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A GEOSPATIAL FRAME WORK FOR MAPPING OF APPROXIMATE CADASTRAL SUB DIVISIONS IN JONIGANURU VILLAGE, SANTHIPURAM MANDAL, CHITTOOR DISTRICT, ANDHRA PRADESH - AN INITIATIVE

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ABSTRACT

The digital cadastral map is the fundamental component of any cadastral system and used for legal, administrative and economic decision making as well as an aid for planning and development. The main objective of the study is to establish methodology for fixing of cadastral sub-divisional boundaries of Joniganuru Village, Santhipuram Mandal, Chittoor District, Andhra Pradesh. To attain this, village cadastral maps, Field Measure Books (FMB) and Adangal records have been used. This paper mainly elaborate the methods used for producing and updating the sub divisions of cadastral map. It investigates the use of High Resolution Satellite Imagery (HRSI) and Differential Global Positional System (DGPS) were vital elements in timely maintaining many of the cadastral maps in GIS. The abilities of remote sensing imageries in sub parcel mapping are evaluated using World View-2 satellite data. With the above background, this paper highlights the process of integrating legal and geometric sub-divisional cadastral information to develop a new digital sub-divisional cadastral system. The study reveals that the sub-parcel wise geo-coded information serves the administrative mandates, maintaining up to date database, assigning values for taxation, addressing rural development, management and services to citizens. The study indicates that the adopted technology can be extended to other areas of the state and updation work can be done in a limited time.

KEYWORDS: Cadastral Mapping, Remote Sensing, HRSI, DGPS, GIS, Sub Parcel Mapping.

INTRODUCTION

The cadastre is a public record of location, extent, value and ownership of land in a village or a district. Updating cadastral information is very essential for recording land ownership and property division changes in a timely fashioned manner. Recent decades have witnessed a rising interest in cadastre, accompanied by the production of a vast amount of work, not only on cadastre but also on related domains, such as registration of property rights and geographic and land information systems. The information revolution has a great potential to support the complex decision making demands of sustainable development. A cadastral map shows the relative location of all parcels in a given village (Kumar et al, 2013). Cadastral maps are indispensable tool for the administration in dealing with day to day revenue and development activities in the state. Any current or future property registration system must be viewed within the larger context of land rights and should be designed to support the massive transfer of land from state to private ownership. This transfer defines the most immediate needs in terms of sub-parcel demarcation, delineation and registration, as the current cadastre maps are some decades old.

The implementation and modernization of field measured books and registration systems have been key components in a number of economic development projects in many parts of the world. The cadastral system is providing a core of information for a multipurpose usage by a variety of users without directly involved in the cadastral system or land administration. Computerization of map and parcel data can enhance the capability to manage, analyze, summarize, display, and disseminate geographically referenced information. Working with digital cadastral maps, cadastral sub-division and tabular related data in a GIS, users can selectively retrieve and manipulate layers of parcel and spatial information to produce composite maps as per their need. Sharing GIS files over internal or external data network makes parcel maps and related attribute information widely available, and reduces the duplication of

effort inherent in separate map systems. Such sharing becomes increasingly sophisticated, ranging from allowing users to download data or prepare maps, allowing users to make required queries that may draw on the power of the crowd GIS's software and hardware. In the present the study an attempt is make to generate approximate sub-divisional parcel boundaries of a cadastral map by using geospatial techniques and develop a web application at field level to create a facility for brows and query functions through a user interface.

REVIEW OF LITERATURE

The developments in the field of Geographic Information System (GIS) technologies have given a new insight in addressing a variety of land development, management, and planning activities for better use of land in resource management. The High Resolution Satellite Imagery (HRSI) is showing its usefulness for cadastral surveys due to which traditional cadastral and land registration systems have been undergoing major changes worldwide (Zahir and Muhammad, 2012). The traditional surveying concept has taken up into new shape from discipline oriented technologies, such as geodesy, surveying, photogrammetry and cartography into a methodology oriented integrated discipline of geo-information. Such methodologies are based on Global Positioning System (GPS), Remote Sensing (RS), and digital photography for spatial data acquisition (Tuladhar, 2005). Rao et. al., (1996) has been demonstrated overlaying of cadastral maps over the merged product of IRS 1C PAN and LISS III data. Similar study has been carried out by Raju et. al., (2008) stated that the potential of very high resolution satellite data is high in urban cadastral mapping. Greenfield (2001) evaluated the accuracy of digital orthophoto quadrangle in the context of parcel based GIS; Singh (1998) has discussed different issues associated with Land Records and modernization of the same. Kumar et. al., (2013) has been demonstrated updation of cadastral maps using high resolution remotely sensed data.

