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Empowering India through Geospatial Technologies

Select Stories

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Compiled by:

Gateway Media Private Limited
Omer Ahmed Siddiqui
Associate Editor - Geospatial Today

FICCI
Suchismita Mukhopadhyay, Senior Assistant Director
Gaurav Gaur, Assistant Director

Edited by:

Omer Ahmed Siddiqui
Associate Editor - Geospatial Today
Gateway Media Private Limited

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All editorial and marketing queries should be addressed to:

Ramprasad
Editor-in-Chief and Publisher

Gateway Media Pvt. Ltd.
#407, 5th Floor, Pavani Plaza, Kharitabad
Hyderabad 500004

Tel : +91 40 2330 0061, 2330 0626
Fax : +91 40 2330 0665
Email : ramprasad@gatewaymedia.in

www.geospatialtoday.com

Sumeet Gupta
Director

Federation of Indian Chambers of Commerce & Industry (FICCI)
Federation House, Tansen Marg
New Delhi 110 001

Tel : +91-11-23736306 (D), 23738760-70 Ext: 515
Fax : +91-11-23765333, +91-11-23320714
Email : sumeet.gupta@ficci.com

www.ficci.com

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FOREWORD



Mainstreaming geospatial technology has been a hot topic for more than a decade now. This technology did not become popular to the expected levels due to technical challenges as well as difficulties in obtaining economies of scale. Started as a specialised technology, it's journey into mainstream began when it became dependent on general IT solutions and with location becoming an increasingly important attribute in carrying out transactions.

Today, geospatial technology applications have become more pervasive impacting everyday life. The utility of this technology has caught the attention of the masses - be it through Google maps or geo-enabled social networks. Complex GIS applications are being developed and consumed by common man during emergencies, while businesses are realising efficiencies in using the technology right from planning strategies to analysing results.

Economies of scale that are required to bring geospatial technology to mainstream began with huge national projects like Re-structured Accelerated Power Development and Reform Programme (R-APDRP), Jawaharlal Nehru National Urban Renewal Mission (JNNURM) and Rajiv Awas Yojana(RAY), where this technology was one of the key enabler.

These projects galvanised the geospatial industry to provide the best of services and solutions. Similarly, major geospatial applications started to help enabling municipalities in enhancing revenue collection, managing natural resources, biodiversity conservation and providing better citizen services.

Much anticipated National GIS eventually shall enable easy data access, promote transparency in functioning of public bodies and embed the technology into the fabric of governance. Despite not having a killer mass application, geospatial technology continues to gain ground and spread its benefits across different verticals.

As a responsible publication, Geospatial Today has always been at the forefront in demystifying the technology to users. In this book, we have compiled select stories of success depicting interesting technology applications and innovations that demonstrate faith in geospatial solutions.

We sincerely hope this book will be both inspirational and insightful for all geospatial enthusiasts.

We are delighted to be associated with this work and would like to thank FICCI for giving us this opportunity.

Ramprasad
Editor-in-Chief and Publisher
Gateway Media

FOREWORD



Technological advancement is a key driver for economic growth and sustainable development. Geospatial technologies with proven capabilities for supporting decision making can effectively support governance, enable sustainable development, assist in better management of business process as well as bring location based information closer to the people. As India endeavours to achieve its developmental goals, the multifaceted and specialised capabilities offered by geospatial technologies will play a defining role for information management in future with applications of great social and national significance.

In the year 2012-13, "Mainstreaming geospatial technologies for effective decision making and better governance" has been the beacon for FICCI's initiatives in the geospatial technologies vertical. *Empowering India through Geospatial Technologies - Select Stories* is an outcome of the joint efforts of FICCI and Geospatial Today to propagate the mainstreaming of this technology. It is a compilation of Indian case studies of successful applications of geospatial technologies, and showcases their immense potential as a tool for planning and management of resources by diverse stakeholders.

I am confident that this publication will be a catalyst for widespread adoption of geospatial technologies by Central government, state governments as well as businesses across sectors in India.

A. Didar Singh
Secretary General
FICCI

INTRODUCTION

FICCI and Geospatial Today are pleased to present the first edition of this unique publication ***Empowering India through Geospatial Technologies: Select Stories.***

With the larger vision of facilitating mainstreaming and widespread adoption of this technology for planning and development, this publication aims to serve as an information bank for potential end-users to gain from the experiences of successful applications by other individuals and organisations.

This publication is a compilation of articles/case studies of successful applications of geospatial technologies for decision-making and governance across sectors in India. The publication captures over 40 success stories depicting the utility of geospatial technologies for achieving varied deliverables in different sectors. An attempt has been made to provide a holistic understanding of various applications across sectors such as governance, municipality, infrastructure, natural resources & agriculture, disaster management, security, FMCG, banking etc. Most of the articles / case studies are previously published in ***Geospatial Today***, while some are unpublished work spanning over last two years.

Geospatial technologies enable generation of cost effective, timely and reliable information in spatial as well as temporal domain. This information can be utilised for regional to micro level management of resources and developmental planning. Owing to their multifarious capabilities, geospatial technologies stand proven as an effective administrative and management tool for decision making in diverse sectors.

We hope that this publication will provide fillip towards enhanced usage of geospatial technologies in India.

MAINSTREAMING GEOSPATIAL TECHNOLOGIES IN INDIA

As India progresses towards high industrialization and technological advancement, decision-makers will continue to face several challenges for effective governance such as rapid growth in population, environmental concerns, resource shortages and security issues. India will require an efficient and advanced information and knowledge regime to brace itself for the envisaged economic growth. Geospatial technologies, with their unique ability for acquisition, integration and analysis of geographically-referenced spatial information, have in recent times been recognised as an effective tool for planning, management and decision making locally and globally. Among various other technologies, geospatial technologies with proven capabilities for supporting decision-making would be fundamental for information management in future with applications of social and national significance.

Geographic information has application in practically all walks of human existence. This technology is therefore relevant to a multitude of sectors such as agriculture, telecommunications, oil & gas, environmental management, forestry, public safety, infrastructure, logistics etc. The common perception regarding the utility of Geographic information Systems (GIS) is in the form of web applications that are used for maps and directions, but these tools have several features which go beyond location based services. Geospatial technologies as a tool for decision-making can add immense value to planning and development. This multifaceted technology can effectively support governance, enable sustainable development, assist in better management of business process as well as bring location based information closer to people.

In the present economic scenario, there is an increasing demand for cost effective solutions for decision-making which is likely to propel the usage of this technology across sectors in the near future. According to the Indian Geospatial Market Report 2009, the market for GIS based technologies has been expanding at such a substantial pace that it is estimated to touch the figure of USD 10 billion by 2019. Geospatial sector is now a full-fledged industry in itself and not a niche area of IT. Major IT companies have started dedicated practices in geospatial technologies. GIS is the core platform of many critical infrastructure and development projects worldwide and serves as a valuable tool for civil society. Businesses today are increasingly adding a spatial dimension to data to help make critical decisions. Enterprises seeking geospatial solutions are not restricted to geospatial companies but also potential end-users that can utilise data for planning and management.

India offers several advantages which enhance the prospects for this industry manifold. The Government has whole heartedly accepted this technology as being pivotal in facilitating good

governance. State government departments are more aware with respect to the benefits and are gradually emerging as the major users. India is recognised for its IT skills and space programmes. It offers good infrastructure and expertise for collection of geospatial data. Players in this domain are already providing solutions to several end-users thus propagating the utility of the technology. Several trans-national companies have outsourced their operations to India in order to harness the significant technical expertise in the geospatial sector. Large numbers of institutions in the country provide courses in geospatial technology and applications to sustain technically sound human resource base.

The geospatial industry is presently witnessing tremendous opportunity within the country as the government has initiated reform projects in several infrastructure segments like rural development, power, land and natural resources and mandated the use of geospatial technologies in these projects. There are various other fields such as, schemes for construction and maintenance of roads, railways and waterways, civil aviation, public utility services, education, health, command area development, flood management programme, flood control, urban renewal, urban water supply, rural water supply, Integrated Watershed Management Programme (IWMP) etc. that essentially use geospatial tools and technologies for spatial planning, management and decision-making.

As the country attains new milestones in industrial and economic growth, there is an intense ongoing debate on development versus environment. In this context, geospatial technology is perhaps the only technology that can provide a holistic approach to the understanding of the interactions and inter-linkages between the earth's biophysical and social elements to strike an optimal balance between developmental and environmental goals. Modern information technology has also greatly enabled complex and advanced mathematical analysis and modelling to devise management plans for natural resource conservation as well as environmentally sound economic development, while considerably economising on time and cost invested in collection, physical storage and manual processing of data. Ongoing advances in GIS functionality and the convergence of network computing and wireless communications with geospatial technologies are expected to further unleash the hitherto untapped potential for applications in development planning.

Geographical information is a ubiquitous part of the governance. The primary role of Governments is decision making in public interest which involves geographically related issues, therefore, GIS can play a critical role in all spheres of good governance. Several local governments have now come to depend on geospatial technologies to not only organise and manage spatial data, but also for dissemination of information and services to citizens. In India, this technology is being used extensively for forest mapping, ground water survey, ocean productivity, environmental impact, land and water management, and disaster management. It is gradually being used for infrastructure inventory, transportation route planning and improved public service delivery by few state governments and departments. Slowly and steadily new frontiers for the usage of geospatial technologies for governance

are also being explored in India. Few of the newer applications are in tax collection, property assessment, housing, rural employment schemes, local level planning, checking encroachments, tourism and urban planning including water supply and sewerage.

However, despite the acceptability that this technology has found amongst different stakeholders and end-users in India, the benefits of this technology are yet to go beyond specific projects to find applicability within the entire gamut of governance, decision-making and nation-building. In relation to the development happening in the country the actual demand for the application of geospatial technology domestically is far from adequate. The awareness and acceptance of the technology has not actually translated into sustained domestic demand for geospatial solutions from prospective end-users. This has somewhat deterred the growth of geospatial industry in India. No doubt, the technology is being used for various applications, but only in segregated pockets and not across the board. It still remains to be incorporated as an indispensable tool for decision-making in business and government. Several potential sectors are yet to adopt the technology and make optimal use of its huge potential for better and cost-effective planning and management. It continues to be seen as a niche technology requiring huge investment and specific expertise leading to an aversion to adopt geospatial tools. The long terms benefits such as economy of time, effort, resources and cost for data collection and analysis are often not understood by the end-users.

In order to mainstream geospatial technologies for better governance and business operations in India, it is imperative to address the factors that are presently hindering the domestic demand for solutions:

- Access to comprehensive data is an important issue to be addressed. Users would require complete data in a convenient format for greater coverage. The data has to go beyond niche applications to mainstream applications for wider outreach.
- Policies and planning for geospatial projects being implemented by the Government is not adequate in certain potential sectors.
- Research outputs are usually stand-alone and there is a lack of unanimity. The results are therefore not getting streamlined for development planning and do not conform to specific requirements of departments. There is a duplication of efforts resulting in multiple sets of non-standardised data being generated at several institutions which eventually remain unutilised.
- Government departments are averse to creating internal capacities within departments resulting in a gap in understanding of processes. The utility of this technology therefore does not percolate within the department leading to a lack of awareness regarding the benefits.
- There is a need to apprise senior administrators and executives regarding the technology to enable the mainstreaming of this technology in development projects initiated by departments.

- As we move from niche to mainstream application of geospatial technologies, the requirement of data would also increase manifold. There will be requirement for more technically trained human resource to meet the growing demand for geospatial solutions at varying levels of detail. Generation of skilled manpower and adequate education/ training for geospatial technologies in line with the practical requirements of industry is also a huge gap area that needs to be addressed.
- Geospatial companies would need to respond to the requirements of the end-users who may not have the technical expertise to understand or use the technology. GIS applications, solutions and interfaces must therefore be easy-to-use, tailor-made and familiar to these users. In case of location based services, it will also help to create applications that can run on multiple devices.

With the unprecedented pace of economic development witnessed in the country, the demand for accurate and up-to-date maps and use of geospatial products has increased exponentially. Considering the capabilities of this technology for multifarious applications, it is apparent that it will not only power future businesses but will also become a formidable driving force for the global economy in the coming decades. The Government of India proposes to set-up a National GIS that would benefit governance and areas of national security and strategic applications. It will also help enterprises to take better technical solutions in support of their activities. India needs to build upon the existing policy initiatives to shape an integrated GI Policy that will further National GIS and will be most conducive for the growth of GIS technology and its applications. We need enhanced inter-sectoral efforts to bring out the geospatial information in the public domain from a business perspective. The need is for the public and private domains to join hands for the development of a mutually conducive and innovative environment for mainstreaming geospatial technology in India.

Indian geospatial industry is in a progressive mode and can make rapid growth with adequate support and encouragement from the Government by way of the right policies, incentives and initiatives. Well articulated policy mechanisms, government support and increasing domestic demand would help popularise geospatial technology in India and bring it into the mainstream as an aid for effective governance and developmental planning.

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Governance



State SDI on a roll

Summary:

With growing awareness on the potential applications of geospatial technology in planning and development, various states across India have embarked on developing Spatial Data Infrastructure (SDI). SDI provides a base for the aggregation, evaluation, and application of spatial data for users within all levels of government, NGOs, private sector and citizens. With high resolution data on hand, never been has it so easy to promote decentralised planning and problem solving at local and community levels than now.

The Karnataka Geoportal that was recently launched in the NSDI-9 meet held at Pune boasts of answering queries in more than 800 fields; Delhi State Spatial Data Infrastructure (DSSDI) with 337 features claims to be a one-stop shop for all geospatial data; Gujarat has made great headway having completed the municipal databases of 189 municipalities; Haryana has just about planned its foray by listing all the features of its geoportal; and Kerala is not far away from coming up with one by August this year. So, what can one make of this enthusiasm? Is it just a fad? Is it a sudden urge for SDI or one state after the other merely joining the bandwagon? It is neither a fad nor an adrenal rush, the eagerness is genuine and there seems to be a realisation for developing core spatial datasets at the state level.

New found enthusiasm

The last few years have seen a spurt of activity and it can be attributed to many reasons. The awareness levels have risen appreciably and government officials have taken cognizance of the potential of spatial data in planning and monitoring programmes. Increasing number of young tech-savvy officers are playing their part. And above all, the Natural Resources Data Management System (NRDMS) programme has created awareness to unprecedented levels. The frequent district level workshops too have played a vital role in the increasing interest in SDI . Decision makers and planners are regularly interacting with NRDMS centres for planning and managing developmental activities like rural drinking water supply; rural resource and infrastructure location/

allocation; watershed; resource and infrastructure mapping for gram panchayats; disaster management; election information system; and urban infrastructure management. The collection of geographic data at different scales on a variety of themes would serve several users. The need for state SDI is growing because it provides a base for the aggregation, evaluation, and application of spatial data for users and providers within all levels of government, NGOs, private sector and citizens. It goes a long way in decentralised planning. With the availability of high-resolution data, solving problems at the local and community level becomes easy.

Off the block

Of the many states that are going for SDI, Delhi and Karnataka have been off the block quite fast. Karnataka Geoportal will initially be used on an experimental basis for providing access to spatial data/ metadata sets currently held by Karnataka State Council for Science & Technology (KSCST) at different District Database Centres set up under NRDMS. These services will be extended to beneficiaries of various developmental schemes/programmes and the general public with certain restrictions under provisions of the prevailing rules and regulations of the Government of India. Other organisations/ agencies will in due course be invited to share their data/ metadata sets held or provided by them by publishing their details in the geoportal/ clearinghouse.

H Hemanth Kumar, Principal Investigator, NRDMS, KSCST, says, "District NRDMS centre provides geospatial services to users through independent systems. This federated method meant that data could not easily be shared between other systems within the state. Recognising the power of centralisation, the Karnataka State Spatial Data Infrastructure (KSSDI) was planned to be an Internet-based geospatial data directory for the entire state."

The geoportal aims to be a centralised hub and single-window access mechanism to assist users discovering geospatial datasets. This ultimately will be useful in local planning initiatives across the state. This gateway will facilitate various data generating agencies to share information across government, scientific organisations and industry.

The first phase of the Karnataka State Spatial Data Infrastructure (KSSDI) project is already underway; user acceptance testing is in progress. Clearinghouse data published through portal includes spatial data with attributes for political and administrative boundaries, state geography, demography, agriculture, economy, resources and infrastructure. The plan is to publish both raster and vector data, but in the beginning, the majority of available data will be vectors stored and served

from RDBMS. For imagery provision, the KSSDI will initially be supported by integration of Google Maps into the portal.

The purpose of the portal apart from data sharing is also to build applications for the users. It will benefit when high-resolution datasets are made available to the planners along with multilingual facility. In the future, the goal is to extend the portal to support online updation and data sales, which will ultimately contribute to state planning and development.

If Karnataka has taken off, Delhi has gone a step further. It has the unique distinction of providing digital details of assets of the capital. DSSDI promises a vision for urban planning. Digital data will now identify exact locations on which various facilities such as schools and hospitals can be built. What's more, the portal has information on physical mapping of the city including underground lines. Utilities like water, sewer, telephone and power lines are now mapped and available on the portal. The information is made available to over 30 departments of the government.

Taking a cue from its neighbour Delhi, is Haryana. Haryana Spatial Data Infrastructure (HSDI) is being planned and is in a formative stage. Haryana Space Applications Centre (HARSAC) has been identified as the nodal agency for the development of HSDI. The project is expected to be completed in two years. "The data would be made available initially to all the authorised users of Haryana government departments through the SWAN network developed in the state up to the block level. Data sharing policy to the general public and private agencies is yet to be decided by the government," says Dr R S Hooda, Chief Scientist, HRSAC. Down south, Kerala government has geared up its activities to set up an SDI to coordinate the activities of the state. State level Geo-portals and Clearinghouses are being set up by Kerala and, the North Easter Region covering all the eight States. Various other State Governments may consider setting up Geo-portals and Clearinghouses based on Karnataka/ West Bengal models.

Issues

Top-down or bottom-up approach

Ron Lake once said, "I have a problem with the word 'data'... no one knows what it means. Most SDIs in the world are focussed nationally. I think that's upside down." His idea has many takers. If anything symbolises the power of spatial data is its use at district and panchayat levels. So how do states measure up? H Hemanth Kumar avers, "From our experience we feel that it is necessary to have district spatial data centre before attempting to create spatial data infrastructure in any state." The same sentiment was echoed by Salil Das, Head, Innovative Projects, People's Science Institute, Dehradun, when he said, "Spatial data at panchayat level must be developed by every state. It will be a very useful tool in planning and monitoring government programmes like NREGA. It will ensure

better planning of infrastructure and government services. Apart from state and district administration, panchayats can use this infrastructure for planning development works in their panchayats." Perhaps the same logic is dictating the formation of a Village Information System (VIS) developed by the People's Science Institute, Dehradun, giving 175 parameters for all the villages of the state in addition to that of Himachal Pradesh, Uttarakhand and UP. What seems ideal is a good mix of top-down and down-up approaches.

Issue of duplication

Duplication is an issue that all state governments have to grapple with. Dr Ajay Kumar, IT Secretary, Government of Kerala, sums it up nicely, "Several organisations have generated data over the years; this has resulted in duplication of work." Duplication happens due to the lack of information and a system for monitoring. H Hemanth Kumar says, "We expect Karnataka Geoportal to look into all such issues by providing a single window access mechanism for both data providers and data users. We plan for a high-level committee constituted under this project to look into all such issues." Synergy among data producers is the need of the hour and will go a long way in avoiding duplication. At the state level, there are more data users than data providers. Maj Gen (Dr) R Siva Kumar, CEO, NSDI advices states to have a high level committee (See interview). States may be generating data but in their eagerness and due to lack of coordination among departments duplication is overlooked.

Demand for data

Data needs to be demand-driven and that will happen when states start providing data for district, village and local level. When planners start using the data and see value in it, the demand will automatically increase. Another area that will propel the demand is when information is given to people in their own language. Few states have spatial data but do not use it to the full potential. States are beginning to develop and use spatial data and this realisation is spreading among officers. Lack of involvement of real end users, however, is a concern.

Issue of interoperability

Organisations follow different standards and this restricts usage to a great extent. As metadata is not available at a central platform, users do not get to know about the quality of data and ways and means to access it. Also, users have no place to access the data as there is no mechanism in place. As different departments and organisations adapt various standards in terms of scale, formats and quality, it becomes even more difficult for the user. To avoid these issues, a single standard has to be specified and all available data has to be converted into an interoperable format.

"Village Development Officers/ Tehsildars should be appropriately equipped with hand-held GPS/ data acquisition tools to help acquire relevant spatial data sets."



Maj Gen (Dr) R Siva Kumar
CEO-NSDI, Head-NRDMS

WHAT IS NSDI's ROLE IN STATE SDIs AND IN THE PROMOTION OF SUCH ACTIVITY?

NSDI encourages states to develop SDI. Each state is dynamic and has its own method of developing SDI. Different states have different types of data sets. In the case of Karnataka, NRDMS had created a district data centre; subsequently, the state government came forward and extended it to all the 24 districts. Karnataka was encouraged for an OGC-based Web Map Service (WMS), Web Feature Service (WFS) and Web Coverage Service (WCS). West Bengal is another state that has come forward. State-level geoportals and clearinghouses are being set up by Kerala and all the eight states in the Northeastern Region. Various other state governments may consider setting up geoportals and clearinghouses based on Karnataka/ West Bengal models.

WHAT ADVICE WOULD YOU GIVE TO STATE SDIs IN MATTERS OF DUPLICATION AND STANDARDS?

The creation of metadata is important as it would answer all questions relating to resolution, accuracy and details of data sets and the redundancy part would be taken care of. A national NSDI metadata standard is available, which is in concurrence with international standard such as OGC. There are kits for exporting in GML format in tune with international standards and interoperable issues are minimised. States need to adopt standards laid out by NSDI or OGC. Vendors need to be educated and insisted on the use of standards.

WHAT IS YOUR TAKE ON PPP IN DEVELOPING STATE SDI?

There is a value to the data and people are recognising this. People would like to pay for what is provided. Industry has to develop a revenue model. Data being the equity of the government there is a possibility for a PPP model. The industry needs to be more active rather than limit itself to supplying equipment, providing software and developing solutions. Investment in geoportals will go a long way.

HOW CAN WE CREATE DEMAND FOR THE USE OF SPATIAL DATA AS THE AWARENESS LEVELS AT THE LOCAL AND DISTRICT LEVELS ARE LOW?

District spatial data centres have proven to be very useful in many applications such as policing, conduct of elections and disaster management. Village Development Officers/ Tehsildars should be appropriately equipped with hand-held GPS/ data acquisition tools to help acquire relevant spatial data sets. Capacity of all the concerned stakeholders like elected representatives, officials at different levels of the hierarchy, surveyors, scientists, and professionals should be adequately built for this purpose. The local administration and people should come forward and maintain data. A recent example of a successful district geoportal is Prakasam in Andhra Pradesh.

IS THERE A WAY FOR MAKING IT MANDATORY FOR STATE DEPARTMENTS TO SHARE DATA?

There is a precedent in the cases of NSDI, Delhi and Karnataka. Standardised data collection and data sharing will help. The way forward would be to create a group of people comprising all concerned stakeholders to create a committee that meets in every six months and gives directions to all line departments.

The route to take

Some states have just launched their geoportals, others are on the verge and a few are in conceptual stage. There are lessons for the states that aspire to go for SDI like how to avoid duplication, form high level committees, bring stakeholders together, monitor line departments, generate demand for data and create standards. Maj Gen (Dr) R Siva Kumar points out that someone needs to champion the cause, create consensus among departments and take the concept to reality. Ultimately, an SDI is for the development of the society. Dr K Kasturirangan, Member (Science) Planning Commission and former Chairman, ISRO once said, "Make data that is required for decision-making available to the right person who needs it, at the right time, and for addressing a rightful need. This is NSDI's goal." This holds true for state SDIs as well.

Development of SDI for Almora district

During the period 2003-2005, SDI for district Almora was prepared in association with different line departments as per their needs. The SDI developed for district Almora includes GIS (Geographic Information System) of 13 different road types, GIS of villages for disaster management, GIS of education (from primary schools to university campuses) and health centres (from ANM centres to base hospitals), Police GIS, Election GIS, GIS of panchyat ghars and post offices, GIS of streams and rivers, GIS of spring sanctuaries for groundwater augmentation, GIS of landuse pattern and forest GIS etc.

Kumaun University with financial and technical support of Department of Science & Technology, Government of India, established a Centre of Excellence for NRDMS in Uttarakhand in 2009. Presently, this Centre conducts two-year Masters Degree Programme in Geographic Information Science and Technology (GIST) in which currently 60 students of 10 different states (Uttarakhand, Delhi, Haryana, Himachal Pradesh, Bihar, Maharashtra, West Bengal, Sikkim, Assam and Manipur) are enrolled; and is conducting different research programmes to develop SDI for Uttarakhand as per needs of the stakeholders of local level planning/administration.



Casing the coastline

Summary:
India has a vast coastline stretching to about 7,500 km with 77 cities/towns located along it, including very important commercial hubs such as Mumbai, Kolkata, Cochin, Chennai and Visakhapatanam. The Ministry of Environment and Forests has initiated the Integrated Coastal Zone Management (ICZM) project with the aim of capacity building of communities living near the coast, mapping and demarcation of hazard lines, wetland conservation, pollution control, anti-sea erosion and promoting economic activity.

East Bengal's New Moore Island for which India and Bangladesh argued for decades has gone underwater. The fate that Moore Island suffered may not befall other islands if the recently announced Integrated Coastal Zone Management (ICZM) project gets underway. Way back in 2005, Swaminathan Committee had recommended for reforms for the development of coastal areas. Though the project was in the dock for quite some time, the recent approval from the Cabinet Committee on Economic Affairs (CCEA) for Rs 1,156-crore World Bank assisted project has come as a shot in the arm. India with a vast coastline stretching to about 7,500 km (of which the mainland itself accounts for 5,400 km, Lakshadweep 132 km and Andaman & Nicobar Islands 1,900 km) forms an important economic zone and has lot at stake. With 77 cities that lie on the coastline including some very important commercial port towns and cities such as Mumbai, Kolkata, Cochin, Chennai and Visakhapatanam, the ICZM project comes as a welcome relief.

It is expected to benefit millions as it aims at capacity building of communities living near the coast. Other activities of the project such as the mapping and demarcation of hazard lines, wetland conservation activities, pollution control and anti-sea erosion measures will go a long way in mitigation measures. ICZM will cover over 6 crore people who live in coastal areas and will be implemented over the next five years by the Ministry of Environment and Forests.

With the Asian Development Bank supporting shoreline management projects in Karnataka, Maharashtra and Goa, the ICZM project in its initial

phase will focus on Gujarat, Orissa and West Bengal. These states are chosen on parameters such as pressure on coast, the state of the ecosystem and the risk of hazards that these areas face. West Bengal has been allotted Rs 301 crore, Orissa Rs 201 crore and Gujarat Rs 286 crore. In the second phase, states such as Maharashtra, Goa, Karnataka, Kerala, Tamil Nadu and Andhra Pradesh will be taken up.

Integrated Coastal Zone Management Project		
Cost	:	₹1,156 crore
Time Frame	:	Five years
World Bank Assistance	:	₹897 crore
Technology	:	Hazard mapping survey to be done with aerial photography and satellites
Four Components	:	Capacity building activities (mapping delineation and demarcation of hazard lines and delineation of coastal sediment cells along the mainland coast of India.) Mapping delineation and demarcation of environmentally-sensitive areas (Identification and demarcation of coastal fragile areas like mangroves, brackish water, wetlands, coral reefs etc.) Establishment of a National Centre for Sustainable Coastal Management at Anna University, Chennai (The centre will conduct research on various aspects of coastal management and would help in advising the Ministry on policy issues.) Nation-wide training programme for coastal zone management It will develop capacity and institutions to take measures to make the coast strong against environmental and terror attacks. Demarcation of hazard lines is one part of the mammoth project
Hazard mapping along the 7,500-km coastline will be carried out by Survey of India at a cost of Rs 125 crore.		

What is the 'hazard line?'

A hazard line is nothing but a line that broadly sums up the maximum distance a wave – both regular and tidal – can travel. The line would be drawn keeping factors like the change in the shoreline, sea level rise, distance of waves travelled over a period of time and seasons etc.

Once the line is drawn, people who live in the hazard-prone areas would be sensitised of the lurking danger and may be relocated as well. In the past various state governments gave permission for commercial activities bereft of the knowledge of the hazard line, but with the completion of this project all that is going to change. Activities such as tourism, hospitality sector, coastal communities, port development and the like will have clear guidelines based on the hazard line. A 'hazard line' for the 7,500 km coastline would be made. Survey of India would undertake hazard mapping using aerial surveys and satellite imageries and it proposes to complete the work at a cost of Rs 125 crore.

According to sources at Survey of India, an MOU is to be signed with the Ministry of Environment and Forests and a plan of action would be chalked out. A realistic time frame for the completion of the mapping exercise would be anywhere between four to five years. Keeping the size of the project in mind, a lot of ancillary work would be outsourced to private companies, say our sources.

Bearing on other industries

The mapping work that would be taken up will have a bearing on other industry – the maritime sector; a major chunk of the infrastructure in maritime sector and petroleum industry is located on the coastline. With 197 ports, 308 large-scale industrial units, the ICZM project if completed in the stipulated time will help the maritime industry to leap frog to the next level as the government plans to increase the number of ports and their handling capacity. Earlier, the government proposed a Rs 57,728-crore plan for the development of major ports and to increase their handling capacity to more than 860 million tonnes. Once the mapping is done, it will be able to provide guidelines to governments about the areas that are prone to high erosion (above one metre a year), within 10 km on either side of eco-sensitive areas. Based on the findings and appropriate modelling studies, sites for new ports would be decided. Coastal fishing employs a million people full time, and the post-harvest fisheries sector employs another 1.2 million in about 3,000 fishing villages and over 2,000 fish landing centres.

With increasing natural calamities such as floods, flash floods, earth quakes, terror attacks and global warming taking its toll, the project is of high value. The ICZM project aims to work for the overall development of coastal zones through a range of activities: providing livelihood options for coastal communities; sensitising people who live in vulnerable areas; providing relocation options; protecting infrastructure; preservation of ecosystem; and helping governments to take measures to combat threats.

Somenath Bhattacharya, Senior Scientist, Institute of Environmental Studies & Wetland Management, (IESWM) and Deputy Director, ICZM project, says, "About US$ 5.2 million have been earmarked for ecological sensitive areas mapping and another US$ 0.5 million for coastal cell or geo-morphological mapping and this is the first of its kind work to be done in India."

He adds, "Temporal data is of great value and mapping vulnerable areas is of utmost importance as it would help in understanding the future locations of investments along the coast as well as help in framing adaptation mechanism for the areas likely to be affected by future sea level rise as predicted in scientific circles. On the other hand, the coastal cell mapping will help in understanding how the coast has evolved over a period of time and will go a long way in understanding how the sediments move from one place to another."



Mangroves: Lifeline to coasts

Mangrove forests have the potential to minimise damage during natural calamities as this was amply evident during the Aila cyclone in 2009 in West Bengal wherever there were mangroves the embankments were saved. But mangroves along the coast have been in danger and are depleting at a fast rate. After Aila, about 3,500 km long embankments in Sundarbans were greatly affected and most of them were destroyed. Mangroves stop soil erosion, allow deposition of sediments and shield the coast from high tides. The ICZM project intends to include identification of environmentally fragile areas and these areas would be classified as 'Critically Vulnerable Coastal Areas.' Sunderbans, home to about 50 lakh people with 70 tigers and more than 50 species of mangroves, is one such area of high priority. India and Bangladesh are to form a plan together to preserve the ecosystem that pans between their borders.

The use of satellite imagery

Satellite imagery is going to be used in the project in a big way say our sources. Satellite imagery of Sagar Island taken over a period of 1979, 1989 and 2003 clearly showed the role of mangroves; wherever there were mangroves, the destruction was less. And safe navigation

improved nautical charts; maps of coastal habitats of species all require cartography. About 37 per cent of the population in India lives along the coastline and the coast provides resources for a range of economic activities. Any calamity affects the people living here, impacts the food production, fish catch and the very lives of people. Satellite imagery is going to be used in a major way as researchers and scientists will need data for assessment and analysis for a variety of purposes like salinity, shoreline changes, bathymetry, soil moisture and potential threats to the coast. Assessments and predictive capabilities through satellite imagery from satellite sensors incorporated with GIS mapping are needed to predict onset of events that may significantly affect human health, critical wetlands and ecosystems, and economic development.

Critically Vulnerable Coastal Areas

As part of the project, areas that are prone to natural hazards would be identified and demarcation of coastal fragile zones like mangroves, brackish water, wetlands, coral reefs etc. would be given special treatment and appropriate measures would be taken to preserve and resurrect the areas. The areas that would be mapped and that come under critically vulnerable coastal areas are: Gulf of Kambatand, Gulf of Kutchchh, Malvan, Vasasi-Manori, Achra- Ratnagiri, Karwar and Coondapur, Vembanad, Bhaitarkanika and Chilka, Coringa, East Godhavari and Krishna, Sunderban, Pichwaram and Gulf of Mannar. The above areas fall in Gujarat, Maharashtra, Karnataka, Kerala, Orissa, Andhra Pradesh, West Bengal and Tamil Nadu. Apart from the areas in the above mentioned states, group of islands that are part of Lakshwadeep on the east and Andaman & Nicobar on the west of India too fall under critically vulnerable coastal areas.

Benefits

Mapping and demarcation of hazard lines is going to make a huge impact in the management of the Indian peninsula. Communities living in hazardous areas will be relocated to safer areas. Ecologically important areas with rich flora and fauna such as coral reefs, mangroves, wetlands etc. will come under critically vulnerable coastal areas giving them a special status and in the process pave the way for their protection. Capacity building of communities will enhance standard of living and overall about 6 crore people will benefit from the project. Way back in 1994 there was an attempt to map the coastal zone but did not materialise. One hopes that this time around it does.

A Centre for Sustainable Coastal Zone Management to be set up

A national centre for research on coastal zone management would be set up at Anna University in Chennai. The idea is to conduct research on various aspects related to coastal zone which would help the ministry in the long run with the findings. The prime focus of the centre would be to foresee viability of economic activities along coasts and how it would benefit the fishing community. Rs 166 crore is earmarked for the centre. M S Swaminathan, the eminent scientist will act as advisor to the centre.



Conserving the coastline

Summary:
India has a 7,500 km long coastline including 5,790 sq km of coral reefs and 6,700 sq km of mangroves. The coastline is characterised by different types of geological biophysical features, making the coastal zone related issues varying from place to place; partly driven by natural forces and mostly man-made. Using advanced remote sensing and geospatial technologies, real-time information on temporal and regional scales can be collected for monitoring, proper decision making, better resource quantification and effective management of coastal zones.

The coast is a unique environment where land, sea and atmosphere interplay continuously influencing a strip of spatial zone defined as coastal zone. Coastal problems of erosion and accretion, inundation and encroachment by sea, shifting of shoreline caused by natural or anthropogenic forces, such as construction of artificial structures for shore protection, port and harbour along the coastal front, emphasise to understand the processes over short- and long-term time scales.

Factors affecting the coastline

The contributing factors affecting the coastline may be global, regional or local in scale, e.g. monsoon / rainfall variations due to global factors like El Nino, variability in sediment supply from rivers due to change in land-use pattern far away in hinterland or human activities such as the installation of coastal defenses that interrupt the sand supply nourishing the beaches. The causes at the local scale are determined by physical properties of the coastline. The climate, through its wind regimes, and the waves generated by those regimes at regional to local scales, are of fundamental importance in major coastal processes in shoreline change. The tidal regime and consequent tidal currents also play significant role over broad inter-tidal zones and in creeks, estuaries, lagoons where the spring tidal excursion is high.

Along-shore winds initiate near shore currents and thereby littoral drift and onshore winds trigger aeolian sediment transport. The most important variable in modulating the coasts is the waves. Waves impinging on a shoreline are generated either by local winds or by distant storms referred to as “seas” and as “swells” respectively.

Water levels variations in the coastal areas are caused by oceanographic, meteorological, hydrologic, geologic, seismologic and eustatic factors. The later four factors are important for long-term variations of seawater level. Beach processes and coastal geomorphology are partly affected by variations of these water levels at short-term or long-term basis. The short-term regular variations are the semi-diurnal and diurnal tidal cycles and are associated with tsunamis and storm surges. Long-term changes are due to eustatic and isostatic effects and the periodic oscillations of sea levels affect the beach processes. Sea level change at the global scale due to anticipated global warming is said to be rising currently at 1-2 mm per year. The possible effects of sea level rise need to be accounted in assessing long-term shoreline changes.

Sediment deposition in harbours, beach erosion and the coastal geomorphology are intimately associated with sediment transport. Sediment movement perpendicular to shoreline (onshore-offshore) is responsible for short-term beach changes, whereas sediment movement parallel to the shoreline (along-shore) within surfzone result in major long-term changes of the coastal zone. The material transported along the shore in the littoral zone by waves is referred to as the littoral drift.

Major coastal zone issues and threats along Indian coasts

India has a 7,500 km long coastline and an estimated coastal population of approximately 295 million people, which is 26 per cent of the country's total estimated population. Its coastal areas include 5,790 sq km of coral reefs and 6,700 sq km of mangroves – 8 per cent of the total area of mangroves in Asia. The coastline is characterised by different types of geological-biophysical features, making the coastal zone related issues varying from place to place; partly driven by natural forces and mostly man-made. Rapid urbanisation, port development, and major coastal related trade and economic activities such as expansion of fisheries, aquaculture in the recent years along Indian coastline have gained major attention affecting the coastal zone.

Natural factors

The coastal erosion problem is severe all along Kerala, some parts of Odisha, Andhra Pradesh and Lakshadweep group of islands. The high wave activity – swells reaching from Indian Ocean – has eroded more than 90 per cent of the total Kerala coast. The east coast of India is highly vulnerable to tropical cyclones of different intensities originating from Bay of Bengal causing storm surges and inundating coastal areas of Odisha and Andhra Pradesh alternately every year. The best example is the 1999 Orissa super cyclone that generated storm surges of the order of 8-10 m, inundating 35-50 km landward and caused a death toll of more than 12,000 human lives in the low-lying areas of north Odisha coast.

The major river systems of eastern coasts cause heavy floods and damage to the West Bengal, Odisha and Andhra Pradesh coasts. A major segment of Indian coast is bestowed with uninterrupted sandy beaches and huge sediment transport rate changes the river mouths, inlets and affects the near-shore processes invariably. The 2004 Sumatra earthquake that generated a tsunami of global reach caused colossal damage to the Tamil Nadu, Kerala and Andaman and Nicobar coasts. This attests to the fact that Indian coasts are quite vulnerable to a number of natural coastal hazards originating from different sources. The narrow strip with rocky cliffs and promontories along Karnataka and Goa coast experience very little sedimentation and inundation; however, the interlocked sandy beaches attract tourists, trade and socio-economic and cultural diversity.

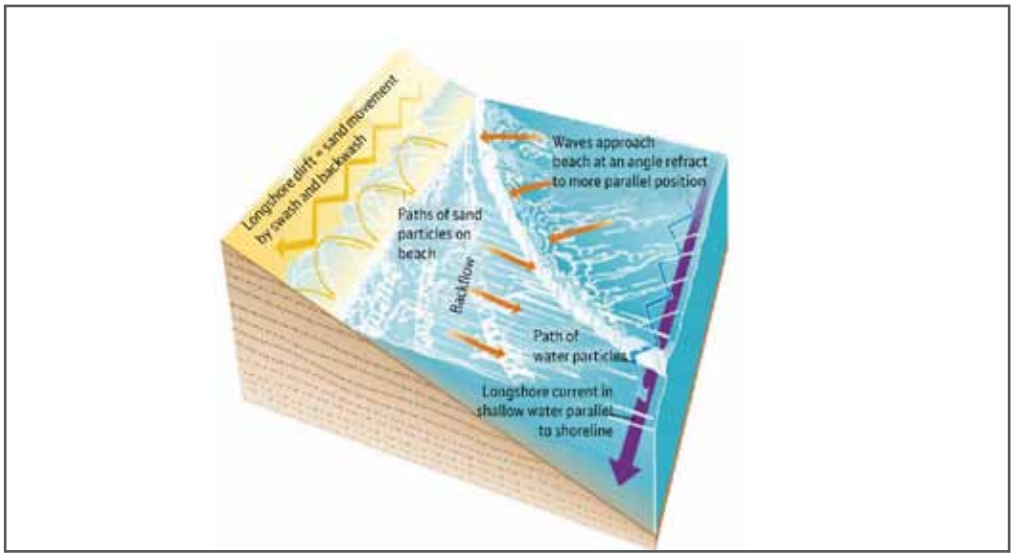


Figure 1: Movement of longshore transport (littoral drift) under the action of wave approaching at an angle

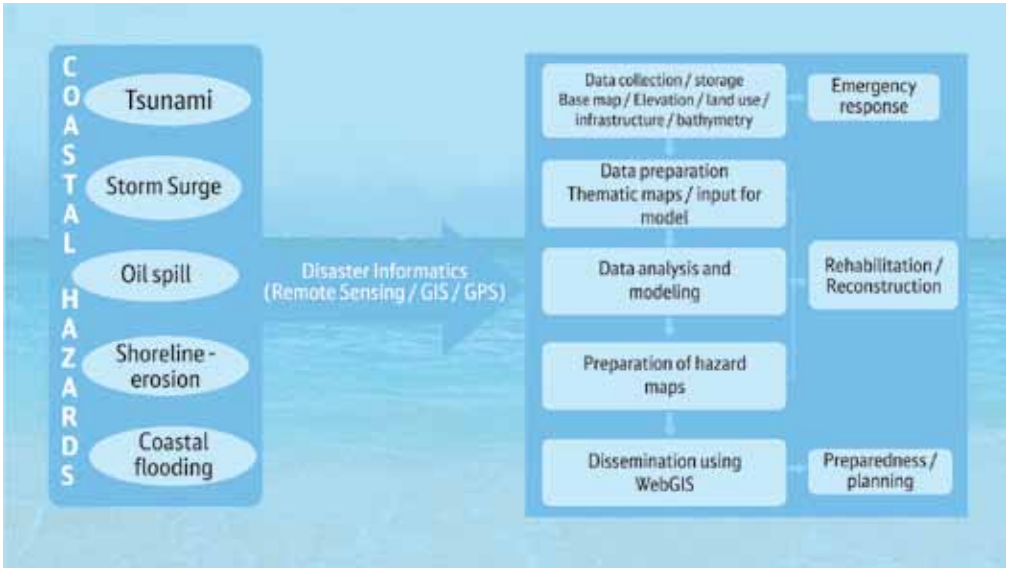
Human intervention

Development of open coast ports and harbours, flattening of sand dunes and altering the coastal land for settlement, road and accessibility purposes, mining of sand dunes for placer deposits for ilmenite, monazite zircon and rutile in Kerala, Tamil Nadu and Odisha coasts have proved disastrous in many instances. Measurements indicate that the construction of groins/ breakwaters trap the littoral drift and build up the beach on one side and erode the coast on the other side (e.g. Madras, Ennore, Paradip and Gopalpur ports).

Mangroves at stake

Some areas of Gujarat, Tamil Nadu, Andhra Pradesh, Odisha and West Bengal coasts are marked by low-lying, wide intertidal huge mudflats and mangrove forests. The total area

of mangrove forests in India is about 7 per cent of world's mangrove area. The east coast of India supports 80 per cent of the total mangrove forests and rest 20 per cent exists in the west coast. Although these mangrove systems support a large fishery nursing ground and act as barriers to natural hazards, but past studies indicate that indiscriminate and diverse human economic activities for fuel wood, fodder have reduced the mangrove extent. Over the past 30 years, India has lost approximately 12 per cent of its mangroves due to human pressures on coastal areas. Encroachment of mangrove habitats for agriculture and expansion of large-scale industries in case of Paradip in Odisha, Gulf of Kutch in Gujarat, and Mangalore in Karnataka inevitably caused destruction of coastal habitats. The Gahimatha north of Paradip Port, world's largest Olive Ridley rookery, had undergone phases of erosion and the habitat is at stake.



Threat to coastal biodiversity

The coastal lagoons, e.g. Chilika lake, Vembanard lake and Pulicat lake, are allegedly dying and are on the verge of environmental catastrophe. Natural forcing through heavy siltation, eutrophication and biological sedimentation has transformed major portion of the lakes into swamps, threatening their existence. Excessive fishing, aquaculture, agriculture, recreation and tourism have caused severe biodiversity loss and pollution. The sprawl of industries and large-scale human settlements generate different kinds of wastes that are discharged to the coastal marine environment either directly or through rivers, canals and creeks. This results in the degradation of coastal water quality which has environmental and socio-economical concern. The growth of maritime and shipping activities has also increased the accident incidents and occurrence of offshore oil spills, affecting the coast, coastal organisms, fisheries resources and biodiversity.

Strategies for coastal zone management

The factors affecting the coastal process as discussed, disparate as they are, illustrate the major coastal biodiversity loss resulting from natural forces and human activities, unrests due to the overexploitation of resources and the need for sustainable development. Increasing population / settlements/ industrial growth along Indian coasts is already exerting immense pressure on coastal resources and is expected to increase even further in near future. Balancing competing demands on coastal resources with coastal conservation and accommodating the growth pressures while sustaining the ecological health and productivity of the coastal and marine environments will be a challenge for coastal planners.



Figure 2: The temporal variation in shoreline position due to construction of groins at Gopalpur Port, Odisha (+values indicates beach width gained, - values indicates beach width lost in the inset Table)

Effective coastal zone management can be done using monitoring and modelling techniques based on reliable and precise data. Conventional field-based data collection and mapping methods demand time, manpower and sometimes have its own logistic limitation for surveying inaccessible coastal areas, e.g. mangrove forests, vast wetlands, lagoon and estuarine processes. The advancement of remote sensing and geospatial technologies in collection and monitoring of real-time information on temporal and spatial scales are helping a great deal in proper decision making, better resource quantifications and good management of coastal zones.

Controlling coastal pollution

In the last two decades the Ministry of Earth Sciences (MoES), through its various programmes such as Coastal Ocean Monitoring and Prediction System (COMAPS) and Integrated Coastal and Marine Area and Management (ICMAM), has initiated long-term studies for coastal marine pollution monitoring at selected points all along the Indian coast.

COMAPS

Initiated in 1991-92, this programme constantly monitors pollution at 80 locations along the coastline of the country. It primarily aims to continuously assess status and trend of coastal marine environmental quality on a long-term basis and to alert government and public institutions, of their implications. Data on nearly 25 environmental parameters including physical, chemical, biological and microbiological characteristics of water and sediment are collected with the help of R&D institutions in 0-10 km sector of these locations. The results obtained under the programme are periodically published in the annual report of the Ministry and also in the website http://www.dod.nic.in

ICMAM

The ICMAM directorate fosters the application of GIS, remote sensing, environmental impact assessment strategies and mathematical modelling in evaluating the impact caused by sectors (like ports and harbours, waste disposal) on coastal zones, to prevent cross-sectoral impact and promote sustainable development of economic activities. Having made significant contributions in analysing causes for coastal erosion and suggesting remedial solutions through shoreline management plans, ICMAM under the Eleventh Plan envisages to:

- Assess vulnerability of coastal areas of Karnataka, Kerala, Odisha and Tamil Nadu to coastal erosion and prepare shoreline management plans
- Develop seawater inundation model for storm surges
- Ecosystem modelling in Kochi backwaters, Chilka lake and Sunderbans
- Prescription of seawater quality criteria for more heavy metals and organic compounds through marine ecotoxicology experiments

Other coastal zone management initiatives include monitoring coastal erosion, prediction and management strategy for oil spill occurrence, modelling and prediction of storm surge and tsunami, preparation of coastal vulnerability maps, coastal flood management, waste assimilation capacity for selected estuaries, development of environment impact guidelines for ports and harbours – shoreline management plans, coastal tourism and waste disposal through marine outfalls.

Monitoring coastal erosion

Coastal erosion is a chronic problem along most open-ocean shores of the Indian coast. As coastal populations continue to grow, and community infrastructures are threatened by erosion, there is increased demand for accurate information regarding past and present shoreline and the erosion and accretion patterns along the coast. In India, satellite data is widely used to study many aspects of coastal zone including coastal erosion and shoreline changes. Availability of remote sensing data for the last three decades has ensured synoptic

and repetitive coverage for the entire coast and this information has been extremely useful in generation of spatial information on coastal environment at various scales and with reasonable classification and control accuracy.

In India, shoreline-change maps have been produced on 1:250,000, 1:50,000 and 1:25,000 scale using IRS LISS I, II and III, LANDSAT MSS/TM and SPOT data. The availability of 1-5 m high-resolution and stereo data from IKONOS, RESOURCESAT-I and CARTOSAT greatly facilitate preparation of large-scale local level maps. The easy access to high spatial resolution data along with multi-spectral characteristics, repetitive coverage and development of geographic information system has provided new impetus to shoreline mapping and coastal erosion studies.



Figure 3: Oil spillage due to ship collision at the world's largest Olive ridley rookery at Rushikulya River mouth, Odisha before hatching (13, March 2010)

Managing oil spills

The Indian coast is susceptible to oil spills as was evidenced in the recent past when the Indian coast guard vessels and helicopters worked round the clock to contain the oil spilling from a stricken container vessel off Mumbai coast in the Arabian Sea. Another recent oil leakage was reported due to the ONGC Uran trunk oil pipeline burst in January this year, causing a major oil spill 80 km away from Mumbai's coast. Even though the oil spill was controlled immediately, it had covered an area of 4 sq km.

The extent of impact from such accidents however is influenced by a number of factors such as the type and amount of oil spilled, the physical characteristics of the affected area, the weather conditions at the time of the spill and the type and effectiveness of the response

methods employed. Numerous oil spill models are available which predict the oil spill weathering profiles but do not predict the potential migration of the slick. For this purpose, GIS-based modelling systems coupled with satellite imagery provide accurate and quick information to responders about the type and extent of resources affected by the oil spill.

Tsunami hazard maps for the Indian coast

Following the disastrous tsunami in the Indian Ocean in 2004, the Ministry of Earth Sciences has set up the state-of-the-art early Tsunami warning centre at INCOIS, Hyderabad with all the necessary computing and communication infrastructure to issue alarms/alerts, whenever a pre-set threshold for the occurrence of a tsunami is crossed. The centre provides information about possibility of tsunami generation, its travel time and likely coastal areas to be affected, using model scenarios generated by Tunami-N2 numerical model.

INCOIS gears up for tsunami vulnerability mapping of the Indian coast

INCOIS has expressed plans to implement a project on "Tsunami Vulnerability Mapping for the Indian Coast," with primary objectives being (i) Generation of tsunami vulnerability maps, (ii) 3D GIS mapping for highly vulnerable coastal areas, (iii) Real time tsunami inundation modelling and (iv) Integrated Software for display and analysis.
An "expression of interest" has also been called for from vendors with proven track record of executing projects of similar nature. Prequalified vendors will be provided with a detailed RFP document by INCOIS, to enable them to submit their proposals for evaluation.

Constructing the tsunami hazard maps is the key step in tsunami risk assessment and forms the basis for evacuation and future land use planning along coastal areas. To this end, a set of inundation scenarios were built based on realistic tectonic sources that can generate tsunamis in the Indian Ocean. Numerical models were constructed to predict the extent of inundation and run-up in each case, using a finite difference code TUNAMI N2 on nested grids derived from the high resolution elevation and bathymetry datasets. Elevation datasets derived from Cartosat-1 were used in the model to capture the extent of run-up and inundation in the land. Large scale tsunami hazard maps were constructed by overlaying the numerical model outputs along with details on land use, elevation, cadastral land parcels, infrastructure, high tide line, and coastal regulation buffer zones. These maps are useful for evacuation and land use planning along the Indian coast.

Vulnerability assessment for coastal zone

Coastal vulnerability maps and coastal resources mapping with special reference to coral reefs and fisheries potential zones, water quality deterioration and pollution need to be developed. The coastal vulnerability maps should be geo-referenced images providing proper classification of the geological, biological features and the extent of disasters due to

natural events such as storm surges, flooding etc that have social implications and relevance. Similarly, coastal resource mapping is necessary for coastal zone resource monitoring, planning, protection and consumption by the society.

