



Workshop on:

United Nations/Philippines Workshop on the Applications of Global Navigation Satellite Systems

Topic:

Exploring Cadaster mapping by GNSS technology to control time and costs, the possibility of sustainable development in Land Management



Key Paper Presented by

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Establishment of Digital Land Management Systems Project

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Ministry of Land, Bangladesh

24 April 2024

History of Land Survey in Bangladesh



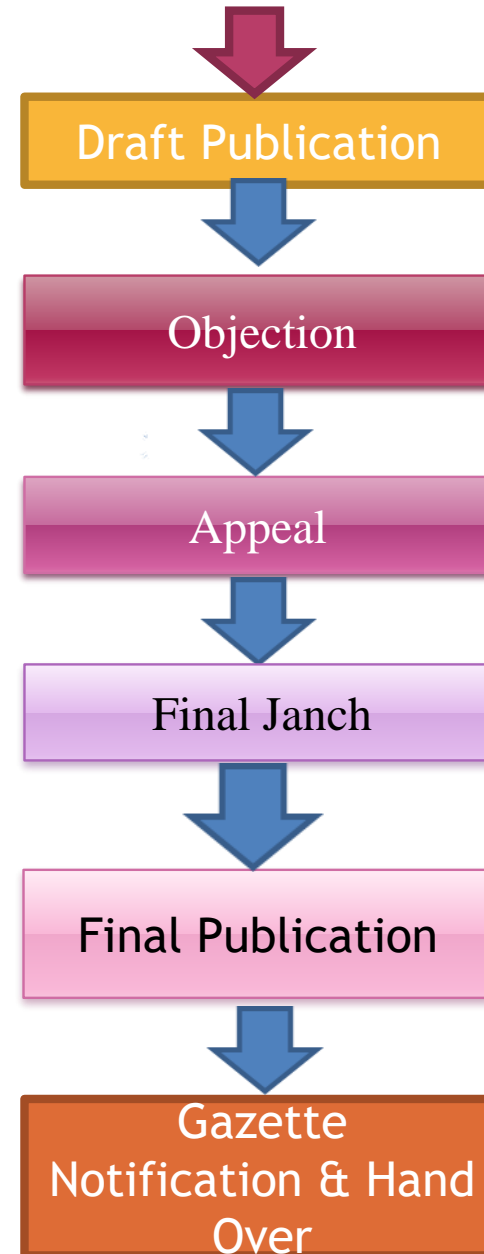
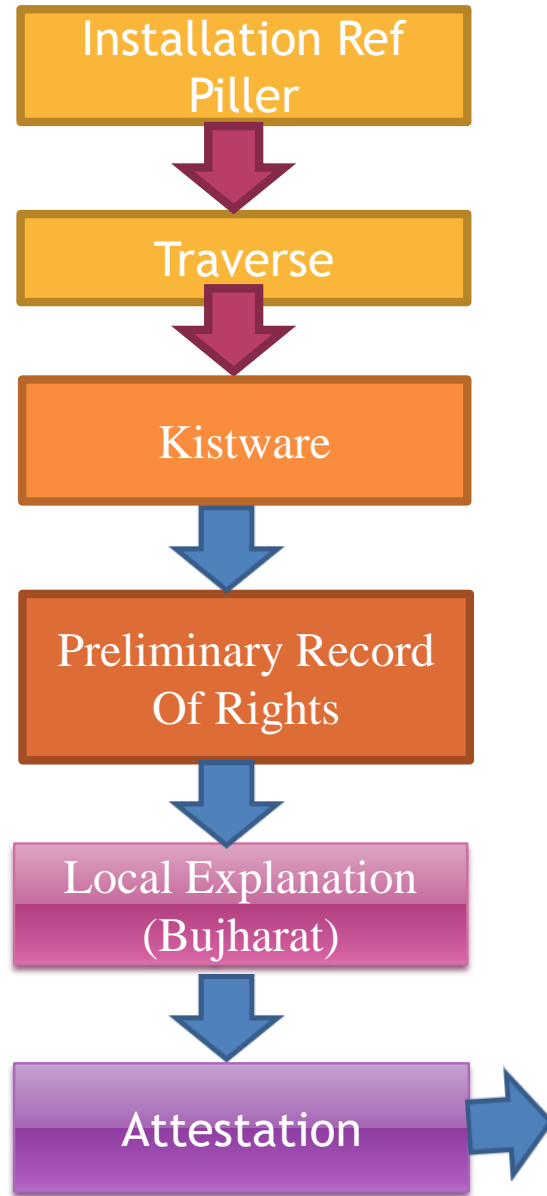
- The history of our land survey is not so long. At the end of nineteenth century it was first introduced in the Indian sub-continent, specially in Bengal tract, as the name of Cadastral Survey (C.S) under the British regime. In 1888 an experimental survey was conducted at Ramu, under the district of Cox-Bazar. At the mid of 1889 it was successfully completed. That gathered experience helped to complete the CS survey around the country. In Bangladesh cadastral survey has been completed from 1888 to 1940. That experiences are still now follows in our survey department. This Land Surveys are conducted for determination of the location of lands and their standard measurement and ownership for collection of revenue at a certain rate:-



Purpose of Cadastral Survey

- The purpose of this survey is to make an accurate plan of the fields in the village or area under survey on the required scale, which is ordinarily 16 inches to one mile. Cadastral Survey means plot to plot survey. Where there is unavailable fixed points or adopted stations, river accreted area is 100 acres or more which is not possible to close by sight vane, Mismatches one-third or more out of total plots between immediate past surveyed mouza map and field and where there is some area which is divided within the river or channel, decision should be made for cadastral survey.
- Making a field survey relates to preparing record of rights. The following process should be followed to conduct a Cadastral Survey.

STEPS OF CADASTRAL SURVEY





Our Objective :

- ✓ Explore GNSS Technology for
 - Cadastral Mapping
 - Georeferencing Historical Mouza Maps
 - Integration general data & Special data

- ✓ Control Time & Cost Approach
- ✓ Sustainable development of Land Management

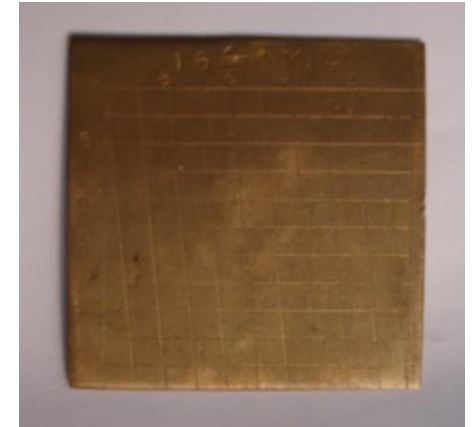


Technology Overview

- What we have passed...???
- Where we are....??
- Where is the Sustainable development goal...???

What we have passed...

Instruments Used in Conventional Survey at the time of Cadaster Survey(CS) Revisional Survey(RS) (heodolite, Divider, Pin, Metal Scale, Ivory Scale, Bamboo Stick, Gunter Chain, Optical Square)



Instruments Used in Conventional Survey (Acre Comb, Pantograph, Flat Ruler)



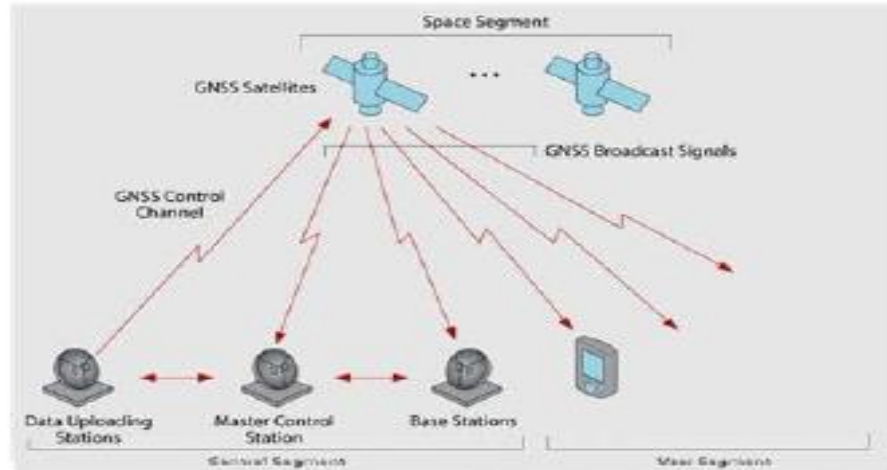
Field Traverse before Cadaster Using Theodolite Machine, At the time of CS Survey list count of Theodolite was 30 second, and RS Survey it was 20 second also locate the position using Theodolite moon or star observation.



