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Applications of Cadastral Geo-Database for Rural Development of Ieeja and Waddepally Mandals in Jogulamba Gadwal District using GIS & Remote Sensing

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Abstract: As rural economy is a backbone of our country, decentralized planning is the need of the hour. For rural development, village level, spatial database which is efficient, reliable, cost effective, scale independent, capable of adopting information from various sources and compatible to the other information systems is essential. The development of an efficient land information system (LIS) requires accurate, up-to-date and standardized digital cadastral maps and high resolution satellite data for geo-referencing of cadastral maps. In Telangana State which is newly formed 29th state of India, has 10,919 cadastral villages. In this State for implementation of schemes at village level, an accurate village database is lacking, which is primary information for all the development activities and flagship programs of the Government.

The main objective of this study is creation of village administrative layers of Telangana State for effective decentralized planning. The hard copies of cadastral maps were in brittle condition, not clearly visible, with Folds, enlargement and stitching problems, which are ironed then scanned to Digital format. The scanned maps are digitized and then parcel attribute information is attached in GIS platform. The GIS layer formed is Geo-Referenced with WorldView-3 (30cm) Satellite data. The GIS cadastral layer of each village is mosaiced with the surrounding villages up to mandal/district/state level. The village level Adangal/Pahani data is linked to the individual parcels of each village.

The Cadastral Geo-Database has the historical information, which is useful for renovation and planning of the village infrastructure, such as roads, tanks (Mission Kakatiya), Government lands, Dry & Wet lands and Forest lands. The database could be put to use for efficient revenue generation through collection of property tax and to facilitate the implementation of Govt. Schemes. There are many other applications of the Geo-Database, if it is integrated with soil database, it helps in making farm level agricultural planning and strategies for recommending suitable crops and soil & water conservation measures, which can be further used in providing soil health cards to each individual farmer.

I. INTRODUCTION

Most human activities and developmental efforts are based on land. Therefore a systematic record of land and rights are vital for public administration, planning, land development and transactions. The increasing growth in rural population and the massive migration of people to the cities especially in the developing countries like India have put increasing pressure on rural and urban lands. Therefore a systematic record and rational use of the land should be of prime importance to planners and policy makers. Again, accurate and efficient land records information system is necessary for appropriate resources management and tackling environmental problems. All these emphasize the need of proper records of land parcels and their ownership.

An information system may be formally defined as a combination of human and technical resources, together with a set of organizing procedures that produces information in support of some managerial requirements (Dale and McLaughlin, 1988). Data are raw collections of facts. Data relating to Land may be acquired and held in alphanumeric form (written in notebook and surveyors field books) or graphically (maps or aerial photographs), or digitally (electronic methods). To become information, the raw data must be processed so that it can be understood by a decision or policy maker and administration.

The operation of a Land Information System (LIS) includes the acquisition and assemblage of data, their processing, storage, maintenance retrieval, analysis and dissemination. The usefulness of such a system will depend upon updation, accuracy, completeness, and accessibility. It is important to consider the extent to which the system is designed for the benefit of the user rather than for the producer of the information.

2. AREA OF STUDY

The study area falls in Ieeja and Waddepally Mandals, which are situated in the south-western part of Jogulamba Gadwal District (Fig. 1). These Mandals lie between 15° 58' 37.460” and 16° 0' 40.119" North Latitude and 77° 30' 42.709" and 77° 30' 42.709" East Longitude. The area of Ieeja and Waddepally mandals is 415.54 km2. It is bounded by Maldakal mandal to the north, Rajoli mandal to the south, Karnataka state to the east, and Manopad mandal to the west.

