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GIS RESOURCES

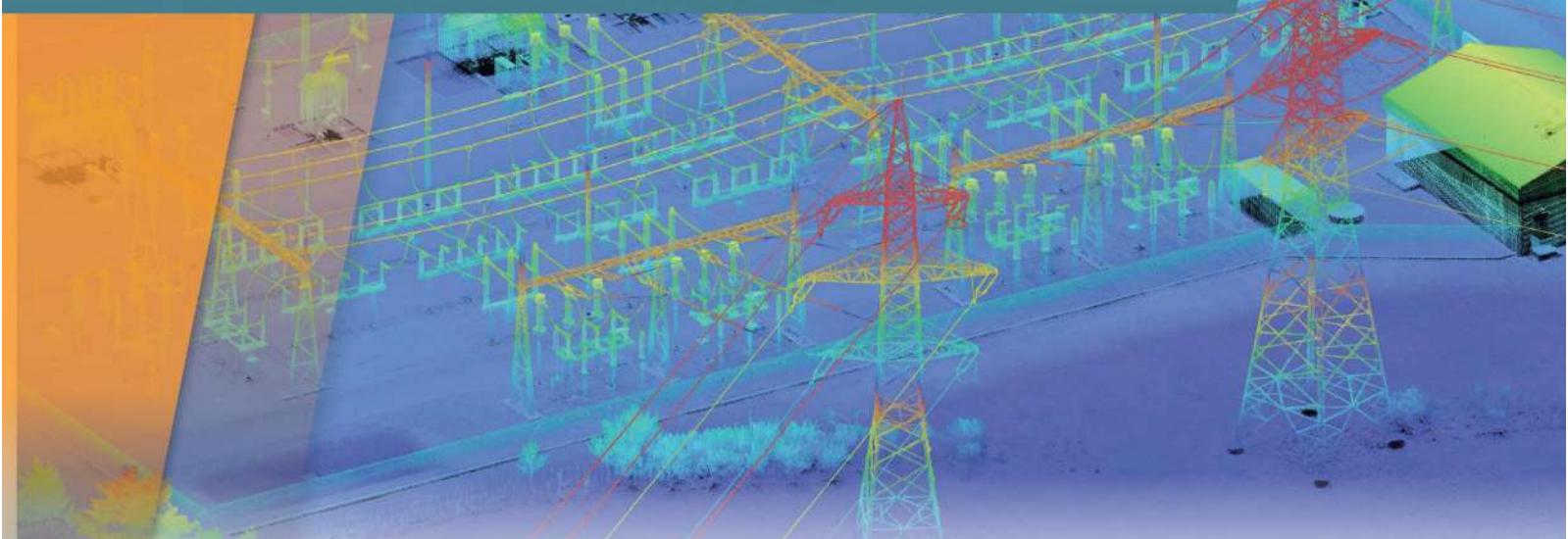
THE ROLE OF GEOSPATIAL TECHNOLOGIES IN DROUGHT MONITORING AND MITIGATION

INTEGRATED DROUGHT
SEVERITY INDEX

IDENTIFYING DRAINAGE TILES
WITH PIX4D FIELDS AGRICULTURE
SOFTWARE

SURVEYING AND MAPPING
IN INDIA: A GROUND
REPORT - THE PAST, THE
PRESENT & THE FUTURE

RIEGL LiDAR Waveform Processing Technology for Professional UAV Surveying Missions



RIEGL Laser Scanners for Small Unmanned Aircraft



RIEGL VUX-1UAV

versatile & powerful sensor for
wide area UAV surveying

- up to 550 kHz Laser PRR
- range up to 1050 m @ $p \geq 80\%$
- 330° field of view
- accuracy 10 mm, precision 5 mm
- up to 15 target returns
- 3.5 kg / 7.7 lbs



RIEGL miniVUX-1UAV/2UAV

minaturized LiDAR sensors
for integration to various small UAVs

- 360° field of view
- accuracy 15 mm, precision 10 mm
- up to 5 target returns
- extremely lightweight 1.55 kg / 3.4 lbs

RIEGL miniVUX-1UAV 100 kHz Laser PRR
range @ 100 kHz: up to 330 m @ $p \geq 80\%$

RIEGL miniVUX-2UAV 100 kHz / 200 kHz Laser PRR selectable
range @ 100 kHz: as given for miniVUX-1UAV
range @ 200 kHz: up to 280 m @ $p \geq 80\%$



RIEGL miniVUX-1DL

„Downward-Looking“ tailored design
for corridor mapping

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RIEGL offers a broad line of LiDAR scanners for integration to unmanned aircraft. Choose the scanner exactly right for your application and benefit from the proven RIEGL LiDAR technology: a sophisticated design, Multiple-Time-Around signal processing, multi-target capability, highly accurate and informative scan data, a wide field of view, customized configurations, and user-friendly integration options.

RIEGL Laser Scanners for Medium-Sized Unmanned Aircraft



RIEGL VUX-240

for high point density corridor mapping

- up to 1800 kHz Laser PRR
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- 75° field of view
- accuracy 20 mm, precision 15 mm
- up to 15 target returns
- 4.1 kg / 9 lbs



RIEGL VQ-840-G

topo-bathymetric scanner
for coastline surveying

- up to 200 kHz Laser PRR
- water penetration ≥ 2 Secchi depth
- 40° field of view
- optional high-resolution digital camera or infrared laser rangefinder
- 12 kg / 26.5 lbs



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SURVEYING AND MAPPING IN INDIA
A GROUND REPORT - THE PAST, THE
PRESENT & THE FUTURE

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editor's note

At a time when rains and floods continue to batter several parts of the country, it would seem misplaced to bring out an issue on Drought monitoring and mitigation. However, it is neither too early nor too late to become aware of technologies and processes that can ameliorate the lives of a large and very vulnerable populace who are often at the mercy of the State to get its act together.

Droughts are a continuing phenomenon. The Government of India, taking cognizance of the problem, has brought out and updated a 'Manual for Drought Management' for the management of this vexatious problem. The effectiveness of the procedure laid down in the manual for drought and its mitigation will be borne out by relief that the distraught farmer would receive at a critical juncture of his life.

However, the sheer number of Ministries and Departments both at the National and State level, that are involved in the process of drought estimation will make it difficult for any timely action to be taken for the benefit of the individual farmer who has been adversely affected and is crying for relief and rehabilitation that he requires here and now.

The advantage in the preparation and updation of the 'Manual for Drought Management' is that now standards, indices, parameters and yardsticks have been established. The need of the hour is to create a 'Drought Information and Management System' that houses all the relevant data to effectively address the issue of drought monitoring and mitigation as given in the manual as well as all data related to a farmer. Thereafter, using the latest data gathering geospatial technologies, mapping, image & data analysis techniques and information and communication systems, the administrators can arrive at the best processes to effectively and efficiently reduce loss of life & livestock as well as provide relief & rehabilitation on a near or long term basis.

Images of the effect of drought can be taken using GPS enabled smart phones wherein the coordinates of the place at which the image has been taken is embedded along with the image. Thousands upon thousands of such images taken by individual farmers can be loaded into the 'Drought Information and Management System'. Using image & data analysis techniques these images can be used to gauge the extent, severity and impact of the drought. Checks and balance are necessary to validate the outcome by using drone to gather images of sample areas. Thereafter, information and communication systems can be deployed to provide cash transfers, grain, fodder, livelihood as well as relief and rehabilitation.

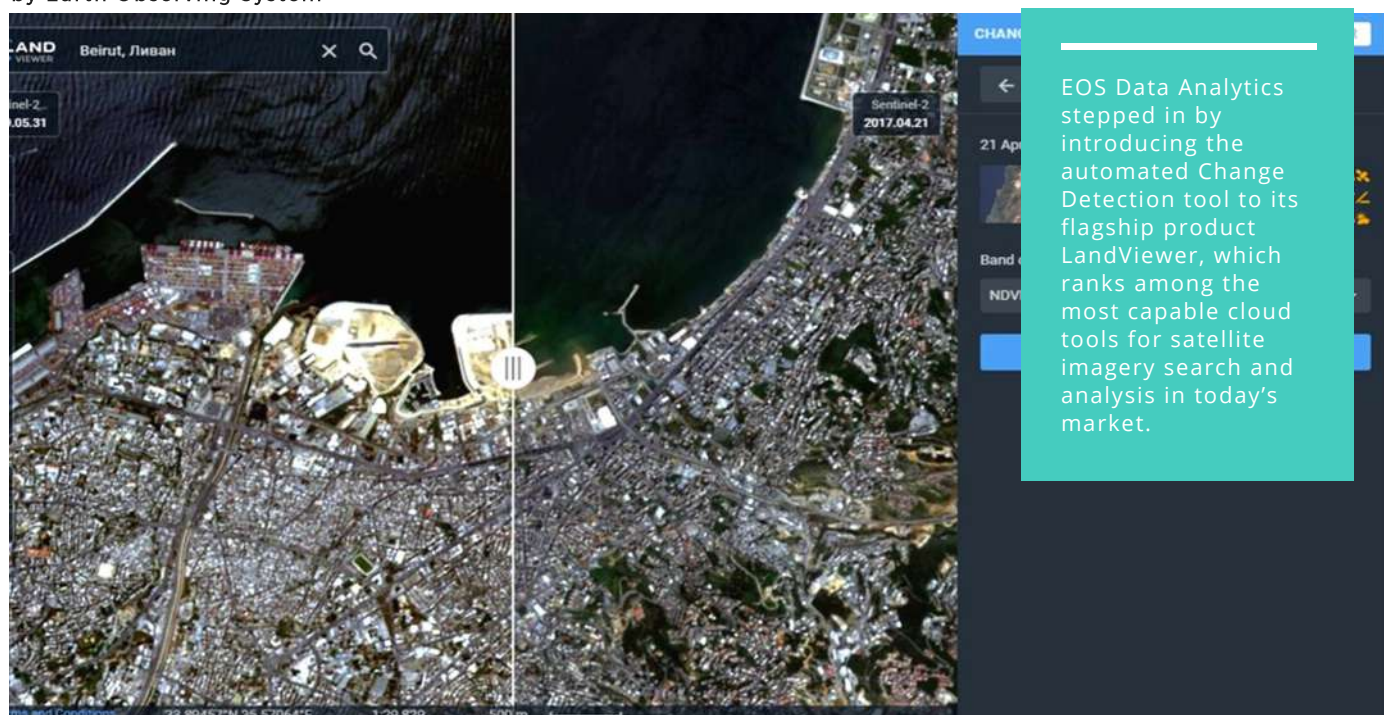
Such a system would be more efficient, responsive, be independent of human intervention and be more reliable to provide timely assistance to the affected farmer, his cattle and his livelihood. A dynamic system needs to be established which can be upgraded to use the latest Geospatial technologies, data analysis techniques and information & communication systems for Drought monitoring and mitigation.