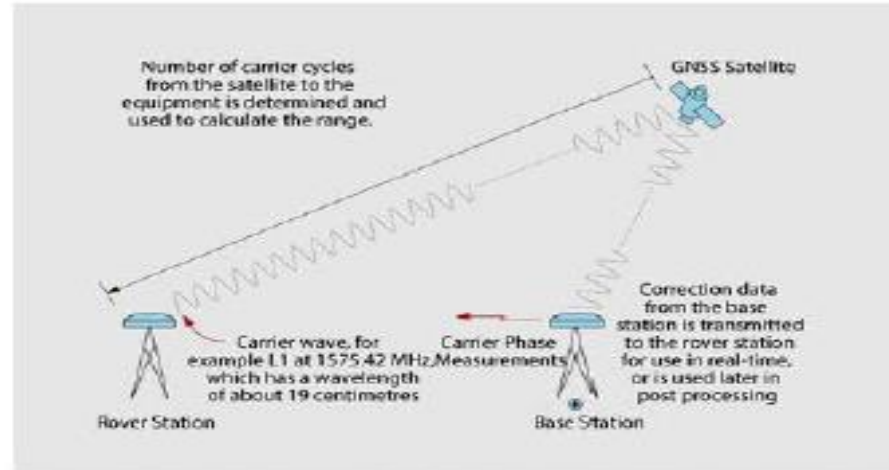
For conventional Survey after completing the Traverse Survey then start Cadaster survey Instruments Used in Plane Table.



Here we are....



GNSS (Global Navigation Satellite System), Architecture



Real Time Kinematic (RTK)

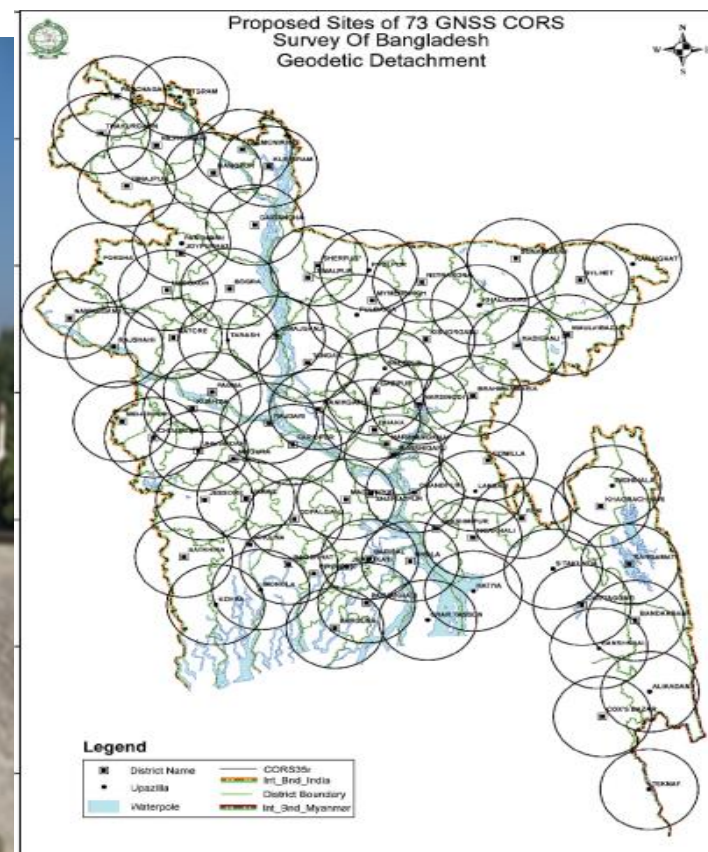
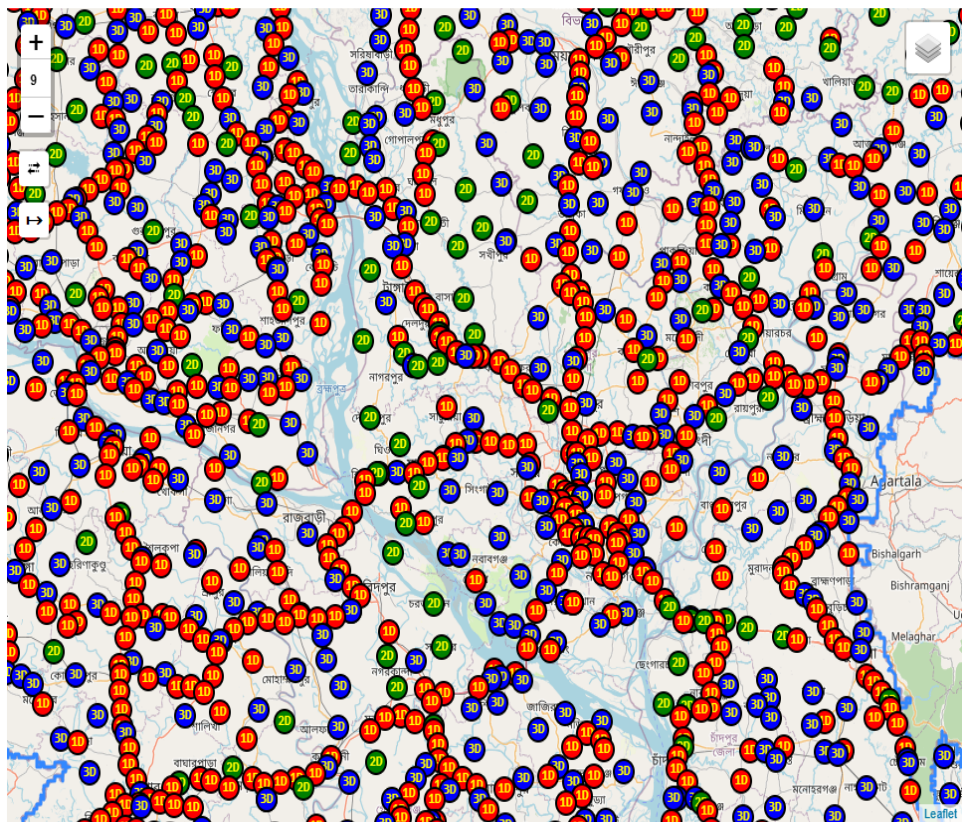


GNSS/RTK Equipment





This is PSM network established by another Department “Survey of Bangladesh under the ministry of Defense”. They have 3000 Reference Pillar name PSM (Permanent Survey Mark) six CORS/Reference Station and plan to more 31 CORS established as early as possible coverage around the country. It will be more cost effective for all kinds of survey.





Scenario of base data capturing through GNSS Receiver and transmitting the same in the sky using radio for RTK survey





Scenario of field data capturing using GNSS and RTK Rover.



DLRS Staffs using GNSS/RTK system for Surveying in Jamalpur Sadar

Cadastral Survey Data Capturing Through Total Station



Beyond ETS, GNSS, RTK...



Now that's how we want to do it!