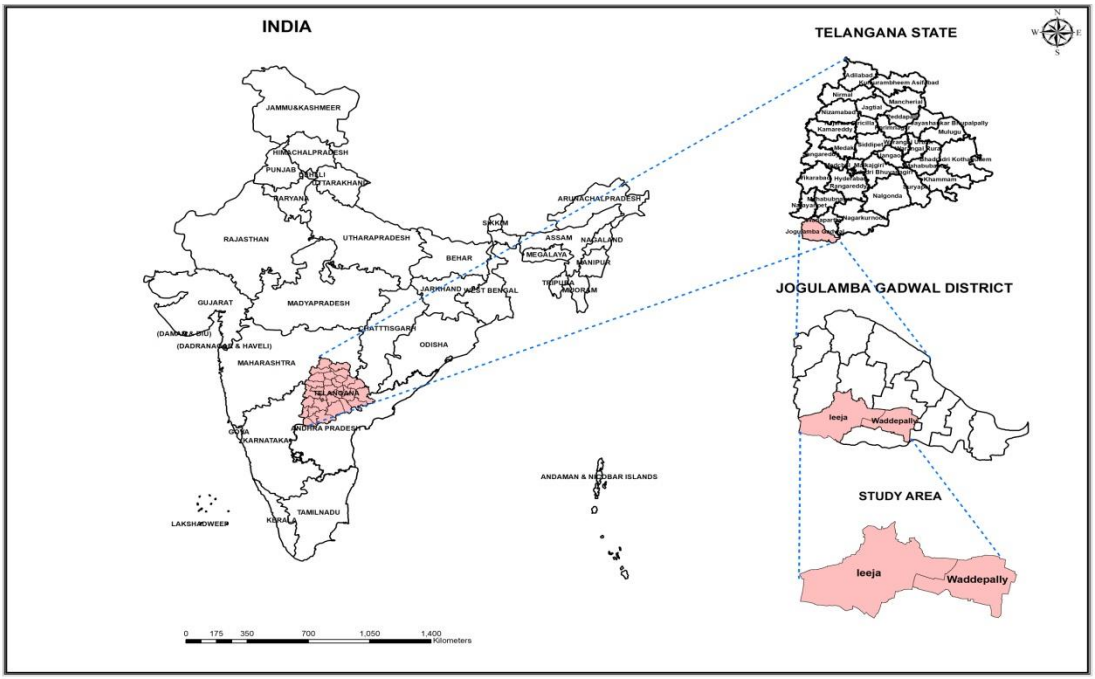

Fig. 1. Location of study area

3. OBJECTIVES OF STUDY AREA

- Identification and Geo referencing of the existing cadastral maps of the study area.
- Integration of dynamic spatial and non-spatial data to individual plots.
- Analysis of accessibility to natural assets and spatio-temporal variability of the potential of the plots.
- Validating the Integrated Geo-Cadastral Database for seasonal updates

4. MATERIALS AND METHODS

The methodology used in the present study is shown in Fig.2. Initially, the cadastral maps of the villages were collected from the Land Record Department (LRD). The cadastral maps were scanned and converted to vector format in GIS environment. The digitized cadastral maps were integrated with attribute data of parcel numbers. Digital cadastral data is Geo-Referenced with fused image of WorldView – 3, 30cm resolution.

