

DIGITAL PHOTOGRAMMETRY REACHES GRASS ROOT LEVELS IN INDIA

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ABSTRACT:

Revenue surveys initiated by East India Company towards the end of 18th Century remained the responsibility of Survey of India established in 1767 till 1904 and later came under the State government Departments.

Starting 1949, attempts have been made to use aerial photography for cadastral surveys. Digital photogrammetry emerged as the most efficient technology for mapping large areas for cadastral surveys. Amendment to the existing Act in 1995 by government of Andhra Pradesh allowed for public-private partnership in cadastral surveys. As a result of this, the first Integrated Land Information System (ILIS) project using photogrammetry materialized and has reached successful completion stage in 2008.

In this project, about 6000 sq km area is involved. In the field, ownership boundaries have been identified on the ortho images. Using the laptop computers, the surveyors produced Land Parcel Maps (LPMs) with an accuracy of 20 cm in position. What is most interesting in this project is delivering latest LPMs to owners within 24 hrs of ground visit with all the measurements and other details.

Cost under ILIS has worked out to less than Indian Rupees 700 per hectare (one US \$ = Indian Rupees 39 approx). Governments in India are planning to take up over 500 districts in India using this technology in the coming years. Digital Photogrammetry thus has emerged as the most efficient and cost effective model while providing land base vital to various development activities and generating huge employment in rural areas in particular.

1. INTRODUCTION:

The first objective this paper is to give a brief overview of the attempts made from time to time to develop an appropriate methodology for cadastral surveys in Indian conditions. The second objective is to present the recent successful project results using aerial photography and photogrammetry for Nizamabad district in India covering about 8000 sq km.

Various methods have been in operation from time to time and pilots have been undertaken using modern technologies. This paper focuses on the aerial photo based methodologies and discusses the Nizamabad project under Bhoo Bharati scheme of government of Andhra Pradesh reaching completion stage.

Attempts to use aerial photography were made in 1929, 1945 and 1954 by Survey of India to produce revenue maps. Based on the recommendations of All India Cadastral Surveys Conferences, Survey of India undertook a pilot project covering 8000 hectares consisting of 16 villages in Goa during 1969-71 under United Nations Development Programme. Photogrammetry methodology using 1:6700 scale aerial photography was employed. The project was technologically successful. But there were some hurdles in implementing at national level.

Angul-Nalco cadastral survey Project in Orissa funded by the government was taken up by Survey of India in 1991-93, using 1:10,000 scale Aerial Photography covering over 300 villages. In this case also some hurdles prevented in adoption of photogrammetry for cadastral surveys on a wider scale. Similar attempts were made to use cost-effective approaches of photogrammetry in some other States of India.

Land records remained out-of-date by several decades in all the States of India depriving proper titles to owners and adversely affecting development projects, with increasing Land litigation cases.

2. DIGITAL PHOTOGRAMMETRY & PPP

As Digital photogrammetry emerged as the most efficient technology for mapping large areas, experts and planners considered this approach. Amendment to the existing Act in 1995 by government of Andhra Pradesh allowed for public-private partnership (PPP) in cadastral surveys. As a result of this, the first Integrated Land Information System (ILIS) project under Bhoo Bharati scheme using photogrammetry materialized in 2005.

Based on the available results of photogrammetric surveys, experts favoured the scale of 1:10,000 for rural areas. For urban areas, 1:4000 scale was adopted in view of accuracy requirements.

National Remote Sensing Agency flew GPS-based aerial photography on 1:10,000 scale and created digital ortho images for the District of Nizamabad.

The total area of Nizamabad district is about 8000 sq. km of which forests cover 1700 sq. km area, constituting 221% of the total district's area. Speck Systems, a Private Company was involved with field operations and development of required spatial data bases.

3. METHODOLOGY

The process involved the following major steps:

- Aerial Photography on scales 1:10,000 and 1:4,000 using RMK TOP 30/23
- Providing Ground Control Points using DGPS
- Generation of digital Ortho images on UTM projection and WGS84 datum for entire district excluding forest and water areas
- Generating images on scale
- Identification of ownerships on the ground in the presence of owners
- Total Station Survey where identification on images was not possible
- Generating Land Parcel maps (LPMs) with measurements and other field collected information on laptops in field
- Delivering the LPMs to owners
- Title process

Initially, there was a lot of movement of persons and records between Nizamabad and Hyderabad (about 200 km) causing delay in distribution of LPMs to owners. In this approach, persons demarcating parcels on the ground were different from those transferring from bromide prints to ortho images. After experimenting with several methodologies/approaches a modified model/approach has been evolved and streamlined for field work.

