its Operations



Scheid Vineyards (originally known as the Monterey Farming Corporation) was founded in 1972 in Monterey County, California. The business has progressively grown, and today it farms approximately 4,200 acres of varietal wine grapes, making it one of the leading independent producers in the United States.

Monterey County is known for having the longest growing season in the state due to the maritime influence of Monterey Bay and the unique geography of the Salinas Valley. This longer "hang time" (the time the fruit spends on the vine) allows the grapes to ripen slowly and evenly and achieve peak flavor development. Scheid Vineyards, with 10 estate vineyards located along a 70-mile spread, is able to grow 29 different varieties in a spectrum of styles.

The first implementation of GIS on the vineyard started in 1998, when Tyler Scheid surveyed all the vineyard properties in submeter

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Land suitable for planting a vineyard to be machine harvested needs a slope of less than 14 degrees for the harvester, good sun exposure in September to ripen the fruit, and to be southern facing. This map shows all three factors and identifies the best places to plant. The map was made using a digital elevation model and ArcGIS for Desktop.

Implementing Web GIS

continued from cover

Deployment Options

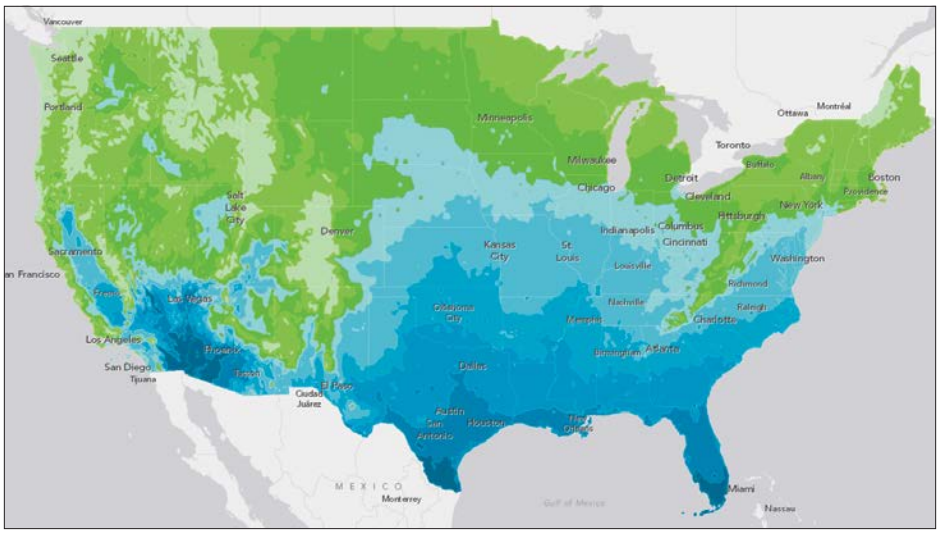
- Cloud only
- On-premises only
- Cloud and on-premises hybrid

tablets, and smartphones for a sophisticated range of activities to apply advanced geographic information.

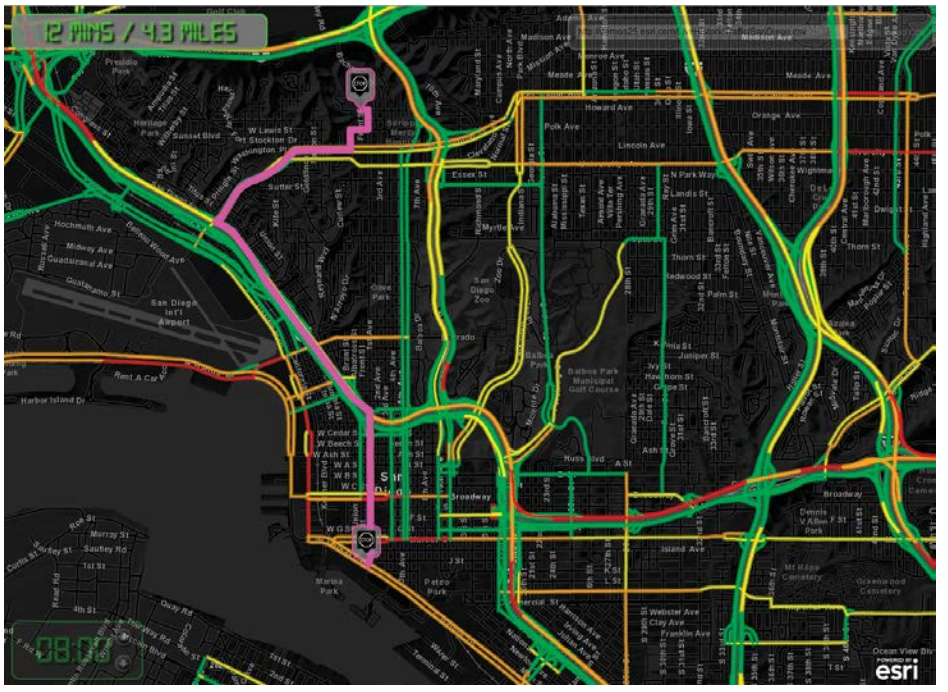
Web GIS is a transformation of GIS that brings analytics to spatial data in a way that wasn't possible before. Previously, spatial data had to be processed, modified, and extracted to answer a predetermined set of questions. Now, the data is transformed into web maps or services that are mashed up with different layers into a web GIS, which provides the flexibility to answer any possible question. The data is ready and waiting to dynamically answer questions. It no longer needs to be processed for each individual question. Web GIS is a much more flexible and agile workflow.

Web GIS brings GIS into the hands of the people. It reduces the need to create custom applications, provides a platform for integrating GIS with other business systems, and enables cross-organizational collaboration. Web GIS allows organizations to properly manage all their geographic knowledge. At the heart of web GIS is a mapcentric content management system.

How does one go about implementing web GIS? One of the strengths of the ArcGIS platform is its flexibility to support the web GIS implementation method that best fits an organization. It can run completely in the cloud, completely within an organization's own infrastructure, or in a hybrid pattern.



Web GIS makes any data, such as the current weather conditions, ready and waiting to dynamically answer any possible question.



Integrating real-time information, such as traffic data, into ArcGIS maps and apps is critical for workers in the field.

Featured in This Issue

Regular Columns and Departments

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Cloud-Only Deployment
The cloud-only deployment pattern is ArcGIS without the box; everything runs in the cloud using ArcGIS Online. ArcGIS Online provides a mapcentric content management system that stores the data, delivers GIS services and content as software as a service, and manages user access and security. ArcGIS Online also provides ready-to-use content from datasets to basemaps and on-demand services that supplement an organization's own geospatial data. It is an excellent entry point to ArcGIS because it provides simple mapping tools that can be accessed from web browsers, tablets, and mobile devices and because setup and maintenance of the GIS infrastructure are securely handled by Esri.

On-Premises-Only Deployment
However, some organizations cannot utilize a cloud-based implementation. They may not have an Internet connection or their connection is unreliable. In many cases, government or industry regulations prevent them from using cloud services or storage. An on-premises-only deployment is ideal for these situations. Everything runs on the organization's own internal IT infrastructure using ArcGIS for Server with the Portal for ArcGIS extension.

