

# Cover 1

# Cover 2

# MAPS TODAY

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# MAPS TODAY

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# Editorial

GeoMap Society(GEMS) as in the past has organised National Survey Day jointly with Instn. of Engineers (India), Hyderabad on 10 April 2019. Presence/participation of more than 10 experts and about 70 students from civil engineering received appreciations. Read the report on this in this issue. Also see some selected pictures of past Map Awareness Programmes (MAP)

Read about the use of Drone based technology to deal with floods and interesting information about NAGI

Views on Digital Earth, Earth Observations and Sustainable Development at World Economic Forum (WEF) are interesting. Equally informative is the United Nations Map which has cartographic section and a treasure house of maps

Views of three experienced professionals about GIS in India are given. Readers are requested to respond, to develop better strategies for increased use of GIS in India

It is a treat for many to recall Prof Manzoor Alam and his services in the field of Geography. Photo taken at his house in Hyderabad, sent by Dr Raghav Swamy is reproduced in this issue.

For GIS Data bases, up-to-date LIS is essential. Telangana government has initiated Land Title system. Read two articles related to this most important issue.

An article on scope of GIS and another on 3D mapping are quite old but still relevant; hence included.

THE INDIAN GEOGRAPHICAL SOCIETY

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Chepauk, Chennai - 600 005, INDIA



Cover page of Indian Geographical Journal (IGJ), published by The Indian Geographical Society (IGS), University of Madras, Chennai ([www.igschennai.org](http://www.igschennai.org))

It is the Special Issue on Theme : Remote Sensing , which contain a collection of 14 contributory Articles from PAN India.

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#### Declaration:

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---- Editor **G.S. Kumar**

# Mohan's Musings

Murali Mohan, ex-scientist,  
ISRO and Photogrammetry expert

The first thing that you need to take note of, in any mapping project, is the list of deliverables and the spatial frame they are defined in. Next point to ponder about is if the inherent accuracy of the raw images will suffice the accuracy requirement. Every image these days - obtained through aircraft, satellite or drone- carries geotags as part of its header. However, these geotags suffer from errors - such as bias in satellites (besides drift in drones and aircraft) - calling for additional inputs to improvise the absolute location accuracy of the end products. However, if one is interested in relative accuracy through measures like length of a pipe line, perhaps one can proceed right away. This is where we consider employing a few accurately measured, sharp and static marks - popularly called Ground Control Points, or popularly GCPs.

## GCP acquired for Cartosat may not be valid for Geoeye.

### Sources of GroundCoordinates

A GCP is a feature that you can clearly identify in the raw image for which you have a known ground coordinate. Ground coordinates can come from a variety of sources such as GPS, conventional ground surveys, orthophotos, vectors, GIS layers, legacy topographic maps, GCP libraries,..

A GCP establishes the relationship between the raw image and the ground by associating the image space coordinates of the imaged point (line, pixel) to the object space coordinates (XYZ or LLH) on the ground. The relationship can be established through simple math models like polynomials or rigorous sensor models.

It is always desired to go for minimum number of GCPs as their procurement is expensive.

### What it means to be a good GCP?

The quality of GCPs directly affects the accuracy of your math model, and that in turn, determines the end product quality. Note the following important qualifiers:

- Identify the features in the raw image that you want as ground control before collecting GCP coordinates in the field using a GPS or ground



survey. The GCP acquired for Cartosat may not be valid for Geoeye.

- GCP distribution is important. The horizontal spread of the points in the project area is often stressed upon. It is equally important to collect GCPs from a variety of height across the project elevation range. Public domain DEMs such as of SRTM can be highly helpful for planning.
- Plan the GCPs in such a way that each of them is spotted in as many images. In a project of high overlaps, it is not uncommon that a GCP can be measured in 8 images (or in other words, 8 rays per point). This produces a more accurate model as one GCP is stitching multiple images together.
- Select features that are close to (or on) the ground. Features having relief, such as buildings, may appear to lean in the image. When a point located on a boundary wall is to be measured, you need to offset for the wall height if GPS is kept on ground.
- Avoid using shadows as GCPs. Although shadows may be easy to spot in the image, they can move from one image to another due to time interval in image acquisition.
- Avoid selecting commonly occurring or repetitive features such as street furniture, parking areas. Point transfer can be ambiguous.

### How many GCPs I need?

It depends. The stability of on-board sensor, terrain ruggedness, the math model employed to process the images are some of the crucial factors. And of course, the fraction of points that you like to earmark for evaluating the deliverables - called Independent Check Points (ICPs).

If the terrain is flat, and that you choose to rectify the images with first-degree polynomial, go for 4 points (3

GCPs + 1 ICP) per image. If you choose to employ rigorous RPC model, for stable satellites such as Cartosat, GeoEye, it is okay with one GCP and one ICP per image. Please note these are bare minimum configurations. It is always desired to acquire a bit more points as deploying field teams is expensive - both in time and money.

**You do not need GCPs here!**

You are lucky you do not need any GCPs or ICPs if only relative accuracy - such as:

- Requirements such as measuring length, area, and volume of features
- Construction Site Management and Oversight
- Crop monitoring
- Accident site reconstruction
- Creating promotional material

Processing is fast that you don't plan and wait for GCP surveys. Collect the tie points; perform the block adjustment. And that's it!

Applications such as Cadastral surveys, as-built surveys, pipeline alignment do require GCPs and 30% of the points are jack-knifed for checking purpose.

**And finally about EPSG**

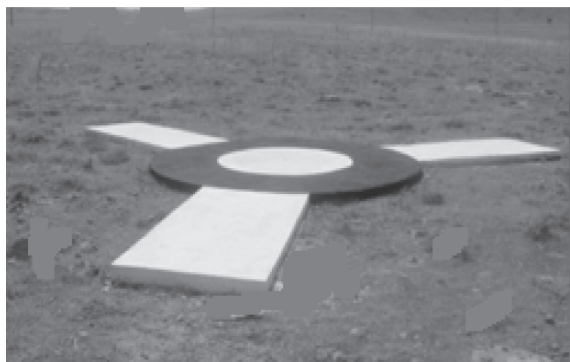
Ensure the spatial frame of the GCPs is compatible

with end-product specification. If the points are in different frame, do necessary transformations. Two instances to illustrate:

- The deliverable is Indian Everest and the GCPs are acquired with GPS, carry out WGS84 to Everest transformation.
- If contours are to be delivered in MSL frame, convert the ellipsoidal heights of GPS survey using the EGM model or through conventional levelling.

**Brace yourself for surprises**

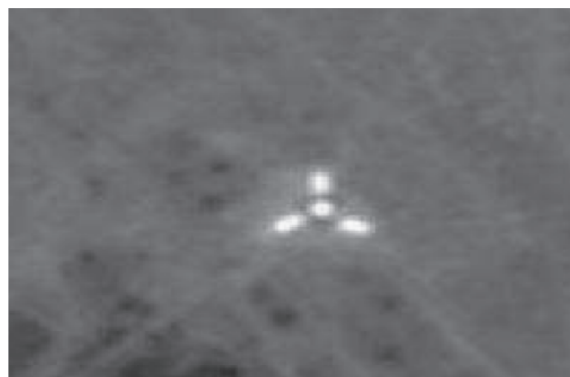
Plan the marking and measuring of GCPs appropriately and quickly soon after acquiring the raw images. GCP survey is a field activity and hence be prepared for unforeseen uncertainties. In a heli-borne LiDAR project, the GCP team assured me they would complete the task by dawn so that the copter could take off in the ensuing morning. The team went incommunicado till noon. Along chase ensued to locate the team - forget the GCPs. The team gave a sombre narrative of the ordeals they went through- the primary being their inability to reach the planned location due to darkness. A nightmarish learning - it gets dark in the nights! So, factor in for the known and unknown unknowns.