Mapping the coastal hazard line

Under the World Bank assisted Integrated Coastal Zone Management Project, the Ministry of Environment and Forests has signed an agreement with The Survey of India to map, delineate and demarcate the hazard line along Indian coast. The hazard line is a composite line of the shoreline change (including sea level rise) due to climate change, tides and waves. The total cost of this survey is projected at ₹125 crore. The project involves collection and presentation of data, identifying flood lines over the last 40 years (which includes sea level rise impacts), and a prediction of erosions to take place over the next 100 years.

Stereo Digitat Aerial Photography (SDAP) will be used to map the coastline. For the purpose of SDAP, the Indian mainland coastline has been divided into eight blocks: (1) from the Indo-Pakistan border to Somnath in Gujarat; (2) Somnath to Ulhas River in Maharashtra; (3) Ulhas River to Sharavathi River in Karnataka; (4) Sharavathi Rver to Cape Comoran in Tamil Nadu; (5) Cape Comoran to Ponniyur River in Tamil Nadu; (6) Ponniyur River to Krishna River in Andhra Pradesh; (7) Krishna River to Chhatrapur in Orissa; and (8) Chhatrapur to Indo-Bangladesh border in West Bengal. Based on this, maps will be prepared in 1:10,000 scale and after ground verification, pillars will be erected demarcating the hazard line.

Coastal regulation zone notification revised

Following representations made by several interest groups pointing at the inadequacies of the coastal regulation zone notification 1991, an expert committee under the chairmanship of Prof M S Swaminathan reviewed the notification in 2004 to formulate the below listed principles that will govern future decisions on coastal zone management:

- Ecological, cultural, livelihood and national security should be the cornerstones of an integrated coastal zone management policy.
- Regulation, education and social mobilisation should be the three major components of a participatory and sustainable coastal zone management strategy. Panchayat Raj institutions in coastal areas should be fully involved in the educational and social mobilisation programmes.
- The protection and sustainable development of the marine and coastal environment and its resources should be in conformity with international law as laid down in 1982 UNCLOS.
- Every effort should be made towards ensuring an Integrated Marine and Coastal Area Management (IMCAM) as prescribed in the 1995 Jakarta Mandate under the 1992 Convention on Biological Diversity.

- Coastal regulation needs to be based on sound, scientific and ecological principles and should safeguard both natural, cultural heritage and areas of environmental significance.
- Precautionary approach should be used where there are potential threats of serious or irreversible damage to ecologically fragile critical coastal systems and to living aquatic resources.
- The regeneration of mangrove wetlands, coral reefs and sea grass beds as well as the promotion of coastal forestry and agro-forestry will confer both short and long-term ecological and livelihood benefits.
- Carbon sequestration through coastal bio-shields will make an important contribution to promoting a balance between carbon emission and absorption, in addition to offering protection during coastal storms and calamities like Tsunami.
- A national coastal bio-shield movement should be initiated, which can be a priority task under the National Rural Employment Guarantee and Food for Work Programmes.
- Coastal zones have been classified into four zones – ecologically sensitive; economically important; islands of the Andaman, Nicobar and Lakshadweep; and other open areas not covered under the above mentioned categories. An integrated coastal zone management approach has been suggested
- The severe losses caused by Tsunami in Andaman & Nicobar Islands and in the coastal regions of Tamil Nadu, Kerala, Andhra Pradesh and Pondicherry teach us that short-term commercial interests should not be allowed to undermine the ecological security of our coastal areas.

It is time users, stakeholders, planners and governments act in unison under the aegis of a broader framework such as Integrated Coastal Zone Management (ICZM) programme to manage development and conserve natural resources by integrating concerns of all the relevant sectors of society and of the economy.

Pravakar Mishra
Scientist-E
ICMAM Project Directorate
Ministry of Earth Sciences
Govt. of India, Chennai

Tune Usha
Scientist-E
ICMAM-PD
Ministry of Earth Sciences
Govt. of India, Chennai



RAY of hope

Summary:

The Rajiv Awas Yojana (RAY) project, initiated by the Ministry of Housing and Urban Poverty Alleviation (MoHUPA) in 2009, aims to eradicate slums and provide a decent dwelling to one and all. In various stages of implementation across the country, the project is using geospatial technology across all the phases from planning to implementation. Mapping and surveying of slums is being done to prepare a GIS database. Non-spatial data is being collected to develop management information system (MIS). GIS and MIS will be integrated to develop plan of action for achieving slum-free cities.

Everyone, right from the upwardly mobile, the jet set businessman, the middle class, salaried class, the socialite, to daily wage earner have come to accept that slums as an inseparable aspect of our lives. All despise the state of affairs but are helpless. For every high rise building there is a shanty coming up; for every gated community there is a slum slowly spreading its tentacles around its periphery. As one section of India lives in apartments and independent houses with water and drainage facilities, just a couple of yards away lie these shanty towns bereft of basic standards of life that befit human beings. Just when the common man almost gave up hope and started to ignore the squalor and the ignominious defeat by the state in providing a decent livelihood to its citizens, the Rajiv Awas Yojana (RAY) has come out as a ray of hope for the teeming millions living in the slums across Indian cities. The scheme calls for temporary rehabilitation, fresh developmental plans and strategies for implementation and finally to bring back slum dwellers to their place of residence. RAY, as the scheme is christened sounds ambitious and if implemented could provide the much needed shelters (pucca houses) to those in dire need of a decent dwelling.

Genesis of RAY

Rajiv Awas Yojana (RAY) has been formulated by the Ministry of Housing and Urban Poverty Alleviation (MoHUPA) with the goal of a slum-free India. The scheme looks to provide support to state governments that wish to give property rights to slum dwellers. The genesis of the RAY project took root in 2009 with a concept paper prepared by the ministry.

After thorough discussions by experts, city commissioners, state secretaries, central ministers, the scheme was prepared. An independent critical appraisal of the draft scheme was completed by the committee headed by Deepak Parekh, which submitted its report in April, 2010 and consequently the draft guidelines under the Slum-free City Planning Scheme have been issued and the states are being provided technical and financial assistance to prepare Slum-free City Plans. This scheme comprises all the preparatory activities such as slum survey, GIS mapping of slums and development of Slum-free City and Slum-free State Plans with the active involvement of experts in the areas of GIS, MIS, planning etc.

First installment of grants-in-aid to 14 state/UTs governments for Slum-free City Plan scheme

S.No	State/UT Name	City Name (No. of Cities)	Sanction Date	Amount of Sanction (₹in lakhs)
1	Jammu & Kashmir	Jammu, Srinagar, Ananthnag, Baramulla, Udhampur, Kathua (6)	Mar 7, 2011	236.8
2	Sikkim	Gangtok (1)	Mar 7, 2011	62.4
3	Delhi	Delhi (1)	Mar 7, 2011	981.97
4	Nagaland	Kohima, Dimapur (2)	Mar 7, 2011	108.03
5	Goa	Mormugao, Panaji, Margao (3)	Mar 7, 2011	111.71
6	Meghalaya	Shillong (1)	Mar 7, 2011	95.63
7	Mizoram	Aizwal, Champhai, Kolasib, Lawngtlai, Lunglei, Mamit, Saiha, Serchip (8)	Mar 7, 2011	467.07
8	Arunachal Pradesh	Itanagar, Naharlagun (2)	Mar 7, 2011	111.29
9	Punjab	Amritsar, Ludhiana, Bhatinda, Patiala, Jalandhar (5)	Mar 7, 2011	538.34
10	Puducherry	Pondicherry, Ozhukarai (2)	Mar 10, 2011	79.02
11	Dadra & Nagar Haveli	Dadra & Nagar Haveli (1)	Mar 10, 2011	43.45
12	Daman & Diu	Daman, Diu (2)	Mar 10, 2011	58.07
13	Lakshadweep	Amini, Kavaratti, Minicoy (3)	Mar 10, 2011	15
14	A&N Islands	Port Blair (1)	Mar 10, 2011	76.18

Source: mhupa.gov.in

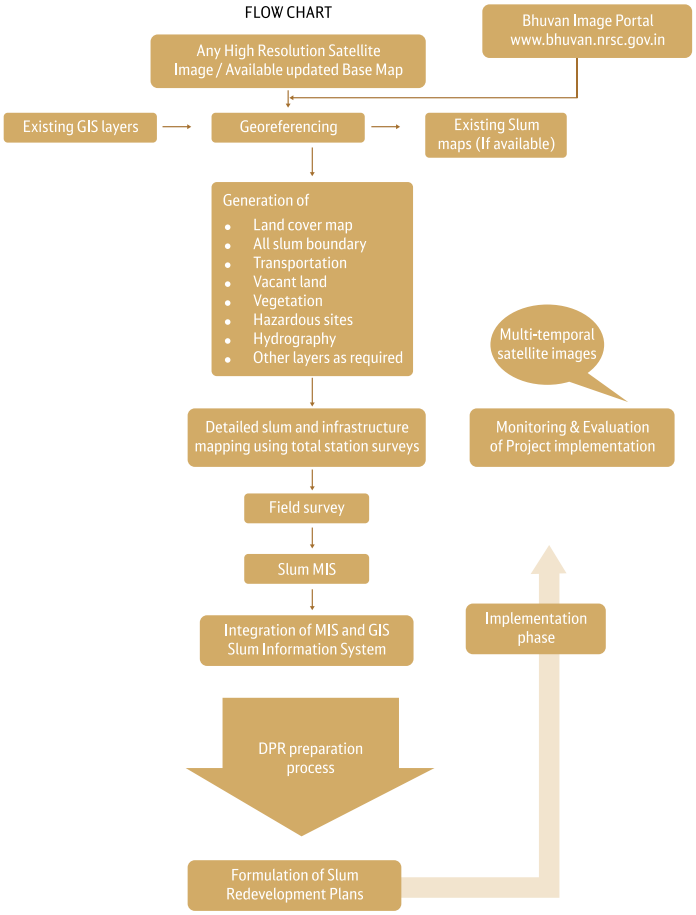
Total States: 14, Total Cities: 38, Total Amount Sanctioned: ₹30.29 crore

Merging of JnNURM projects

Prior to RAY project, there were other projects such as BSUP and Integrated Housing and Slum Development Programme (IHSDP). The two projects are now absorbed in RAY as it is more comprehensive and encompasses all social and economic aspects with the ultimate goal of providing permanent housing for slum dwellers. Apart from these projects, the housing schemes like Interest Subsidy for Housing the Urban Poor (ISHUP) and Affordable Housing in Partnership would be dovetailed into RAY.

The preparation of Slum-free City Plan will broadly involve survey of all slums – notified and non-notified; mapping of slums using the state-of-art technology; integration of

geospatial and socio-economic data; and identification of development model proposed for each slum. To achieve this, a systematic approach is laid out which will be useful for various other developmental planning initiatives for the urban poor. The steps to be followed for slum mapping using satellite data, GPS, Total Station Survey in preparing GIS database, MIS development of non-spatial data collected and integration of GIS with MIS to enable generating Plan of Action (PoA) for slum-free cities are put forth.



Present status of RAY project in leading states

Among the states, Gujarat, Andhra Pradesh, Maharashtra and Karnataka have taken the lead. In some cities within these states, considerable work has been done. The collection of socio-economic data and slum mapping has been completed. Management Information System work is going on in all the cities. In one of the cities in Gujarat, biometric survey for one lakh households has been completed. In Rajasthan, survey has been completed in 115 of the 184 towns.

Andhra Pradesh

In Andhra Pradesh, GIS-based slum mapping commenced in 14 ULBs. The number of cities to be taken up for phase-wise slum mapping has been decided. In phase I, 25 ULBs have been selected, in the second phase, 63 and in the third phase 37 towns have been earmarked. Socio-economic household survey started in 34 ULBs. K Vidyadhar, Addition Mission Director, Mission for Elimination of Poverty in Municipal Areas (MEPMA), MA & UD Department, Government of AP said, "The success of the project lies in involving the community and the department is keen on the matter. So far, the towns Kurnool, Ramagundum, Chirala, GVMC, Cuddapah, Suryapet, Nizambad, Warangal, Guntur, Tirupati have made presentations and consultants too have presented their proposals for pilot studies. The technical committee identified some issues regarding data integration on which necessary action is being taken. The household numbers are not matching with the properties on the images and workshops and awareness programmes are being conducted to tackle the issue. Work on detailed property mapping is in progress." He adds, "Once the methodology is finalised, the integration too can be done easily. About 90 per cent of the methodology is finalised; only linking problem has to be taken care of."

Karnataka

In Karnataka, 10 cities have been selected in Phase I. Sources at the nodal agency KSRSC said that they have imagery for two cities and request for the remaining eight cities has been put forth. A scientist at the centre was of the opinion that once they procure the imageries for the remaining cities, they would be able to complete the slum mapping within nine months. The DGPS survey of Gulbarga is completed and georeferencing work is in progress. In Tumkur, survey work is going on. N Jayanthi, Deputy Director, Department of Municipal Administration, says, "The RAY project is underway and slum survey and livelihood survey for 214 ULBs has been completed. The identification of notified and non-notified slums too has been done. In Mysore city, the verification and validation work will be completed shortly. Over all, 2,073 slums have been notified and 1,495 are non-notified."

Maharashtra

In Maharashtra, under Phase 1, 24 cities have been selected for slum mapping. The state level technical cell is in place but it is not ready in the ULBs. MIS work is going on in the 24 cities. Among the cities, considerable amount of work has been done in Pune and Nanded. The budget allotted for the year 2010-11 is 130 crores. Amit Khadam, Asst Engineer, JnNURM Cell, Housing department, Mumbai says, "One of the major problems is the acquisition of land as they fall under state, central and Railway jurisdiction. Also, the awareness of the project at various section levels in ULBs is low. Another problem cited by the ULBs is that they are unable to get good GIS specialists. Socio-economic data of the various slums in the cities is being collected."

Gujarat

When asked if Gujarat has taken a lead in the RAY project, Abhijeet Date, who was formerly with Gujarat Urban Development Mission, (GUDM) as Deputy Manager, Housing said "At the face of it does look as though the state has taken a lead, some work has been done in Ahmedabad, Surat and Rajkot. In one of the cities biometric survey for 1 lakh households has been completed. BISAG has played a major role in slum mapping and some work was completed in previous housing project. But the problem is that a lot of changes have taken place on the ground in the last few years but integrating the latest data with the old and updating it will be a difficult task."

Eight cities have been selected for the first phase of RAY project. The cities are Ahmedabad, Surat, Vadodara, Rajkot, Jamnagar, Bhavnagar, Porbandar and the eighth city is to be decided. The budget allotted for the eight cities is ₹8.32 crore out of which ₹5 crore is allotted for Ahmedabad, Surat, Vadodara and Rajkot. Among the cities, Rajkot has almost completed total station survey. In phase II, 17 cities would be taken up for Slum-free City Planning.

Challenges

Integration between GIS and MIS

One of the challenges of the project is the integration between GIS and MIS. The perfect coordination between various teams that deal with GIS mapping, MIS and household survey teams becomes essential for the success of the project. It has been found that the survey data collected is not in uniform format and presents difficulties in streamlining and centralising the data at single source for easy analysis. The creation of slum profile is a herculean task. The Urban Local Body (ULB) needs to issue a unique number to each house/dwelling that does not have a number. Once the slum profile is completed and priority slums are identified, total station survey and detailed mapping of these slum areas at 1:500 scales is to be carried out.

RAY Project

- Launched in June 2009, RAY is meant to make India slum-free.
- It took almost two years to prepare the scheme after the announcement of the RAY. Now the implementation stage has come.
- There is a shortage of 25 million housing units in the country and the government intends to construct about 10 million houses under the RAY. GIS mapping under progress to identify slums in cities.
- "The sanction of ₹ 6,000 crore for RAY is being announced in the last year of 11th Five Year Plan. More grant would follow in the 12th Five Year Plan," the official said.
- As per the scheme, 50 per cent of the cost of construction would be borne by the Centre and the rest would be borne by the state government, the urban local body and the beneficiary.
- The Ministry of Housing and Urban Poverty Alleviation (MoHUPA) has prepared Guidelines for Slum Free City Planning to assist the preparatory activities under RAY and this has been circulated to all States/UTs.

Community participation

The purpose of the project is to provide decent housing to the slum dwellers and it becomes imperative to make them aware about the government's intention. The community participation becomes important as it is their socio-economic data that is collected becomes the backbone for the decision makers. The role of NGOs is crucial and in Andhra Pradesh they have been playing a pivotal role in the collection of data.

Biometric survey

The UID project is underway and the Slum-free City Planning (SFCP) scheme too envisages for a biometric survey. The RAY project stakeholders need to ensure that individual households identified as part of SFCP survey are able to be mapped on the basis of the UID. It is essential that both sets of data are interlinked. This calls for proper coordination between government agencies.

Timeline

Initially the government had set an ambitious timeline of five years and according to estimates there would be 93.06 million slum dwellers in urban India. There is a shortage of 25 million housing units in the country and the government intends to construct about 10 million houses under RAY. Since the scheme was launched recently, only a few states in India have been able to start the work. Many states and ULBs have been asked to commence preparatory phase of slum planning, but the work is not satisfactory. Full-fledged work is to commence in West Bengal, Kerala, Assam, Tamil Nadu and Puducherry in May after the assembly elections.

Survey

The main objective of household survey and Web-based GIS-MIS is to help ULBs to prepare a detailed project report (DPR) and action plan for slum areas. The survey itself is a mammoth exercise; firstly, they need to map as many slum areas as possible, collect socio-economic data and present a comprehensive picture of the slum, i.e. non-spatial and spatial data supported on a MIS. The challenge is to see that GIS map queries will be able to fetch MIS reports and similarly, MIS tables could fetch specific GIS outputs as required for cross-comparison.

The way forward

The ultimate aim of RAY project is to make India a slum-free nation. Though the intention of the government is laudable, the completion of the project is far from easy. The Deepak Parekh committee has made following recommendations: the duration of RAY should be extended beyond 5 years to 20 years; the implementation of reforms must be ensured and funds for states should be ring fenced; the central subsisdy should be attractive for incensitivising states; and a credit-enabling environment needs to be created to facilitate access to long-term finance at a concessional rate for the beneficiaries.

In spite of the complexities and challenges, the project has witnessed a few interesting and positive developments as well. For instance, the Karnataka government has taken a noteworthy decision regarding the ownership of flats. N Jayanthi, Deputy Director, Department of Municipal Administration, Karnataka, explained, "The government has decided not to give patta rights for housing but has come up with a novel idea of giving the right to occupancy and after a period of 15 years the beneficiaries would be given absolute ownership for built-up floor area in the multi-storied building. This decision is hailed by one and all as it has been seen in recent studies that whenever slum dwellers were given pucca houses they sold them and started living in slums. This model will ensure that they would remain living in the newly built apartments and studies indicate that after a period of 15 years the likelihood of them selling the flats is minimised."

Work has started in some states and is in different stages of development. Pilot studies are underway in some states. The centre is looking at involving private developers in a big way to complete this task. In order to ensure that private-public partnerships (PPP) alliances are a success, the centre is ready to give up to 40 per cent viability gap funding along with capital subsidy and interest subsidy. Also, the government is about to announce ₹6,000 crore for RAY in the last year of the Eleventh Five Year Plan and more grants would follow in the Twelfth Plan. As per the scheme, 50 per cent of the cost of construction would be borne by the centre and the rest would be borne by the state government, the urban local body and the beneficiary.

More than 26 per cent of the urban population lives in slums. The task of slum-free cities does seem difficult but not insurmountable. Few states have started work but there are many that need to catch up.

The RAY scheme does give a hope to the lakhs of slum dwellers; it is up to the states to take the project ahead to provide proper housing to all.



Reaching out to the poor

Summary:

The Mahatma Gandhi National Rural Employment Guarantee Scheme better known by the acronym MGNREGS, intends to provide basic employment guarantee in rural areas with multiple objectives to support the social and economic conditions of the rural mass. For effective planning, implementation, assessment and monitoring of the work done under the programme, decision support tool based on geospatial technology is being used. This not only reduces the time and cost in planning and implementation of the programme, but is also helping in gauging its impact.

Planning is now a widely accepted way to handle complex problems of resource allocation and decision-making. It involves the use of collective intelligence and foresight to chart direction, order, harmony and progress in public activity relating to human environment and general welfare. Planning is the most essential part of successful and result-oriented implementation of any scheme or plan. The Mahatma Gandhi National Rural Employment Guarantee Scheme (MGNREGS) has a broad horizon and high promises; the government is investing a majority of its finances in this particular scheme. Considering the high expectations and investments, planning becomes most vital for this particular scheme. A key indicator of success is the timely generation of employment within 15 days while ensuring that the design and selection of works ensure development of good quality assets. The need to act within a time limit necessitates advance planning.

The process of planning has been laid down under the Section 16 of the Act, giving it the power to make recommendations on the works to be taken up under NREGA to the Gram Sabha and the power to prepare a development plan comprising a shelf of projects on the basis of these recommendations of the Gram Sabha to the Gram Panchayat. The Gram Panchayat has to forward the development plan with its priorities to the Programme Officer for preliminary scrutiny and approval prior to the commencement of the year in which it is proposed to be executed.

NREGA intends to provide a basic employment guarantee in rural areas with multiple objectives to support the social and economic conditions

of rural mass. The act indicates that the following kinds of works may be taken up for the purposes: (i) Water conservation and water harvesting, (ii) Drought proofing including afforestation and tree plantation, (iii) Irrigation canals including micro and macro irrigation works, (iv) Land development, (v) Rural connectivity to provide all weather access, (vi) Flood control & protection works, including drainage in water-logged areas, (vii) Renovation of traditional water bodies including de-silting of tanks etc. It is therefore important to make an effective planning for implementation of such activities and develop appropriate mechanism for their assessment and continuous monitoring.

In order to provide a more effective and meaningful direction for better planning, monitoring and development of NREGA activities, Geographic Information System (GIS) based resource mapping is required. The emergence of Remote Sensing and Geographic Information System as a powerful tool for spatial analysis and storage has alleviated the problem by computerisation of the spatial data. This technology can reduce the time and cost to the planners in organising the data in arriving at precise conclusion and decisions.

NREGS Planning: Gaps and challenges

- Planning by the high stakeholders: The higher stakeholders do not have featured resource databases. Although there are a number of processes mentioned for streamlining the planning process, a holistic vision at each level is missing. Planning at the Gram Panchayat level is supposed to be done in the Gram Sabha, which is actually done by the block level officials at some places and by the Secretary or Sarpanch / Mukhiya at others. It is found that the majority of the plans are prepared by the higher stakeholders who need a detailed resource data base available
- Consolidation of resource database: One of the important factors that hinders effective planning of works under NREGS is non-availability of a consolidated resource base at the district or block level. The current portfolio of resource database exists in files of different departments, including the forest department and the minor-irrigation department. They have a department-specific resource database that is rarely accessible to the larger audience. Thus, this affects effective planning as well as coordinated action under NREGS. This has been seen as an important area that needs attention.

Role of Geographic Information Systems (GIS) for NREGS

In view of enormous size of the MGNREGS programme it is necessary to make best use of latest Information and Communication Technologies (ICT). This will not only help in ensuring effective implementation and proper management of the programme, but will also bring transparency and thereby credibility. Geographic Information System (GIS) analyses geographic phenomenon that exist and events that occur, on Earth. GIS technology integrates common database operations such as query and statistical analysis with the

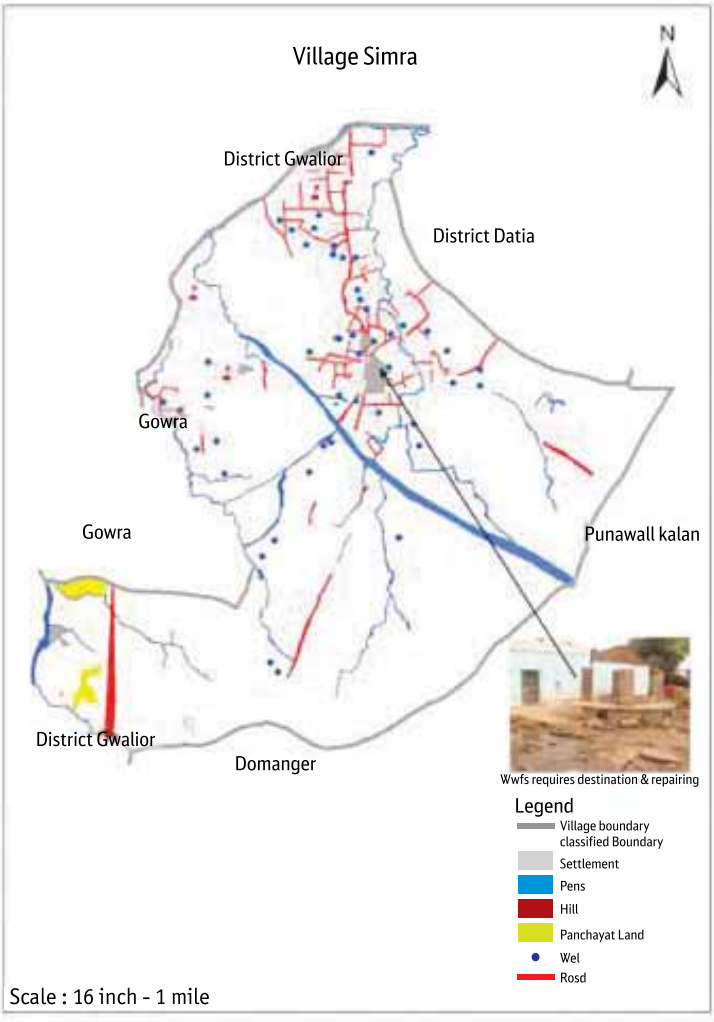
unique visualisation and geographic analysis benefits offered through maps. These abilities distinguish GIS from other information systems and make it valuable to a wide range of public and private enterprises for explaining events, predicting outcomes, and planning strategies.

PROPOSED CHECK LIST OF POTENTIAL WORK

As per the focus group discussion with the village community, PRI represent resources along with the Ameen in each village, the following works were in implementation under NREGS.

Proposed checklist of potential work in Simra Village

- Plantation can be done along both side of the canal
- Community well desiltation, digging & repairing is required and the we of the village
- Few other wells requires cleaning and repairing
- Internal drains are choked: cleaning is required
- Internal streets: paving can be done



Spatial Information on various resources in the Panchayat and villages is very critical for effective planning and action under NREGS. However, this critical factor quite often takes a back seat during the normal course of actions. The required information, which is available in different formats at different places, cannot be easily accessed whenever required. Urgent need of basic information on the resources and its spatial distribution is required for effective planning and monitoring of NREGS activities. Geographical Information System is a powerful tool to store, manage, update, manipulate and analyse spatial data related to natural resources, socio-economic parameters, environment and utilities. GIS can be used to prioritise huge area of work under NREGS programme. GIS has wide ranging capabilities for data analysing such as overlaying different themes, suitability criteria ranking and identifying potential area of work under NREGS. GIS can be used to prioritise NREGS work based on their relative volume and days of work.

GIS can also help in projecting the spatial impact of the activities covered by NREGS. These maps can also aid the policy makers in making decisions on current and future course of work and will give an analytical tool for sharing information, identification of potential areas of work, planning, monitoring and management. Resource Mapping

is required to understand the existing resources and its spatial distribution, which would enable effective planning and implementation under MGNREGS. The resource mapping involves collecting, collating and plotting information on the occurrence, distribution, access and use of resources within the economic and cultural domain of a specific community.



Broadly, GIS is able to:

- Collect and consolidate information on the existing natural and physical resources of the villages
- Support the comprehensive village planning and to identify the potential areas for creation of sustainable livelihoods through the Convergent Action Plan
- Facilitate ready development of shelf-of-project aiding sustained employment opportunities in the region
- Re-focus on creating/improving livelihoods assets which, of late, has been a missing link in NREGS

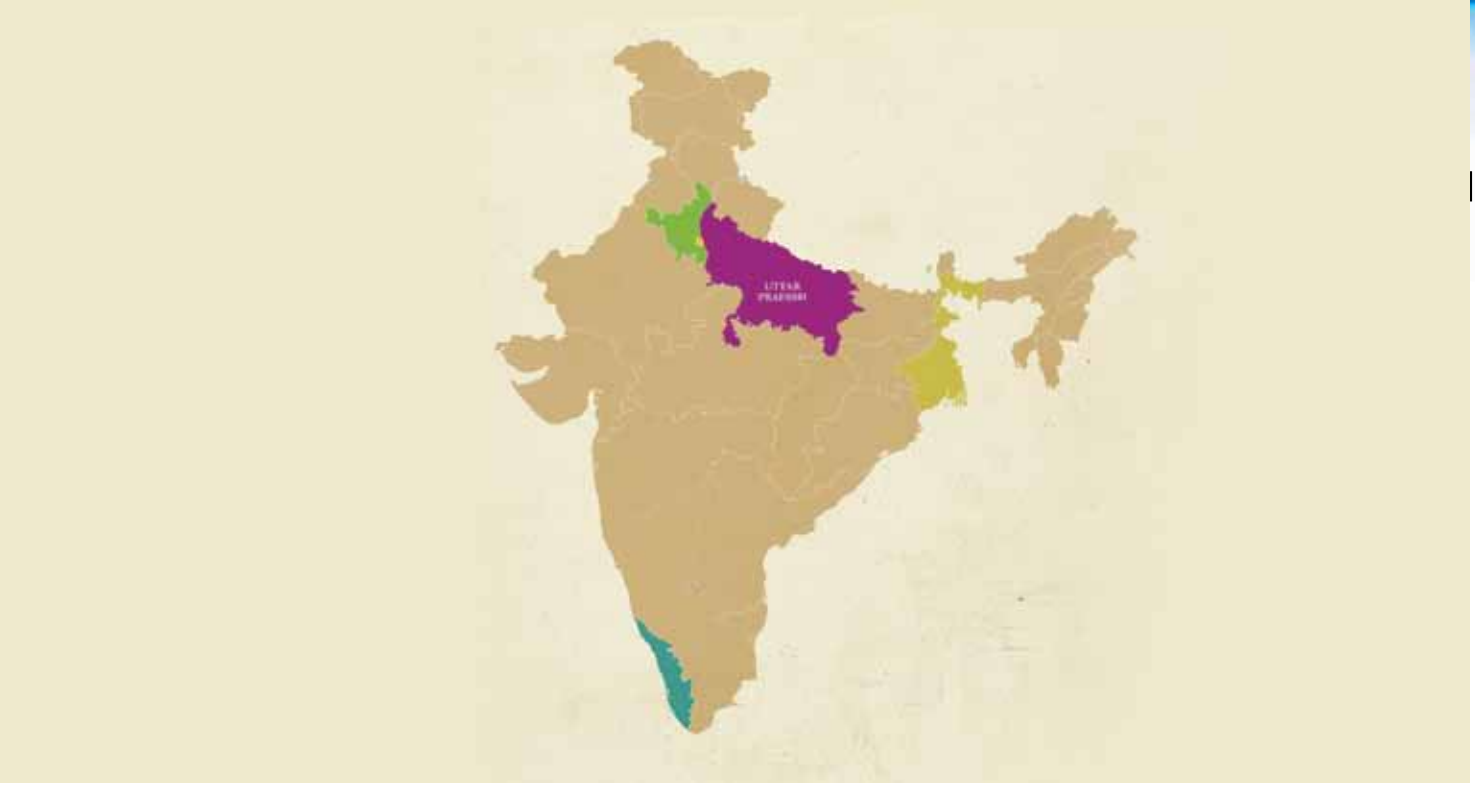
Development Alternatives has been involved in the resource mapping under the MGNREGS in Tikamgarh and Jhansi districts. The entire resource mapping was carried out in three steps – Situation analysis of existing resources, plotting of resources on cadastral maps using GIS and designing and developing the interactive database on resource maps. Intensive resource mapping has been done in two blocks of Tikamgarh and Jhansi districts of MP and UP respectively. The exercise was done to elicit the available opportunities at ground with reference to NREGS and leverage NREGS for human development through inter-sectoral convergence or other innovative ideas, thereby also strengthening the implementation of NREGS. Such a resource mapping exercise can become integral part of participatory monitoring and evaluation of the village resources. It shall help in generating qualitative and quantitative information for the Convergent Action Plan of each village.

A Decision Support Tool (DST) is developed comprising of interactive geospatial maps and databases. The DST provides an inventory of spatial databases on the available village resources (human and natural) and livelihood situation, which will help in planning of the NREGS effectively, and at the same time facilitates in quick planning & prioritisation of the NREGS activities. The DST is developed in the form of an interactive CD.

GIS can be used to assimilate both spatial and non-spatial data. Projecting the available natural resource information on maps will enhance decision-making regarding which resource area needs to be developed and conserved and bringing them under the umbrella of NREGA. It can also help in projecting the spatial impact of the activities covered by NREGA. GIS-based maps can also aid the policy makers in making an analytical tool for sharing information, identification of potential areas of work, planning, monitoring decisions on current and future course of work and will give and management. GIS-enabled systems strengthen the planning process and also support strengthening of monitoring and evaluation mechanisms. The output, outcome and impact level indicators can also be plotted on the GIS and can be tracked from time to time within one interactive system (Decision Support Tool).



Anand Kumar
Associate Director
Development Alternatives



Summary:

In an attempt to promote decentralised and local level planning and development in rural areas, the constitution of India has vested certain powers with the local bodies at the district and village level. This decentralisation of power has opened new opportunities for local level planning to effectively implement and monitor development programmes. To support such programmes, initiatives such as the ESD-GIS project in Uttar Pradesh provide a delivery mechanism for disseminating information in the form of maps for planning, decision making and achieving equitable development across different regions.

Strengthening local level planning in Uttar Pradesh

Since the beginning of the First Five Year Plan in 1952, the focus has been on encouraging rural development & planning. Decentralised and integrated district level and local level planning are being implemented to promote balanced development, especially in rural areas. The 73rd and 74th amendments to the Indian Constitution have bestowed greater responsibilities and powers to the local bodies, positioning them as the third tier of governance. This decentralisation of power has opened new opportunities for local level planning to effectively implement and monitor development programmes.

Geospatial technology is playing a key role in disseminating information at the local level for promoting and monitoring balanced development across rural areas. The technology is being used to improve planning, design and delivery of initiatives, particularly to address the needs of underprivileged groups and individuals. The policy framework provided by the IT Task Force of India, set up by the Prime Minister's Office, emphasises on the availability of spatial data to the user community. The policy framework has enabled the development of local level databases and spatial decision-support information systems network, with distributed network-centric Web-enabled GIS applications.

One of the initiatives for strengthening of local level planning at village, block, town and district panchayat levels is the ESD-GIS project, which aims to set up GIS infrastructure and applications in the state of Uttar Pradesh to facilitate collection and dissemination of information at the local level. A funding of ₹5 crore has been allotted for the project which is jointly initiated by Economics & Statistics Division (ESD) of Planning Department, Government of Uttar Pradesh and NIC-UP State Unit (NIC-UPSU).

The project has the following objectives:

- Creation of GIS infrastructure
- Creation/updation of digital base maps
- Development of thematic planning atlases
- Satellite imagery based application for integrated decentralised district planning
- Development of state GIS portal
- Development of multi-layered GIS system
- Human resource development

Creation of GIS infrastructure

The Planning Commission of India (PC) has launched a central sector scheme on Spatial Data Infrastructure (SDI) for developing multi-layer GIS to facilitate the work on national GIS. Particularly, the emphasis is on developing minimum multi-layer GIS at district level. Under this scheme, a National GIS Facility has been established at NIC-HQ, with a similar facility developed at PC and other nodes spread across the country. A state GIS server has been set up at NIC-UPSU data centre, Lucknow under this scheme.

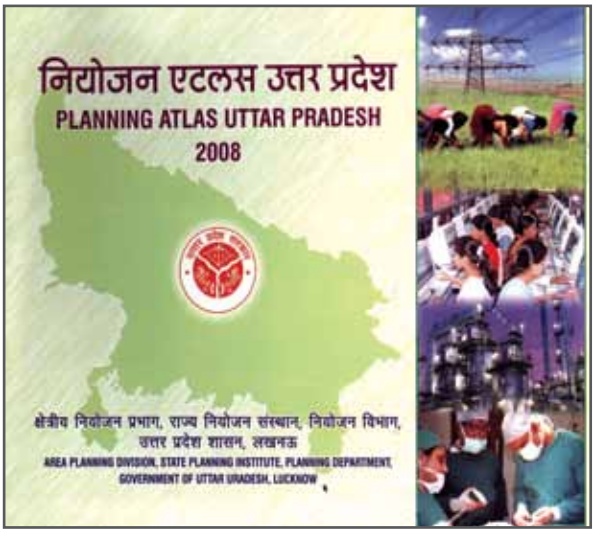


Figure 1: Planning Atlas Uttar Pradesh, 2008

Under ESD-GIS project, GIS cells have been set up at ESD-Headquarter as well as in the 70 district offices and are connected through NICNET/SWAN/ other networks for exchange of geospatial information. A GIS server, 5 clients, a colour laser printer, a A0 colour scanner and Plotter, a 5-KVA UPS, Windows server Std 2003, ArcInfo 9.x, Arcview 9.x, Arc GIS Publisher and Image Web Server have been procured for the ESD-Headquarter. Two PCs, a colour laser printer, two 700 VA UPS, Arcview 9.x are installed to form a network at each district office. More than 350 officers/officials of ESD and NIC have been trained on GIS tools and applications.

Creation/updation of digital base maps and data

The digitised boundaries of state, districts, blocks and villages already available with NIC and are being used to create micro level maps. Gram panchayat boundaries have been created from village boundaries available from NIC-Headquarter/RSAC-UP. Besides administrative boundaries, locations of state capital, district headquarters and sub-district headquarters, major towns, villages/habitations, transportation and land-use/ land cover databases, water bodies, forest, soil, wasteland, drainage, watershed, geology & geomorphology layers and satellite imageries of varying resolutions like AWiFS (56 m), LISS (23.5 m), PAN (5.80 m) etc. are also available with NIC. Procurement of high-resolution satellite imagery of Mau district is still under process.



Figure 2: Classification of districts according to composite index of development (based on 36 important indicators)



Figure 3: District Planning Atlas of Lucknow

Local Level Data (LLD) of all the 97,942 inhabited villages is collected in a Village Proforma (VP) and updated annually which are maintained in all the 821 blocks of the state. Gram, Block, District and Divisional Sankhyikiya Patrika (SP) having information on more than 3,500 parameters of village, village panchayat, block, district and divisional levels is updated and published annually since the year 1976. It covers major sectors like agriculture and allied activities, industry, social sector, power, transport and communication, banking, urban facilities, rural infrastructural facilities etc. There are 15 sections in village proforma covering information on introductory details of village, population census, livestock census, agricultural census, educational facilities, medical & health facilities, drinking water facilities, transport, communication &

miscellaneous establishment facilities, loan facilities, and total irrigated area under main crops. Computerisation of Sankhyikiya Patrika was started in the year 1993. A Web enabled SPIDER (Sankhyikiya Patrika: Internet based Data Entry & Retrieval) system, using ASP as front end and SQL server at the backend, has been implemented for data feeding/updation directly from the districts on a centralised server located at the data centre in Lucknow in a decentralized manner on 24 X 7 basis.

Thematic planning atlases

In an attempt to address the issue of regional imbalance in terms of development and to promote inclusive growth, State Planning Atlas (SPA), District Planning Atlas (DPA) and Block Planning Atlas (BPA) are being developed and they will be used for resolving disparities in development at village panchayat, block, district and state levels. State and district level static thematic planning atlases have also been prepared for Uttar Pradesh.

State planning atlas

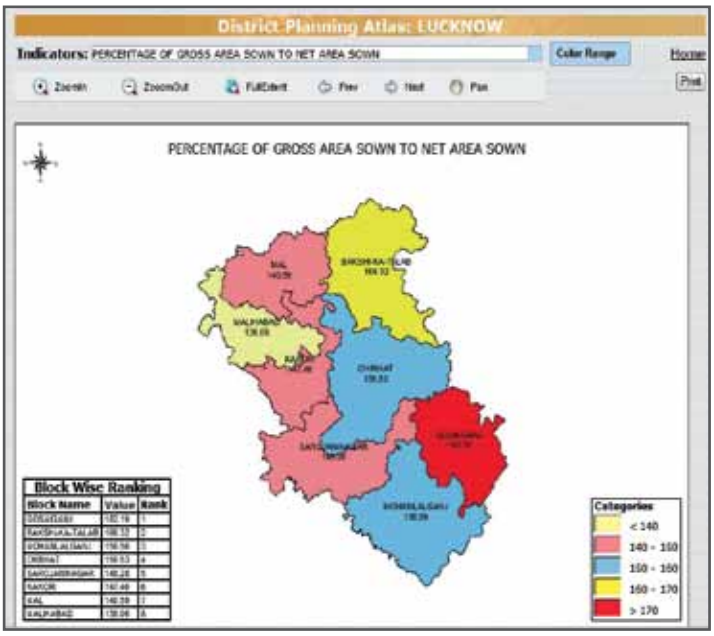


Figure 4: Classification of blocks in Lucknow district according to the percentage of gross area sown to net area sown

The planning department under the government of UP in collaboration with NIC-UPSU has prepared a bilingual state planning atlas using GIS tools. The atlas for the years 2003-08 have been published in the book form as well as on the Web.

The atlas has been prepared in three parts: Part-I – Maps and charts showing inter-state position of important indicators, Part-II – Indicator-wise ranking of the regions according to the level of development and Part-III – Maps and charts showing the classification of the districts on the basis of indicators of development.

In the atlas more than 100 thematic maps have been presented showing inter-state and inter-district positions of the important development indicators. Districts have been classified as backward and forward on a composite index based on 36 indicators as given in Figure 2.

District planning atlas

On a pilot basis, Lucknow district planning atlas was prepared using ArcView in the year 2006, both in the book form and digital form available on the Web. It has been presented in two parts: Part I – Maps and charts based on 30 indicators, showing comparative position of the districts within the administrative division and Part II – Maps and charts based on 69 indicators showing the development position of the blocks in the district. The atlases are regularly being updated in all the districts of UP.

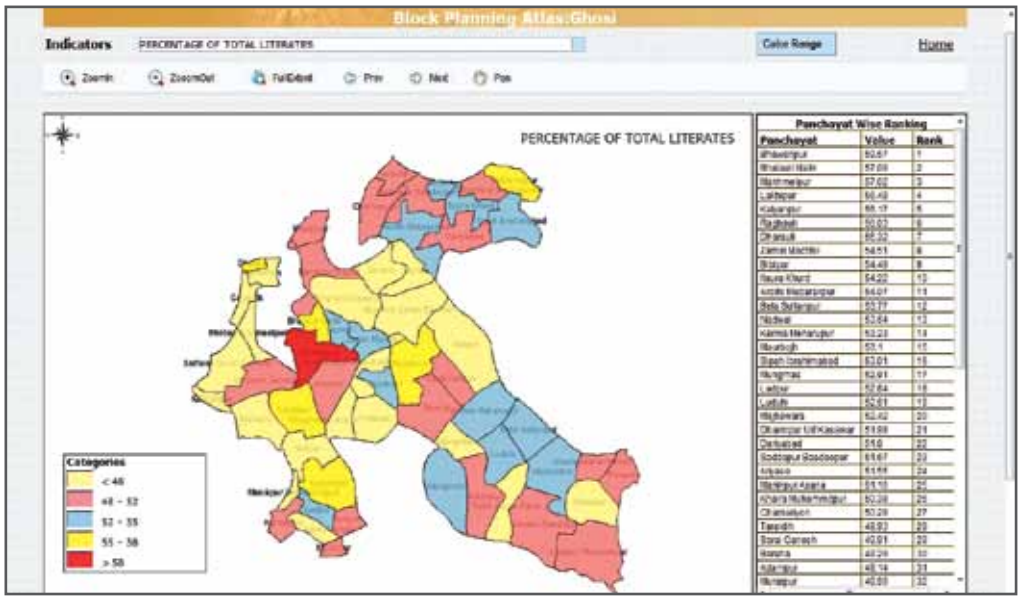


Figure 5: Classification of Gram Panchayats in Ghosi block of Mau district according to the percentage of total literates

Dynamic thematic planning atlases

A Portal e-MANCHITRA (Map based Analytical Charting and Reporting Application) has been developed for generating dynamic atlases and disseminating various other GIS products. This portal will have linkage with national GIS portal as well as other GIS websites/portals. For measuring the local level (village panchayat, block and district) sustainable developments, a very large number of maps based on Sankhyikiya Patrika databases are required to be dynamically and interactively generated for decision making. Dynamic SPA, DPA and BPA have been developed using Arc GIS Server with .Net application development framework and integrated with e-MANCHITRA portal. Integrated spatial and non-spatial data are stored in SQL server through ARC SDE (Spatial Data Engine) in the multi-user geo-database form. Indicators used in different types of dynamic atlases are generated automatically through a software module from SPIDER portal. Sample thematic maps of DPA and BPA are given in Figure 4 and 5 respectively.

Mapping of infrastructural facilities

Databases containing information on the availability of basic infrastructural facilities for each village of Uttar Pradesh is available since 1995 and is being updated annually through the SPIDER portal. A GIS base system has been developed for mapping of infrastructure, which is very helpful in identifying the gaps in availability of basic amenities and to identify the locations where facilities are necessary to be provided.

Web-based multi-layered GIS system

This application facilitates instant displaying of multiple data sets. Various thematic layers like rail track, road, canal, forest, structural lineament, drainage line, drainage polygon, land category, ground water, lithological, land-use/land cover, watershed, geomorphological, soil, settlement area etc. can be overlaid and analysed.

Conclusion

Successful implementation and integration of spatial and non-spatial data into a GIS framework with proper local level planning is critical for attaining sustainable development. Planners, managers and administrators should be facilitated with maximum information that they can utilise with proper geospatial tools. Dynamic thematic planning maps will provide a clear picture of any facility, as it would help the planners to gauge the effects of any plan and to effectively monitor the utilisation of funds. This approach for integrated decentralised planning at local level is presently totally dependent on government agencies for all kinds of information.

With the unprecedented pace of economic development witnessed in UP, the demand for accurate and up-to-date maps and use of geospatial products has increased exponentially. The ESD-GIS project provides a cost-effective framework which helps in showing different indicators at the districts, blocks and village levels on maps. It facilitates a delivery mechanism for disseminating information up to local level in the form of map for planning and decision making. This will aid in achieving equitable development across the different regions of the state.

L R Yadav
Senior Technical Director
National Informatics Centre
Department of Information Technology
MoC&IT, GoI, Lucknow

R S Singh
Principal Systems Analyst
National Informatics Centre
Department of Information Technology
MoC&IT, GoI, Lucknow



A panchayat digitised by undergrads

Summary:
A government college in Kariavattom, Kerala, introduced a small add-on course in digital cartography. Even though the college did not have proper infrastructure, the students, with little available resources learned to digitise maps, attach non-spatial data, upload GPS data to geo-referenced maps and design thematic maps. Using these skills the students prepared a digital map of their panchayat which became immensely helpful in planning developmental activities.

One hears everyday about the lack of infrastructure, callousness of faculty and of crumbling buildings of government colleges, but there is an exception. The department of Geography, Government college, Kariavattom which is in the outskirts of Thiruvananthapuram has prepared digital maps of their panchayat with minimum resources and a lot of grit. What is unique in this endeavour is that the department which had no proper lab and computer facilities until a year ago, managed to complete such a complex project.

Geospatial analysis across disciplines has accelerated rapidly in recent years. In response to the growing demand for geospatial resources in research, teaching, course work, and local level planning, many short and long-term courses were offered by both private and public sector institutions. While the private institutions were quick to respond, public institutions, particularly, colleges in rural India had a slow start mainly due to lack of funds for GIS labs and associated infrastructure.

The turn around

Fifteen months ago it was decided to conduct a short-term add-on course in digital cartography. But the resources were few and until that point the students were exposed to few practical sessions that taught outdated

survey techniques – chain, plain table and prismatic compass. Total Station, Geographic Information Systems and Global Positioning Systems were unheard of. There were two problems – lack of resources and development of skills using modern technology. A nearby company that was moving out donated computer tables; the Public Works Department got the leaky lab room re-roofed; and with the annual allotment of ₹50,000 for purchase of lab equipment, a Garmin handheld GPS was bought. The students now had a lab so to call, and some equipment that could help them prepare a digital map of their panchayat.



Hands on experience

Twenty six final year B Sc students were put through intense training. With limited resource at hand, they learned to digitise maps and attach non-spatial data, upload GPS data and design various thematic maps. Students of the first batch for the add-on course were introduced to computer-aided cartography which helped them understand the basics of geomatic tools. They were trained to do semi-automatic and manual digitisation, collecting field data using GPS, uploading them to the georeferenced maps, attaching non-spatial data in attribute tables, analysing the data and creating thematic maps. Primary goal was to help them learn modern interpretation of classical cartographic theories. Since these students were unfamiliar with the basics of computer applications, they were given ample time to familiarise with it for first two weeks. They were briefed about hardware component and software categories such as proprietary, free and open source software. They learned about the operating systems and file management before embarking on World Wide Web and particularly, web for digital information. They were quick to learn word processing, spreadsheets, presentations and database management.

Next stage in their learning process was to introduce them to theoretical aspects of cartography. Care was taken to walk them through each stage – map design and layout, particularly, components of an analogue map and comparison with digital maps. Learning conventional map projections is an essential step before starting on georeferencing in digital cartography. Once they started analogue to digital conversion, they understood the need for georeferencing. Next important step was to learn about the data – about data sources, quality and metadata, spatial and non-spatial data, raster data and vector data. With the acquisition of comprehensive knowledge on data, they were able to rationally use digital cartographic tools. At this stage, an intense field-oriented GPS mapping was carried out and as a result, performing tasks such as georeferencing the maps, attaching attribute tables and playing around with thematic map productions became easy for them. While learning cartographic presentation through different methods, experts from various fields – Planning, Soil Survey, Land Use Board, Forest Resources and Geology – were invited to give lectures on the application of Digital Cartography in their respective fields.

Kerala is one of the most progressive states in the field of panchayat raj institutions. Maps play a vital role in planning economic and social development programmes. The digital map prepared by the students has been a boon to the panchayat. The thematic maps have been found invaluable for their planning purposes. Students presented the maps to panchayat president of Kazhakoottam. A striking feature of the project is the project was completed in a small budget and that too by undergraduate students on open source GIS system.

D Nandakumar
Dept. of Geography
Govt.College, Kariavattom
Thiruvananthapuram-Kerala



Rajasthan Urban Information System Enabling e-governance in Rajasthan

Summary:

Rajasthan was the first state in the country to implement a single GIS based e-governance system for decision makers of eighteen government departments across six cities.

While plenty of such work has been done across the globe for similar requirements, the current project under discussion was unique because of:

1. Scientific collection, organisation, and management of data
2. Data usage across various departments within the government
3. Edit and update of data by 18 departments in a centralised database over the Web
4. Access to the system by a wide range of people, from citizens to almost all the ministries of the government
5. Direct benefit to citizens from the data and access to a grievance management system over the Web for urban assets
6. Enabling workflow to promptly manage grievances by the department officers
7. Routing for citizens, home department and state's main stream business clients – tourists
8. Hierarchical mapping of cities at various scales includes underground mapping
9. System support with limited trained manpower

The case study details the development of this enterprise system and how it is helping citizens and 18 different departments in their daily spatial analysis needs along with providing required information for perspective plans, master development plans, zonal development plans, and town planning schemes.