Use of Satellite Imagery for Georeferencing Old Mouza Maps & Cadastral Mapping



Methodology

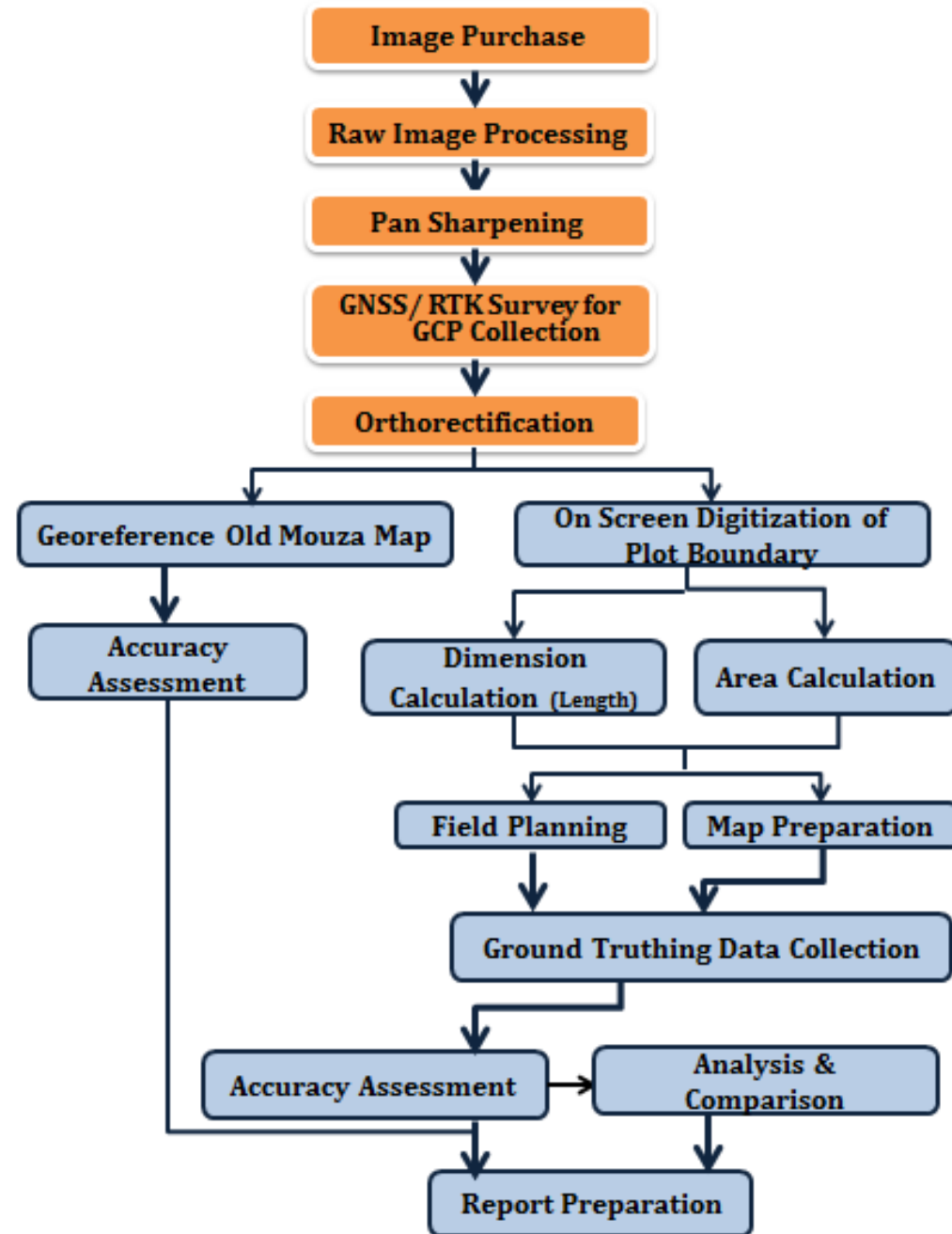


Outsourced



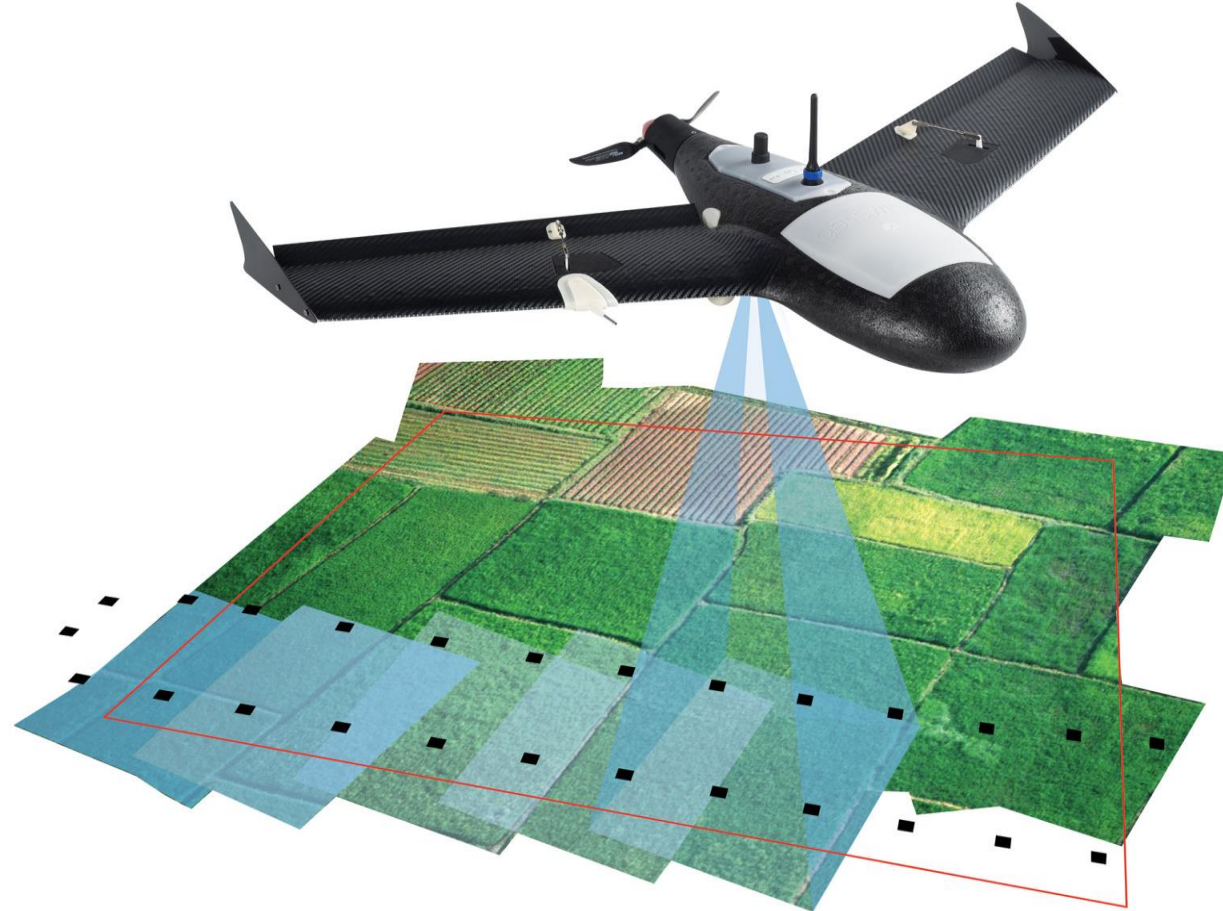
Project Staff

Satellite Ortho-image (WorldView-3: 30cm Pan Sharpen)