Pre-pointed (targeted) GCP on ground



Improperly designed target - poor definition of dot size, repetitive pattern, less contrasting



GCP as seen in image



A post-pointed GCP - Crigth angle intersection of two contrasting features

# Land Information System (LIS)

Data is a hot topic today. Data leaks are headline news. Data security is an important issue. Add spatial dimension and a good policy, the normal data. really becomes *khatarnaak*. It is a double edged sword.

It is heartening to note, after many decades, a firm announcement of 4 March 2019 by the chief Minister of Telangana (KCR) about “Major reforms in Revenue department” . He talked about conclusive Title to land-holders. He added that if there is any issue related to title, government will be liable to pay penalty. In most developed countries conclusive title is given on registration and compensation to affected. Litigations are very few.

For many of us, this announcement is music to ears. Some years back, we tried to engage advocates to take up the issue of title on registration as in many developed countries. I was told that major governing systems in India are sustaining mainly because of land litigations. So there is resistance to land titles to owners. KCR has taken up a great challenge as issue of “conclusive title” will be opposed strongly by vested and powerful interests.

If GIS is applied to ownerships, it is called Land Information System (LIS). I was instrumental in initiating Photogrammetric survey under Integrated Land Information System (ILIS) in Nizamabad District.. Many helped in the success of this challenging project. Key persons are – VK Agarwal, IAS, Commissioner, Land Survey; Late PVS Madhusudan Rao, Dy Director, State Land Survey Department; Dr. Kalyan Raman, NRSC; Dr DP Ro (Padmasri), Director (etd), NRSC. An article jointly prepared with VK Agarwal was included in the proceedings of International Society of Photogrammetry & Remote Sensing (ISPRS)

The union cabinet has approved introduction of the Land Titling Bill 2010, a draft of which has been hosted on website [www.dolr.nic.in](http://www.dolr.nic.in) ( email: [da-dolr@nic.in](mailto:da-dolr@nic.in) ). Any reader can supply latest information on this !!

The document consists of 78 clauses and subclauses in 56 pages, difficult to understand. What was required is to amend the present Registration Act to include a clause that registering authority should verify the documents and complete the registration within ( say ) 3 months maximum. Registration should mean absolute



**GS Kumar,**  
Retd Director, Survey of India;  
Editor, Maps Today

title.

For example, Government staff in the Land Titles Offices in Calgary and Edmonton, Canada examine and register the documents and issue the titles. The government then guarantees the accuracy of the title and as a result, anyone who suffers a loss due to an error on the title or even as a result of a fraudulent transaction is entitled to compensation from the government. The liability associated with this potential compensation is funded through the collection of assurance fees.

Same is the system in many other countries. The proposed Act puts the onus of verification of records on the buyer, whereas it should rest with the government which has all the records and information

In Canada, Australia and other developed countries, buyer and seller approach the Registration authority. Within about a month, the Registration authority carry out the verification (themselves ) to establish if the transaction is authentic. If it is correct, the parties will be called and registration completed and title handed over. If later, the transaction is proved to be defective, the winner in the litigation which may last several years will be entitled to compensation but the title remains absolute. This is a positive system ( Torrens).

## ‘Bhu Bharathi’ works to nearing completion

The Hindu, February 27, 2016

**Chief Minister K. Chandrasekhar Rao is keen to implement the project across the State. Details of the aerial survey conducted under the programme will be given to the Revenue Department, he said.**

# Drone mapping for Floods

**Drones, supercomputers and sonar deployed against floods AP | 21 April 2019**

<https://www.thehansindia.com/tech/drones-supercomputers-and-sonar-deployed-against-floods-522826>

An arsenal of new technology is being put to the test fighting floods this year as rivers inundate towns and farm fields across the central United States.

Drones, supercomputers and sonar that scans deep underwater are helping to maintain flood control projects and predict just where rivers will roar out of their banks. Together, these tools are putting detailed information to use in real time, enabling emergency managers and people at risk to make decisions that can save lives and property, said Kristie Franz, associate professor of geological and atmospheric sciences at Iowa State University. Also Read - iPhones to sport 3-camera setup, 12MP selfie shooter



The cost of this technology is coming down even as disaster recovery becomes more expensive, so “anything we can do to reduce the costs of these floods and natural hazards is worth it,” she said. “Of course, loss of life, which you can’t put a dollar amount on, is certainly worth that as well.” US scientists said in their spring weather outlook that 13 million people are at risk of major inundation, with more than 200 river gauges this week showing some level of flooding in the Mississippi River basin, which drains the vast middle of the United States. Major flooding continues in places from the Red River in North Dakota to near the mouth of the Mississippi in Louisiana, a map from the National Weather Service shows.

“There are over 200 million people that are under some elevated threat risk,” said Ed Clark, director of the National Water Centre in Tuscaloosa, Alabama, a flood forecasting hub. Much of the technology, such as the National Water Model, didn’t exist until recently. Fueled by supercomputers in Virginia and Florida, it came online

about three years ago and expanded streamflow data by 700-fold, assembling data from 5 million river miles (8 million kilometres) of rivers and streams nationwide, including many smaller ones in remote areas. “Our models simulate exactly what happens when the rain falls on the Earth and whether it runs off or infiltrates,” Clark said. “And so the current conditions, whether that be snowpack or the soil moisture in the snowpack, well that’s something we can measure and monitor and know.” Emergency managers and dam safety officials can see simulations of the consequences of flood waters washing away a levee or crashing through a dam using technology developed at the University of Mississippi — a web-based system known as DSS-WISE.

***There are over 200 million people that are under some elevated threat risk,” said Ed Clark, director of the National Water Centre in Tuscaloosa, Alabama, a flood forecasting hub***

The software went online in 2017 and quickly provided simulations that informed the response to heavy rains that damaged spillways at the nation’s tallest dam in northern California. The program also helped forecast the flooding after Hurricane Harvey in Texas and Louisiana that year. Engineers monitoring levees along the Mississippi River have been collecting and checking data using a geographic information system produced by Esri, said Nick Bidlack, levee safety program manager for the Memphis district of the US Army Corps of Engineers.