Business need

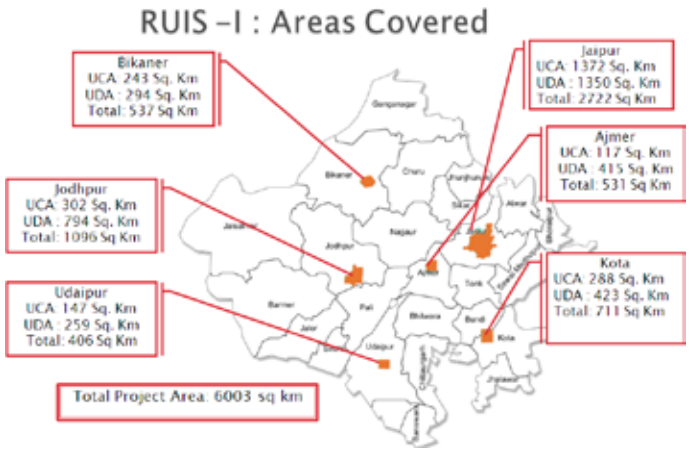
Departments within the Rajasthan government were using traditional paper maps & historical field survey data for their administrative functions such as town planning, traffic management, power, drainage, forestry, mining, & natural resources amongst others. Every department had their own individual databases that resulted in duplication of efforts, considerable waste of time & resources and use of different data for their respective functions. To overcome the above issues and achieve operational excellence, the state government wanted to implement an Urban Information System with a centralised geodatabase for six principal towns in the state -Bikaner, Jaipur, Jodhpur, Udaipur, Kota, & Ajmer (Class I towns with a population base of more than hundred thousand as per the 2001 census) with the following objectives:

- Planning and management by urban local bodies
- Support in preparing detailed Master Development Plans and Zonal Development Plans
- Location of slum areas and their uplifting
- Mapping of land use pattern for potential growth
- Decision support
- Project prioritisation and optimal utilisation of funds for various developmental activities
- Grievance management

The business need for the project was to create a GIS database for the six principal towns of Rajasthan along with a GIS application suite that will enable the success of the information system for its intended use. The project focused on providing mapping & GIS tools for planning, implementation & e-governance solutions for urban development initiatives.

Geographical area under consideration

Six cities of Rajasthan as shown in the following image (UCA stands for Urban Core Area and UDA stands for Urban Developing Area).



Solution

RMSI in consultation with the client undertook a detailed User Needs Assessment (UNA) to better understand the client's requirements & come up with the best fit solution. RMSI commissioned a dedicated team that comprised software, GIS, & remote sensing experts. Based on the UNA, RMSI developed an Oracle based system with a customised user interface. RMSI closely worked with the end users at client side for:

- Gathering and consolidating the requirements
- Designing and development of a logical geospatial database to hold all relevant information in a central hub
- Data creation, conversion, and cleaning using survey data and other source data to ensure accurate data is used in the software application
- Creating thematic maps for lithology, physiography, soil, geomorphology and ground water potential
- Creation of a customised user interface with features including user management, grievance management, navigation, routing, spatial data editing and report generation capability
- Implementing advanced functionalities like NUIS based thematic, map book generation, dynamic query and predefined queries developed as part of the application
- Imparting extensive training to the end users (more than 50 users from 18 departments) for using and managing the developed application

Key features of the system include user & grievance management, navigation, routing, spatial data editing, & report generation. Furthermore, the system also supports various master & zonal development initiatives of the state government. The key project activities included:

- **Collection of base data & collateral data:** Ground based area mapping surveys were important sources for spatial data creation. Data was collected through GPS/ DGPS and GCP establishing. Hand operated ground profiling/ penetrating radar was used for survey of sub-surface or underground utilities, viz. sewerage & water networks in the towns. The utilities mapping was undertaken on the scale of 1:1000 (derived from 1:2000 scale map) for urbanized core areas based on line/km survey. In addition to above, collateral data (map/statistical) was generated by conventional field methods including TSS, GPS, DGPS etc. The area (Km) of total survey was 6016 sq. km.

- **Spatial data (on 2 scales - 1:10000 & 1:2000 from satellite & existing aerial data)**
  - City planning zone & jurisdiction boundaries of interest, slopes (city & outside core area)

- Location & attribute information of education & medical facilities with proper categorization, other important settlements/infrastructural nodes of public interest, location of industries & related facilities, location points of major utilities (water, post office, telecom, power, sewerage etc.), location of all heritage/tourist important sites, location of slums, squatters & other blighted areas
- Land value, property maps (foot print only)
- Transportation network (including rail, road & air) nodes, canal

- **Non-spatial data (Collected from secondary sources by limited surveys)**
  - Land use: Location of education & medical facilities, industrial/infrastructural/ service, special development/economic zones, inter & intra-settlement linkages, slums & urban poor, heritage, tourist place, traffic generators, reserved zones, arterial road-grid network & hierarchy, conservation & eco-sensitive zones datasets
  - Settlement pattern, housing & property details, property tax details
  - Socio-economic, demographic datasets & characteristics
  - Land resource & utility, water bodies, parks, open spaces - conservation & rejuvenation
  - Air pollution datasets, water level, quality, solid waste management disposal datasets
  - Preservation of erosion & other infrastructure of regional importance
  - Ground water datasets, historical climate datasets

- **Ground based data survey** (Collected from GPR, GPS & other collateral datasets on 1:1000 map derived from 1:2000 map): Undertaking specialized ground surveys to detect & map underground assets - water supply network, sewerage network

- **Database development:** Designing & creating a systematic multi-layered & multi-scale geospatial database to act as a centralized information hub, & store both spatial & non-spatial components. This GIS will also include city-level developmental data & attributes

- **Development of spatial decision support system:** Designing & developing a customized Web based GIS application that will allow easy access to the RUIS on the network, allow extraction of inputs required for master/development planning. The software application is on Oracle Spatial database & built in Java technology;

- **Training** & development of a cadre of GIS-savvy professionals from the departments to administer utilize & manage the RUIS.

Software used

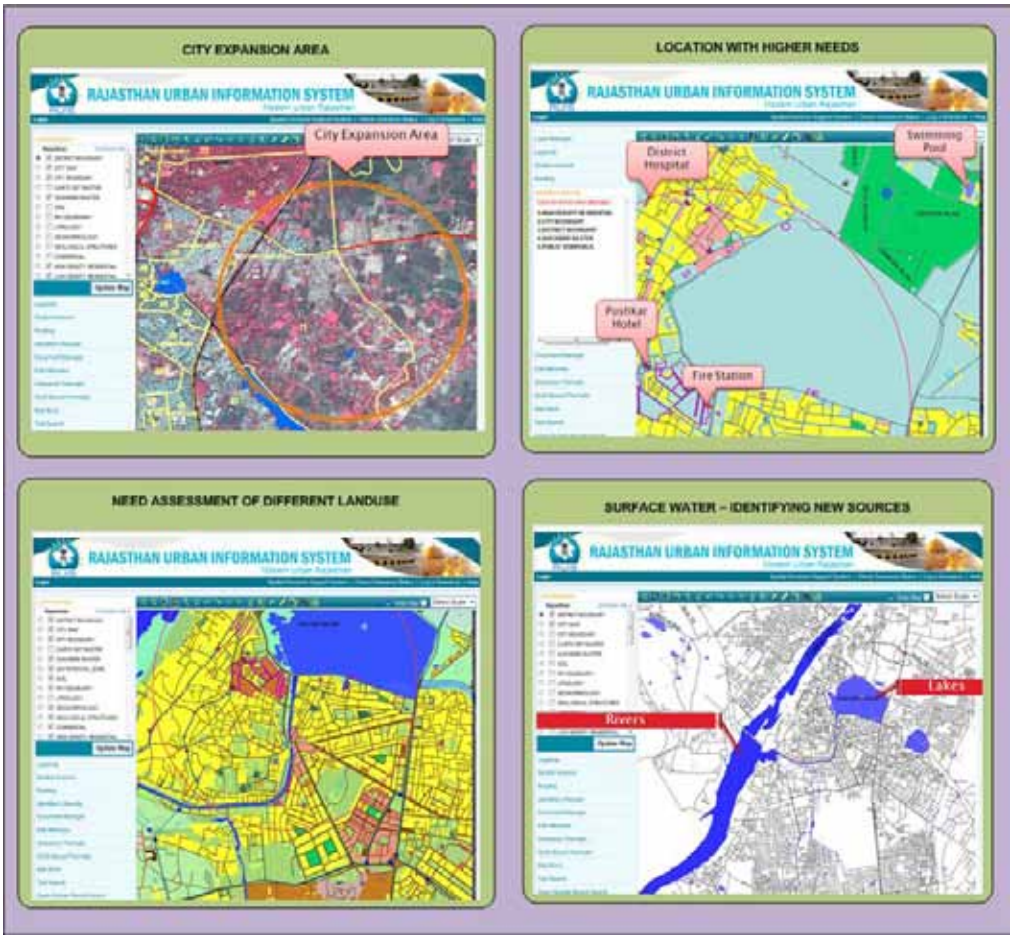
- Database : Oracle 10g release 2 Spatial for LINUX
- Application Server: : Oracle Application Server 10.1.3 for LINUX,
- System Software: : Operating system: Red Hat Enterprise Linux 5.0
- Technologies Used : Java/J2EE, JSP, Javascript

Benefits

The application is being used for decision support for 18 departments of the Government of Rajasthan. In this document five such cases have been discussed:

- Water Resources Demand Generators
- New water sources for growing demand
- Solid Waste Management
- Emergency Response
- Information to Tourists

Demand generators: This application provides functionalities to help departments like PHED and town planning in identifying areas of rapid urbanization (city growth), locations with higher needs, need assessment of different landuse and new sources of surface water.

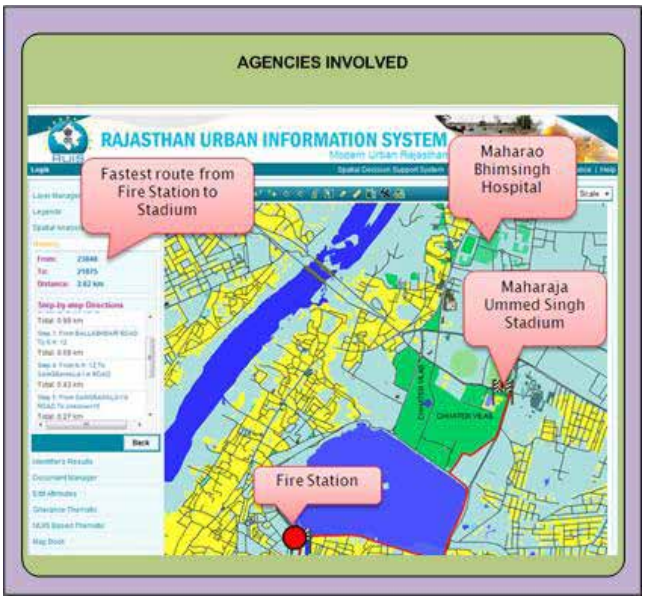


Identification of groundwater potential zones: Groundwater potential information can be derived from the application for the above mentioned six cities from geomorphology, lithology, soil and physiography. Ground slope helps optimize height for maintaining

pressure head for the overhead tank, which could be a valuable analysis for PHED (Public Health Engineering Department). Also the related departments can get required information for planning to lay the pipelines for water supply. This information could be 1) what lies below the ground while excavation for the purpose of laying the pipe, 2) site selection for assets such as overhead tank & pipe line etc.

Solid Waste Management: Nagar Nigam of respective cities can identify land for solid waste dumping. This identification parameters could be 1) distance from residential areas, 2) road connectivity, 3) proximity to water bodies, 4) type of land (Is it a wasteland?), 5) soil characteristics (to avoid seepage of toxic waste to the ground water). Information related to such parameters is available in the system which will ease the decision making capabilities of the decision makers of the respective departments.

Emergency Response: Emergency response efficiency can be enhanced using this application and this service could be of help for all eighteen departments in the city involved in this project. In this document we have taken a simple example of identifying locations for different agencies involved during any emergency such as medical, fire brigade, and police. This consolidated information at one place from all departments and field survey will help respective stakeholder departments in mobilization of resources to minimize the damage during any such accident. This application has a very effective search engine which will provide information such as 1) hospitals with more than 250 beds, 2) fastest route of the incident site from fire station, 3) fastest route from the incident site to nearest water body for fire brigade refill.



Tourism: Last scenario discussed in this document is usage of this application for the purpose of tourism. The State of Rajasthan gets maximum revenue from tourism business and hence this RUIS information hub has been made more interactive to help the tourists and new-comers to these cities. Information such as 1) hotels within 500 mtr from the airport, 2) nearest bank for currency exchange, 3) route from one location to other location will make tourists life easy in these cities.



Conclusion

The above five examples were just to provide a high level information on the project. However in real life the information stored in the system is many folds and has been collected from all possible sources and methods. It's a complete city information system and hundred such scenarios can be created for eighteen stakeholders departments i.e. almost all urban local bodies in the city.

Vikrant Karandikar
Vice President, Business Development
RMSI



Summary:

Summary: In hilly areas centralised governance is difficult and ineffective, and so the Indian constitution has made provision for empowerment of urban and rural local bodies such as the Panchayati Raj institutions (PRI) for self-governance in such areas. To promote local self governance in Uttarakhand, the Development Centre for Alternative Policies (DCAP) has taken up the initiative for capacity building of PRI in a selected block of Almora District. The initiative involves preparation of master plans to help the local communities in development and management of natural resources (primarily water).

SDI enables local self-governance in hill areas

In the Indian Constitution 73rd and 74th Amendment Acts (1993) were enacted to strengthen local bodies by mandating the elections of urban and rural local bodies and by making provisions for the transfer of sufficient powers and functions for self-governance. In spite of these constitutional provisions, Panchayati Raj Institutions (PRIs) in India are yet to achieve full capacity for self-governance. This situation prevails in Uttarakhand also. The empowerment of PRIs in this hilly state is particularly important as the very hilly terrain and topography render centralised governance difficult and ineffective. The constitutional amendments on PRIs give particular importance to the involvement of local bodies in planning and implementation.

Our institution, Development Centre for Alternative Policies (DCAP) has taken up the challenging task of building capacity of PRIs in a selected block of Almora District, Uttarakhand, to develop collectively, at village, Gram Panchayat and Kshettra Panchayat (Block) level, plans for water resources development. This initiative has been taken up with financial support from the NRDMS Division of the Department of Science and Technology, Ministry of Science and technology, Government of India.

Objectives

The objectives of the project are:

- To prepare a comprehensive and scientific natural resources (specifically water resources) database through a decentralised and basin approach for the upper catchment of the Kosi river, located in Takula Block, Almora district.
- To facilitate the preparation of community resource maps and village resource planning maps [annual and five year plans] for all villages in Takula block through the agency of village panchayat institutions utilising PRA techniques.
- To facilitate the preparation of a block level master plan [including annual plans and five year plan] for integrated natural resource conservation, development and management, and the constitution of a block natural resources committee to enable its future implementation.
- To enable the regular updation of village level NR data through the medium of sub-block level GIS cells.
- To disseminate the results of the project to all the Block and District Panchayat Institutions in Almora District.
- The larger goal of the project is to recharge the endangered Kosi River, the lifeline of the district.



Figure 1: Community participation in developmental planning

Scope of the project

The subject of water resources was chosen as there is acute water distress in the hilly state as a whole, as well as in Almora. In spite of good rainfall, due to extensive degradation of forests, and degradation of land due to landslips and erosion, water sources such as streams and springs, which are the only source of water for all rural purposes, have dried

up or become seasonal. The selected block Takula lies in the watershed of the Kosi River, the lifeline of the district, which has become endangered.

River Kosi originates in the Bhatkote reserved forest (pine) area at altitude of 2520 metres. and is situated 43 km north of Almora town. The total length of Kosi river is 265.17 km and the total area of its watershed is approximately 452.9 sq km. Within the watershed there are 350 villages, 8 urban centres (Kosi, Hawalbagh, Someshwar, Chanauda, Takula, Majhkhali, Kathpudia and Sitlakhet) and North West part of Almora town. Within Almora district Kosi river is fed by 22 tributaries and 11 sub tributaries. In 1960, the length of these tributaries and its sub tributaries was 225.58 Km. At present it has decreased to 41.18 Km and is drying up at the annual rate of 4.5 Km.



Figure 2: Using GIS maps in the planning process

In June, 2003, except Khulgad tributary, all the 21 tributaries had dried up. The situation continues till date. The drying up of tributaries and sub tributaries indicates that first order, second order and third order streams and rivulets within boundaries of villages are drying up or becoming seasonal. This further indicates that rejuvenation of these tributaries and in turn River Kosi itself has to start at the origin of small streams and rivulets at the village or hamlet level. This again indicates the necessity of involving local communities at that level in rejuvenation of water sources.

The project is the first of its kind in the state, wherein the latest scientific technology has been used to enable accurate and efficient planning at the village level. GIS technology has been used for developing spatial data through participatory processes. This data – in the form of community resource maps and database – is provided to local communities at each revenue village level (below Gram Panchayat level). Villagers are facilitated to develop annual and five year plans for water resources conservation and development.

For the first time in the history of the state land administration, the village cadastral maps are being utilised for preparing natural resource maps and for developmental planning, whereas hitherto they have only been used for revenue purposes. The maps provide a platform for combining information about land, water and forest resources, that too in an updated form.

The institutions and people involved in this project are Gram Sabhas of 158 villages, and representatives of 7 Nyaya Panchayats, 89 Gram Panchayats, 1 Kshettra Panchayat (Takula) and the Almora District Zilla Panchayat.

Through a strategy that combines a sequence of laboratory-based scientific work (GIS, computer cartography) and community based participatory survey and planning, the project enables integrated resource mapping and planning, covering all 158 revenue villages in the whole block of Takula in the first phase.

In the second phase, the results will be consolidated for the purpose of preparation of block level master plan for water resources conservation, development and management, through the agency of the Kshettra Panchayat, thus enabling this (usually most neglected) tier of Panchayat Institutions to participate in planning at macro-level (block level) based on scientific data inputs. In this phase, sub-GIS cells will also be set up to make accessible the technology and data to villagers and local representatives for continuous use and updation.

Development of SDI for Almora district

- The digitisation of cadastral maps has to be undertaken for all villages of the state, so that similar decentralised planning for development can be done on the basis of spatial data.
- To enable this program on a state level, this process has to be adopted by the State Government in policy and law, so that it is done on a sustainable basis.
- Training programs should be undertaken for government officials of all developmental departments and Panchayat representatives, and youth from village, so that the skills and capacity are widely distributed.
- Spatial data Infrastructure in the form of Sub-GIS cells should be set up by Government at least at every Nyay Panchayat level, so that the technology is made accessible to rural citizens.
- Similar program can be undertaken for urban areas also, in collaboration with urban local bodies.

Technique adopted

Community participation - The participation and involvement of the common people in the planning process requires that a part of the decision-making process should be left

to the people themselves. They must decide on the priorities of development, as there are many schemes to choose from, and they must be made to work out their solutions to pressing problems of the area in terms of their own perceptions of needs and priorities. This is where GIS can be of direct use in visualising for the villages the consequences of alternative priorities as well as decisions on location, e.g. of check dams, wells, etc. This was used during meetings at Nyay panchayat level, Gram Panchayat level and Gram sabha level, wherein detailed discussions and consultations were held on the resources problems and needs of the village, and appropriate plans and schemes to be undertaken.

GIS - In this project work, GRAM++ software was used for georeferencing digitally mosaiced cadastral image of Takula Block villages, and for the vectorisation of spatial features (point, line and polygon). Attribute data attachment like plot numbers in the whole village was also possible. This software generates some additional attribute data like area, length and perimeter of the spatial feature.

GPS - Garmin GPS receivers were used to collect the ground control points (GCP) in the village, these GCPs helped us to geo-reference (registration) the digitally mosaiced cadastral map and also the GCP were taken to locate the different features in the village.

Computer Cartography - Computer Cartography also plays a major role in GIS based project work. Computer cartography is equipped with better symbols, pictures, fonts, appropriate colour choices, and line types, which helps to give a professional look to the output maps of Takula Block villages. Computer cartography generated maps display information, convey the meaning of its underlying attribute data, which finally help us to create meaningful maps which are more easy to interpret.

Results

In 50 villages where community resource maps, natural resource database and community planning maps have been completed so far, villagers identified a total of 59 different types of problems and needs (with each village facing an average number of 13 problems); 59 per cent of these problems and needs relate to natural resources, with water accounting for 32 per cent of all problems. Sixty two different types of programs and schemes have been identified as solutions by the villagers, with 44 per cent relating to natural resources, and water alone accounting for 29 per cent of all schemes. The District Development Administration of Almora has adopted these maps as a basis for selection of schemes and has initially allocated a total fund of ₹25,30,000.00 for water resources development in nine villages covered by DCAP project.

Awareness and interest has been generated among government representatives of line agencies at the district level, who find the detailed village maps very useful, particularly in consideration of the difficult hilly terrain.



Conclusion and recommendations

This project work showcases how we can efficiently plan,manage and conserve natural resources through participatory processes by using GIS technologies. The usefulness of Spatial Data Infrastructure and GIS technology for enabling local self-governance in hill areas for management of natural resources, cannot be ignored. Takula block's physical and social conditions provide opportunity to implement this technology. However, some barriers to effective utilisation do also exist - such as cost of the software, lack of institutional and funding support that is sufficient and appropriate for hill conditions; present-day requirement for skilled personnel to handle GIS software; and lack of adequate skills and facilities at village level for use of latest scientific technology. However, these barriers do not reduce the appropriateness of this technology. It is hoped that this project will bring awareness among all the villagers, local and regional authorities on the importance of GIS database and maps for decentralised development planning and implementation.

The Director
Development Centre for Alternative Policies
New Delhi



Creation and management of urban property ownership records in Karnataka

Summary:

The purpose of this project is to create digital urban property ownership records using modern survey techniques, continuously update and manage the records using a 'state of the art' software solution and disseminate through citizen services using IT & GIS technologies. This project is amongst the first GIS projects implemented in a Public Private Partnership (PPP) model under a BOT scheme for the modernisation of urban land records in India. This is also one of the first e-Governance initiatives in India for the creation, maintenance, management and dissemination of urban property ownership records incorporating efficient G2C, G2G and G2B services.

Customer

Government of Karnataka.

Business need

The Government of Karnataka had been maintaining data relating to urban properties of numerous towns of Karnataka through its city survey offices on paper records using age old systems. The government envisioned updating these records in digital format using IT & GIS technologies which would ensure modernization of urban land records, offer efficiency in management, transparency and security in transactions and revenue generation for the government exchequer as a self-sustained e-governance system. Infotech was selected to implement and operate this ambitious program as a technical service provider and also as a service provider to create the property data for a couple of towns.

The project required the following tasks to be executed and implemented:

A. Fresh survey and mapping of all properties within the 5 chosen cities in Karnataka and building a robust geo-spatial data framework with authentic and legally acknowledged digital Property Information.

B. Development of a single interface application portal with payment gateway integration. The Portal was to be a single window interface for the government, citizens and businesses in the state to update and manage urban property ownership information, provide citizen services for giving digital property cards online & through mobile applications against a service delivery fee and help the property owners with updated & authentic property related information.





Project scope

1. Infotech was selected to develop and operate the urban property ownership application and the portal involving data and transactions for all the 5 towns selected initially and other towns that would incorporate in future. This was done through an open tendering process.
2. Infotech was also selected as a service provider for carrying out fresh survey and creating the urban property records in digital form for approximately 80,000 and 175,000 properties in Shimoga (around 75 sq. kms) and Mangalore (around 132 sq. kms) towns which would be used by the application mentioned above.

Infotech's solution

Infotech designed and delivered a robust and technically superior solution based on the requirements that involved:

1. Creation of the fresh urban property ownership records from scratch starting from ground control network establishment, demarcation of properties/plots, measurement of plots through ETS, document collection, title enquiry, creation of property cards and establishment of service centre for issue of property cards.
2. A Web-based application has been developed using MS .Net technologies with Autodesk Map Guide spatial engine for data management and service delivery in all the towns involved.

3. Building data centre and data recovery centre meant for all the towns under the purview of the program.

Some of the key highlights of the Infotech deliverables were:

Creation of the fresh urban property ownership records : Pure ground survey techniques using DGPS and ETS were adopted to establish the ground control points of very high accuracy levels with monumentation using DGPS and properties were demarcated and measured using ETS. Documents regarding ownership / enjoyment were collected from the respective owners / enjoyers and a title enquiry was carried out by department officials to establish final right and title on the land. New set of updated urban land records were created to replace the old ones. A +/- 5cm positional accuracy was achieved for the survey data of the land parcels.





Preparation of GIS base maps of different scales ranging from 1:500 to 1:20000 for control network, properties, ward, circle and town: The data prepared was validated by the government surveyors and all necessary assistance was given by Infotech during the process of finalization of the property ownership records. The final data was published in GIS format to be used by the application for data management and service delivery.

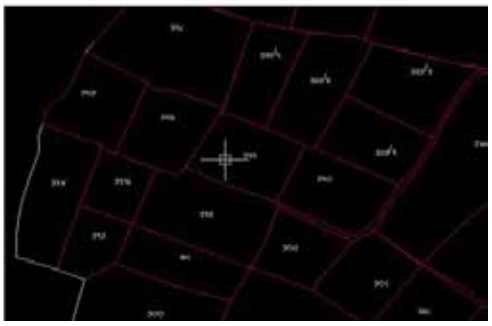
The urban property ownership application and portal: The application has been developed around Service Oriented Architecture framework using Microsoft.NET technology and AutoCAD Map Guide, integrating spatial, non-spatial, biometric and payment gateway interfaces. All the service delivery components are exposed through XML Web Services, mobile services, etc.

The application has the following key features:

- Data entry for the non-spatial RoR and other information
- Vectorization (digitization) for creation of spatial data
- GIS module to view maps
- Management Module for geospatial records of Property Ownership

- Integration with a Payment Gateway for online transactions on PR cards
- Integration with Biometric device to ensure security in data maintenance
- Remote management of DMS
- Performance monitoring of both Service Provider and Technical Service Provider
- MIS reports module for everyday tracking of system and delivery of various services
- Module for reconciliation of accounts



Establishment of service centers and render citizen services using the application: Service delivery channels or service centres will be established by Infotech for delivering the property cards to the citizens in each town selected under this program. In addition to Property cards, these centres are also endeavoured to deliver various other property record related services to the citizens.

Challenges & mitigations

- Lack of coordination amongst various stakeholders – worked closely with all stakeholders to bring them all on the same page.
- Garnering public support within the city limits – Educated the property owners about the benefits of the system.
- Document collection - Repeated visits to the residences at different times of a day for collection of property documents caused delays in finalizing the data - Established a citizen facilitation centre with 24X7 services to collect documents from the owners.
- Preserving and maintenance of documents – Storing documents in safe, fire proof Almirahs; Proper Index sheet was maintained so that anybody can pick the required document with minimum search.
- Cooperation from other departments for integration.

Benefits from the project

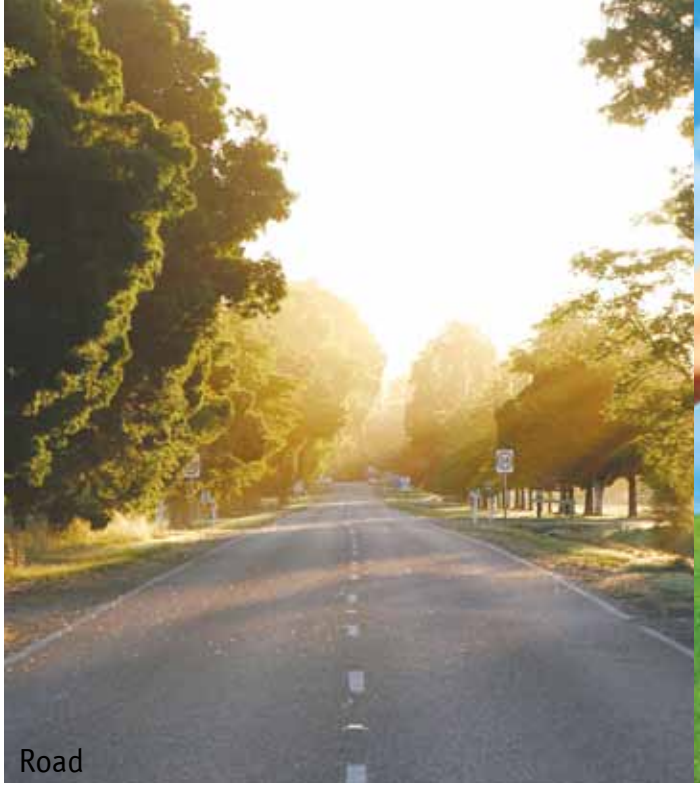
- Single window interface for providing updated, authentic and legalized digital property ownership cards created out of highly accurate spatial data, linked with updated ownership and land use information.
- Automation in maintenance and updating of urban property records for the selected towns of Karnataka.
- Single window interface for service delivery platform for efficient G2C, G2G and G2B services.
- Citizen service related to property records becomes more effective and fast.
- Transparency in urban property management and administration.
- Expected to significantly reduce urban land litigations with clear-cut ownership records in place.
- Sustainable PPP model under which revenues are generated through the sale of PR cards and shared between stakeholders in a pre-determined manner.

Infotech Enterprises Ltd.

geospatial TODAY

FICCI

Municipality


Road


Property Tax

Summary:

Kanpur Municipal Corporation was plagued by several issues such as lack of a proper mechanism to check property tax collection and track tax evaders, poor operational transparency and delays in processing consumer grievance. To resolve these issue the civic body developed an online GIS-based property tax calculation, information & payment system. This resulted in a three-fold increase in property tax revenue collection. Other benefits include increased transparency in governance, reduction in delays in grievance processing. The GIS maps are also being used for planning and developmental activities.

Streamlining municipal operations The KMC story

Municipalities at large are taking up e-governance initiatives to improve efficiency, transparency and accountability in their functioning. Such an initiative has enabled Kanpur Municipal Corporation (KMC) to leap frog in enhancing the quality of citizen services it offers. KMC is one of the largest commercial and industrial Municipal Corporation in Uttar Pradesh, India covering an area of about 260 sq km with a population of about 2.5 million. Since 2002, KMC had been using ESRI software ArcSDE and ArcView, and a (total station) digital map of Kanpur City that was integrated with other property tax related attribute data in the desktop platform. The municipality was plagued with several issues such as lack of a proper mechanism to check property tax collection and track tax evaders, poor operational transparency and delays in processing consumer grievance.

To cope up with these issues and enhance operational efficiency, KMC embarked on an e-governance initiative that included development of an online GIS-based property tax calculation, information & payment system as a pioneering effort in the country. Tenders were called for and the contract was awarded to ESRI India on basis of best technical cum financial performance.

The project involved:

- Creation of a GIS-based spatial property database using QuickBird Image (0.6 m resolution) for the entire KMC jurisdiction, geo-rectification of the satellite image from the GCPs collected from DGPS survey and updation of digital maps of KMC using geo-corrected QuickBird data and preparation of data for assessment list
- Conduct a property level survey for every property unit
- Development of Informative and Interactive WebGIS system for online property tax calculation and payment
- Development of desktop application for property database repository management and tax assessment
- Supply and installation of software, hardware and networking with server and additional peripherals
- Training of KMC Personnel
- Renumbering of properties with unique premises numbers and fixing of house number plates.



Sewage



Drinking Water

The scope of work mentioned above could be categorised into two broad components based on requirements of the KMC project as:

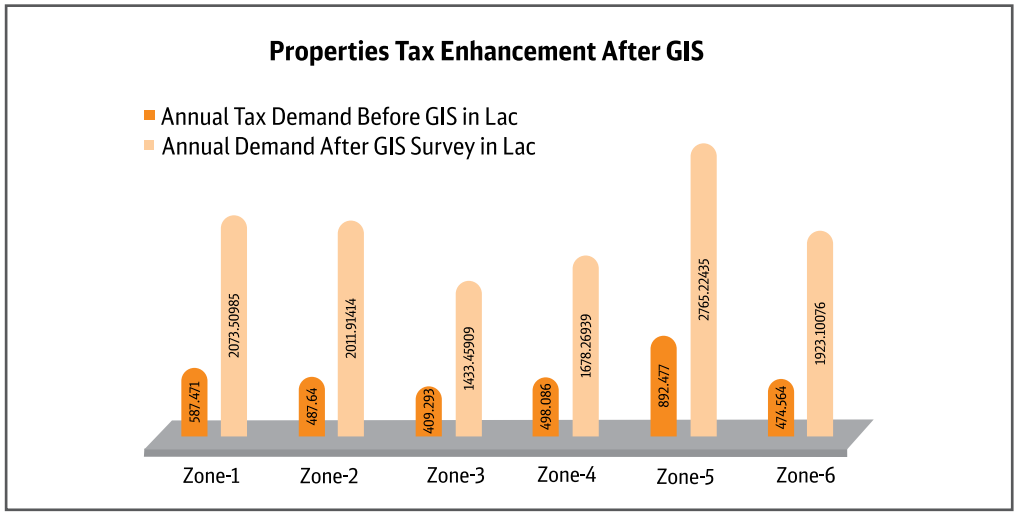
- Property survey & GIS database creation
- Property tax application and website development

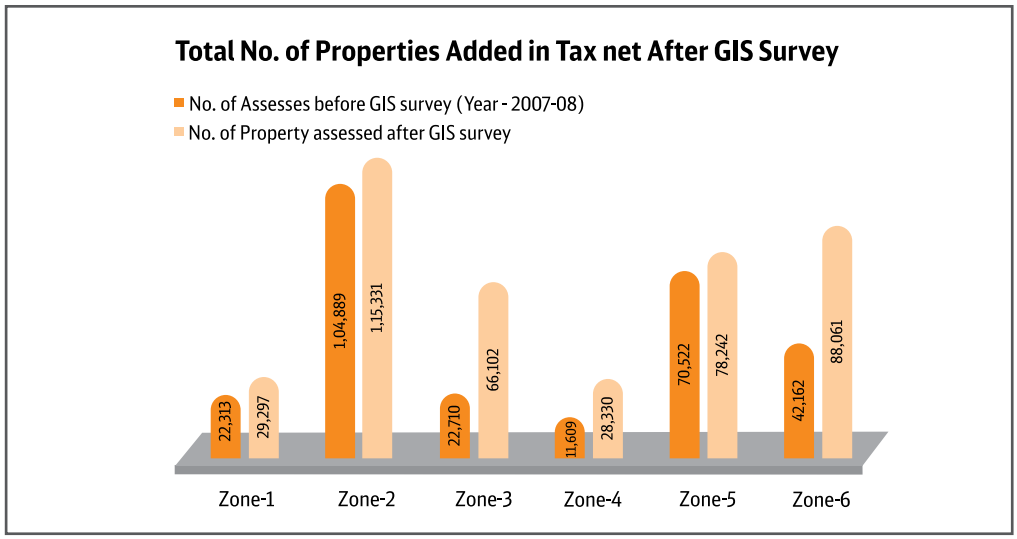
Property survey & GIS database creation

QuickBird satellite data was procured and geo-referenced based on the ground survey conducted to collect the GCPs through DGPS. Base data of 1:1000 scale was created through digitisation of satellite imagery and supplemented with secondary ground survey to capture information on covered / carpet area, land use, occupant's details, condition of structure etc. The mapping done using QuickBird satellite data, was used for conducting primary contact property survey.

Property tax application and website development

A property tax application has been developed providing a GIS interface to perform conditional queries on database such as 'tax collected by zone' or 'tax collected in a financial year for a selected ward' etc. The database is linked to spatial layers to display results of analysis and queries on GIS maps. The application also enables KMC staff to calculate tax based on digitised areas taking into account the unit area method and generate various kinds of MIS reports required in the day-to-day operations of KMC. Primary focus of the application was to provide a server-based GIS with key spatial layers and links to the relevant textual / graphical information available in the database.





KMC application uses the three-tier architecture based on ESRI technology. An ArcSDE service conveys spatial data between GIS applications and a database. The system architecture uses database management systems (RDBMSs) – SQL Server with ArcSDE. It is a registered collection of ArcGIS feature classes. A system that can connect to and access spatial data from an ArcSDE service, is automatically designed in the application. The solution component for KMC application development and deployment follows three-tiered system architecture as given below:

- Presentation tier or client tier where the users access the KMC application through internet browser
- Application tier where the KMC application business logic resides
- Data tier where the KMC application databases reside

An interactive GIS based website was developed for KMC to provide on-line information to citizens on property tax details such as property tax liabilities, existing status of paid taxes and annual taxes due to be paid. On-line property tax calculation is done based on the unit area method and on-line tax payment. A facility to access maps based on zones, wards, blocks and chaks has been provided. In case an individual or an organisation wishes to buy relevant maps, the site also provides for visualisation of maps and placing an on-line purchase request. The website provides on-line information to citizens on transaction failure redressal, automatic receipt generation and automatic data updation based on time specific scheduler.

Property numbering

Property addressing is one of the most important components in property management system.

A proper addressing system is a prerequisite for efficient management of many of the public services. Considering the complexity of the Indian metropolitan house pattern, it is very difficult to find out a foolproof numbering system. However, with the application of modern tools like GIS it has become easy to design a logical and consistent numbering system. Considering the actual scenarios in Kanpur, administrative boundary-based numbering system has been found to be more appropriate and practical. In this system, the house number or premise number is unique within the smallest administrative boundary that is chak/block. The project was completed after numbering all the properties in KMC jurisdiction and launching a GIS-based property tax management portal.

The project was estimated to be completed in one year, but was extended twice and accomplished in a period of three years. The property tax management system is a critical part of spatial decision support system for e-governance. It has resulted in a three-fold increase in property tax revenue collection. Other benefits include increased transparency

in governance, reduction in delays in grievance processing by government and streamlined revenue collection due to a middle-men-free online tax payment and status verification facility The KMC maps are being used for planning and revenue generation, delimitation of KMC wards, ward-wise backward population survey, below-poverty-line survey, for planning, design and implementation of water supply and sewage projects under JNNURM and for power distribution, planning and revenue generation by Kanpur Electric Supply company. Thus, a GIS-based property tax management system has enabled KMC in not only increasing collection of property tax but also in enhancing the quality of services offered to the citizens.

U N Tiwari
Additional Municipal Commissioner
Kanpur



Sagar Municipality goes digital

Summary:

Lack of accurate ward boundaries resulting in property disputes were among the major issues that hampered the operational efficiencies of Sagar Municipal Corporation located in Madhya Pradesh. The civic body resolved these issues by developing a digital urban land use map of Sagar city that enabled municipal property assessment, resulting in increased tax revenues. As part of the initiative a Web-enabled GIS has been developed that will aid both government and private bodies in planning developmental activities.

Sagar Municipal Corporation (SMC) took the lead, upping its services to increase its revenue. There was a time when the municipality was caught in a quagmire of land/property disputes and the sheer lack of accurate ward boundaries made matters worse. Today, however things are different. SMC has assessed the need of the time and taken a lead in planning and decision making by stepping forward to implement a municipal GIS.

The objective of the project was to develop a Digital Urban Land Use Map of the SAGAR to facilitate the municipal property assessment that would help for future master plans, and build a Web-enabled GIS that would help industry, trade and government institutions.

The project comprised the complete new mapping and survey of the city. The data was compiled under several layers such as Settlements, Transportation (Rail/Roads Networks), Hydrology and Forest/ Agriculture.

Approach & planning

To ensure the successful completion of the project, realistic delivery schedules, milestones and deliverables were set. The project plan was prepared outlining the each step of the project. Measures were taken to ensure the availability of all the necessary equipment and resources.

Guidelines were formulated to ensure the required quality controls are in place. It was decided that there would be a proper documentation of all the project activities. The indirect costs were also identified and estimated.

Methodology

To ensure the smooth execution of the project, the entire process of execution was planned in structured manner. The process was therefore divided into following steps:

- Data procurement with proper documentation
- Smooth time schedules as per project specifications
- Ensuring quality standards
- Monitoring day-to-day progress
- Embedded quality check and online error rectification
- Check, measure, and review project performance regularly
- Scheduled delivery
- Project contingency planning



Figure 1: Digitised map of Sagar

Execution

Data Procurement and preparation of base map

Latest high resolution satellite imagery (60 cm resolution) of the municipal area (approx. 60 sq km) was procured from QuickBird. Further, existing data such as Survey of India's

topo sheets, district/ward maps, property tax registers (from SMC) were also collected and documented. A base map was prepared for the reference purposes, using the procured and collected imagery, to depict/display the important landmarks on the database.

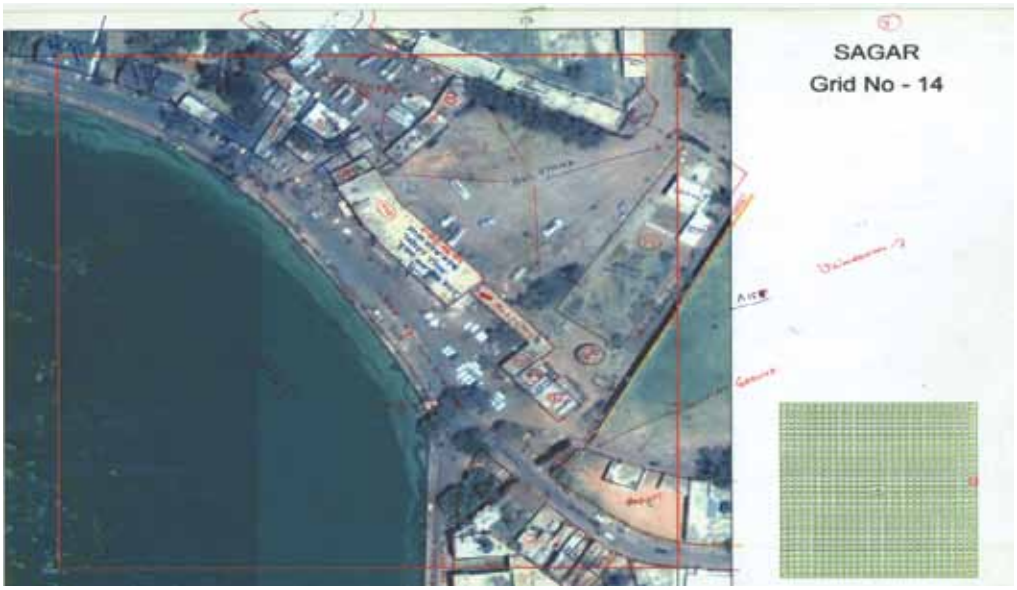


Figure 2: Map sheet with survey information

Image processing and georeferencing

The image processing techniques were then applied to ensure that procured satellite data doesn't have any noise, blur or radiometrically poor areas that may hinder interpretation of the features. The raw satellite imagery generated by imaging may not be on uniform scale due to various geometric anomalies. Hence, in order to create an image of uniform scale, it is essential that these anomalies/ distortions are rectified with the help of image processing software (Erdas Imagine 8.5). Accordingly, the georeferencing was done and the images were rectified. The georeferenced image contains information either within itself or in a supplementary file (a world file) that explains to a GIS system how to align the image with other data.

Grid generation and tile cutting

A grid of 1x1 sq km was then generated for cutting tiles and feature extraction. Later, these tiles were used for door-to-door survey.

Vectorisation of satellite imagery

The digital landbase maps were then created by adding different vector features into different layers based on geometry type of representation – point, line and polygon – on

the base map. After the digitisation, a topology was created for the each layer of the city / town landbase map using Autocad / ArcGIS 9.3. Feature extraction was done with required annotation, line, symbology and unique IDs for the different layers such as transport network, hydrology features, settlements and buildings, other civic infrastructure, electrical and land use – agriculture, forested land and rocky terrain. All the required features were digitised in AutoCAD (.dwg formats).

Household survey

Door-to-door survey was carried out for every unit / property for gathering the information pertaining to respective property. The team was provided an image of an area / ward along with a Form (based on National Urban Information System (NUIS) Guidelines) to collect the information. While carrying out the household survey, the team collected specific information on the following criteria: type of construction of the house/ property; land-use identification (residential /commercial/semi-residential); determination of registered and unregistered properties; and information regarding the owned/rented property. The information thus collected was recorded in MS Excel sheets. Later, this attribute data was linked to individual respective property on the landbase map.

Fixing ward boundaries

While surveying, it was noticed that wards of the municipal corporation were not demarcated with accurate boundary lines. In some areas, it was very difficult to accurately locate the ward boundaries as they did not follow any road or lane. There were no norms to fix the ward boundaries. Most cities (unmapped) in India still do not have accurate ward boundaries.

Advantages of Municipal GIS

1. Growth in revenue
2. Transparent, unbiased and better services
3. Elimination of land/property disputes
4. Access to property related information online
5. Automatic generation of reports on non-payment of bills
6. The same database can be used by other departments inventory of assets including land, building, vegetation, parks, monuments etc.
7. Common state level digital database & inventory of assets
8. Clear land titles
9. Optimisation of state revenues – both urban and rural
10. Web-based E-Governance
11. Multiple views of data through Web-based interfaces
12. Comprehensive and flexible integration of several map layers
13. Thematic maps with high visual impact
14. Generation of cartographic legends
15. All kinds of querying capabilities through Web interfaces
16. Capability to generate reports in (Web HTML) and (Microsoft Excel) formats

The accurate ward boundaries were therefore fixed with the help of tax collectors of the respective areas.

Data linking on landbase map

The attribute data thus collected from the household survey was attached to the respective properties using customised GIS software (As per the client's requirement). The integration of spatial and non-spatial data created a dynamic picture in Web-based applications.

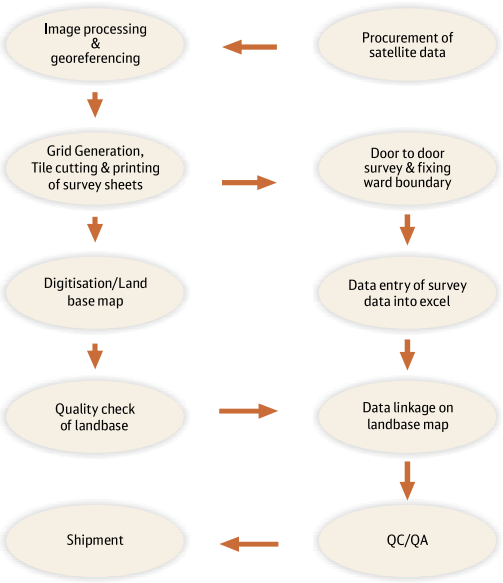


Figure 3: Flow chart of approach for Sagar Municipal Corporation

The time schedule was strictly adhered to in all the processes including creation of landbase maps, door-to-door survey, attribute linking and the delivery of final maps.

Quality control assurance

Rigorous quality control techniques were implemented to ensure the data accuracy and attribute integrity. Development of appropriate and consistent QC/ QA, data validation and assessment protocols along with an efficient data management system for quality that can be shared with client is key to the successful implementation of project.

Observations

The developed GIS has capability of add layer, remove layer, zoom in, zoom out along with a query tool to display the property by name etc. and has proved to be very useful for the corporation.

It has been observed that after door-to-door survey, there was a phenomenal growth in revenue as it increased by 36 per cent by way of taxation.

It is estimated that Municipal GIS segment has a huge potential (Approx. ₹250 crore) for Mapping and Surveying Work in next three years. The Geospatial data is playing a significant role in planning, decision making and implementing a Web-enabled GIS system. The government needs to be proactive for such kind of plans/projects as the developing technology will certainly help the entire country. These maps, however, need to be updated after every five years.



Nailing on encroachments

Summary:
Structural encroachments in Rohtak city, in Haryana, have resulted in unplanned urban growth which negatively impacted the urban infrastructure and service functions. A study conducted by MD University using geospatial technology identified the encroachments by developing maps and comparing planned land use with actual land use. This vital information can be instantly used by Haryana Urban Development Authority (HUDA) to nail on encroachments and foster planned development

Planning and managing cities in the era of globalisation and economic liberalisation has become a challenging task, calling for new skills and approach. This is very important for decision making of sustainable land use planning at both national and regional levels. It will help develop strategies to balance conservation, conflicting uses and developmental pressures. Remote Sensing and GIS techniques have become potential and indispensable tools for analysis and management of many problems of urban environment. Remote sensing observations provide data on Earth's resources in a spatial format on regular basis with more frequency than conventional surveying methods and GIS co-relates different kinds of spatial and attribute data.

Information created by these techniques in the form of maps and statistical data can update legislators, planners, state and local governmental officials on changing proportions to determine better land use policy. With the help of remote sensing, GIS and their integration with conventional data, we can have accurate and real-time information on the present status of land use /land cover as well as their changing proportion in dense urban built-up environment.

The present study highlights the critical role these technologies can play in understanding the structural encroachment in residential areas of Rohtak, a developed city of Haryana. Structural encroachment has

resulted in unplanned urban growth and its overall impact upon urban infrastructure and service functions. Remote sensing & GIS have helped in exploring structural changes which are affecting urban growth in negative manner. These technologies provide the necessary intelligence for formulation of planning proposals and act as a monitoring tool during the implementation phase. However, the information has to be accurate and real-time. Lack of such timely intelligence on structural encroachments in settlements has been plaguing Haryana Urban Development Authority (HUDA).

Study Area

Huda Sector 14, Rohtak is located between 28 52'53"N-28 53'20"N and 76 37'20"E-76 37'38"E falling in SOI Toposheet No 53 D/9 which lies in north-east part of Rohtak city.

The city of Rohtak with an area of 30.16 sq km has a sub-tropical location lying about 600 km north of the tropic of cancer. Rohtak is located 70 km West of National Capital New Delhi on National Highway 10. Sector 14 is strategically located in the city of Rohtak in the sense that neither it is located in the traffic area of the old city, nor it is considered outskirts of the city.

Following data sets have been used in the study

- Cartosat-1 (2010, resolution 2.5 m)
- LISS-IV (2010,resolution 5.8 m)
- Merged image of Cartosat-1 and LISS-IV
- SOI Toposheet no 53D/9 (1:50,000)
- Zoning Map of HUDA Sector14, Rohtak City.
- M.C. boundary Map of Rohtak city.
- In addition to the above data GPS readings were taken for ground truth verification.

Methodology

For mapping and identifying structural encroachments in Rohtak, remote sensing and GIS data have been acquired, which are geocoded and toposheets have been prepared. Following the georeferencing and rectification of data, preliminary visual interpretation, digitisation and correction has been performed. Overlay analysis of data resulted in the identification of encroachments. ARC GIS 9.3 and ERDAS 9.0 software have been used in the process.

Observations

The study area covers a total area of 2,41,735.05 sq m. It is predominantly a residential area, which constitutes 53.23 per cent of the total area. The land use categories in HUDA sector 14, such as residential, commercial, parks, green belt, school, boosting station and others, have been identified and mapped from the zoning map and satellite data. The zoning map was used as a reference map to see the difference between planned land use and actual land use.

