Hybrid Survey methodology using Aerial Photography and Ground Truthing with TS/DGPS in Bihar

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LAND SURVEY – SCENARIO

• Land Survey of Bihar had been earlier carried out in the year 1910.
• In the last hundred years, actual picture on the ground has changed a lot.
• Old cadastral maps face critical preservation issues.
• Many new Districts/Circles and Village Panchayats and Municipal bodies have been created since the last survey which poses great difficulties in today’s revenue administration.
1. Hybrid Method
   - Aerial Photography
   - Ground thruthing (with TS + DGPS)

2. Collection of Plot ownership information

3. Integration of Map with ROR
## LAND SURVEY (MAP) - APPROACH

<table>
<thead>
<tr>
<th>Old Technique</th>
<th>vs.</th>
<th>Modern Technology</th>
</tr>
</thead>
<tbody>
<tr>
<td>Complex, tiresome and time taking and labour oriented.</td>
<td>Map of approx. 100 sq. km area can be prepared in one hour using Aerial Photography method.</td>
<td></td>
</tr>
<tr>
<td>Change of scale in the map is a very complicated and difficult process.</td>
<td>Change of scale in the digital map is easily done with full accuracy.</td>
<td></td>
</tr>
<tr>
<td>Plot wise map for holders/farmers from the Mauza map is very cumbersome.</td>
<td>Generation of plot map is easy.</td>
<td></td>
</tr>
<tr>
<td>Updation is not possible.</td>
<td>Updation is very much possible.</td>
<td></td>
</tr>
<tr>
<td>Solution of land disputes becomes difficult in absence of updated land records.</td>
<td>No issue in updation.</td>
<td></td>
</tr>
</tbody>
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Contd...
AERIAL SURVEY- SCOPE

- Permission for Aerial Photography
- Setting up the Ground Control Network - Primary, Secondary and Tertiary Control Points.
- Aerial data acquisition through aerial photography with Ground Sampling Distance (GSD) of **10 cm** or better.
- Generation of land parcel maps in 1:4000 scale and 1:1000 scale for Abadi area.

**Alignment of map with ground realities**
- Comparison of new re-survey maps with CS/RS Map and map based plot area with chalu khatiyan / khesra panji.
- The Survey & Settlement Office shall verify boundaries of the land parcel on the hardcopy in the presence of the owner(s) /enjoyer(s) of the adjacent land parcel.
- In case any variation is found with respect to ground realities, maps to be re-generated with the revised land parcel map based on their TS reading and obtain acknowledgement / objection.
Aerial photography is the taking of photographs of the ground from an elevated position. The term usually refers to images in which the camera is not supported by a ground-based structure. Platforms for aerial photography include fixed-wing aircraft, helicopters, multirotor Unmanned Aircraft Systems (UAS), balloons, blimps and dirigibles, rockets, kites, parachutes, stand-alone telescoping and vehicle mounted poles.
AERIAL PHOTOGRAPHY - STEPS

• Flight, acquiring of images
• Image processing
• Processing of GPS/IMU (Inertial Measuring Unit)
• Aerial Triangulation
• Digital Terrain Model
• Ortho-rectification and mosaicking process
• Delivery of final data in .SHP format
GCP @ 16 Districts

Overview

Legend
Gaya_Laid
- <all other values>
Type
- ADD
- PGC
- SGC

NEW PATHS. NEW APPROACHES
MONUMENTATION : PRIMARY POINTS

PGCP - Supaul

PGCP - Saharsa

Madhepura PGCP
INSTALLATION OF BASE

TX / RX ANTENNA

BASE
Aircraft – Used for Flying from CAE Aviation

D-FCAE (Delta Fox Charlie Alfa Eco)
Camera - UltraCam XP
Aerial Photography: Components

**Aircraft**

- Beechcraft KING AIR C90 (Pressurized Cabin Aircraft)
- Max. Flight Duration: 5 hours
- Ceiling: 30,000 feet
- Speed: 90-180 Knots

**Aerial Camera**

- ZEISS RMK TOP 30 Aerial Camera
- ZEISS RMK TOP Film Magazine with FMC
- CCNS Navigation Unit with Airborne GPS
- AEROCONTROL II (Inertial Measurement Unit)
- Gyro Stabilised Mount
- Omnistar FUGRO Airborne DGPS
- Ashtech Z Ssurveyor GPS Base Receiver

Two Pilots along with two navigators and one security officer are crew members in flight.
AERIAL PHOTOGRAPHY - ACQUISITION

discrete perspective images

overlapping aerial photographs
60% forward overlap and 30% side lap

Camera Fitted
AERIAL PHOTOGRAPHY

Digital Photogrammetry (GPS Geodetic cadastral control + Image + Topographic features + map) Almost 100 Sq. Km survey in one hour with aircraft
AERIAL PHOTOGRAPHY – PROCESS FLOW