***.....engineers are increasingly flying drones to get their own aerial photography and video of flooded areas they can’t otherwise get to because of high water or rough terrain, said Edward Dean, a Corps engineer. “We can reach areas that are unreachable,” Dean said.***

The company produces mapping tools such as an interactive site showing the nation’s largest rivers and their average monthly flow. On the Mississippi River, flood inspectors use smartphones or tablets in the field to input data into map-driven forms for water levels and the locations of inoperable flood gates, seepages, sand boils or levee slides, which are cracks or ditches in the slopes

*Contd.....12*



# 3D Mobile Mapping for Solid Waste Management

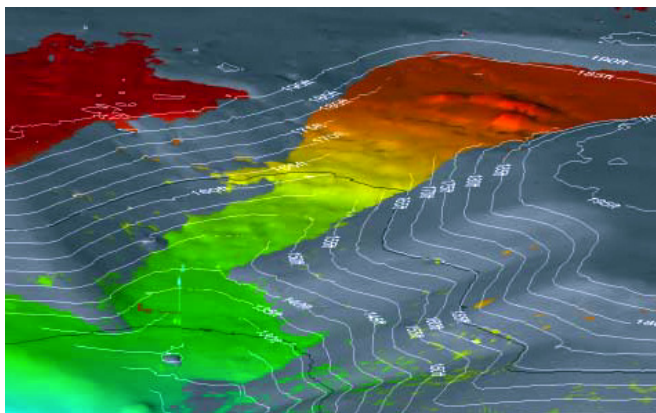
Compaction and Airspace: The Keys to Landfill Profitability

*Posted on June 15, 2011 by Caleb Cass in 3-D Mapping, Blog, Education, Gallery, Landfills, Portfolio*

<http://firmatek.com/?p=835>

The business of landfills is air, selling empty space to be filled with solid waste, and in this industry not all air is equal. Landfills have the unique ability of being able to modify the lifespan of their product without changing the amount of product they started with. It all comes down to compaction. Volume may be fixed, but density is not, and the more solid waste you can fit into a given volume, the more valuable that space is. That is why it is absolutely necessary to have an accurate and reliable way of tracking the change in the volume of solid waste before and after compaction.

One of the newest and most helpful technologies being used to measure compaction ratios and airspace utilization is Mobile Mapping, also known as 3D laser scanning or ground-based LiDAR. By scanning an active fill area at two different points in time to obtain a fill volume and then dividing that by the weight of the waste received during that period, accurate densities can easily be calculated.



Active Fill Area:  
Updated surface (colored) on original surface (grey)

Mobile mapping provides the accuracy and data density of an aerial flyover, with the mobility and flexibility of a ground survey. Benefits include:

- **Cost Effective** – Focusing on active fill areas reduces the time and cost of updating operations
- **Scalable** – Project coverage areas ranging from ¼ acre to 500+ acres using the exact same technology
- **Efficient** – Much higher data acquisition rate, up to 36,000 points per second, compared to manual surveying
- **Accurate** – A typical point cloud contains millions of measured points, with real coordinates, providing detailed terrain modeling
- **Protection**- Stay in compliance with design requirements from regulatory agencies. Problems can now be identified and fixed before they become expensive and time-consuming to repair

Mobile Mapping makes tracking compaction ratios and airspace utilization more efficient than ever. Results can usually be delivered within a week of the initial data collection survey. Having accurate volume measurements performed regularly and reported quickly allows landfill operators to maximize the space they have available, which is the most influential and most controllable variable for increasing profitability of a landfill.

Firmatek's 3D mobile mapping provides clients with a wealth of fast, dependable information to better manage, predict and plan the operation of their landfills. And all of this comes without the need for managers to purchase additional equipment or software, hire additional personnel or pay for specialized training.

The May 2011 issue of MSW Management, the solid waste industry journal, features a cover article detailing the importance and subsequent profit potential of managing and regularly monitoring compaction in solid waste landfills, the article can be found here:

<http://www.mswmanagement.com/may-2011/airspace-compaction-techniques.aspx>

# National Survey Day- 2019

As in the past, National Survey Day was organized by The Institution of Engineers (India) Telangana State Centre (TSC) and GeoMap Society (GEMS), Hyderabad on 10 April 2019 at “Visvesvaraya Bhavan”, Khairatabad, Hyderabad

Survey Quiz was conducted in which about 80 students from four engineering colleges took part.

The programmed began with invocation song *Vandemataram* followed by lighting of lamp. Er T ANJIAAH, FIE Hon. Secretary, IEI, TSC in his welcome address, explained the importance of Surveying and the role of Instn. of Engineers in observing Survey Day every year.



R - L : Dr G Rameshwar Rao; Prof I V Muralikrishna; Er T Anjaiah (Podium); Mr. GS Kumar; Dr M V Venkateswara Rao

Dr G Rameshwar Rao, FIE Chairman, IEI, TSC in his opening remarks brought out the importance of 10 April, the day in 1802 when first accurate base was measured at Chennai. He explained about the importance of surveying in various aspects of life and in particular in civil engineering projects. He shared his experience of projects of Metro Water Works as a civil engineer.

Er G S KUMAR President, GEMS, conducted Survey Quiz with five selected questions as below one by one(PPP) with limited time for each question.



**GS Oberoi**

Maj Dr. G.Shiva Kiran and Mr. Rakesh Bhatnagar evaluated the answer sheets.

The team of Shadan College of Engineering & Technology, Hyderabad emerged topper. When there was a tie for third position, Dr Shiva Kiran asked “What are the latitude and longitude values of this place?” MGIT GS Oberoi teams came second and third ( Prizes sponsored by Mr. GS Oberoi, Retd Director, Survey of India)

### Prize winning teams are:

#### First Prize

**MA Kashif & Mohd Faiza**, Shadan College of Engineering & Technology, Hyderabad

#### Second Prize

**M.Aravind & Nityanand Sai**, Mahatma Gandhi Institute of Technology, Hyderabad (MGIT)

#### Third Prize

**L.Chaitanya & N.Sireesha**, Mahatma Gandhi Institute of Technology, Hyderabad (MGIT)



Survey Quiz Prize winners of Mahatma Gandhi Institute of Technology (MGIT), with Organisers. (Mr. Sankar Kumar Reddy, Asst Prof MGIT, is at extreme left

Highlights of discussions on the five questions are covered here.

**Question 1.** Accuracy of distance measured from SOI map of scale 1:50,000

- (a) 5 metres (b) 12.5 metres (c) one metre

**Correct answer is (b).**

Mj Gen Dr.R. Siva Kumar explained the concept of one-fourth millimeter of the scale as the limiting factor for accuracy. On 1:25,000 accuracy, for example, expected accuracy is 6.25 metres which is  $\frac{1}{4}$  mm of 1:25,000 scale map.



Maj Gen Dr.R. Siva Kumar, explaining answer to a question of Survey Quiz

**Question 2.** Resolution of Cartosat2 Imagery

- (a)15 metres (b) 5 metres (c) one metre

**Correct answer is (c).**

Prof IV Dr I V Muralikrishna, briefly outlined how India evolved from 1972 (80 metres resolution) to present one metre resolution of Cartosat 2.

**Question 3.** Height accuracy of leveling

- (a) 0.002m (b) 0.01 m (c) 0.1 m

**Correct answer is (a).**



Mr. KK Pappan elaborating answer to a question of Survey Quiz. Maj Gen R Siva Kumar and Mr. Murali Mohan listening to the discussion.

Mr. KK Pappan commented that accuracy of leveling is related to the lengths. He referred to the formula  $\sqrt{0.25}$  of distance (Km).