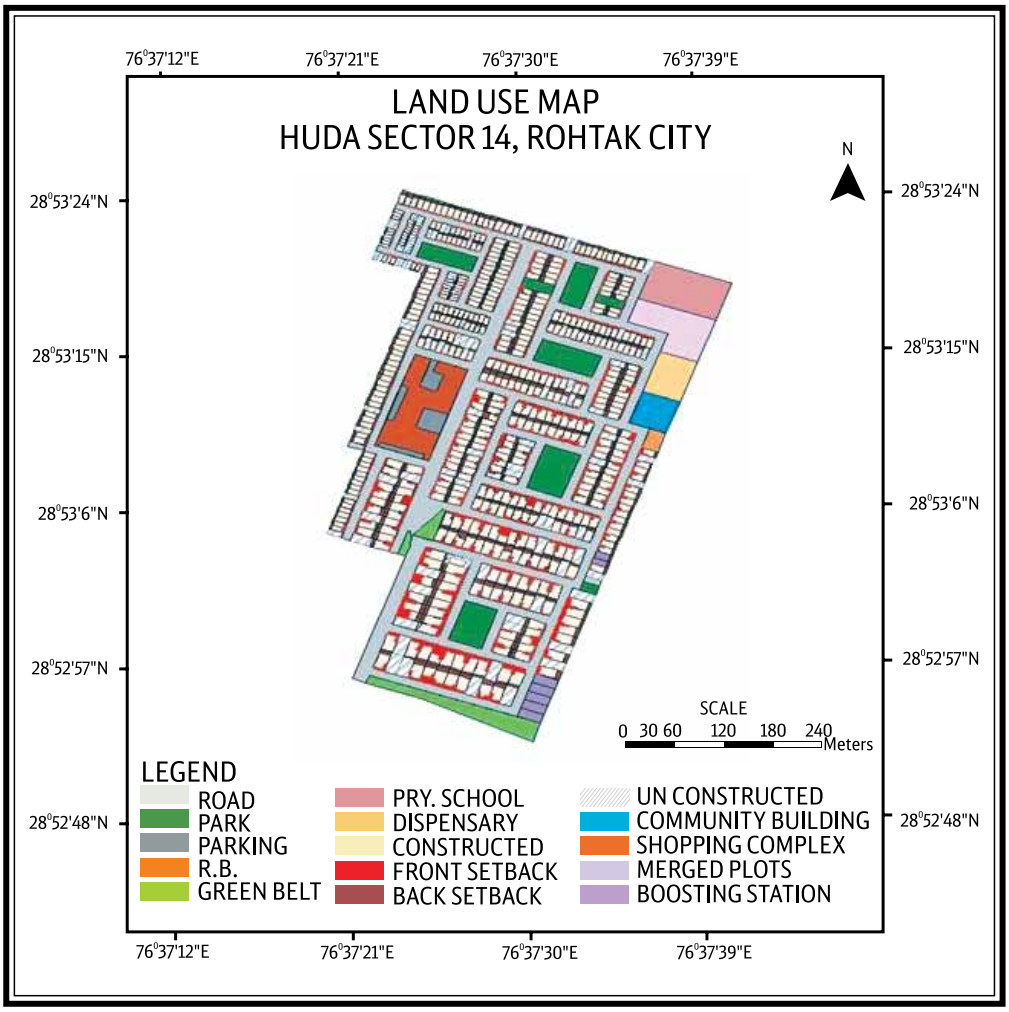


Table 1: Multidate Land Use Statistics of HUDA Sector 14, Rohtak City

Sr No	Category	Area m² As per Plan	Area m² 2009	Encroachment (m²)	Encroachment (%)
1	Residential	128670.74	129052.31	381.57	0.30
2	Roads	66774.12	66774.12	0	0
3	Parks	13273.53	12982.48	291.05	2.19
4	Parking Place	2620.10	2620.10	0	0
5	Shopping Complex	7586.48	7570.97	15.51	0.20
6	Primary School	5935.29	5935.29	0	0
7	Boosting Station	5318.46	5318.46	0	0
8	Dispensary	3080.52	3080.52	0	0
9	Community Centre	2470.08	2470.08	0	0
10	Reserved Buildings	631.19	631.19	0	0
11	Green Belt	5374.54	768.03	4606.51	85.70
	Total	241735.05	237203.55	5294.64	

Table 1, which shows different land uses in the study area, clearly illustrates that it is predominantly a residential area. Among 10 different land use categories, four categories, namely, residential, parks, shopping complex and green belt have recorded encroachments. The remaining six categories like roads, parking place, primary school, boosting station, dispensary, community centre and reserved buildings, have not recorded any encroachments. The study found that the categories which did not record any encroachments are walled areas. It was found that most of the encroachments have taken place in the areas where there were no such physical restrictions. The biggest victim to this encroachment is the green belt where up to 85.70 per cent of the area has been encroached. Other categories where some encroachments have taken place are residential parks and shopping complexes.

Hence keeping in mind the severity of the problem, it is time HUDA embark on a mission to act tough on encroachments and keep track of developments in the city to foster planned development. And, geospatial technology could be of great help in accomplishing its mission.

Parmod Bhardwaj
Associate Professor - Geoinformatics Division
Department of Geography
M.D. University

Renu Joon
PG Diploma student in RS/GIS
M.D. University



Summary:

Following a Supreme Court verdict, civic authorities in Mumbai had to cut water supply to the city for one day every week. This process disturbed the hydraulics mechanism of the water supply network, causing several hours of delay in water reaching to the last nodes of the city when the water supply was resumed the next day. However, the municipal authorities resolved the crisis using geospatial technology. Satellite images of the city were obtained and the entire water supply network was overlaid on it to prepare a simulation of the crisis condition and to identify operational inefficiencies in the water network. After analysis, several re-engineering scenarios were considered. Corrective measures in the water network were implemented to enable reliable and efficient supply of water to the city.

A crisis resolved

Imagine a population of 170 lakh people in one of the fastest growing cities of India going without water. There would be mayhem, and that is just what had happened in Mumbai Metropolitan Area (MMA). A city that was used to getting its water supply all along got a jolt with a Supreme Court verdict when the Krishna River Tribunal allowed only annual flow of 585 thousand million cubic feet (TMC) in westward flowing rivers in Maharashtra. This led the authorities to cut water supply for a day each week. This affected 17 million people of the Mumbai Metropolitan Area. Every Friday, the pumps were switched off and the valves closed at 6 am After restarting the pumps and opening of valves after 24 hours, water received by most of the cities had a long time lag of average 17 hours. Last node of the city at tail end received water only after long 30 hours of waiting. The hydraulics of the transmission network was disturbed due to this one-day cut. There was a lot of hue and cry over the situation as water supply of 17 million people was not sustained. All the engineers and the administrators at the helms of water supply system were helpless. Hence to study this problem and offer a solution, a hydraulic model has been devised to simulate the pipe network of the entire MMA. Various scenarios of re-engineering of the system including valve operations

Table 1: Valve settings

Valve Status	Meaning
Inactive	Fully open
Active	Partially open to pass a certain flow through valve
Closed	Valve closed fully

were created and analysed for solution. The model simulated the behavior of systems in crisis and helped in restoring water supply.

Hydraulic model

Obstacles faced: Creating a hydraulic model in short time in crisis period itself was the obstacle. Simulated hydraulic model was prepared and it helped in solving the crisis effectively. Bentley's Microstation along with WaterGEMS, Bentley Maps and Bentley Water have helped us in preparing the hydraulic model in time and resolve the crisis.

The model: Modelling of the crisis condition in the water supply system of MMA has been studied. The aim of creating such model is to prepare simulating scenarios of the actual crisis conditions that were operating the water networks. After analysis of the re-engineered network, the solution is expected to serve community reliably, safely and efficiently in the crisis period. The hydraulic model provides a thorough understanding of the water infrastructure, and helps to take knowledge-based decisions.

The model contains all the details of the existing pipelines in the Mumbai metropolitan area. Features such as flow controlling valves, reservoirs as source node, pipe junctions, pipe elements and demand nodes are included to help to analyse water transmission networks. It can quickly identify operational inefficiencies of the system.

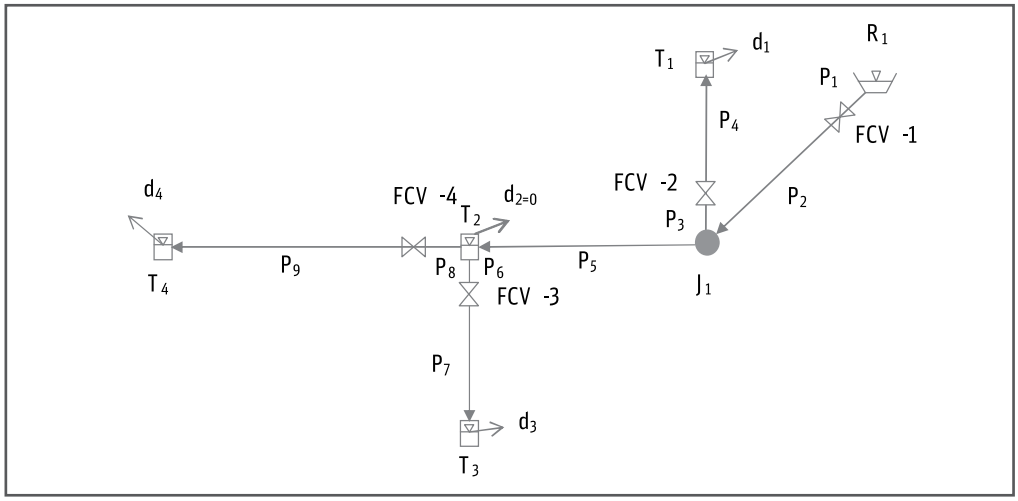


Figure 1: Simulation of pipe network

Principle of risk management model

Simulation of one-day cut: Let R1 be a reservoir which supplies water to junction J1 and then storage tanks T1, T2, T3 and T4 as shown in Figure 1. Flow control valves FCV-1 through FCV-4 are installed to control the flow. Notations for these valves are shown in Table 1. Tank T4 is the last tank.

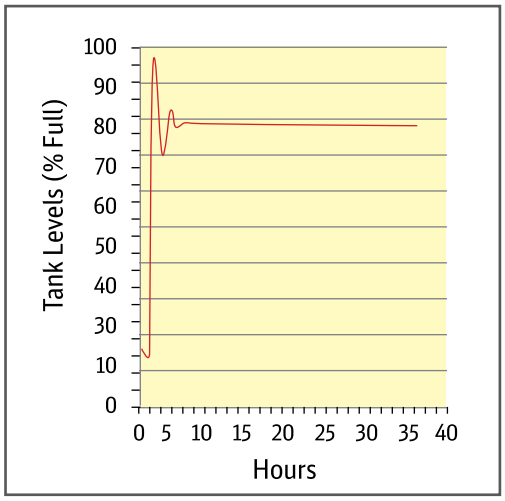


Figure 2: Levels in Tank T_2

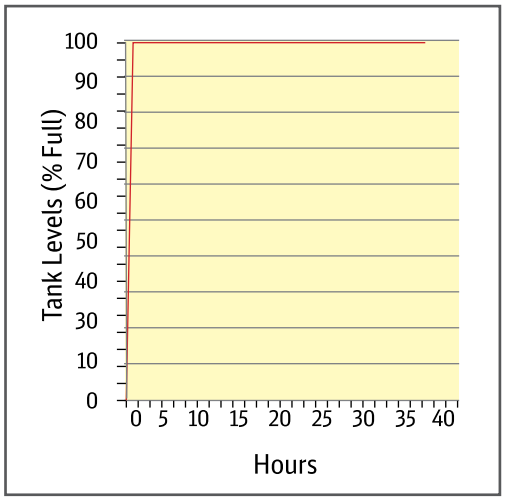


Figure 3: Levels in Tank T_4

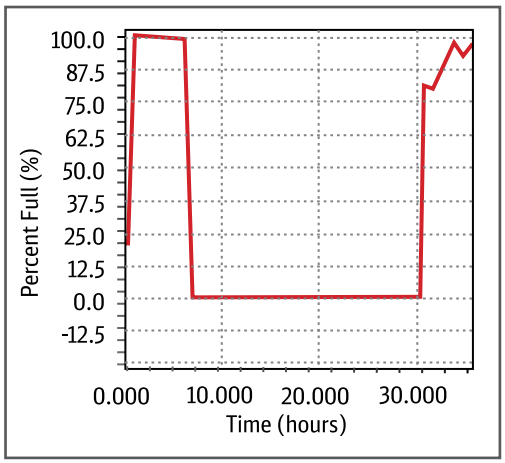


Figure 4: Levels in Tank T_2

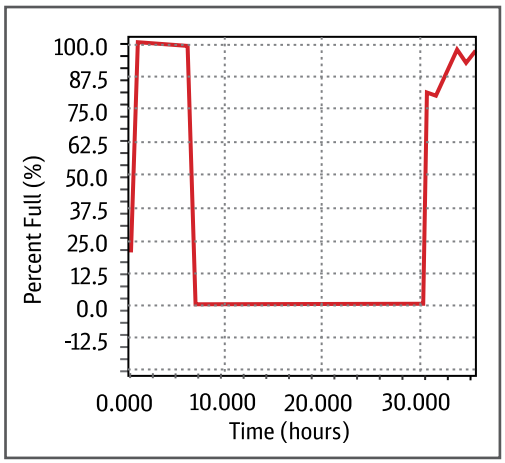


Figure 5: Levels in Tank T_4

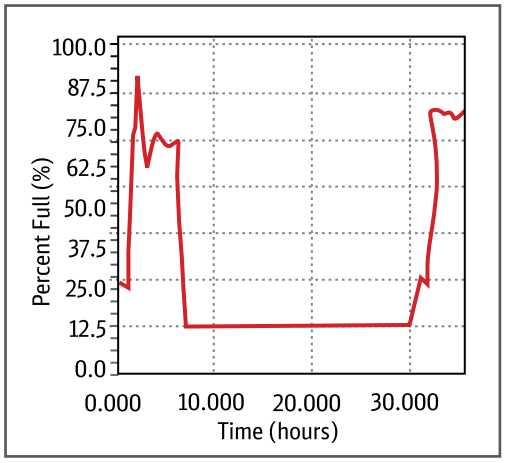


Figure 6: Levels in Tank T_2

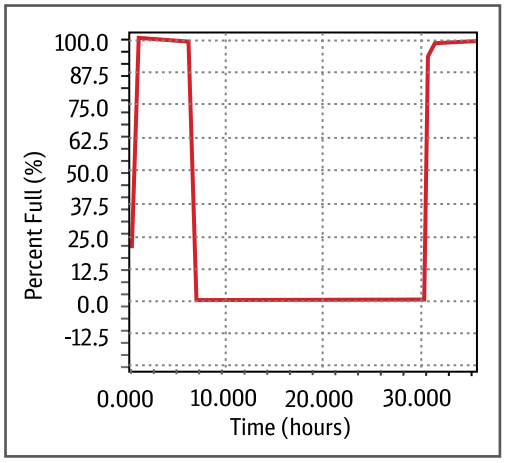


Figure 7: Levels in Tank T_4

What happens when FCV-1 closes at 6 am on Friday?

Let Valve FCV-1 close on every Friday at 6 am. When this happens, hydraulics of the network gets changed. Flow controlling valves FCV-2, FCV-3 and FCV-4 are allowed fully open. Here, flow levels in tanks play an important role. No sooner did we close the valve FCV-1, than the pipes P2...P9 get emptied. As levels in storage tanks deplete, demands d1, d3 and d4 at Tanks T1, T3 and T4 suffer.

What happens when FCV-1 reopens at 6 am on Saturday?

When valve FCV-1 reopens at 6 am of next day, i.e. on Saturday, water rushes to the Tank T1 which is on low lying area. Then it enters Tank T2. On attaining level in this tank, water fills the emptied pipe lines P6...P9. When level in last tank T4 attains water is supplied to the last node. Following scenarios emerge.

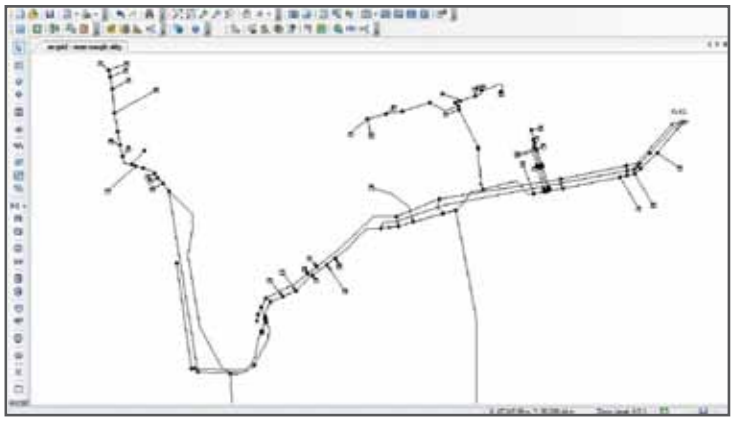


Figure 8: Pipe network of Mumbai Metropolitan Area in WaterGems

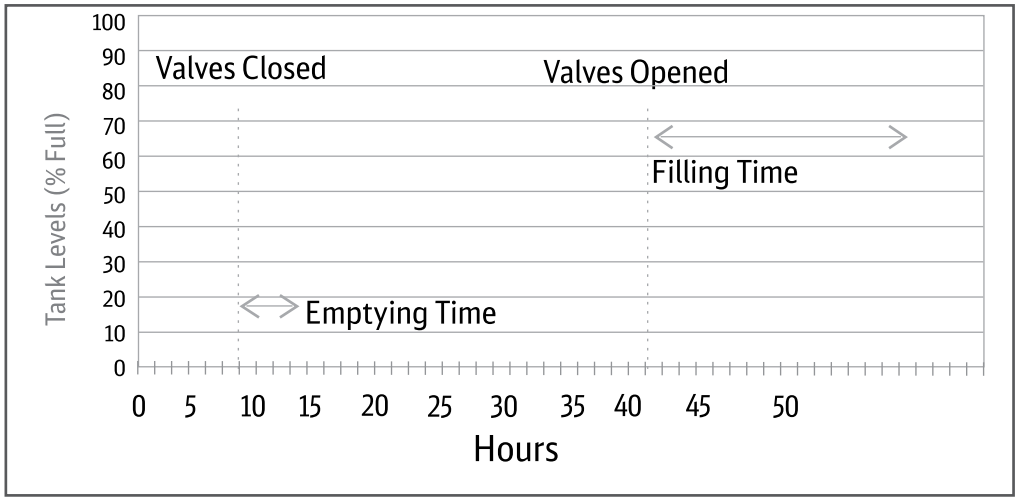


Figure 9: Water levels in Shil reservoir

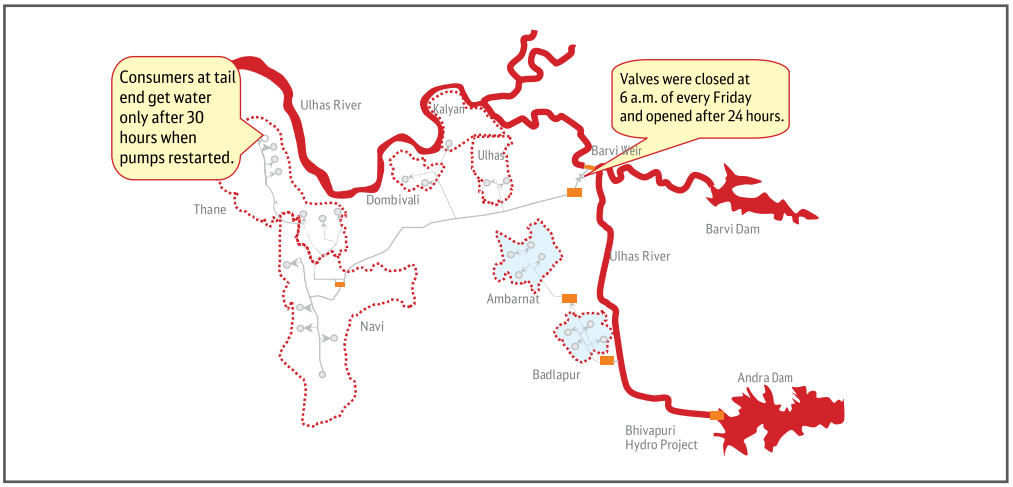


Figure 10: Water transmission mains of Mumbai Metropolitan Area



Figure 11: Krishna River



Figure 12: Hydro-electricity plants

Mumbai Metropolitan Region

Mumbai Metropolitan Area (MMA) consists of the area of Greater Mumbai as well as adjacent blocks of Thane and Raigad district. MMA covers the area of 7 prime municipal corporations and 13 municipal councils. It has a population of 25 million which is 22 per cent of the population of the entire state. Its progress matters for the growth of the state. Gross Development Product (GDP) of the MMA is ₹62,000 per person which is twice than that of the rest of Maharashtra (₹28,962 per person).

Water supply: Most of the cities in the area get water from the Ulhas River as well as Barvi dam (Figure 1). Ulhas River gets water throughout the year from tailrace tunnel of the Bhivapuri hydro electricity plant, therefore, it is perennial and lifeline of the cities in the area. Total water supply of the cities in MMA is 5,000 million liters per day (mld).

a. Scenario of normal water supply.
b. Scenario of one-day cut in water supply – all valves except FCV-1 open fully.
c. Scenario of one-day cut in water supply – All valves except FCV-1 are set to pass flow equal to the demand at tank.

(a) Scenario of normal water supply: In normal water supply all valves including FCV-1 are open. Water level in the tanks T2 and T4 are shown in Figures 2 and 3. Since, Supply is more than the demand the tanks T2 and T4 are always filled 70 per cent and 100 per cent respectively.

(b) Scenario of one-day cut in water supply: All valves except FCV-1 fully open. In this scenario, when the valve FCV-1 closes at 6 am on Friday, other valves, i.e. FCV-2, FCV3 and FCV-4 are allowed fully open. Water level in the tanks T2 and T4 are shown in Figures 4 and 5.

Even though the valve FCV-1 closes at 6 am, the tanks T2 and T4 take some time to get fully emptied. When the valve FCV-1 opens at 30 hours on Saturday, again it takes some time to get 100 per cent full. The last tank T4 takes four hours to achieve 100 per cent full condition. It is this level that will be taken as criteria to check effectiveness of the system.

Modeling process: As shown in Figure 10, water treatment plant at Jambhul (Barvi) provides water to most of the cities in MMA. For the purpose of simulation of crisis conditions, it is very essential to develop a model of all systems on a base map, i.e. base scenario representing all the systems in their present working conditions.

Following steps are involved:

GIS maps: A raster satellite image was procured with 0.6 m resolution. This image was digitised. Various elements of the pipe network such as reservoir, flow controlling valves, pipes, junctions, and tanks are overlaid on the digitised map. A vast data, describing real-world network system, is collected from all water works. The attributes of these elements are given to the model. Thus, a base scenario of the entire area has been prepared.

Simulation of crisis conditions: The problem was studied holistically. It was found that the long pipe network remained empty. It took long time of 14 hours to just refill network. Moreover, the entire terrain was uneven in levels. Operation of entire system was disturbed as some of agglomerates in low-lying area were drawing more water and cities at tail end were getting water after long 30 hours on resumption of supply.

We created scenarios of various re-engineering of the system simulating above difficulties and the network is solved for solution. Various interlinks have been suggested and schedule

of valve operations was freshly prepared using the hydraulic model. Corrective measures in field were taken with the help of police force. We operated entire system as per the re-engineered plan using Bentley's technology.

Benefits

The hydraulic model prepared by Bentley products has the following benefits:

- Avoided a law and order problem
- Crucial time lag of 30 hours was saved every week
- Entire population would have required about 26,000 tankers. A cumulative ₹4.7 billion was saved

The project re-engineered the entire pipe network of the six municipal corporations and 13 municipalities in the region. It has, therefore, optimised the flow and pressures in the system which now uses water resource in the most optimised way.

S V Dahasahasra
Member Secretary, Maharashtra Jeevan Pradhikaran, Mumbai

M R Mulay
Deputy Engineer, Maharashtra Jeevan Pradhikaran, Thane



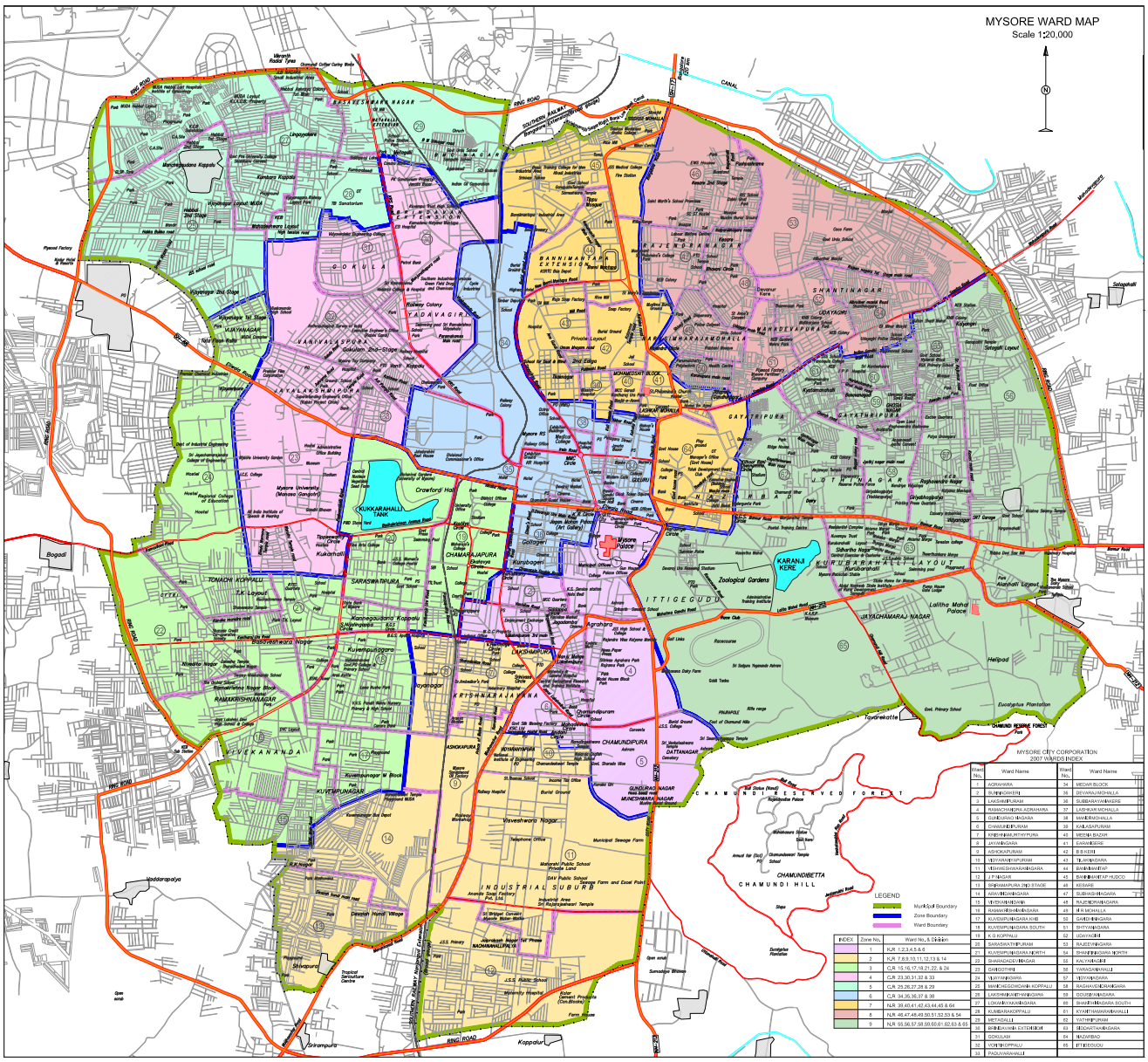
Summary:

The Department of Survey, Settlement and Land Records (SS & LR) in Karnataka envisaged the urgent need for updated urban property ownership records for preparing, maintaining and preserving spatial and non-spatial data relating to ownership of properties in the state. Hence, the Karnataka Government initiated the Urban Property Ownership Records (UPOR) project, upon the completion of which, the state government will issue a Property Record card (PR card) for each property in all the cities, which will only be the authentic identifying document for all the property owned and will be accepted for all property transactions. This will enhance property tax collection and prevent fradulent property dealings.

Towards flawless property records management

Just like the UID project that gives every citizen a unique identification number linked to their demographic and biometric information, which they can use to identify themselves anywhere in India, there should also be a UID for properties, since this is a permanent and valuable asset. Proper documentation of land ownership will avoid the issues of fraud and duplicate ownership in property related transactions. This can be done by mapping and developing a proper updated digital database of properties. Urban/rural area surveys can be done for ground verification and validation to enhance the authenticity of property ownership and also to rectify errors in property boundaries. In urban areas land is very costly and so the error tolerance in property boundary marking should be <10 cm per property corner. Customised maps and GIS software can be created to retrieve information from the database and to rapidly and accurately distribute it to the public and government authorities. The property database will have multiple benefits: It will greatly enhance the tax revenue of the government, since all properties will be mapped and recorded; tax defaulters can easily be identified; It also helps in checking on encroachments and issuing of construction licences. For instance, as per the old records there are 2 lakh properties in Mysore, but the UPOR project has revealed the existence of 2.75 lakh properties, which means around 75,000 property owners have not been paying tax.

The Department of Survey, Settlement and Land Records (SS & LR) in Karnataka envisaged the urgent need for updated urban property



ownership records for preparing, maintaining and preserving spatial and non-spatial data relating to ownership of properties in the urban area of Mysore. Hence, the Karnataka Government initiated the Urban Property Ownership Records (UPOR) project, which is one of the first programmes of its kind in India. It is being implemented on pilot basis in five large cities of Karnataka including Mysore, Shimoga, Hubli-Dharwad, Bellary and Mangalore, and will subsequently be extended to other parts of the state. The project was inaugurated on December 17, 2011, by the Chief Minister of Karnataka. Upon the completion of the project, the state government will issue a Property Record card (PR card) for each property in all the cities. This PR card will be the only authentic identifying document for all the property owned and only this identification will be accepted for property transactions, securing bank loans etc.

The Government of Karnataka has tied up with Bangalore-based SECON Pvt Ltd, on a PPP basis for undertaking survey, property measurement, data collection and database creation for Mysore city. The city has a population of over 10 lakhs with over 2,75,000 properties in an area of around 200 sq km. SECON is a GIS-driven multidiscipline engineering consultant with domain expertise in large-scale surveying and mapping in India. The project for Mysore City is almost complete and will be the first project to be completed under this programme. The city area as specified by the Mysore Municipal Corporation has been mapped on 1:1,000 scale under the project. Layouts formed by the urban development agencies have also been covered even if such layouts are outside the Municipal Corporation limits.

An additional area equivalent to 20 per cent of the area of the municipal corporation to cover adjacent villages where significant urbanisation has taken place, has also been covered. Fory-two villages were covered under the area of interest. SECON has also established a Citizen Facilitation Centre (CFC), which will be operational for the entire duration till property records are created.

Methodology

Preparation of Base Map: Base map on scale of 1:20,000 has been compiled from Mysore city maps, topographical maps and is updated using satellite images.

Establishment of high-precision survey control network: This consists of the establishment of primary and secondary control points. The primary and secondary control points were further extended to establish tertiary control points to monitor the survey process and check the authenticity of survey data collected.

Preparation of index map

The index map facilitates monitoring and controlling the field activities of the project. The comprehensive index map contains the following features:

- Control points location (primary, secondary and tertiary)
- Geo-referenced village maps with survey numbers
- Layout and town maps from the municipal, MUDA and urban local bodies
- Road network maps from local authorities
- Zones, sectors and blocks demarcated in consultation with department for easy guidance and monitoring the field activities of the project

Preparation of sector map

In the sector map, all properties in Mysore have been divided into 20 phases of 10,000 properties each. Each phase is further sub-divided into two sectors of 5,000 properties each. Total 48 sectors are covered under the project, and each sector is further sub-divided into blocks, enclosed by roads on all sides.

Serving notices

Serving notices is an important activity preceding the measurement of property. The printed notice, signed by the authorised official of SS&LR, is served to each property owner at his door step by SECON, at least three days prior to measurement date.

Data collection and incorporation into property records database SECON collected the following documents from the owner, scanned them, and incorporated them into a property records database that managed both the spatial and non-spatial data:

- Sale deed executed by the owner
- Possession certificate issued by the concerned department
- Encumbrance certificate
- Tax paid receipts and Khata certificate
- Approved layout plan (if applicable)
- Conversion certificate (if applicable)

According to Rajeev Chawla, Secretary, state revenue department, of the total properties, documents for 47,660 properties have been collected. Survey of 1,87,820 properties has been completed.

Identification and marking of property boundary corners

This critical and important activity is done by the SS&LR surveyor. The departmental surveyor identifies the corner point of each property and physically indicates to SECON for marking each corner.

Measurement of property boundary corner points

Measurement of co-ordinates of each plot boundary corner point was completed within 1-2 days after serving notice. All the accessible plot boundary corner points were measured using Electronic Total Stations (ETS). Corner points which could not be physically accessed for mounting the ETS or the prism were measured manually using measurement tapes. The location co-ordinates of each point on the boundary facilitate fixing the exact shape of the plot polygon, facilitating in deriving exact area of plot polygon.

Photographs

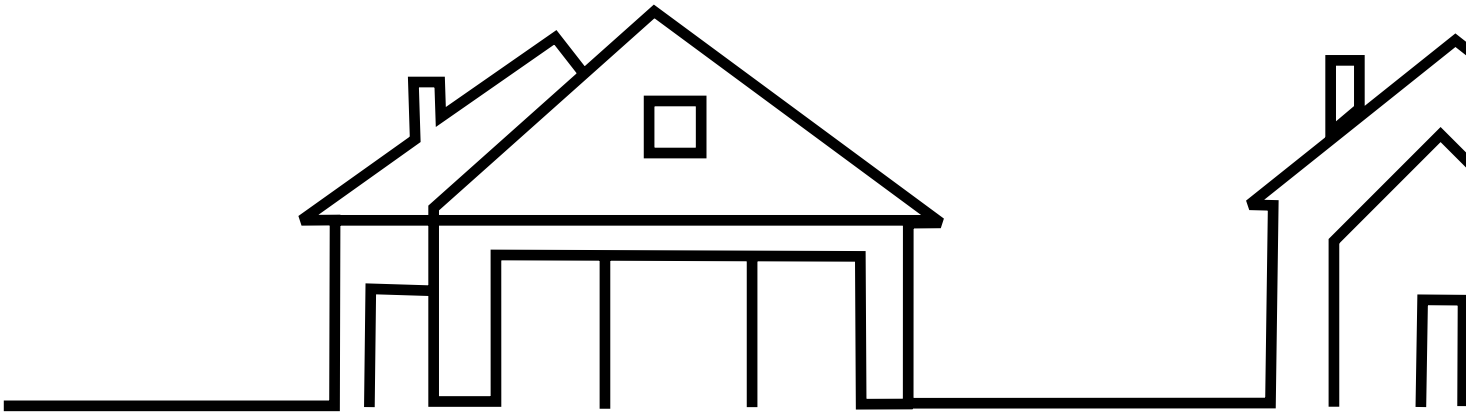
A minimum of 2-4 photographs are taken for each property, from a distance of not more than 25 feet away from the building. The photographs are taken on as-is where-is condition and no modifications, such as digital or optical zoom, have been done.

Map digitisation and creation of GIS database

The following layers were created in a GIS database:

- Ward maps
- Layout maps
- KIADB maps
- Forest maps
- MUDA maps
- Road maps
- Railway maps
- Corporation CDP plan
- Government land details
- Existing city survey records
- Revenue department details (Tippans)
- KHB details
- Collection of alienation data from DC/AC
- Wakf board and religious institutions details
- Khata details

The UPOR project will be a continuous process and property records database will be updated as and when new localities come up. The verification and updation can be done from UPOR centres across the state. Spatial data such as extract or sketches of property to a given scale can be obtained by the citizens from the UPOR centres. Any mutations in urban property records will be reflected in the database automatically and the property owners will not have to apply for mutation separately. Other details provided by the database include encumbrances of properties, easementary rights, restrictions, details of common boundaries and demarcation of government properties. To ensure consistency in data collection, SECON Pvt Ltd has been roped in for six years for conducting surveys. The distribution of ownership records will start from April 1, 2012, and objections will be invited, if any, after the issue of records.



Summary:

The Bruhat Bengaluru Mahanagar Palike (BBMP) has initiated the unique property identification (PID) number project, wherein each property can be identified by the PID number. East Delhi Municipal Corporation is developing a database by mapping all the properties, and each property will be given a unique identity code. Not to stay behind, the Greater Visakhapatnam Municipal Corporation is also developing a database of properties, and the Patna Municipal Corporation has initiated a survey of properties to check on illegal use. All these initiatives will aid in getting hold of tax defaulters, clamping on encroachments and development of illegal colonies.

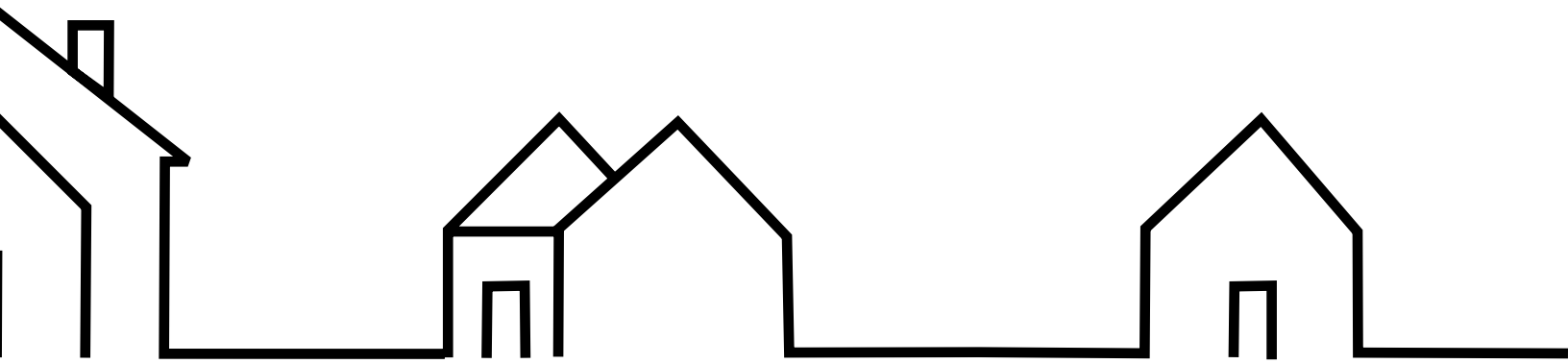
Widening the tax net

Municipal corporations across India are gearing up to enhance operational efficiencies and plug holes in the revenue collection process using high-end technologies. These civic bodies are all set to bring defaulters under the tax net, clamp on illegal encroachments and check development of illegal colonies. For instance, Bruhat Bengaluru Mahanagara Palike (BBMP) was in the news recently for initiating the unique property identification (PID) number project, under which a PID number is issued to all property owners in Bengaluru. This helps in bringing all properties in the city under tax net. Through the project BBMP was able to identify 16.19 lakh properties in the city for collection of taxes, which raised the property tax collected to nearly ₹3,000 crore.

East Delhi Municipal Corporation

Following suit, the East Delhi Municipal Corporation is set to implement its first project to clamp on tax defaulters and keep a check on unauthorised colonies and encroachments. Under the project, a colony-wise database of East Delhi will be developed and continuously udpated through mapping
of individual properties, conducting door-to-door survey and developing a three dimensional GIS. The mapping is being carried out by Geospatial Delhi Ltd and will help in identifying the nature of property.

The database will help in checking the status of each and every property, which will ultimately help in boosting revenues by increasing property tax collection. In the database, properties will be classified based on



their use: commercial, residential, educational and health. Each property will be given a unique identity code, under which all details about the property will be listed. The code will also be used for varied purposes like passing of a building proposal and amendments in the layout plan.

Elaborating on the project, Sajjan Singh Yadav, Municipal Commissioner said that a large number of properties in East Delhi are still not registered in the civic records, resulting in heavy evasion of property tax and licensing. The civic body has two zones under its purview — Shahdara (North) and Shahdara (South). According to details revealed by civic authorities, both the zones are grappling with major property tax evasion. Shahdara (North) has around 1.5 lakh properties, of which 70,000 are not registered in the municipal records. Shahdara (South) has over 52,000 properties for which taxes are not paid. Of the total receipt of property tax in the city, the property tax collection in the East region accounts for a meagre share of 25 per cent. Under the project, cameras will also be installed on high-rise buildings to keep a guard on the surroundings and prevent encroachment and unauthorised construction.

Greater Visakhapatnam Municipal Corporation

Not to stay behind, the Greater Visakhapatnam Municipal Corporation had also initiated GIS-based survey of properties in its jurisdiction three years ago. Results of the survey have been double checked through on-field and random verification, and a database is being developed incorporating other details such as property photographs. The corporation will now issue fresh demand notices for collection of property tax, incorporating results of the survey. Approximately 3.56 lakh properties have been covered under the survey, According to K Ramesh, Additional Commissioner (Projects), the survey has indicated around 32 per cent increase in revenue collection from property tax.

The survey identified 50,000 properties that had error in registered details regarding the use of property (residential/ commercial) and in plinth area measurements. According to the corporation officials, about ₹19 crore more from property tax can be realised per year using the developed database.

Patna Municipal Corporation

Patna Municipal Corporation (PMC) has initiated a survey of properties for the first time in Patna to identify the residential complexes which are being illegally used for commercial purposes. PMC has roped in Infotech Limited, a Gurgaonbased company for conducting the survey, based on which the municipal corporation will collect holding tax as applicable to commercial complexes from such residential complexes. The survey project has been divided into three phases: The first phase involved satellite mapping of the structures in the jurisdiction of PMC for developing a new map covering 109.218 sq km of PMC area. The second phase involves a door-to-door survey by the personnel of Infotech Limited and PMC. According to Amit Sharma, head of Infotech's Patna office, in the door-to-door survey the area of properties will also be measured to tally with the municipal records. On pilot basis, survey in ward number 21 was conducted covering areas like Boring Road and SK Puri, wherein, many owners of residential complexes were found to be running coaching classes, hostels and even beauty parlours. However, they were paying holding tax applicable to residential properties.

According to Pankaj Kumar Pal, Commissioner, PMC, several residential complexes are being used for commercial purpose but are paying property tax as applicable to residential properties. Under the project, about 2.25 lakh structures have been mapped which will be surveyed and verified. PMC has been loosing out significant amount in tax from such properties that are illegally used for commercial purpose. The survey is expected to be complete in six months. Meanwhile, a notification has been published by PMC alerting the residents regarding surprise visits by tax collecting officers. Once the survey project is complete, the civic body expects a significant increase in tax collected. The survey is being funded by JNNURM.

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Connecting rural India

Summary:

The Pradhan Mantry Gram Sadak Yojana (PMGSY) aims at providing better road connectivity in rural India. The project uses an Online Management, Monitoring and Accounting System (OMMAS) that operates in collaboration with GIS for managing spatial and attribute data on the project. This helps in better planning, information sharing, monitoring progress, generating reports and decision making.

The key to effective planning, implementation and monitoring of any infrastructure development project primarily depends on the availability of current, correct and relevant information. Socio-economic development of a country like India where majority of population lives in rural areas largely depends on the development of rural road network. The roads that connect village to a nearby market or higher category road, are generally called as 'rural roads'. Realising the role of rural road connectivity to transform our country into a developed nation, the Government of India has formulated a nationwide development programme, popularly known as Pradhan Mantry Gram Sadak Yojana (PMGSY), to provide connectivity to all habitations up to population of 500 and up to 250 in hilly, desert and tribal areas.

Salient features

The PMGSY scheme is one of the biggest ever infrastructure development project conceived by the government of India targeting to construct about 3,68,000 km of new road construction and 370,000 km of upgradation/ renewal at a cost of about $26 billion. The planning and execution of PMGSY for enhancing transport infrastructure is unique in many aspects, i.e. planning, execution and quality of work.

- Planning of PMGSY roads are based on the core network: All roads under PMGSY have been prioritised out of the core transport network identified for development.

- Roads are being properly designed based on climatic and traffic conditions.
- A three-tier quality control system has been envisaged to enforce the quality of construction of roads.
- The complete programme is monitored and planned using online monitoring system called as Online Management, Monitoring and Accounting System (OMMAS).
- GIS is being used for monitoring, management and building transparency in programme implemented in two pilot states – Rajasthan and Himachal Pradesh.

Project planning and monitoring

Implementation of PMGSY scheme poses major challenges to the nodal executing agency National Rural Road Development Authority (NRRDA). It was very difficult to manage this giant project using traditional methods of project management as these methods are not only tedious and time consuming but also difficult to retrieve the desired information. Allocation of funds in a developing country like India was also a barrier to implement this ambitious project. To overcome these barriers, innovative concepts and technologies such as introducing concept of Core Network, use of Online Management Monitoring and Accounting System (OMMAS) and use of GIS are being used.

Core network

The concept of core network was introduced for the first time in India during planning of rural roads. The objective behind adoption of this concept is to optimise road network and minimise the total cost of the project. It has helped in connecting eligible habitations by providing basic connectivity. Basic access is defined by one all-weather road access from each village/ habitation to the nearby market centre or Rural Business Hub (RBH) and essential social and economic services. A core network is extracted out of the total network mentioned in the District Rural Road Plan (DRRP) and consists of existing roads as well as the roads required to be constructed to the as yet connected habitations.

It consists of "Through Routes" and "Link Routes". Through routes are the ones which connect traffic from several link roads serving a long chain of villages and lead to market centre either directly or through the higher category roads such as NH, SH etc. On the other hand, link route are the roads connecting a single habitation or a group of habitation to through routes or major link road leading to market centre.

OMMAS

The NRRDA has established an Online Monitoring Management System (OMMAS) to effectively monitor and manage various activities under PMGSY. The database for the system is established at various district project implementation units in each state and it is being updated regularly. The database includes information on connectivity status of habitations,

district rural road network, core network, proposals made for each batch of works, works sanctioned, contractors' details, physical and financial progress, unit costs, quality monitoring, pavement condition index etc.



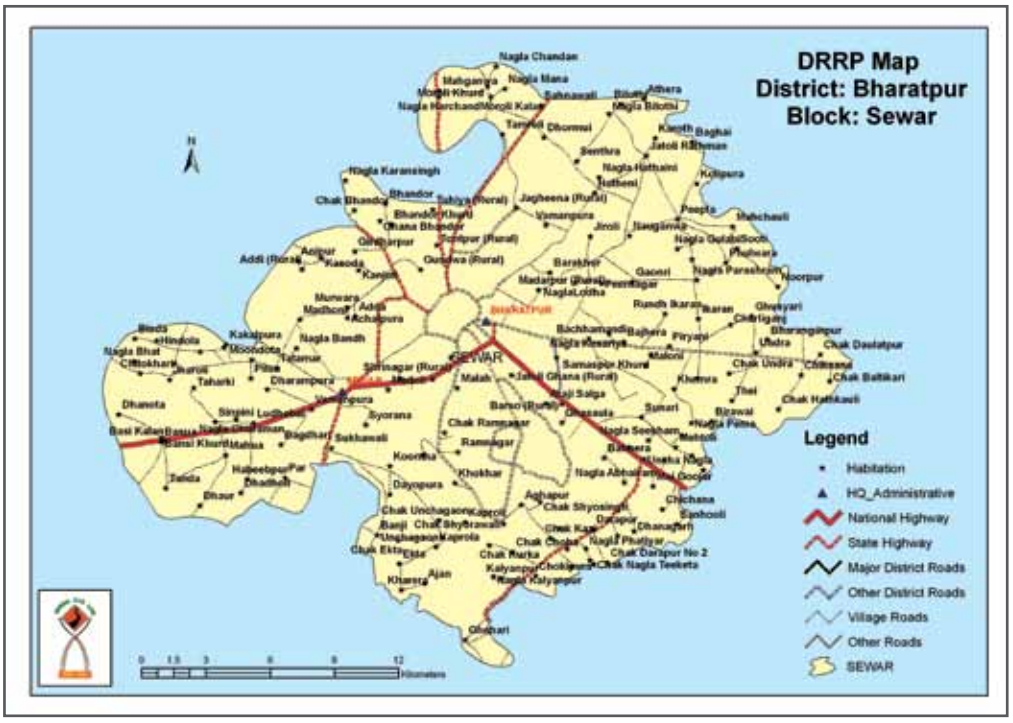


Figure 1: DRRP and Core Network roads

The spatial and attribute data shall be linked with the OMMAS in order that the spectrum of information available online could be mapped spatially for a seamless graphic output which could be easily assimilated. The ROMAPS software prepared to take care of preparing maintenance plans is also integrated to this system. The integrated system allows user to:

- Link OMMAS data with maps
- Address basic and advanced spatial queries
- Answer queries on Master data
- Monitor physical and financial progress
- Generate reports on the quality aspects
- Generate road status reports
- Perform various queries
- Generate road condition reports
- Review maintenance aspects and plan
- Generate management reports as required by NRRDA and the states
- Prepare Comprehensive New Connectivity Priority List (CNCPL) proposals based on the predefined conditions, e.g. population range: 500-999 and connectivity status as on 2007 is "No"
- Prepare Comprehensive Up-gradation Priority List (CUPL) proposals, e.g. Road Category belonging to Village Roads or Other District Roads and Pavement Condition Index = 2 and year of construction of road more than 10 years old.
- Generate various status reports demanded from time to time. A conscious decision was made to close-couple OMMAS and GIS as this would ensure sustainability of the spatial database. The Web-based GIS system would carry forward the transparency of the programmes by dissemination of information relating to programme status in spatial format, which would be usable by non-technical people as well. The huge database and various reports related with habitations, roads, works etc. can be accessed at http://omms.nic.in

Geographical Information System

In the project, spatial data analysis of land resources plays a major role in designing the road network. The management and analysis of such large volume of spatial data require use of GIS. In GIS, both spatial and non-spatial data are integrated and sets of spatially registered layers are analysed independently or in a combination. The following are some of the major applications of GIS in PMGSY:

- To make existing maps more quickly and cheaply
- To facilitate map making and updating when the data are already in digital form
- Analysis of the data that demand interaction between statistical analysis and mapping
- Development of 3D or stereoscopic maps

The online data entry from the data source is dynamically linked as attribute data of main GIS database, enabling real-time updation of the whole GIS database.

Development of GIS for rural roads

The database of GIS contains spatial data (geo-referenced) and attributes data (that describe characteristics of spatial objects/entities). A GIS is capable of combining different layers of spatial information and also link spatial data with attribute data. Here the spatial data contains multiple layers while all attribute data is being stored in OMMAS.

Data input covers all aspects of transforming data captured in the form of existing maps, field observation and different remote sensing products into a compatible digital form. Here the statistical data for PMGSY consist of three different basic features such as DRRP/ core network, various administrative boundaries and village. The maps created by SOI at the scale of 50,000 are used as base map for creating DRRP and core network maps. These maps are overlapped on digital maps received from Survey of India (SOI). Once both the spatial and non-spatial data have been input, the linking operation provides an ideal chance to verify the quality of both spatial and non-spatial data.

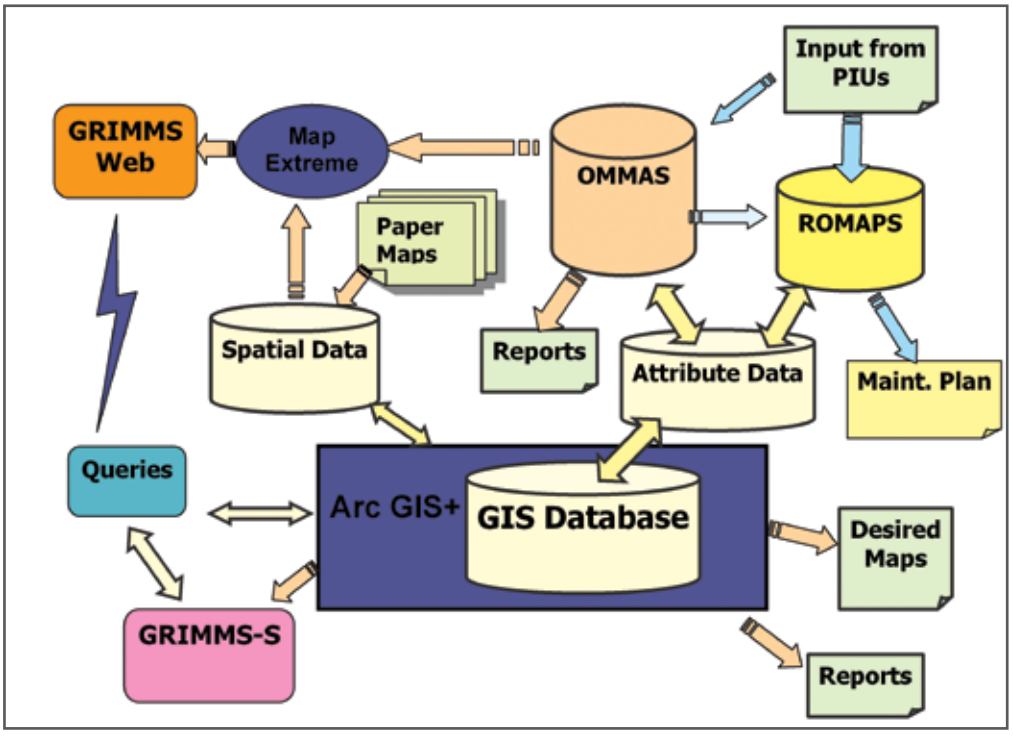


Figure 2: Data flow & relationship chart

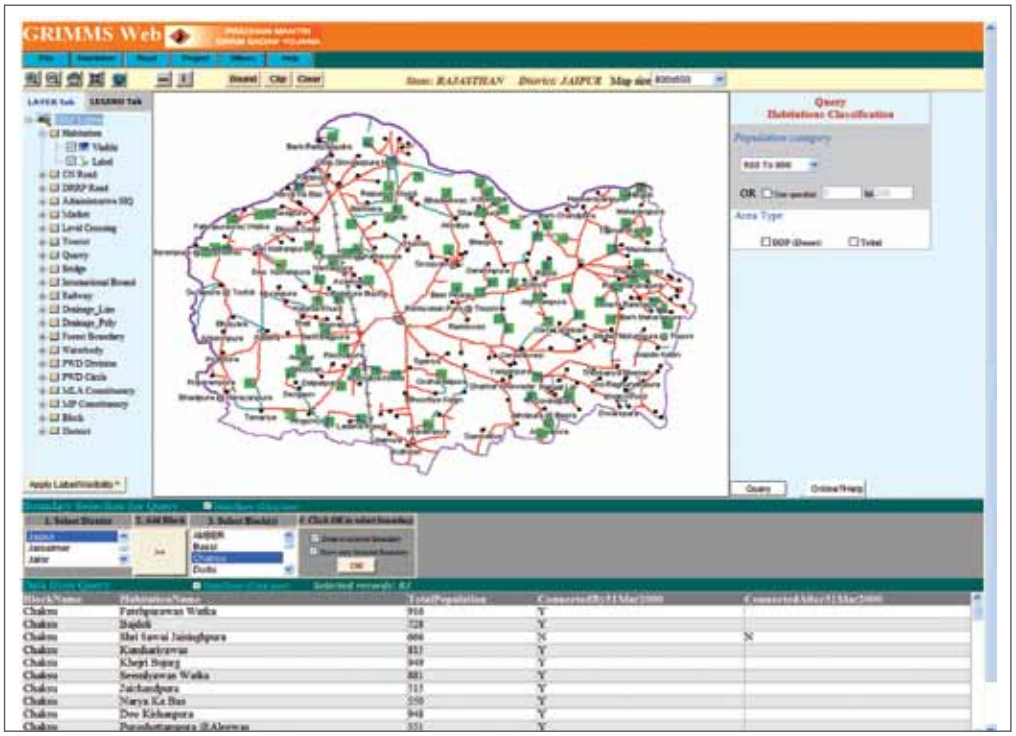


Figure 3: GRIMMS-W Web version of costomised GIS

After completing the database creation, data is ready for analysis and preparing various reports. Different queries can be performed, which can be further used for decision making. The GIS database which consists of spatial and attributes data requires updating over the period of time. Since the attribute data is dynamically linked with backup of OMMAS website, this part is being updated continuously. The updating of spatial database due to change in alignment, new construction or due to any other reason has to be incorporated as and when required. Ultimately, data can be produced as maps, tables and figures, text etc in several ways in the digital format or in a hard copy as well. Decision makers can use digital maps during the meetings as powerpoint presentation to analyse the situation.