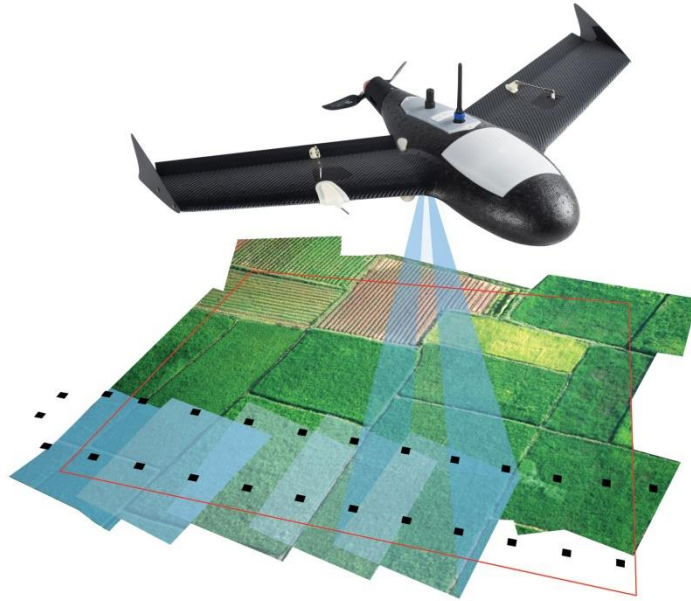


Now that's how we want to do it_2

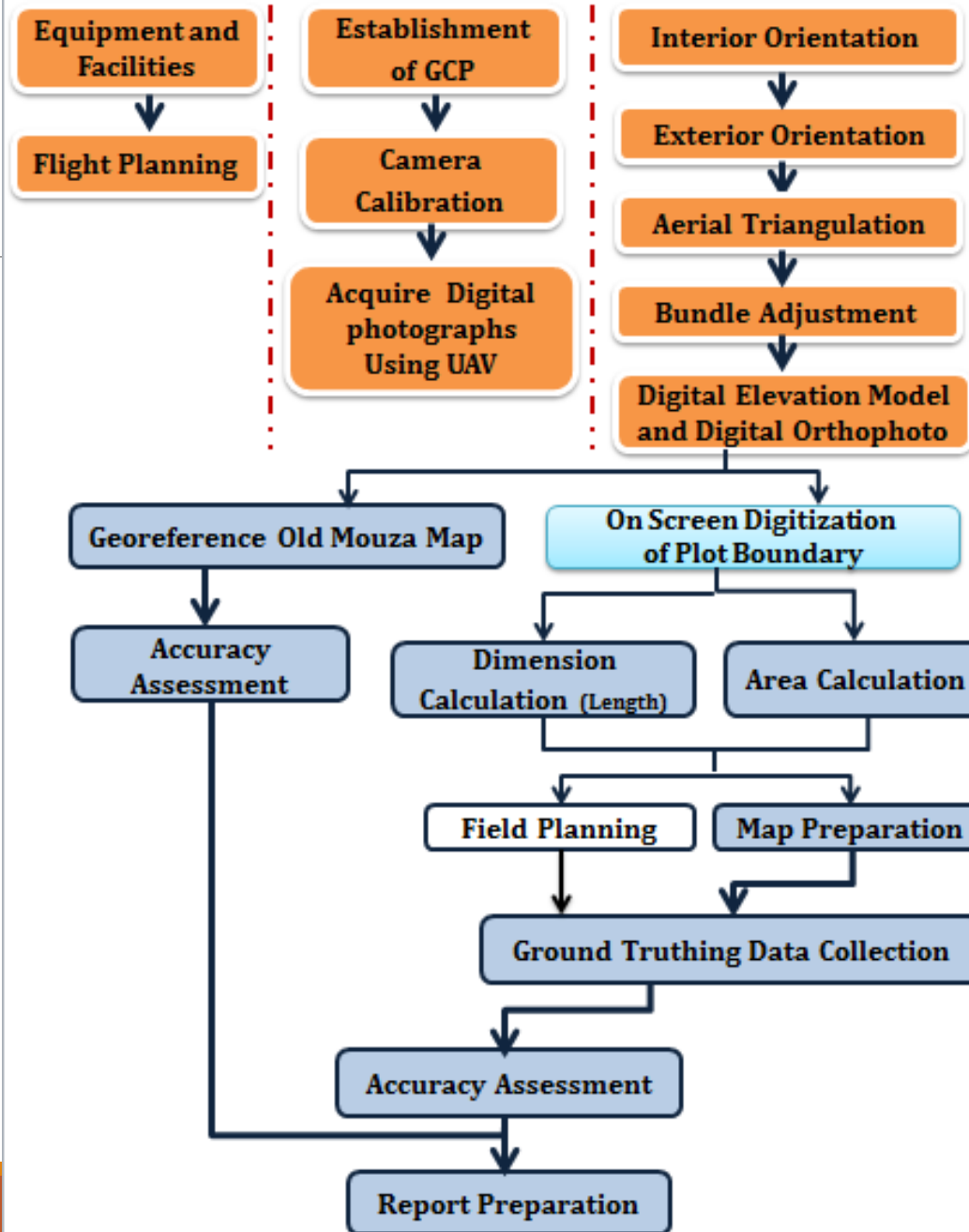
Unmanned Aerial Vehicle (UAV)



Methodology



Unmanned Aerial Vehicle (UAV) Orthophoto



Comparison of Time , Manpower & Cost for Different Survey Methods in 3 Pilot Sites



Traditional Manual Survey

ETS & GNSS/RTK Survey

Combined Method (ETS & GNSS/RTK + Orthophoto)

Pilot Project Area



Mohonpur, Rajshahi

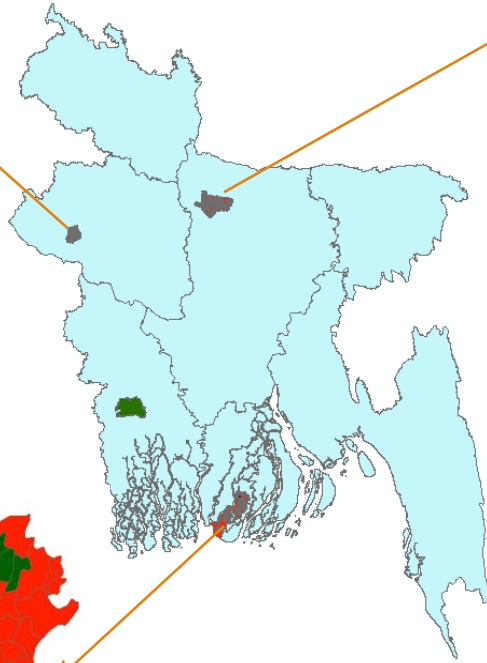
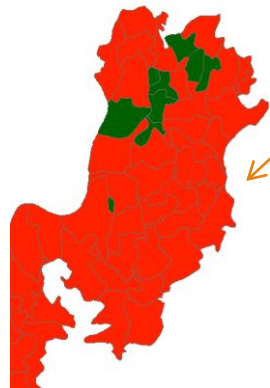
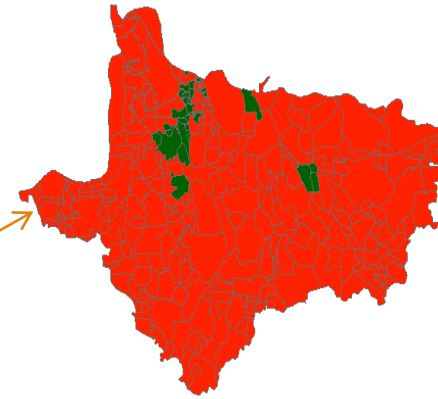
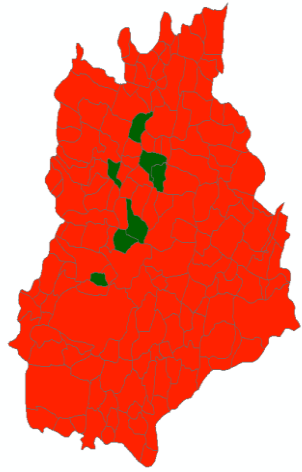
Unmanned Aerial Vehicle (UAV)

Jamalpur Sadar, Jamalpur

(Satellite Image)

Amtali, Borguna

(Sob Orthophoto)



Tools/Techniques for Georeferencing Scanned Mouza Sketch Maps & Extract Plot Boundaries for Cadastral Mapping



Option-1: GNSS/RTK & ETS

Option-2: High resolution Ortho-Imageries

- ❖ **Open Source (Google Earth, Google Map, Bing etc.)**
- ❖ **Orthophoto (Survey of Bangladesh-SOB)**
- ❖ **Satellite Ortho-Image (DG-Worldview-3)**
- ❖ **Unmanned Aerial Vehicle (UAV) Orthophoto**