**Question 4.** Accuracy of survey depends on

- (a)Terrain (b) Instruments (c) Ground control points

**Correct answer is (c).**

Mr. KK Pappan commented that accuracy depends on all the three factors.

**Question 5.** Survey of India completed topo survey of India first time using

- (a) Chain survey (b) Plane Table (c) Theodolite

**Correct answer is (b).**

Mr. Murali Mohan, ex-scientist, ISRO and Photogrammetry expert elaborated on the concept of accuracy and pixel size in image based mapping. Dr.V.Raghava swamy enlightened the students and others about different types of resolution in imagery. He commented that Cartosat 2 imagery with one metre resolution is good for mapping on scale 1:10,000.

Dr G Rameshwar Rao shared some informative aspects related to alignment surveying and posed some questions about better accuracies using latest technologies in Surveying & Mapping. Impressed by the interest by the participants and also considering he developments in Surveying & Mapping, he proposed holding 2-day conference on “Digital Technologies in Surveying & Mapping” in October 2019.

Then came the much awaited address of chief guest Prof IV Dr I V Muralikrishna on “Artificial Intelligence and Surveying Technology”. His address, interestingly presented, rich in ideas and technological aspects, was listened by all with great interest.



Prof IV Murali Krishna, Chief Guest delivering the address

Highlights from his presentation:

- New technologies are add-ons and not replacements to traditional methods. Basics are not changed.
- SoI maps have limitations in accuracy. We need to use new technologies for improving standards.
- Machine learning is very important in the current situation
- Artificial Intelligence (AI) is useful for many mapping products like Terrain modeling, quality control, field productivity, etc..
- Digital Elevation Model (DEM) is an example of integration of technologies, the present need for efficient solutions.
- AI and surveying knowledge is useful for engineering students of all disciplines.
- Use of technology should lead to smart solutions.
- Data Mining, Research, Big data, 3D mapping , Analytics etc need to be focused
- Dealing with “Gaps and Limitations”, he spoke about predictive analytics from Imagery.
- He exhorted all to use technology innovatively. He quoted Texla – an example of Mobile system on road.
- He spoke of “Four System” – Clarity; Ideation; Develop and Implement” as an approach to the use of technology.

Dr M V Venkateswara Rao, Committee member, IEI, Hyderabad, in his vote of thanks covered various aspects including his own experience of how surveying helped resolve a critical situation in valuation by obtaining correct values of area. He thanked all the experts, students and others for active participation. Programme came to end with :” *Jana gana mana...*” It was around 1:15 pm and Lunch was arranged for all.

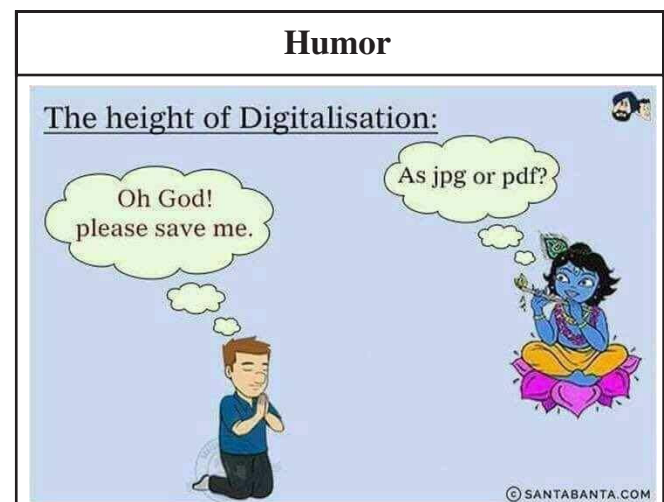
After being part of the National Survey Day Programme on 10 April 2019, I have no hesitation to say that

- \* Speeches and Quiz with discussions at the programme were enriching.
- \* Surveying as a Spatial Data Capture Technology has emerged as the most efficient “*IT based Integrated Planning, Management, Implementation and Monitoring System*” - **GS Kumar**

## ***Drone mapping for Floods continued.....8***

of an earthen levee. Photos, videos and other data are sent to an emergency flood operation centre in real time, allowing Corps officials to visualize any problems and their exact location, instantly informing the response, Bidlack said. “If people in the field have concerns about something, they can let us know to go out there and look at it,” Bidlack said. “There’s a picture associated with it, a description of it, and it helps us take care of it.” Corps engineers are increasingly flying drones to get their own aerial photography and video of flooded areas they can’t otherwise get to because of high water or rough terrain, said Edward Dean, a Corps engineer. “We can reach areas that are unreachable,” Dean said.

The Corps also now uses high-definition sonar in its daily operations to survey the riverbed, pinpointing where maintenance work needs to be done, said Corps engineer Andy Simmerman. The Memphis district uses a 26-foot survey boat called the Tiger Shark, with a sonar head that looks like an old-fashioned vacuum cleaner and collects millions of points per square inch of data, Simmerman said. The technology has helped them find cars and trucks that have been dumped into the river, along with weak spots in the levees. “These areas are 20 to 80 feet underwater, we’d never get to see them without sonar,” Simmerman said. “The water never gets low enough for us to see a lot of these failures.” During recent flooding near Cairo, Illinois, a culvert that should have been closed was sending water onto the dry side of a levee. The sonar pointed engineers to the precise location of a log that was stuck 20 feet deep in murky water, keeping the culvert open. Plastic sheathing and sandbags were brought in to stop the flow and save the land below. “The sonar definitely made a difference,” said Simmerman. “A big success.”



# United Nations Maps



Committee of Experts on  
Global Geospatial Information Management

First session 26 October 2011 Item 8 of the  
provisional agenda \* Consultation on United Nations  
Maps

[https://www.un.org/Depts/Cartographic/english/  
htmain.htm](https://www.un.org/Depts/Cartographic/english/htmain.htm)

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Section as a comprehensive digital map (geo-database)  
covering the entire globe at various levels of detail. It  
consists of basic cartographic and place-name  
information at different scales. As a geo-database,  
UNmap is designed to store, query, manipulate and  
exchange geospatial information, in order to be the  
primary spatial dataset for map production and digital  
display for users in the UN Secretariat and UN field  
missions.

## Geographic Resources and Information

### Working Group

#### UN-GGIM

The UN Committee of Experts on Global  
Geospatial Information Management (GGIM)  
aims at playing a leading role in setting the agenda  
for the development of global geospatial  
information and to promote its use to address key  
global challenges.

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#### UNGIWG

The United Nations Geographical Information  
Working Group was established in March 2000.

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#### UNGEGN

Link to the UNGEGN web site (United Nations  
Group of Experts on Geographical Names)

### Documentation

#### Map Library

The Map Collection houses over 80,000 maps, some  
3,000 atlases, gazetteers, travel guides, cartographic  
and geographic reference works as well as digital  
cartographic products.

## GIS Data Bases – Updating through crowd sourcing



Maj Gen Dr. R Siva Kumar (Retd),  
President, IIC Technologies  
conferred with ISG FELLOW award

**Dr R Siva Kumar;** Former Head (NRDMS) & CEO (NSDI), Dept of Science & Technology, Govt of India <rsk2602@gmail.com>

Today in the digital world, the biggest challenge is to keep the data up-to-date and thus data maintenance is assuming greater significance. Many of the service providers resort to crowd sourcing. But the question is about the reliability and accuracy of the data. No agency can invest resources to maintain huge databases.