ArcGIS for Server transforms data, whether it's a file, a database, or a real-time data stream, into services that people can access over the web. It enables GIS capabilities in the organization's infrastructure so they can be accessed anywhere and at any time. The Portal for ArcGIS extension provides the mapcentric content management system and collaboration tools that connect GIS data and services with people through apps. This implementation can be supplemented with Data Appliance for ArcGIS, which provides local instances of ready-to-use services from ArcGIS Online.

Cloud and On-Premises Hybrid Deployment
Combining the cloud and on-premises deployment methods into a hybrid deployment can provide the best of both worlds. ArcGIS for Server provides the behind-the-firewall data storage, sharing, and processing, while ArcGIS Online provides cloud-based sharing, dissemination, and collaboration. This implementation also allows organizations to integrate the ready-to-use content from ArcGIS Online with the data and services hosted on their internal infrastructure. This method allows organizations to take full advantage of the advanced capabilities of ArcGIS for Server while taking full advantage of the cloud GIS platform provided by ArcGIS Online.

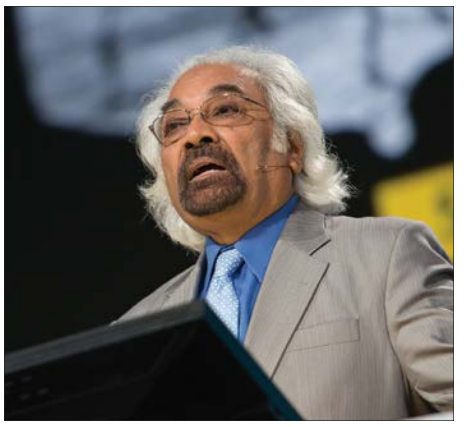
The hybrid deployment method also provides the most flexibility to adapt a GIS infrastructure to meet an organization's changing needs.

Conclusion
The ArcGIS platform flexibility allows organizations to choose the best implementation method for them, whether that's cloud, on premises, or a hybrid. The determination of which implementation method an organization should use should be based completely on which one works best with its needs and existing IT infrastructure.

For more information about ArcGIS Online, visit esri.com/agol. For more information about ArcGIS for Server, visit esri.com/server.

India's Platform Connects Everyone to Information

Esri UC Keynote Speaker Sam Pitroda Shares a Nation's Technology Plan



Sam Pitroda talks about India's National GIS platform.

India has one of the fastest-growing economies in the world. Renowned for its IT and software development, it is an important component in the world's technological advances. The prime minister of India declared the period of 2010 to 2020 the decade of innovation.

Sam Pitroda is the technology adviser to India's prime minister and the thrust that is forwarding the implementation of a national GIS. "Technology is key for driving India's development," he said in his keynote speech at the 2013 Esri International User Conference.

As a young man, Pitroda left India for 20 years to work in the telecom business in the United States. While visiting India on a business trip, he tried to call his wife from his hotel and could not make a connection. That day he committed himself to improving India's communication system. Pitroda took up his mission in 1980, at which time the country had 2 million phones for 750 million people. Today, India has 900 million telephones for 1.3 billion people. He posed the question: what can 900 million connected people do? As the chairman of the national innovation council, his plan has been to build technological infrastructures that connect everyone to information.

India's development is challenged by disparity, demography, and the lack of infrastructure. To meet these challenges, leaders have designed a plan for expansion, which includes building more hospitals, schools, and roads; producing quality goods and services; and making the most of its investments. The plan includes a strategy for equity. The poorest of the poor will be served. In 2010, the World Bank reported that 32.7 percent of India's population lives on less than $1.25 a day, while 68.7 percent live on less than $2 a day.

"We have a huge amount of young talent, and we have a moral responsibility to solve the problems of the poor," Pitroda said. "Technology, including GIS, is going to help us do this during the next two decades."

In other countries, the populations are aging and decreasing; however, in India the population is young and growing, with 550 million below age 25. Each year, 25 million young people are added to India's work force. Successful development means creating jobs for everyone.

"We have to make sure that the poorest of the poor can get the best education possible. To do this, we have decided to focus on information. We believe a lot of the poverty has to do with the poverty of information," Pitroda explained. "We have introduced the right to information as a pillar of democracy in the 21st century. We have to democratize information."

India has been ramping up its technology infrastructure with platforms that connect a large portion of the population to information. Its platform that connects voice has already been successful. Now the country is creating a platform to connect data for police departments, intelligence agencies, and food distribution. Next, India will create an identification (ID) platform that is connected to every resident via unique ID, including facial features, fingerprints, and iris codes. People will use their unique IDs to connect to bank accounts, mobile phones, ration cards, food distribution, and employment applications.

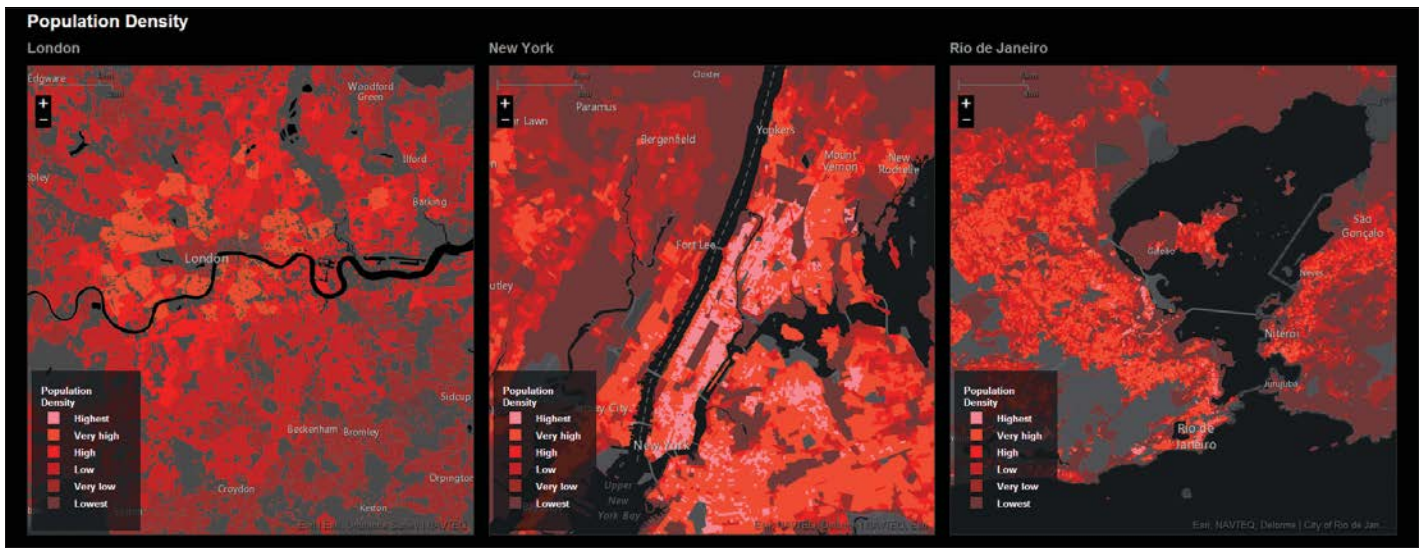
Recently, India rolled out its Knowledge Network that connects all universities, libraries, and research and development institutions to improve collaboration and share resources. It is now designing a government network, which will tie 250,000 local governments together through optical fiber. The network should be operational in 18 to 24 months. It will allow India to reengineer its government processes and education system, help agriculture and health industries, and improve public service delivery.

"Our goal is to empower a billion people through knowledge and information," said Pitroda. "GIS has a big role to play. It will help state and federal government share information and work hand in hand to meet India's challenges."