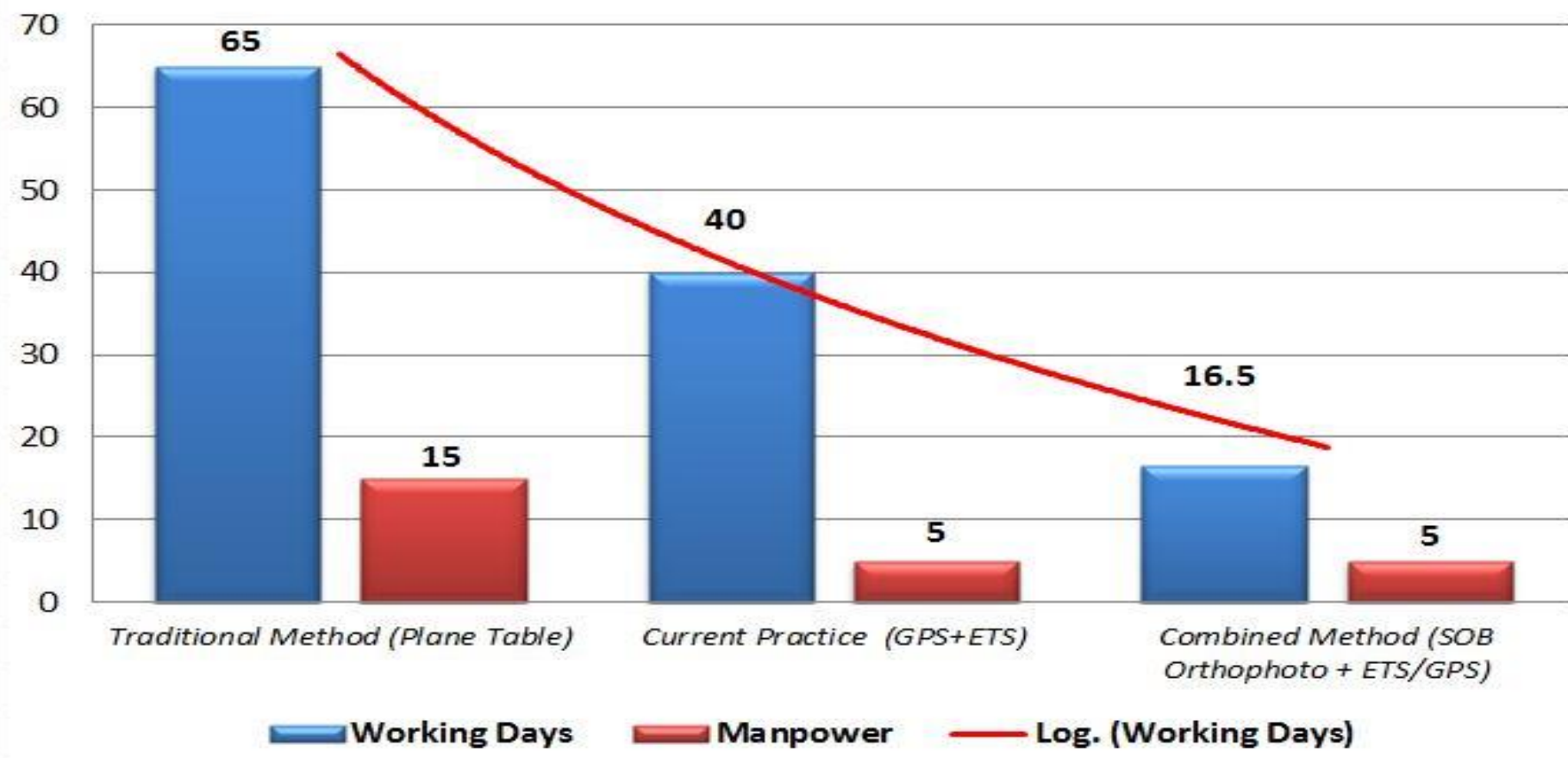


Chalitabania Mouza, Amtali Upazila, Borguna; Total Area: 230.55 Acres

Traditional Method			
Current Practice			
Proposed Combined Method			
SOB Orthophoto + GPS/ETS			
<i>Task</i>	<i>Days</i>	<i>Manpower</i>	<i>Expense</i>
1. Image Purchase from Survey of Bangladesh	2	ASO-1	1,000/- (Per 10 Sqm or 2471.05 Acres) 570/- (230.55 acres)
2. Feature Extraction/ Digitization, Area Calculation, Hal-Sabek Compare, Map Preparation	4	GIS Expert-1 Draftsman/ Surveyor -1	
3. Field Verification 4. Vegetation Covered Area by ETS Survey 5. Merging ETS & Orthophoto Data	1 8.5 1	Draftsman/ Surveyor -1 Khalashi-2	
Total	5 Days for 70%	5	
	12 Days for 30%		
	16.5 Days for 100%		



Working Days



Method	Working Days	Time Efficiency%	Manpower	Efficiency %	Expenditure %
Traditional Method (Plane Table)	65	-	15	-	
Current Practice (GPS+ETS)	40	38.46	5	66.67	
Combined Method (SOB Orthophoto + ETS/GPS)	16.5	73.85, 57.50	5	66.67	

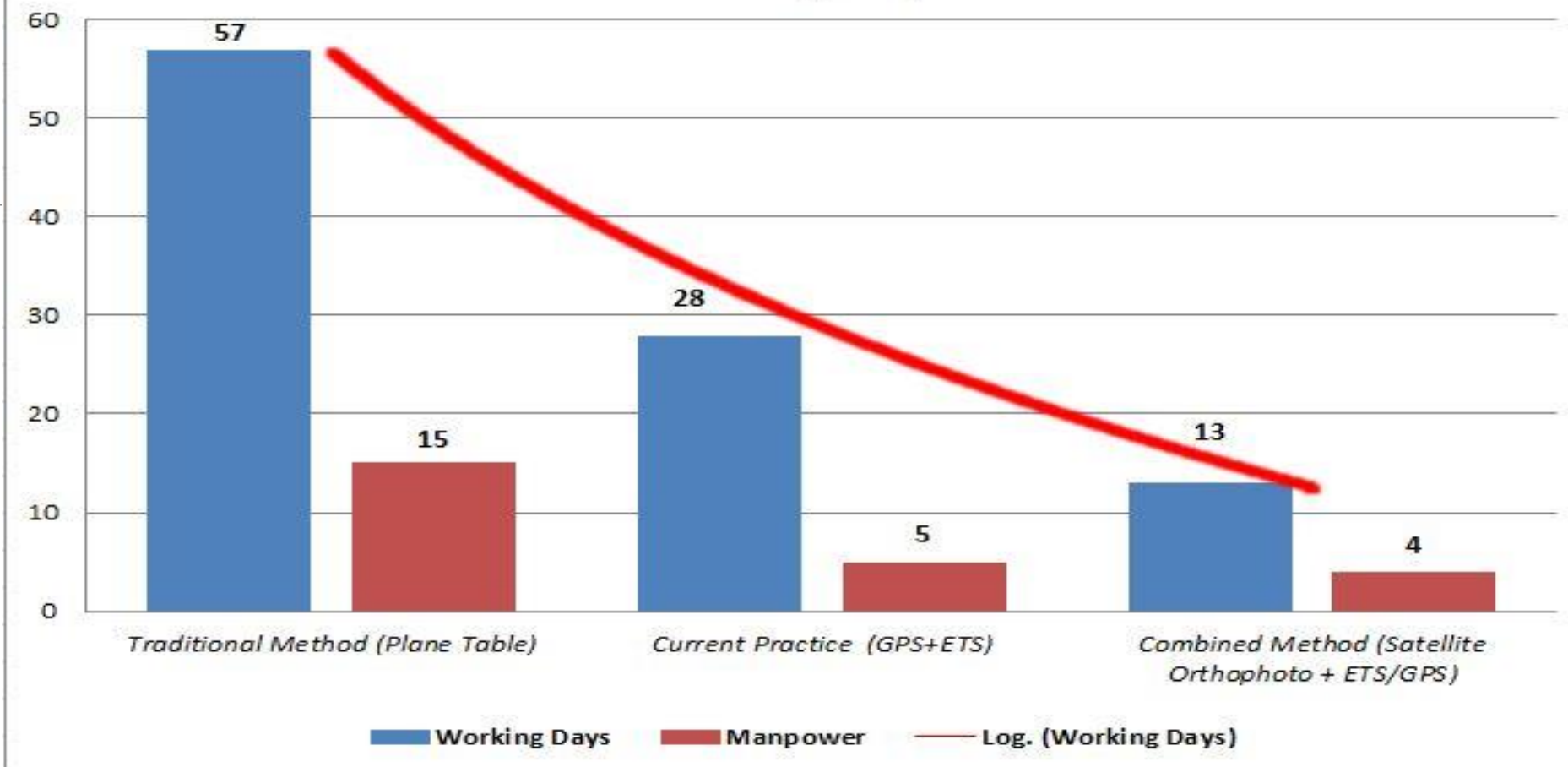
Kalabaha Mouza, Jamalpur Sadar, Jamalpur; Total Area: 130.03 Acres



Traditional Method			
Current Practice			
Proposed Combined Method			
Satellite Orthophoto+GPS/ETS			
<i>Task</i>	<i>Days</i>	<i>Manpower</i>	<i>Expense</i>
1. Image Acquisition 2. GCP Collection 3. Prcessing/ Georeferencing	14 0 (Zero)	Vendor 0 (Zero)	500,000/- (Per 100 Sqm or 24710.5 Acres) 26,000/- (130 .03 acres)
4. Feature Extraction/ Digitization, Area Calculation, Hal-Sabek Compare, Map Preparation	3	GIS Expert-1 Draftsman/ Surveyor -1	
5. Field Verification 6. Vegetation Covered Area by ETS Survey 7. Merging ETS & Orthophoto Data	0.5 8.5 1	Draftsman/ Surveyor -1 Khalashi-2	
Total	3.5 Days for 70%	4	
	9.5 Days for 30%		
	13 Days for 100%		



Working Days



Method	Working Days	Time Efficiency%	Manpower	Efficiency %	Expenditure	%
Traditional Method (Plane Table)	57	-	15	100		
Current Practice (GPS+ETS)	28	50.88	5	66.67		
Combined Method (Satellite Orthophoto + ETS/GPS)	13	77.19, 53.57	4	73.33		