Customisation of GIS software

The GIS operations under PMGSY involve generation of spatial database, customisation of a standalone GIS system (GRIMMS-S) and development of Web GIS (GRIMMS WEB). The GRIMMS-S has been developed using Arc Editor 9.0, Arc objects and VB.Net tools. The standalone version has the capability to activate the Arc Editor and use its objects to run required GIS functions. Users need not learn Arc-editor features, as user-friendly menus are available separately for GRIMMS-S. GRIMMS-Web is developed using ASP.NET, Java script, objects of Map Extreme 2004 and SQL server 2000. Microsoft Web control is used for the tree and tab controls. Similar to the standalone version, GRIMMS-Web displays menus, icons, tree-view of layers/legend, map display, quarry dialog box and attribute data display

sections. It has a user-friendly interface which helps even common person/citizens to operate and view information in an interactive and exciting way without installing any specific hardware or software. The Web-based GIS allows transparency to PMGSY programme and disseminate the related spatial as well as attribute information related to progress and status of PMGSY roads in a user-friendly manner. GRIMMS-WEB can be accessed at http://omms.nic.in/grimms

K K Mishra
State Nodal Officer (GIS)
PWD Rajasthan

Monalisha Mishra
GIS Analyst, RRRDA GIS Lab
PWD Rajasthan



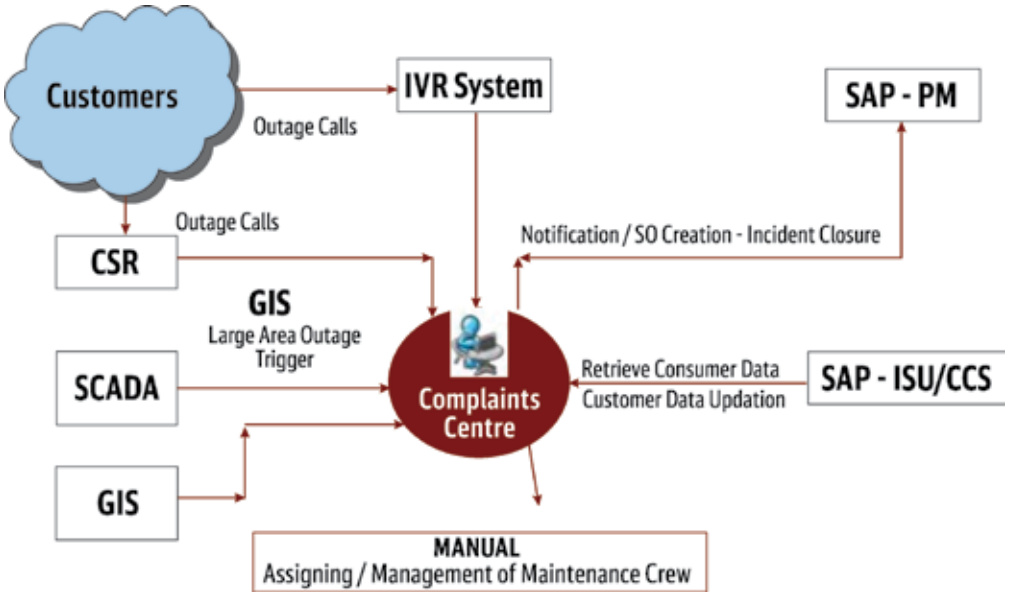
Cutting down the power cuts

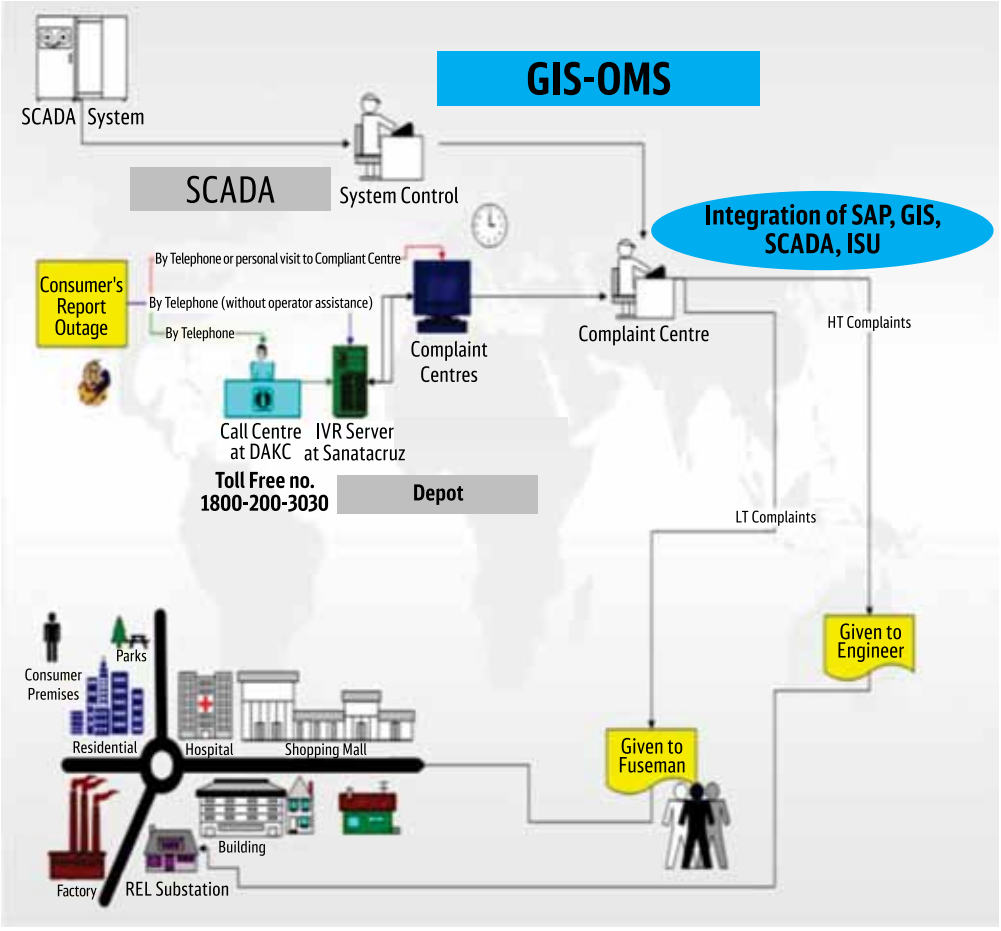
Summary:
Reliance Infrastructure Limited (RInfra), India's largest integrated power distribution company, has launched India's first GIS-based Outage Management System (OMS) in Mumbai. The system integrates existing complaint handling system with SCADA, GIS and SAP. This helps in better network opertions/maintenance, quick identification of fault locations, resulting in better outage management and quicker response to consumer complaints.

While the government of India is enhancing the efficiency of the power sector through the R-APDRP programme, utilities are also gearing up individually to enhance the quality of services offered. Reliance Infrastructure Limited (Rinfra), India's largest integrated power distribution company, has launched India's first GIS-based Outage Management System (OMS) in Mumbai. The system is primarily aimed to resolve consumer complaints faster during the outages.

RInfra supplies power to 27 lakh suburban consumers, who will now experience quicker response and faster outage resolution, resulting in reduced inconvenience caused to them by the impact of planned and unplanned outages. With the newly installed system, quick identification of the probable faulty locations has become a lot easy, which in turn reduces the response time to consumer complaints.

Commenting on the OMS, Lalit Jalan, CEO & Director, Reliance Infrastructure Ltd said, "In today's world, technology adoption in power distribution is a crucial and essential aspect for improving efficiency and meeting ever growing consumer expectations. RInfra has been a pioneer in implementing latest technologies in network operation and maintenance, fault identification and database management. We are happy to launch India's first GIS-based Outage Management System for our consumers, who will now get much quicker response in case of any outages."


Customers
Outage Calls
IVR System
SAP - PM
Outage Calls
CSR
Notification / SO Creation - Incident Closure
GIS
Large Area Outage Trigger
SCADA
Complaints Centre
Retrieve Consumer Data
Customer Data Updation
SAP - ISU/CCS
GIS
MANUAL
Assigning / Management of Maintenance Crew


GIS-OMS
SCADA System
SCADA
System Control
Integration of SAP, GIS, SCADA, ISU
By Telephone or personal visit to Compliant Centre
Consumer's Report Outage
By Telephone (without operator assistance)
By Telephone
Complaint Centres
Complaint Centre
HT Complaints
Call Centre at DAKC
IVR Server at Sanatacruz
Toll Free no. 1800-200-3030
Depot
LT Complaints
Given to Engineer
Consumer Premises
Parks
Residential
Hospital
Shopping Mall
Given to Fuseman
Building
Factory
REL Substation

RInfra currently uses Complaint Management System for tracking the status of consumer complaint. Status data is manually fed by the personnel at the complaint handling stations. Fault identification that is critical to faster resolution of outages still depends solely on the experience and intelligence of the field personnel resolving the complaints.

Highlights of OMS

Consumers will get quick response and faster fault rectification during outages

- OMS will identify likely faulty section prior to site visit by field personnel
- Fault identification intelligence derived by integrating SCADA, GIS and SAP
- Consumers will remain informed during planned outages
- Outages frequency will be reduced by better planning

The newly implemented OMS integrates existing complaint handling system with SCADA, GIS and SAP. This enables identification of faulty section prior to the site visit by field personnel. Intelligence derived from the integration of the system with SCADA will identify major breakdown in the network; integration with GIS will help it capture the network details from source to the consumer supply point; and integration with SAP will help it refer the customer database and also communicate with the consumer about the outages. The system enables emergency service officials to access key information about the outage, which will be updated in real time during the resolution of the complaint.

All outage details will be available through a call centre and on an IVR, so in the event of planned outages, consumers will get prompt response. Area-wise, duration-wise and equipment-wise historical data on faults will further help maintenance personnel in better planning of preventive maintenance schedules and reduce the frequency of outages.

RInfra is renowned for implementing consumer-friendly technologies in power distribution, and has implemented several leading IT-based services like 'E-Courtesy' – automated follow-up mail service for information sought; centralised Web / email handling desk; complaints registration and closure alerts; SMS bill payment using ITZ Cash Card; introduction of Pull SMS services for bill delivery complaint; new informative website; and mobile bill view and payment.

RInfra is the largest power distribution company in Mumbai with the licensed distribution area spread over 400 sq km in suburbs and surrounding areas of Mumbai. It supplies power to around 2.7 millions consumers. The company has been recently mandated to distribute electricity for next 25 years, i.e. till August 14, 2036.

geospatial TODAY

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Natural Resources & Agriculture



Harnessing hydro power

Summary:

Small hydropower can play a significant role in meeting the increasing power requirements of the country. Hence, the Ministry of Non-conventional Energy Sources in India has taken up small hydropower development as one of the thrust areas of power generation from renewables. From locating potential sites for generating small hydropower, identifying generation potential, to enhancing operational efficiency of power plants, geospatial technology can be used as a key enabler.

INDIAN POWER SECTOR HAS AN installed capacity of 86,000 MW, out of which 25 per cent is hydro power and remaining are thermal, nuclear and gas-based projects. Power shortages in our country are estimated as 9 per cent of total energy and 18 per cent of peak capacity requirements. Thermal-based power projects have environmental repercussions related to emission of suspended particles and gases. While, large hydro power plants could lead to degradation and erosion of soil, loss of forests, wild life habitat and biodiversity and most important is the resettlement of people. However, small hydro power projects are more eco-friendly and could help solve the acute power problems in India

Developing small hydro power projects

Small hydropower development is one of the thrust areas of power generation from renewable in the Ministry of Non-conventional Energy Sources (MNES). In 1989, when the subject of small hydro projects up to 3 MW station capacity was given to the Ministry of Non-conventional Energy Sources, the total installed capacity of such projects was only 63 MW. In just 10 years, this capacity has increased three-fold. Among the major initiatives taken in this regard include identification of potential sites and their feasibility studies, R&D-cum-demonstration projects with new and innovative approach and technical and financial support to set up grid-connected as well as decentralised small hydro projects.

Estimating hydro power potential

To know the full potential of a proposed small hydro power project, it is essential to derive flow duration curve of the intended location of the project. Flow duration curve is a simple graphical depiction of variability of water flow at a location without any reference to the sequence in which this flow would be available. To derive a flow duration curve for a location on a stream for which adequate flow data are not available, regional flow duration curve may be used. Regional flow models are developed on the basis of data available for a few other gauged catchments in the same region or transposed from similar nearby region. Such models are employed to compute flow duration curves for ungauged catchments in that region. Availability of such regional flow duration models is of paramount significance in estimating the potential of hydro-power in remote hilly regions of the country.

Regional flow duration model developed under UNDP-study

The regional flow duration models for hilly states have been developed by National Institute of Hydrology, Roorkee in association with Alternate Hydro Energy Centre (AHEC) under Zonal Plan Activity of UNDP-GEF Hilly Hydro Project – Ministry of Non-Conventional Energy Resources, Government of India. The yearly flow duration model provides the pattern of flow at an ungauged catchment. For the development of flow duration model, the physiographic characteristics of catchment like catchment area, perimeter, length of main channel, elevation of highest and lowest points, geology of area, hydro-geology of area, land use pattern are used. Climate and other parameters have to be taken into account. However the model developed under above study is based on catchment area of gauged site only. The main reason was non-availability of topographical features for significant number of gauged catchments, availability of data for individual catchment for short length and paucity of time and resources in carrying out detailed study. It was decided to pool the available data together within a region to form a single data series by making them non-dimensional for obviating the need of relating the flow data of individual catchment with their physiographic characteristics. Only mean flow from a catchment, used for making the flow record non-dimensional, was related to catchment area.

The flow duration models, under the above study, were developed for nine regions covering all 13 states of Himalayan region. These models are expressed mathematically in the form of algebraic equations and graphically in the form of plots. The model data was verified with the actual measured data. As the confidence limit is not very encouraging, so the flow duration obtained from above regional flow model may be used only for pre-feasibility studies. The installed capacity may be based on the actually measured discharge data.

Utility of remote sensing data for catchments analysis

Remote Sensing data available in the near infrared region (0.8-1.1 μm) provides clearly the contrast between land and water features and therefore is best suited for mapping perennial streams. IRS-LISS III-Geocoded False Colour Composites (FCCs) data may be used for identification of catchment boundary, drainage network; perennial streams, land use and vegetation cover for these projects. Digital Elevation model (DEM) of these catchments may be generated by digitising the elevation contours and spot heights from topographic maps and using capabilities of Arc/Info GIS module (Arc-Tin) with user defined azimuth, elevation and look angle. The catchment boundary, drainage network and location of major habitation may be overlaid on these DEMs for further analysis.

Locating small hydro potential sites

To develop the modified regional flow duration model for ungauged catchments and to update the database of small hydro potential sites in northeastern states, following data are being collected by this centre for the gauged sites:

- Physiographic characteristics of catchments – name, geographic location, catchments area, altitude of gauging station, mean & maximum altitude of catchments, influence of ice/snow/glaciers, catchments map/drawing, stream network in catchments area, portion of catchments which is forest or under glacier, area of catchments covered by snow (mean of maximum snow cover).
- Meteorological data time-series of river flow data, monthly precipitation, temperature, solarity, relative humidity and wind speed for all meteorological station with altitude of station.
- Arial climatology digital or paper maps of monthly/seasonal/annual precipitation, evaporation, temperature, snow cover, relative humidity, solarity, wind direction etc.
- Digital Terrain Model data (DTM) is being procured with different elevation posting in a grid data structure. DTM shall be used for computation of slope, channel length, area of catchments, head available for power generation and location of suitable sites for civil structures of small hydro power projects such as diversion weir, feeder and head race channel, desalting tank, fore bay tank, power house building etc.
- Repetitive satellite data for these catchments may be effectively used to locate the region of deforestation and impact of small hydro projects development on forest in the catchments.
- Transmission Line Network Data: It is proposed to integrate the existing 11 kV transmission line network with small hydro potential sites. This information will have a bearing on priority of sites selected for development as for those sites which are close to existing transmission line network, expenditure on laying and maintenance of transmission line from small hydro project up to the existing network will be reduced considerably.
- Other data include geology, hydro-geology, soil cover and land use and other parameters are to be related with modified flow duration curves.

Once a potential site is selected and small hydro power project is installed, geospatial technology has to be integrated with the IT infrastructure of the project to enhance operational efficiency, maintenance and outage management.

GIS integration

The key to hydro power success is in complete integration of GIS in utilities located across the country. A fully digital environment, leveraging on geospatial technology to monitor and map the utility's infrastructure and to dispatch field crews should be developed. With a proven return on investment on GIS, a next-generation system built on open standards that could upgrade and consolidate disparate systems is to be installed.

Next generation system

With the new system, the utility will have greater capabilities for performing spatial analysis with its GIS data, as well as any other data that can be represented spatially. This visualisation greatly enhances and expedites decision-making processes. The new system also gives the capability to create more accurate maps and data.

Additionally, the system feeds latest updates to the utility, its mobile workforce management system and its circuit analysis programs. It also allows crews in the field to view the same visual representation of assets as those back at the office. The integration of GIS information with the utilities will continue to improve its response times for outages. Enhanced geospatial models promote better capabilities for determining the cause of disruptions on the power grid. This results in better communication with customers for outage restoration. The consolidated system also enables operational personnel to easily view and submit GIS data to the utility's central database from the office or field environments.

The future

As we move forward with smart grid strategy and similar initiatives, the upgraded, consolidated GIS will become more critical to its operations as the utility increases its focus on configuration management to be able to operate its grid in real time.

Overall, the integrated GIS serves as the foundation for a wide variety of hydro power initiatives, including an enhanced response plan and energy-efficiency programmes.

Anit Ghose
Director
Netwings Infotech (P) Ltd.



Exploring resources the eco-friendly way

Summary:

The petroleum industry's performance in minimising environmental impact has steadily improved by using latest technologies. Geospatial technology is being used as a key enabler right from identification of underground hydrocarbon reserves, site selection for drilling, to planning transmission routes and in continuous monitoring of the oil fields to minimise impact on the environment and surrounding populations.

The petroleum industry's exploration and production activities may have impacts on air, land and water. To offset these impacts, the industry invests in programmes and technologies that help to reduce its environmental footprint. The presence of hydrocarbon in the environment need not be the result of human causes such as accidents and routine exploration and exploitation activities. Natural phenomena such as seeps could also affect nature. A large number of reserves are associated with visible micro seepages and many oil fields are found due to natural seeps.

Fuel extraction is somewhat less disruptive to the earth's surface than the extraction of solids. Petroleum industry locates promising formations through various activities such as applying various exploratory tools, drilling exploratory wells, installing and maintaining production wells, carrying out preliminary separation of materials extracted from the wells, plugging wells that have reached the end of their economically useful life, removing the surface penetrations and finally restoring the sites. The industry uses much less disruptive production installations than a typical mine. Some production wells (Sucker rod pumps) can be found right in the middle of a field with rows of paddy or other vegetation, or even near highways, each pump rocking up and down without disturbing locals. Such eco-friendly sharing of land uses may not be common in other mineral industries (Figure 1).

Oil and gas development

Oil and gas development typically involves three phases: exploration; well completion and site construction; and operation of extraction and processing facilities. Related activities include the transport of extracted oil and gas to large storage and distribution facilities and then to refineries. As far as the oil & gas exploration is concerned, the available information suggests that the environment is mainly affected due to the accidental releases of oil or gas and land use/ land cover changes.

With the use of remote sensing and GPS technologies, surveying of geological formations has been simplified to a great extent, reducing the number of visits to the sites. High-resolution stereoscopic images provide detailed structural and stratigraphic information to develop geologic model. The maps prepared on GIS platform help in better understanding the surface distribution of various features, their inter-relationship and integration with other information. Conventional land gravity-magnetic surveys, to decipher preliminary information about the subsurface structures, have now become air borne. This not only reduces the cost and time but also helps be eco-friendly. This information when integrated on GIS platform helps in identifying the areas for further detailing by seismic surveys. In the seismic survey, acoustic waves are transmitted underground. As these waves travel through different rock layers, some are reflected backward by the different subsurface layers to an array of receiving geophones. These reflections of subsurface layers are then used to generate multi-dimensional representations of the subsurface.



Figure 1: Production facility in the midst of an agriculture field

Explosives or vibrating plates generate the acoustic waves. The amount of shaking associated with different seismic surveys varies depending on site-specific factors such as soil and rock type, how deep the survey needs to image, and the required source. However, because the charge is smaller (about four times less than used for large construction site or four hundred

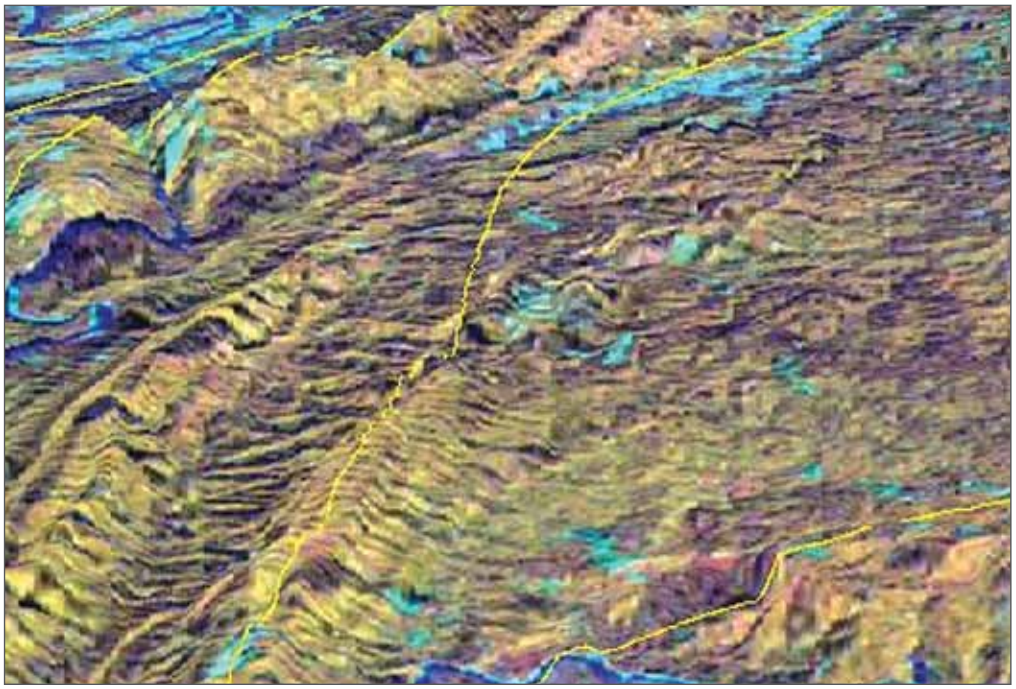


Figure 2: DEM-draped satellite image with other information to plan seismic coverage field



Figure 3: Monitoring reclamation efforts using remote sensing images

times less than for a medium mine blast) and deeply buried for seismic surveys, we may feel only a small pulse up to a few hundred feet away. The survey may require local slashing of ground cover and removing shrubs/vegetation to prepare shot holes for charging devices and installing geophones. The industry applies low-impact seismic technologies to find oil and gas reserves in environmentally sensitive terrains and in urban areas. Vibroseis trucks are used with a large pad that is lowered from the vehicle to the surface and then vibrated to generate seismic waves.

In an urban environment, vibroseis-generated waves are less than background noise generated by buses, trucks, and trains. To minimise the seismic coverage, high-resolution remote sensing data, GPS and DEM are used to understand the land cover, integrating them with other geologic information on GIS platform (Figure 2). The information thus derived helps in locating existing trails using the narrower, non-linear seismic lines, minimising its impact on vegetation and wildlife.

Drilling rig is used for drilling the well and involves rotation of drill bit, attached to a long string of a drill pipe down the well. Drilling mud is pumped through the drill string, through the drill bit, which returns up the annulus between the drill string and bore along with cuttings. If the presence of hydrocarbons is detected during drilling, production testing is normally conducted. The production testing is carried out to ascertain the reserves and economic viability. The land requirement per well depends on the drilling rig and the well head facilities are located in such a manner to avoid settlements. Since the operation is temporary in nature, land use pattern is not affected. The management of drilling mud and drill cutting is an essential component of safe drilling. The present generation of synthetic-based drilling fluid has environmental advantage because of low toxicity. Drilling mud is re-used as much as possible and the residual unusable mud is collected in lined pits and solar evaporated. The solids retained at the bottom of the pit are disposed off in a lined landfill site. The solid waste generation is limited to spent drill bits, packaging wastes and used containers, drill cuttings and waste oil. The environmental impacts during the construction stage to drilling phase are temporary in nature and do not entail any displacement of people. The utilisation of remote sensing, DEM and GIS helps not only in selecting a suitable drill site, but also in reducing the environmental impact.

Once production is complete, the industry's goal is to return the land to an equivalent capability by following a comprehensive land reclamation process. This includes safe removal of hydrocarbons, salt or chemicals from soil and restoring the productivity of the land using eco-friendly reagents; grading and contouring disturbed land; and replanting the land with vegetation in ways that meet regulations and are consistent with local land use. Such efforts can be monitored by remote sensing (Figure 3).

In case of offshore exploration, drilling mud and cuttings are of environmental concern due to their potential toxicity and the large volume of waste that is discharged during drilling. These materials are shipped to onshore oil field waste sites or injected into disposal wells at sea. While natural seepages contribute more hydrocarbons to the marine environment by volume, the quick influx and concentration of oil during a spill makes them especially harmful to localised marine organisms and communities. Satellite SAR survey helps in the timely identification and monitoring of such oil spills and reduces environmental hazards (Figure 4, 5).



Figure 4: Accidental oil spill from an offshore production facility (Bright dot)



Figure 5: Oil spill from an offshore vessel

To reduce the drilling and production facility footprint, laterals are drilled from individual wells. Laterals are short, horizontal branches drilled from a single well bore. With current technology, several laterals may be drilled off the main vertical well bore to reach individual reservoirs. In these cases, the main well bore is followed by the drilling of several smaller-diameter lateral well bores.

Transmission pipelines are used to transport the crude oil and natural gas over long distances from producers and processing plants to local distribution companies or directly to large industrial consumers. Before laying a pipeline, industry conducts an environmental study to assess its impact on soil, water, vegetation, wildlife, archaeological resources and current uses. Remote sensing, GPS and GIS is used to ensure that proposed routes are planned to minimise the impact on land and populated areas. Routine aerial surveys help in maintenance and avoiding unwanted accidental hazards .

In general, the Petroleum industry's performance in minimising environmental impacts has steadily improved by using latest technologies and compliance with state regulations and restrictions. Routine flaring of gases from producing wells are declining and can be monitored by GPS, GIS and thermal remote sensing. Oil and gas can now be recovered from ecologically sensitive areas and from very inhospitable locations with much less damage and risk than would have been the case in earlier years.

Geospatial technology is an essential component of the Environmental Impact Assessment process, as environmental resources are directly affected by changes in the shape and extent of the proposed disturbance caused by the exploration and exploitation. With the use of spatial techniques like remote sensing, Geographical Information Systems, and Global Positioning Systems, mitigation and monitoring plans can be effectively formulated.

D S Mitra
DGM (Geology) & Head
Remote Sensing & Geomatics Division
KDM Institute of Petroleum Exploration
Oil & Natural Gas Corporation Ltd



At ease with the sea

Summary:
The petroleum industry's performance in minimising environmental impact has steadily improved by using latest technologies. Geospatial technology is being used as a key enabler right from identification of underground hydrocarbon reserves, site selection for drilling, to planning transmission routes and in continuous monitoring of the oil fields to minimise impact on the environment and surrounding populations.

It is early in the morning, Kunjumon and his team of four others are busy getting their fishing net and other paraphernalia ready. One of the team members is a bit hesitant to go, for he hasn't sighted the ubiquitous sea birds that frequent the zone – a belief that if the birds are around, the sea would be calm. The dark sky and receding clouds are giving him the jitters. But then the others convince him to join and assure him that all will go well. The fishermen of Kerala, for as long as one can remember, have relied on traditional wisdom like the congregation of birds, colour and smell of sea water, bubbles breaking on the sea surface, muddy and oily water with a calm sea and reflection in the night before venturing out to sea. Today, however, they need not depend on hearsay or plain blind beliefs, but on scientific proof and authentic information on the weather conditions. What's more, they not only get to set out to sea confidently but also know exactly where to fish, thanks to the alerts given to them by Kerala State Remote Sensing and Environment Centre.

Kerala State Remote Sensing and Environment Centre (KSREC) in collaboration with Indian National Centre for Ocean Information Services (INCOIS), are working towards the transfer of the technology to the coastal fishing community for benefiting their livelihoods. KSREC has setup mechanism for the effective transfer and usage of the Potential Fishing Zone (PFZ) advisories received from INCOIS. Remote Sensing Satellite data application stands unique, which provides real-time information and provides service at grass root level helping common fish folks. The forecasting of fishing zone in marine water is achieved by

correlating information on Sea Surface Temperature (SST), pigment concentration and the oceanic features. The service will help increase the fish catch and reduce the searching time in fishing operations.

How it is done

In this scientific process of PFZ forecasting, parameters such as sea surface temperature, chlorophyll, nutrients, dissolved oxygen, salinity, winds and currents are used to study the feeding and breeding habits of fish, and thus to evolve scientific indicators of potential fishing zones. Features such as oceanic fronts, meandering patterns, eddies, rings, upwelling areas etc. that are proven to be prospective sites for fish accumulation are identified from Sea Surface Temperature generated using NOAA-AVHRR Satellite data. The availability of Chlorophyll from OCEANSAT has enriched these advisories in recent years. Information is given to user community thrice a week. In South Kerala, KSREC coordinates the dissemination and validation of Potential Fishing Zone Programme in association with INCOIS.

Project implementation

The implementation of project involves four main steps: Forming of fishermen clubs; conducting awareness campaigns; ensuring that advisories are disseminated; and evaluating advisories through a validation exercise.

Fishermen clubs

The success of PFZ technology depends on the transfer of the technology among fishermen community and effective dissemination of the forecast to the community. Fishermen clubs were formed in various fish landing centres. President and Secretary were selected among fishermen and a local social worker was also selected as patron. The club meetings were held regularly to discuss various issues in fishing sector and knowledge was shared. Data dissemination and feedback collection were also done through these clubs.

Awareness campaign

Awareness campaigns were held regularly to educate the community regarding the technology and to clarify doubts. This process helped create confidence in the community as well as the centre in the effective transfer of the technology. It also helped create enthusiasm among local people regarding the technological capabilities particularly of Remote Sensing and Geographic Information System (GIS).

Why fishermen matter

Kerala produces about 6 lakh tonnes of fishery resources which constitute one-third of the fish landings of the country. The state has seven major fishing harbours and hundreds of small landing centres spread over 222 fishing villages of nine coastal districts. The sector provides employment to about 2 lakh people directly and another 2 lakh in allied sectors.

Dissemination of the information

Real-time transfer of PFZ forecast to the fishermen is the key component in the technology transfer process. As the information is dynamic in nature and the validity is only up to 48 hours, effective arrangements are made to deliver the information to the communities.

Validation exercise

The validation of PFZ advisories is also regularly carried out to evaluate the service provided. The landing data of vessels operated within and outside PFZ were collected and analysed for the effectiveness of the technology. It was observed from the results the vessels which used the PFZ advisories increased their catch by 30 per cent.Searching time also reduced by 15-20 per cent, reducing the fuel usage as well.

The fishermen in Trivandrum coast are now utilising the service and demanding for species-wise forecast as well. Information on sea conditions, surface temperature, winds, waves etc. were also provided to help the fishermen for the safe fishing operations. Warnings on Tsunami-like disasters are also provided to the community. The programme has become a success story as it brings together technology, scientists, institutions and user community.

Electronic display boards

INCOIS and the Ministry of Earth Sciences, Government of India sanctioned two electronics display board to KSREC which were installed in two major landing centres of the Trivandrum coast in Anchuthengu and Mariyanadu.

The digital board at Mariyanadu was inaugurated on July 28, 2009 and the State is planning to establish the facility in all the fish landing centres. In other landing centres, the information is passed to the fishing community through Phone/ Fax/ Internet. The information is translated to Malayalam, the local language, and delivered to the fishermen. The measurement is also converted into local measurements for easy usage.

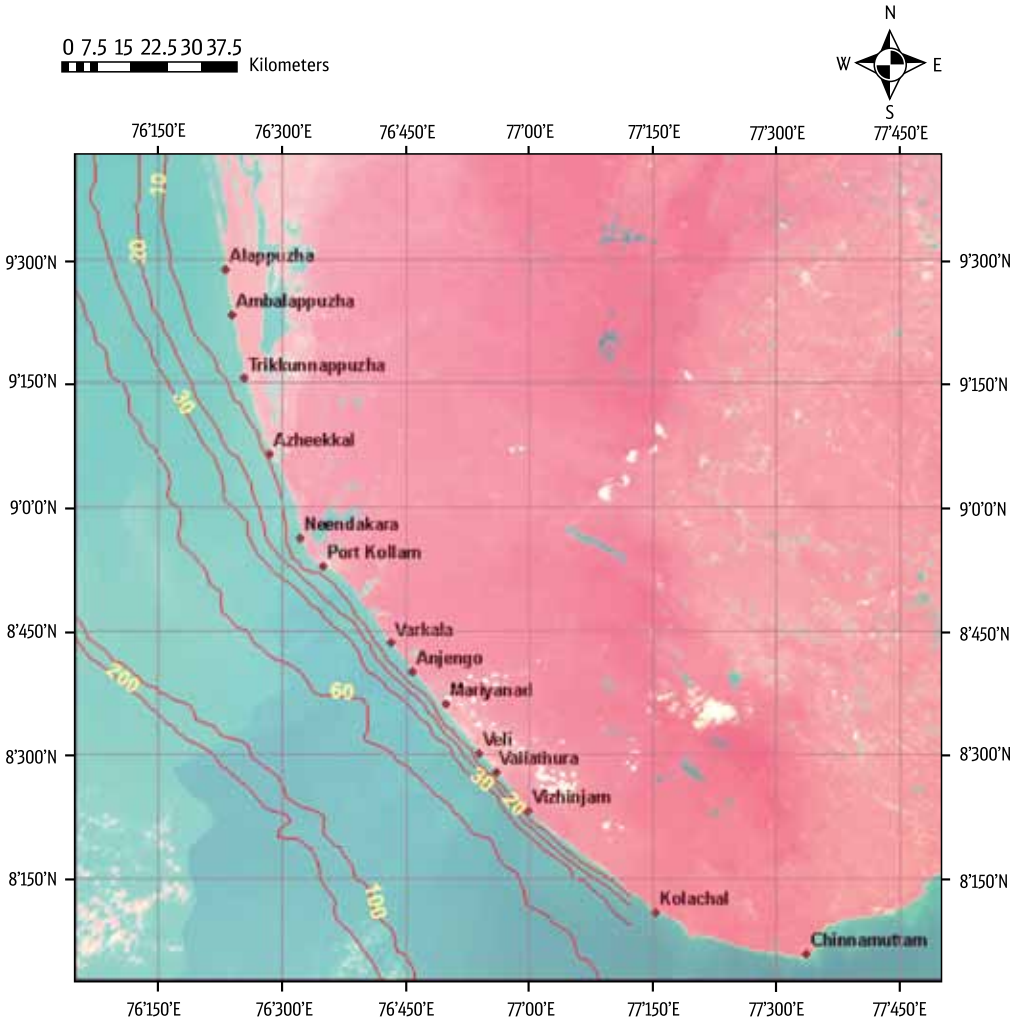


Figure 1: Fish landing centres in South Kerala Coast

The warning system has come as a welcome relief to the fishing community in Kerala. The benefits are already visible with improved fish catch and the quality of life of fishermen rising by many notches.

N C Anil Kumar
Scientist
Kerala State Remote Sensing and Environment Centre



Summary:

Growing demand for ground water by various sectors has raised a serious concern on its sustainability and quality. Hence there has been a paradigm shift in the government strategy from development to management of ground water resources.

To support the initiatives implemented for management of ground water, Central Ground Water Board (CGWB) and National Informatics Centre (NIC) have jointly developed the Ground Water Information System. Based on GIS technology, this Web-enabled application provides ground water related data/ information such as thematic layers, nationwide database on ground water levels and water quality being monitored by CGWB.

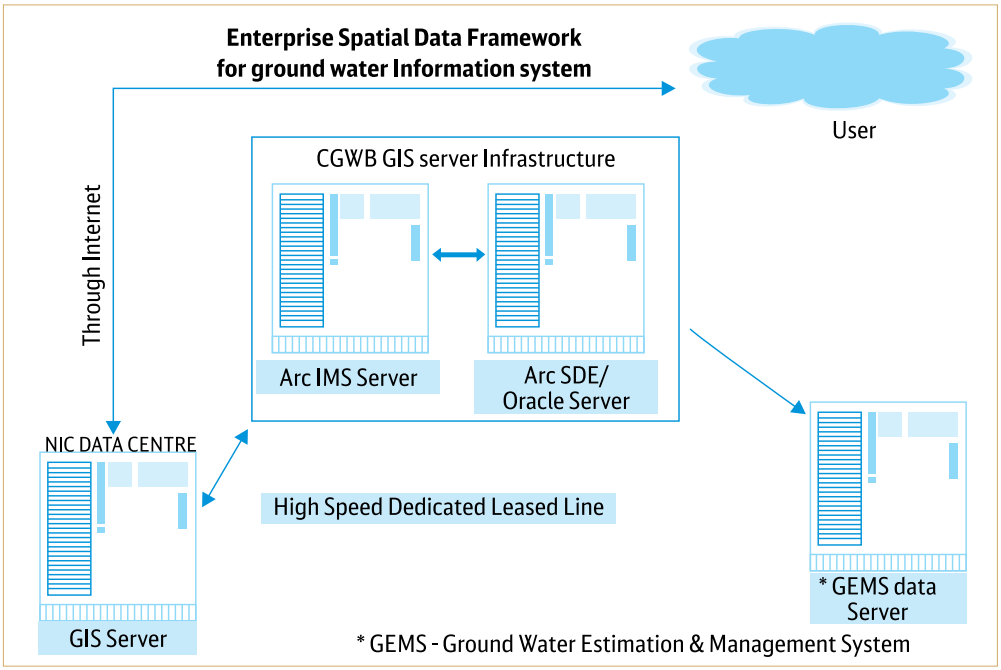
Streamlining ground water resources

Availability of quality ground water is crucial to meet the future water requirements. A number of ground water development programmes are in progress, but growing demand for ground water by various sectors has raised a serious concern on its sustainability and quality. Considering the present scenario, there has been a paradigm shift from development to management of ground water resources.

A number of efforts are being made for management of ground water, but planning and success of any strategy for ground water management largely depends on the availability of accurate data on accessibility status of ground water. With a vision to provide a comprehensive database on accessibility and quality of ground water, Central Ground Water Board (CGWB) and National Informatics Centre (NIC) jointly developed the Ground Water Information System.

Launched by the Union Minister for Water Resources, Pawan Kumar Bansal on March 22, 2010 that coincides with the World Water Day, this government-to-government (G2G) information system uses state-of-the-art GIS technology in a Web-enabled environment to provide ground water related data/information such as thematic layers, nation-wide database on ground water levels and water quality being monitored by CGWB.

Efforts are being made to integrate ground water related data from agencies both at state and central level to provide comprehensive and



up-to-date information through the Ground Water Information System. Stakeholders involved in ground water development and management can access and visualise data pertaining to ground water condition through framework Service Oriented Architecture over Enterprise Spatial Data Infrastructure around Multi-layer GIS. Technologies involved in the development of this information system include ArcIMS 9.2 on Windows 2003 Server, ArcSDE 9.2, Oracle 10g and ASP.Net 2.0.

Spatial data provided by the information system includes administrative boundaries to village level, drainage, ground water (watershed boundary, well inventory, water quality maps, ground water potential map, notified blocks and artificial recharge feasible areas), soil, geology, hydrogeomorphology, land use/land cover and isohyetal maps. Non-spatial/ attribute data includes water level and water quality data.

The framework architecture of this information system is scalable and can be updated/ modified to add more information. A number of updation plans are scheduled for the information system including integration of spatial layers in 1:50,000 scale, linking of information from state ground water organisations and other resources, integration of MIS data of minor irrigation census, drinking water supply and various schemes and programmes of ministry of water resources and bringing value-added analytical services as per the needs of various stakeholders.

Omer Ahmed Siddiqui
Associate Editor - Geospatial Today
Gateway Media Private Limited



Remote Sensing fits to a 'T'

Summary:
Remote sensing and GIS have emerged as key enablers in monitoring tea plantations. From gauging soil fertility to monitoring pest control and studying crop health, these technologies can be effectively used for gathering timely and accurate information.

India is one of the largest tea producers in the world and consumes more tea than any other country except China, but the production could be much more if modern technologies are used. This research work carried out in collaboration with the Indian Institute of Remote Sensing, Indian Space Research Organisation and International Institute for Geoinformation Science & Earth Observation, ITC, The Netherlands with field support provided by Tea Research Association, Jorhat, Assam is a step in that direction.

Crop monitoring is a dynamic phenomenon with the important changes taking place on a day-to-day basis. In order to monitor the tea plantations from pests and disease infestations, the use of remote sensing has become a pressing need.

Remote sensing offers an efficient and reliable means of collecting the information required and to map tea type and acreage. Remote sensing provides information on the health of the vegetation. The spectral reflectance of a tea field always varies with respect to the phenology, stage type and crop health and these could be well monitored and measured using the multispectral sensors. Information from remotely sensed data can be fed in Geographic Information System (GIS) which when combined with ancillary data can provide insights into the cultural practice being implied in the cropping system. Stress associated with, for example, moisture deficiencies, insects, fungal and weed infestations,

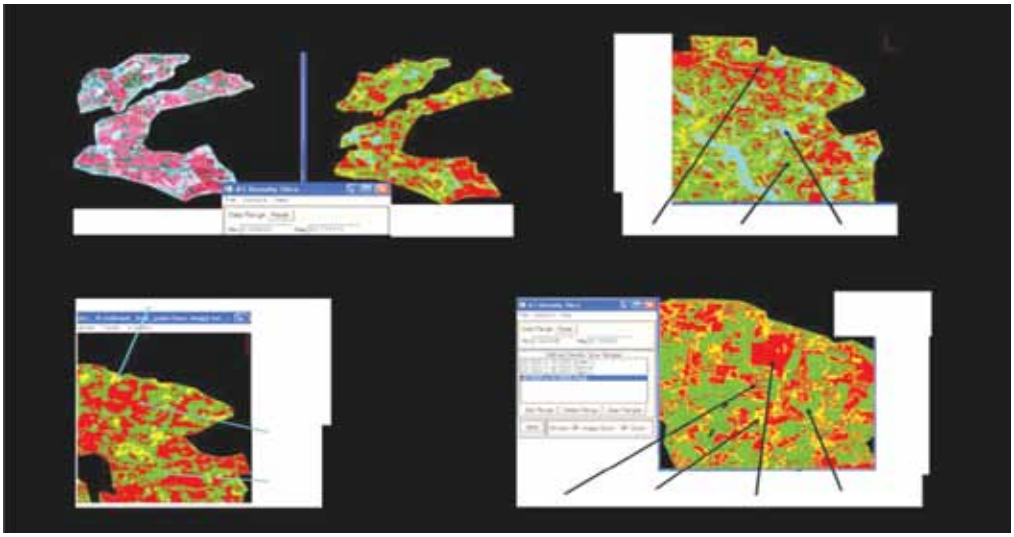


Figure 1: Delineation of affected and non-affected tea patches using multi-temporal images

must be detected early enough to provide an opportunity for the planters to mitigate. There are also instances where the tea growth varies from one spot to another. These growth differences may be due to soil nutrient deficiencies and other stress conditions through signature variations. Remote sensing will help the planters to identify areas within a field which are experiencing difficulties, so that he can apply, for instance, the correct type and amount of fertiliser, pesticide or herbicide. Using this approach, the planter will not only improve the productivity from his land, but will also reduce his farm input costs and minimises environmental impacts. Remote sensing has a number of attributes that lend themselves to monitoring the health of tea plants. One advantage of optical sensing is that it can see beyond the visible wavelengths into the infrared, where wavelengths are highly sensitive to crop vigour as well as crop stress and crop damage.

Remote sensing can aid in identifying the tea crops affected by conditions that are too dry or wet, affected by insect, weed or fungal infestations or weather related damage. Images can be obtained throughout the growing season to not only detect problems, but also to monitor the success of the treatment. Healthy plants have a high Normalized Difference Vegetation Index (NDVI) value because of their high reflectance of infrared light, and relatively low reflectance of red light. Phenology and vigour are the main factors in affecting NDVI. Examining variations in tea crop growth within one field is possible. If the data is georeferenced, and if the planter has a GPS (Global Positioning System) unit, he can find the exact area of the problem very quickly, by matching the coordinates of his location to that on the image. As traditional yield estimating processes are elaborate and time-consuming, remote sensing can play a vital role in effectively estimating the yield of crops. To achieve timely and accurate information on the status of crops, there is need to have an up-to-date crop monitoring system that provides accurate information. The benefits from using Remote Sensing and GIS technology depend on the level of success of its application for solving a concrete task.

Soil fertility status can be generated with the help of satellite images in conjunction with the field data. Other limiting factors like pest and disease attack can be timely monitored and assessed with the satellite data. Drainage congested areas can also be easily discerned from the image which can form the basis of drainage improvement schemes.

Area of study

A case study was carried out using remote sensing technology in the Sonitpur district of Assam, which has 73 tea gardens. The study involved monitoring of affected and non-affected tea patches using multitemporal satellite data. For this study, LANDSAT (30 m), LISS III (23.5 m) and ASTER (15 m) images were used.

Delineation of affected and non-affected tea areas

In this study we tried to assess the tea bush health using texture and tonal variations from remotely sensed images. The Grey Level Co-occurrence Matrix (GLCM) technique was applied to the different images to categorise the patches into healthy, moderately healthy and unhealthy tea plants (Figure 1). The patches were delineated using both texture and the classified images. The percentages of healthy, moderately healthy and unhealthy tea patches were delineated. It was observed that LANDSAT image of December, 2001 showed 60.4 per cent area under healthy tea, 23.6 per cent area under moderately affected tea and 16.2 per cent area under unhealthy tea plantations. For the LISS III image of February, 2004, it was found that 43.9 per cent of the area under healthy tea, 36.8 per cent under moderately affected tea and 19.3 per cent under unhealthy tea plantations. Similarly for ASTER image showed 24.9 per cent area to be healthy, 50.1 per cent under moderately healthy and 25.1 per cent of the area under unhealthy tea plantations. The results were finally compared with the ground Leaf Area Index (LAI) and the yield which confirms that there is a considerable decline in yield over the years, thereby stating that the texture analysis and tonal variations attempted here could play an important role in monitoring affected and non-affected patches in tea plantations. A qualitative analysis was also carried out which further showed the area under affected and non-affected tea plantations (Table 1).

Table 1: A qualitative valuation of the percentage of healthy, moderately healthy and affected tea areas

Classes	LANDSAT Image		LISS III Image		ASTER Image	
	Area (Ha)	Area (%)	Area (Ha)	Area (%)	Area (Ha)	Area (%)
Healthy Tea Patches	26,737	60.4	17,759	43.9	6,209	24.9
Moderately Healthy Tea Patches	10,426	23.6	14,878	36.8	12,495	50.1
Affected Tea Patches	7,157	16.2	7,800	19.3	6,259	25.1
Sum	44,321		40,438			24,965

LAI and NDVI relationship

MODIS NDVI image was generated and the tea garden patches were masked out. Using the masked NDVI image, the NDVI values were extracted from the tea masked area using 3 x 3 kernel for extracting the pixels. The average of the actual LAI and NDVI values were calculated and the linear regression analysis was carried out using the LAI and NDVI values. It was observed that there exists a linear relationship between LAI and MODIS based NDVI. It could be inferred that MODIS derived NDVI can approximately provide information on leaf area index for tea.

Relation between tea leaf yield and MODIS NDVI

Correlation analysis was carried out between area weighed averaged NDVI of tea for selected tea estate with their tea leaf yield for different years (2000-2004). The correlation coefficient 'r' values between yield and NDVI at critical time periods are shown in Table 2. Results showed that correlation is positive and significant irrespective of the month of the NDVI over the years. During 2000 and 2001, tea leaf yield was found significantly related to NDVI at 95 per cent level of significance while during 2003, correlation is positive at 1 per cent level of significance.

Table 2: The correlation coefficient 'r' values between yield and NDVI at critical time periods

Year	April	June	August
2000	0.503*	0.475*	0.440*
2001	0.489*	0.492*	0.469*
2002	0.561**	0.629**	0.520*
2003	0.643**	0.670**	0.680**
2004	0.530*	0.559**	0.553*

*Note: *Significant at 0.05% level & **Significant at 0.01% level*
Year wise correlation between tea leaf yield and MODIS based NDVI of tea estates during different months

Variations could be well observed from Table 2 may be due to factors like outbreak of pests infestation and frequent weather changes. The ground LAI collected from field also showed variations due to continuous plucking, different cultivars used also due to un-plucked areas. Even then a significant correlation could be observed between tea leaf yield and MODIS NDVI of tea estates during the different months.

From the study it was concluded that high-resolution images serves better for effective monitoring of tea plantations. The study showed that decline in yield is mainly due to old age of the plantations, closer spacing, planting on marginal and un-rehabilitated or poorly rehabilitated soils which restricts root growth and development. Other factors which contribute to yield decline are higher applications of manures and fertilisers, continuous use of pesticides and absence of proper drainage within the plantations.

The study showed that MODIS based NDVI during April, June and August was significantly correlated to tea leaf yield at estate level. However, it was found that NDVI observation at different time period alone could not explain the variance in tea leaf yield. The performance of the current statistical model for tea yield does not seem to be encouraging and it would have been much better if the weather parameters for the entire state would have been taken into consideration. So, an improved statistical model for tea yield needs to be developed.

Based on the above study Tea Research Association, Assam, India in collaboration with International Institute for Geoinformation Science and Earth Observation, ITC, The Netherlands and Indian Institute of Remote Sensing, Indian Space Research Organisation is carrying out a study on monitoring tea replantation and assessing environmental factors influencing tea quality by using image mining techniques and GIS-based approaches.