Ashok Prim
Editor

LANDVIEWER NOW FEATURES CHANGE DETECTION THAT RUNS IN BROWSER

With LandViewer's change detection tool, farmers can quickly identify the areas on their fields that were damaged by hail storm, flooding or drought.

by Earth Observing System



The major utilization of remote sensing data has been to compare images of an area taken at different times and identify the changes it underwent. With a wealth of long-term satellite imagery currently in open use, detecting such changes manually would be time-consuming and most likely inaccurate. EOS Data Analytics stepped in by introducing the automated Change Detection tool to its flagship product LandViewer, which ranks among the most capable cloud tools for satellite imagery search and analysis in today's market.

Unlike the methods involving neural networks that identify changes in the previously extracted features, the change detection algorithm implemented by EOS is using a pixel-based strategy, meaning that changes between two raster multi-band images are mathematically calculated by subtracting the pixel values for one date from the pixel values of the same coordinates for another date. This new signature feature is designed to automate your change detection task and deliver accurate results in fewer steps

About Author



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and in a fraction of the time needed for change detection with ArcGIS, QGIS or another image-processing GIS software.

Unlimited Scope of Applications – From Farming to Environmental

One of the main goals set by EOS team was to make the complex process of change detection in remote sensing data equally accessible and easy for non-expert users coming from non-GIS industries.

With LandViewer's change detection tool, farmers can quickly identify the areas on their fields that were damaged by hail storm or flooding. In forest management, satellite image detection of changes will come in handy for estimation of the burned areas following the wildfire and spotting the illegal logging or encroachment on forest lands. Observing the rate and extent of climate changes occurring to the planet (such as polar ice melt, air and water pollution, natural habitat loss due to urban expansion) is an ongoing task of environmental scientists, who may now have it done online in a matter of minutes. By studying the differences between the

past and present using the change detection tool and years of satellite data in LandViewer, all these industries can also forecast future changes.

Top Change Detection Use Cases: flood Damage and Deforestation

A picture is worth a thousand words, and the capabilities of satellite image change detection in [LandViewer](#) can be best demonstrated on real-life examples.

Forests that still cover around a third of the world's area are disappearing at an alarming rate, mostly due to human activities such as farming, mining, grazing of livestock, logging, and also the natural factors like wildfires. Instead of massive ground surveying of thousands of forest acres, a forestry technician can regularly monitor the forest safety with a pair of satellite images and the automated change detection based on NDVI (Normalized Difference Vegetation Index).

How does it work? NDVI is a known means of determining vegetation health. By comparing the satellite image of the intact forest with the recent one acquired after the trees were cut down, LandViewer will

detect the changes and generate a difference image highlighting the deforestation spots, which can further be downloaded by users in .jpg, .png or .tiff format. The surviving forest cover will have positive values, while the cleared areas will have negative ones and be shown in red hues indicating there's no vegetation present.

Another widespread use case for change detection would be agricultural flood damage assessment, which is of most interest to crop growers and insurance companies.

Whenever flooding has taken a heavy toll on your harvest, the damage can be quickly mapped and measured with the help of NDWI-based change detection algorithms.

How to Run Change Detection in LandViewer

There are two ways you can launch the tool and start finding differences on multi-temporal satellite images: by clicking the right menu icon "Analysis tools" or from the Comparison slider – whichever is more convenient.

Currently, change detection is performed on optical (passive) satellite

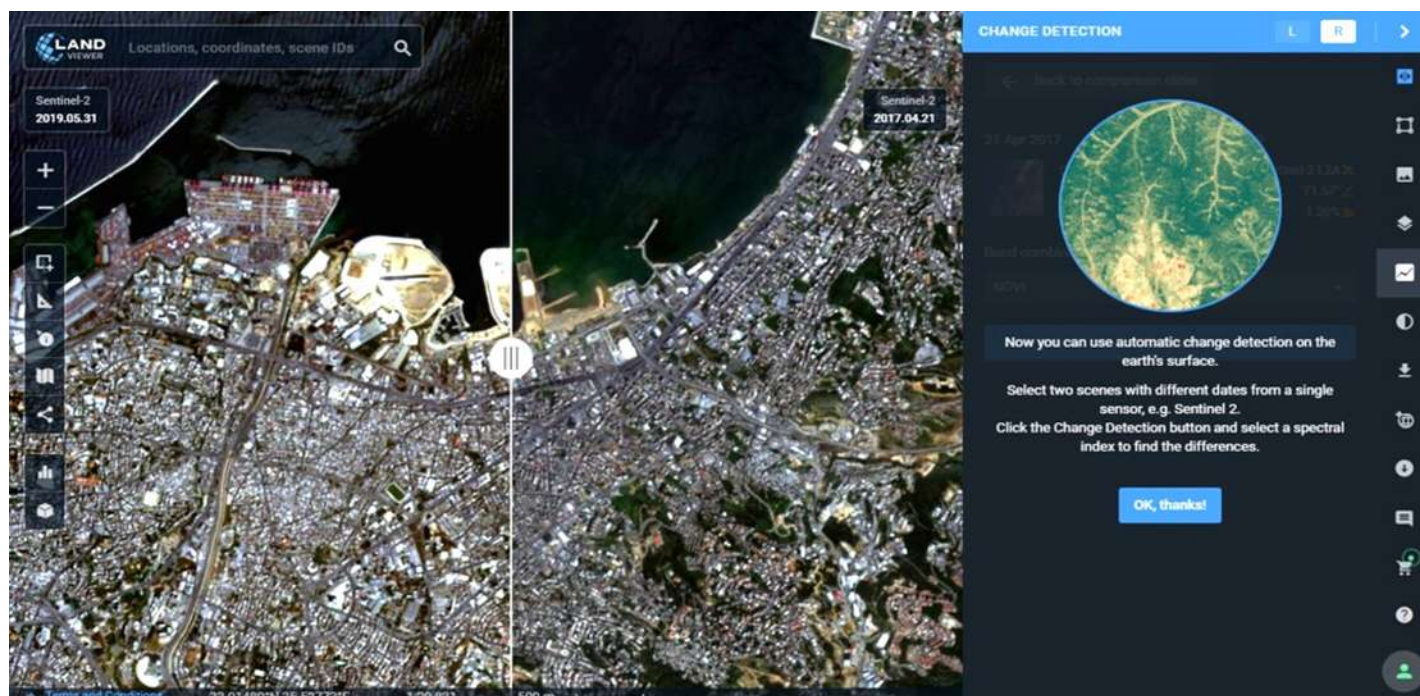


Figure 1: Change detection interface. Images of Beirut city coastline selected for tracing the developments of the past years.

data only; addition of the algorithms for active remote sensing data is scheduled for future updates.

For more details, please read this guide to LandViewer's [change detection](#) tool.

Or start exploring the latest capabilities of [LandViewer](#) on your own.

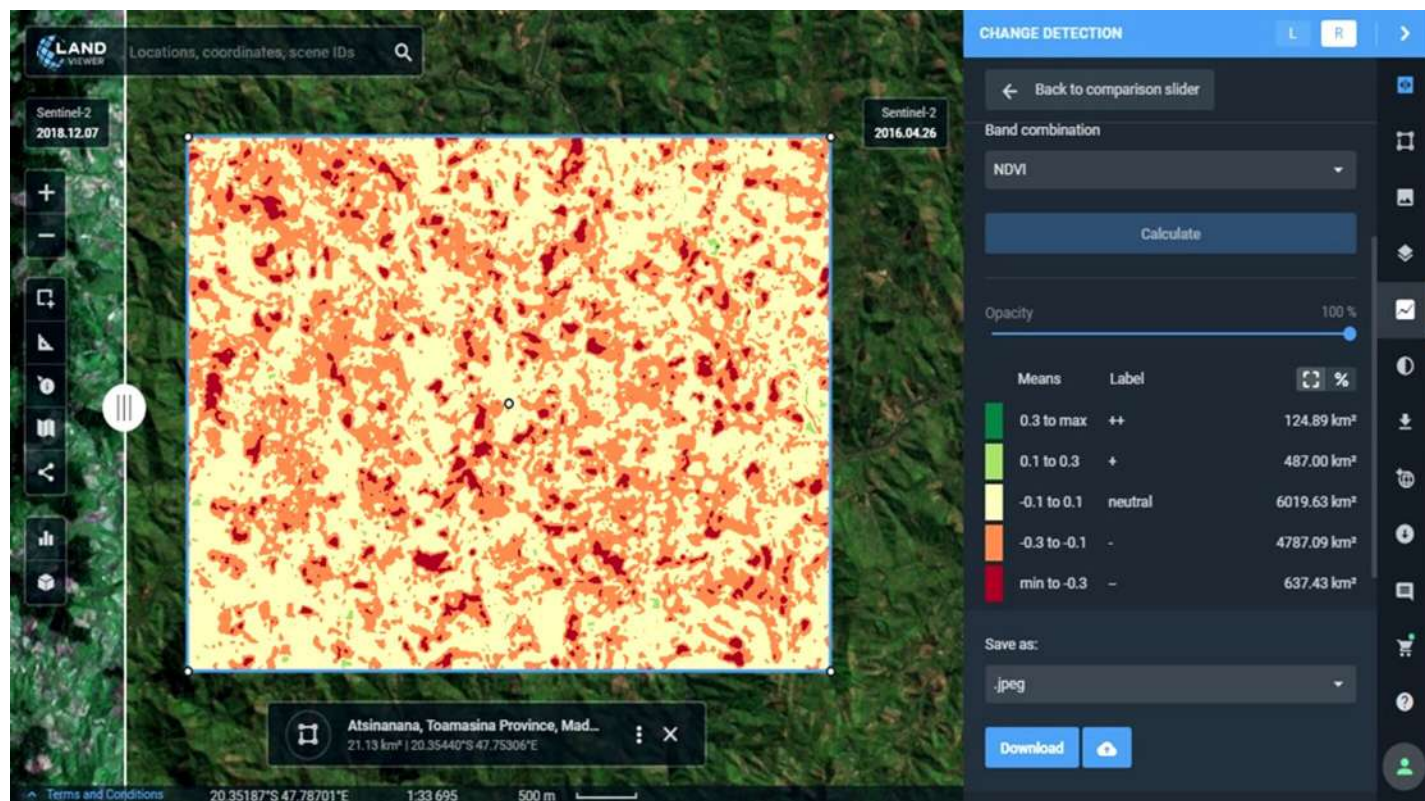


Figure 2: A difference image showing the extent of deforestation in Madagascar between 2016 and 2018; generated from two Sentinel-2 satellite images.