STUDY AREA

The study area, Joniganuru village is located in Chittoor district of Andhra Pradesh state. It lies between the longitudes from 78°22'17" E to 78°23'29" E and the latitudes from 12°52'18" N 12°53'11" N and shown in figure-1. The village has almost flat terrain and covers an area of about 306 acres.

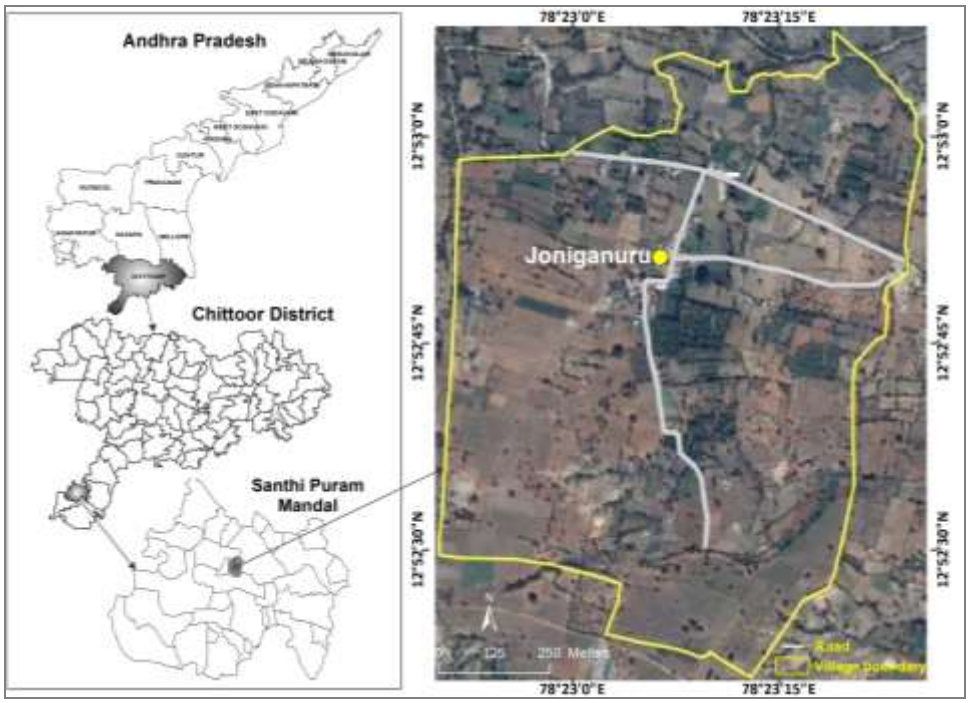

Figure 1: Study Area

OBJECTIVES

The main objective of the study is to determine a selective methodology for mapping of approximate geo-referenced sub-division parcel boundaries of each survey number in cadastral map using high resolution satellite data together with field data and to create a facility for brows and query functions through a user interface.

METHODOLOGY

The mapping of approximate geo-referenced sub-division parcel boundaries of the study area goes through several distinct stages. The first is data collection and conversion, the second is editing & geo-rectification with HRSI data and final is geospatial database development as well as create a facility for brows and query functions through a user interface. The cadastral map was acquired from Survey Settlements and Land Records (SSLR) department in paper format, scanned and parcel boundaries were digitized. World View-2 PAN & MSS images were acquired and separately geo-rectified with collected GCP's in conjunction with Digital Elevation Model (DEM). These two images were geo-rectified separately and merged for final fusion product generation using ERDAS Imagine software (Rao et. al., 2014). After the finalization of satellite data, the digitized vector parcels were transformed on satellite data by using affine method of transformation tool in the GIS environment (NRSC, 2011). Geo-referenced parcel maps were prepared and printed on 1:1000 scale for demarcation of each sub-division in the field which is required for easy identification by the surveyors. During field visits stakeholders, land agency officials, land owners, and tenants are involved. The comprehensive methodology used in the present study is shown in figure-2.