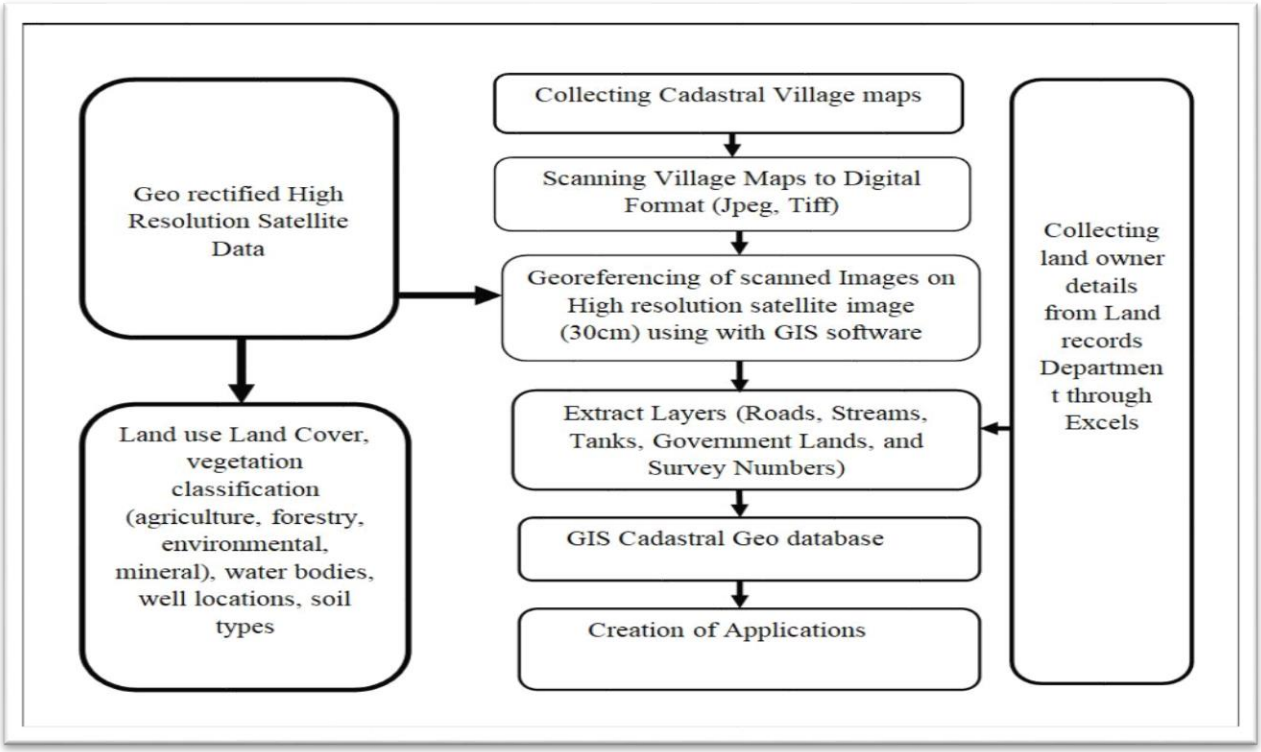

Fig.2 Flow chart showing the geo-referencing of digital cadastral maps

4.1 Scanning of the analog maps (converting analog to raster images):

The cadastral maps are scanned using A0 size raster scanner. While scanning, the-important parameter DPI (Dots per inch) has to be precisely set. The DPI is set based on drawing characteristics and information required. In general, following minimum specifications should be adopted while scanning the cadastral sheets. Maps are scanned at 100-200 DPI Black/White (8 bit gray tone) modes depending upon the density of the features. If all the details are not picked up during scanning, the scanning parameters are changed to 400 DPI on 24-bit color. While scanning, the sheet has to be fed-in straight upright position and smoothened so that any fold is not generated while scanning. In the flat-bed scanner, the map has to be laid flat on the glass, smoothened and scanned. In the process, bulging, folding, Enlarging should be avoided

Fig.3 Enlarged Image

Fig.4 Folding and Gaps of Image

The raster image of scanned map stored in TIFF format (*.tif) in Fig.3. The scanned map is oriented upright (North oriented). The scanned map is cleaned and checked for free from noise (unnecessary pixels or darkness in the image) in Fig.4. To remove the noise, de-speckling is applied. The measured length and width within the bounding box of the scanned map is maintained to +/-0.1% of the map manuscript measurements. The scanned image should not be skewed or warped. If there are any, it should be de-skewed or necessary correction should be applied or re-scanned. The scanned image should not have any line dropouts or stretched pixels, in such case it has to be re-scanned.

4.2 Geo-referencing:

Geo-referencing can be defined as the process of transforming the data from one grid system (image row and column coordinates) into another (map coordinate system) using an nth order polynomial. For geo-referencing the cadastral map, sufficient number of GCP's with real world coordinates is required. This can be done through primary or secondary sources. The primary sources consist of three modes, ground control survey, topographical maps and coordinates obtained from GPS. The secondary sources consist of aerial

images or high-resolution satellite images. The very high-resolution space images available today and planned in the near future have spatial resolution close to that of aerial images. The high-resolution satellite images are rectified using the control network derived from topographical maps. The other source for deriving the real world coordinates is GPS which uses geodetic coordinate system based on WGS 84 Ellipsoid and provides coordinates on any point on earth's surface. The Everest spheroid is used as reference surface in India. Transformation models are used to transform coordinates from one system to another system.

4.3 Geo-referencing of cadastral map using High resolution Image:

In this case, topographic map of the study area is used as a referenced map in geo-referencing the WorldView-3 Image. Then the cadastral map is geo-referenced using WorldView-3 Image. In geo-referencing, same points both on WorldView-3 Image and in village cadastral map are considered. As the topographic map of the study area is correctly georeferenced, the co-ordinates of the WorldView-3 Image to cadastral map are fixed; there by the cadastral map is geographically referenced. For this study, third order polynomial is considered for more precise than the previous orderings. The digital cadastral layer overlaid on rectified WorldView-3 Image is shown in Fig. 5.