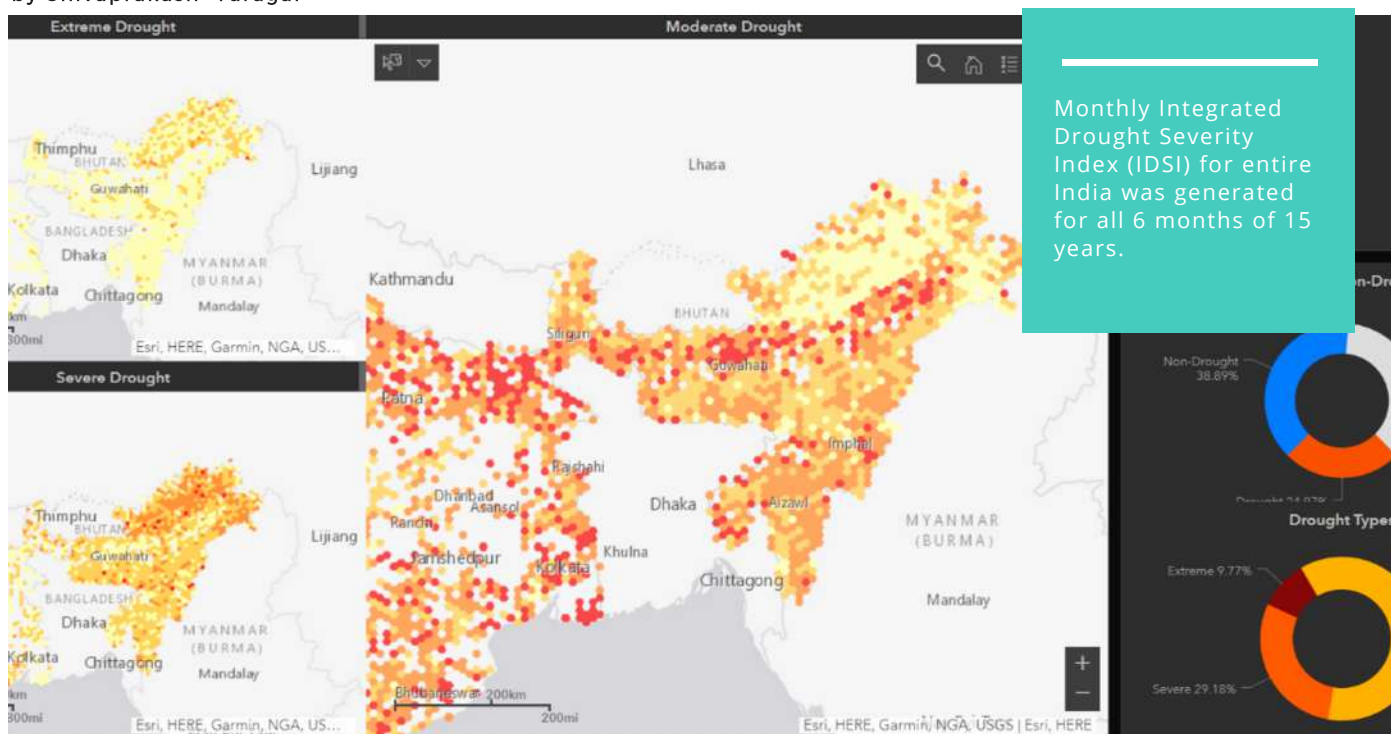


Figure 3: Results of Sentinel-2 scene change detection: the red and orange areas represent the flooded part of the field; the surrounding fields are green, meaning they avoided the damage. California flooding, February 2017.

INTEGRATED DROUGHT SEVERITY INDEX

Drought is a complex phenomenon and it moves slowly and steadily. It is very difficult to see the onset of the drought. There are simple indices like NDVI, NDWI and NDSI that gives indication of existing condition of vegetation and moisture content.

by Shivaprakash Yaragal



Drought is a temporary meteorological event. It stems from the deficiency of precipitation over extended period, compared to some long-term average conditions. Drought always start with shortage of precipitation however may have depletion of ground water, soil moisture, drying of streams etc in long run[1]. Drought is a complex phenomenon and it moves slowly and steadily. It is very difficult to see the onset of the drought. In order to have clear picture on complexity of drought national and international organisations have

used Remote Sensing data. There are simple indices like NDVI, NDWI and NDSI that gives indication of existing condition of vegetation and moisture content. However, these are not comparative indices. In order to understand complexity of drought its necessary to have comparative indices and some sort of integration of these indices.

Drought has become more common all round the world and especially in South Asia. International Water Management Institute (IWMI) based in Colombo, Sri Lanka; looks into

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scientific research that focuses on sustainable use of water and land resources in developing countries. IWMI along with other research institute like ICAR has developed Integrated Drought Severity Index (IDSI), which combines 3 indices Temperature Condition Index (TCI), Precipitation Condition Index (PCI) and Vegetation Condition Index (VCI). Formulas for TCI, VCI and PCI are given below.

$$TCI = \frac{LST_{max} - LST_{curr}}{LST_{max} - LST_{min}} * 100$$

$$PCI = \frac{TRMM_{curr} - TRMM_{min}}{TRMM_{max} - TRMM_{min}} * 100$$

$$VCI = \frac{NDVI_{curr} - NDVI_{min}}{NDVI_{max} - NDVI_{min}} * 100$$

Where,

LST - Land Surface Temperature

NDVI - Normalised Difference

Vegetation Index

TRMM - Tropical Rainfall

Measurement Mission

curr - Current

min - Minimum

max - Maximum

Data required for this study is 15 Years of data from 2001 to 2015. At India level compiling 15 years MODIS product data requires processing of more than 300 GBs of data. However, we were able to get processed data from blog on [Climate Data for India](#) (By Shivaprakash Yaragal, Senior Executive, ESRI India).

TRMM data for 15 years was downloaded from [Neo a NASA website](#).

The study area

- Entire India

In order to generate VCI, PCI and TCI we need following

- Raster grid having Minimum values in all 15 years. This Minimum grid should be for LST, NDVI and TRMM data.

- Raster grid having Maximum values in all 15 years. This Minimum grid should be for LST, NDVI and TRMM data.

Getting Minimum and Maximum Raster grid is the major part of the work as it is time taking task. Using these Minimum, Maximum and Current raster grid data; we created VCI, PCI and TCI for Monthly data.

For our study area, VCI, TCI and PCI was calculated for February, March, April, May, June and July. Generated VCI, TCI and PCI (monthly) data was used in order to create

Month wise Integrated Drought Severity Index using below formula.

IDSI varies between 0 to 100.

IDSI with values near to zero means Extreme Drought condition and IDSI with values near to 100 means a Healthy. As IWMI, classified IDSI into following Categories.

$$IDSI_{ijk} = \left[L * VCI_{ijk} * \left\{ c + \frac{1}{(L * (VCI_{ijk} + TCI_{ijk} + PCI_{ijk} + c))} * (TCI_{ijk} + PCI_{ijk}) \right\} \right]$$

- Healthy
- Normal
- Watch
- Stress
- Moderate Drought
- Severe Drought
- Extreme Drought

Methodology

Methodology involves use of arcpy tools (both these have been developed by author)

- Custom Arcpy Tools for MODIS data processing
- Custom Arcpy Tools for generating IDSI

Analytics

Optimistic Story of Drought

This Optimistic part story is about "Number of Non Drought months" in our datasets and how these are distributed all-round the India. To show the distribution, have used Hexagon grids (with 259 sq km) to show aggregated data.

This map (Figure 2) depicts drought free months. More blue, more are the drought free months. Lesser the blue; less are the drought free months. If we scan the entire aggregated map we find areas which seems to be drought prone area have less months of drought. This is particularly true with areas of Rajasthan and Madhya Pradesh. These areas have more non-drought months compared to rest of the India.

In the 15 years of summer months (90 analysed) most of the

central India has had drought free months some were between 45 to 60 months.

Himalayan belt and Terai region also fairs well with the similar number. However, same is not the story for plains of northern India.

Southern India along with Deccan plateau doesn't shows gloomy statistics, however it has non-drought months somewhere between 35 to 44.

What is worrying that came out of analytics is number of non-drought months in the North East India, Coastal Andhra Pradesh, Odisha and

Data used

Parameter	Spatial Resolution	Temporal Resolution	Source
LST	1 Km	8 days	MODIS data from Terra Satellite
NDVI	0.5 Km	16 days	MODIS data from Terra Satellite
TRMM	27.64 Km	1 month	TRMM data

Western Ghats region. These are the lowest in the India, which means drought like conditions more or less exist every year during summer.

Pessimistic Story

In the analysed 90 months' summer; on an average of 12 months are of no use due to non-availability of data. In remaining 78 months of data India has seen all 3 kinds of drought:

1. Moderate Drought
2. Severe Drought
3. Extreme Drought

What is Drought Frequency?

Drought Frequency is number of time a specific drought type repeats itself in the area. Frequency is categorized into 4 classes. This gives information in percentage. If a region has color coding of drought Frequency for severe drought as 1-25, it means that percentage of drought that occurred and belong to severe class are between 1 to 25 %. Rest percentage will be for the other class of drought.

Presented dashboard has 3 maps. Moderate Drought condition is the type of drought which is spread over India are Moderate droughts. Severe drought and moderate drought are widespread with varying intensity. Extreme drought is less widespread in nature. This data set is for entire India, and hence there are lot of untold stories exist in this analytics.

Conclusion

Following are the observation

1. Drought in most part of India is recurring with 20% of (90 summer months) facing drought like situation.
2. Northern India, Eastern India and Some parts of Southern Interior faces drought upto frequency of 20 to 60%.
3. Its only in Kerala and North East India the frequency above 60% is observed; which is very worrying condition.

Scope of Output

- IDSI could be used as one of the important layer in WRO for identifying Vulnerability of population using socio-economic data.
- IDSI could be used as one of the layer for watershed management, rainwater harvesting, micro irrigation planning.
- IDSI could be used in planning and designing drought relief.

Reference -

[1]http://www.iwmi.cgiar.org/Publications/IWMI_Reseach_Reports/PDF/PUB133/RR133.pdf

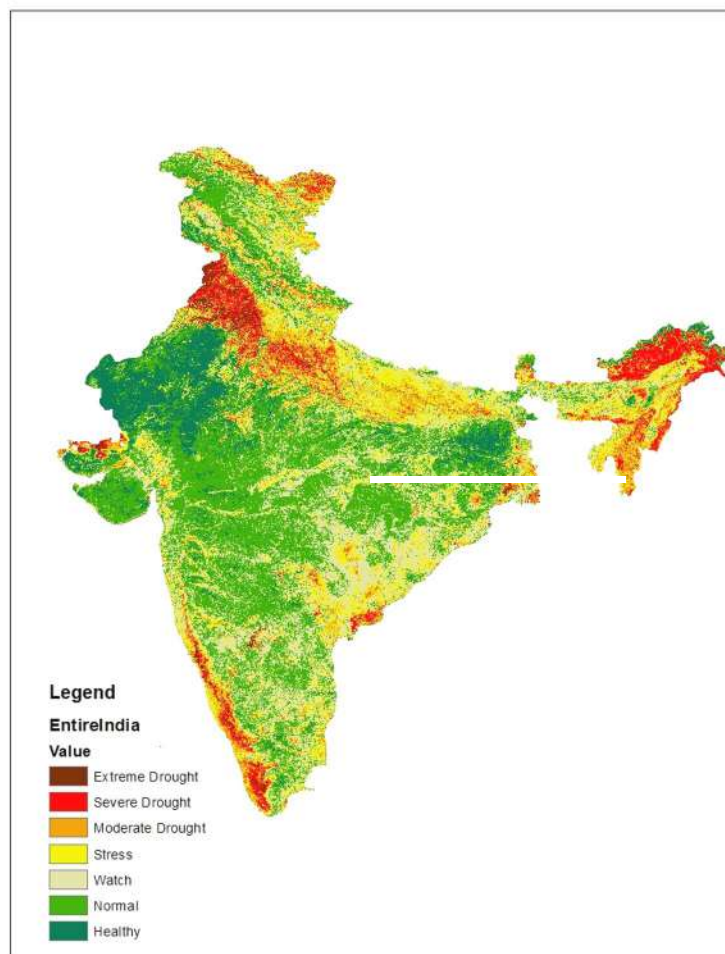


Figure 1. Map as Outcome of Analysis.