Today, India is building a nationwide GIS platform. For many years, the country has used GIS in bits and pieces for energy, transportation, agriculture, etc. It uses GIS for government projects and disaster management. By creating a national GIS platform, India will link together these activities and many others.

"All our cities and centric services would be plugged into GIS," Pitroda said. "We would focus on citizen services, as well as enterprise and government applications. As a result, the GIS platform will be built on GIS infrastructure and accessible via a national portal."

Pitroda envisions the national GIS platform supporting good governance; public service; sustainable development; and, ultimately, empowering a billion people. Alongside its GIS platform, India will be growing a work force with the capacity to build and use it. Applications will be designed for e-government, census data, and natural resource management. *(See pages 16–21 for more on India.)*



Small area boundaries allow meaningful comparisons of population density from city to city.

precedes action. That's why we built the Urban Observatory. To provide greater understanding."

The Exhibit and Application

After months of preparation and organization, Esri UC attendees were witness to the worldwide unveiling of the Urban Observatory exhibit, which featured large digital displays of maps, images, videos, and authoritative data for cities around the world. It stood in a half-circle of 16 pylons—each representing a city—in the center of the Esri Map Gallery, the annual popular Esri UC showcase for exciting maps created by the Esri GIS community. On each Urban Observatory display were HD screens continuously rotating authoritative city maps and recognizable images. Anyone could stand and easily compare and contrast complex systems using visualized map information.

Several cities contributed data. The creative and technical forces at @radical.media and Esri built the first iteration of the exhibit with state-of-the-art software, hardware, fiber optics, kiosks, and high-quality monitors.

As a new thematic map displayed on one city pylon, similar themes appeared for each of the featured cities. For instance, a map showing housing density or urban footprints appeared simultaneously for each of the participating cities. Many different types of map datasets enriched the exhibit and website, including imagery, weather information, and population data. In addition, aerial fly-through videos for each city were displayed on top monitors, while eye-level monitors below showcased specific maps—the combination created a unified experience that continually looped within the interior of the exhibit.

The Urban Observatory organizes maps into five major categories:

- Work
- Movement
- People
- Public
- Systems

Each category includes a number of subcategories organized into "nouns or subject," representing more specific map themes relating to one of the five categories. In addition to the nouns, more precise thematic subcategories organized by "verbs or magnitude" provide the capability to drill down into additional specific issues and city phenomena. For example, people may be interested in understanding more about the noun "movement" in a city. They can then drill down to view "verbs or magnitude" including road speed, traffic, or airport locations.

The ArcGIS Online web application allows people to directly interact with rich datasets for each city participating in the Urban Observatory experience. The application, available to the public, allows anyone to zoom in to one digital city map while two other city maps simultaneously zoom in parallel, revealing differences and commonalities in density and distribution. For instance, a person can simultaneously view new developments for Abu Dhabi, Tokyo, and Hamburg or simultaneously view open spaces for London, Mumbai, and Rio de Janeiro.

"Think of the Urban Observatory as a 21st-century live museum," says Wurman. "It's not static and stagnant. It's dynamic and living through constantly updated information from the cloud."

The Urban Observatory application and exhibit will continue to evolve. Future iterations will include more content and cities. The Urban Observatory will supply extensive benefits for government agencies and private businesses. For example, governments can view commercial, residential, and park land use for one city and compare it to another, making discoveries along the way that have implications ranging from attracting business to planning new communities. Businesses can also greatly benefit. By comparing and contrasting population data, infrastructure, and traffic, better decisions can be made about expanding assets and offices. Anyone with a free ArcGIS Online account can access the web application, which lets people explore mapped information by theme or city.

For more information about the Urban Observatory, visit **www.urbanobservatory.org**. To learn more about the 19.20.21 initiative, visit **www.192021.org**.

India's Geospatial Success

By Jack Dangermond

When I visited India in April 2010, I had the honor of meeting with Prime Minister Dr. Manmohan Singh and many other Indian leaders. It was during that visit that I learned of India's vision for a comprehensive National GIS. I had many interesting conversations with various experts where we discussed some of the challenges for such a national endeavor, not the least of which was that a project of such massive scale could only be successful if it involved all levels of government, private enterprise, and the citizens of India themselves—thereby making it a truly *national* enterprise.

I returned to India in September 2011 and was thrilled to see the progress India had made toward realizing its vision of National GIS. In the National GIS workshop that I attended, I interacted with some of the key visionaries of the National GIS—Mr. Montek Singh Ahluwalia, deputy chairman of the Planning Commission; Mr. Sam Pitroda, adviser to the prime minister on information technology; Dr. K. Kasturirangan, member (science) of the Planning Commission; Dr. Shailesh Nayak, chairman of the National GIS Interim Core Group and secretary, Ministry of Earth Sciences; Dr. T. Ramasami, secretary of the Department of Science and Technology; and Dr. Mukund Rao, secretary of the National GIS Interim Core Group and chairman of the GIS Task Force of the Karnataka Knowledge Commission—who, I must say, over past years has played a prominent and leadership role for this Indian endeavor. Apart from these key personalities, the Interim Core Group had 10 other national experts—together it was their experience and visionary perspectives that have shaped the National GIS vision. In that workshop, there were 200 experts—from government, industry, and academia—who spent a whole day debating, sharing, and fine-tuning the already crafted (and well discussed) National GIS vision. In all these interactions, what struck me was that a national movement had been set in action that was shaping a new dimension of nationally and socially relevant GIS.

This July at the 2013 Esri International User Conference (Esri UC), the vision of National GIS was unfolded by Pitroda in a Keynote Address that struck the plenary audience of thousands with awe about how India was slowly transforming its strengths (and complexities) into a great innovation advantage to set about a new information regime that empowers citizens, brings good governance, and encourages sustainable development—thereby bringing benefits of GIS to citizens, government, and enterprises. As Pitroda said at the Esri UC, " . . . addressing the bottom of the pyramid" was essential, and a National GIS is expected to do that. He also pointed out that the program has now been approved and sanctioned by the Indian government and that the program will take off this year and even establish a separate Indian National GIS Organization that will be dedicated and committed to further the use of GIS. It is truly visionary of the Indian government to undertake such a broad-based social infrastructure project that promises to bring tremendous dividends and benefits to the citizens of the world's largest democracy.

Even as India has made this great stride toward visualizing National GIS, a big challenge that it faces is the need for technically strong and visionary leadership for implementing National GIS successfully. I am very impressed and thrilled by what India has been able to accomplish in such a short amount of time. The following article shares some of the unique and important characteristics of India's National GIS vision. I believe that India is on the right track and that it can serve as a role model for other nations looking at the idea of National GIS as a platform for bringing together governments, businesses, and people. The world can learn a lot from India.

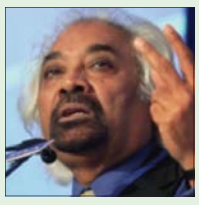
A Model for Good Governance, Enabled Citizens, and Successful Enterprises

India: A Vision for National GIS

India has long been a leader in using modern spatial technologies and started its tryst with satellite images and GIS in the 1980s by having its own Indian Remote Sensing satellites and image-based mapping and creating GIS databases and applications. In the early 2000s, it took steps toward designing a National Spatial Data Infrastructure. With a large talent pool and many veterans providing the vision, leadership, and drive, now a national movement has taken shape in India's next-generation GIS program—National GIS. Moving away from looking at GIS as just a mapping or database tool or as scientific software, India recognized that the true power of GIS can be realized only when it reaches the hands of the governed—those who can demand efficiency of governance/development and transparency in democratic action.