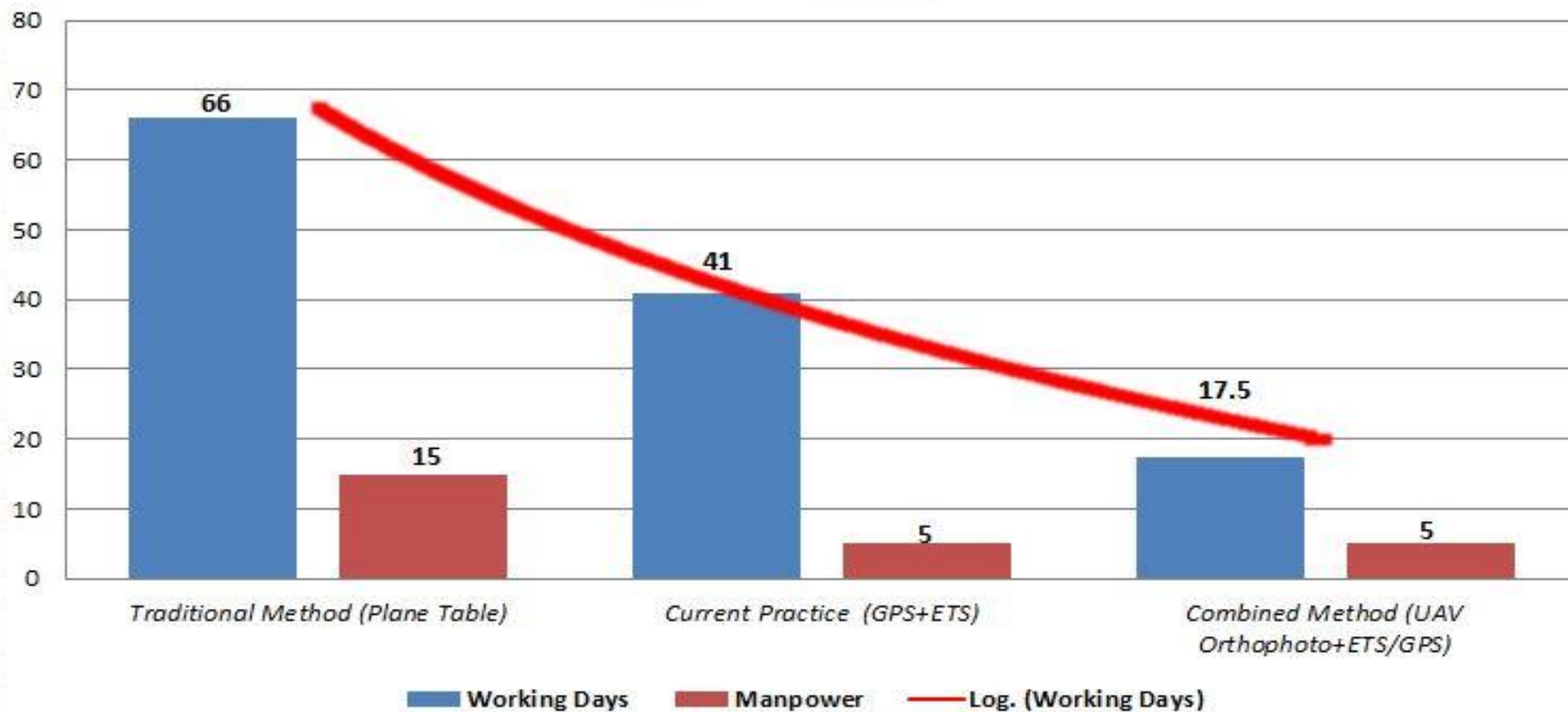
Brihatra Mouza, Mohanpur Upazila, Rajshahi; Total Area: 235.27 Acres



Traditional Method			
Current Practice			
Proposed Combined Method			
UAV Orthophoto+GPS/ETS			
<i>Task</i>	<i>Days</i>	<i>Manpower</i>	<i>Expense</i>
1. Image Acquisition 2. GCP Collection 3. Image Proessing	7 0 (Zero)	Vendor 0 (Zero) UAVExpert-1 Surveyor-1 Draftsman-1	220,000/- (Per 6 Sqm or 1482.63 Acres) 34,910.50/- (235.27 acres)
4. Feature Extraction/ Digitization, Area Calculation, Hal-Sabek Compare, Map Preparation	4	Draftsman/ Surveyor -1	
5. Field Verification 6. Vegetation Covered Area by ETS Survey 7. Merging ETS & Orthophoto Data	0.5 12 1	Draftsman/ Surveyor -1 Khalashi-2	
Total	4.5 Days for 70%	5	
	13 Days for 30%		
	17.5 Days for 100%		



Working Days



Method	Working Days	Time Efficiency%	Manpower	Efficiency %	Expenditure	%
Traditional Method (Plane Table)	66	-	15	-		
Current Practice (GPS+ETS)	41	37.88	5	66.67		
Combined Method (UAV Orthophoto+ETS/GPS)	17.5	73.48, 57.32	5	66.67		



As a Result

- In a word the more GNSS technology is applied, the more time and cost can be reduced.
- Once the Survey is done, there is no need to re survey, just update in real time.
- As previously we used to make map 16" = 1 mile, in future there will be no need for any more scale when I can make maps at the required scale.



What is our Difficulties?

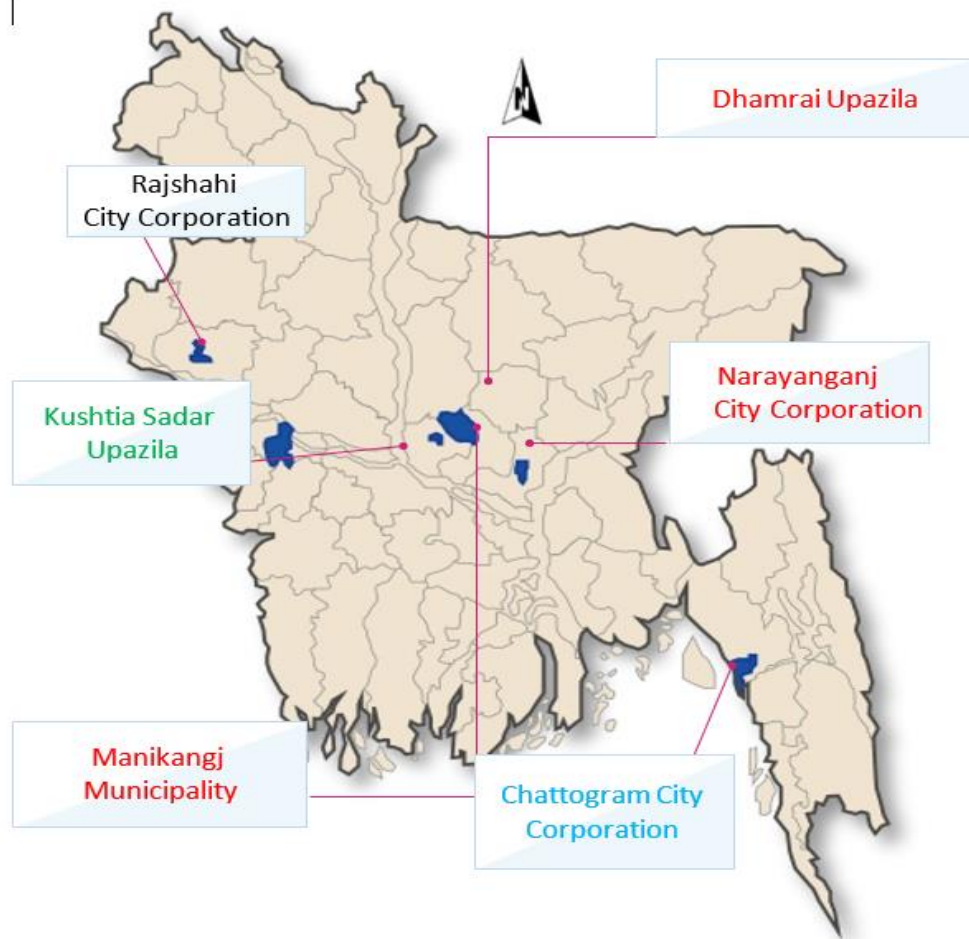
- Modern Techniques and Equipment.
- Qualified Manpower.
- We are not yet able to integrate land ownership data and map data that is general data and special data.



New Project

Utilizing the experience of three pilot area in the past and in order to complete the survey work using modern GNSS technology, we have undertaken a project called "Establishment of Digital Land Management System" with the support of Exim Bank of South Korea. Among them, we have selected six areas including three city corporations, one municipality and two upazilas. The project will provide GNSS, ETS, UAV and other modern equipment. Already around 975 networking pillar sites have been selected in the project area and construction work has started.