Crowd sourcing through smart apps is the best option. However, we need to develop systems to validate the data to maintain data integrity and to avoid mischief. Rule based systems and automated tools can help to some extent and flag the issues which need human intervention.

We have in Survey of India, Top Hand Book (THB) Chapters which can be used to create the rule base for the IT persons to develop the tools and mechanisms.

Such ideas have been tested earlier and one example is the pilot project Mapping the Neighbourhood in Uttakhand (MANU) launched just after Kedarnath Tragedy. College students were given short training for 3 days at IIRS Dehradun and provided with handheld devices with preloaded apps. The locational data with attributes was directly posted onto Bhuvan portal of NRSC from the field. The attributes also contained scientific information which was used subsequently by the experts to suggest actions.

SOI carried out LIDAR mapping and the the integrated database is being used by the scientific community.

Similar concept was suggested by me in 1989 in the form of a paper 'A case for Survey Net' for the INCA conference held in Dehradun. I suggested keeping a small team ( 2 to 3 members) in each District Headquarters (at that time about 585 districts) who will be given the

responsibility to update the data regularly

**Dr. K Brahmananda Chari**

<dr.kbchari@gmail.com>



### Use of Phtotgrammetry/GIS in India

I agree that photogrammetric surveys are not happening as expected.

However, The Digital India Land Records Modernisation Programme (DILRMP)—the erstwhile National Land Records Modernisation Programme—seeks to improve the quality of land records in the country, make them more accessible, and move towards government-guaranteed titles. Almost all the states are implementing this at a considerably good pace. The states like Odisha, Karnataka and three union territories have completed 100% work on the computerization of the land records. Though not accurate, this is a huge and essential step, quick and easy path towards building digital GIS.

The R-APDRP, the GIS component of Restructured Accelerated Power Development and Reforms Programme is eye popping - the scale of implementation across India remains unprecedented.

Most of the surveys, such as OFSDP and forest boundaries, now are using DGPS, Total station. The GIS data is disseminated on web.

Mumbai and Mysore 24/7 water supply utility projects are world class in both surveying the assets and implementing the projects on ground.

### GIS Market

Personally, I feel there is huge market for GIS - both international and domestic. The domestic market has gained good pace in the last 5 years. However, the L1 tender processing has become a hurdle in delivering the

goods of GIS. A few greedy companies quote unreasonably low prices and don't deliver the goods

### **GIS Softwares – Open Source & Commercials**

Foreign SW developers are selling software because there is a need and demand for them.

The free softwares are good. But they are not reliable for implementing huge projects such as R-APDRP. This is where enterprise GIS software is kicking in.

Personally, I have used free software such as QGIS and enterprise GIS like ESRI Arc GIS and MapInfo. Unfortunately, the production level GIS is not yet a reality with free GIS software.

### **Lack of participants in GIS Training**

There could be two reasons for this.

The first reason, most of the universities are now offering GIS courses at Masters level. And GIS is being taught in the mainstream in BTech and MTech Engineering courses also. Since last 5 years there are many GIS trained students.

The second reason, when there is requirement in the market, most of the corporates employ BTECH and MTECH students and train them as it suits them

### **GIS/GST has become part of our daily life**

Its true. Google and Jio have revolutionized the way we use maps and the way we communicate. Google Earth and Google Maps have brought GIS revolution in India and across the world. We, the GIS community owe hugely to Google for bringing GIS into our lives and making maps and living smarter

### **GIS Jobs**

When I browse GIS Jobs in Hyderabad – typically I see 158 openings in Naukri; 70 jobs in Indeed; 150 jobs in monsterindia websites.

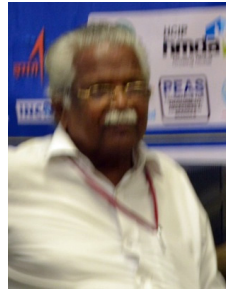
The scenario of jobs in GIS is similar as the jobs for Engineers, Biologists and Environmentalists in India.

### **Slow adoption of GIS in India**

Systems and rules improve efficiency in a community ONLY if it is inclusive. The success of a system depends on how effectively it can include the stake holders.

Supreme court has made it mandatory for using DGPS for surveying forest boundaries. The world bank projects have GIS mandatory.. Similarly GIS can be made mandatory for area related projects in India.

# **Gis Scenario In India**



**KK Pappan**, Senior Scientist (Retd), NRSC, ISRO

kk.pappan@yahoo.co.in

*Mr. KK Pappan started his career in Survey of India in a junior post and rose to a senior position as head of Aerial Phtotraphy, NRSC. Tough retired he is acive as consultant. He is known for innovative idea and iiatives. Read his views on GIS scenrio inIndia*

- GIS is a lazy man's job
- Field Surveyor a hard working, selfless person, acquires all the inputs required for GIS as far as the terrain in concerned.
- GIS Projects are vendor driven
- The indentors of GIS data are the middle level managers of State and Central Govts. , PSUs, Quasi govt organizations, sporadically some private user such as telecom services providers
- GIS Packages are GREEK and LATIN for the indentor; vendors rule the roost. There come the consulting firms, survey and mapping, photogrammetry, GIS operators etc. Companies
- The middle level private company managers who have been trained in GIS operations therefore are the exparte experts
- Competition amongst vendors paves way for creating additional packages as ADD-ONS.
- These add-ons continue as 'One-upmanship' and is the business model
- During the process very many GIS packages were sold out. *A setu himachalam*
- The decision makers in the respective offices were mute spectators of the GIS applications projects. They were signature enabled persons to authorize if the project is budget strengthened.
- GIS now is a dead horse taking all the whips
- GIS database have two components, spatial and non spatial
- Spatial is nothing but a replica of the ground reproduced in a miniature form as analogue (paper) analytical (numerical) and digital (computer compatible)

- The lowest grade technician who surveys the land in Survey of India is the Plane Tabler *grade IV* who is the most reliable person as far the mapping is concerned. He sees the ground bit by bit and surveys and draws the map on the hard mapping paper pasted on the plane table assigning proper symbols and colors.
- Accuracy standards are met strictly so also the symbolization. Periodical inspections at three levels (the camp officer, the officer in charge of the survey unit (party) at HQ and the Director of the region) have been carried out to ensure the accuracy and quality of the map so produced. The process is cumbersome and laborious as compared to current technologies but more reliable.
- The second option of preparing GIS layers is in imaging technologies.
- A number of GIS layers such as forest, (scrub, teakwood), agricultural, wastelands, rocks, barren etc. land classifications. Road rail, river stream other water bodies buildings and many more layers are generated by image interpretation (aerial photo, satellite image, LiDAR etc.)
- Thus the thematic layers of the terrain are in hand now.
- The subject theme is derived from reports, discussion, literature, existing reliable datasets etc,
- The other thematic layers if needed in near real time can be made from aerial data, lidar data and satellite images on specified date /time.
- With the amalgamation of all the above layers becomes the GIS data set. Then what?
- The GIS analyst enters and here comes the failure, because the desired result is not achieved.
- Large number of people are trained in autocad , layerization and data overlying and they are called GIS specialists.
- In the beginning (*as the bible says*) all the companies big and small jumped into training GIS specialists.
- The consultants fool the indentors and the first symptom of ill health of GIS starts.
- Finally GIS nearly get killed
- GIS specialists do not have enough employment; those who aspired for a good career are now a disappointed lot.
- Now who killed GIS? We celebrated a limping GIS day in IETS, Hyderabad.
- I shall tell my version without favour or fear sometime later.