India is a vast country, with a population of more than 1.2 billion people spread over 3.29 million square kilometers. The country is composed of more than 600,000 villages and 7,000 cities and features a varied geography with a rapidly changing and complex social and economic character. As a democracy, India is constantly dealing with ways and means to comprehend social and economic challenges and bring a good quality of life to all its citizenry—aiming to bridge the wide disparity in economic and social character. It is in this democratic character that India visualizes National GIS as important—to easily map, note changes to, and understand the complex interplay of social order and economic growth. India has visualized that GIS is not just essential but is now an urgent necessity—so as to empower its citizens and bring an inclusive economic growth and prosperity to its people. It hopes to reap demographic dividends, expedite development, and reduce disparity—thereby bringing more equity among its people.

To many, developing a national GIS would seem to be an insurmountable task. How would a single, comprehensive system ever



Sam Pitroda, Adviser to Prime Minister on IT and Innovations

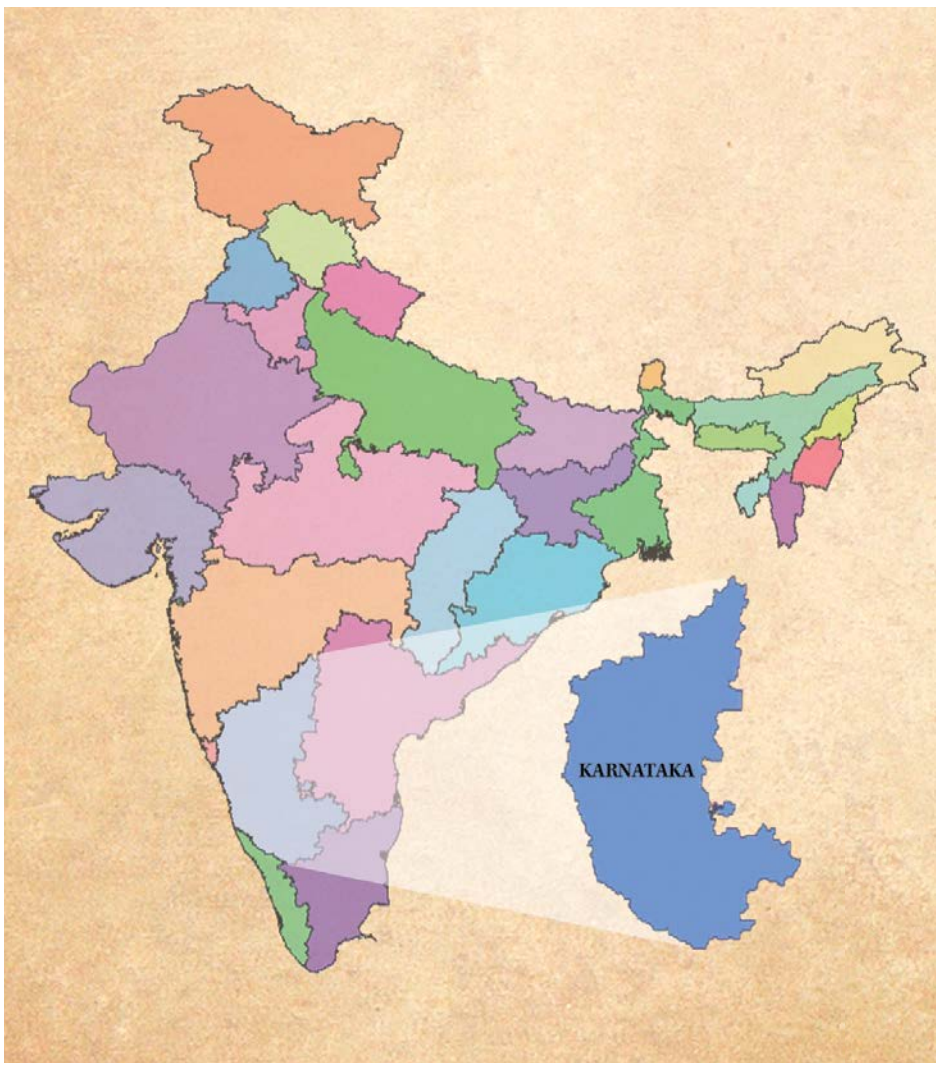
"India is at the cusp of another technological and development curve, and in its drive for inclusive growth, social equity, and development, a major requirement would be to reengineer many systems and processes. Information will be the fourth pillar of democracy, and GIS will be that important element of the fourth pillar—helping in the concept of unified information infrastructures. National GIS is envisaged not just to provide GIS data and GIS applications but serve as a platform for a host of e-services to every citizen—be they in urban or rural areas—and thereby leading India into inclusive growth and prosperity, expediting development, reducing disparity, and bringing rich demographic dividends."

—"A National GIS for India's Development," Keynote Address, Esri International User Conference, San Diego (July 8–12, 2013)

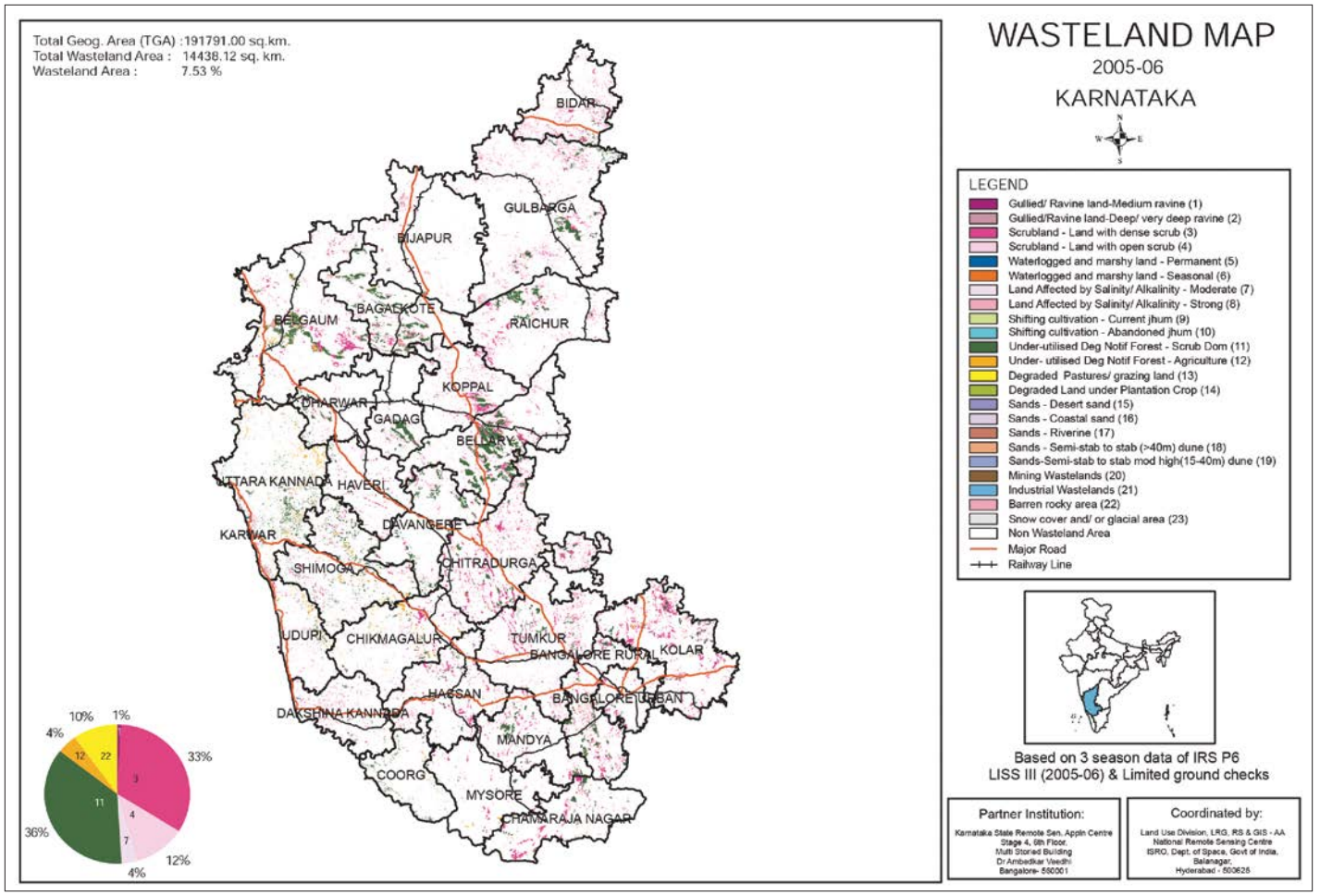
Dr. K. Kasturirangan, Member (Science), Planning Commission