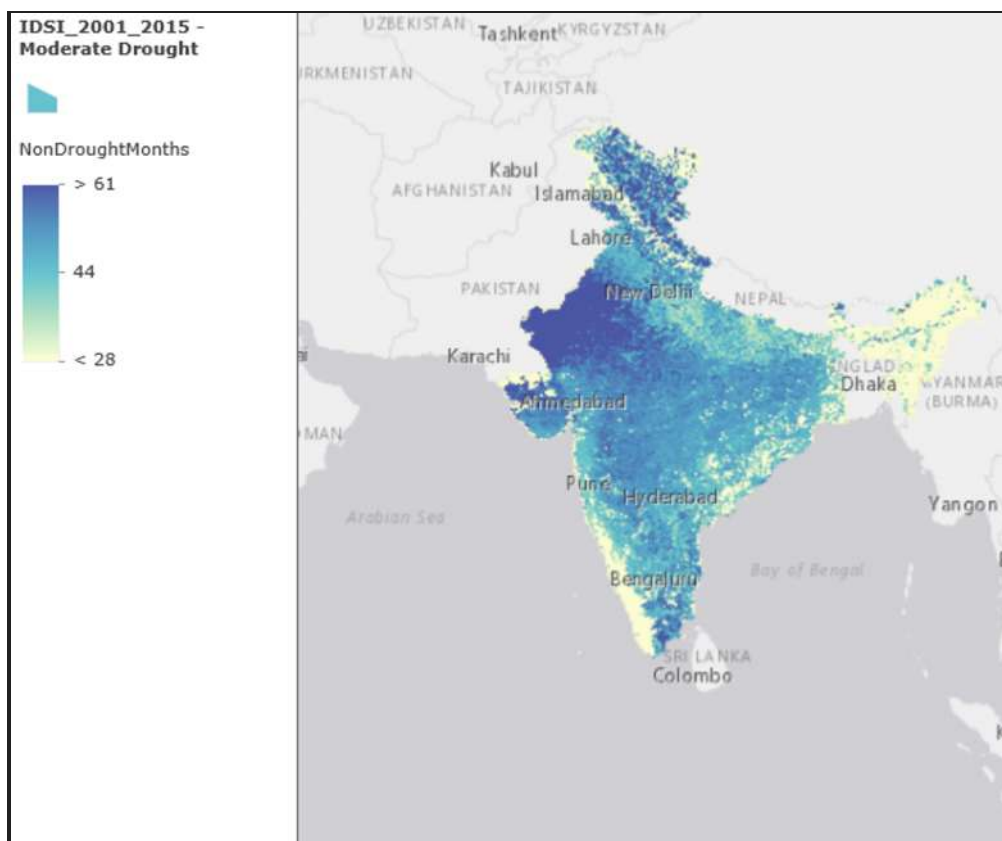


Figure 2. Map Depicts Drought Free Months.

IDENTIFYING DRAINAGE TILES WITH PIX4DFIELDS AGRICULTURE SOFTWARE

Pix4Dfields provides powerful agricultural tools like vegetation indices, zone and prescription maps to prescribe and monitor applications.

by Barbara Horvatic



Using Pix4Dfields the HeartWood Labs team was able to process the RedEdge data right after the flight on a laptop computer.

HearthWood Labs, a part of Arrowmaker Group Inc., is a drone service provider offering multispectral imaging for agriculture. Earlier this season, one of their customers, a soybean farm in Northwest Iowa, hired them to identify where existing drainage tiles were located in some of their fields.

Drainage tiles are extremely important because they help control moisture levels in soil and are also a significant investment for farmers. Knowing where existing pipes are can save growers lots of time and money while ensuring optimal crop growth.

Flying with MicaSense RedEdge

For this particular job, HeartWood Labs flew a DJI Matrice 100 equipped with the MicaSense RedEdge and analyzed the results in Pix4Dfields. "We prefer flying the RedEdge over other multispectral sensors that we own because we feel the quality of the reflectance maps it produces is superior, and the five available bands are better suited to identifying the features we are looking for, in this case, drainage tile," said Adam Batschelet, Business Manager of Ag Technology, at Heartwood Labs.

RedEdge is a professional multispectral sensor for agriculture

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that captures five spectral bands (red, green, blue, near-infrared, and red edge) to enable more detailed analytics. Its ease of integration with a wide variety of drones, allows growers to optimize management practices, streamline operations, detect stress and disease early, and capture accurate data for scientific analysis.

Processing with Pix4Dfields

Using Pix4Dfields the HeartWood Labs team was able to process the RedEdge data right after the flight on a laptop computer, enabling them to present the results to their client and take action without leaving the field.

"Pix4Dfields cuts down on our processing time by a very large margin. Processing for us is typically the most time intensive and costliest part of the services we provide. By using Pix4Dfields, we are able to spend much more time out in the field collecting data, instead of sitting in the office processing."

Including preflight checks, flying and processing, the total time from start to finish was approximately 1 hour for a 160-acre field.

Analyzing the Data in the Field

After processing the imagery in Pix4Dfields, the team was able to analyze the resulting data in the same platform and while still on the field.

Pix4Dfields provides powerful agricultural tools like vegetation indices (including NDVI and NDRE), annotations to facilitate scouting, zone and prescription maps to prescribe and monitor applications, and split-screen and double-screen features to compare different layers and provide context.

The team was able to identify the drainage tiles using the NDRE index, an index that can only be calculated if the red edge band is available. Since the RedEdge sensor captures the red edge band, the team was able to spot the differences in the

vegetation growing along the field.

The plants over the tile lines were healthier than the plants not directly over the lines.

With the tiles identified, the team presented the results to the customer using the split-screen comparison tool in Pix4Dfields to highlight the differences between layers. "The comparison tool is fantastic as it allows us to sit down with the grower and demonstrate how important multispectral imagery really is. Comparing the RGB ortho in real time against the NDRE index really helps us to sell the benefits of the multispectral data. The RGB ortho was unable to show the tile

lines, while the calibrated multispectral NDRE results showed them perfectly."

Then they used the zonation tool to delineate areas of the field that were experiencing more stress, and ground-truthed those areas to determine where new tile should be installed.

Most of the stress was occurring where water drainage was not being handled sufficiently. Using the annotation tool, they marked the spots where the tile lines were throughout the field for future references. The Digital Surface Model generator came in handy to show the grower a 3D model of



Figure 1. RedEdge-M on a DJI Matrice 100.

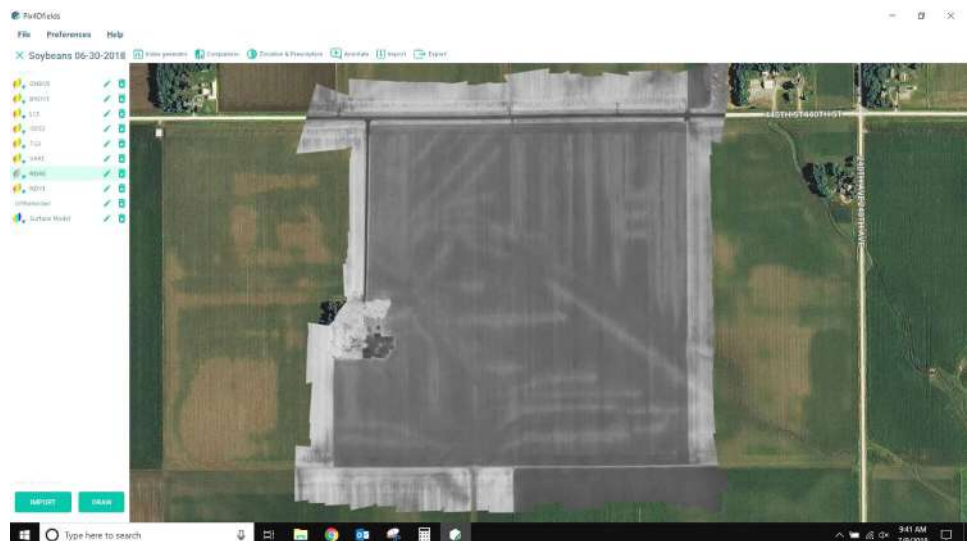


Figure 2. NDRE Grayscale in Pix4Dfields.

exactly how water behaves on his field due to the low slopes and small hills that aren't always obvious.

Conclusion

By using RedEdge and Pix4Dfields, the HeartWood Labs team was not

only able to identify the drainage tiles, but to fly and deliver these results all in the same day and while still in the field.

"Previously we have used Pix4Dmapper and achieved great

results, however the decision to use Pix4Dfields was a no brainer once it became available. The ability to process RedEdge data very quickly (under 8 minutes) and at the fields edge is a tremendous asset to us."



Figure 3. NDRE index vs orthomosaic using the split-screen comparison tool in Pix4Dfields.

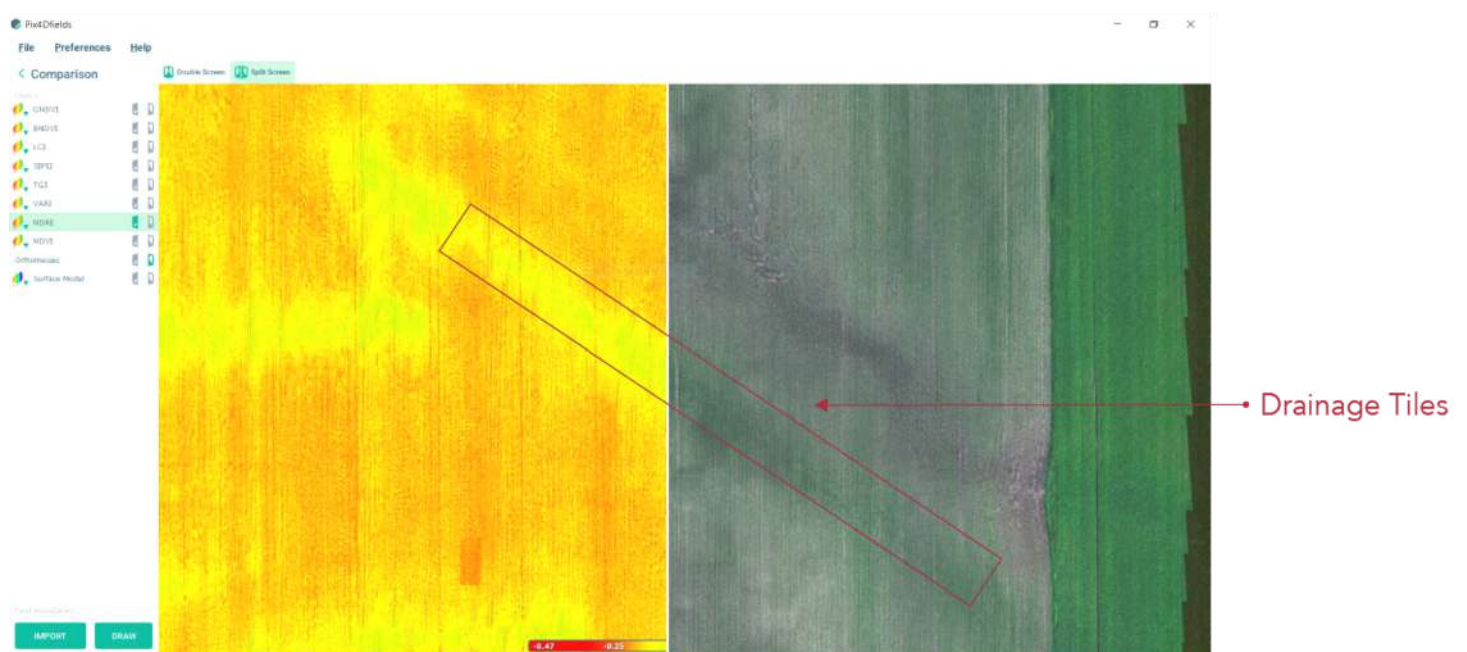


Figure 4. Due to The Changes in The Vegetation Above the Drainage Tiles, Those Were Easier to Identify Using the NDRE Index.