DATA USED

The old cadastral map of Joniganuru village at 1:8000 scale, Field Measured Books (FMB) and tabular data has been collected from O/o the Commissioner, Survey Settlement & Land Records Department, Govt. of Andhra Pradesh. World View-2 satellite data of PAN (0.5m) and Multispectral (2m) were acquired from National Remote Sensing Centre (NRSC). Differential Global Positional System (DGPS) is used for collecting Ground Control Points (GCP) for rectification of the high resolution satellite data.

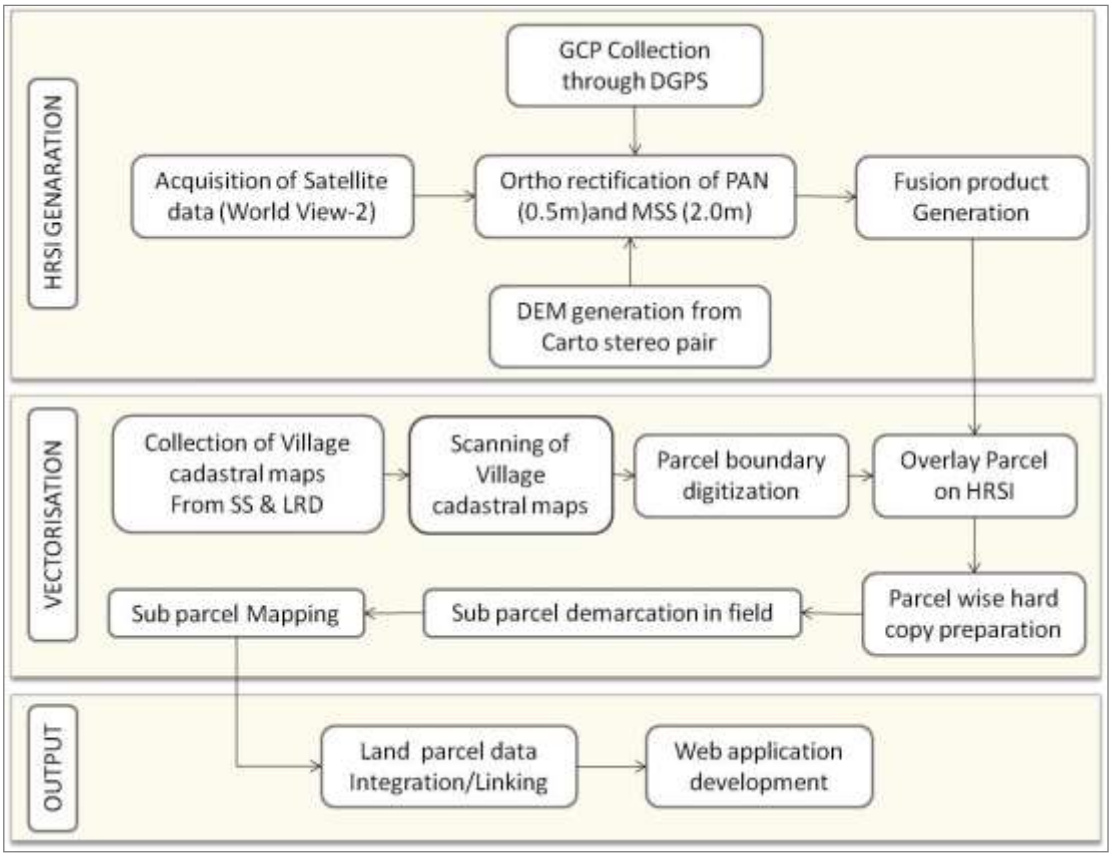

Figure 2: Methodology

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RESULTS AND DISCUSSION

In the present work, from the scanned cadastral map, the digital cadastral map is prepared by digitization method in GIS environment. The digitized cadastral map of Joniganuru village is shown in figure-3. The digital cadastral map has been geo-referenced to high resolution satellite data with 2nd order polynomial for more precise. The digital cadastral layer overlaid on rectified HRSI is shown in figure-4. During the geo-referencing, two modes of methodology are attempted for accuracy assessment in the process of geo-referencing of cadastral map i.e visual (quality) and numerical (quantitative). The visual assessment includes validation of geo-referenced map for the village and with neighborhood using the high-resolution satellite as the reference. The quantitative method includes transformation model assessment and positional and area accuracy (Murthy et al., 2003). Each polygon in the cadastralel (polygon) vector represents a parcel and it will have unique parcel number or survey number. Topology validation has been performed for creation of spatial releationship between the adjacent parcel boundaries. The methodology presented in this paper is useful to update the cadastral maps and demarcate approximate sub-divisional boundaries with low to medium accuracy.