"There are three important issues related to GIS. First, how can we ensure that our decision/governance system is supported by a comprehensive, easy-to-use GIS decision support system—whatever the *decision maker* wants must be supported by GIS? Second, how can any *user* be rid of the hassles of GIS data organization that he now faces—ensuring that GIS-ready data is readily available? Third, how can we have an institutional system in the country that is responsible for GIS and is accountable to meet the GIS needs of the country?"

—Key Address, National GIS Workshop, Delhi, India (September 14, 2011)



The state of Karnataka's GIS program is a successful model for National GIS.



Wasteland map of the state of Karnataka based on three seasons of data, 2005–2006. Source: Director, Karnataka State Remote Sensing Centre (KSRSAC, Bangalore).

be expected to serve the varied and separate needs of so widely contrasting elements? To others who know the challenges of GIS data availability in India, it would sound almost impossible to visualize a seamless national GIS that covers the whole nation. But a blueprint has been developed, and there is now a clear agenda that has been set for establishing and making operational National GIS—becoming one key element of a new innovative information foundation that will empower governance, enterprises, and citizens across the country.

The vision of National GIS for India has now been widely debated, discussed, and endorsed in a series of national-level meetings involving users, stakeholders, technical experts, policy makers, and the government. The National GIS vision document can be accessed at **moes.gov.in/national_gis.pdf**. The National GIS has now been incorporated into the Government of India Planning Commission's *Twelfth Five Year Plan 2012-17* as a new initiative for the future (**planningcommission.gov.in/plans/planrel/12thplan/welcome.html** Vol. I, page 248).

Reaching Full Potential

The vision report states that in spite of the wide usage of GIS as a technology, the potential of GIS has not yet been fully exploited for decision support by planners, stakeholders, decision makers, citizens, and others. Some of the initiatives have certainly been successful and have proved the potential of GIS for project work, but in many places, GIS has yet to achieve a full-service orientation and become a core component of the process of governance, planning, and nation building. Some key challenges that India faces in this regard include the following:

- How can the nation ensure that its decision-making/governance process is supported by a comprehensive, easy-to-use GIS decision support system that brings scientific, participatory, and quality dimensions into decision, planning, and development?
- How can the nation ensure that GIS-ready data is always easily available and maintained/updated by adding that critical capability differentiator over the images and maps that have already been invested in?
- How can India maintain a high level of national capability in this important technology area and leverage itself to be in the forefront of GIS technology in the international arena?

India has also recognized that there are some gaps in the widespread adoption of GIS in the country, and these need to be addressed as part of the process of building National GIS. GIS is technology-centric but needs to be decision-centric. This means that all types of decision makers—governments, enterprises, and citizens—should have the ability to easily make use of readily available GIS data and applications that can help solve their problems. GIS needs to become so easy to use and so deeply embedded in workflows and processes that it becomes integral to modern governance and nation building. In addition, there is as yet no widespread availability of GIS-ready data for the whole country, and no agency in India has overall responsibility for this activity. These shortcomings have been identified as critical and need to be addressed before GIS can become pervasive at both the state and national levels.

Key elements of India's National GIS vision include the following:

- A National GIS platform with GIS-centric computing and networking infrastructure
- Seamless, nationwide National GIS asset at 1:10,000 scale, as well as city-level data at larger scales
- Targeted National GIS applications to support government ministries and departments, private enterprises, and citizens and delivered through a National GIS portal; planned GIS dashboards for use by the Prime Minister's Office, Planning Commission, Cabinet Secretariat, and key dignitaries
- Focused GIS capacity-building initiatives
- Pragmatic geographic information (GI) policy positioning and best practices for National GIS

India has recognized that a strong organizational framework is essential for bringing focus and for institutionalizing National GIS and promoting geospatial technology use by government, enterprises, and citizens. To ensure success, it considers having an agency be made responsible for overseeing the vision of National GIS important. The Indian National GIS Organization (INGO) would have the primary mandate for the establishment, maintenance, and operation of National GIS. It would be responsible for guiding and shaping disparate components relating to infrastructure, technology, and services into a cohesive system.

In addition, a robust management structure has already been put in place to bring high-level focus and alignment across multiple ministries and all states and territories and to provide a flexible operational mechanism for implementation of National GIS. The Department of Science and Technology (DST) has been assigned the responsibility of implementing National GIS, and Dr. T. Ramasami, secretary, DST, is driving all the actions for the implementation. A National GIS Advisory Board has been established, with Dr. K. Kasturirangan as its chair, to provide overall policy direction and advice on implementation of the National GIS vision. A high-level National GIS executive committee has also been established to facilitate National GIS implementation, ensure INGO establishment, and help position across the entire country the concept of e-governance; e-governing is governing that takes advantage of the convergence of the newest geoinformation and communication technologies, such as improved spatial data management, GIS, GPS, remote sensing, satellite

continued on page 18

Montek Singh Ahluwalia, Deputy Chairman, Planning Commission

"National GIS can serve multiple needs—government, enterprises, and citizens—and must power more open government and thereby leverage economic and social development and reach the gains of development to the most needy and at the right place. National GIS must also aim to bring accountability and responsibility of public activities where decision making can be centered around GIS—thus factoring location and time-domain map information."

—Inaugural Address, National GIS Workshop, Delhi, India (September 14, 2011)

Dr. Shailesh Nayak, Chairman, National GIS Interim Core Group/Secretary, MoES

"GIS is of great relevance for many government activities and enterprises and for citizen services. National GIS has the main aim of thrusting the use of GIS applications into governance/planning/development activities. While India has made some progress in using GIS, a national system of a GIS is very important and timely for the nation to adopt. An organizational focus on GIS is important as an agile, rescoping organization—Indian National GIS Organization."