GEO-IOT: A DATA-DRIVEN DISRUPTING TECHNOLOGY FOR SMART CITIES

IOT is defined as the system of interconnected devices that has the capability to exchange data over wired or wireless communication.

by Damandeep Singh



Integrating LI with GIS results in Geo-IOT. With Geo-IOT, not only the position of the asset is recorded but also its attributes which further contributes to spatial analysis.

One of the main goals of UNDP (United Nation Development Program) is working towards sustainable development across the globe. To achieve this task, UNDP, a United Nation agency have broadly classified the goals in two main categories:

- Millennium development goals (MDG)
- Sustainable development goals (SDG)

It is evident from the Figures 1 and 2, that MDG and SDG are further classified into sub-categories. These categories are heavily dependent on data. Data is one of the prerequisite

to establish sustainability worldwide.

Embracing the disrupting technologies of the modern-day such as GIS, Remote Sensing, IOT (Internet of Things), etc, helps in easy capture of the data. With the advancements in technology both in hardware and software, data accessibility is like shooting a fish in a barrel i.e. within the reach of the masses. GIS and remote sensing use satellite data to perform the spatial analysis. Satellite not only helps in acquiring the data of the areas that are inaccessible but also aid in change detection and time series analysis of various classes that

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the image is classified into such as built-up, barren land, etc.

At the micro-level, the numerical data such as PM (particulate matter) values, noise values, rain, temperature, humidity can be integrated into GIS. Heat maps or density maps are easily prepared using numerical data.

The numerical data is easily acquired using sensors. Sensors are basically an electronic circuit, that sense the changes in the nearby environment by varying the electric and the voltage signals. The technological breakthrough has enabled the sensors to use them in numerous IOT projects. IOT is defined as the system of interconnected devices that has the capability to exchange data over wired or wireless communication. For example, Kulkarni & Sathe (2014) have discussed, how IOT is used to monitor the various health parameters such as heartbeat, diabetes and other parameters in real-time. In another example, IOT is used in agriculture for monitoring diversified parameters such as salinity, temperature, soil moisture, humidity that are essential for monitoring the growth of crop (Elijah, Member, & Rahman, 2018).

IOT not only enables the easy capture of data but it also has the ability to arrest the location of the sensor. Location analytics is one of the crucial components of GIS. Location plays an integral part of doing business. Deriving insights from the data captured from a particular location result in locational intelligence (LI). LI or spatial intelligence (SI) is often interchangeably used terms. Spatial analytics allows binding the tremendous amount of data by establishing its relationship with the whereabouts.

Integrating LI with GIS results in Geo-IOT. With Geo-IOT, not only the position of the asset is recorded but also its attributes which further contributes to spatial analysis. Geo-IOT is considered an important driving factor for Smart Cities. The concept of



Figure 1: Millennium Development Goals.



Figure 2: Sustainable Development Goals.

Smart cities varies from place to place and is not universally defined. The Indian Government launched “Smart Cities Mission” in June 2015. To fulfill the conception of “Smart Cities” various technologies mentioned above such as IoT, Big Data are exploited. With the help of emerging technologies, information from every possible dimension is captured and processed to meaningful insights. Leveraging the potential of low-cost sensors, Geo-IOT helps in creating a sustainable environment and providing a decent quality of life to citizens, hence working towards the goal of achieving the concept of “Smart Cities”.

Data, the vital requirement for Smart Cities is gathered using IOT via Smart City Applications in various domains such as energy, waste management, health, etc. For example, a research conducted by Santos *et al.* (2018) in the city of Portugal, wherein environmental parameters such as

temperature, humidity, air quality were monitored using sensors deployed at certain locations. The data from the sensors were then analyzed for any temporal or spatial granularity and then visualized onto the map.

This article presents one such application areas of Smart City i.e. “Smart Bins”. Smart Bins stands for the smart dustbins, wherein the status of the bins is known using IOT and the data impending from the sensors, can then be used for creating maps such as heat maps.

Smart Bins

Waste Management is one of the areas of Smart Cities that needs serious attention. A trash bin, powered by IOT device that monitors the status of the bin i.e. whether the bin is empty, half-filled, fulfilled and so on. This status can then be updated to the municipal corporation of the

concerned areas so that a garbage van is arranged to pick up the garbage.

Components of IOT Device Required for Smart Bin

1) Arduino Uno: An electronic board that consists of a single chip microcontroller i.e ATmega328P. The various pins of board act as input/output that are programmed using the integrated development environment (IDE) of Arduino via USB cable of type B.

2) Ultrasonic Sensor: For measuring the depth or the height of the bin, an ultrasonic sensor i.e. HC-SR04 is used. Its range varies from 2cm to 400cm. The sensor consists of a transmitter and receiver that aids in computing the distance or height, which is based on a simple mathematical formula

$$\text{Distance} = \text{speed} \times \text{time}$$

3) Jumper wires: The wires are used as a passage for the current to flow easily. Solid strip jumper wire such as male to male, male to female, female to female are used.

4) USB/ Battery: To power, the electronic board and ultrasonic sensor, either a battery of 5V is connected or a USB cable is used. A USB cable is also used for programming the electronic board.

Integration of Arduino Uno with Ultrasonic Sensor

The above-mentioned components of the IOT device are integrated as shown in Figure 4. This complete setup is now capable to capture the height or the depth from the sensor to the surface or ground. The output from the device is viewed onto the monitor of the PC as shown in Figure 5. The status of the bin is visualized and is saved onto the system using various methods which then is further used for analysis.



Figure 3: Arduino Uno, Ultrasonic Sensor (HC-SR04), Jumper Wires, USB Cable, 5V Battery (Top to Bottom - Left to Right).

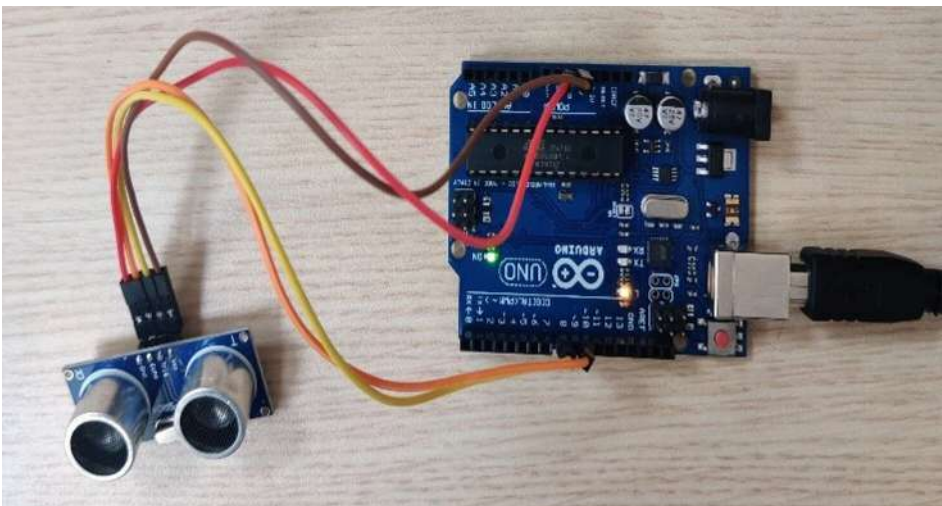


Figure 4: Integration of Arduino Uno with Ultrasonic Sensor.

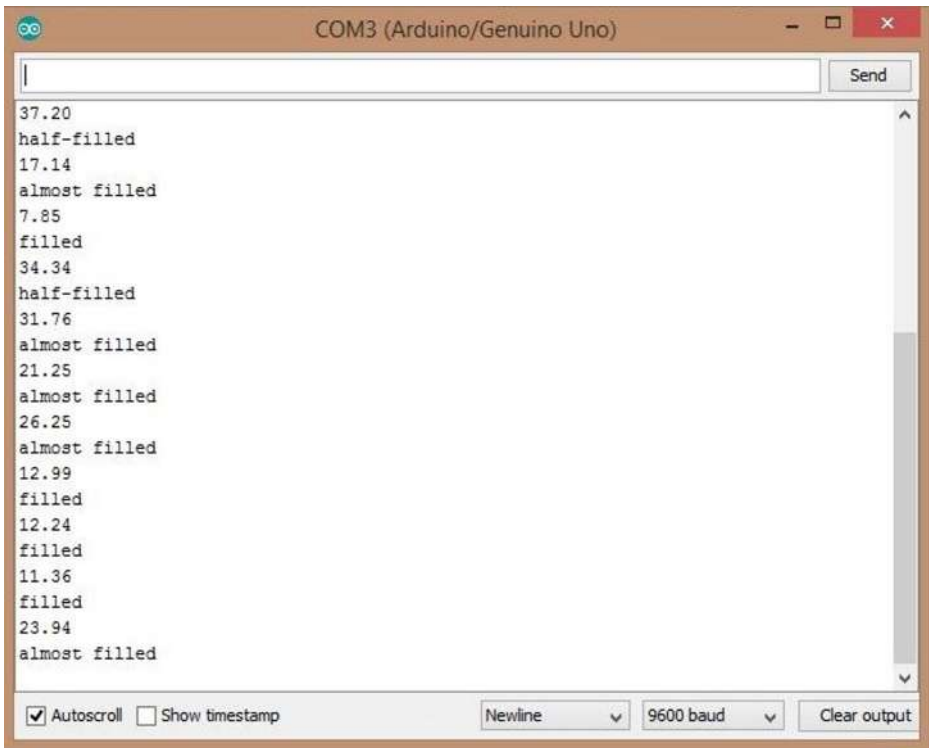


Figure 5: Serial Output from Integrated Device.

Techniques for Saving Captured Data from Sensor:

1) Third-party software/

applications: Numerous open source software are available via which the data from the sensors is saved on to the system in different formats according to the need of the user. One such software is "Tera Term". This software saves the output from the sensors in .csv format. Tera Term also provides an option of saving the data, including the date and time stamp.