Rishiraj Dutta
Department of Earth Observation Science
International Institute for Geoinformation
Science and Earth Observation (ITC), The Netherlands



Saving wildlife with satellites

Summary:
Wildlife conservationists are catching up with geospatial technology, be it the tiger census and mapping of their habitat in India, or using remote sensing technology to locate and count large animals in the African forests.

Tracking Stripey

Of late the little cub, Stripey, is all over the place, on billboards, TV, newspapers and advertisements. The cub has indeed caught the imagination of the people. In our cover story, "Pawing its way back with technology", (August 2009 issue) we had lamented the lack of awareness in using geospatial technology that was hampering tiger conservation programme in India. Today, however things are changing for the better. Use of satellite imagery for wildlife conservation is growing. The Wildlife Institute of India (WII) and the National Tiger Conservation Authority (NTCA) are jointly conducting an all-India 2010 census on the tiger population. It is hoped that the census will be authentic. In the past there were allegations that states fudged figures of tiger populations. Rajesh Gopal of NTCA says, "For the first time, we will be using the double sampling method which will be a combination of using camera trapping of the big cat. We will also be using GIS maps to help factor in the habitat and the status of the forests."

On a wildlife trail

Scientists from the Bronx Zoo-based Wildlife Conservation Society (WCS) in New York City are using satellite technology to monitor wildlife in remote areas. Satellite data is found to be efficient in tracking large animals in remote locations.





Using cameras fixed to an orbiting satellite 450 km overhead, WCS scientists say that they will be able to take high-resolution photographs of specific areas to determine the wildlife composition within that area. They will later on compare images from different dates to see changes, such as population growth, decline in numbers etc.

Saving African wildlife

The mere mention of Africa is enough and people start relating to the wildlife there. But, with rampant poaching, habitat loss, war, pollution, climate change and other factors, wildlife in Africa is taking a beating. However, there are efforts by various organisations such as Virunga National Park in Congo, Volcanoes National Park in Rwanda and the Rwenzori Mountains National Park in Uganda who are doing their bit. Satellite images have been used to support GIS Wildlife Habitat mapping projects.

Up-to-date high-resolution satellite images and GIS can help observe species habitats and their environment over time which allows researchers to predict the best remaining areas to protect and manage. Tracking elephants in Botswana has been successful. Satellite collars helped a great deal in wildlife protection in Africa.

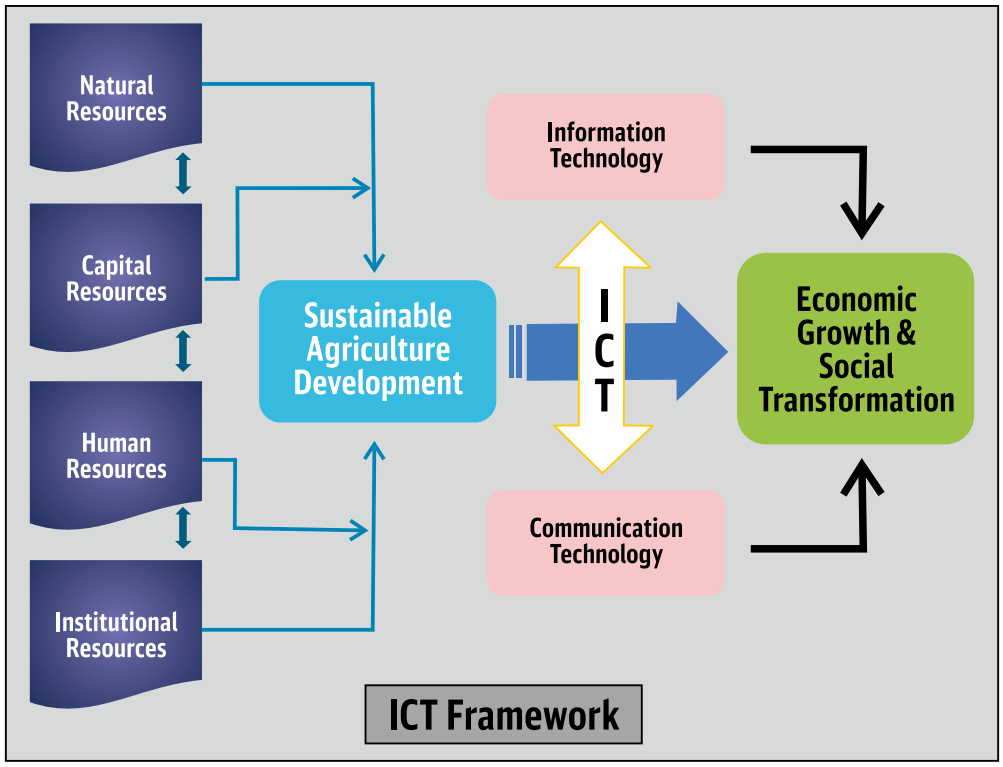


Summary:
Considering the present population growth in India, the food grain requirement is expected to reach 300 million tonnes by 2025. Thus, there is an urgent need to support the farming community with information driven communication services pertaining to pre-cultivation, in-cultivation, post harvest, transport, marketing and banking, to make agriculture more remunerative. A number of ICT projects such as GeoSense and establishment of village knowledge centres have been initiated to enable farmers' access to information. However, certain issues such as lack of awareness, localised content, easy accessibility to information and willingness to adapt new technologies need to be resolved.

Empowering farmers through ICT

Achieving a stable food security system in India is need of the hour. In India, about 60-65 per cent of people living in villages earn their livelihood through agriculture and allied activities. Rural population of India was 91 per cent in 1901 and is expected to come down to 50 per cent by 2020. Rural people migrate to urban areas for employment and better amenities. However, these opportunities could be created at the village level through selective adoption of information-driven communication services pertaining to pre-cultivation, in-cultivation, post harvest, transport, marketing and banking to ultimate beneficiaries. This is ardently needed to keep pace with the present population growth and food grain requirement of India, which has been estimated to be 300 million tonnes by 2025. Major research achievements in agriculture domain are devoted to devising methodology for soil fertility, inter culture, hybrid varieties, harvesting, soil and water conservation, optimal land-use, enhancement in cropping intensity etc. Agriculture may contribute only 17 per cent or so to India's GDP, but the challenges it faces, and therefore the challenge it poses for India's future, is as humongous as the challenge of physical and social infrastructure. Indeed, if India's politicians, planners and non-agriculturists do not take a more informed, more futuristic, and a more holistic view of this sector, we run the risk of facing mass socio-economic disruptions on the same scale as the drought-blighted years of the previous centuries.

Our perception on inter-relationships between agriculture policies, administrators & policy makers, farming communities and farming techniques are inadequate and disjointed. Although laws, communication chain, infrastructure and financial instruments exist to influence what happens on real farms, there is very little support or consistency in terms of information coalition. There exist a need of an unbroken bi-directional flow of support information and statistical data that meet the strategic aspirations in government and the practical aspirations of farmers. This can be achieved by adopting ICT tools and techniques that support every day farming decisions with information from various sources.



India and agriculture ICTs: ICT in agriculture is an emerging field focussing on the enhancement of agricultural and rural development in India. It involves application of innovative ways to use information & communication technologies in the rural domain. The advancements in ICT can be utilised for providing accurate, timely, relevant information and services to the farmers, thereby facilitating an environment for more remunerative agriculture. The contribution of information and knowledge in bringing about social and economic development has been well recognised globally. However, communicating agri-based knowledge and information to rural communities continues to remain as a major challenge even today, though the world has been better connected than ever before. The advent of new age ICTs, especially, personal computers, the Internet and mobile telephone during the last two decades has provided a much wider choice in collection, storage, processing, transmission and presentation of information in multiple formats to meet the

diverse requirements of the people. Inter-governmental agencies, NGOs and the industries during the last two decades have invested significantly in extending the reach of ICTs. Many of them have also experimented with new and varied applications in promoting development. Their reach has included areas such as health, agriculture, governance, financial services, employment and education. In the last decade, the Indian agriculture has witnessed the emergence of several new ICT projects which either substitute or support extension services by enabling farmers' access to information.

Here are two such examples of ICT projects that not only proved successful, but also gave further impetus to the use of information technology in India:

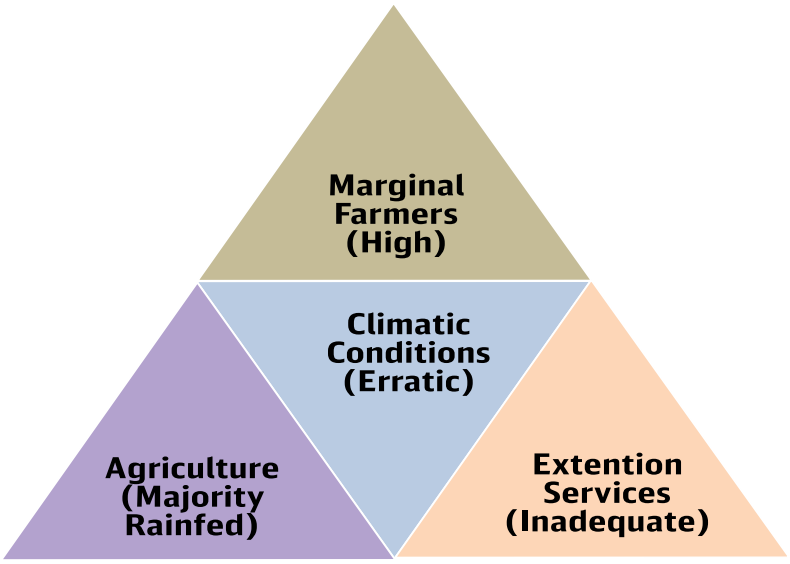
GeoSense: GeoSense, an initiative taken up by IIT Bombay and NARO-NARC Japan to assist Indian farming community and policy makers, not only provides information on the onset of drought or any unpleasant weather/climatic conditions. It also monitors the crop conditions / productivity / soil health / soil moisture or any dynamic situations that the rural communities require in a (near) real time mode. Different dynamic parameters like soil moisture, weather/ environmental conditions, crop growth/health etc. can be obtained from the sensors and passed on to the rural stakeholders for their use. This will allow the farmers to relate the data to the ground reality and take necessary actions for their respective fields. High-density sensor network coupled with the Geo-ICT and grid computing technologies are utilised for this purpose.

VRCs / VKCs: Village Resource Centers have been set up by ISRO around 2007 and Village Knowledge Centers have been set up by the M S Swaminathan Research Foundation (MSSRF) in 1992. These VRCs and VKCs mainly provide need-based locale-specific, demand-driven information content based on the collection of several secondary data and a well-planned need assessment. The centres also periodically organise training and awareness programmes and establish linkages with several leading institutions for translating the content into field-based applications. There are many such initiatives taken up by various organisations/departments demonstrating the use of ICTs in providing variety of services in agriculture sector.

Issues and challenges in ICT adoption

Information sharing is a core component of any ICT initiative. In agriculture domain, this is quite complex as many aspects and dimensions play a role. An installed base of information systems that lacks standardisation can hamper efficient exchange of information. This leads to inefficient business processes and hampers adoption of new knowledge and technology. Especially, the exchange of information at whole chain or network level is poorly organised.

The common problems in adoption of ICT in rural segments are ICT illiteracy, lack of availability of relevant and localised contents in their own languages, easy and affordable accessibility and other issues such as awareness and willingness for adoption of new technologies among the rural people. One critical aspect in the usage of ICT for farmers and their groups, as seen in some of the ICT-driven initiatives, is the involvement of human interface at the last mile indicating that there is a human dependency in transmission of Information/Knowledge to farmers. Thus, there is a need to understand as to how far the ICT initiatives are able to address the farmers need so that better solutions can be developed to address those unmet needs. Since India has different types of terrain, resources, climate, socio-economic levels, administrative cultures etc., the micro-level planning, large-scale mapping and modelling requires for comprehensive village-level spatial and non-spatial

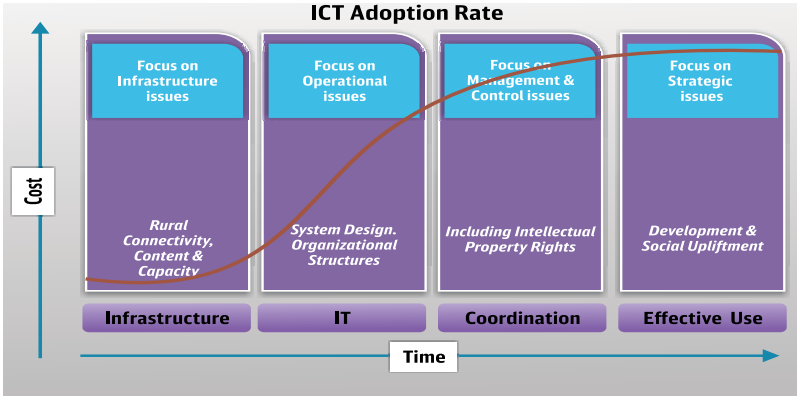


information contents. Important points that are holding up adoption of ICTs in agriculture are as follows:

- There is a sheer lack of understanding and awareness about the needs and challenges faced by small-scale farmers in villages
- Lack of participatory approach among experts, technologists and ultimate beneficiaries
- Need to inculcate ICTs in national poverty reduction strategies and programmes
- ICT policies should be pull-driven and not push-driven in nature
- Building the capacity of communities and local organisations to lead and own the process of appropriation
- Lack of proper coordination among donors, inter-governmental agencies and NGOs
- Convergence of old and new technology to create a three-tier system: public, commercial and community

With new ICTs, rural communities can acquire the capacity to improve their living conditions and become motivated through training and dialogue with experts to a level where they make decisions for their own development. Giving farming community a voice means giving them opportunity to express their views and opinions and make them part of the decision-making process. In order to make ICTs adoptable, it is recommended that:

- ICTs should be established in a pilot scheme so as to integrate it later into the extension delivery system of the region
- Organise frequent training for farmers in the use of ICT facilities
- The facilities should be adequately maintained to avoid constant breakdown. Otherwise, it could lead to a low perception of the technology among beneficiaries



Expectations of farming community

Farmers expect to get quick, exact and authentic information in the changing scenario of agriculture at global level. Dissemination of the required and recent agricultural information to the farmers in scattered villages at the variegated geographical situation in India is very difficult task. Transfer of technology to farmers is not a one-time exercise as the new farm technologies are constantly evolving. Farmers can utilise different services more efficiently and they are able to outsource some of the tasks they had previously performed themselves. Major expectations of farming community from ICTs are:

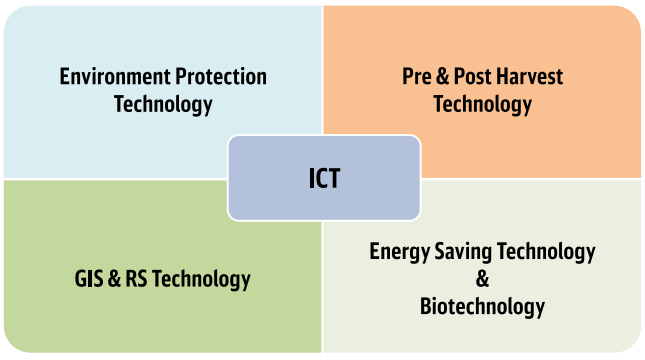
- ICTs should play a complementary role with extension personnel as the importance of personal contact cannot be undermined in extension delivery.
- Farmers expect ICTs to provide updates on the current agriculture education and research. This will help them adopt new farming practices. ICTs should boost research and assist in acquiring new knowledge.
- ICTs could help in bringing scattered members of farming community together so as to help them reach consensus on several issues. Progressive farmers of the region should be given an opportunity to share their expertise with farming groups through ICTs. This

aspect is very important in the specific case of poor communities with relatively low incomes and high communication needs.

- With regard to time management, ICTs should facilitate communication and reduce the time needed for transactions, which is an important consideration in rural areas. In the main production domain, producers, in the absence of any information on prices and potential outlets, are often at the mercy of intermediaries, who generally do not add any significant value to the production chain.
- ICTs should facilitate business development through improved access to information on product prices (inputs and outputs) and markets. Therefore, farmers expect ICTs to facilitate access to high yielding varieties at competitive prices, input suppliers, agri-clinics, credit institutions and information on how to improve their farming practices to increase yield.
- They expect that the cost of running and maintaining the ICTs should be borne by government.
- The information on farmers' related sites are expected to be in local language, that too in the audio-visual form.
- Women seem to be less able to express what they want from ICTs. The majority feel that these instruments are not made for them. This situation needs to be changed by involving women in the mainstream of ICT implementation.
- As a rule, villagers expect the use of ICTs to make positive changes in their farming jobs, farm education and environment.
- Elaborative training schedules should be organised at individual villages as per the convenience of the farmers.

Geo-information – A bastion of agriculture ICTs

Location or spatial information has become an important aspect of farm information management. The location of cultivation is important for regulatory purposes, logistics and farm management. The location within a field is linked to the known spatial variability in that field and allows farmers to make location-specific choices. Spatial data is now being used widely in the agriculture domain, especially for information management.



Geo-information specialists are developing systems and solutions at all levels. Timeliness and accuracy of information is key to success in agriculture. Use of satellite imagery, mapping services and GPS are becoming common place throughout the industry. Constellation of



earth observation satellites are positioned to provide critical information to the precision agriculture industry. Thematic experts, remote sensing experts, software programmers and system engineers process satellite images to generate products and services for the entire agricultural sector.

The satellite images are mainly used to observe crop production patterns, optimise the use of fertilisers, improve logistics and monitor food safety and quality.

Narrowing digital divide

Amongst the various means of information communication, satellite-based Internet communications are very efficient, accurate, quick and cheaper in the field of disseminating the information from research system to farmers. Internet communication has touched almost all the districts in our country and has trickled down to the village level. Internet offers a means for bridging the gap between developmental professional, rural people and agricultural producers through the initiation of interaction and dialogue. There is an increasing realisation that the digital divide – the gap between those who have access to technology and those who do not – is narrowing down. Besides the digital gap between women and men in the society, the social divide between rich and poor, as far as digital literacy is concerned, has also reduced in recent times. Over the past few years, the Government of India, has invested heavily in strengthening the ICT infrastructure and has taken several policy initiatives to attract private sector investments in ICT infrastructure and service delivery. In response to this, access to ICTs has been growing at a higher rate. Consequently, the digital divide, in terms of access to mobile subscribers, fixed telephone lines and Internet is getting narrowed down. As part of the National e-Governance Plan, a massive country-wide e-infrastructure reaching down to the remotest villages is evolving and a large-scale computerisation is taking place to enable easy and reliable access of public services over the Internet (Government of India, 2009).

India has the second largest network with 723.28 million telephone connections at the end of September, 2010. The rural areas in the country have experienced rapid growth in telecom services and the tele-density has risen from 21.16 per cent in December 2009 to 60.99 per cent in September 2010. The latest figures released by the Telecom Regulatory Authority of India show that tele-density in rural India was 28.42 per cent in September 2010, compared to 137.25 per cent for urban areas.

Building a promising agriculture ICT

Modern agriculture ICT has to reflect the different needs of farmers (marginal, small, large and cooperative holdings), farm advisors, extension services, stakeholders, co-operative farms inclusive of their horizontal and vertical integration. Structured and managed public private entrepreneurships, training, know-how transfer, capacity building are also integral part of the ICT. Following are the important steps required in building an effective and promising agriculture ICT:

- Use of GIS and basemaps (ortho-image, ownership and field data) as the planning instrument.
- Development of farm management, farm advisory applications with GIS, with an access to structured local expert data pertaining to crops, machinery, fertilisers, pesticides etc. for cost calculation, fertiliser balance, energy, and ancillary documentation.
- Precision farming tools to communicate directly to machines including map communication, map-management and integration of satellite based results.
- Virtual Farming with tools for a virtual land consolidation to overcome small and bad shaped field restrictions for productive machinery use.
- Creation of forest inventory of both large forest enterprises as well as smaller forest elements within agricultural holdings and development & use of forest management tools.
- Environment risk management enabling integration of farmers and foresters into urgent needed services regarding environment.
- Integration of meteorological and soil sensors as countrywide infrastructure network for a further enhancement of irrigation, pesticide and fertiliser use.
- Integration of agricultural banks and insurance.
- Development of accessible agri-clinics to impart technical know-how and immediate remedial measures to farming community.

Vinod M Bothale
Director, Maharashtra Remote Sensing Applications Centre, Nagpur
(Dept. of Planning, Govt. of Maharashtra)

Prashant Rajankar
Scientist, Maharashtra Remote Sensing Applications Centre, Nagpur
(Dept. of Planning, Govt. of Maharashtra)



Mapping watersheds in Narmada basin

Summary:
In a first of its kind project implemented in India, SECON Pvt Ltd has mapped 10 watersheds (sub basins) of Narmada river in Madhya Pradesh using advanced geospatial technologies. The maps will be used for planning minor projects in the sub basins, and for a variety of applications including disaster preparedness, response, recovery, risk assessment and mitigation measures.

Lead: In a first of its kind initiative in India, watersheds in the Narmada basin have been mapped using high-resolution satellite imagery supplemented by ground surveys.

Watersheds are hydrologic units that are considered to be efficient and appropriate for assessment of available resources and subsequent planning and implementation of various development programmes. Watershed is defined as "Natural hydrologic entity that covers a specific area expanse of land surface from which the rainfall as runoff flows to a defined drain, channel, stream or river at any point."

Of late, geospatial technologies are being extensively used for optimum development of land, water and plant resources within the natural boundaries of a drainage area for watershed management, to meet the basic needs of agriculture in a sustainable manner.

Another important aspect of water resource management is flood hazard mapping. Flood hazard mapping is of utmost importance in order to assess the impact of floods and plan mitigation measures, such as development of channels to drain off flood water. Flood hazard maps have been evolved over the years in response to user needs and are developed using improved technologies. However, production of new and revised maps has always taken place within the real-world fiscal

constraints. Newer digital mapping techniques are often more cost-effective, in both short and long term than the old conventional methods.

Be it watershed management, irrigation, flood control or rain water harvesting, in any water resources project, right from planning to design and execution, preparation of base map with accurate contours is essential. Development of a Digital Terrain Model (DTM) is primary requirement for developing a base map. Conventional methods for development of a base map are very laborious, time-consuming and uneconomical. Many modern techniques using satellite imagery and geospatial technologies can be used very effectively to meet survey requirements for any mapping project.

Mapping watersheds

SECON Pvt Ltd has conducted a first of its kind study to map the 10 watersheds (sub basins) of Narmada River in the state of Madhya Pradesh. Narmada, the largest west flowing river of the Peninsula, rises near Amarkantak in the Shahdol district of Madhya Pradesh at an elevation of 900 m in the Maikla range. The total length of the river from the head to the outfall into the sea is 1,312 km.

Objectives of the study include:

- Mapping the area for an extent of 13,817 sq km
- Contour map preparation to obtain the contours of 0.50 m intervals so as to plan the medium and minor projects (micro water sheds) in the 10 sub basins/water sheds
- Geo referencing
- Establishing ground control points
- Digitising and editing data
- DEM generation
- Ground truth validation
- Base map preparation
- Screening of the projects
- Identifying and locating the projects (location of dam sites)
- Water availability studies, water balance, basin plan
- Assess submergence and command area for 1,300 sq km of culturable command area
- Classification of land use/ land cover

Data used

The different types of data used for the project include:

- 0.50 m high-resolution, stereo satellite imagery
- Topographical maps
- Ground data obtained from field

Methodology

The basic requirement for developing engineering design for projects of big magnitude such as watershed management, flood control studies and rain water harvesting is the generation of an accurate base map with contours providing the details of 3D terrain configuration, catchment area, forest cover, land use, utilities, places of inhabitation etc. of sub basin area.

If the base map for this project was to be generated using conventional ground survey method, the volume of work to be executed was estimated to be about 100 land surveyors working for 8 to 10 years in undulating and forested terrain on each of the sub basin.

The process can be expedited using aerial surveys, but there are restrictions and limitations on successfully and rapidly executing aerial surveys in India because of security clearance, customs delay, and weather conditions.

The High Resolution Stereo Satellite Image (HRSI) mapping method combined with ground control and validation was chosen as the fastest and cost-effective technique possible. 3D ground features were extracted from HRSI using a combination of suitable software along with photogrammetric software. The stability, speed and the user-friendly interface of software helped to extract the required information accurately from the large stereo pair images, each over 2 GB in size.

In order to compile data from stereo HRSI, Differential Global Positioning System (DGPS) control was established. It was post pointed and processed to achieve the desired accuracy.

Topographic compilation was performed and an automatic DTM was created. The DTM was edited to eliminate any spikes or error points. Ortho-rectified images were generated. Planimetric details were digitised from ortho-rectified imagery by on-screen digitisation. Contours were generated from the DTM after generation of Triangulated Irregular Network (TIN). All data was merged to create a map on desired scale with contours at 0.50 m interval. CAD editing was carried out to create map as per cartographic standards. Suitable software was used as drafting tool during photogrammetry compilation and CAD editing.

Thus, combination of ground survey and planimetric topographic compilation in photogrammetry work station using HRSI has helped the project team to complete desired tasks in a short duration as compared to the time required by conventional ground surveys alone.

Macro-level mapping can be developed using Stereo HRSI, and this can be supplemented with LiDAR mapping to develop micro-level mapping with more details and higher accuracy.

The maps thus produced by using modern methods was used for further planning, design of medium and minor projects in the 10 sub basins. These maps are used to support flood insurance and flood plain management activities. Maps can also be used for a variety of applications including disaster preparedness, response, recovery, risk assessment and diverse mitigation measures.

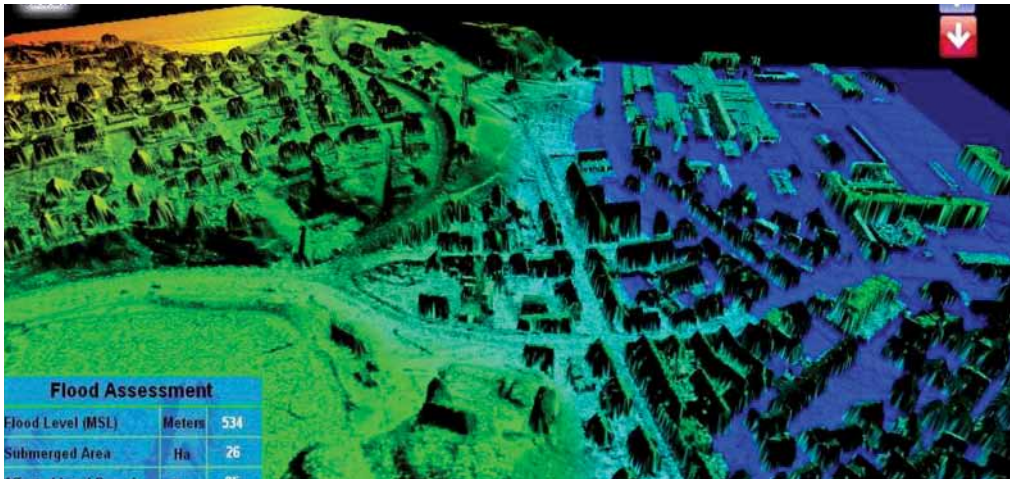


Figure 1: Flood mapping & modeling



Figure 2: 3D map overlay of HRSI Over Terrain Model

Conclusion

Conventional methods along with modern techniques can be sucessfully used for developing maps for all water resource projects without compromising on data quality. Remote Sensing and GIS proved to be very comprehensive in the study of large areas like watershed, flood plain studies and rain water harvesting where integrated and simultaneous activities have to be executed.

geospatial TODAY

FICCI

Transport



Towards sustainable road transport system

Summary:

A recent study conducted by the Ministry of Urban Development (MOUD) reveals that most of the major metro cities in India fair very badly on the congestion index with its value much higher than the average. This is mainly due to the ongoing urbanisation and motorisation trends, and their impact on mobility and safety of the population. This clearly points out to the unsustainable state of transportation systems in India. To deal with the scenario, most of the urban local bodies (ULBs) and urban public transport organisations are catching up with geospatial technology to ease traffic congestions and increase efficiency of public transport.

A recent report on congestion index of 30 cities of India concludes that most of the major metro cities fair very badly on the congestion index. There is unprecedented growth in registered motor vehicles; roads are chock-a-bloc and cities are bursting at the seams. Sustainable road transport seems to be the answer. So what does it involve? There is transportation system management, energy management, capacity management and environmental management. The present urbanisation, motorisation trends, and their impact on mobility and safety issues clearly point out to the unsustainable state of transportation systems in India.

According to a recent study by MOUD, the average journey speeds in 2007 on important city corridors was in the range of 17-26 kmph, which is considerably low as compared to design speeds for the same roads. Also, as per an interesting finding from MOUD report on calculating congestion index of 30 cities of India, it is concluded that most of the major metro cities fair very badly on the congestion index with its value much higher than the average.

Catching up with technology

Most of the urban local bodies (ULBs) and urban public transport organisations have started creating network and zonal level databases in GIS, however their present use is limited to database creation, and basic

query and search. The advanced applications that can provide decision support for ULBs and public transport undertakings are still to be explored effectively. Some of the examples of such applications are: use of GIS tools and database for master planning of new public transport systems like, metro, BRTS etc., route and schedule rationalisation of existing bus system, integrated public transport planning, use of GIS tools in identifying feeder areas of metro or BRTS stations and corresponding design of good feeder network etc.

Many of the urban bus transport undertakings like Bangalore Metropolitan Transport Corporation (BMTC), Indore City Transport Services Limited (ICTSL) etc. have equipped their buses with GPS and along with a detailed GIS network and database they are carrying out functions like vehicle tracking to monitor the movement of vehicles for schedule adherence, reliability etc. (Figure 2); passenger information system at bus stop i.e. estimating and displaying the expected arrival time of buses at a bus stop; daily and monthly performance evaluation and reporting in terms of, veh-km, passenger-km traveled etc.; fleet management for better utilisation and effective management of the fleet and real-time driver monitoring and assistance etc.

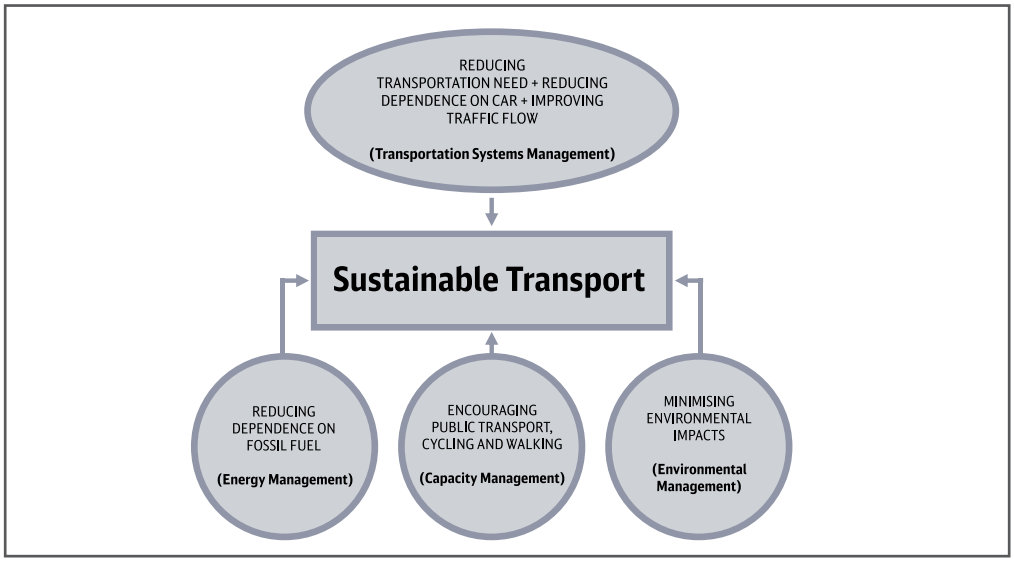


Figure 1: Components of Sustainable Transport

Call taxi services

Most of the Indian metropolitan cities are witnessing a growth in the quality of Intermediate Public Transport (IPT) services that are available on a phone call. Typically, call taxi services like, Meru, Easy Cab, Metro Taxi etc. have started their services in multiple Indian cities in recent years. Since, these services use a combination of GIS and GPS technologies to provide efficient and timely services to the customer (Figure 3). The service provider equips each of its taxi with a GPS and once a customer calls to the service station, they first identify the exact location of the caller on GIS map based on the location information provided by the

caller and then through a simple network analysis on GIS they identify the nearest taxi to the caller and instruct it to provide service to the caller.

The same concept can be potentially adopted for effective police patrolling and emergency police response, where the nearest police patrolling vehicle can be sent to the crime or accident location once the location of crime/accident is identified by the police control room on a GIS map.

Traffic management and law enforcement

Some of the Indian cities like Bangalore, Delhi etc. are effectively using geospatial and other intelligent transport system (ITS) technologies for effective traffic management and law enforcement. In 2007, the traffic police department of Bangalore started the JnNURM funded "Bangalore Traffic Improvement (B-TRAC) project. Under this project, the department has set-up an ITS based Traffic Management Centre (TMC) in Bangalore, which manages traffic and enforces traffic law using a network of 160 Pan Tilt Zoom (PTZ) cameras placed primarily at junctions (since, the traffic delays occur mainly at junctions). Using the live feed received from these cameras, the traffic police attempt to minimise the delays over the entire network. They also attempt to improve the efficiency of signalised junctions by changing the signal cycle and phasing (if required), directly from TMC based on the data received from the cameras. Also, they create colour theme based congestion map

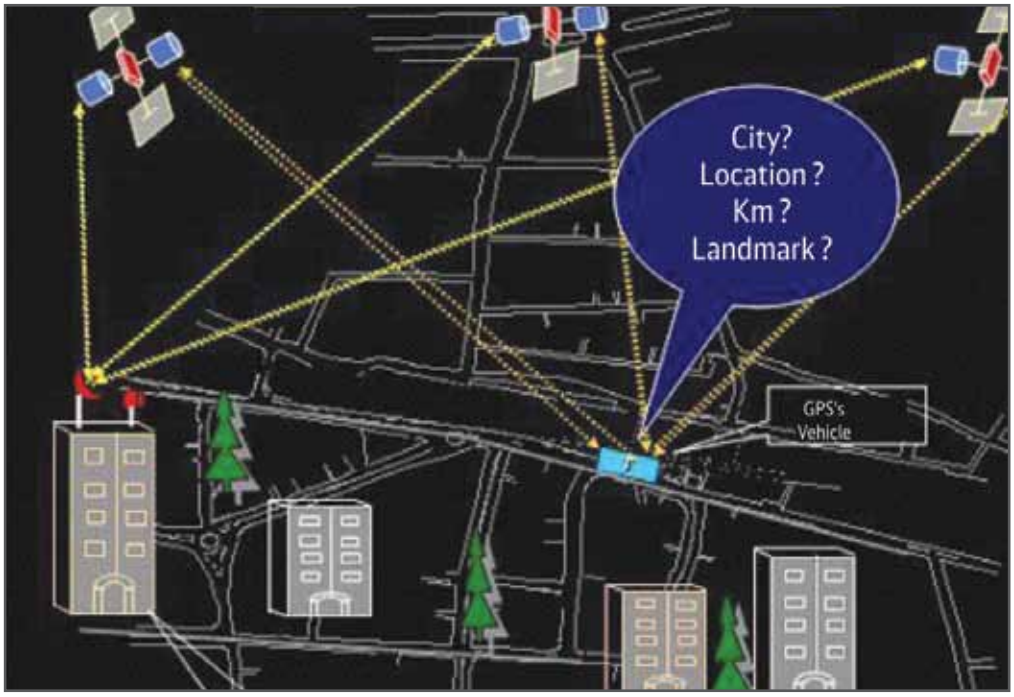


Figure 2: Tracking buses

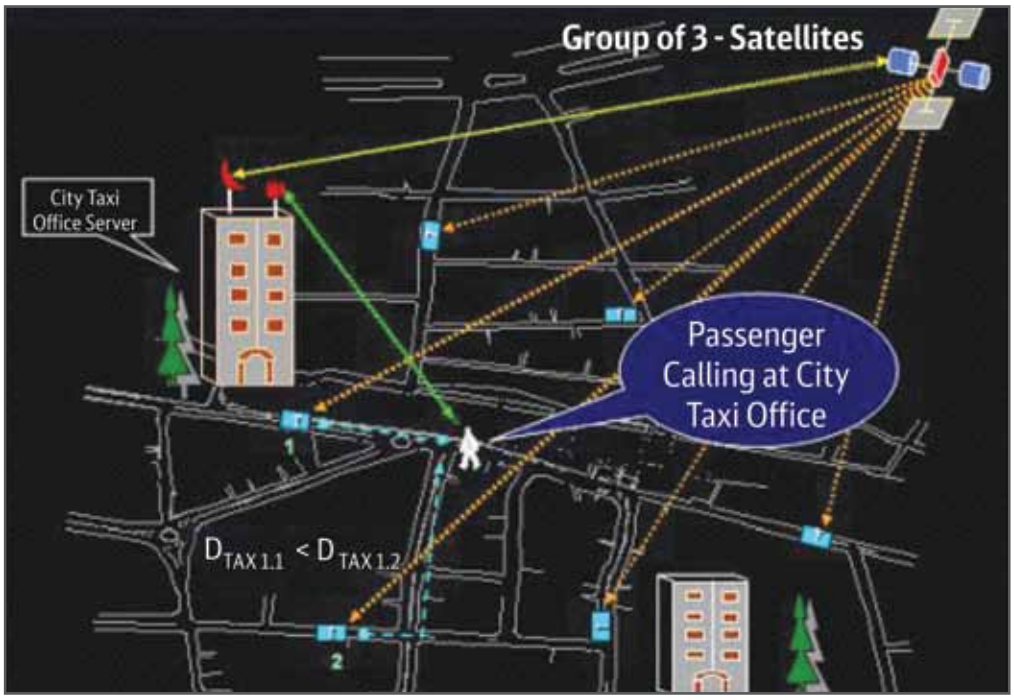


Figure 3: Use of geospatial technologies for call taxi services

of Bangalore road network using the live speed data of GPS-enabled BMTC buses and the GIS road network map of Bangalore city. The same network of PTZ cameras is used by Bangalore traffic police to enforce all visible types of traffic offences like, crossing of Stop/Zebra lines, parking in no-parking zones, not wearing helmet, seat belt etc.

Vehicle navigation system

Vehicle navigation systems have entered the Indian market recently. A typical navigator is a portable device (either hand-held or on dashboard of car) that helps a driver or a person to navigate in real time through the road network to reach a particular destination from the origin. Basically the device is GPS enabled and shows the real-time location of itself, while in motion, on the GIS map available in device. The navigator helps the driver to navigate through the shortest path to reach his/her destination.

Potential areas for application

There are many areas where urban local bodies (ULBs) can use geospatial technologies for efficient functioning, such as:

- Pavement Management System (PMS)
- Incident management
- Multi-criteria evaluation of route alignments
- Optimum routing of emergency services based on travel time.

- Developing optimal route configurations for public transport
- Vehicle routing problem
- Postal services
- Public transport companies
- Arc routing problem
- Municipal waste collection
- Network partitioning problem
- Jurisdiction of police stations
- Jurisdiction of municipal maintenance offices
- Earmarking areas for road maintenance for various ULBs etc.
- Network band creation
- Location of emergency services like fire stations, ambulance, hospitals.
- Evaluation of effectiveness of locations of above services, etc.

Challenges in implementation

Unlike developed nations, India is currently experiencing major infrastructure expansion at all levels (urban, intercity, and rural). This poses major challenge to update network database on the navigator devices. In urban areas traffic management measures like one-way etc. change frequently and it is difficult to update the same on navigation devices. In urban areas and for the commuters, the objective is to minimise travel time and not distance. Therefore, providing dynamic change of travel time as per change in v/c levels while navigating, can be a problem. Indians are not used to long driving on intercity highways, therefore the use of navigator devices may be limited for intercity travel. The device can also pose road safety hazard, owing to complex and difficult driving conditions on Indian urban roads as drivers cannot afford to lose attention of the road and traffic, even for seconds, while trying to seek guidance from navigator devices.

Potential research areas

Geospatial technologies could be very useful in assessing the impact of changing land use and /or control policies, slum development etc. on transportation and vice versa, assessing the required land-use control considering the holding capacity of transport infrastructure, developing integrated approach for corridor identification (for Metro, BRTS etc.) in metropolitan cities, route and schedule rationalisation, planning Transit Oriented Development (TOD), evolve Passenger Information System (PIS) design (especially for pre-trip planning) that is suitable for Indian cities and use of GIS to assess the impact of pedestrianisation, pedestrian zones etc.

Ashish Verma
Associate Faculty - CiSTUP
Indian Institute of Science (IISc), Bangalore



Summary:

Reliance Infrastructure has been awarded two projects for installing geospatial technology in Delhi and Mumbai Metro rails. The technology will help a great deal in train traffic monitoring, emergency response and maintaining security. Once implemented, passengers and Metro staff will have access to GIS through electronic displays and web portals. Passengers will benefit from critial information like optimum route from point A to B, real-time train movement details, availability of various surrounding facilities like hospitals in case of disaster and relevant contact details. The Metro staff will have all the assets mapped in 3D for remote management and monitoring, better collaboration and coordination among a dispersed team will enhance operational efficiency and decrease turn-around time.

Trailing the metro

One has often heard of railway accidents and stories of harried passengers, of lack of information on train movement and, worst still, their state of total helplessness during breakdowns. With GIS implementation in both the metros in Mumbai and Delhi, the time is not far away when passengers can take a sigh of relief, for most of their problems can be solved.

Reliance Infrastructure has been awarded two metro projects in Mumbai and Delhi. The metro business is characterised by a large physical spread of assets, work sites and offices. The spatial element plays a significant role in the work for the field staff. In order to model their physical workspace into a digital workspace, the GIS solution was envisaged.

GIS has proven itself, from our past experience in the utility as being the tool for representing real-world conditions on digital/electronic media that remotely monitors and manipulates asset-related data and quickly represents linkages and interrelationships between the assets. It not only visualises the current demands and priorities but also effectively predicts future needs. It decreases turn-around time by collaborating and coordinating more effectively with a globally dispersed team. GIS leverages the power of Global Positioning System (GPS) for real-time asset tracking and monitoring.

GIS technology not only saves time but also allows for several alternatives to carry out the task on hand quickly and cost-effectively.

Benefits of the GIS

- Improves driver safety
- Increases in traffic efficiency
- Reduces traffic congestion
- Improves environmental quality and energy efficiency
- Improves economic productivity

For any transportation system, it is essential to carry out many studies for connectivity, accessibility, location and allocation, preparation of master plans etc. All the studies require generation of databases at regular intervals and on different scales and levels. It is here that remotely sensed data and GIS systems offer optimal data sources at different spectral and spatial resolutions and at different intervals of time that could help to carry different studies on transportation.

The GIS will play a major role in the metro including train traffic monitoring, emergency response, security, medical emergencies etc. as it is probably the only system that can encapsulate the entire physical details of a complex geographical spread.

People interaction at operational levels

Once the GIS in Delhi and Mumbai Metros is fully implemented and goes live, passengers and internal operations and maintenance staff of both metros will have access to GIS through electronic displays and web portals.

Methodology for the creation of GIS for Metro

1. Obtain detailed spatial and nonspatial information for Area of Interest (AOI). Satellite Imagery of better resolution is used. Further, DGPS Survey is carried out to obtain Location/ Coordinate of all Stations, along with alignment drawing for the track.

2. Install and configure GPS devices for each of the assets and assimilate the GPS feeds to locate and plot the assets on map. This helps to monitor and track the status and movement of assets.

3. As the data is created in different layers (Buildings, road, tracks, and station boundary etc.), it can be used to perform analysis to search for anomalies or to detect optimisation potential.

A Geographic Information System (GIS) links locational (spatial) and database (tabular) information and enables a person to visualize patterns, relationships, and trends. This process gives an entirely new perspective to data analysis that cannot be seen in a table or list format. The five components of a GIS are listed below.

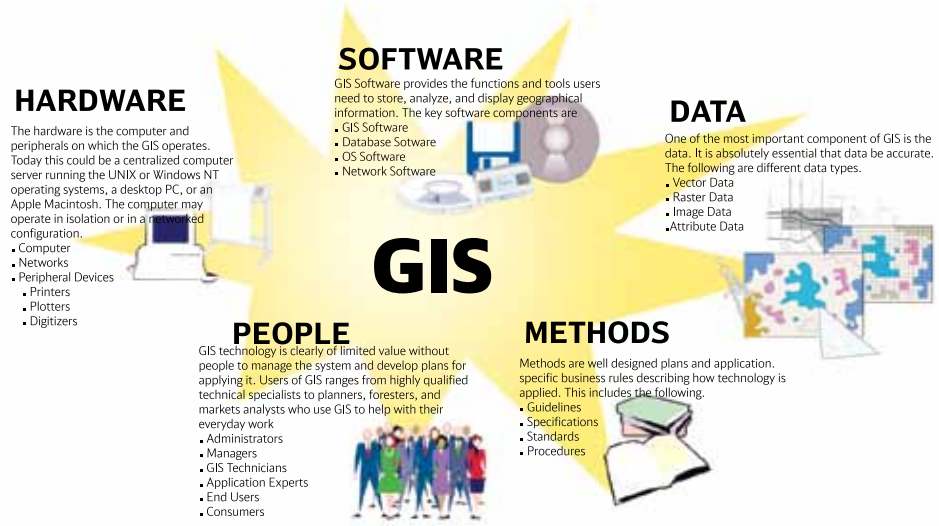
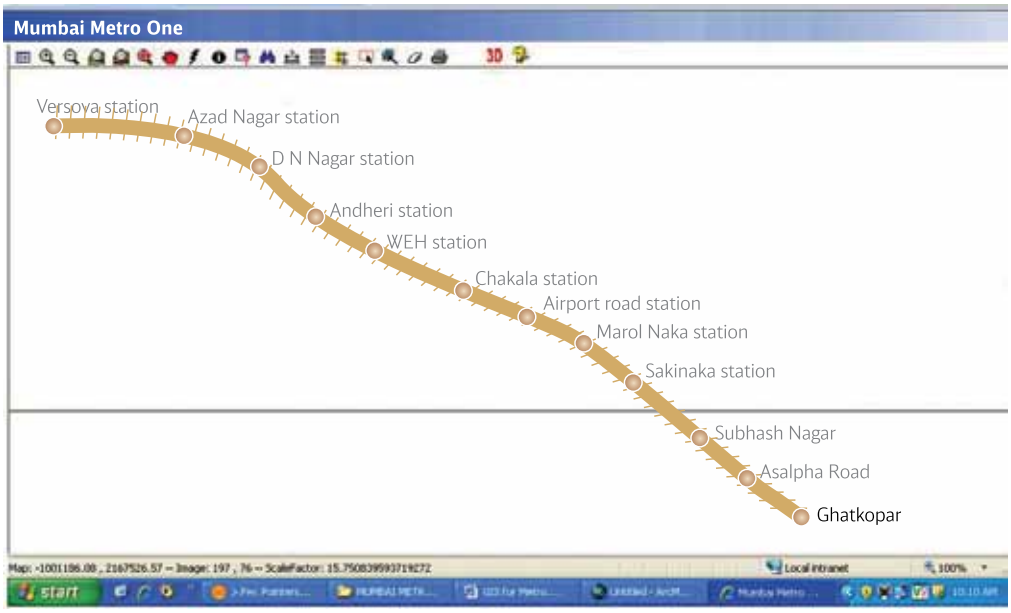


Figure 1: Methodology for the creation of GIS for Metro



GIS for Metro helps

1. To know the shortest path from origin to destination.
2. To know the location of the train.
3. To evacuate the passengers at the time of emergency.
4. Interlink 3D Models of Stations.
5. Finding path to closest facility (Tourist places, hospitals, Government & private offices, stadiums, bus & railway stations).
6. Information regarding arrival and departure.
7. GIS-based multi-modal transport for passengers to help them plan their itinerary.
8. GIS-REVIT Integration – GIS will have information of all the assets and will get mapped/ updated with detailed structural 3-D drawing which is in REVITS. Hence, GIS acts as a gateway.
9. GIS-PRIMAVERA Integration – In the project management phase, WBS structure are prepared in PRIMAVERA and the status of various components can seen in GIS through REVITS. This will help to monitor the progress.
10. GIS-SCADA Integration – for Signaling System. In conducting Site suitability/ Feasibility studies.
11. To make an environmental impact assessment using LULC (Land Use Land Cover) analysis from satellite imageries.
12. GIS-based geological assessment and ground-truthing.
13. Retrieve relevant and business critical information from the analysis.
14. Automatically generate state-of-the-art reports for presentation purposes.

For the passengers, GIS will represent the situation on the ground, resulting in its efficient usage and increase in productivity. Also, the spatial data like train movement, availability of various surrounding facilities like hospitals etc. facilities in case of disaster and relevant contact details will be made available to the passengers with the help of GIS.

Access to relevant layers/ functions will be controlled by defining user groups and appropriate roles. Some of the items that staff will access in GIS are:

a. Maintenance Manager can select layer containing information regarding 'Tracks or Signaling Equipment' and then perform various processes related to maintenance, such as querying the maintenance work carried on the asset in the past.
b. Security/Safety Officer can create a buffer in GIS to quickly determine the nearest police station to contact in case of emergency scenarios.
c. Line Controller can determine the location of the train on GIS and in case of breakdown/ emergencies formulate a quick evacuation plan.

Maintenance cost

Safety and security are critical aspects of metro operation and maintenance. Implementing GIS will significantly enhance the capability to deliver high quality service to customers. Also by integrating GIS with other applications such as Maintenance Management System, high level of efficiency is accomplished in maintenance of various metro assets, thereby reducing maintenance costs. GIS implementation will result in tremendous benefits in the long run.

Implementation challenges

Lack of exposure to IT and GIS among the employees will make things difficult in implementing the project. Hence, using it to access information and execute operational/maintenance processes would require proper training to the users and is extremely critical for the success of the project.

The integration of GIS with Maintenance Management System and other Metro applications/ systems is complex and needs to be looked into.

Prashun Dutta
Sr. Executive Vice President (Quality & IT)
Reliance Infrastructure Limited



Public transport gets intelligent in Mysore

Summary:

The Karnataka State Road Transport Corporation (KSRTC) has recently introduced Intelligent Transportation System (ITS) in Mysore, which is also one of the first of its kind in India. Under the project, vehicle tracking system will be installed in buses and 100 bus stops in Mysore will be installed with an electronic display to show bus timings, routes and bus locations. The system enables tracking of buses in real-time, helps commuters in taking informed travel decisions and reduces waiting time and uncertainty over the arrival of buses.

The Karnataka State Road Transport Corporation (KSRTC) provides services to about 179,000 commuters per day by city bus services and to about 128,000 by mofussil services. The corporation has been one of the first in India in adoption of technology and advanced initiatives like induction of international standard modern buses, introduction of blended fuels and award-winning online reservation system. The recent initiative of introducing intelligent transportation system (ITS) in Mysore, one of the first of its kind in India, adds another feather in the cap of KSRTC. Mysore has been chosen for the ITS project considering its tourist attractions, high growth in traffic density and medium size of the city, which makes the project affordable.

Under the ITS project, KSRTC is planning to introduce a new commuter-oriented system, which upon implementation will equip 100 bus stops in Mysore with an electronic display of timings, routes and locations of buses. The system enables tracking of buses in real-time, helps commuters in taking informed travel decisions and reduces waiting time and uncertainty over the arrival of buses. It also improves accessibility of buses to commuters and reduces fuel consumption, operational cost, pollution and traffic density.

Of late, improper sequencing of buses, and lack of punctuality in bus arrival has marred the image of KSRTC. Subsequently, people were forced to opt for private conveyance. Public transport currently accounts for

only 13 per cent of total commutation in Mysore. The ITS project is aimed at reviving the operational efficiency of KSRTC and gaining back user confidence. A survey conducted prior to launch of the project, revealed that 89 per cent of the respondents were willing to use public transport provided it became more reliable. One of the main objectives of ITS, is to promote the use of public transport among the people, reduce the use of private conveyance and hence resolve the issue of traffic congestion in Mysore.

Project funding

The project is a part of sustainable urban transport initiative which is jointly being implemented by the Indian government and the World Bank for various cities in India. The complete installation of ITS is estimated to cost ₹21 crore, and is being implemented by CMC Limited, a Tata Group company.