# Geo Map Quiz

**Some pictures of GeoMap Quiz of the past as part of Map Awareness Programmes are reproduced below**



6 December 2014, Indira Park, Hyderabad

A Group participating in Finals of GeoMap Quiz in Map Planning Module. Other modules are Map Fun and Skill Test



17 December 2012

GeoMap Quiz Finals - Prize winners with some organizers and chief guest at Indira Park, Hyderabad



# Earth observations (EO) and sustainable development

<https://www.gim-international.com/content/blog/on-earth-observations-for-evidence-based-policymaking-and-other-reflections-from-the-wef-annual-meeting-2019>:

**Blog**

**EO for Evidence-based Policymaking Discussed at World Economic Forum (WEF) 2019 - 14/02/2019**

Steven Ramage

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My talk was about the value that can be achieved through distributed ledger technology and machine learning in the field of Earth observations. But like every technology advance, these are the enablers rather than the goals. The issues we are facing are still around the lack of data and institutional strengthening. For example, it's my understanding that 93 of the (230+) SDG indicators are related to environmental topics; however, only 34 of those indicators already have established methodologies and data available from UN member states to support reporting and monitoring. Hopefully much more detailed information on this will be made available in UN Environment's 6th Global Environmental Outlook Report in March 2019

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**Sustainable development and policymaking**

Otherwise, I didn't hear much talk at the Summit on sustainable development, and I certainly didn't hear anything about Earth observations. This wasn't surprising given the focus was on blockchain and artificial intelligence (AI). However, depending on how you define sustainable development, it could be argued that many of the discussions addressed topics that expert practitioners would say fall under sustainable development.....

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Professor Alex (Sandy) Pentland, one of the main organisers of the Blockchain + AI + Human summit, has written extensively on this topic, and yes, there were even a few of his books available! There was certainly a lot of talk about innovation and some of the ethical, moral, privacy, and security issues around the topics, and maybe some of it translates quite readily into sustainable development.

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..... but since it was my first time I was quite impressed by the senior level of attendees. For example, just before I jointly hosted a session on Digital Earth Africa with a colleague from WEF, I found myself standing next to Al Gore, former U.S. Vice President and original thinker behind the Digital Earth concept. It was a privilege, and a rare opportunity for me to be able to tell him about the success of Digital Earth Australia paving the way for the Committee on Earth Observation Satellites (CEOS) Open Data Cube and the work GEO and its partners are doing to expand the Africa Regional Data Cube to the entire African continent as part of transformational Digital Earth Africa programme.

Stemming from these and other conversations at WEF, my goal is to elevate the awareness of the value and usefulness of Earth observations (EO) science, technology and policy to respond to sustainable development. I would love to work with the global EO community at this leadership level and also bring in some grassroots activities to get a feel for both top-down and bottom-up approaches to evidence-informed policymaking. Feel free to get in touch at sramage@geosec.org with your insights.

*The original version of this contribution was published at [www.sdsntrends.org](http://www.sdsntrends.org), the website of the Sustainable Development Solutions Network.*

# Prof Shah Manzoor Alam

Note by .Dr. Raghavaswamy



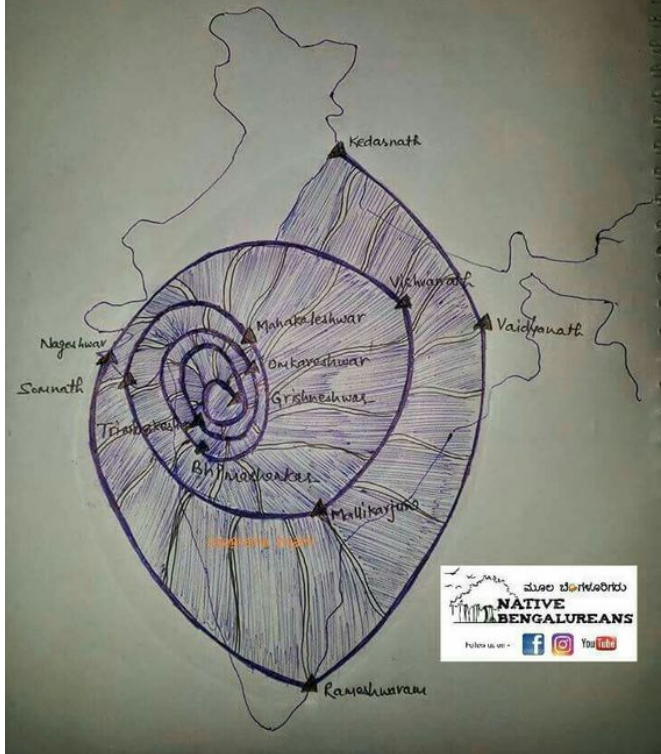
The Photo was taken at Prof Alam's home at Hyderabad, on the occasion of Handing over the Prestigious, 'BHOOGOL RATNA AWARD' for 2017. The award was bestowed by NAGI (National Association of Geographers India), New Delhi, during the 39th, Indian Geography Congress (IGC) held at Osmania University, during December 5-7, 2017

Prof Shah Manzoor Alam was a former Head of the Department of Geography, Osmania University, Hyderabad. He was the founder Director of , Centre for Area Studies on the Indian Ocean Region, Osmania University, Hyderabad . Also, former Vice Chancellor, Kashmir University, Srinagar.

# Ancient India

Importance of Locations seems to hold relevance in Ancient India known for "Vaasthu" science

## ALL 12 JYOTIRLINGAS CONNECTED IN THE FORM OF CONCH



## Humor

Impact of Digitalization and automation... Lollll



# Why we need conclusive titles

<https://telanganatoday.com/why-we-need-conclusive-titles>

**Why we need conclusive titles:** *This will make property records clear and easily accessible through IT-enabled citizen services*

Dr Chennamaneni Ramesh - Published: 24th Apr 2019  
( In India registration is related to document and not title. In Australia and many other countries, registration means title. It can be legally challenged. If challenger wins, he gets compensation and not title. This is a positive system. Indian system has resulted in litigations and short-term benefits to exploiters. For decades, efforts were made for absolute title. Nizamabad District Project was completed successfully using Photogrammetry ten years back under Integrated Land Information System (ILIS) at a cost of less than Rs 200 per acre. It stands out as a model for Telangana and the country. This is the first time that a firm announcement by the chief minister of Telangana has been made. Extracts from the article by a senior politician supporting issue of Title are given here – Editor, Maps Today)

Telangana Chief Minister K Chandrasekhar Rao recently declared that the State government will enact a "revolutionary and path-breaking" Revenue Act by this June. "Every little bit of land will be accounted for. After June, once the Act is in place, every issue, whether related to ownership by tribals, non-tribals, podu, revenue or non-revenue land, will be identified and conclusive titles will be issued," he said

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Currently, the Transfer of Property Act, 1882, provides that the right (or title) to an immovable property (or land) can be transferred or sold only by a registered document. Such documents are registered under the Registration Act, 1908. Therefore, the registration of land or property refers to the registration of the transaction (or sale deed) and not the land title. This means a registered sale deed is not a government guarantee of land ownership.