2) Data/Web server: Feeds from the sensors can be saved in data servers via different techniques:

a) Using IP address: Addition of wifi module i.e ESP8266 generates an IP address for the setup shown in Figure 4. ESP8266, if configured and installed properly can be pinged and used for getting the feeds on webpage. The IP address generated is used for pushing the feeds into the server. Due to the instability of the ESP8266, the module is not recommended. Instead of adding a separate module, an electronic board should be used that has inbuilt Wi-Fi module such as raspberry pi. With the improvements in technologies, numerous servers for storing the data are available that are broadly classified into two categories open source and proprietary versions.

b) Manually saving the sensor

feeds: The feeds from the sensor are saved in a .csv file using open source software mentioned above in point 1, this .csv file is further accelerated to the server manually. On the other hand, Arduino Uno can be programmed using IDE to save the output from the sensor to the desired location in the system, in required format.

For the Smart-Bins use case to be considered in Geo-IOT, coordinates of the device is a must. There are various ways of adding the coordinate information along with the other

attributes captured by the device:

a) Using a GPS module:

Incorporating the latitude and longitude information to the device outputs, require a GPS (Global Positioning System) module to accurately determine the position on earth. Neo-6M one of the GPS modules available in the market can be used for capturing the coordinates

b) Manually feeding the device:

The coordinates of the location can be manually added to the .csv output file from the device. This .csv file is pushed into the server. In this article, coordinates are added manually while programming the Arduino Uno with ultrasonic sensor. This aids in depicting a location of the device onto the map. The coordinates added to the device is taken from google, marks the location of Shri Vishwakarma Skill University (SVSU), established by government of Haryana, based in Gurugram. The output from the device with the coordinates is shown in Figure 6.

The IP address and the coordinates of the device generated along with the other attributes output from the device can be further pushed to Geo-Event server via GET or POST method. Geo-Event server is a proprietary product of ESRI, that has the capability to retrieve

the live data from the sensors in different formats such as csv, json, geo-json and so on. With the help of Geo-Event server, spatial analysis is performed on the numerical data obtained from the ultrasonic sensor depicting the status of the bin, thereby creating heat maps. A heat map is a data visualization technique that represents numerical data in the spectrum or gradient of colors.

The numerical data depicting the status of the bin can be used for creating the heat maps. The status of the bins is visualized using heat maps.

Depending upon the status of the bins, a vehicle is arranged from the municipal corporation, to empty the bin. Further application of the GIS can be the implication of network optimization algorithm that can be applied for routing the vehicle to the desired location. Using network optimization algorithm, the shortest path to the required location is known, alternative path in case of any barrier in the path is computed, etc.

References:

Elijah, O., Member, S., & Rahman, T. A. (2018). An Overview of Internet of Things (IoT) and Data Analytics in Agriculture: Benefits and Challenges. *IEEE Internet of Things Journal*, 5(5), 3758–3773. <https://doi.org/10.1109/JIOT.2018.2844296>

Kulkarni, A., & Sathe, S. (2014). Healthcare applications of the Internet of Things: A Review. 5(5), 6229–6232.

Santos, P. M., Rodrigues, G. P., Cruz, S. B., Lourenc, T., Orey, P. M., Luis, Y., ... Queir, C. (2018). PortoLivingLab: an IoT-based Sensing Platform for Smart Cities. 4662(c), 1–9. <https://doi.org/10.1109/JIOT.2018.2791522>

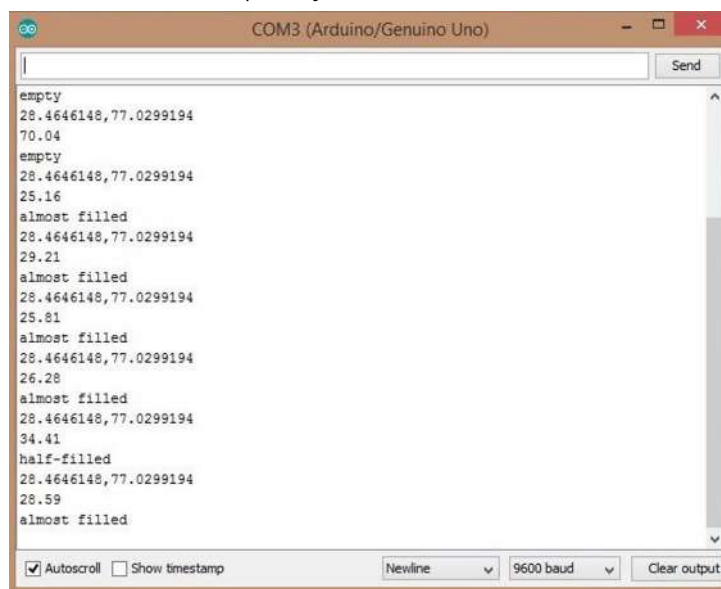


Figure 6: Status of the Bin with the Coordinates of the Location (SVSU).

SURVEYING AND MAPPING IN INDIA

A GROUND REPORT - THE PAST, THE PRESENT & THE FUTURE

This report though structured as an article, in fact is more like a conversation with the reader, an attempt to engage at a very basic level to inform them on the realities that exist on the ground and the direction that they may be heading in.

by M.D. Karan Cariappa



This article has been penned down solely based on experience as a Qualified Surveyor on Ground Zero with the sole purpose of addressing the elephant in the room that no one is willing to acknowledge, exists.



Introduction

The word "Surveying" instantly brings to mind the picture of a 'map', in most peoples' minds. And probably a Map is the best representational symbol that can be associated with this line of work. Over the course of history, from a science that was primarily used to devise and execute military tactics and plan military strategy, Surveying (and Mapping) has evolved into a major tool for administrators, planners and Engineers while retaining its importance to the Military.

We, in the industry in India, have seen it grow, over the past decade, from occupying a small, not very relevant role, to what it is today and more so, after the use of GIS based technology and data, has become widely accepted by different fields. With time we have also seen the influence of technology growing by leaps and bounds and constantly shaping the industry to become more efficient.

Despite all these amazing achievements there are many issues

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that have constantly been nagging the industry here in India and have acted as roadblocks in establishing this industry in the form of an organized model that many would envy being a part of. I believe that for this industry to grow into an established profession in the true sense, many of these issues, first need to be acknowledged before we as a unit can get down to solving them.

The Gap

The Surveying and Mapping industry in India has grown by leaps and bounds over the past decade and as an industry that has its core concepts based on Applied Science and Technology, it has been supported or buffered with many publications and magazines that inform members of this industry and the people outside about the present happenings and the direction this field is heading in, in the future.

Articles are published in these magazines on a regular basis by many informed and established stalwarts of the industry that give a reader a glimpse into the working of the industry. In my opinion, these articles, though written with utmost sincerity and dedication to the field of interest or line of work are well written and very informative, but I feel that we as an entire industry are missing something very important. Something is being overlooked, which has over the years, created this huge gap between what is being written in these articles, what is being planned before the start of a project and what is actually happening on ground.

As this industry is growing, more and more people are coming in touch with it and parts of it are also fusing and joining other lines such as UAV applications, LiDAR scanning applications etc. Through this ever-continuous process of intermingling of sciences, I feel a lot of important concepts related to the core of mapping –surveying and cartography

are being lost. These practices, built and perfected over hundreds of years not only ensure accuracy but also make mapping one universal language, that each one in this line of work understands and adheres to. These practices bring in a measure of reliability for the data being collected by ensuring that checks and balances are an inherent part of the entire process to mitigate errors and improve productivity at the same time.

So, with these thoughts in my head, I proceed to give you a REAL picture of the Mapping industry in India, at the ground level and the problems that plague it.

In this part of my report, I will not emphasize on the solutions. as that may end up with old fashion story. Before I start, I would like to shed some light on my experience as a Surveying Professional.

Professional Experience

Over the years, I have been associated with projects ranging from Surveys for Gas and Product Pipelines, Airport Surveys, Roads, Military Installations to Cadastral Surveys on a Large Scale and Projects involving collection of extensive GIS Data in large Project Areas and Limits. Being a part of these projects has been a great journey of learning and personal development. But the journey has a much humbler start than the position I occupy currently, in a Private Surveying Organization.

After working in the civil infrastructure construction industry post my graduation and having been part of projects in India and Afghanistan, I qualified as a Surveying Engineer from the Indian Institute of Surveying and Mapping in Hyderabad under the aegis of Survey of India after completing the Course 500.

As many within the industry would have not heard about it, I would go

on to explain that this is unquestionably the only Survey/ Geomatics, 2 years long, full-time course in the country which places more emphasis on the principles of field data collection and achieving perfection in doing it, than office/ lab based training courses which are extremely popular these days. The Course 500 is equivalent (in many ways) to a Masters in Geomatics (recognized by Jawaharlal Technological University, Hyderabad) that is offered by the same Institute but places more stress on field data collection activities related to Surveying by incorporating a 6-month field tenure where the students' live outdoors (in tents) and handle and care for their own survey equipment. The course is a pre-requisite for any Officer deputed to the Survey of India and is also open to private candidates, though I happen to be the only one to have opted for it thus far.

I believe my experience in two different yet interconnected stages of projects – Surveying and Execution at the grass root level provide me with knowledge that very few people have. This very same experience has also been the reason for me believing that all is not as well as it sounds or is presented. It is with this belief that I have decided to put to paper some thoughts which may get a lot of people in the industry thinking and may help the many uninitiated, who are thinking of making this line of work their profession, in making the right choices so that they may not end up in dead-end alleys and ensure that every turn in their careers as Geo-spatial professions leads to a new beginning. Because the amount you learn in this line of work is never ending and great fun also..... most of the time!!!

The Ground Report

This report/article/conversation has been penned down solely based on my experience as a Qualified

surveyor on Ground Zero with the sole purpose of addressing the elephant in the room that no one is willing to acknowledge, exists. It is said that the first part of solving a problem is admitting that there is a problem.

Many in the industry may agree with my point of view and many more may disagree, but I guess, that's the advantage of living in a free country. This report though structured as an article, in fact is more like a conversation with the reader, an attempt to engage with him/her at a very basic level to inform him/her on the realities that exist on the ground and the direction that we "may" be heading in. I use the word "may" as the future can be only speculated on and with technology in the fray it is extremely difficult to be certain of what's going to come.

Before I delve on the issues plaguing the industry it would be good to acquaint the reader with a few terms and ideas that they are going to come across pretty often in the article.

Surveying and Mapping - It may not be very necessary to explain to the reader the difference between Surveying and Mapping but to the uninitiated, in very general terms, the difference between **Surveying** and **Mapping** is small, if you are not actively involved with this profession. So, keeping in mind my intention of connecting with the masses (as mentioned above), I will try and explain the differences in Surveying and Mapping as we in the industry see it, in the simplest of words.

Surveying, in today's industry standards is the term used for collection of High-accuracy **Geo-Spatial Data (Any data that has a connection with Geography/ Location, such as coordinates)** using modern equipment, whereas mapping is the process of collecting data on a larger scale (not to be confused with "scales", used in Maps) and preparing maps of large areas

that may or may not be accurate to the centimeter. This would solely depend on the intended use of the finally produced "Map". In other words, a map intended just for navigational purposes may not need to have centimeter or millimeter level accuracy and will just give the user or map reader a general perspective of roads and terrain in the "Area of Interest" (AoI). On the other hand, a map intended for use in planning of Engineering Works may have to incorporate High-Accuracy Survey data, for use while designing, planning or execution. These maps are usually known as drawings and are one and the same.