Aerial photo capturing

Camera

Temporary Mass Storage

Raw Data process

Archive System

Plotter

Digital WorkStation
For accuracy **Global Navigation Satellite System (GNSS)** will be used with ground reference stations. Two or three of ground stations will be established on safe locations. One station will be set up close to the **Airport**. The other 1 or 2 stations will be placed in such a way that the distance to the aircraft is max. 70 km for high accuracy of the airborne GNSS data.
GROUND CONDITION

Aerial Survey

Aerial Survey + DGPS

Aerial view of plot with tree

Crops on Field

Land Parcel boundary
SECURITY VETTING OF AERIAL DATA

Aerial Photography / Survey Re-survey of Bihar

Scale 1:50000

GIS Consortium India

Security Vetting by Agencies

Sheet No. - 72/18

86° 45'E
10° 30'N

87° 00'E
38° 30'N

15° 15'N
86° 45'E

2015-02-17 14:16

2015-02-17 14:17
AERIAL PHOTOGRAPHY DATA

Primary Control Point
Madhepura
KISTWAR PROCESS

NOTIFICATION
BOUNDARY IDENTIFICATION ON FIELD
GOVT LAND VERIFICATION ON FIELD
EXPLAINING KISTWAR TO DEPT SURVEYORS

INTIAL SUBMISSION MAP FOR KISTWAR
KISTWAR COMPLETED & UPDATED MAP

Reconciliation Report
NEW PATHS. NEW APPROACHES

KHANAPURI PROCESS

GRAMSABHA

GRAMSABHA RECORD

FIELD WORK

NOTIFICATION

DEMARCATION OF PLOTS

ROR DATA PREPARATION
SURVEY PHASES

ETS SURVEY

SURVEY TEAMS

FIELD VISITING
Aerial Flying inaugurated by Shri Nitish Kumar, Hon’ble Chief Minister of Bihar
AGENCIES LAB AT DIFFERENT LOCATIONS

Begusarai Lab.

Bihar Survey Off., Gulzarbagh

Khagaria Lab.
LAND SURVEY STATUS

• Total area of survey of Bihar is 93,358.8 sq. km.
• Aerial photography was launched by Hon’ble Chief Minister Shri Nitish Kumar at Suryagarha in Lakhisarai district on May 22, 2013.
• Three agencies are selected for aerial survey
  ▪ M/s IIC Technologies Ltd, Hyderabad
  ▪ M/s GIS Consortium India (P) Ltd
  ▪ M/sIL&FS Environmental Infrastructure & Services Ltd., Gurgaon
### Agencywise progress of generation of Revenue Maps through Aerial Photography

<table>
<thead>
<tr>
<th>SI No</th>
<th>Company Name</th>
<th>Alloted Districts</th>
<th>Date of Agreement</th>
<th>Work done by company</th>
<th>Supply of Revenue Maps</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td><strong>IIC Technology Ltd Hyderabad</strong>&lt;br&gt;Begusarai, Lakhirarai, Khagaria, Muzafarpur, Sitamarhi, Vaishali, Sheohar, Purnea, Katihar, Kishanganj, Arraia, Motihari</td>
<td>12 District 04-01-2013</td>
<td></td>
<td>Aerial photography completed&lt;br&gt;Security vetting completed&lt;br&gt;Work completed</td>
<td>Begusarai, Lakhirarai, Khagaria, Muzafarpur, Purnea, Katihar, Kishanganj, Arraia&lt;br&gt;Begusarai, Lakhirarai, Khagaria, Motihari&lt;br&gt;Begusarai, Lakhirarai, Khagaria, Purnea, Katihar, Kishanganj, Arraia</td>
</tr>
<tr>
<td>1</td>
<td><strong>GIS Consoetium India Pvt Ltd New Delhi</strong>&lt;br&gt;Gaya, Jehanabad, Arwal, Aurgangabad</td>
<td>04 District 09-10-2013</td>
<td></td>
<td>Date 05-05-2015&lt;br&gt;Gaya, Jehanabad, Arwal, Aurgangabad Flying completed</td>
<td>Gaya, Jehanabad, Arwal, Aurgangabad Flying completed</td>
</tr>
<tr>
<td>2</td>
<td><strong>IL&amp;FS(E) Ltd, New Delhi</strong>&lt;br&gt;Siwan, Patna, Bhojpur, Buxar, Rohtas, Kaimur, Gopalganj, Darbhanga, Madhubani, Samastipur</td>
<td>10 District 04-01-2015</td>
<td></td>
<td>Not yet started. Got Flying permisstion from GOI for Aerial Flying in Nov 2014</td>
<td>Siwan, Patna, Bhojpur, Buxar, Rohtas, Kaimur, Gopalganj, Darbhanga, Madhubani, Samastipur</td>
</tr>
<tr>
<td>3</td>
<td><strong>IL&amp;FS(E) Ltd, New Delhi</strong>&lt;br&gt;Nalanda, Saran, Bhagalpur, Munger, Shekhpura</td>
<td>10 District 02-01-2015</td>
<td></td>
<td></td>
<td>Nalanda, Saran, Bhagalpur, Munger, Shekhpura</td>
</tr>
</tbody>
</table>
Thank You