Field teams are organized in the following manner :

- Demarcating parcels on ground and identifying them on the bromide print
- Transferring boundaries from bromide print to ortho images on Lap top and generating land parcel maps

Ortho Image in the field



Farmer showing boundary



In this model farmers generally got LPMs within 24 – 48 hours and they are happy about it. When farmers are helping the demarcation work by comparing with bromide print they are excited to identify micro-details in their farms on the photographs. In the past it used to take several months/years to supply LPMs. Villagers are not able to believe that parcel maps can be made available within such a short time after ground survey, that too in India. Their confidence levels have gone up because of the scientific and transparent approach

In the new model, persons who demarcate on the ground and transfer from bromide print to ortho image are the same, thus ensuring accuracy, efficiency and saving of time.

Total Station is used for village boundaries and for surveying such details which are not identifiable on the photographs. It was interesting to know that one team completes about 70 acres per day, perhaps the out-turn of traditional survey team in one month. In April 2008, 1,50,000 acres have been completed, indicating improved out-turn with experience. Another interesting aspect is that there are 25 Lap Tops with printers available with the survey teams in the field area for providing on the spot village maps. This project has created employment opportunities to the rural areas and also the opportunity to work on their lands. Local knowledge proved to be a plus point in these operations.

The feed back points obtained from the villagers based on the distributed LPM are promptly attended and rectified to the extent possible. Objections on LPMs was a mere 1.6% thus establishing credibility of the adopted system. This speedy and efficient system of service has provided a high level of satisfaction to the farmers.

Thus, the efficient technology of Digital Photogrammetry has reached grass root levels to serve the villagers/farmers and help development projects – a most important mapping need of the country.

Whenever Resurveys/fresh surveys are done, particularly after decades of gap as in India, the present data will not agree with old data. Acceptance of the owners should be made legally possible. This has to be tackled under the existing rules or new rules, to ensure eventually clear and proper title to the owners.

4. ACCURACY ASPECTS

For Rural areas: Prescribed accuracy of the linear measurements better than 0.25 m, with a confidence level of 90% for distances within 1000 m

For urban areas: Prescribed accuracy of the linear measurements better than 0.25 m, with a confidence level of 90% for distances within 1000 m

Tests done on the ground by measuring 10 distances on the ground with Total Stations and compared with Photogrammetry derived measurements.

90% agreed within the prescribed limits. However, the identification of point on the ground and in the image is very critical in determining the accuracy. Therefore, the points selected in the field for measurements must be properly documented in the form of simple field sketches for accurate identification on orthoimage in the laboratory.

5. COST ASPECTS

In Nizamabad Project, the cost works out to Rs 500 per hectare. Encouraged by this experiment the government approved ILIS projects for five more districts of Andhra Pradesh. It is possible to complete the LIS for the whole country in five to ten years through PPP system.

Considering the average cost of rural land as one million Indian Rupees per hectare and other numerous benefits of ILIS, the investment on ILIS is a fraction and is insignificant. This approach can be adopted in other countries where resurveys are required to prepare LIS. This approach is not only economical and speedy but also helps in providing proper land ownership title, an important need of the society.

6. CONCLUSIONS

The paper briefly reviewed the experimentations carried out in India for cadastral surveys in the past four decades. Traditional ground surveys using measuring chain/Plane Table, Analogue photogrammetry techniques, Simple Rectified aerial photo techniques, DGPS & Total Station based ground surveys and finally Digital Photogrammetry methodology have been examined. Based on the case study of Nizamabad District in Andhra Pradesh (India) with an area of 8000 sq km using digital photogrammetry, it has become clear that the hybrid methodology using combination of Digital Photogrammetry, DGPS and Total Station yielded best results in terms of cost, accuracy and efficiency. A different strategy may be needed for forested areas. Thus India is on the verge of implementing land survey projects at national level, using digital photogrammetry and involving grass root level population in the field tasks.

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