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FOREWORD

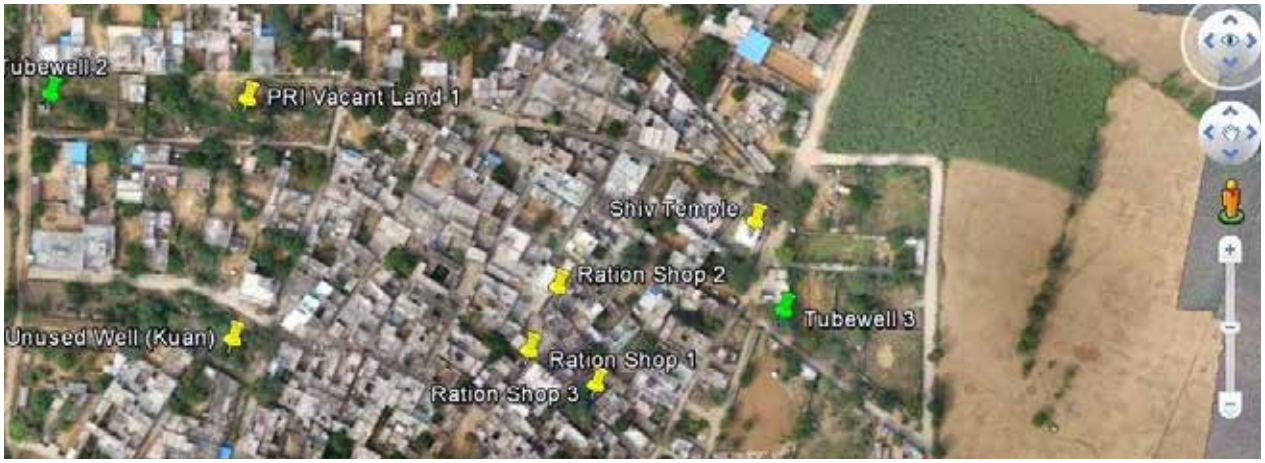
Technological advancement is the key driver for economic growth and sustainable development. Geospatial Technologies are considered as one of the most powerful technologies that can effectively serve overall developmental needs of the modern world. Today such applications and tools are available and are being advanced for improved performance of a country towards all major verticals of economy like agriculture, mining, infrastructure, transportation, logistics, homeland security, disaster management, defence, urban planning etc. As India endeavours to achieve its developmental goals, the multifaceted and specialized capabilities offered by geospatial technologies will play a crucial role for information management in future.

Mainstreaming geospatial technologies for effective decision making and better governance is one of the mandates of FICCI. This publication is an effort in this direction. It is compilation of Indian case studies of successful applications of this technology, and showcases their immense potential as a tool for planning and management of resources by diverse stakeholders.

I am confident that this publication will help in propagating the adoption of this promising technology by various stakeholders from public as well as private sector.

A. Didar Singh
Secretary General
FICCI

Integrating UAVs in Social Research: Summary of a Successful Pilot Study



Introduction

A significant portion of Outline India's work is conducted in rural parts of India which are either unavailable on Google Maps or lack geo-spatial details. Intermittent or lack of connectivity along with outdated satellite images escalates the problem. The geo-referenced aerial and 3D maps, created with the help of drones offer a technologically advanced solution to aid social science research, implementation programmes undertaken by the government and other stakeholders. Moreover, this can be fed into the existing Google database to add value and improve our current understanding of the landscape and infrastructure.

To explore the potential of geospatial data and the use of geospatial technology in social research, a pilot study was undertaken at Bhora Khurd, a village situated in Manesar tehsil of Haryana. The intention was to understand the technical feasibility, scalability and gauge challenges that may arise in the process. While drones were used to produce detailed images along with elevation profile of the geographical space, a household level survey was conducted alongside to geo-reference granular-level information collected on-ground. Due permissions from the local Police Thana and the Village Sarpanch were taken for conducting the study.

Objectives of the Study

- To understand demographic and socio-economic profile of the village, spatially.
- To study the availability of and access to basic infrastructure services (including healthcare, education, water and sanitation).
- To establish correlations, between social stratification and access to basic resources, and infrastructure.
- To identify demographic variances spatially and identify priority intervention areas.

Research Methodology

The first objective was to profile the village spatially through transect walks, aerial mapping using UAVs while taking down the geo-coordinates of community infrastructure, resources, unutilized spaces, waste lands, disposal grounds and so on.