Fig.5.Vector layer overlaid on rectified WorldView-3 Image

4.4 Cadastral Map Preparation:

The digital cadastral map, the fundamental component of cadastral system, is not a map in the traditional sense. A basic cadastral map is organized into layers such as parcels, roads, rail, tanks, etc. In the present work, from the scanned cadastral map, digital cadastral map is prepared by digitization method in GIS environment. The digitized cadastral map of Ieeja and waddepally villages is shown in Fig. 6. Then the digitized cadastral map is converted in Shape file to create the topology and to calculate the areas of land parcels. The vector layer of the cadastral map with attribute information is shown in Fig.7.

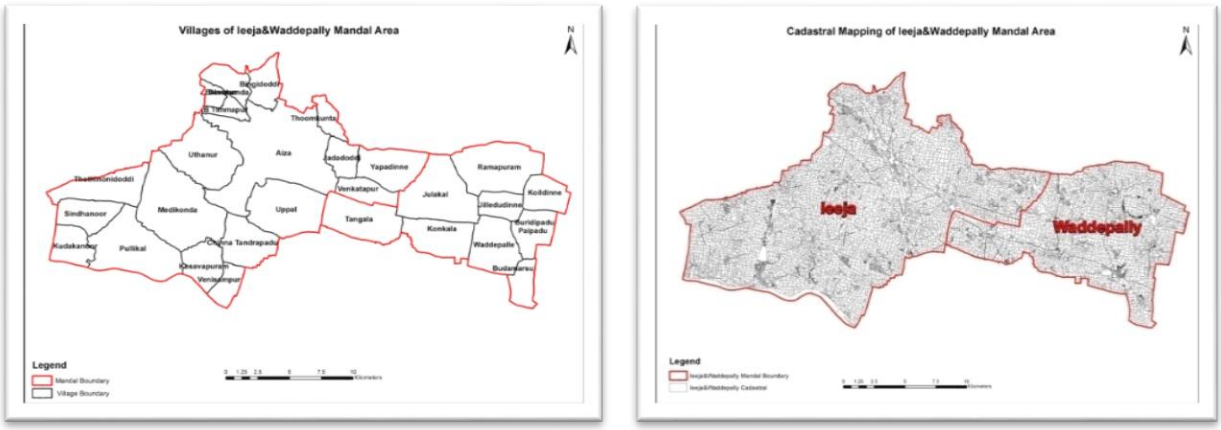

Fig.6.Digitized Cadastral map and Layout of Ieeja&Waddepally Mandals

Fig.7 Attribute information of Yapadinne village

4.5 Village/Mandal/District wise Mosaic:

After geo-referencing the cadastral maps to the required accuracy standards, a number of maps are mosaic at the next higher administrative level. Mosaics of polygon, line and point features of Cadastral maps are generated at the Halka, Mandal and taluka levels. The village boundary maps are generated up to taluka, district and state levels. While mosaicing, feature continuity as well as attribute accuracy is maintained. These are the final products of geo-referencing of cadastral maps (Fig.8). These products are directly linked to LIS and GIS databases. The village Adangal/Pahani data is linked to the individual parcels of each village.

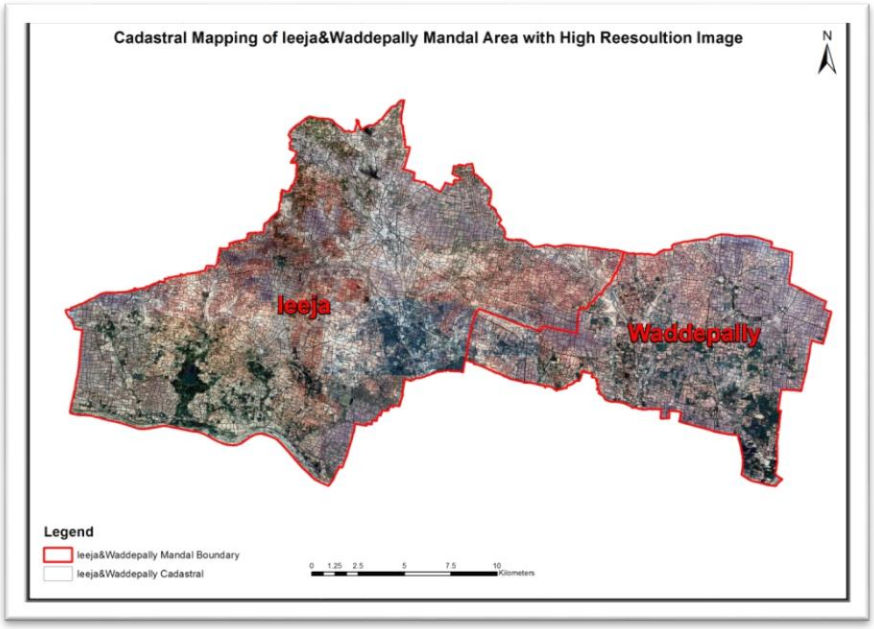

Fig.8 Ieeja and Waddepally Mandal Mosaic

5. RESULTS & DISCUSSION

Use of Cadastral Information in Asset mapping:

The Cadastral Geo-Database has the historical information, which is useful for renovation and planning of the village infrastructure, such as roads, Tanks(Mission Kakatiya), Government lands, Dry &Wet lands and Forest lands. Integrating captured assets with cadastral maps in web portal, enabling environment is useful for activity planning of various schemes according to survey number.

Cadastral map for soil health analysis:

There are many other applications of Geo-Database, it is integrated with soil database, it helps in making farm level agricultural planning and strategies for recommending suitable crops and soil & water conservation measures, which can further used in providing soil health cards to each individual farmer. It provides a qualitative assessment of soil health. Its purpose is to use indicators that assess each soil's ability to support crop production within its capabilities and site limitations (Fig.9).

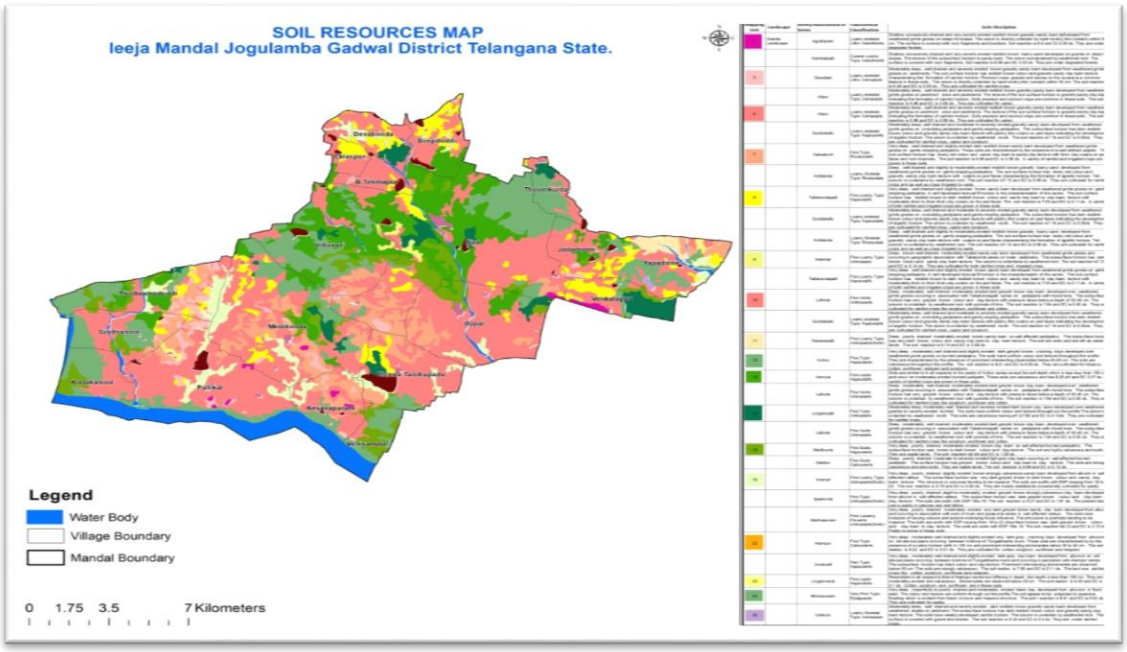

Fig.9 Soil health map of Ieeja mandal

6. SUMMARY & CONCLUSION

Cadastral map shows the boundaries of all land parcels on large scale maps together with the village registers which contains the ownership, land use details. Updating the cadastral information is very essential so that transformations/changes of ownership of parcels etc. can be recorded in an orderly manner for documentation and further use. Presently, the cadastral maps are being updated with high resolution remotely sensed imageries using Geographical Information Systems (GIS) and Global Positioning System (GPS). Present paper discusses Cadastral maps preparing with GIS Techniques for various applications like Mission Kakatiya, National Soil Health Information, Asset mapping. Cadastral information updating and linking with different departments databases like Agriculture (Farmer, cropping details), Forest, Irrigation (Tanks, canal, Stream, River) would be useful for comprehensive analysis and for efficient implementation of various schemes by the departments.

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