KSRTC will source funding for the project from Ministry of Urban Development, Government of India, under the Global Environment Facility (GEF) of the Sustainable Urban Transport Project (SUTP). The total cost of the project along with the use of e-diesel (Ethanol-diesel blend) in buses plying in Mysore is around ₹22.7 crore, of which 35 per cent will be borne by GEF funding and 52 per cent will be provided by the Government of India. The State Government of Karnataka and KSRTC will equally bear the balance 13 per cent of the cost. Approximately 73 per cent of the total project funding will be released during the first year of implementation, 9 per cent in the second year and 18 per cent in third year.

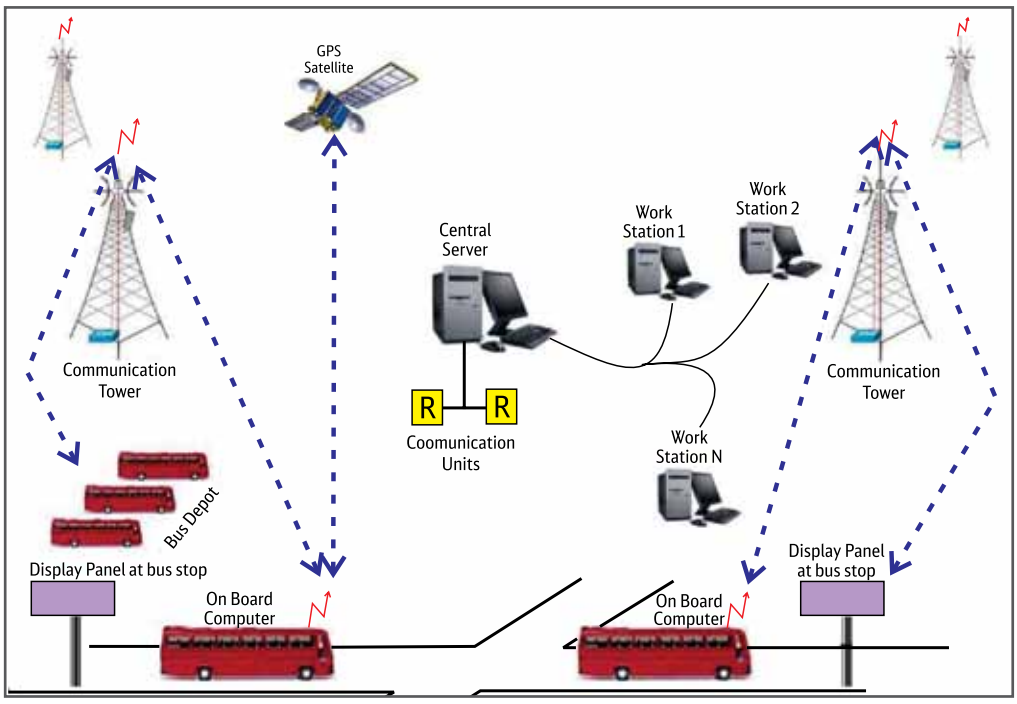


Figure 1: Functioning of the Intelligent Transport system

Components

Core components of the ITS system include vehicle tracking system, real-time passenger information system and central control station. Core technologies used include GIS, GPS, electronic display systems, and other information & communication technologies. Sub systems under ITS include vehicle-to-vehicle communications, collision avoidance and crash detection system, monitoring traffic and controlling signal lights, electronic speed limit signs, reversible lanes and other road safety aspects.

Project implementation includes:

- Installation of automatic vehicle location tracking system for 500 buses
- Installation of electronic display systems that will show estimated time of arrival at 105 bus stops and shelters, 45 bus terminal platforms
- Next bus stop name display and announcement inside the bus
- Providing real-time information to passengers on the KSRTC website

Functioning of ITS

The vehicle tracking system /VMU (Vehicle mounted unit) fitted in the buses will calculate the position using the GPS receiver and transfer the data to the control centre server through GPRS interface for processing and prediction of arrival time of buses at different bus stops. The GPS unit will also transfer the current longitude/latitude data to the bus mounted display unit for display /audio announcement of bus stops. Each bus mounted display will have a database of 100 bus routes and 200 bus stops. When the display unit receives the current positional information from the tracking unit, it will then check in the database for the nearest forthcoming bus stop and will display the name. The display system will also have an inbuilt audio port with amplifier and is connected to two powerful speakers mounted in the front and rear of the bus for making announcements in English and Kannada.

The electronic displays installed at the bus stops will periodically query the central server through HTTP request to obtain and display information such as the buses which are about to leave the bus terminal, their route number, destination and the expected time of arrival and departure. Information will be displayed in English and Kannada. The communication between the central server, bus display and electronic displays at bus stops will use TCP/IP and HTTP protocol.

Central control station

The central control station will be equipped with servers for processing the data received from buses. Based on the data received from the buses, the server will compare the actual location of the bus at any given time with its scheduled location. Also, the server calculates the time for the bus to reach all subsequent stops along the route, taking into consideration

bus speed and any deviations from the schedule. On processing, this information is transmitted by the central control server to the relevant bus stops for displaying predicted arrival time of the bus.

Real-time information on Web

The GPS and GIS system will be integrated so that information from the GPS system will be passed into the GIS application to be accessed by the passengers to see the bus route maps and bus location in real-time. Third-party streaming servers will be used to stream advertisements onto the buses/bus stops.

The ITS will generate reports on vehicle performance based on the data obtained in real time. These reports will aid in making informed decisions for better management of the existing fleet, upgrading transport schedules and the number of trips and passengers carried.



Need a ride, call Mega carpool

Summary:

Mega Carpool, a project launched by Hindustan Infrastructure Construction Corporation Ltd. is a car pooling service, wherein, any car owner interested in carpooling can register. A centralised helpline can be called to request a ride. Once a member makes the call, the request is flashed on the GPS devices of all the car pool members moving on the particular route. For security reasons, all the registered cars are tracked using GPS and the details of people offering and using the ride is exchanged between their respective GPS devices.

Delhiites troubled by frustrating traffic jams, parking woes and rising pollution can heave a sigh of relief with the new car pooling service introduced by Mega Carpool, a project launched by Hindustan Infrastructure Construction Corporation Ltd. Any car owner interested in carpooling can register with Mega carpool to get a GPS device (My Screen) installed in his car and obtain a smart card bearing his photo. A centralised helpline can be called to request a ride. Once a member makes the call, the request is flashed on the GPS devices of all the car pool members moving on the particular route. For security reasons, all the registered cars are tracked using GPS and the details of people offering and using the ride is exchanged between their respective GPS devices through a backend server. People registering for the service need to be registered car owners, undergo statutory verification process and due diligence before a smart card is issued to them. The concept is endorsed and encouraged by the Government of Delhi.

Car pooling process

When a ride-giver enters car pooling details in My Screen, the best route to the destination is displayed with pick-up points. Photo and details of ride-seeker is flashed on the screen and the ride-seeker receives an SMS about the tentative pick up time. The ride-seeker before entering the car has to enter his password on My Screen. The ride-seeker is now logged-in and his kilometre count starts. When he gets down, the distance traveled

is calculated and corresponding kilometres are debited to his account, while the same is credited to the ride-giver's account. A miles account is maintained for all the members to ensure fair exchange of rides. People who do not wish to take ride from others can gift their accumulated points to other members who do not own a car called 'ride matches.'

The carpooling service is of two types:

1. Fixed route service wherein people with matching partner preferences moving daily on the same route are paired
2. AD hoc route service wherein people can randomly request a ride

The navigation system

Mega carpool uses 'My Screen' an advanced navigation system with Windows-based smart phone. Prime features include most accurate 2D and 3D maps of India with voice directions provided by Tele Atlas, three quarterly map updates free of charge, 5-inch TFT touch screen (3D accelerator), tri-band GSM/GPRS module, high sensitivity GPS for navigation, Win CE 6.0 core operating system, wide screen Internet surfing, wireless connectivity via Wi-Fi and Bluetooth, expandable memory up to 8 GB and advanced multimedia functions. Other value-added services include 24X7 car breakdown service, real-time traffic updates, book movie and flight tickets, utility bill payments, stock market updates and restaurant reservations.



Jumping onto the fast track

Summary:
In an attempt to offer better travel experience to passengers and enhance operational efficiencies, the Indian Railways is going hi-tech and is implementing a number of initiatives/services such as online ticket booking through cell phone, implementation of GPS systems, train alerts for passengers and installation of train protection systems.

The Indian Railways is going hi-tech to enhance operational efficiency, safety and to offer a better travel experience. If the recently released railway budget is anything to go by, travelers can expect facelift of stations, berths and coaches; introduction of online ticket booking through cell phone; implementation of GPS systems and train alerts for passengers. Train journeys can be expected to get a lot safer with train protection systems proposed to be installed in 90,000 trains. Unmanned rail crossings will also be made secure across the nation over the next five years. While land acquisition for this purpose appears to be a major hurdle, the railway ministry plans to set up a special purpose vehicle for accomplishing the task in the stipulated time.

A target has been set to lay 725 km of new railway lines, doubling of tracks for 700 km, gauge conversion for 800 km of tracks and electrification for 1,100 km of railway lines during 2012-13. Accordingly, a funding of ₹6,872 crore has been provided for new lines, ₹3,393 crore for doubling of tracks, ₹1,950 crore for gauge conversion and ₹828 crore has been allocated for electrification projects. Passenger traffic is expected to grow by 5.4 per cent in 2012-13, and approximate gross traffic receipts are estimated at ₹1,32,552 crore, an increase of 27.6 per cent over RE, 2011-12.

Green initiatives proposed include setting up of windmills with a power generation capacity of 72 MW in Andhra Pradesh, Karnataka, Kerala,

Tamil Nadu and West Bengal, setting up of 200 remote railway stations which will be the 'green energy stations,' powered entirely by solar energy. Other proposals include: Lighting system at 1,000 manned level crossing gates powered with solar energy; introduction of mobile emission test cars to measure pollution levels of diesel locomotives; commissioning of two biodiesel plants at Raipur and Tondiarpet; introduction of green train in the fragile ecosystem of North Bengal forests; and introduction of bio toilets in 2,500 coaches.

New railway line projects sanctioned in 2012-13 include:

- Bhadrachalam - Kovuur
- Kulpi - Diamond Harbour
- Unchahar - Amethi
- Tarakeshwar - Furfura Sharif
- Rohtak - Hansi via Meham
- Nandigram - Kandiamari (Nayachar)
- Akkanpet - Medak
- Itahar - Buniyadpur
- Nandakumar - Bolaipanda
- Mukutmonipur - Jhilimili
- Rajabhatkhowa-Jainti

New surveys to be conducted for gauge conversion sanctioned in 2012-13 include:

- Kalol-Kadi
- Gandhidham-Anjar-Mundra
- Khambhat-Khambhat port
- Ahmedabad-Sardargram-Dabhoda Nandol Dahegam-Rakhiyal-Jaliyamath-Pratij-Himmatnagar
- Navlakhi-Malia-Rajkot
- Tantpur to Bansi Paharpur
- Bhavnagar-Adhelal-Dholera-Vataman-Petlad

New railway electrification projects sanctioned in 2012-13 include:

- Itarsi-Manikpur-Cheoki
- Titlagarh-Sambhalpur-Jharsuguda and Angul-Sambalpur
- Pakur-Kumedpur including Malda-Singhabad
- Nallapadu- Guntakal
- Hospet - Guntakal and Torangallu - Ranjitpura
- Garwa Road-Chopan-Singrauli
- Manheru-Hisar
- Amla - Chhindwara- Kalumna
- Coimbatore-Mettupalayam
- Andal-Sitarampur via Jamuria - Ikhra



Summary:

Considering the growing vehicle traffic in India the road infrastructure needs to be developed/upgraded to provide safe and comfortable commuting. Indian road transportation infrastructure is rapidly expanding under ambitious projects like National Highways Development Programme (NHDP), State Highways Improvement Programmes (SHIPs), Bharat Nirman, Pradhan Mantri Gram Sadak Yojana (PMGSY) etc. GIS is being used right from planning through development and monitoring of road network. The Central Road Research Institute (CRRI) has taken up a major project for developing GIS-based information system for planned expansion, repair and maintenance of roads. NHAI is also developing geo-enabled database for the complete length of national highways under the National Highway Development Programme (NHDP).

Developing sustainable road transport infrastructure

Transport infrastructure forms a critical component of economies worldwide, and more so for developing economies like India. In India roads are the largest and most widely used mode of transportation. They not only connect interior villages for initiating development activities, but also play a vital role in evacuating people and implementing rescue operations during emergencies. Indian road transportation infrastructure is rapidly expanding under ambitious projects initiated by the Indian government like National Highways Development Programme (NHDP), State Highways Improvement Programmes (SHIPs), Bharat Nirman, Pradhan Mantri Gram Sadak Yojana (PMGSY) etc. These programmes also aim at upgrading the road network by developing high-quality pavement structures to meet the increase in traffic, both in terms of number and axle loading.

The current commutation trend in India indicates towards an increase in the number of private vehicles and reduced trips of public transport. Thus, the road infrastructure needs to be developed/upgraded to provide safe and comfortable commuting. While planning a road network its ecological impact also needs to be considered, since the transport sector alone accounts for 24 per cent of CO2 emissions worldwide and is

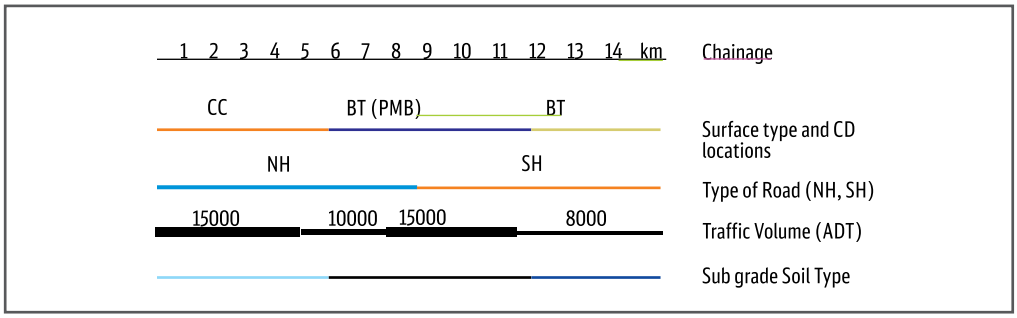


Figure 1: Dynamic segmentation process of typical highway section

the second largest cosumer of energy. Under the Twelfth Five Year Plan, development of sustainble road transport network has been set as a priority.

Major components of a road development project include planning, project preparation, construction, monitoring and maintenance. Planning includes preparation of road plans and core network plan which is helpful for identification of the links to be developed, and a broad estimation that is required for allocation of funds, since each selected link of roads is considered as a project. For every project, a detailed project report (DPR) is developed that includes the survey information such as detailed design and drawings, cost estimates for various road works etc. The same information will be highly useful during construction monitoring, quality control and maintenance activities. For better planning, monitoring, coordination and controlling of work-in-progress across various road projects, the road development plan is prepared on a GIS platform which can be extended as a road information system for each project by incorporating the detailed project report data and drawings.

The road information system helps in estimating the quantity of raw material required in various road development operations such as cutting and filling, crust thickness design for various locations and estimation of cost for individual items. This information can be utilised, firstly, for award of the contract to the construction agency and then for monitoring the construction activities in terms of progress of the work in the particular link as a part of the core project. Real-time information updates can be made on daily basis in the road information system to report on the work accomplished against set targets.

Dynamic segmentation modules can be developed for division or segregation of road network links into segments that are homogeneous for the specified set of link attributes. The dynamic segmentation process of typical highway section for monitoring/ management aspects is shown in the Figure 1. This information system will be highly useful for monitoring the various work awarded along the road section.

Once the road construction is accomplished, monitoring and maintenance needs to be carried out at regular intervals. Most of the information required for maintenance planning

is available in the road information system in various formats such as base planning data from DRRP and Core Network Plans, detailed project report (DPR) data including the design details of the road, traffic flow, materials used etc., which can be used for maintenance planning activities. Further, carrying out condition surveys at regular intervals helps in assessing the pavement improvement measures required for various sections. Based on the pavement damage data, it is possible to separate the medium and long-term maintenance measures required within the next 2-3 years for various periodic maintenance or rehabilitation measures.

Information system for Indian roads

To facilitate planned expansion of the road network to meet the transport requirements of expanding cities, and to support repair and maintenance activities, the Central Road Research Institute (CRRI) has taken up a major project for development of GIS-based information system for roads that provides information such as inventorisation of national highways

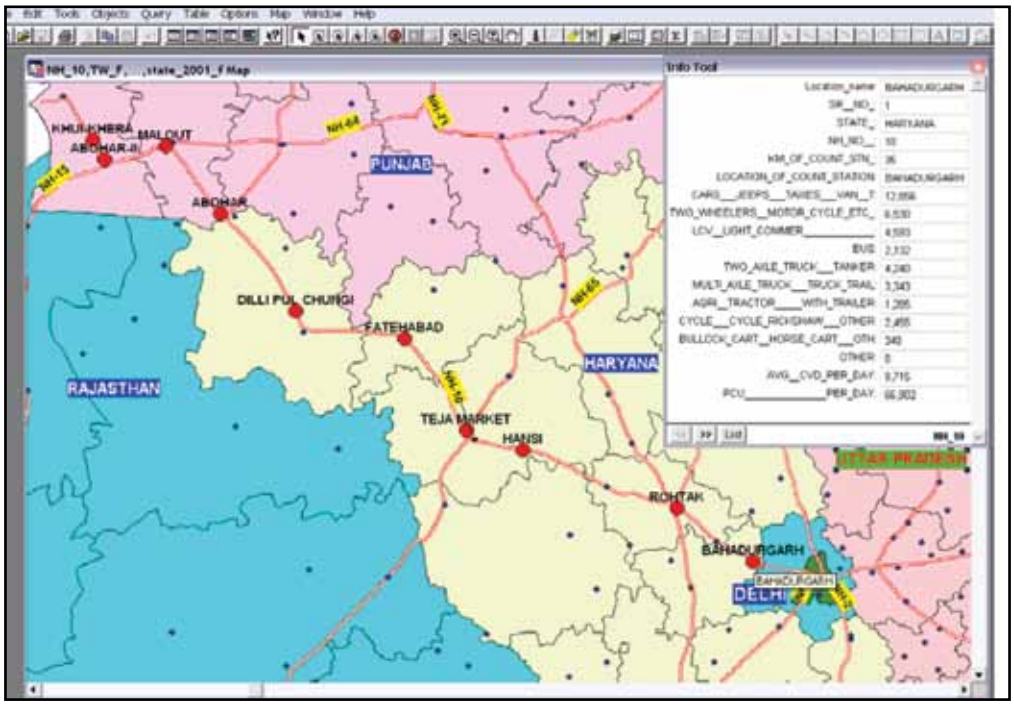


Figure 2 : A GIS map of a road section with detailed data and the typical detailed alignment plan

(through conducting primary surveys and collection of secondary data); traffic volume surveys (automatic portable traffic counter-cum classifier); and long-term maintenance and rehabilitation strategies using HDM-4 for the entire national highway network (excluding the roads under NHDP (Phase I and Phase II) totaling to about 50,000 km. The highway information system brings the information of the entire national highway network

on a common query-based platform, enabling users to interact with the system. It will help in identifying spots for road widening, locating accident-prone locations and implementing appropriate measures to enhance traffic safety, schedule repair and maintenance activities on priority basis.

The CRRI has also taken up various projects using GIS for rural road network planning to provide better transport facilities in rural areas. An ongoing project is in Ghaziabad in the state of Uttar Pradesh where satellite imageries are being procured to extract the data on roads and bridges to develop a GIS-based road/bridge information system, where complete information on each road/bridge will be available. CRRI has also acomplished a project for evaluation of maintenance and management system for Delhi roads. A high priority transport corridor map has been created on a 1:25,000 scale, for the Ring Road in Delhi for maintenance management on GIS platform.

National Highway Authority of India (NHAI) is developing database for the complete length of national highways under the National Highway Development Programme (NHDP). All of this data will be put in a GIS platform and will be supplemented by satellite imageries to form the Road Information System (RIS). RIS is an application having data of highways on Golden Quadrilateral (GQ), North-South (NS) and East-West (EW) corridors of NHDP with features of graphical viewing through GIS technology. The application provides the information through different modules on various parameters such as national highway location details for above mentioned corridors, wayside amenities, bridge location and details, corridor environment related information, toll plaza location and toll data, construction contractor details. Additional thematic and raster maps are available over the GIS interface. Figure 2 indicates typical traffic volume data presentation in GIS environment (Traffic Count Station in Haryana State).

Transport service management

In addition to developing and maintaining road network geospatial technology is also being used in traffic management. For instance, Bangalore Metropolitan Transport Corporation (BMTC) is using GIS/GPS technology for fleet management. Over 1,000 BMTC buses, including all the 50 Volvo buses are GPS-enabled. Synchronised by GPRS, a public information system (PIS) has also been developed. GPS tracks the movement of buses which can be checked using GIS-enabled digitally mapped road network of the city. Using this information, the GPRS-enabled control room of the service provider is able to record and forecast the minute-to-minute update of movement of buses. GPS devices have been fitted in radio taxis plying in Delhi and Mumbai for navigation purposes as well for tracking their location.

Anuradha Shukla
Senior Principal Scientist - Transportation
Planning and Environment
Central Road Research Institute (CRRI)



Wi-Fi on wheels

Summary:

Indian Railways is gearing up to provide Wi-Fi connectivity inside the coaches.The Internet facility will be provided through a satellite-based system and the connection will be shared across railway coaches through Wi-Fi. A major benefit of this facility is that passengers will be able to track their current position and movement of the train on a map. The Centre for Railway Information Systems (CRIS) has partnered with ISRO to develop GPS-based devices for tracking trains, which can be integrated with Google Maps, enabling passengers to view their current location in real time.

A passenger boards a train and after settling down in his coach he powers up his laptop to productively use the travel time on his 12-hour long journey. But as the train leaves the station and moves out of the urban centers, both the cellphone signal and internet connectivity seem to die down. Lack of good connectivity can be a big turn off for frequent travellers, especially for professionals who are used to stay online 24X7, whether at home, office, at a restaurant or while travelling. Well, this sceario is soon set to change as Indain Railways is gearing up to provide Wi-Fi connectivity inside the coaches. If the statement made in the Parliament by K H Muniyappa, the Union Minister of State for Indian Railways, is anything to go by, three coaches of Howrah Rajdhani Express will soon be provided with Wi-Fi connectivity on a pilot basis.

The Internet facility will be provided through a satellite-based system and the connection will be shared across railway coaches through Wi-Fi. The service is expected to be rolled out by the end of September 2012 and is estimated to cost ₹6.30 crore for the railway department. Not to stay behind, the RailTel Corporation of India has also initiated a similar initiative for providing free BluFi connectivity in the Bengaluru railway station. BluFi is a distributed form of Wi-Fi that enables access to Bluetooth-based services across the station. The service is being provided by TelIBrahma, a developer and provider of mobile solutions, using Augmented Reality, Bluetooth and Wi-Fi technologies. Under the RailWire Retail Broadband initiative, users can request RailTel Corporation for Internet access by sending an SMS, following which the password for connecting to Wi-Fi is sent to them via SMS. Travellers will

be able to access railway Information, videos, downloadable games, and wallpapers via Bluetooth.

Indian Railways, in collaboration with Techno Sat Comm, has also rolled out similar services on pilot basis in the Mumbai-Ahmedabad Shatabdi Express, while Zylog Systems India is providing wireless broadband service called Wi5 on the Chennai-Bangalore-Chennai Shatabdi Express.

A major benefit of Wi-Fi connectivity on the train is that passengers will be able to track their current position and movement of the train on a map. The Centre for Railway Information Systems (CRIS), the IT arm of Indian Railways, has partnered with ISRO to develop GPS-based devices for tracking trains, which can be integrated with Google Maps enabling passengers to view their current location in real time.

Track your journey on a smartphone

Peeping out of the train window to check the station passing by is often painful, and more so during the night time when visibility is marred by the poor lighting at the stations. However, using smartphone it is now possible for a passenger to conveniently check all the stations passing by. For instance, a passenger can use his Gmail ID to login to "places" defined in Google Latitude using his smartphone. Each of the stations on his route can be registered as places on Google Latitude. For all these places check-in is automatic. Now as the train passes through the various stations, the Android phone will automatically check-in. All his friends who are connected to him through Google Latitude can know the last station where the train has checked-in. This strategy can also be used by the Indian Railways to provide train information in public domain.



AAI expedites no objection certificate issuing process

Summary:

The Airports Authority of India (AAI) has implemented a completely online system called No Objection Certificate Application System (NOCAS) for the purpose of automating the process of issuing a no objection certificate for height clearance of buildings or masts being constructed near airports in India. NOCAS is based on ArcGIS software and processes each application in just 5 minutes, which earlier used to take a month or two when done manually.

Airports Authority of India (AAI) was constituted by an Act of Parliament and came into being on 1st April 1995 by merging erstwhile National Airports Authority and International Airports Authority of India. The merger brought into existence a single organisation entrusted with the responsibility of creating, upgrading, maintaining and managing civil aviation infrastructure both on the ground and air space in the country.

AAI manages 125 airports, which include 11 International Airport, 08 Customs Airports, 81 Domestic Airports and 27 Civil Enclaves at Defense airfields. AAI provides air navigation services over 2.8 million square nautical miles of air space.

The main functions of AAI include:

- Construction, modification & management of passenger terminals, development & management of cargo terminals, development & maintenance of apron infrastructure including runways, parallel taxiways, apron etc., Provision of communication, navigation and surveillance which includes provision of DVOR / DME, ILS, ATC radars, visual aids etc., provision of air traffic services, provision of passenger facilities and related amenities at its terminals, thereby ensuring safe and secure operations of aircraft, passenger and cargo in the country.

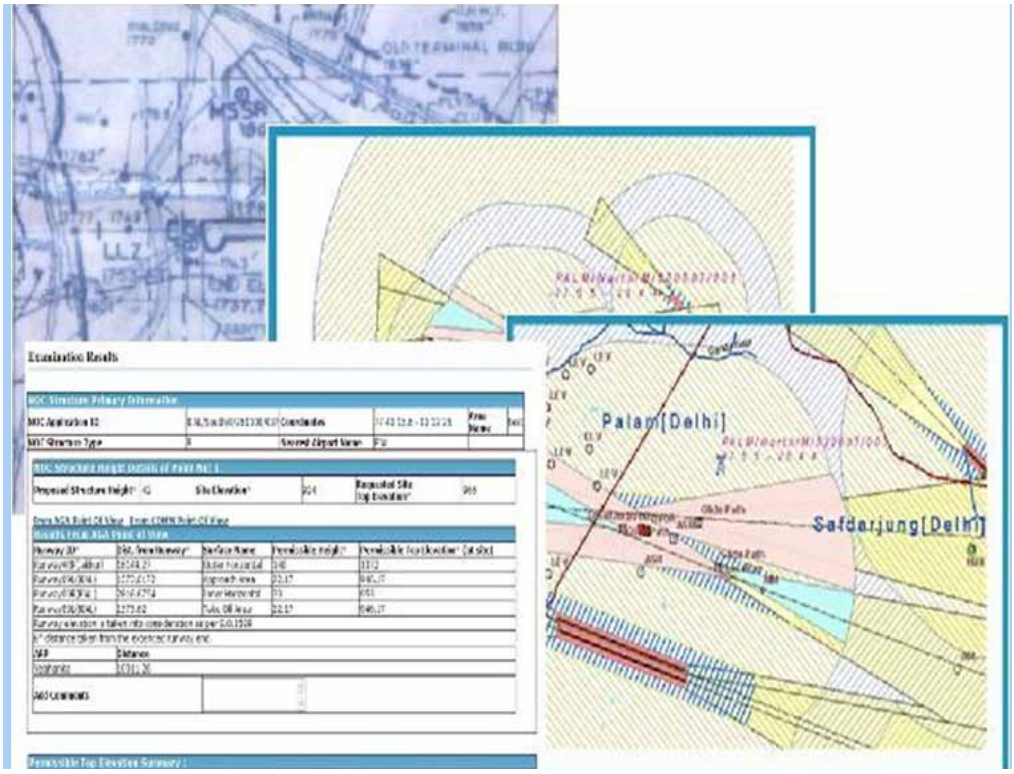
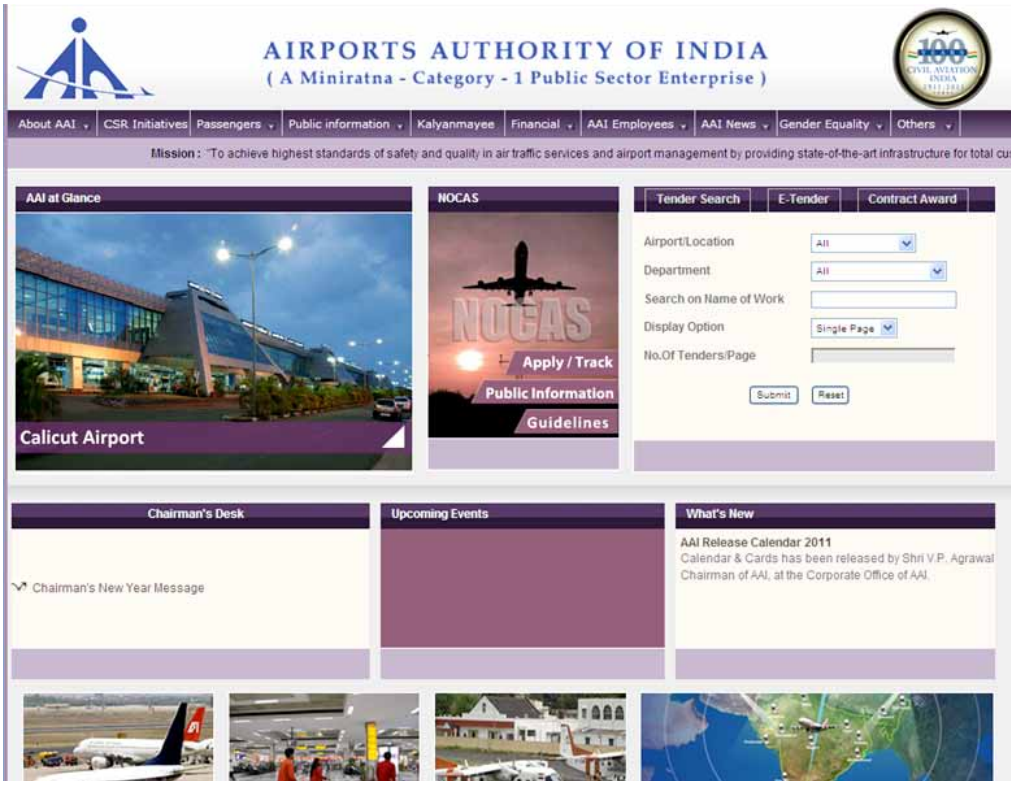


Figure 1: Airport map and height calculation sheet



Access website through: www.aai.aero

- Control and management of the Indian airspace extending beyond the territorial limits of the country, as accepted by ICAO.
- Issuing no objection certificate for building and mast construction. As a statutory requirement all construction in and around an airport anywhere in the country needs "No objection certificate" from AAI.
- Expansion and strengthening of operation area, viz. runways, aprons, taxiway etc.
- Provision of visual aids.

To fulfill some of the above mentioned requirements, AAI planned to go for such system which can make their work easy and help their personnel's to work in a faster and most proficient manner, resulting in development of GIS based System "NOCAS."

No Objection Certificate Application System (NOCAS)

The Airports Authority of India (AAI) has implemented a completely online system for the purpose of automating the steps involved in obtaining a NOC (No Objection Certificate) for height clearance. This process substitutes the manual process followed by the various NOC departments of AAI who are empowered to issue the certificate to applicants who wish to construct building or mast structures.

Earlier, for the NOC department it took nearly a month or two to process the NOC application fully, and sometimes it took even more time due to non availability of hard copy maps. All the calculations were done manually, whereas by processing the application through NOCAS it takes maximum 5 minutes to process one case and in a more precise manner.

This Web-based application called NOCAS involves a critical GIS component which is necessary to perform the permissible height calculation for buildings and masts. NOCAS provides role-based login and rights to different category of staff within AAI for processing the NOC. On the other hand, anyone from the general public can register for an applicant login online. On getting the login credentials, the applicant can apply online application for obtaining NOC for a proposed building or mast.

Typically, when an applicant submits an application for building or mast online through NOCAS, he/she has to submit the requisite hard copy documents of the proposed site to the concerned airport officer of AAI for the purpose of verification. This NOC officer, logs into NOCAS and finds pending NOC applications on his computer screen. He/she can easily plot the proposed site on a digital map, and using a tool can generate the height calculation sheet for the same. This sheet shows the maximum permissible top elevation allowed for the proposed site, considering the height limitation criteria that are used for the purpose of NOC. These results are saved in a data repository, and the NOC application follows the workflow defined for processing of NOC. Finally, the NOC is either cleared or rejected, and an appropriate letter is visible to the applicant, who can take a printout of that letter.

Technology used

The system is based on ArcGIS Server 9.3, ArcGIS Desktop 9.3, and ArcSDE 9.3 with SQL Server 2005. The geo-database for this system includes landbase features (road, railway, locality, benchmark, water body etc.) and the virtual height limitation surfaces pertaining to aerodrome and communication, in and around the airport; and the navigational aids features, which help in the landing and take-off of aircraft. The virtual height limitation surfaces extend up to 20 km from the central point of an airport.

Benefits

1. Fast processing of NOC cases.
2. Airport Maps can be viewed on computer screen.
3. More precise calculation.
4. Less human intervention.
5. Current status can be viewed at any level.
6. Bundles of hard copy maps not required.
7. Applicant can approach the authorities any time for any number of cases (24X7).

Deb Jyoti Pal
Vice President and Head-Technology and Services
NIIT-GIS Limited (ESRI India)










Geospatial technology in the travel and tourism sector

Summary:

GIS is an effective tool for managing, analysing, and displaying large volumes of diverse data pertinent to many local and regional planning activities. Due to the complex nature of tourism planning issues, the potential of GIS in resolving these issues is increasingly acknowledged.

It will come as a surprise to many to learn that in India, the tourism industry is one of the largest job creating industry and accounts for 6.23% to the national GDP and 8.78% of the total employment, making it the highest contributor second only to oil and gas industry. But there are umpteen challenges - the prominent ones being infrastructure, growth in skill, promotion and marketing at global levels, imparting of education related to tourism, or improving the expertise in service management. To address all of the above challenges, one of the major needs of tourism is to have accurate and up-to-date information in geospatial platforms on related entities so that different maps, GIS data, and applications can be generated for the tourism industry. GIS can be very useful in tourism for facilitating, planning and monitoring the services including facilities, activities and to deliver a prompt response to the tourist needs.

Promoting tourism is the way to showcase the potential of our unique country to prospective traveller. Since tourism was discovered as one of India's fastest growing markets which was creating millions of service industry jobs, Government of India also took the initiative of plugging the gaps. The Ministry of Tourism launched Incredible India campaign in 2002, promoting India as a premier vacation destination. The campaign was quite effective, making India one of the top destinations for travellers.

Print and visual media are particularly important when it comes to promoting tourism opportunities anywhere. We are all aware of the



Figure 1: Map displaying tourist locations and bus-routes

old adage, a picture is worth a thousand words, and quite a few travel agencies, resorts, government campaigns are taking advantage of media such as print, Internet and television to tempt potential vacationers to travel to these destinations. MapmyIndia Geospatial Travel solutions fulfill several needs of tourism that require accurate info through platforms like print, web, mobile, and TV & GIS data.

Some successful implementations in tourism sector

Hop On Hop Off Tourist Bus

MapmyIndia partnered with HOHO bus service which was an initiative of Delhi Tourism and India's Largest Operator in tourism and inter- city bus services Prasanna Purple Tours Pvt. Ltd during the Common Wealth games to cater to the inlet of tourism in Delhi. As part of this service, 14 air conditioned buses were launched in New Delhi, which were supposed to run on a fixed route having about 20 stops which were a mix of tourist attractions, shopping arcades etc. MapmyIndia provided their state of the art vehicle tracking system and GIS Platform to help operations and on time performance. The requirement of the project was to map the bus stops onto the digital map and geo fences were created for the same on the application. Further, the bus routes were studied and plotted on the map on which the vehicle data was overlaid. This helped the operations and management teams in keeping a check on route adherence.



Figure 2: City map of Srinagar showing city map along with the tourist locations

Jammu & Kashmir travel and map guide

MapmyIndia partnered with Jammu and Kashmir government in providing them with detailed travel and map guides. The J&K state map book provides an in-depth knowledge of the state in a strategically planned yet enthralling format. The book's inventive use of contextual facts, perceptive POI symbols, 3D images, colour coded geographical attributes, 101 things to do, variations on urban and rural regions offer a user-friendly approach for newbies' new found foray into map reading and an interesting read for the experienced. Covering an extensive spectrum ranging from history to cuisine, religion to recreation and nature to monuments, the book delves into the very essence of Jammu & Kashmir giving visitors the opportunity to be one with the rustic feel of the state. Its comprehensive coverage stretches from Kathua to Nubra Valley, including Jammu, Pir Panjal Range, Srinagar, Ladakh, Kargil, etc, in between.

Over 2300 POIs, detailed view of all primary areas, umpteen trekking routes, and connectivity of roads will keep the readers/visitors afresh to the 'Paradise on Earth' that is Jammu & Kashmir.

Deepro Ganguly
DGM-Sales and Marketing (Web, Mobile and Print)
MapMyIndia

geospatial TODAY

FICCI

Disaster management / National security



Space technology for flood disaster management

Summary:
Remote sensing technology has emerged as the most powerful tool for decision making in flood disaster management. Satellite images provide vital information required by the decision makers at different phases in flood disaster cycle i.e. pre flood (preparedness), during flood (relief and rescue operations) and post flood (mitigation measures). During the 2008 Kosi river floods, IRS satellite images were used for preparing flood maps which were provided to state government departments in near real-time mode for keeping a close watch on flood situation and for carrying out relief and rescue operations.

Last few decades have witnessed an increase in the number of hydrological (mainly floods) related disasters by 7.4 per cent per year on average (http://www.cred.be/publications). The Asian region is mostly affected by floods and during the last three decades (1976-2005), 332 flood events have killed about 7065,000 and affected over a billion people in South-Asia region (Shrestha, 2008). Two of the eight South-Asian countries, i.e. India and Bangladesh happen to be the worst flood affected countries in the world.

Nearly one-eighth of Indian geographical area is flood prone and the country's vast coastline of 5,700 km out of 7,500 km is exposed to tropical cyclones. The Indo-Gangetic and Brahmaputra river basins are the most chronic flood prone areas of India and regarded as the worst flood-affected region in the world. The huge amount of discharge and sediments brought down from the Himalayas by Ganga and Brahmaputra Rivers and their associated tributaries cause severe flooding problems in the states of Bihar, Uttar Pradesh, West Bengal and Assam located in these basins during the monsoon season.

Space inputs for flood disaster management

Space technology has emerged as the most powerful tool for decision making in flood disaster management and happens to be a critical source of information, on flood inundation, progression/ recession and damage

assessment. Satellite images provide vital information required by the decision makers at different phases in flood disaster cycle i.e. pre flood (preparedness), during flood (relief and rescue operations) and post flood (mitigation measures). EO missions like IRS, Radarsat, ENVISAT, ERS, and SPOT provide data in a variety of spatial, spectral and temporal resolutions very useful for mapping and monitoring flood events in near real-time and operational mode.

Near real-time flood mapping activity at NRSC/ISRO

Space based flood mapping and monitoring in the country is carried out by Decision Support Centre (DSC) established at National Remote Sensing Centre (NRSC) in 2002 under the ISRO Disaster Management Support (DMS) Programme. DSC keeps a continuous watch on the flood situation in the country through different sources. Based on the cloud cover pattern observed from meteorological satellite KALPANA-1, rainfall pattern from Indian Meteorological Department (IMD), hydrological data from Central Water Commission (CWC), and flood related information from websites, news media and state departments, satellites are programmed for acquiring data. Figure 1 shows the various components involved in flood disaster monitoring.

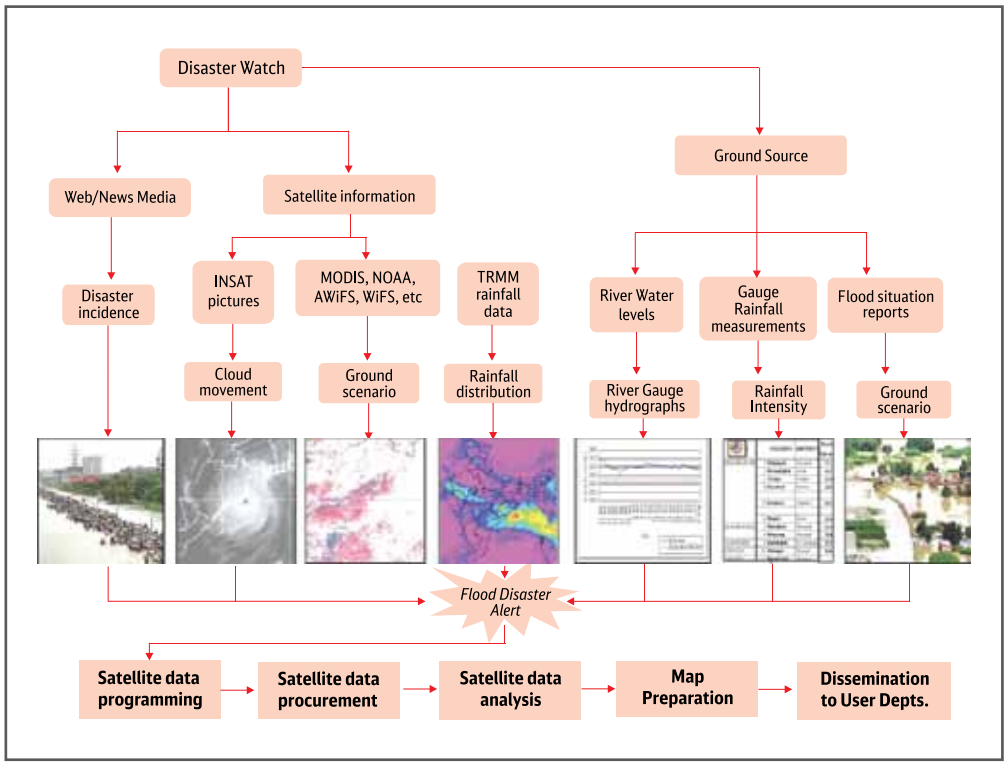


Figure 1: Flood disaster monitoring cycle

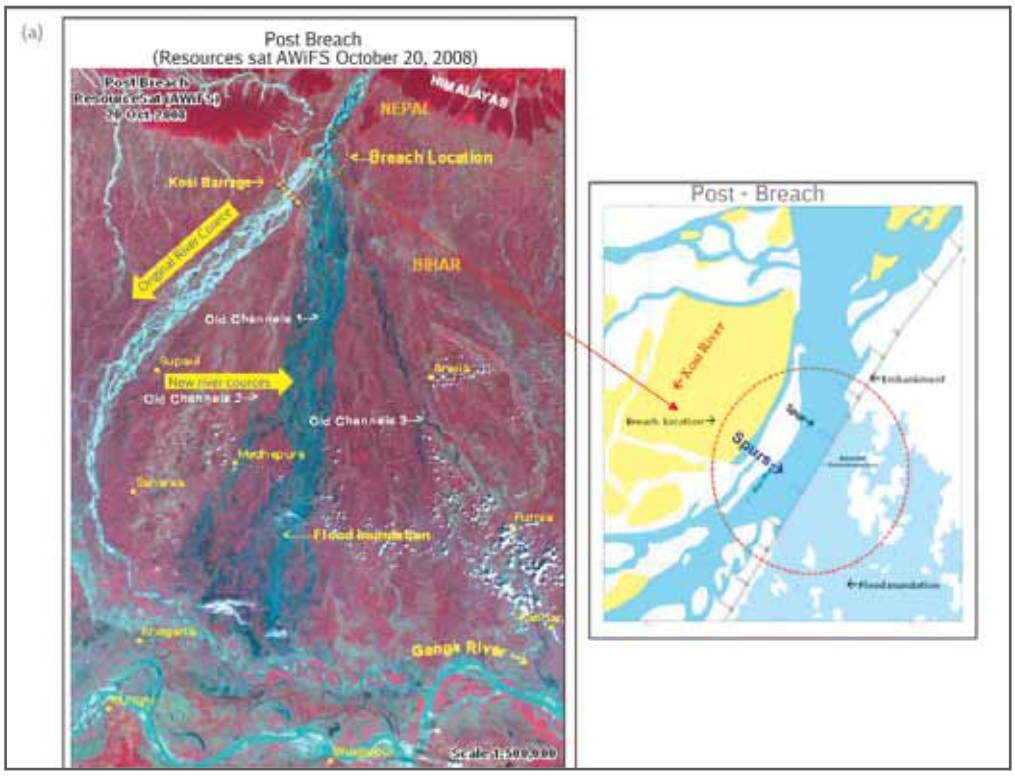


Figure 2a: IRS P6 AWiFS satellite image showing the change in the course of Kosi river and map showing enlarged view of the damaged river control structures (pink colour) and flood inundation (cyan colour)

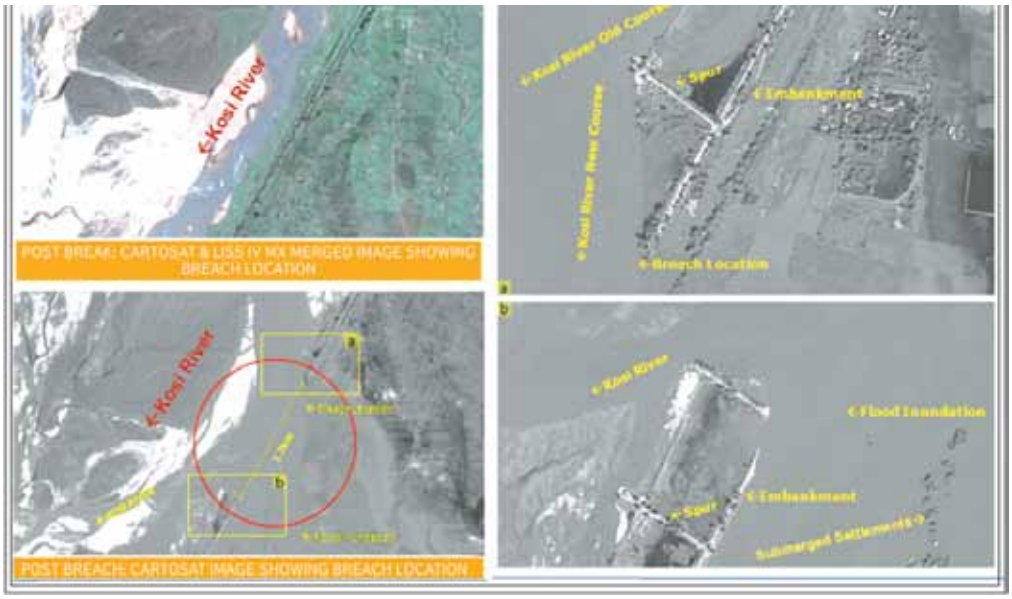


Figure 2b: High resolution images showing the extent of breach (1.7 km) and the enlarged view of the submerged embankment, spurs and settlements due to flood inundation

Presently, optical satellite data from IRS-P6 satellite and microwave data from RADARSAT/ERS SAR satellites is being used for flood mapping and monitoring, whereas for detailed damage assessment Cartosat-1 & 2 images are used. The extent of flood inundation is extracted from the satellite data and flood maps at various scales i.e. state, district and detailed levels are prepared for the flood affected states. The spatial inundation maps along with estimates on submergence are generated within 5-6 hours after receiving raw satellite data product and disseminated to the State and Central governments and user departments through a VSAT based satellite communication network. In addition to the flood maps, the flood inundation layer in GIS compatible format are also transmitted to the state remote sensing application centres for further value addition and dissemination as per the requirements of the user/ line departments.

ISRO plays a key role in international collaboration programmes like International Charter on Space and Major Disasters, Sentinel Asia, UN-Spider etc. by providing satellite data on the disaster affected areas. ISRO as a signatory to Sentinel Asia has responded to 8 emergency disaster requests during 2008 and 11 requests during 2009 mainly from countries like Indonesia, Myanmar, Nepal, Laos PDR, Thailand, Mongolia, Vietnam and Philippines by uploading the IRS satellite data on the Sentinel Asia Server.

Application of space technology during Kosi Floods, 2008

Bihar faced one of the worst and disastrous floods in the recent past when Kosi river breached its left bank on August 18, 2008, near Indo-Nepal border. The Kosi River breached its left embankment about 12 km upstream of Birpur barrage, near Kusaha in Nepal on August 18, 2008. The river abandoned its original south-westerly course and took a new course in southerly direction (Figure 2a) which was 120 km in length and about 25 km wide and approximately 45 km away from its present course. The breach caused damage to 1.7 km stretch of the left embankment and damaged four of the spurs as observed from high resolution Cartosat data (Figures 2a & 2b).

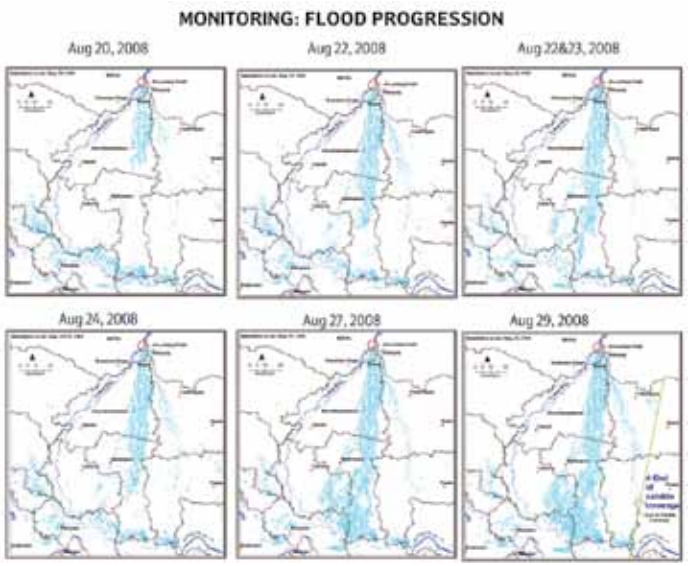


Figure 3a: Maps showing progression in flood inundation between August 20, 2008 and August 29, 2008

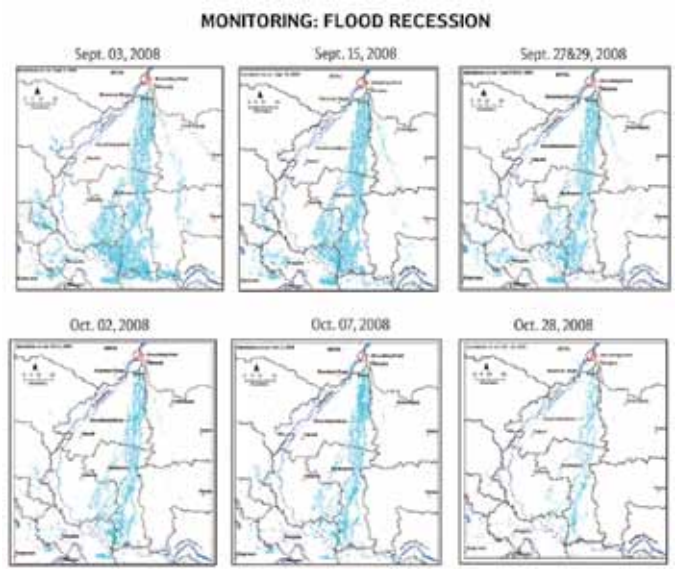


Figure 3b: Maps showing recession in flood inundation from September to October, 2008

Response prioritisation

Efforts were made by DSC to tilt the IRS satellite cameras and acquire the earliest satellite data over the breach affected region. The earliest microwave Radarsat-SAR data of August 20, 2008 available for the region affected due to the Kosi breach was programmed under the emergency programming mode. Flood inundation maps at various scales along with submergence statistics were provided to state government departments in near real-time mode for carrying out relief and rescue operations.