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This means, land ownership is presumptive in nature, and subject to challenge. The onus of checking past



**Dr Chennamaneni Ramesh,**  
MLA and Expert in Agriculture,  
Environment and Cooperation)

ownership records of a property is on the buyer, and not the registrar.

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As a result of conclusive titling, maintenance of property records will cease to be merely a tool for governance and revenue generation but will be added to the agenda of citizen services. This is a fundamental shift from the past and the new approach is in the absolute interest of the people.

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Land' is a State subject .....Each State government will have to bring in its own laws keeping in mind the overall spirit of conclusive titling and at the same time adjusting local requirements.

## Mail from Maj Ramana on MAP news

I congratulate you for your continued effort, in promoting " Map Awareness

Mr. G. S. Oberio was my director, when I was working in Mussorie ( as O. C. 27 party)

He is a thorough gentle man, & a good guide, soft ,kind and a religious man. And his wife too.

His magnanimity can be seen in his contribution of " one lakh rupees " to this cause.

He too has conducted such programmes. In fact I held an Exhibition " in Town Hall " Mussorie, in 1982 , similar to the one I organised in Hyderabad " All India Industrial Exhibition " & got the best Central Govt. Stall.in the year 1995.

I shall post some photos very soon.

# *Scope of geospatial technologies in large scale land resource inventory*

G.P. Obi Reddy, Principal Scientist, National Bureau of Soil Survey & Land Use Planning, Nagpur-440 033  
[https://www.researchgate.net/profile/Gp\\_Obi\\_Reddy2](https://www.researchgate.net/profile/Gp_Obi_Reddy2)

## **Data acquisition and processing is important stage in any large-scale mapping exercise**

In recent years, there is an increasing demand for large scale land resource inventory and mapping to meet the various demands in the fields of land resource planning, management, conservation and sustainable agriculture. With the advent of geospatial technologies (high resolution remote sensing, Geographic Information System, Global Positioning System), the process of land resource inventory and mapping has changed significantly. Various geospatial technologies have much potential to contribute to understand the spatial distribution of terrain, soils, land use/land cover and other landscape qualities, which affect land resource planning and management. Large scale land resource inventory provide a wealth of information about the distribution of main landscape qualities like climate, soil and water, their properties, limitations, and expert interpretations for land use planning and management. It also provides the details on slope, soil depth, erosion, drainage, hydrolic conductivity, pH, groundwater depth, land capability and irrigability of the given area.

Data acquisition and processing is important stage in any large-scale mapping exercise. High resolution satellites like Cartosat-1, dedicated to stereo viewing for large scale mapping and terrain modeling applications. Standard products are generated after accounting for radiometric and geometric distortions while precision products are ortho-rectified. Ortho-rectified products are corrected for terrain distortions and camera tilt effects with the help of control points and using Stereo Strip Triangulation (SST) based DEM (only for Indian region). Cartosat-1 data products supplied with 10 bit radiometry for both PAN Fore and Aft cameras. The geo-referenced IRS P6 satellite data could also be effectively used with suitable image enhancements to facilitate the delineation and interpretation of different thematic information. It

would be more appropriate to adopt the Universal Transverse Mercator (UTM) coordinate system with WGS 84 datum. It is also compatible with GPS, remote sensing data and the Open Map Series now under preparation by Survey of India.

It is essential to have accurate base maps for any large scale resource inventory, so in large scale land resource inventory, transfer of spatial components from high resolution satellite images to map is crucial. With the published topographical maps, the capabilities of base maps generation is possible at 1:50,000/1:25,000 scale. In view of this constraint, it is a necessary prerequisite to generate large scale base maps for use in land resource inventory and mapping. With the available latest satellite technology, the large-scale map could be generated using high-resolution space borne imagery as Digital Topographical Database comprises both vector and raster layers representing the topography of a given area. Geospatial technologies like remote sensing, digital elevation data, and ground based sensor data provide a wealth of site-specific resource information with dependable ground truth datasets. However, collecting detailed ground truth information is to be cost effective for land resource inventory, land use planning and management applications.

In data interpretation, visual and digital interpretation methods could be used to prepare pre-field interpreted map. The satellite data could be interpreted based on photo elements like tone, texture, size, shape, pattern, aspect, association etc. These pre-field interpreted maps and digitally enhanced satellite data could be used on the ground to identify different landform units and elements of various themes. Suitable field sampling techniques like transects/random sampling/quadrants could be followed to assess the interpreted elements and relate with satellite data. In present day, the field data collection is eased by GPS in order to locate the ground verification points on the image and ground for further incorporation of details. During sample collection for the identified field points, collection of attribute information like vegetation, geomorphologic, soil and topographic parameters will be

of immense help in finalization of thematic maps.

In land resource inventory and mapping, based on lithology, relief, drainage pattern, natural vegetation, land use and satellite image elements, the distinct landscape/landform units to be delineated. Necessary field verification is essential to finalize interpreted landscape units through satellite imagery. Then, the soil profile points to be decided based on the geological/Geomorphological/soil heterogeneity mapped from the satellite data. During inventory, through study of landscape elements and soil profiles, delineates the soil boundaries of different kinds of soils whose characteristics are markedly different due to the various factors affecting soil formation. The detailed study of soil-site properties to be undertaken in each soil-mapping unit by traversing and collecting surface soil, minipit and soil profile observations depends on landscape heterogeneity and soil variability. The collected soil samples need to be analyzed based on standard methods for determination of various soil physical and chemical properties. Based on the landform units, soil properties and necessary ground truth verification, final soil maps could be prepared on 1:10,000 scale. Such type of detailed soil maps and spatial information enable the planners and scientists for effective land resources planning, management and adoption of suitable conservation measures.

Geospatial technologies discussed in this article also stand as a necessary tool in the design of land resource information systems and decision support systems in GIS for sustainable management of land resources. In GIS, the attribute database on soil site characteristics, physical, morphological and soil chemical properties could be entered in a seamless soil polygon layer based on the unique soil mapping unit. GIS technology can integrate both spatial and non-spatial data through polygon processing and common database operations such as query and statistical analysis with unique visualization through maps. The framework of land information system in GIS is the ability to systematically organize, search, discover, access, visualize and even update geospatial land and allied data to develop services through customized user interface. The attribute database could be used to generate various thematic maps and generation of area statistics. The outputs are of the converted data, can easily be translated into information. Development of metadata on various parameters of land information system provides a formal structure to identify the land resource databases of a given area and it assist to identify,

discover and use of detail land information of that area.

It is evident that geospatial technologies have immense potential in inventory, planning and management of land resources. The appropriate geospatial tools and techniques need to be adopted in execution of land resource inventory, so that much needed standardized geospatial information could be generated for effective implementation of various land use plans to enhance the agricultural productivity. Not only is the combined use of GIS, GPS and remote sensing technologies essential for land resource inventory and development of spatial data, which are indispensable devices in decision making across all sectors of land resource planning and management in the given area. The availability of digital land resource databases in GIS enhances its utility in applications like thematic mapping and analysis, soil-landscape modelling, agro-ecological characterization, land degradation assessment, land evaluation, crop suitability evaluation, land use planning, development of soil conservation strategies, and development of spatial decision support systems for land use planning.