This was followed by mapping and identifying population distribution, demographic and socio-economic attributes along with other household level information to obtain granular data. An in-depth interview was conducted with the Village Sarpanch to gather an overall understanding of social governance of the community, with an emphasis on general issues.

During the survey, 107 household were selected through random sampling to assess the socio-economic profile of the members, their access to basic infrastructural services and their perceptions of major problems in the village.

The GPS coordinates of the surveyed households were also recorded using tablets to feed into the GIS dataset. One must note that the accuracy level of geo points recorded using tablets ranges between 0-30 meters, while aerially produced maps and KMZ (Key Hole Markup Language) datasets are accurate to the range of 5-20 cms.

Findings

Demographic profile

- Bhora Khurd village has 324 houses (Census 2011) and is divided into two residential clusters – Bhora Khurd and Dhani Khurd with a population of 1495 and 524 respectively. Schedule Caste (SC) constitutes 25.90 % of total population in Bhora Khurd village.

Figure 1: Ground images obtained through UAVs reveal on-ground nuances in comparison to satellite images

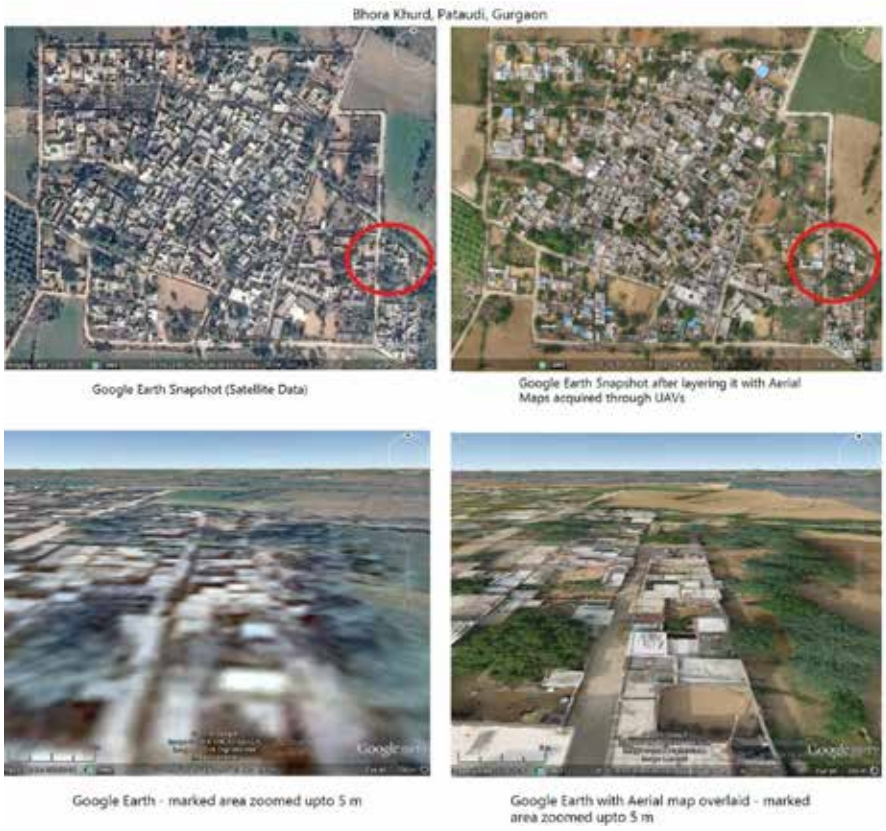
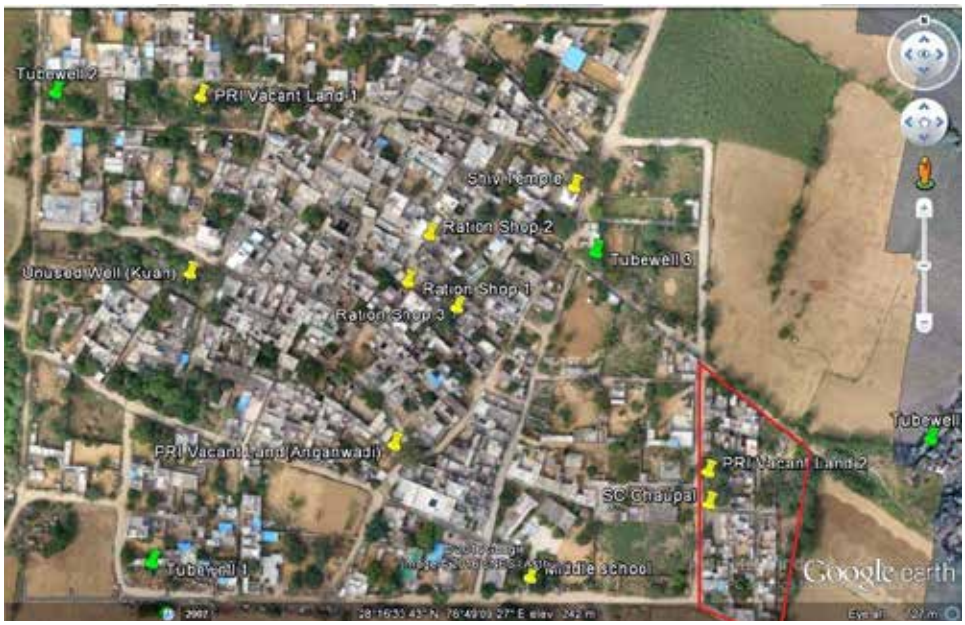