—Key Address, National GIS for G-Gov Workshop, Delhi, India (December 12, 2012)

Dr. T. Ramasami, Secretary, Department of Science and Technology

"National GIS is a logical requirement—while e-Governance (e-Gov) is the current paradigm, the future is in embedding the GIS in governance and in establishing G (*G* signifying GIS-based)-Governance (G-Gov) as the next frontier. India is poised for developing GIS-based solutions as the next paradigm in governance. National GIS would also catalyze and transform the methods in which GIS is practiced in the country, the way maps/images as GIS-ready data get organized and the way customized GIS applications get created, managed, and deployed as unique GIS services. An institutional framework for National GIS is also a necessity, and evolving INGO [Indian National GIS Organization] must be a priority."

—Key Address, National GIS for G-Gov Workshop, Delhi, India (December 12, 2012)

India: A Vision for National GIS

continued from page 17

and mobile communications, and the web. A mission-mode implementation of National GIS is being taken up under DST, and soon, a mission director will be positioned to be responsible for implementing National GIS.

A National GI Policy

India also recognizes that a strong policy foundation is essential for National GIS and also for furthering a good GIS ecosystem in the country. An independent study on GI policy perspectives has been undertaken by the National Institute of Advanced Studies, Bangalore, for the Government of India. The study has brought out a comprehensive report that outlines the framework of India's GI policy document (www.nias.res.in/docs/R11-2012-GI-Policy.pdf).

Presently, India has five policy tenets:

- **National Map Policy**, defining the scope, distribution, and access of Survey of India topographic maps
- **Civil Aviation Requirement**, detailing procedures for issuance of flight clearances for agencies undertaking aerial photography, geophysical surveys, cloud seeding, etc.
- **Remote Sensing Data Policy**, defining the process for distribution of satellite imagery
- **Delhi Geographical Spatial Data Infrastructure (Management, Control, Administration, Security, and Safety) Act**, defining the mandatory sharing, accessing, and utilization of Delhi geospatial data
- **National Data Sharing and Accessibility Policy**, declaring open access to data generated through public funding

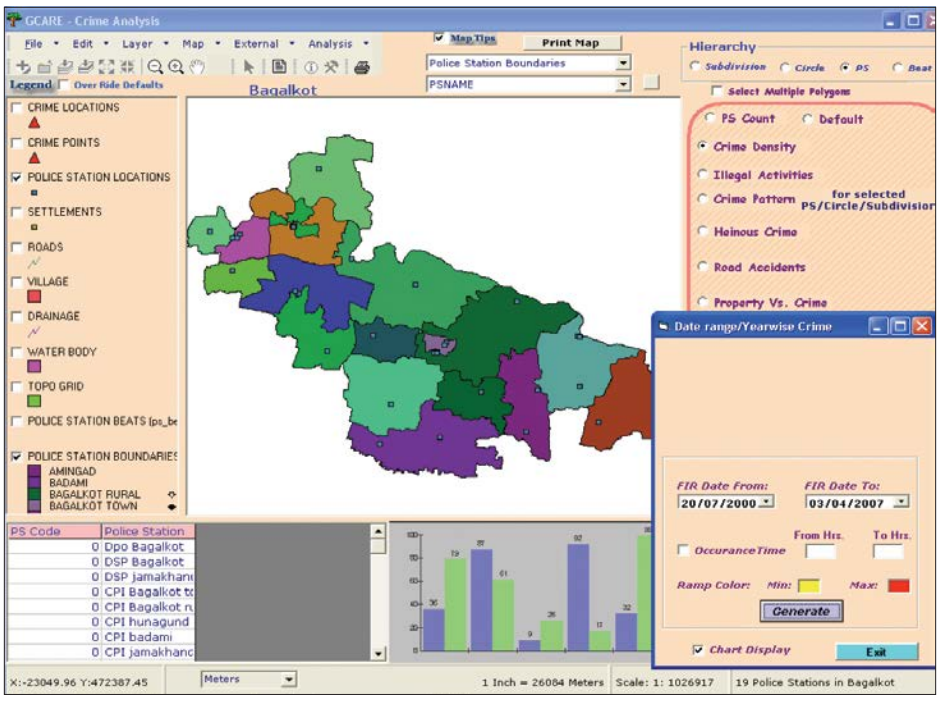
The above existing policies have been analyzed, and the need for an overarching policy regime for GI has been emphasized. To bring rationality in policy analysis, seven basic segments were identified that describe a national capability in GI and that need to be factored into a GI policy: imaging capability, precise positioning capability, advanced surveying capability, mapping capability, GIS capability, GI knowledge capability, and GI policy capability. In addition, four major cross-cutting GI policy considerations were identified as key factors for policy definition: national security, social relevance, legal issues, and creation of industrial capacity. Based on these seven segments and four cross-cutting considerations, the policy analysis identified 62 critical parameters that are constantly assessed from a policy definition point of view. Based on these factors, the case has been built for a comprehensive, overarching, and visionary policy. The report has also drafted the text of the national GI policy that aims for an advanced and impacting national capability in GI that empowers citizens and governance and also for positioning India as a global leader in GI. Toward this aim, it identifies two important near-term goals:

- Establish National GIS in the next three to five years.
- Institute g-governance models in Indian society.

In India, individual states are the main delivery mechanisms of development and social programs, so it became clear very early in the visioning process for National GIS that success would be dependent on acceptance and buy-in at the state level. Various state GIS initiatives have brought good operational examples of statewide applications to the national forefront. Some very good statewide GIS examples that have been established are in states like Gujarat and Karnataka. Gujarat has developed comprehensive statewide GIS data and has operationalized GIS services to grassroots level in a unique way. Karnataka has multilayered statewide GIS data and a wide range of GIS applications. In other states like Andhra Pradesh, Maharashtra, Rajasthan, and Haryana, GIS usage has been good. Many other states also use GIS for specific projects. These state-level efforts, in addition to establishing the relevance of GIS for development in a wide spectrum of areas, provide significant insight into successful applications, which are closer to citizens' needs and direct governance. In addition to these government agencies, many private-sector agencies have also been successful in implementing GIS solutions and in providing GIS services.

Karnataka GIS

The state of Karnataka determined to define state GIS in the context of National GIS implementation and to address the model of *governance-enterprise-citizen*. The prototype that the state then developed resulted from close examination of governance issues and citizen empowerment (see www.karunadu.gov.in/ksac/documents/K-GISVisionDraftVerWshop_Jan18.pdf and www.karunadu.gov.in/ksac/documents/KGisUserNeedsDraftWshop_Jan18.pdf). Once Karnataka had developed its strong state GIS model, it became a successful model for both state and national GIS implementation.



The Karnataka state police department has undertaken a pilot project for crime analytics and real-time monitoring. Source: Director, Karnataka State Remote Sensing Centre (KSRSAC, Bangalore).

Karnataka recognizes that GIS provides tangible benefits and that it is a key platform for the future of state governance. An institutionalized system that will ensure the availability and accessibility of GIS data and applications to different user groups and citizens is an important consideration in the vision of Karnataka's 21st century governance. With the vision for Karnataka GIS now defined, the result is a robust information and decision support system that upholds the decision-making process for planning and implementing various state developmental programs and also for empowering citizens in the state, apart from contributing common content and linking to National GIS. Thus, the Karnataka GIS is well-aligned with the vision of National GIS, ensuring seamless interoperability and cooperation between the states and national-level government.