CADASTRAL SUB DIVISIONS (SUB-PARCEL) PREPARATION

This study introduces a geospatial frame work for mapping of approximate cadastral sub-divisions by integrating existing cadastral maps, HRSI and DGPS data through GIS technique. Digital cadastral map overlaid on high resolution satellite imagery and survey number wise hard copy maps prepared on 1:1000 scale for each parcel, which is required to demarcating the parcel subdivisions in the field by surveyors. These demarcated parcel subdivisions on hard copy were incorporated in digital cadastral map. For the validation of a digital cadastral map, the survey number 25 with an area of about 10.35 acres is considered as a sample. The cadastral sub-divisional map of survey number 25 and comparison of areas with respect to Field Measured Book and GIS mapping are shown in figure-5a & 5b.

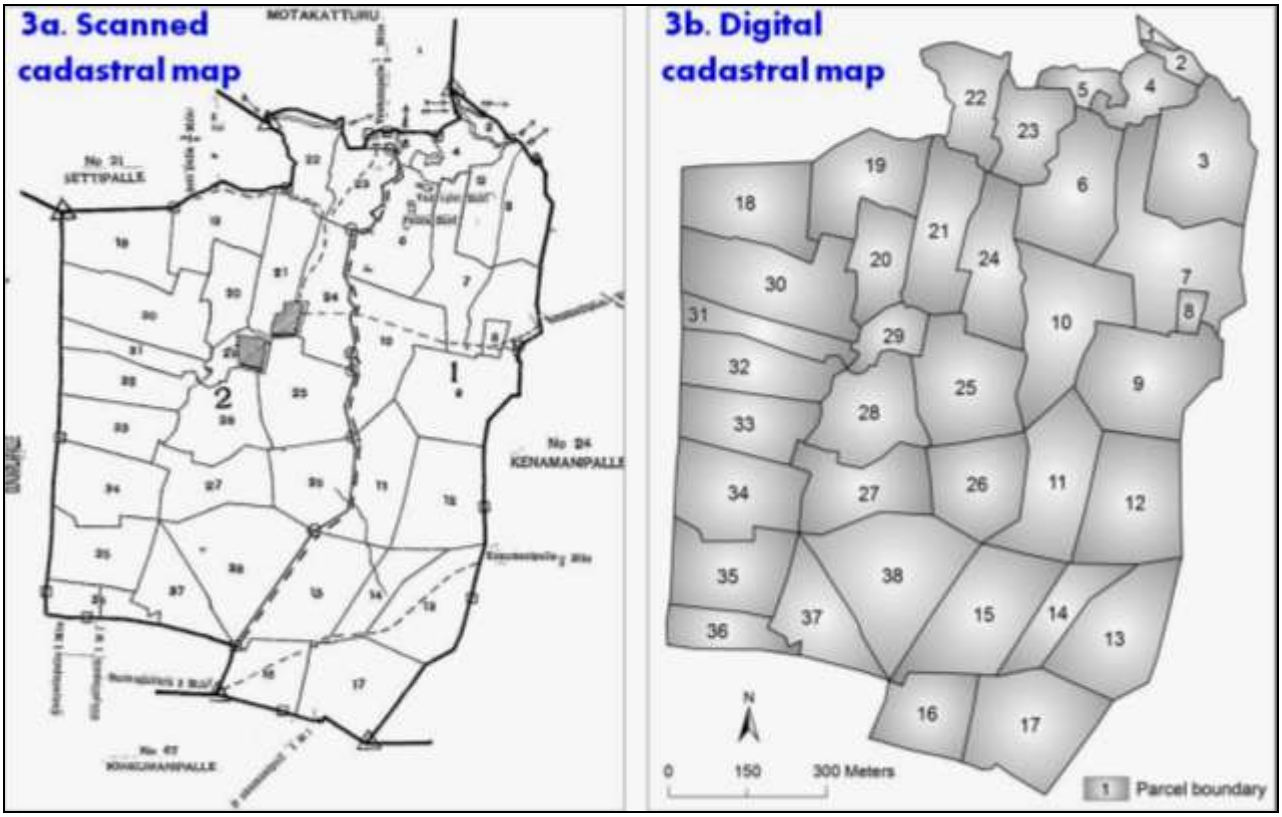

Figure 3: Shows scanned cadastral map (3a) and digitized cadastral boundaries with survey numbers (3b)