Figure 2: Complete UAV image reproduced on Google Earth



- Sampled households plotted on the geo-referenced aerial maps indicate that the households are distributed along caste lines. While upper and dominant caste households were scattered across the village, lower castes occupied a cluster commonly referred to as SC colony (SIC), in the south-eastern part of the residential area.

Basic Infrastructural Provisions

- **School**: There is a middle school in Bhora Khurd and a Primary School in Dhani Khurd. On an average, the households reported to have 1 child in the age group of 6 to 18 years, all of whom were enrolled in a school/college. Since there is no upper primary or secondary school in Bhora Khurd, the parents are forced to send the children to a private school after 8th standard. The middle school in Bhora Khurd is well maintained, with separate toilets for boys and girls and drinking water taps. Sidhrawali, located 3 km away from the village, has a degree college, secondary school and a private school.
- **Anganwadi Centre:** Both the residential clusters, Bhora Khurd and Dhani Khurd, have an Anganwadi centre each. However, in Bhora Khurd cluster, the building for Anganwadi has not been constructed and they operate out of rented premises. 73% of the children in the age group of 6 to 18 years in the sampled households have received vaccination such as polio, TB, hepatitis etc.
- **Healthcare**: There is no public dispensary or health centre in the village, and the nearest government hospital is in Sidhrawali which is 3 kms away. Consequently, 50% of the households reported that they consult an unqualified practitioner for primary health issues and 32% consult a private qualified doctor. Merely 16% of the households reported that they approach a government health facility.
- **Water**: 66% of the sampled households have piped water connection inside the household, and 18% collect water from pipelines/piped water points outside the household. 15% of the households use a mechanically or a manually drilled deep bore well for their water needs.

- **Sanitation:** At 86%, majority of households reported that they have a toilet within their household. Among those who do not have an individual household latrine, 80% defecate in the open, while rest use their neighbour's or relative's household toilet.
- **Solid waste disposal:** Household waste is generally discarded in pits lining the agricultural land, or designated areas in the agricultural land by households which own land. 21 out of the 107 sampled households reported disposing waste in open land, and out of those, most of them do not own agricultural land and belong to lower caste households (kumhar, harijan and valmiki). Animal waste is generally dried and used as fuel or fodder.
- **Electricity**: All households have government supplied electricity connection but have reported frequent power cuts. On an average, there is a power cut of 8 to 9 hours every day.