Project Area Map EDLMS





Purpose of this Survey

- Completed Digital Land Survey of 634 mouza (Village) in six Locations of the project area.
- Establishment of cadastral database by combining Mouza map and mutation record with digital record data.
- Establishment of land database system within the Department of Settlement, Management and Land Registration.
- For this reason, a network will be established between Depart of Land Records & Surveys, Zonal Settlement Office, Upazila Settlement Office, Assistant Commissioner (land) Office and Sub Registry Office.

Underlying Prospects & Future



We are hopeful that we will be successful in this project and later we will use this technology across the country to develop a time and cost saving sustainable land management system. Other then we will get:

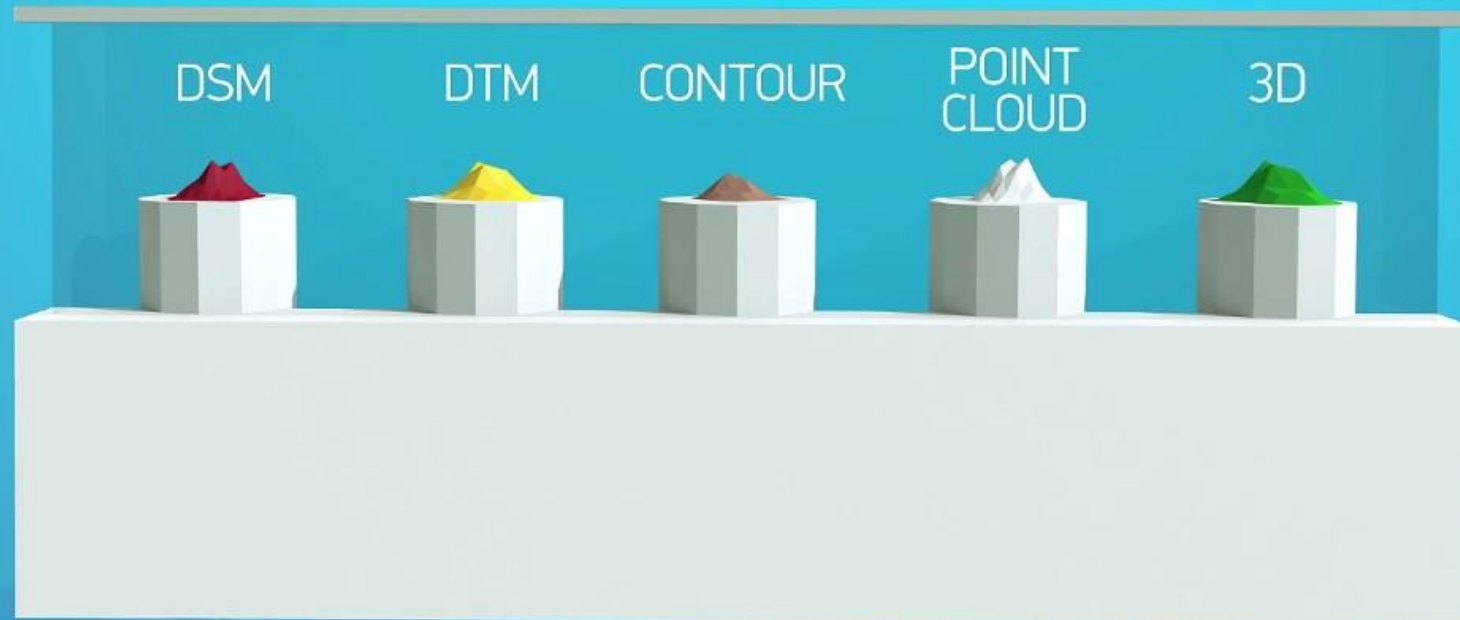
- Digital Surface Model (DSM)
- Digital Terrain Model (DTM)
- 3d Color Point Cloud
- Couture line
- Plot based Land Zoning
- And many others

Potential source of revenue without further investment.