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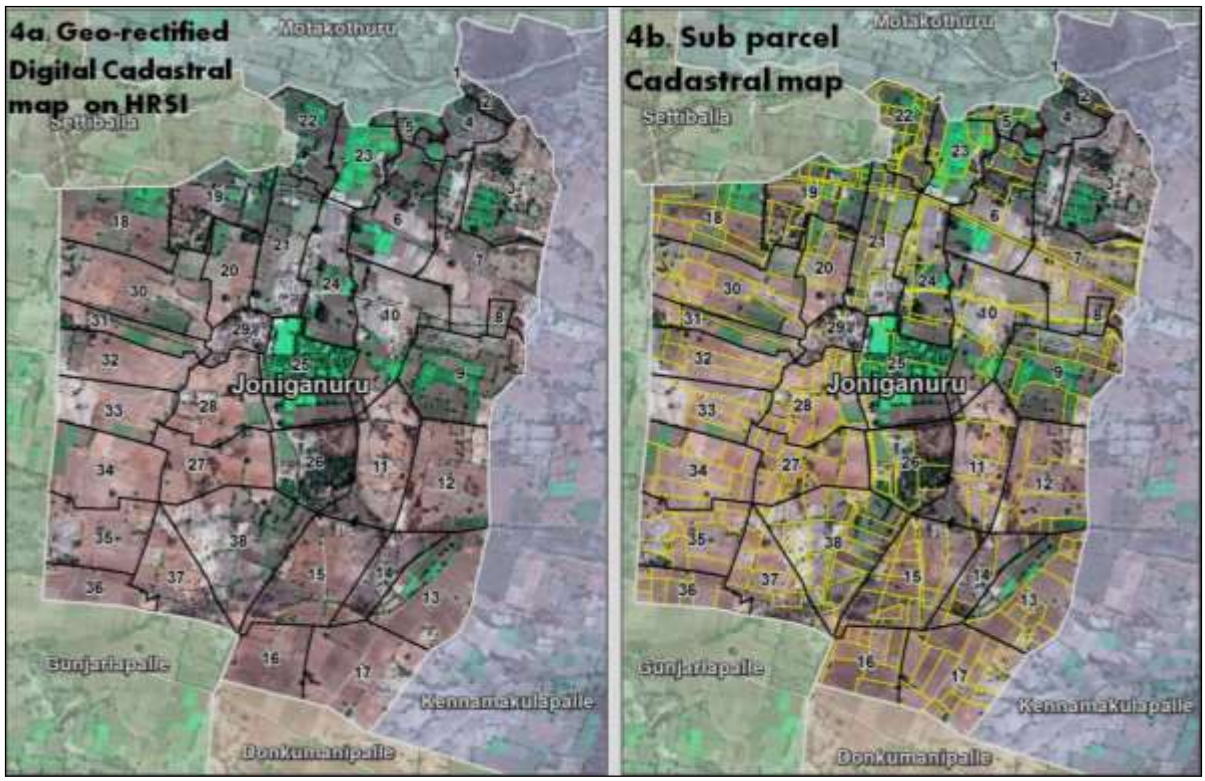

Figure 4: Shows vector layer overlaid on HRSI (4a) and sub divisional cadastral boundaries on HRSI(4b)