So, it can be safely said that, in today's world, Mapping incorporates the entire process of data collection, quality checking and control, and finally plotting or publishing this data in a pre-defined format.

Maps over Other forms of Data -

Before get into explaining any aspects about the Mapping industry I would like to illustrate for the reader, the advantages Maps have over other forms of data in terms of storing and representation of data.

One glance at a map can give the user immediate knowledge about terrain, features – man-made and natural, direction, orientation and many other aspects related to geography. This is the biggest advantage of a map over other formats such as text and numbers.

Though the above mentioned points about mapping may be sufficient to prove the advantages Maps have as a form of representation of data, I would like to add that Mapping is not only a different form of representation, it's a complete different language that one may use for showcasing data.

A Brief History

A very good measure of determining the future can be done by glimpsing at the past. And for this reason,

I would like to give the reader a very brief history of Surveying in times bygone around the world and especially in India.

It is said that Temudjin, the Great Mongol conqueror, also more famously known as Genghis Khan won his great empire on the backs of the Mongolian Horse and with the strength of the Mongolian composite bow. But very few historians have tried to answer the question, that how could a small leader of a pastoral clan in Mongolia know which direction to turn his galloping horses and how far to shoot his arrows. It has been said that he as a Military Professional understood the value of knowledge about the terrain his horses would have to cover and the kind of advantages he could garner from natural features around a battlefield.

This led him have the best scouts of the time in his army, who could ride well in advance of the main forces and report back with details and maps, drawn on sheepskin pieces, of the areas that lay ahead.

In short, these scouts may well be compared to Field Data Collectors (or Surveyors) of today's times. In many ways nothing much has changed in a 1000 years. A Surveyor still has to go into areas that are unexplored for reasons that are unique, he needs to travel light, has very little time to complete his assignment and return with the most accurate data possible for it to be of any consequence to the user. Something that also remains the same is that, no one really remembers the scout or the surveyor who mapped the Khan's path, but no will really forget the Khan who built his empire on the backs of these men who rode hard and fast, usually unarmed, into foreign territory. This may sound romantic and bordering on humor to the reader but I would like you to hold on to this thought as it will come up again a few times as we

move forward. To keep it simple I will just use the terms *"forgotten are those, who's feet tread first on the paths to the Khan's empire"*.

In India, the advent of surveying, in the form we know it as today, can be traced back to the late 1700's after the Mysore Wars between the armies of British East India Company and Tipu Sultan. Though, surveying and mapping would have existed before in some form or the other before this period, contrary to what the British would like us to believe, it had not been practiced on a scale this large. The British East India Company established the Survey of India, under the command of Colonel William Lambton during this time and thus, started the great odyssey of Mapping in the Sub-continent. Soon the British undertook one of the greatest endeavors' in the history of mapping which is admirable even by today's standards by commissioning the Great Trigonometric Survey (GTS) which was done to map the entire sub-continent in size and scale. One of the outcomes of this undertaking was also the Everest Datum which acted as the principle reference datum for the entire sub-continent for the next 150 years. The very scale of this project is unimaginable even today and one wouldn't be very wrong in even comparing it to some better known endeavors' undertaken by the British during their time spent in India, such as setting up of The Great Indian Railways. But I bet very few of us have even heard of these achievements because, *"forgotten are those, who's feet tread first on the paths to the Khan's empire"*.

Keeping the above in mind, the history of mapping in the sub-continent can never be separated from the History of Survey of India which is the oldest Scientific Department of India. Survey of India currently is under the department of Science of Technology and this has changed a lot of its structure and effectiveness from the time it was under the Ministry of Defense before independence and for some time

after. Survey of India is responsible for collecting and publishing Geo-Spatial data mainly in the form of maps of scale 1:50000 and 1:25000. It also undertakes projects of National Importance for the Government of India and acts as the Governments Mapping Agency.

In many ways Survey of India had a major role to play in setting standards in the country for data collection, cartographical presentation and other processes involved during mapping. Since our discussion here is mainly about Field Data Collection I will restrict myself mainly to this part and most of the methods and 'ways' that are used in the field to collect and record data have been passed down to government agencies and private organizations by Survey of India.

So, this should give the reader a general understanding of the history of mapping in India. Now, I would like to move ahead and tell the reader about what actually happens in the field today and some of the reasons for things having to have turned out this way. I will not go very deep into the reasons as these have been explained in the last stage, in detail.

Present - Reality Check

As per a paper published by Mr. M.M.K.Sardana [1] the value of the Geospatial Industry stood at a value of USD 4 Billion in the year 2018. This is expected to grow to a value of USD 25 Billion by 2025. These figures are impressive and really show that the industry has come a long way. I will not get into disputing these figures, but I would surely like to ask if we are prepared to handle an Industry that is valued at USD 25 Billion, 6 years from now. From my point of view, we have a long way to go. I agree these figures are representative of the entire Geospatial Industry and not just the part of the industry that deals with Field Data Collection.

But, it should be remembered that

Field Data Collection is a very important part of the processes that define this industry and though technology plays a very important role, it has not been completely able to substitute the need of manpower. Boots on ground are still important, trained ones at that!

There were many ways, in which, I wanted to introduce the reader to the Ground Realities on site. I also had to take into account, readers from different backgrounds. I chose to make an aspiring surveyor with a Bachelor's in Engineering degree qualification my point of focus because it would help me address the doubts and fears shared by all graduates entering this line of work and at the same time properly describe the ground truth of Surveying in India. I feel that this is the best point in this narration to provide an aspiring surveyor, the true nature of the industry he/she plans to enter, because most articles talk either about the past or the future in almost a romantic, literary sense but omit details about the present that an individual must deal with as he/she enters this line of work.

The Dream Period

Starting with your first day of employment with an established surveying company, you will be expected to spend the first week or the first 3 months in the Head Office, while getting trained in one or more methods of using Survey Equipment.

These may be Electronic Total Stations, Levelling Machines – Auto and/or Digital and GPS Equipment. In case the particular company deals with UAVs and LiDAR equipment you may be asked to "assist" with these teams and work as a "trainee-helper". Now, this would be disheartening for most aspirants reading this, but you need to get it into your head that being an assistant is the best role you will play in this line because that would mean you would be learning

every second of the job.

A few of you, with good communication skills and decent command over the English language may get pushed up to be management-trainees. For someone who has always loved the outdoors more than the office environs, I feel really sorry for this kind. But anyways, I call this a “dream period” for the “new-comers” because you will have no responsibility and no one will expect anything from you.

One issue, you are going to face at this time is that you are going to be extremely confused about how things work around you, especially the GPS equipment and other surveying machines, and there is no one going to be around to drive away these doubts. The reason behind this is two-fold. Firstly, your colleagues and seniors will mostly be comprised of personnel possessing qualifications from ITIs’ (Industrial Training Institutes) – Surveying & Civil, Diplomas in Civil Engineering and a sprinkling of Graduates of Civil Engineering. In India, none of these branches teach the core concepts of Surveying and Mapping, which are collectively known as Geomatics.

These details are usually relegated to one or two papers in their entire course and not considered very important. So, what you will encounter is a bunch of people working in a general direction based on some method of trial and error that gets them the result with a little support from the OEMs (Original Equipment Manufacturers) of the equipment they are working with. Also, as mentioned earlier, other than Indian Institute of Surveying and Mapping, Hyderabad, there are no Institutes of repute that can truly claim to produce Surveying Engineers and Specialists that are directly employable for field work in the industry. These few are also the ones who have completed Survey of India’s customized, full-time, long-term courses, so this brings down the number greatly. I am not trying

to be a snob here, but just stating the harsh reality. This may pinch many, but what I am stating is after having worked with people from all over the country. I also strongly believe that this needs to change at the earliest.

Secondly, technology being employed for surveying is changing on a daily basis. Equipment such as UAVs and LiDAR are new to the industry in India and many people working with these equipments have had very little exposure to the science that makes these equipments do what they do.

On a lighter note, this ensures one thing, if you feel lost.....Trust me! You are not alone!

Map reading, which is one of the most important part of Mapping, may or may not be taught to you. You will hear about the Survey of India Topo-sheets on different scales, but again you may or may not get to see one during this time. This according to me is one of the most unfortunate happenings of the profession today, wherein a mapping professional is left to discover for himself the very art he is trying to create. On a personal level, I have tried introducing a fresher to Topo sheets and cadastral maps but this needs to be taken up on a larger scale.

So, coming back to the matter at hand, the training period will also be a time where you learn other aspects related to administration such as accounts and reporting. But remember, with the market booming and projects coming in one after the other, you have a very high chance of being deployed on-site right after the first week. Most companies have cut down on their training modules, with cut-throat competition and demand for faster delivery timelines.

On-Site and the Outdoors

After this period, your “dream run” will certainly be considered “over” and you will be expected to handle a

crew – ETS, GPS or Levelling in production mode, on site. Now, this will be a very interesting time of your life and this is the time you will see most of the country and if you are lucky, also abroad. If you have the travel bug inborn in you, this period would pass as a dream, if not you will just remember these years as the time you spent packing and unpacking and sleeping in the weirdest of places, from train stations to damp and dingy survey camps. One certainly needs a sense of adventure in him/her to live through this period. The highest attrition of Engineers takes place during this phase of the profession, to other related fields such as Civil Infrastructure Construction (most commonly).

Apart from this, you will certainly learn to appreciate the width and length of this country and the raw beauty that has been bestowed upon us by the almighty. A Control Point Observation on the Western Ghats will show you the wide expanse of forests and jungles, while a traverse line in Rajasthan will introduce you to the unforgiving Desert. A Recce through Jharkhand will open your eyes to tribal cultures while Pillar embedding in Mizoram will set up a meeting with beautiful jungle rivers and streams. You will mostly be the first to get to any of these places and will go through an ordeal before you reach or complete your objective. Being alone, is a feeling you will have to get used to because, surveying mostly takes place in places where data hasn’t been collected and travelling light and nimble without large teams is the requirement of the job, so be ready!

From my personal experience, I have heard many people say that surveying is a tough line and brings out the toughness in you. I believe this is true, but the reason for this is not actually the unforgiving locales and conditions surveyors work in, but because one has to get up every morning and go back morning after morning. A hill has to be

climbed, a river has to be crossed or a swamp has to be waded across, the cycle is never ending. This requirement of the job, coupled with the fact that, a surveyor has to rise above all these discomforts and is always calculating and analyzing the terrain around him, brings about an awareness and toughness that is seen rarely in other professions.

You will also learn that, contrary to advice from the old hands, your smartphone will be your best friend in the field. Today, open source apps such as google maps and google earth are used extensively for navigation. Also, the internet and smartphones enable quick transfer of data that otherwise would've taken ages through courier or post, like in the old days. It's a sad truth, but you will realize that Google has more takers than the good old Sol Toposheet.