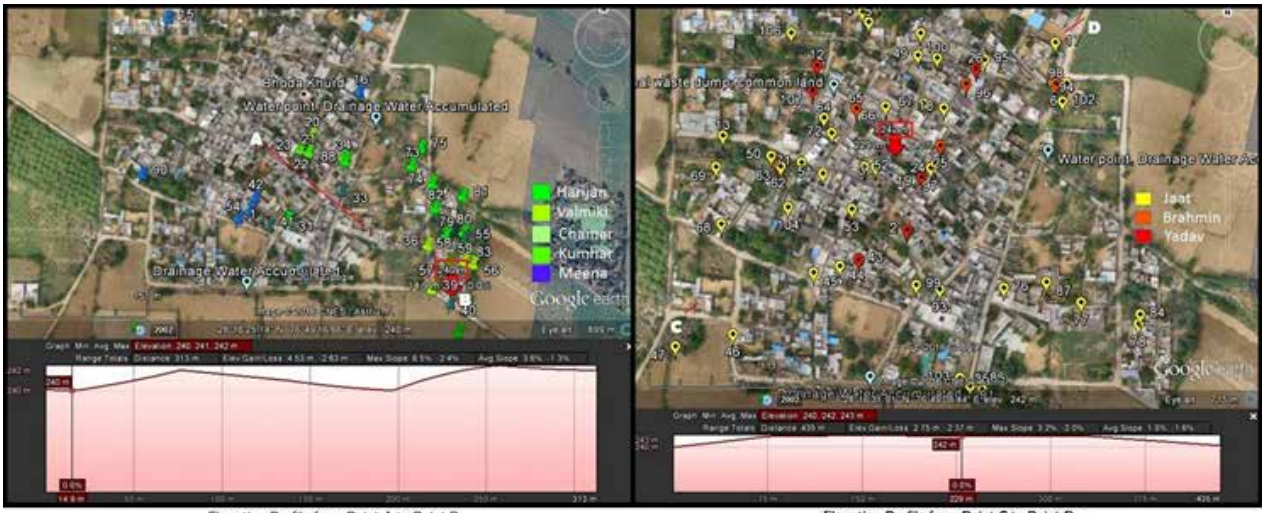
Problems Reported

- 71 households reported improper water drainage and 38 households reported lack of general cleanliness and unavailability of dustbins for waste disposal. These are some of the major problem faced by the village.
- The study also found that there is no dedicated building for Panchayat meetings since the land allotted is swampy, soiled with animal waste. This was visually evident during aerial mapping as well.
- Further, due to improper drainage leading to accumulation of waste water, the households reported to have suffered from common water borne diseases like Typhoid, Diarrhoea, Chikungunya and Malaria in the past three months.
- Lack of public transport from the village, unavailability of the public health center and frequent power cuts were some of the other problems stated by the village households.

Topographical Profile

The elevation differences in the village area, which are significant in geological terms, are crucial for understanding the drainage failure in the village, and for providing evidentiary explanations behind water accumulation at certain points.

Figure 3: Topographical Profile



Elevation Profile from Point A to Point B:
Depicts drop in elevation and clustering of lower caste households

Elevation Profile from Point C to Point D:
Depicts elevation gain in the centre by 2.75 m and distribution of dominant caste households

The elevation profiles of the Bhora Khurd residential area reveals the following:

- In general, the elevation around the perimeter of the residential cluster is 238-240 metres above sea level which is lower than that in the centre. For example, the elevation of the southern perimeter is 238 metres above sea level. The elevation gain from south-west corner to the centre of the village is 2.75 metres, with elevation at the centre ranging from 241 to 243 metres above sea level.
- As expected, the areas where drainage water is accumulated are at a lower elevation, ranging from 238 metres above sea level to 241 metres above sea level.
- The topographical profiles were also compared with demographic distribution of the households. The south-eastern part of the residential area where lower castes are clustered is at a lower elevation (240 metres above sea level) and witnesses frequent accumulation of drainage water, hinting at a more systematically-entrenched form of discrimination (Figure 3).

Significance of the Study and the Way Forward

As indicated above, absence of proper drainage system and failure of existing drainage lines due to uneven topography of the village area emerged as one of the most apparent problems in the village. The population distribution is based on the social stratification of the village and the location of the lower caste households is at a topographically disadvantaged area as compared to the upper castes or the dominant castes.

However, the Sarpanch had not been able to get a Gram Development Plan approved for fixing the drainage system or utilising the common land in absence of conclusive proof. The map provided by the Patwari which depicted land distribution in the village, did not include details on the elevation or the actual and real-time use of the land.

Evidentiary proof of failure of drainage system owing to the area's elevation profile which was captured through geo-referenced aerial maps (KMZ files) and orthophotos in this study was shared with the Village Sarpanch along with demographic distribution and analysis of data collected from households on access and availability of basic infrastructure resources. This helped the authorities in identifying and visualising priority areas for development plans. With the help of the compelling report and visual evidence the Block Development Officer would take the necessary steps such as levelling of land.

The intention of this was to work in partnership with local authorities and state governments in order to propel on-ground work through effective policy measures. The challenge remains in scaling the use of UAV technology owing to the ethical considerations and the legalities centred on gathering geo-spatial data. However, with the ability to integrate on-ground insights and operationalize the information through the effective use of geo-spatial technology will change the way evidence-based policy is current practiced. Inaccessible geographies which remain beyond the purview of door-to-door enumeration can now be gauged, mapped and produced on visual platforms to understand resource oriented gaps and eventually lead to better governance.

Mahima Taneja, Samayita Ghosh & Nishmeet Singh