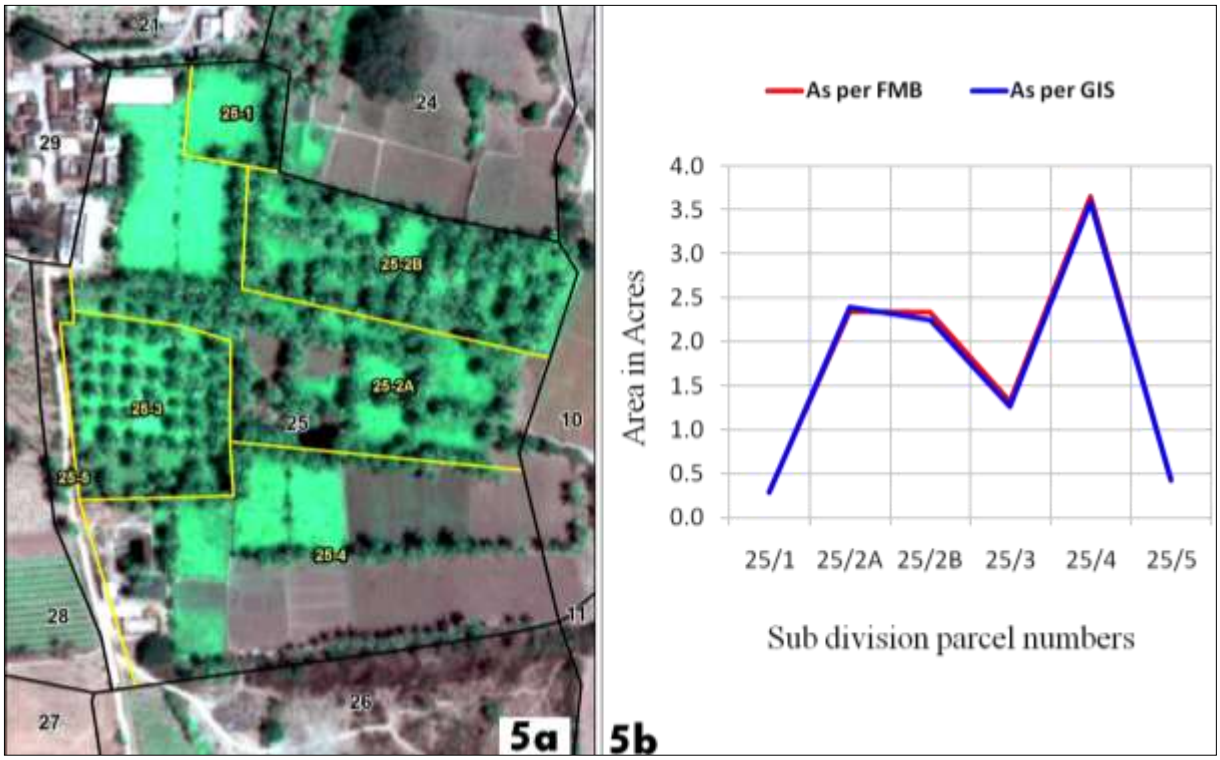

Figure 5: Shows sample sub-divisional survey number (5a) and Comparison of Area deviation with respect to FMB and GIS mapping

From the statistical analysis, it is concluded that the accuracy of parcels representation depends upon the parcel size. The large parcels are represented more accurately than the smaller parcels. it is also found that the deviation of parcels area is decreasing with increase in size. The number of sub-divisions and its areas were calculated in GIS environment. The field boundaries from FMB and the same extracted from image were compared in terms of area and shown in Table-1. The total area of the sub-divisions from the image and that of from the FMB were 10.18 acre and 10.35 acre respectively. The maximum and minimum % of difference in areas of the sub-divisions was 4.5% and 1.2% respectively.

Table.1. Comparison of areas for selected parcel with FMB and digital sub-divisions

S.No	Parcel Number	Sub-parcel Number	Area as per FMB (Acres)	Area as per digital cadastral map(Acres)	Difference	% Deviation
1	25	25/1	0.29	0.28	0.01	3.44
2		25/2A	2.34	2.39	-0.05	2.13
3		25/2B	2.33	1.24	0.09	3.86
4		25/3	1.32	1.26	0.06	4.54
5		25/4	3.65	3.58	0.07	1.91
6		25/5	0.42	0.53	-0.01	2.38
Total			**10.35**	**10.18**	**0.17**	**9.25**