Elevation Models

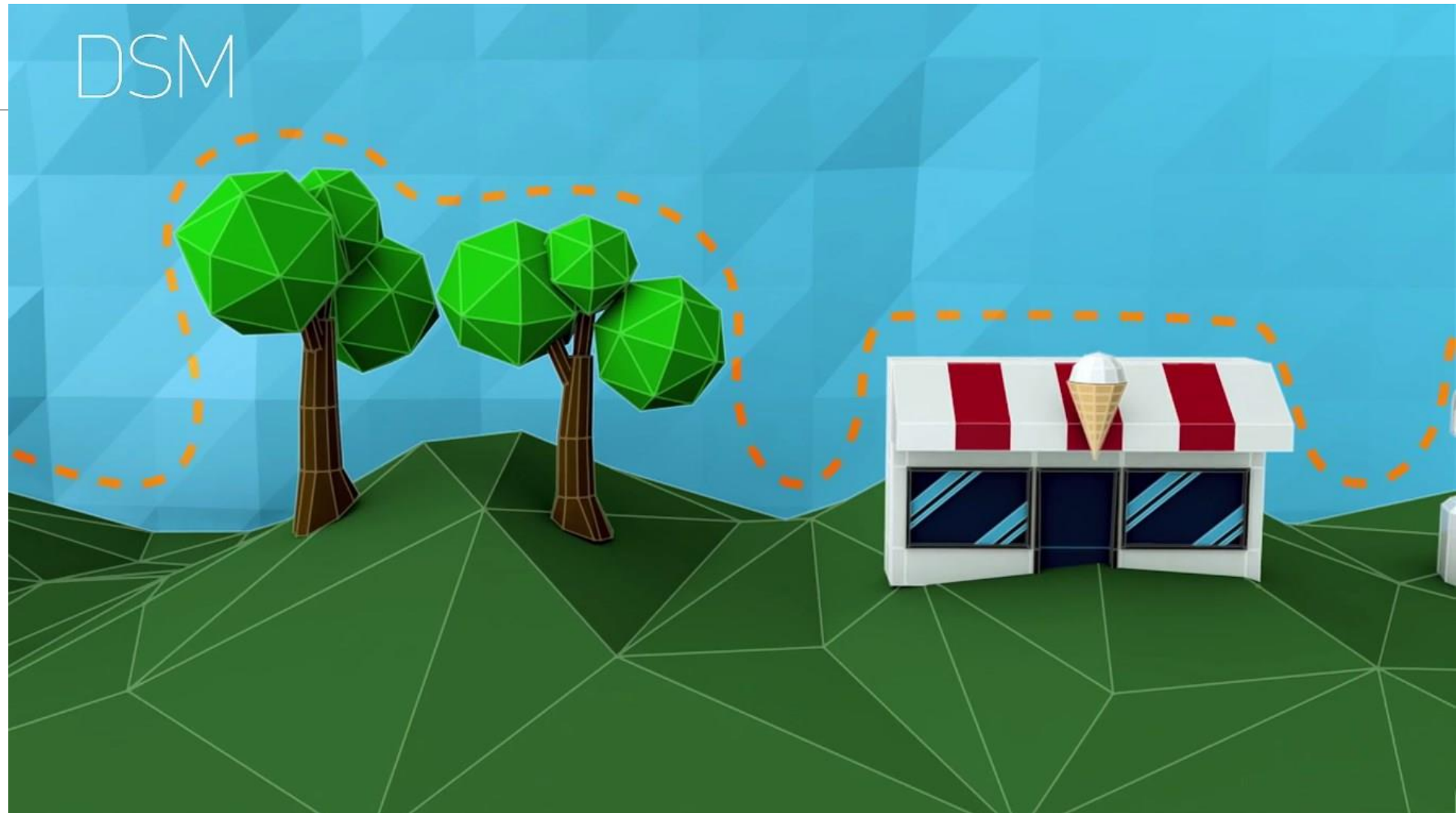


Elevation Models



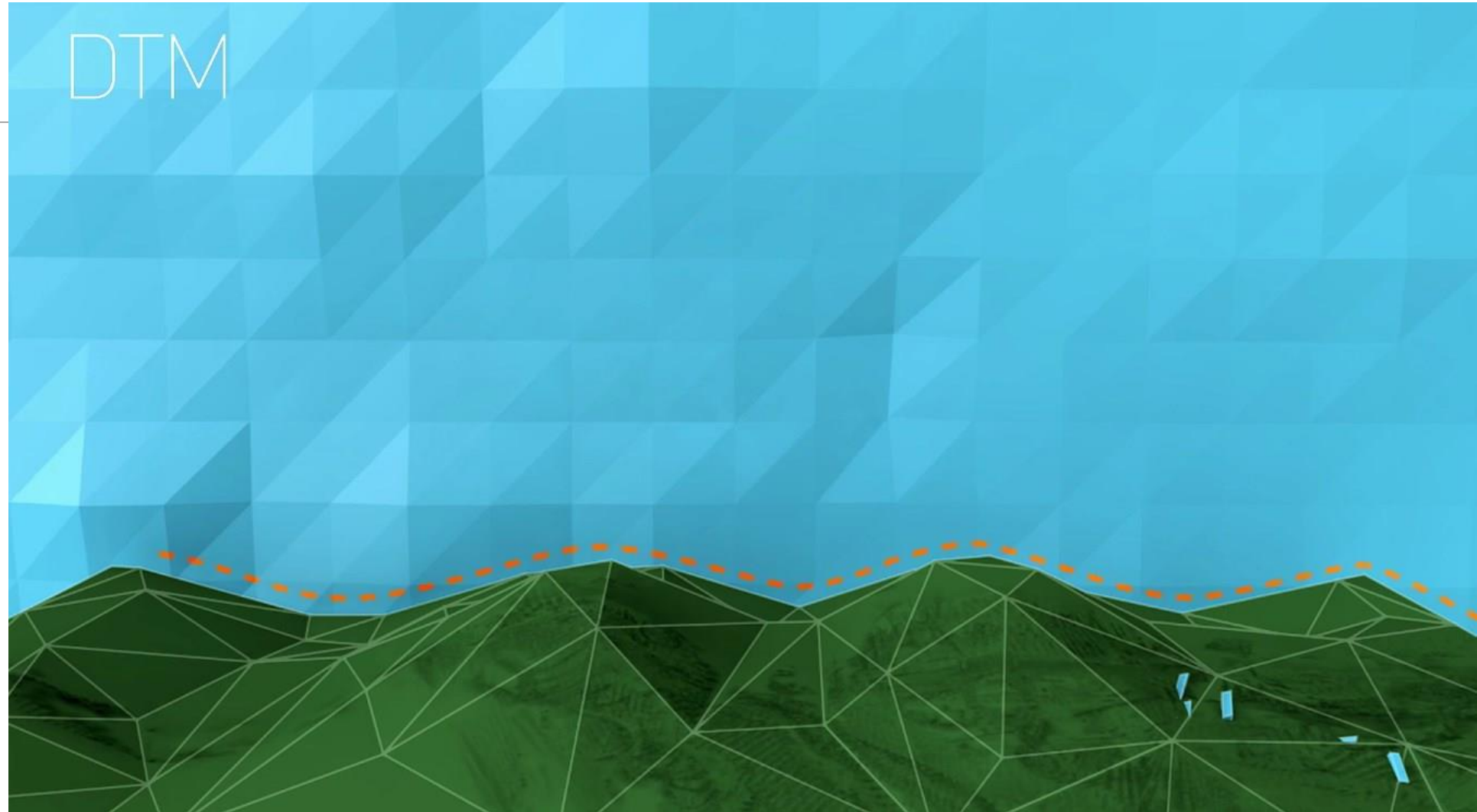
(Source: <https://www.digitalglobe.com/>)

Elevation Models - DSM



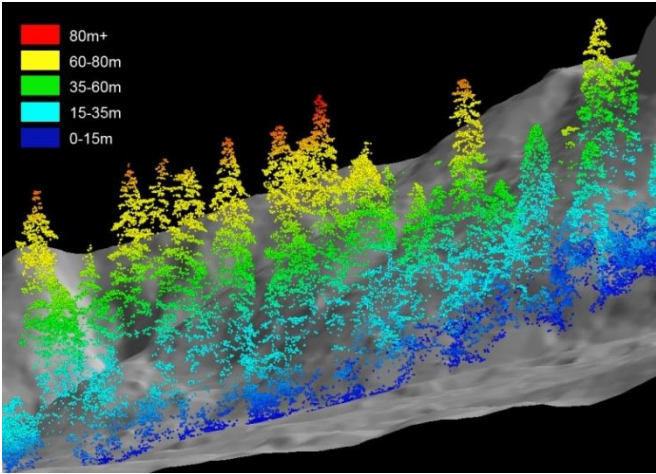
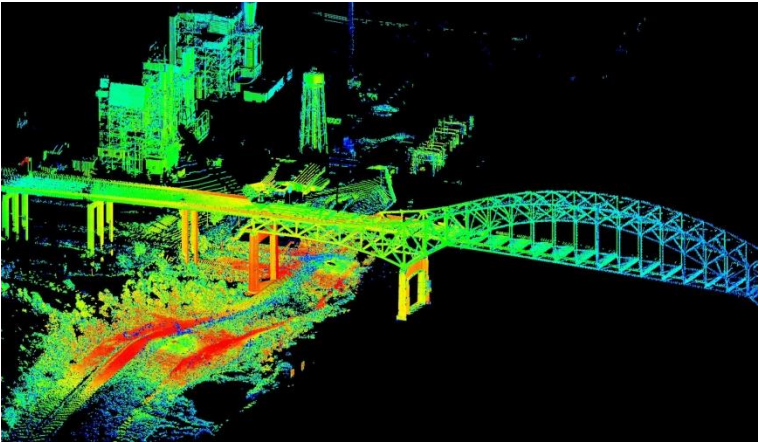
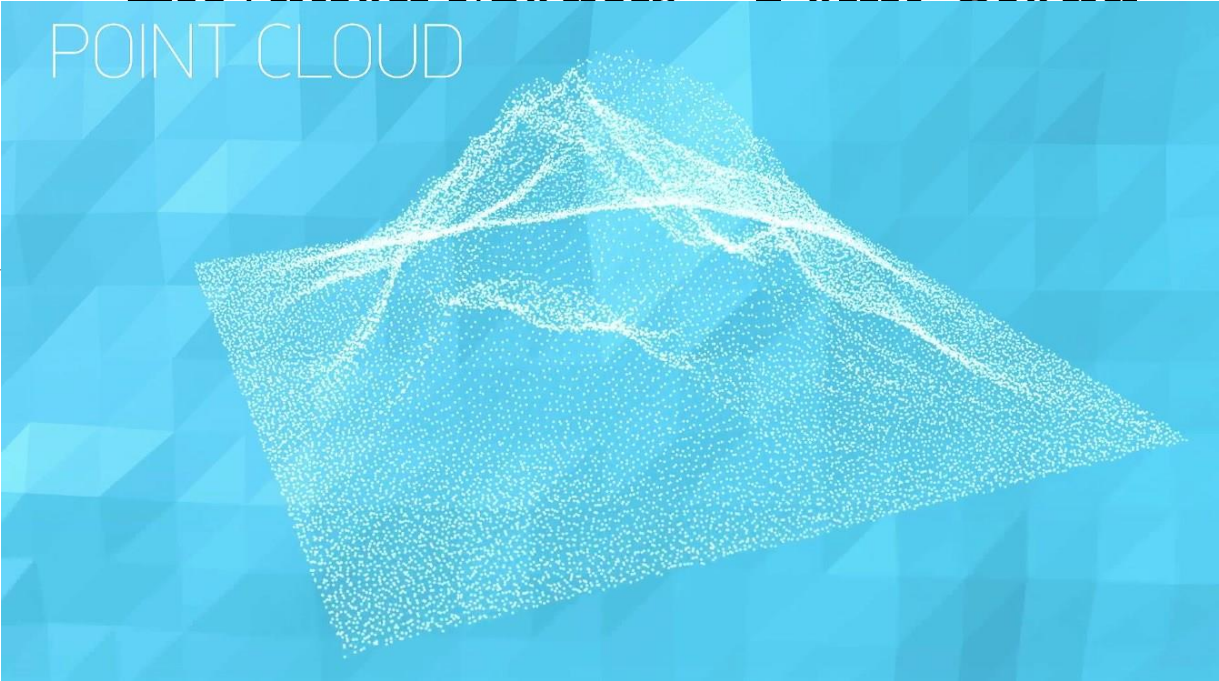
(Source: <https://www.digitalglobe.com/>)

Elevation Models - DTM



(Source: <https://www.digitalglobe.com/>)

Elevation Models – Point Cloud



(Source: <https://www.digitalglobe.com/>)

Thank you for

Attention



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- Survey of Bangladesh
- Ministry of Land
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