The Karnataka GIS visioning exercise, undertaken by the Karnataka Knowledge Commission's GIS Task Force, has resulted in focusing unique and innovative ways of implementing GIS. Apart from the vision definition, a comprehensive assessment of user needs, in terms of GIS data and applications for various state departments, citizens, and others, has been documented. A good matrix structure has been identified for implementation where multiple agency capability is integrated at the state level.

India's National GIS: A Model for the World

The Indian government's vision is to create a new paradigm for governance and development with emphasis on inclusive growth and development—especially to reduce disparity, expedite development, and bring demographic dividends that will be unique. The vision of National GIS is aligned to enable a scientific mapping of resources, disparities, and needs to meet the aspirations of beneficiaries and society, especially the most disadvantaged; support sustainable and spatial planning; assist quick and reliable monitoring of plan implementation and status of development; enable transparent systems for inclusivity of society; and support real-time mapping of feedback and redress systems.

The process of establishing and implementing the state and national vision will also provide considerable opportunities for the private sector to contribute to and be part of this national endeavor. The national and state GIS will also boost education and research in GIS with specific school, university, and research programs focused on training the leaders of tomorrow in spatial thinking concepts and the core principles of GIS.

In today's rapidly changing world, India recognizes that nations that possess a sound and progressive GIS vision will lead and chart ways not only within their own borders but also across the international arena. India is gearing up to implement National GIS and make it fully operational.

Concluding Note from Jack Dangermond: *There is something for all GIS users to learn from this vision. It is sincerely hoped that what has been conceived as a national GIS platform to help bring growth, efficiency, transparency, equity, and inclusiveness to India will also serve as a useful model for other countries wishing to implement a national GIS.*

S. V. Ranganath, Chief Secretary, Government of Karnataka

"The role of Karnataka GIS to the state's planning and development process is critical. Karnataka is committed to support a Karnataka GIS initiative to serve as an important tool to support governance and particularly to empower people of the state. Karnataka GIS is an innovative knowledge initiative and has far-reaching implications to the state."

—Inaugural Address, Karnataka GIS Workshop, Bangalore, India (January 23, 2013)

I.S.N. Prasad, Principal Secretary (IT&BT), Government of Karnataka

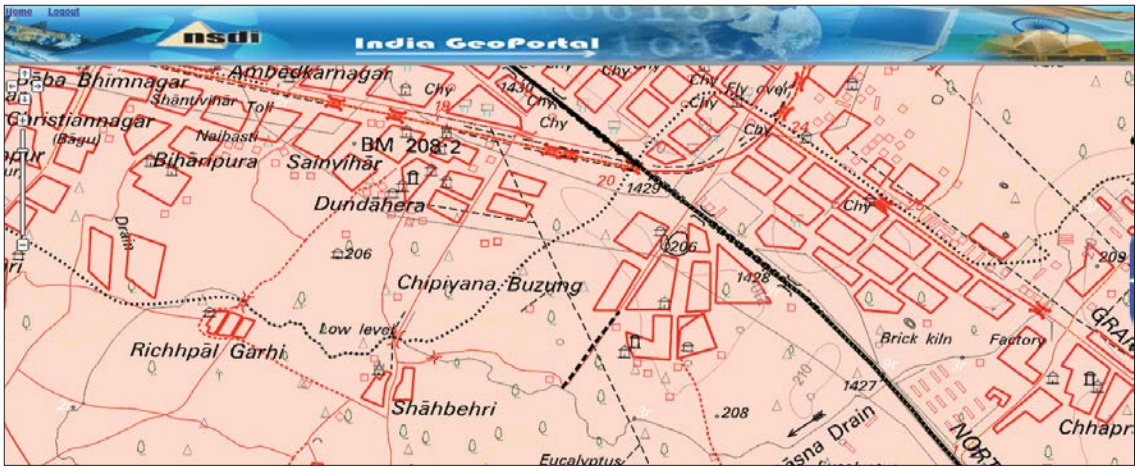
"Various Information Technology tools are being used for providing various citizen services and government programme outreach in Karnataka. Now, GIS will be yet another decision-support system that will bring benefit to the various departments of the state of Karnataka and citizens who seek the GIS data and services for their needs. The vision of Karnataka GIS has emerged after inclusive consultation and discussions amongst various department officials, industries, academia—thereby defining a statewide GIS ecosystem for growth and governance."

—Panel Discussion, Karnataka GIS Workshop, Bangalore, India (January 23, 2013)

National GIS Is for People's Empowerment and Better Governance

An Interview with Mukund Rao

National GIS of India is an innovative program within the country's Twelfth Five Year Plan that has generated much interest. Spearheading many of its component efforts is Dr. Mukund Rao, member-secretary of the National GIS Interim Core Group and chairman of the GIS Task Force of the Karnataka Knowledge Commission. Rao has more than 32 years of experience in earth observation (EO) and GIS programs and building space activities. His unique experience—working in both government and the private sector and now in the consulting domain—brings impactful and effective practices. Over the years, he has also provided leadership to many national and international forums related to EO, GIS, and space. Recently, *ArcNews* had an opportunity to speak with Rao.



India has a demonstration National Spatial Data Infrastructure (NSDI) portal that uses all the technology elements required for metadata and map data organization. (Source: India NSDI Portal at nsdiindia.gov.in/nsdi-portal/index.jsp.)

AN: What is National GIS?

Rao: National GIS is India's next-generation GIS program, envisioned as critical support to the national governance and empowering its citizens—thereby extending GIS to all levels of society. In the long term, National GIS is envisioned to build national capability in GI and enable India to maintain global leadership in GI. India has vast experience in mapping and GIS—systematic mapping has been carried out for more than 200 years; remote-sensing images have been used for the past 40 years, and GIS technology has been used for almost 30 years. India has realized that the true power of GIS can only be realized when GIS is embedded within governance and taken to every citizen.

AN: What is the significance of National GIS now?

Rao: First, as a nation, we are witnessing tremendous progress, and our economy will grow significantly in the coming 5 to 10 years. With such growth, society will demand very high efficiency in governance and quality services, and the government will depend on very efficient, guaranteed methods of nation building and bringing equity in quality of life for people—doing so with transparency, speed, and compassion. Immense amounts of analytics will be called for. Support data/information systems have to be ready to use and no longer limited by the need to start getting organized. As demand on governance is becoming anticipative and futuristic, the decision process must always be a step ahead of the people's demand. Similarly, democracy demands inclusiveness, and thus citizens must be able to participate in and judge every development option/decision or even demand specific development needs—this, too, National GIS should be able to provide. Thus, National GIS will not only improve the efficiency of governance but also enable citizens to participate in the development process.

AN: How is this different from GIS in India today?

Rao: I think the key differentiator is the shift from a data generators drive to a user demand or national needs drive. Meeting what the user needs (or what the nation wants) is the supreme goal rather than providing only what is available—most times, data generators seem to be driven by what technology can offer or make available, whereas user needs require ready-to-use authoritative GIS data; therefore, a wide gap emerges between these two ends. Thus, even though the nation has a long history of surveying and mapping, years of imaging, and many years of GIS project activities, the usage of images/maps/GIS has yet to be impactful and meaningful to grassroots levels. Until such GIS-ready and user-specific data for the whole nation is easily available, how can a user or governance mechanism or citizen make the best use of GIS technology in decision making, and how can citizens be really empowered? National GIS would bridge this wide gap and ensure that GIS-ready data that is regularly updated as users require is made available.