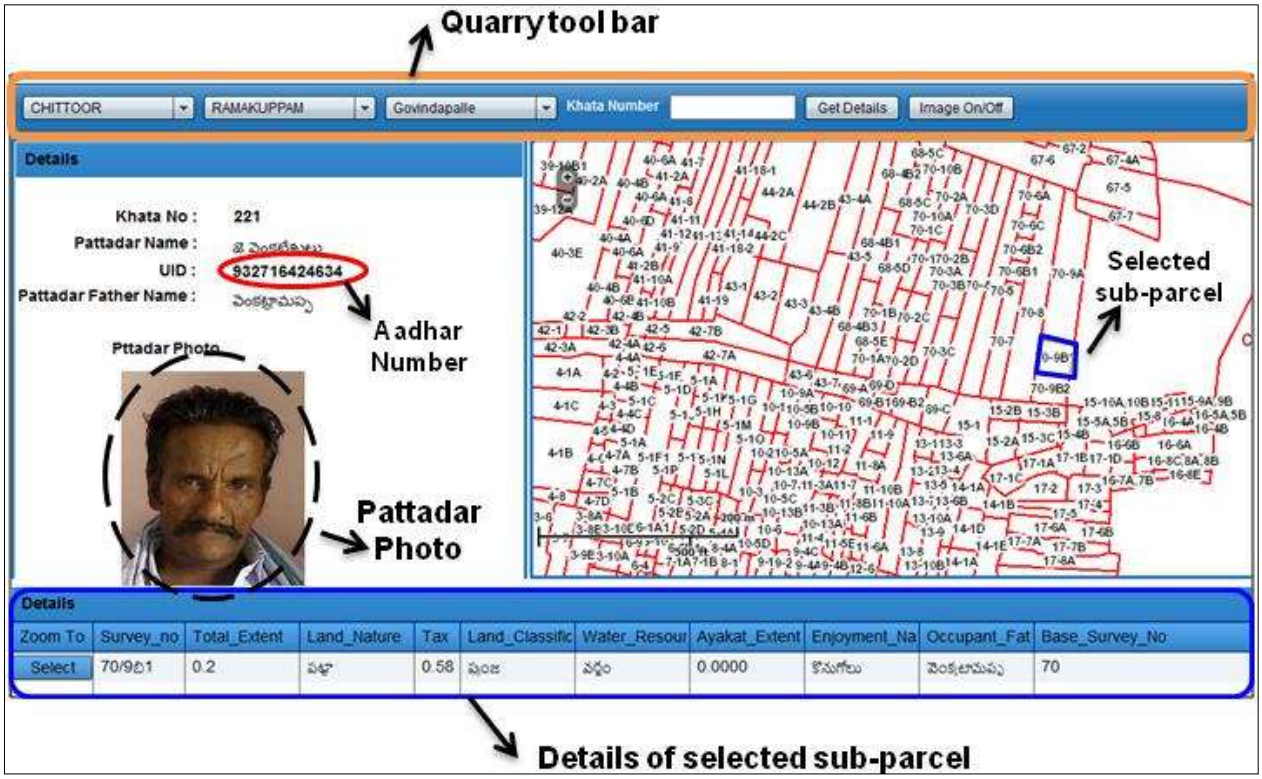

Figure 6: Shows sub-divisional boundaries along with its information, Photo and UID number

Cadastral Information System

The major component of the study is to facilitate the web enabled sub-parcel information system to the public. This will serves the administrators in maintaining an up to date database, assigning values for taxation, calculating subsidies, addressing rural development and management and providing products and services to citizens and companies. Integrating graphic and tabular data opens the way to powerful new ways of looking at and analyzing data. It is possible to access information in the tabular database through the map, or to create maps based on the information in the tabular database. For example, the area that represents a sub-parcel on a map does not tell much about the parcel except its location and shape. To find out the sub-parcel's owner, one could use the computer's screen cursor to point at a parcel on the map and display a list of all relevant descriptive information (figure-6&7). Conversely, using the information stored in the database, it is possible to create a display symbolizing the parcels belonging to one particular owner. The integrated sub-parcel information is shown in figure-6 and some of the sample screen shots have been depicted in figure-7. The Web GIS based systems provides the key for the development of modern information system. Information in this form can be easily recalled, updated and selectively manipulated. Complex data analysis and efficient data administration is only through the automated systems. The need to provide GIS based information systems with an effective capability is broadly recognized today.

Figure 7: Shows sample sub-divisional boundaries along with its information

CONCLUSION

The village maps are generally very old and need thorough updation as they have gone through various stages of manual settlement resulting in degradation of quality. The cadastral map was perceived as a static, plain view of preselected areas, available at fixed scales, but due to the advances of the geospatial technology, it is now evolving into a dynamic, continually updated network of interrelated databases with volumes of geographically referenced information linked to a comprehensive digital cadastral database. High resolution remote sensing image data shows a high level of details and it provides many opportunities to be used as base for cadastral map generation. The comparison of area derived from the image with that of field measurements book shows that the percentage of difference is negligible. It is also observed that the plot area of digitized cadastral map and the image map are matching but in case of certain plot area shows consirable variation in FMBs. This approach provided an effective technique for capturing sub-divisional cadastral data and facilitate to public dynamically. This would be extended to the entire state in future.

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