## ***Feed back***

In March 2019 issue of Maps Today, following defects are pointed out:

**Page 7:** The article says at the end of column one “ In case of heavy downpour or a hailstorm, the drones will come handy”.

This is incorrect.

**Page8:** Para beginning with “Surveying and mapping...” repeated

**Page 9 :** Solar Inspection picture doesn't seem to be a picture from drone.

**Page 11:** In the last para, Drone's flying height given as 800 metres seems wrong!

**Page 12:** UAV stands for Unmanned Aerial Vehicle and not Aircraft vehicle as mentioned in second para.

**Page 15-21:** There is repetition of information about regulations for Drones.

There are other editorial defects. Please pay more attention to avoid such deficiencies.

Good wishes

**A concerned reader of Maps Today**

*( We thank the reader for pointing out defects in the journal. We will make efforts to void errors- Editor)*

## EVENTS

GISTAM 2019	May 3-5, 2019	Greece	<a href="http://www.gistam.org">www.gistam.org</a>
Information Fusion & GIS	May 10 – 12, 2019	St. Petersburg, Russia	
International Symposium on Deformation Monitoring	May 15 – 17, 2019	Greece	<a href="http://isd2019.survey.ntua.gr/">isd2019.survey.ntua.gr/</a>
GeoMATES '19 International Congress on Geomathematics in Earth- & Environmental Science	May 16-18, 2019	Hungary	<a href="http://www.geomates.eu">www.geomates.eu</a>
URISA GIS Leadership Academy.	May 20-24, 2019	Raleigh, NC, U.S.A	<a href="https://www.urisa.org/education-events">https://www.urisa.org/education-events</a>
ESRI UK Annual Conference 2019	May 21, 2019	London, UK	<a href="http://www.esriuk.com/en-gb/about/events/ac/overview">www.esriuk.com/en-gb/about/events/ac/overview</a>
GEO Business 2019	May 21 – 22, 2019	London, UK	<a href="http://www.geobusinessshow.com/">www.geobusinessshow.com/</a>
Urban Remote Sensing Event	May 22 – 24, 2019	Vannes, France	<a href="http://www.jurse2019.org">www.jurse2019.org</a>
China Autonomous Driving HD Live Map Innovation Conference 2019	May 23 – 24, 2019	Beijing, China	<a href="http://en.hdmapconference.com/">http://en.hdmapconference.com/</a>
GEOINT 2019	June 2-5, 2019	TX, U.S.A	<a href="http://geoint2019.com/">http://geoint2019.com/</a>
UAV-g 2019	June 10 – 12, 2019	Enschede, The Netherlands	<a href="http://www.gsw2019.org">www.gsw2019.org</a>
Geospatial Week	June 10 – 14, 2019	The Netherlands	<a href="http://www.isprs.org/">www.isprs.org/</a>
19th International Multidisciplinary Scientific GeoConference SGEM 2019	28 June - 7 July 2019	Bulgaria	<a href="http://www.sgem.org">www.sgem.org</a>
GI_Forum 2019 - Symposium and Exhibit of GIS	July 2-5 2019	Salzburg, Austria	<a href="http://www.gi-forum.org">www.gi-forum.org</a>
Esri User Conference	July 8 – 12, 2019	San Diego,	<a href="https://www.esri.com">https://www.esri.com</a>
WGDC 2019	July 9-10 2019	Beijing, China	<a href="http://wgdc.taibo.cn">http://wgdc.taibo.cn</a>
Society for Conservation GIS 22nd Annual Conference	July 15 – 17, 2019	CA, USA	<a href="http://scgis.org/conference/30">scgis.org/conference/30</a>
19-23 August URISA GIS Leadership Academy	Aug 19-23 2019	Toronto, Canada	<a href="https://www.urisa.org/education-events/urisa">https://www.urisa.org/education-events/urisa</a>
FOSS4G 2019 Bucharest	Aug 26-30 2019	Bucharest, Romania	<a href="https://2019.foss4g.org/">https://2019.foss4g.org/</a>
EUROGEO 2019 'Hidden Geographies'.	Aug 28-31 2019	Ljubljana, Slovenia	<a href="http://hiddengeographies.com">http://hiddengeographies.com</a>
GeoInformation for Disaster Management	September 3-6, 2019	Prague, Czech Republic	<a href="http://www.gi4dm2019.org">www.gi4dm2019.org</a>
INTERGEO 2019	17th – 19th September 2019	Stuttgart, Germany	<a href="http://www.intergeo.de">www.intergeo.de</a>
International Symposium on Digital Earth	September 24-27, 2019	Sesto Fiorentino Italy	<a href="http://www.gis-professional.com/content/event/11th-international-symposium-on-digital-earth-isde-11">www.gis-professional.com/content/event/11th-international-symposium-on-digital-earth-isde-11</a>
MVP BIM 2019 " Prague, Czech Republic	September 24-25, 2019	Prague, Czech Republic	<a href="http://mvpbim2019.org/">http://mvpbim2019.org/</a>
GIS-Pro 2019,	September 28 – October 2, 2019	LA, USA	<a href="http://www.urisa.org/gis-pro">www.urisa.org/gis-pro</a>
LADM 2019 Workshop SDSC2019 - Conference on Smart Data and Smart Cities GGT2019 - Geomatics Geospatial Technology	Oct 1-3 2019	Kuala Lumpur, Malaysia	<a href="http://isoladm.org/LADM2019Workshop;">isoladm.org/LADM2019Workshop;</a> <a href="http://www.geoinfo.utm.my/geospatial2019">http://www.geoinfo.utm.my/geospatial2019</a>
IMAGERY TO DIGITAL REALITY: ERS & Photogrammetry	Oct 28-31 2019	Seoul, Republic of Korea	<a href="http://conf.racurs.ru/conf2019/eng/">http://conf.racurs.ru/conf2019/eng/</a>
Africa GIS 2019.	November 18 – 22, 2019	Kigali, Rwanda	<a href="http://www.eis.africa/">www.eis.africa/</a>
Amsterdam Drone Week, ,	December 2-6, 2019	Amsterdam	<a href="https://www.amsterdamdroneweek.com">https://www.amsterdamdroneweek.com</a>
InfraTech 2020	14-16 January 2020	Germany	<a href="https://www.infratech.de">https://www.infratech.de</a>
FIG Working Week 2020 - "Smart surveyors for land and water management	10-14 May 2020	Amsterdam	<a href="http://www.fig.net/fig2020/">http://www.fig.net/fig2020/</a>
FME International User Conference	16-19 June 2020	Vancouver, Canada	<a href="https://fmeuc.com/">https://fmeuc.com/</a>
ISPRS Geospatial Week (GSW) 2021	21-25 March 2021	Dubai, U.A.E.	<a href="https://www.isprs.org/">https://www.isprs.org/</a>

*Information about events has been compiled from different sources. Readers are advised to check correctness from the organisers*