The Camp

Added to all this, you will get the first taste of the Camp. The camp will be your home and your lifeline to the outside world. In the earlier days, Surveying Camps comprised of tents and hutments put up in areas outside villages and usually at the edge of forests depending on the area being surveyed. In today's times, Survey Camps are usually houses taken on rent for a period of a few months to a year. With development, it has become easier to find Pucca houses available on rent.

In smaller projects, a local lodge may serve as the camp, but as things get bigger, expect a complete structure dedicated for the running of the project.

It may also be an unused school or a marriage hall in the off-season. Some of the weirdest structures I have come across are a newly built hospital (with fresh paint) and a half constructed shopping complex. It may sound funny, but just think about how resourceful the site in-charges' need to be to walk in to

a completely new area, convince a stranger to rent out his building (whatever it may be) and make sure his team of 30 to 40 surveyors is safe and accounted for.

As a newbie, you will learn that the camp is your place for refuge from everything strange outside. You will be surrounded by surveyors and nothing they talk will make sense to anyone outside. Hindi will be the most common language of communication unless, a majority of the inhabitants are from particular ethnic group. Terms like, "*Mandir pick up kar liya sir*", "*Offset nahin mila*", "*station barbaad ho gayaa*", "*50 kilometer ka line marna hai*" will be common parts of your conversation.

Food will be a nagging pain, because apart from being incomprehensible in taste, it will never be enough to do the kind of work that is expected of you. During this time, you will also learn to appreciate and cherish about home food and your mother's cooking. A good cook is of great value in Surveying Camps, that almost always have their own kitchens.

Sleep, most of it will be in bits and pieces and like food will never be enough. The camp floor will be your regular snooze spot and a chatai will be the favorite part of your bedding, which will usually be "assorted mix and match".

You will soon realize that sleeping in the open is much more comfortable than a hot stuffy room shared with 20 something people. So, expect every corner of the terrace or balcony to be reserved and in high demand.

Washing your own clothes will become your favorite past time because one visit to the site will ensure the clothes you wear will never look or smell, the way they did before. This can be worked around by spending a little more money and hiring someone to wash your clothes. (A little cheat, that most surveyors employ).

The off-days will mostly be Chicken Days and you will have to get your food fast or risk ending up without any. The site in-charge may organize a small outing to any of the local tourist spots and this may be the farthest you go from site with an intention of "leisure". Transport will usually comprise of your own two legs but a 4X4 pick-up will usually be at hand for longer distances. Also, a common mode of transport in camps are, Autos, Rickshaws and Bikes. If you're lucky you may have Aircon.

Finally, a silver lining. Modern technology, in particular smartphones have had the most positive effect on a surveyor's life, professional as well as personal. A quick call home or an online streamed movie have become the favorite past times for all site deployed personnel. This will be a major motivating factor during your tenure as an on-site surveyor.

The Silent Beasts of Burden

This narrative will be incomplete without describing a large hidden majority of professionals from the industry, that no one talks about and whose presence many refuse to even acknowledge. But they are the people who carry this industry on their shoulders and are one of the main reasons to have ensured its survival.

A little detail is needed here to explain this anomaly. I call this an anomaly because most would wonder, what is an uneducated person doing in a line that is steeped in science. In many ways, this is an irony of sorts, but growing demand for man-power and willingness to work with a low salary has ushered, in large numbers, people, mostly from rural backgrounds to join this trade and earn a decent living, while learning a specialized craft. Many, outside and inside the industry, may disagree but in my opinion the ratio of these individuals to trained and qualified surveyors is around 4:1 and may be

higher. These personnel are employed mostly on data collection sites and seldom come to the fore in corporate headquarters. They include persons that may or may not have completed their basic schooling, persons who do not know how to read or write and also those who ever never stepped in to a classroom.

Now, I would like to impress on the reader a few points that will help him work with and learn from, these people, some important aspects, not only about the profession, but also about life. The first thing would be to cast your "qualified" ego aside and understand the fact that in the true sense of the word these are the only and real professionals in this line, in India. To understand this, you will have to understand the fact that, in the absence of a formal qualification for surveying these persons, knowingly or unknowingly, are the only ones who have dedicated their entire lives to the trade of surveying, with no other alternative to fall back on. And that maybe described as the true definition of a professional.

Now, many with a qualification (Degree or Diploma) in Civil Engineering may like to disagree with me, but you would have to read further to understand what I am talking about.

As a fresher, when you interact with a Surveyor who has had no formal education but is perfectly adept at using Surveying equipment and also understands the nitty-gritty of surveying, it will leave you a bit amazed, but get used to it!

In my years as a Surveyor, I have come across individuals who could not read a single line of English, but were able to write the best possible Point description of a control point. I have also come across men, who have worked in more than 20 states of India, including the North-East, which by far is one of the toughest environments for a surveyor to work in. These men have the experience in living and working through the

length and breadth of this country. They have been on projects that built this country while being considered as outsiders by this system. No process exists that can formalize their presence in system or put a seal of qualified approval on their experience, so they carry on working quietly in the shadows.

Another reason, that makes them important as guides for a fresher is that with nothing to fall back on, I have seen these individuals attain a very high degree of intelligence in the trade that they practice and an almost near perfect efficiency in the use of equipment they know how to use. That coupled with the experience they possess would put any educated and qualified engineer to shame.

Here, I would like to make a suggestion to you. When, you finally get to interact with the kind of surveyors, I have described above, do not make the mistake of letting your pride get the better of you. I say this with experience and having seen many engineers making the same mistake. It would be advisable for you to interact with them, watch them work, see for yourself the adroitness they show with equipment and lastly learn from their experience, the way to conduct yourself in the field.

This would more or less be almost everything you will experience in the first 2-3 years of your career as surveyors and at the end of it, if you last the distance, you would've learnt a lot, seen some amazing places and gained a whole lot of experience.

To the reader, this should be an eye-opener on how things run in the surveying line. Hope you enjoyed it!

Reality on the Government Side

The narrative given above is about the Private Sector and deals with projects conducted by private organizations. A very important part that cannot be overlooked is the reality, regarding government

departments and bodies. Here, I will only be dealing with the lower levels of the government machinery and will not be going in to the details at the higher levels. This is because I feel, that the government machinery is a very large system that cannot be addressed in one article. It is sub-divided into many divisions, each with a specific role, personnel belonging to which need special skills for doing their jobs.

The shortcomings I would like to bring to attention here are purely based on experiences of working for private organizations and interacting with lower and mid-level government officials mainly in-charge of monitoring work on-site, vetting the data collected and approving the deliverables submitted. The reason for sticking only to this level is that, I believe enough has been written and said to provide guidance to high-level administrators and planners.

Very little is actually spoken about how these plans get implemented on the field and about the people who are in-charge of executing these plans, the last few links in the government machinery before the job is finally done by us, in the private world. I do not intend to blame any person, or body in this article but want to bring to light the fact that, I have found that on ground almost every Government official is dedicated in some degree, to the proper application of policies and plans laid out by the government.

There is a visible lack of knowledge and expertise among the personnel handling Survey projects and this can be attributed to a few opinions or schools of thought that are widespread in government circles at the lower levels.

Firstly, a civil engineer with experience in infrastructure development and construction and no formal training in surveying can handle surveying and mapping projects. This view has led to many

projects being delayed or not having been implemented as they were planned to have been implemented. I would like to add here that Surveying and Mapping is an entire world in itself and Civil Engineering only uses a small part of it. Until, this mindset is changed, we will continue to see the same results regarding the implementation of Mapping Projects.

Secondly, technology can replace the human component in Surveying. Many OEMs, in a bid to market their products, sometimes end up over-selling the capabilities of their products and this leads many government officials in believing that humans are expendable in Surveying and Mapping. To be completely honest, we are far from the day where no human will be needed to map and validate an AoI, if we are even heading in that direction. A very clear example, is the making of LiDAR data collection a necessity in Surveying of Highways. This was an excellent idea and ensures the modernization of man and machinery to handle the necessary equipment. But without having a clear methodology for processing, classifying, storing and publishing the data collected and with the lack of infrastructure needed to handle this data, the entire process can turn into a white elephant that can haunt the government for years to come.

Thirdly, Maps are irrelevant documents that look good on walls. The reason for this particular way of thinking is not the fault of any particular person or organization but, can be attributed to the lack of importance that is placed on maps as a medium for storing, publishing and viewing some very complex and large data sets. To solve this problem, this issue needs be dealt with at the initiation process itself by incorporating knowledge about mapping and geospatial awareness in training modules at every level.

I would like to reiterate in different words the point I am trying to make here. It should be remembered here that all Government administration

and Services in India and likewise, around the world are limited on the basis of Geography. In short, the jurisdiction of the government only extends to its borders of the area it governs and not an inch further. For e.g. the welfare and services to be provided to Rajasthani people living in Karnataka is the sole responsibility of the government of Karnataka. Likewise, for any unlawful activity perpetuated in Maharashtra, by a person belonging to Punjab and living in Maharashtra, he will be answerable to the Maharashtra Government. Thus, you can see that geography has a major role to play in government functioning. The examples given above are not representative of any person or community or any region) Alas, we can be masters of only the lands we hold, everything else is out of jurisdiction. In my point of view, a project will never fulfill its objective unless the geography of where it has to be implemented is studied beforehand. This underscores the importance that Geospatial data like maps have in analyzing and planning major government schemes.

There exist certain other issues that need to be fixed to create a healthy and productive environment for Mapping related projects in the country. These have been listed and discussed below, but at the grass root levels, the issues listed above are the main stumbling blocks. Many may term me as a whistle blower and accuse me for pointing out problems and getting away without offering solutions. But I would like to state here that I am only pointing out issues that I have faced in the real world, during execution of projects as a contractor working for a private organization.

Future

So we are finally at a point that everyone wants to know about – The Future. Though the story is titled the, “A GROUND REPORT - THE PAST, THE PRESENT & THE FUTURE “, I have decided to not really delve in to the future. The main reason for that

being, that, at the Grassroots it's very difficult to envision the future on a large scale. Secondly, since the government plays such an important role in this industry, I feel that it would be inappropriate to draw up a picture of the future without having the experience of interacting with the Government at the decision maker's level. Thirdly, the impact of technology on this industry has today is profound. And technology like many variables is extremely dynamic, which also makes it unpredictable.

A few basic aspects must be remembered. It is natural human tendency to hope, pray and prophesize of a better future while ignoring the pitfalls of the present. Keeping this in mind, I would state that in the real world, it is impossible to have a bright future, unless hard work is put into making the present less cluttered and confusing. This puts a great onus on the people and organizations in the industry to ensure that the right decisions are taken so that the Mapping Industry performs to its maximum capability, becoming an asset to the country.

In this whole conversation, the smallest role that will be played in the future will be that of the Surveyor. A small role but a very important one. He/she will be the medium that covers the last mile in the journey of data collection and representation. In many cases the Surveyor will be the human factor inserted in this ethereal world of GPS Satellites and laser scanners. All I hope is that enough is done to create an ecosystem where the boots on the ground are given their due credit and as a responsible industry we look at eliminating as many obstacles as possible to build a strong foundation for Geospatial Sciences in India.

Reference -

[1] *An Overview of Geospatial Industry in India* - M.M.K. Sardana

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