Another differentiator is in the shift toward a mandated, organizational structure for National GIS and the shift away from just doing GIS projects—thereby critically aligning the existing multifarious remote-sensing and GIS activities to this national goal. Over the past 20–30 years, many GIS projects have been carried out by quite a few organizations—thus, while projects have been completed, these are contributing less to effective and efficient use in decision making and becoming part and parcel of good governance. We have realized that simply doing GIS projects is not leading us to this goal, and we need an organizational mandate at the national level—that way, GIS will get the responsibility and also bring accountability. To this important shift, the visualization of the Indian National GIS Organization is something critical, important, and unique.

AN: What are the challenges for National GIS?

Rao: The biggest challenge is already behind us; that is, getting the concept debated/discussed and endorsed. This has happened very efficiently, thanks to the Planning Commission's efforts. Almost all ministries (in central and states), GIS industries, GIS academia, etc., have been consulted, and a wide range of discussions have taken place. This first round of consultations led to the vision document for National GIS (in October 2011). Even after the vision document was prepared, the Indian government has undertaken another round of in-depth consultation for programmatic and financial approvals. Now, National GIS has been marked down as a new initiative in the Twelfth Five Year Plan. As I gather, the last round of processing is in its final stage of approval by the Indian Cabinet. So, I think, now the issue is not what National GIS is or whether National GIS is required but when National GIS will become operational.

Workwise, there are many challenges, but none of these are insurmountable. Technically, one challenge is organizing the National GIS asset that is seamless, nationwide, and GIS ready. Getting almost 41 parameters of data organized into a national spatial frame is a challenge—India still does not have an authoritative spatial foundation framework, and this will have to be organized for the first time. Similarly, bringing in myriad sets of available survey data, maps, images, tabular development data with geotagging, cadastral data, etc., is also going to be a challenge—a voluminous challenge! Designing and developing a data updating cycle and creating a GIS warehouse for timeline GIS assets will also be important. Even as the GIS asset is organized for the first time, the importance of updating existing content, adding more content, and keeping the GIS asset live and updated will become a prime goal.

At the same time, creating an environment for the widest usage of GIS applications is yet another challenge—especially considering the wide variety of user ministry (at central and state levels) and citizen needs that will have to be met from a GIS perspective. Thus, a culture of National GIS apps has to be developed and positioned. Similarly, establishment of the GIS infrastructure and systems has to be undertaken.

There would be critical policy, access, and licensing issues that would have to be positioned. Already, some thought has been given to the GI policy (through a study undertaken by the National Institute of Advanced Studies), and tenets for a national GI policy have been worked out. Human resource development in states, central government, and citizens at large will also be important, and program elements for these have been defined in a report being prepared by the Ministry of Human Resources Development.

What will be also challenging (and proof of success) is to make all these elements work in tandem and establish an operational framework by which GIS data and GIS application services become a reality and for National GIS to be firmly embedded in the nation's information and governance regime.

AN: What about policy needs? You have also been associated with the GI policy study.

Rao: National GIS will need innovative policy instruments that are quite different from those available today in the five individual policies. Policy has to be determined in an analytical manner—defining the long-term "GIS ecosystem" goals and short-term achievements. Such an overarching GI policy should not only operationalize National GIS (in the short term) but also enable national GI excellence, industry participation, academic emphasis on GIS, and the nation's commitment to citizens for GIS. In a study undertaken in India, we have prepared a comprehensive, first-of-its-kind policy report that includes a draft of the national GI policy (**www.nias.res.in/docs/R11-2012-GI-Policy.pdf**). The report has already been submitted to the government and is a major input for positioning National GIS.

AN: What about the Karnataka GIS?

Rao: When we completed the visioning of National GIS in October 2011, it was recognized that the success of National GIS will be exponential if states' GIS needs are also met; after all, states are a more direct mechanism for delivering governance and are directly closer to citizens. So, thanks to the government of Karnataka, we took up a task force study to logically drill down National GIS to a state requirement study. We conducted state-level discussions and workshops and stakeholder/user meetings and determined that states' needs would be much greater and quite different than what would be required in a national GIS. The GIS data needs comprise almost 60 parameters, and most of the GIS applications need to be linked to cadastres—that becomes very important at the state level.

What we also see happening is that if state GIS programs are organized, they not only achieve some key goals of National GIS but also trigger a set of GIS apps at the state level—thus, Karnataka GIS (and other state GIS programs) can become vehicles for quickly and systematically organizing an aligned GIS that not only serves state-level governance and citizen needs but also integrates well into National GIS. Many other states are also being primed to align their GIS tasks into the National GIS system. Now, with the vision of National GIS and the Karnataka GIS, we understand what it will mean to develop state systems and how the dovetailing to National GIS would happen. Now, we see a GIS system of systems—meeting state and central governments, citizen, and enterprise needs.

AN: What about schedule and budget and official sanctions?

Rao: National GIS is now part of India's Twelfth Five Year Plan. The proposal is to deploy National GIS in two stages and complete the establishment process (with many GIS data and app services also rolled out) in about three to five years—after which the operations and maintenance phase would be undertaken. As I said earlier, all the groundwork is now done, including financial approvals, and it is just the last step of cabinet approval that must be accomplished. Within the state of Karnataka, the schedule for Karnataka GIS is about two years, and here, too, the state-level processing is in its final stage.

Budgetwise, I can only say that, as the government of India (and state governments) is determined to implement National GIS, budget would not be an issue—especially for such a well-developed program that has endorsement at all levels.

Like many in India, I am keenly looking forward to National GIS becoming one core element of the development process and for GIS to be firmly embedded in every governance process and for empowering every citizen of India.

For more information, contact Dr. Mukund Rao (e-mail: mukund.k.rao@gmail.com).

A NATIONAL GIS
BENEFITING INDIA

LEADING TO INCLUSIVE GROWTH & PROSPERITY |
DEMOGRAPHIC DIVIDENDS | EXPEDITED DEVELOPMENT | REDUCED DISPARITY

State GIS to power development and citizen engagement

KARNATAKA

1980
- Early GIS Experimentation
- First Indian Remote-Sensing Satellite

1990
- Small-Area GIS Experimental Projects
- Systematic Large-Area GIS Application Projects
- District/State Small-Scale GIS NRIS/NRDMS
- National Spatial Data Infrastructure Strategy

2000
- Comprehensive RS and GIS Standards NRIS, NSDI, NNRMS
- Ideation of National GIS: Focus on GIS Content/Apps
- Concept of N GIS/Content fo and Citizen En
- Visio Proposal Gr

National GI Policy

GIS to power governance and enterprises and empower citizens

INFORMATION
the FOURTH PILLAR
of DEMOCRACY

EXECUTIVE LEGISLATURE JUDICIARY INFORMATION

The Future of Governance

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2011
National GIS Program:
Part of 5-Year Plan
Government of India

2012
…on of National GIS:
…for INGO National Core
…roup Committee

National GI Policy
Project Report

2013
State-GIS Definition:
Vision of Karnataka GIS

Government Approvals and
National GIS Mission Definition

2014 – 17
National GIS:
V.1 GIS Asset / Limited
App Services (2014)
V.2 Full-Scale Content, 25 – 30
GIS App Services (2017)

Establishment of Indian National
GIS Organization (INGO)

2018
Maintenance, Updating
and Operations of
National GIS by INGO

2018 –