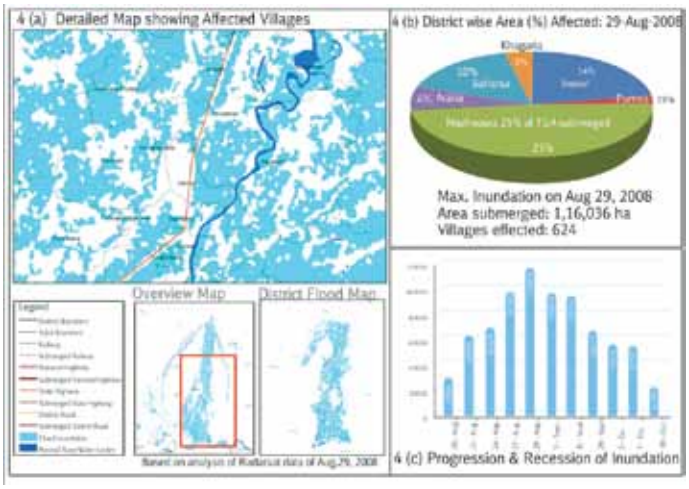


Figure 4a: Flood inundation maps generated at various scales for Kosi floods, **Figure 4b:** District-wise (per cent) area affected due to the floods on August 29, 2008 and **Figure 4c:** The progression

Flood monitoring

A continuous watch on the flood situation was kept by programming the IRS and Radarsat satellite coverages over the flood affected region at frequent intervals during August-October, 2008. More than 200 flood maps for Kosi breach flood affected districts, using optical and microwave satellite datasets were prepared and disseminated to the concerned state agencies including Flood Management Information System Cell (FMISC), Government of Bihar and Bihar State Remote Sensing Application Centre (BIRSAC). Progression in flood inundation was observed from August 20 to August 29, 2008 (Figure 3a) and thereafter flood situation started improving gradually with recession in the flood waters (Figures 3b). Figure 4c shows the progression and recession observed in submerged area due to the Kosi floods between August and October, 2008.

Damage assessment

Flood inundation was observed to be the maximum on August 29, 2008 when about 1,16,036 ha of land was assessed to be inundated and more than 600 villages affected. Figure 4a shows the overview of flood situation on August 29, 2008, flood inundated areas in Madhepura district and a detailed level map (1:50,000 scale) for part of Madhepura district. The detailed level flood map shows the flood inundated areas (cyan colour) and submerged road/rail overlaid with village boundaries. Madhepura district was the worst flood affected district with 25 per cent of its district area submerged (256 villages affected) followed by Supaul district and Saharsa districts (Figure 4b). More than 130 villages were found to be under submergence for more than a month in Madhepura district as observed from the analysis of satellite datasets acquired during August to September, 2008 (Figure 5).

Monitoring of restoration work

Satellite images also have an important role in monitoring the post-flood restoration and channel stabilization work and strengthening of embankments/ spurs carried out to prevent

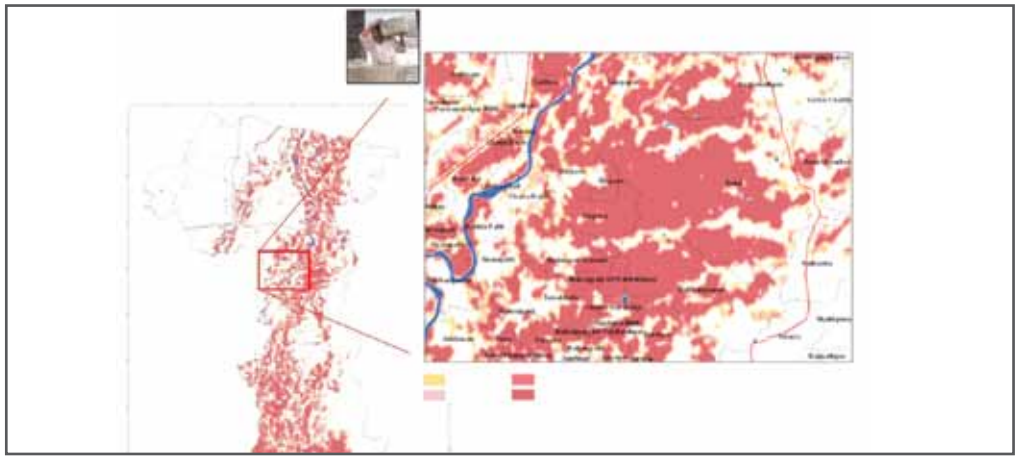


Figure 5: Flood inundation persistence map for Madhepura district

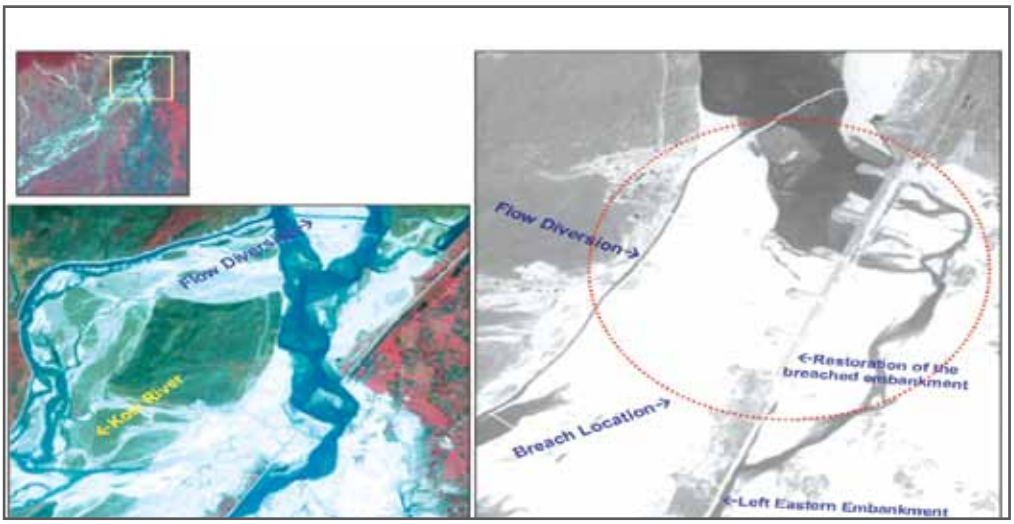


Figure 6: IRS images showing the progression in restoration of river control works at the breach site

future breach incidences. From analysis of IRS P6 LISS IV MX and CARTOSAT-1 images it is observed that diversion of channels and plugging work is being carried out during January, 2009 and the plugging work appears to be in completion stage by April, 2009 (Figure 6).

Mitigation

From analysis of multi-temporal satellite data, two stretches, one upstream of Birpur barrage and another downstream of the barrage were identified where the river has shifted its course due to the channel aggradation and needs to be monitored in future to prevent any breach. Upstream of Birpur barrage in Figure 7a shows that along this stretch, the major flow of the river water was taking place towards the eastern side during 1999 and over the years a lot of sedimentation has taken in the main channel and the river has gradually shifted to west.

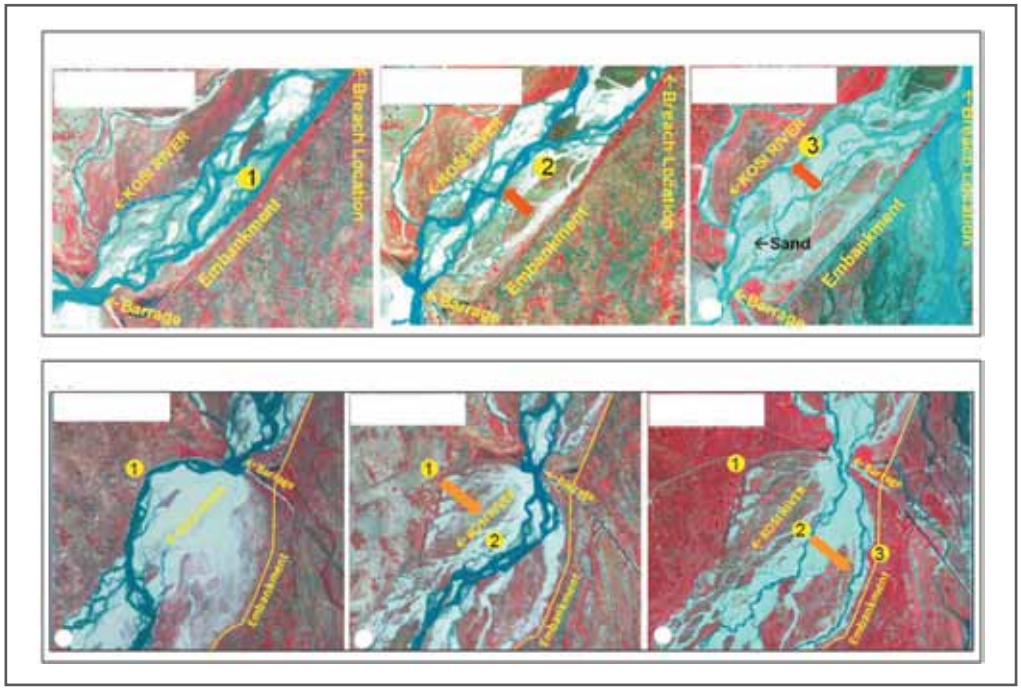


Figure 7: Shift in river course observed (a) upstream and (b) downstream of the Birpur barrage

Figure 7b shows downstream of barrage where the river has shifted its course by 7 km from north-west to south-east in the last five years and the river presently can be seen abutting the eastern embankment.

Conclusion

Space technology can help in disaster identification, response prioritisation, damage assessment, inundation monitoring, river course changes and identification of vulnerable zones required for flood disaster management. In major disasters like the 2008 Kosi floods, satellite images can be the best source of providing critical information required about the flood inundation progression, recession, marooned villages, submerged road and rail network and carrying out relief and rescue operations. The near real-time information provided during flood disaster can be of immense help to decision makers to evolve risk reduction strategies. Remote sensing technology due to its repetitive and synoptic coverage and cost-effectiveness can also provide vital information on the vulnerable stretches by monitoring the river shifting, proximity of river course to the embankments and channel aggradation and therefore in for taking adequate measures for channel stabilisation and strengthening of embankments.

V Bhanumurthy, C M Bhatt, G Srinivasa Rao , P Manjusree
Disaster Management Support Division
National Remote Sensing Centre, ISRO



Expediting response to distress calls

Summary:
The police department in Chandigarh wanted to enhance operational efficiencies, speed up response to distress calls, ensure safety of police officers handling crisis situations, and spruce up data management capabilities. Meeting these requirements Rolta developed and installed in the police control room, an IT based application integrating GPS, GIS and Web technologies.

Chandigarh is one of the major cities of India with a population of approximately 10 Lakhs. The Chandigarh Police is responsible for maintaining law and order in the entire city, covering an area of approximately 120 Sq. Kms. To cover this area the police dispatches and monitors a fleet of 60 vehicles. The police department responds to over 10, 000 calls for service per year.

Chandigarh Police intended to upgrade the Police Control Room operations to improve the response to distress calls received on police assistance no. 100. It was desired to design the system with a long-term vision using contemporary technologies in the telecommunication field.

Chandigarh police initiated implementation of customised IT application integrating GPS, GIS and Web technologies to improve the call response service to the public by providing greater accuracy and significantly reducing the response time to the caller. This project also involves the use of GIS/ GPS based automatic vehicle tracking system including automatic call distribution for optimisation of portal van management. Rolta was selected to provide GIS/GPS based automatic vehicle tracking system for efficient data handling, better resource management.

Solution overview

Understanding the Chandigarh Police's requirements, Rolta provided fully compliant, comprehensive and world class solutions. The GIS solutions addressed the following needs:

- Provide greater accuracy and speed up the response to the caller
- Minimising data handling
- Enhance every officer's productivity (resource management)
- Enhance the police officer's safety through detailed information management and regular updating
- Provide accurate/up-to-date information for police control room management

The Solutions provided by the Rolta include:

- Conversion of landbase map in the application format and integration of available GIS data with the database of Chandigarh city
- Primary data entry and data conversion
- Design, development and customisation of Distress Call Response Management Services (DCRMS).
- DCRMS is offered through a system that provides electronic interface to the "PA-100" call tracking, response team identification and guidance functions at the police control room on the GIS based application
- Design, development and customisation of Automatic Vehicle Tracking System (AVTMS)
- Commissioning, installation, implementation training, hand holding, support, post-installation maintenance and warranty of the solution

This Solution is classified into three categories:

1. Conversion of landbase map into application format
2. Development of Distress Call Response Management Services
   - Call Taking (PA-100 application)
   - Automatic Vehicle Tracking System
3. Advanced GIS facilities and analysis

Solution impact

The solution provided by Rolta has significantly improved Chandigarh police capabilities in quickly responding to distress calls and taking control of emergency situations by effective deployment of patrol vehicle.

Roshan Lal

DSP Communication
Chandigarh Police

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FICCI

FMCG/Banking/Sports



Catching up with technology

Summary:
Businesses in the FMCG, retail and banking sectors are catching up with geospatial technology. With growing sales force, expanding markets and increasing consumer base, the technology is helping in enhancing operational efficiencies, monitoring sales force and better decision making.

Geospatial technology application in India is expanding to newer verticals as businesses in FMCG, retail and banking sectors that had missed to exploit the technology potential seem to be catching up now. With growing sales force, expanding markets and increasing consumer base, the FMCG and retail sector is now coming to terms with technology to monitor their sales force and to reach out to the rural India. FMCG giants such as Marico and Hindustan Unilever Limited (HUL) are using mobile technologies such as low-cost handsets and tablet PCs to innovatively arm their field representatives for carrying out their procurement process.

FMCG catching up with GPS

Marico procures safflower seeds from farmers in seven states. Contacting the farmers was often a problem and a solution was required to not only help the representatives in locating the farmers but also monitoring them. The IT team at Marico developed a mobile-based application for Nokia 5235 series handsets. These GPS-enabled phones with mapped routes enable the field representatives to get the exact route to reach the farmers and also save time. The application also helps in getting real-time data from farmers. For instance, pictures of crop and soil can be obtained for monitoring progress of contract farming, seed information and weather condition. This data can be made available online and helps the company in analysing and taking decisions quickly. A management information system that maintains a track of the inventory with all distributors has been developed. If the system senses that a distributor's stock needs replenishing, it automatically generates a sell order.

In an attempt to extend its rural reach, HUL has prepared a map of its target market. This includes details on all the villages, their total strength, nearest distributor available, location of schools, hospitals and primary health centres. The map helps the management in identifying the opportunities in the villages. To expand its reach, the company is employing village representatives who act as distributors. The representatives are provided with a GPS-enabled handset to track their movements. HUL has also developed a large supply chain of 600 trucks equipped with GPS sets.

Rohit Surfactants, the Kanpur-based detergent maker, is using information technology to compete with international brands such as HUL and P&G. The company has equipped its sales force with GPS-enabled cell phones to book sales and track distributor's positions and sales. A mobile application "msales" that enables the sales force to manage sales activity on the go and directly enter the order on a mobile has been developed. It also enables real-time information exchange between the corporate centre and the field staff. The GPS helps in tracking sales beat of people on the field. The sales beat and GPS coordinates of the sales team are recorded in a central server and mapped on a geographical mapping tool. Technology application has helped Rohit Surfactants to almost double its market share in India.

Banking

In the banking sector, IDBI has initiated a mobile banking facility called 'Vikas Yatra' in Mumbai with a noble vision to reach out to rural India. The bus is equipped with a BSNL line and GPS to track its movement. Commenting on the initiative, R M Malla, chairman cum managing director, IDBI said that the bank aims to reach every nook and corner of the country and promote developmental activities. He opined that there is a huge untapped potential in rural India for the sector as banks have not even reached 1 lakh villages of total 6 lakhs.



I'm not getting lost anymore!

Summary:
Adventure tourists are increasingly catching up with GPS, as these navigation devices can help a great deal in clearly chalking out routes. Whether it is trekking through the forest or paragliding, GPS increases navigation skills and nullifies one's chances of losing way or getting lost.

For all those adventure freaks who do not like the beaten track and like taking adventure trips such as climbing mountains, paragliding, taking a trip on an hot air balloon or going deep into jungles and end up where no-one else ever went, navigation gadgets come handy. And, the chances to be in a spot are fairly high considering the risks these adventure lovers love to take. And their numbers are growing.

Navigation gadgets such as GPS devices and smart phones further add to this trend as adventure enthusiasts equipped with a navigation device can clearly chalk out their route and confidently set their foot on various adventure sports from trekking through the forest to paragliding. GPS in conjunction with a compass substantially increases navigation skills of the traveller provided that GPS receivers are utilised to their maximum potential. Further practice would nullify one's chance of losing way or getting lost. While choosing a navigation device factors such as weight, size, battery life, price, navigation features etc. of the system need to be considered. Basic GPS should at least contain the features to track one's latitude and longitude.

GPS is a necessary accessory during flight competitions like paragliding, where it has to be demonstrated that way-points have been correctly passed. It can also be interesting to view the GPS track of a flight when back on the ground, to analyse flying technique. Other uses include being able to determine drift due to the prevailing wind when flying at altitude, providing position information to allow restricted airspace to be avoided, and identifying one's location for retrieval teams after landing-out in unfamiliar territory.





During hiking trips through dense forests, navigation systems help in planning the route, to check deviation from the path and in calculating the amount of journey completed. During mountaineering, GPS could be used to check the elevation so the climbers are not confused by false summits. A GPS unit also gives the times of sunrise and sunset for a given location. This is useful for planning movement and ensuring that the trip is completed in daylight. GPS devices can be used to take photo place marks, as they help in visualising the terrain at any given point in the journey.

Before setting on an adventure trip, journey route can be set in the GPS by defining it as a series of waypoints. When one waypoint is reached, the GPS guides to the next with a pointer and so on through each successive waypoint until the final destination is reached. This is extremely useful at times of bad weather when map and compass navigation is difficult.

In underwater adventures, whether searching for a ship-wrecked treasure or an exotic marine life, GPS device can help to zero in on the next dive. An ordinary hand-held GPS with a directly attached antenna will not work underwater. The signal strength of GPS will not penetrate more than a very thin layer of water. So it can be carried in a water-proof case and used along with a hand-held marine radio to report position after drifting away from the boat.

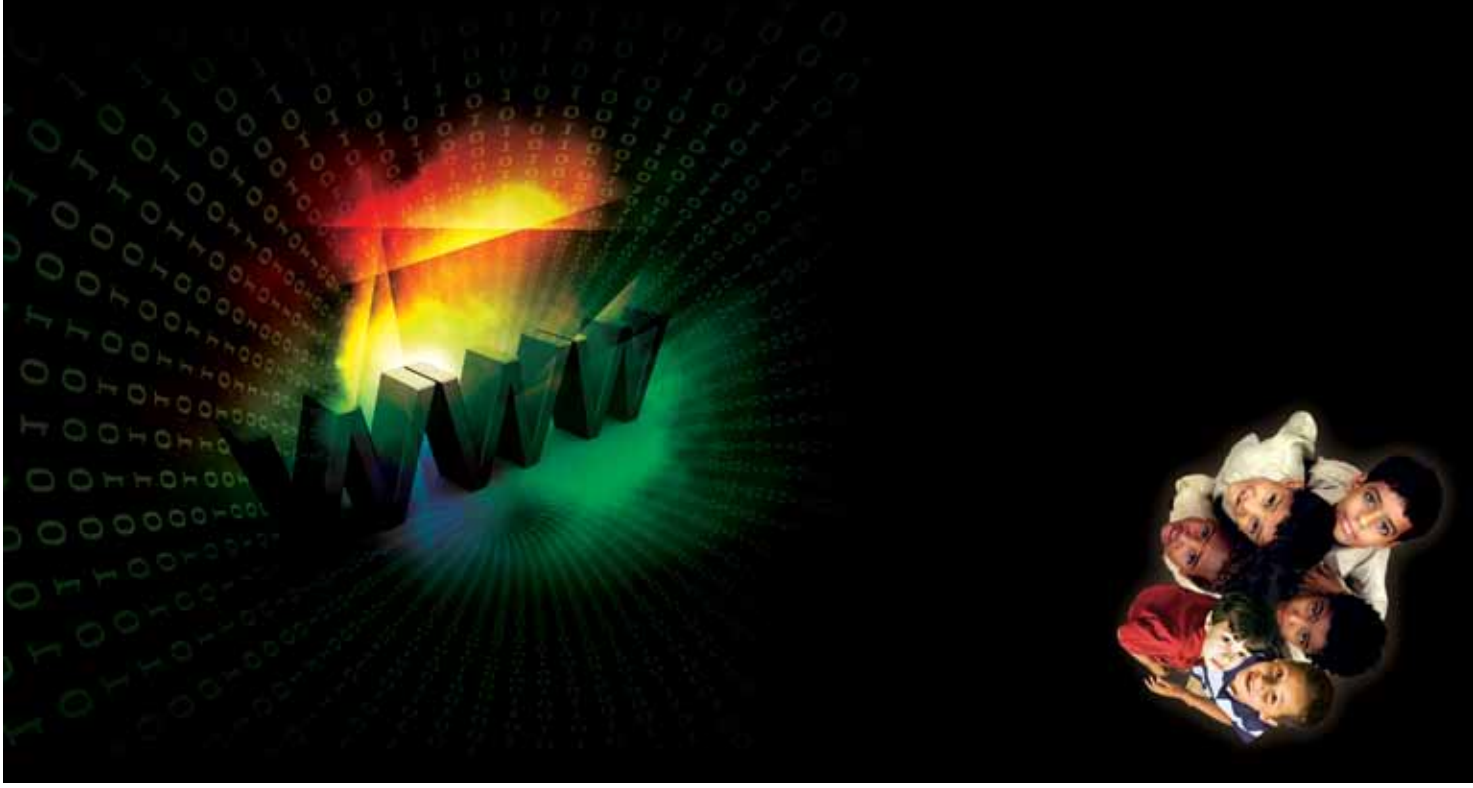
With a GPS unit, hot air balloon enthusiasts can ride over places as far as they want, knowing that they can safely land back. It also helps in efficient control of the balloon's horizontal movement, and gets necessary information on land traffic to make landing safer. The use of GPS in adventure trips makes it more exciting because those who love great outdoors can go in a little deeper with a reduced risk than otherwise.

"I'm not going to get lost anymore!" would be what the adventure freaks would be telling their doting parents. They have the devices, the will and the power. Fortune favours the brave they say, but with some really sound tracking devices at hand, why not? So what are you waiting for? Just get your hands on the GPS devices and follow your heart.

geospatial TODAY

FICCI

Mapping



Summary:

The Rural Technology and Business Incubator (RTBI) of IIT Madras, under the "Rural Collaborative Platform Initiative," developed a website for Thirukostiyur village in Sivaganga District. The entire village was mapped and details were made available online. The website acted as a platform for connecting the urban and rural population. Following the success of this initiative, RTBI in collaboration with the National Internet Exchange of India started the Namma Ooru Website competition, wherein, all the colleges in the Sivaganga District were invited to participate and develop a website for respective villages. The website would include a village map and comprehensive information on resources. The initiative helped in empowering rural youth with digital literacy and in creating an online identity for villages.

Crossing the digital divide

For long, villages have been sidelined out of our country's robust economic picture. Most of us do not know the significance and prominence of villages, and those who have moved away from their native villages rarely stay connected to their roots. Given the rapid migration to cities instilled by seeking better livelihood opportunities over the past few decades, a pertinent need is felt to capture information about Indian villages and create an online identity for them by making information easily available and accessible through the Web.

A humble beginning

The Rural Technology and Business Incubator (RTBI) of IIT Madras is a not-for-profit organisation whose primary motive is to design, pilot and create successful businesses in rural space, leveraging information and communication technology (ICT). RTBI has experience in using ICT for initiatives across domains including health, agriculture, financial inclusion, village community development and for rural distributed production services.

A recent initiative by RTBI was to create an online identity for villages and make available this information to those people who have migrated to cities. When this idea was further explored by talking to non-resident villagers, they provided suggestions on

what information they would perceive as useful when they read or hear about their village. So on a trial basis, the RTBI team began with an exercise to build a website for Thirukostiyur village in Sivaganga District as part of "Rural Collaborative Platform Initiative," the larger intent of which was to create formalised communication channels and virtual platform to connect rural and urban population, especially the non-resident villagers. This was achieved by creating a detailed village website (http://now.rtbi.in/demo/), village-specific maps and finally SMS groups to network in the absence of Internet. Information such as about village, history of the village, tourism information, village map was provided through the website. A mapping exercise was done for the village, wherein the resources were clearly mapped including details on the timing, address and contact information wherever applicable.



Figure 1: Students participating in village website development

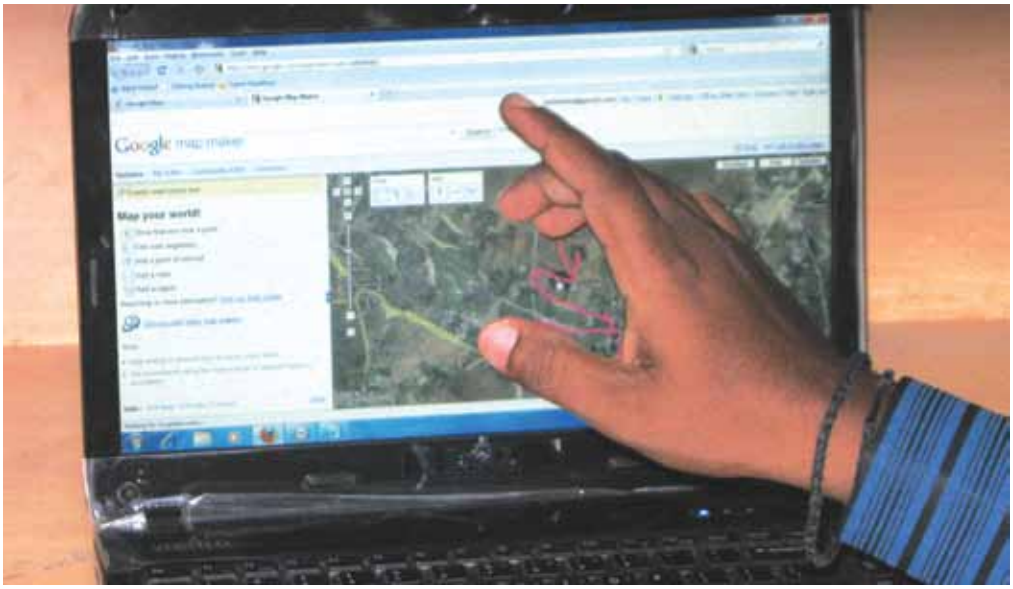


Figure 2: Mapping being taught to villagers

The success of this pilot project was fructified when National Internet Exchange of India and RTBI collaborated in November 2010 to initiate the NOW – Namma Ooru Website (Our Village Website) initiative. Sivaganga District in Tamil Nadu was chosen as the pilot district for this initiative. The novelty of this idea was to involve the rural youth and empower them to help create an identity for their own village. The NOW team conducted a district-wide "Namma Ooru Website Creation Competition" for this purpose.

Launch of NOW competition

All the colleges located in Sivaganga District were invited to participate in the "Namma Ooru Website Creation Competition" irrespective of streams (Engineering or Arts and Science) or category (Government or Private) colleges. The NOW team made effort to meet and discuss the larger objective of the initiative, i.e. to encapsulate and disseminate village-specific details and to create a rural identity for Indian villages, with all the college mentors who expressed interest to enroll their students in the contest. The colleges were asked to nominate students and form them into groups of three members each. The student groups were divided into batches and detailed technical training was provided. At a later stage, the NOW team also inducted village participants who were not affiliated to any educational institution in the training process.

Three main components were taught during the training sessions:

1. Creation of a village website
2. Using an SMS group for social networking in rural areas
3. Creation of a detailed village map

After the completion of the technical training workshop, the students were given a three-month time period for creating a website for their village. During this period the student's progress was regularly monitored by having reviews with them. The NOW team travelled extensively across Sivaganga in the past year meeting and interacting with students, mentors, villagers, panchayat officers. It was evident that NOW's intent to capture village-specific information such as historical significance of villages, demographic details, livelihood, rural businesses, self-help groups, education and literacy levels, tourism, local self-government, and most importantly a detailed village map was slowly coming to life at the hands of the rural youth. Besides this, the youth created numerous village SMS groups and enrolled villagers into it and used it as an official networking platform. The outcome of the NOW initiative was two-fold – empowering rural youth with digital literacy and creating a rural identity for villages.

Voicing rural issues: The scope of the initiative does not end with just capturing and showcasing glorious village information, but it also aspired to give the villagers an opportunity to voice the local issues, concerns and areas that need development. The award winning team at the competition was from Puduvayal village that dedicated an entire page to



Figure 3: Singampuneri village before mapping



Figure 4: Singampuneri village after mapping

talk about the environmental issues ruining the village and went ahead to propose solutions for the local issues. In addition to dissemination of information, the website also offers rural entrepreneurs, self-help groups and small-scale businesses a platform to connect with and cater to larger audience.

Rural tourism: Another fascinating component that the participants most effectively brought out on their websites was Rural Tourism. Ancient temples, mosques, churches, local markets, palaces, prominent place were written about, photographed, mapped and showcased to the world. Most of the information provided on the websites included: name and contact details of the local self-government (Panchayat Raj), details on hospitals, banks, educational institutions, historical significance of the village. Few of the participants even admitted that they came to know these details only after participating in the competition. The websites were evaluated by not just the appearance and design, but also by the uniqueness of content presented.

Mapping rural resources

The existing maps available on the Web (such as Google or Bing) show clear distinction between rural and urban areas. While urban region are mapped extensively to provide street-level details, it can be observed that rural maps are ambiguous or unavailable. Take the case of Tamil Nadu, where villages have only been mapped to the boundary level. Detailed digital maps of rural areas, with natural and physical resources marked, are currently unavailable. But mapping of this sort is vital and serves as a tool for understanding socio-economic and infrastructure facilities available and disparities in the villages, without which meaningful policy making and development programmes cannot be undertaken at the grassroots level. It will also be useful for developing a micro-evel plan of each village. Mapping of rural resources can open up rural markets to the world. To bridge the information gap between rural and urban areas, NOW conducted detailed mapping of rural villages at a large scale with local community participation. The mapping project included:

Points of interest mapped	Mapping process	Advantages
• Water bodies: ponds/lakes/ streams • Village boundaries • Educational institutions • Health care facilities (PHCs, SHCs, private clinics including RHPs' clinic) • Religious centres: temples/ mosques/churches • Utility services: Bank/ATM, post offices, ration shops • Small-scale industries • Any additional prominent places used for common purposes	• Waypoint of each resource are marked using GPS device called data-loggers • The tracks are extracted from the GPS device to PC using Phototagger s/w • Using Google Map Maker tool, the resources are plotted • RTBI volunteers acted as moderators to ensure accuracy of data • Google community approved the data and published it in Google Maps	• The output of the exercise is useful for development workers/ village community to prepare a micro-level plan for livelihood opportunities in their respective villages

- Mapping of natural and physical resources with local community participation
- Development of an effective village resource mapping methodology for NGOs, government sectors or any other development practitioners
- Using technology-based approach in mapping to improve accuracy
- To make the mapped resources available in digital format on a Web portal for wider accessibility by the public



Figure 5: Technical training workshop for villagers

Data collection

Participants enrolled in the NOW initiative for mapping village resources included school students, village elders and panchayat clerks, demonstrating the ease of use of the existing mapping technology. All the participants were provided with a data logger for a period of two weeks. The participants felt empowered and thoroughly enjoyed the responsibility of carrying a GPS device for mapping resource points in their villages for the very first time. Most of them chose to teach their fellow villagers how to map their village and carried out the exercise as a team.

After the map points were collected, the tracks were downloaded from the GPS device to PC using the software GPS phototagger and these tracks were uploaded in Google Map Maker as overlay that allows users to place KML and image files on top of the map tiles to assist with mapping. Google map tools were used to mark the locations in Google Maps. For the convenience of villagers, the maps were made available in both Tamil and English. Once these resources were mapped on Google Map Maker, Google community approved and published the resources in Google Maps in one or two weeks of time. In few cases, it took even a month to get it approved.

Issues and challenges

- Some of the resources marked by the participants were not approved by the Google community though it was verified by the local villager
- Low Internet bandwidth in remote areas took longer time for opening Google Map Maker website

- Good resolution satellite imagery was not available for some of the villages, and so the mapping was done purely with GPS tracks on the map view and not hybrid view of Map Maker

Accomplishments

Namma Ooru Website (NOW) initiative has given a face to 55 different villages across Sivaganga and 5 other districts in Tamil Nadu. As many as 165 rural beneficiaries were trained and they have mapped 43 different villages in detail. The Top 11 websites (out of the 55)were selected by a preliminary judging session held at IIT Research Park on November 12, 2011. NOW Competition concluded on December 17, 2011 in a Grand Finale organised at IIT Madras. The Top 11 groups were given an opportunity to come to IIT Madras along with their team mates and give a detailed presentation to the Panel of Judges who selected the Top 3 winners (Puduvayal, Kanadukathan and Iyyampalayam villages).

Sustaining the websites

The grand finale of NOW was a conclusion only for the contest, but the larger objective to sustain the created village websites is an area which is currently being massively explored. The team from RTBI is putting in considerable effort to explore various means to sustain and scale up this initiative. All the participants involved in the website development are being inspired to continuously update the village website and sustain this initiative. To this end, the participants have demonstrated a lot of ownership for maintaining their village websites. In certain villages, even the local panchayat body had come forth to sustain the village website. Overall the NOW initiative proved to be a community activity, a common thread which brought together people from different walks of life for the larger cause of creating a niche for their village in the virtual world.

Suma Prashant
Vice President
Rural Technology and Business Incubator (RTBI)
Indian Institute of Technology Madras (IITM)

Vasumathi Anandan
Project Associate
Rural Technology and Business Incubator (RTBI)
Indian Institute of Technology Madras (IITM)

Vincy Pushpa Mary
Project Associate
Rural Technology and Business Incubator (RTBI)
Indian Institute of Technology Madras (IITM)



The town of Fazilka comes of age

Summary:
With a vision to put Fazilka, a small town situated close to Indian border with Pakistan, on the map, the Graduates Welfare Association Fazilka (GWAF) developed a digital map of the town, in collaboration with Guru Nanak Dev Engineering College. Geeta Softech, a private firm provided the required software and services. The initiative also helped in promoting tourism in Fazilka.

Ever heard of Fazilka? The chances are low. This sleepy little town with a population of a lakh may not be on everyone's lips, but it has its own identity and uniqueness. Not so long ago, Fazilka was in the thick of the 1965 and 1971 Indo-Pak wars. Situated just 11 km from the border with Pakistan, it had its fair share of fame and glory. Today, however Fazilka's inhabitants pass their days without much fuss leaving behind the glorious days. But some citizens of Fazilka, especially the Graduates Welfare Association Fazilka (GWAF), had other ideas. They were not content by the fact that their town was fading away in the pages of history. They wanted to put Fazilka back on the map and what better way than come up with a digital map. The GWAF and Guru Nanak Dev Engineering College (GNDEC), Ludhiana came together to develop the map under the Openstreet Map project. Geeta Softech is offering software and the service for the project.

There is more to Fazilka

There is more to Fazilka than meets the eye says one of the members of GWAF. Our town is just 14 km from the border post of Sadqi. If one wants to witness the jingoistic retreat ceremony, where the Border Security Force from our side and Pakistan Rangers display their skills with gusto, you may as well do that, but before that a visit to the famous Ghantaghar (clock tower) is a must. Vinod Kumar Jangira, Director, Geeta Softech says, "This project of digital mapping was expressly started to put the city of Fazilka on the world



tourist map." The 165-year-old historical town is also known as Bangla. There were no maps available and people from other parts of India and the world just did not know enough about their township. Fazilka is famous for its handmade footwear (jutti), and sweet meat Tosha both of which are indigenous. Vinod says, "People should know about Fazilka. They will do so once the maps are ready within a few days' time."

As a part of the project, a mapping party was held on April 16, 2011. Geeta Softech was the local host for the map party at Fazilka. The day started with an introduction on Digital Mapping and GPS devices. Field data was collected, web-based maps were made and views were exchanged. This was followed by a discussion on mapping and editing.

The unique part of the project is that people from diverse fields took part to capture the landmarks, eating places and and the ground verification was done using GPS. Draftsmen, students of engineering and architecture, members of the Defence services and farmers, or simply map lovers actively participated in the project. Those who did not own a GPS or laptop computer were given GPS units on loan. Rajvinder Kaur, a resident of Fazilka says, "Our town is unique and it needs to be projected. It not only has historical importance but has tremendous potential for tourism."

Fazilka will gain importance within the next few years due to the Tapi Gas Project which has a 1,735 km long pipeline laid from Turkmenistan to Multan that will end at Fazilka. With the second largest TV tower in Asia and a major rice exporting centre, Fazilka is all set to regain its past glory. There are only three joint check posts (Wagah in Amritsar, and Hussainiwala in Ferozepur district are the two others) where a retreat ceremony is performed by the Border Security Force and the Pakistan Rangers. The Asafwala War Memorial nearby was built in memory of the soldiers of the 1971 Indo-Pak war. With a digitised map, Fazilka and its citizens are ready to map a story of success and put it back to where it belongs. This initiative not only helps the people to be proud of their town, but also helps the government in undertaking development programmes.

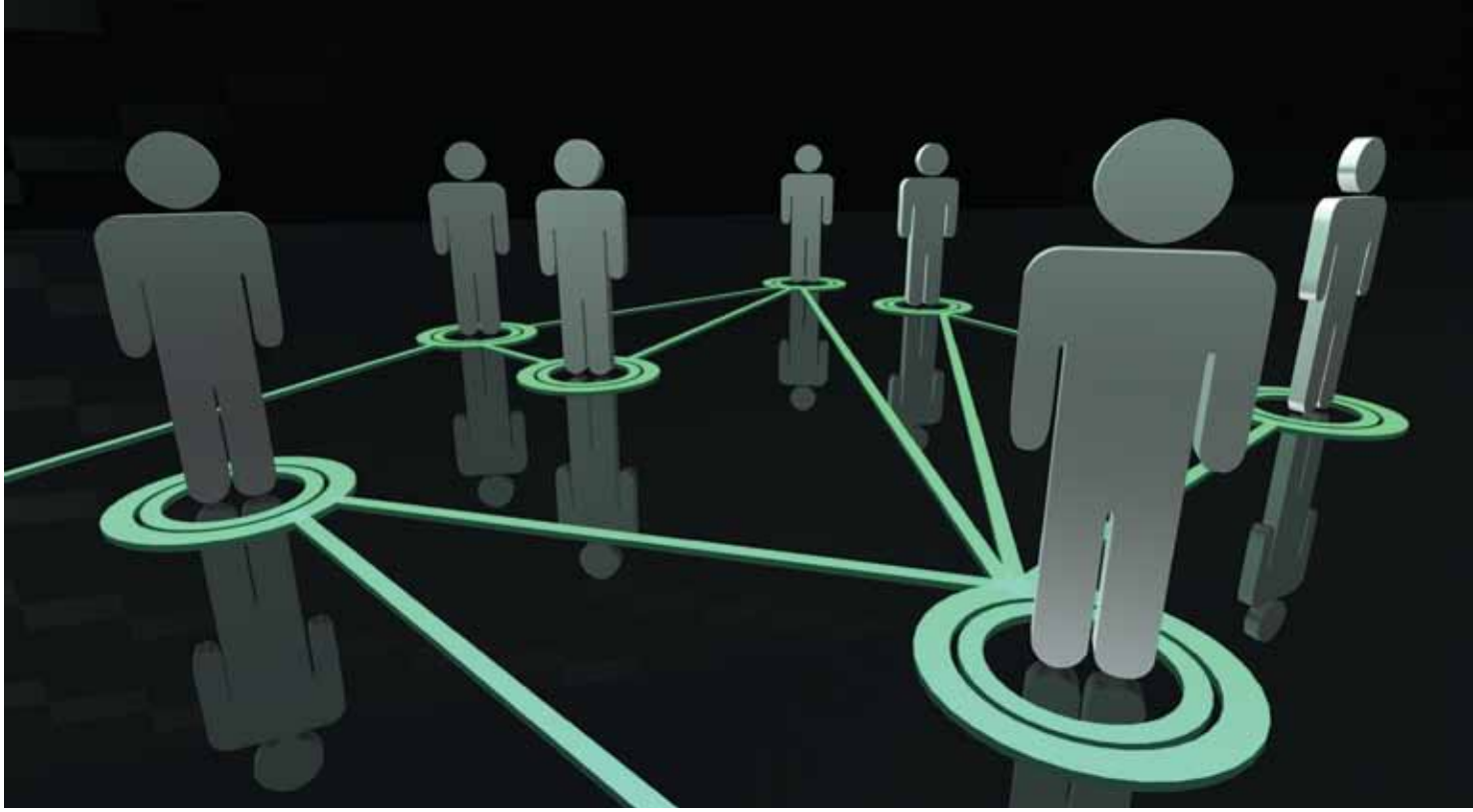
Open Street Map

Open Street Map (OSM) is a mapping project that bases itself on the idea of collaboration. The project, which is inspired by the concept of Wikipedia, allows anybody to contribute, edit and use the maps. Local knowledge plays a key role. The maps are created using data from portable GPS devices, aerial photography, other free sources. OpenStreetMap (OSM) was founded in July 2004 by Steve Coast. In 2006, the OpenStreetMap Foundation (OSMF) was formed with the aim of providing free geospatial data for anybody to use and share. By the end of 2009, OSM had more than 200,000 registered contributors.

The Fazilka story is bound to have its positive effect on other places as well and with modern technology and the internet available in every nook and corner of the country, in times to come we would surely hear more initiatives from citizens of other towns going for mapping their regions. For now, it's Fazilka that is in the limelight.



Beyniaz Edulji



Summary:
Presenting an innovative application of social media, Ajay Kumar, a software engineer developed a Web page using Google Maps that mapped tweets reporting on power cuts across India.

Moving beyond networking

If the right to vote is the most powerful tool in the hands of a citizen, then social media is nothing less for a netizen. From bringing down regimes to developing instant rescue plans for disasters, social media such as Twitter has proved its mettle time and again. Adding to the list of innovative applications of social media is the recent infographic developed by tweeters for mapping power cuts across India. As a group of twitter users casually discussed the power cut issues across India, Shefaly Yogendra, a London-based investment consultant suggested if these tweets could be mapped. Ajay Kumar, a software engineer caught up with the idea to develop a Web page that mapped tweets reporting on power cuts across India.

The project crowd sources, primarily from twitter, all the information on power cuts happening in India, which is mapped at http://powercuts.in/main. A Twitter account by the name @PowerCutsIn has also been created for collecting data. People interested in providing details on power cuts can tweet in any of the following hashtag format: #powercutindia (street, city - location name/pincode) #from (time) #planned or #unplanned (if it's a scheduled load shedding or unexpected outage). When the power supply resumes people can report with #powercutindia #back. Efforts are in progress to collect data from other social media applications as well.

Reporting power cuts

The project offers three ways of reporting power cuts:

- On twitter by using the hashtag #powercutindia
- Online reporting using the submit report form on the website (http://fmi.me/power)

- iPhone/Android users can download the Ushahidi app from their App stores and add the site URL in its settings as http://powercuts.in/ and start reporting.



Mapping power cuts

An interactive Google map of India at a scale of 1:14 million is used to plot various details which are categorised into planned / unplanned power cuts, voltage supply, good news (indicating no power cuts), comments and daily updates. The first city to be mapped was Gurgaon, from where 46 reports were mapped in the first couple of days, recording a reporting rate of 9.2 reports a day.

Privacy issues

People concerned about revealing their identity can report anonymously on the website or by using the smartphone app. The application is being enhanced to ensure that reports do not link to individual person who reports.

Applications

The portal can be used to develop and compare reports on power cuts across different state or cities in a state. This will highlight the disparity in power distribution. It will also bring to light regions suffering power cuts due to reasons other than power shortage.

BIBLIOGRAPHY

Success Story	Contact person	Contact details
Conserving the coastline	**Dr Pravakar Mishra** Scientist-E ICMAM Project Directorate Ministry of Earth Sciences Government of India, Chennai	mishra@icmam.gov.in
	Dr Tune Usha Scientist-E ICMAM-PD Ministry of Earth Sciences Government of India, Chennai	usha@icmam.gov.in
Reaching out to the poor	**Mr Anand Kumar** Associate Director Development Alternatives New Delhi	akumar3@devalt.org, anandbhu@gmail.com
Strengthening local level planning in Uttar Pradesh	**Dr L R Yadav** Senior Technical Director National Informatics Centre Department of Information Technology Ministry of Communications & IT Government of India Lucknow	lr.yadav@nic.in
	Mr R S Singh Principal Systems Analyst National Informatics Centre Department of Information Technology Ministry of Communications & IT Government of India Lucknow	rs.singh@nic.in
A panchayat digitised by undergrads	**Dr D Nandakumar** Department of Geography, Government College, Kariavattom Thiruvananthapuram, Kerala	nandan4@gmail.com
Rajasthan Urban Information System Enabling e-governance in Rajasthan	**Mr Vikrant Karandikar** Vice President, Business Development RMSI	Vikrant.Karandikar@rmsi.com

SDI enables local self-governance in hill areas	The Director Development Centre for Alternative Policies New Delhi	devcentreap@gmailcom
Creation and management of urban property ownership records in Karnataka	Infotech Enterprises Ltd.	content@infotech-enterprises.com
Streamlining municipal operations The KMC story	**Mr U N Tiwari** Additional Municipal Commissioner Kanpur Nagar Nigam Kanpur	udai_amna@rediffmail.com
Sagar Municipality goes digital	**Mr Mridul Kumar** SGS Infotech Private Limited	kumarmridul@rediffmail.com
Nailing on encroachments	**Dr Parmod Bhardwaj** Associate Professor - Geoinformatics Division, Department of Geography M.D. University, Rohtak **Ms Renu Joon** PG Diploma student in RS/GIS M.D. University, Rohtak	bhardwajpk95@gmail.com
A crisis resolved	**Dr S V Dahasahasra** Member Secretary, Maharashtra Jeevan Pradhikaran, Mumbai **Ms M R Mulay** Deputy Engineer, Maharashtra Jeevan Pradhikaran, Thane	Drsvd14@gmail.com
Towards flawless property records management	**Mr Dhyan Appachu** Director - International Operations Chief Technical Officer SECON Pvt Ltd	dhyan.appachu@secon.in
Connecting rural India	**Dr K K Mishra** State Nodal Officer (GIS) PWD Rajasthan Ms Monalisha Mishra GIS Analyst-RRRDA GIS Lab PWD Rajasthan	mishra_kamalkant@hotmail.com

Harnessing Hydro Power	**Mr Anit Ghose** Director-Netwings Infotech (P) Ltd.	anit.g@netwingsinfotech.com
Exploring resources the eco-friendly way	**Dr D S Mitra** DGM (Geology) & Head Remote Sensing & Geomatics Division KDM Institute of Petroleum Exploration Oil & Natural Gas Corporation Ltd, Dehradun	dsmitra@gmail.com
At ease with the sea	**Dr N C Anil Kumar** Scientist, Kerala State Remote Sensing and Environment Centre	ksrec@yahoo.com
Remote Sensing fits to a 'T'	**Dr Rishiraj Dutta** Department of Earth Observation Science International Institute for Geoinformation Science and Earth Observation (ITC) The Netherlands	dutta13191@alumni.itc.nl
Empowering farmers through ICT	**Dr Vinod M Bothale** Director, Maharashtra Remote Sensing Applications Centre, Nagpur (Dept. of Planning, Govt. of Maharashtra) **Dr Prashant Rajankar** Scientist, Maharashtra Remote Sensing Applications Centre, Nagpur (Dept. of Planning, Govt. of Maharashtra)	vinod.bothale@gmail.com
Mapping watersheds in Narmada basin	**Mr Dhyan Appachu** Director - International Operations Chief Technical Officer SECON Pvt Ltd	dhyan.appachu@secon.in
Towards sustainable road transport system	**Dr Ashish Verma** Associate Faculty – CiSTUP Indian Institute of Science Bangalore	rsashu@yahoo.com

Trailing the metro	**Mr Prashun Dutta** Sr. Executive Vice President (Quality & IT) Reliance Infrastructure Limited	Yuvraj.Mehta@relianceada.com
Public transport gets intelligent in Mysore	**Mr Ananth Murthy** CMC Limited, A TATA Enterprise **Mr Karthi Madhavan** Global IP Head, Transportation CMC Limited, A TATA Enterprise	ananth.murthy@cmcltd.com karthi.madhavan@cmcltd.com
Developing sustainable road transport infrastructure	**Dr Anuradha Shukla** Senior Principal Scientist - Transportation Planninig and Environment Central Road Research Institute	anuradha.crri@nic.in
AAI expedites no objection certificate issuing process	**Dr Deb Jyoti Pal** Vice President & Head – Technology & Services NIIT-GIS Limited (Esri India)	deb.pal@niit-tech.com
Geospatial technology in the travel and tourism sector	**Mr Deepro Ganguly** DGM - Sales & Marketing (Web, Mobile and Print) MapmyIndia	deepro.ganguly@mapmyindia.co.in
Space technology for flood disaster management	**Dr V Bhanumurthy** **Dr C M Bhatt** **Dr G Srinivasa Rao** **Dr P Manjusree** Disaster Management Support Division National Remote Sensing Centre, Indian Space Research Organisation Department of Space, Government of India	bhanu634@gmail.com cmbhatt@nrsc.gov.in rao_goru@yahoo.com pmanjusree@yahoo.co.in
Expediting response to distress calls	**Mr Roshan Lal** DSP Communication Chandigarh Police	pcrchandigarh@gmail.com

Crossing the digital divide	**Ms Suma Prashant** Vice President Rural Technology and Business Incubator (RTBI) Indian Institute of Technology Madras (IITM)	suma@rtbi.in
	Ms Vasumathi Anandan Project Associate Rural Technology and Business Incubator (RTBI) Indian Institute of Technology Madras (IITM)	vasumathi@rtbi.in
	Ms Vincy Pushpa Mary Rural Technology and Business Incubator (RTBI) Indian Institute of Technology Madras (IITM)	
The town of Fazilka comes of age	**Ms Beyniaz Edulji**	bvedulji@gmail.com

For other articles, please contact:
Omer Ahmed Siddiqui
Associate Editor - Geospatial Today, Gateway Media Private Limited
omer@gatewaymedia.in

About FICCI

Established in 1927, FICCI is the largest and oldest apex business organisation in India. Its history is closely interwoven with India's struggle for independence, its industrialization, and its emergence as one of the most rapidly growing global economies. FICCI has contributed to this historical process by encouraging debate, articulating the private sector's views and influencing policy.

A non-government, not-for-profit organisation, FICCI is the voice of India's business and industry.

FICCI draws its membership from the corporate sector, both private and public, including SMEs and MNCs; FICCI enjoys an indirect membership of over 2,50,000 companies from various regional chambers of commerce.

FICCI provides a platform for sector specific consensus building and networking and as the first port of call for Indian industry and the international business community.

Our Vision

To be the thought leader for industry, its voice for policy change and its guardian for effective implementation.

Our Mission

To carry forward our initiatives in support of rapid, inclusive and sustainable growth that encompass health, education, livelihood, governance and skill development.

To enhance efficiency and global competitiveness of Indian industry and to expand business opportunities both in domestic and foreign markets through a range of specialised services and global linkages.

About Geospatial Today

A focussed, reader-friendly monthly magazine devoted to geospatial sector, Geospatial Today aims to demystify the spatial technology and its applications to one and all including its users and professionals.

Launched in the year 2002, the magazine has grown from strength to strength and has emerged as a resource for industry professionals and new entrants to geospatial sector. The magazine serves as a platform for both service providers as well as users to access cutting-edge content across industry verticals.

The magazine covers various issues related to the industry such as Geographical Information System (GIS), Global Positioning System (GPS), Remote Sensing (RS), Photogrammetry, Lidar and Hyper Spectral Imaging, Marine GIS, Land Information Systems, Agricultural GIS, climate change, e-governance, surveying, utilities and facilities management apart from topical issues, markets and government policy.

Through its articles, case studies, product and industry profiles, special features, news, events, columns and everything that concern geospatial industry, the magazine caters to the industry and technology market, both globally and from the Indian perspective.