



## Integration of Web GIS and Remote Sensing for Trees Management Outside Forest

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### ABSTRACT

“Integrating of Web GIS and Remote Sensing for Trees Management outside Forest” refers to delineation of tree cover outside forests. This initiative is taken by using high resolution CARTOSAT-1 satellite imagery. This paper introduces an integrated Web-based GIS architecture by combining three levels of geographic information services. A prototype Website (Online Forest Portal) has been developed to provide easy access of analyzed geospatial information and to facilitate web –based data sharing for natural resource managers and regional park rangers. In this context, an accurate assessment of forest and tree resources is essential for formulating sound strategy for forestry sector. Forest areas using satellite Remote Sensing are used as a tool for mapping Zones.. The Web-based integration frame work emphasizes user- oriented services, distributed network environments, metadata standards, communication protocols, client/server computation and ubiquitous access for rational utilization of funds for forest management.

### INTRODUCTION

Trees are very valuable natural and renewable resource and it is difficult to understand its diverse topographic, climatic, socio-economic and its role in making the environment healthy. Deforestation is one of the major destructive elements outside forest and causes enormous damage to biotic resources, the regeneration and productivity capacity of trees is essential. Conventionally identifying the trees outside forest areas was based on knowledge and experience of the foresters by some of conservative measures. All these protective measures failed respective of all risk prone areas outside forest. Lack of scientific approach in delineating priority areas for trees has caused immense damage to the national economy. The advent of the internet and web-based geographic information systems provides a convenient and efficient way to

access and disseminate geospatial data and remotely sensed imagery. There is a great potential for using web based GIS and image tools in the areas of natural habitat preservation and environmental monitoring. This research explores to develop an updated framework for combining Web GIS and remote sensing and creating a web repository for spatially analyzed data. The present paper evaluates major components by mapping and showing their inter relationship, describing status of forest health and prone areas from lowest to highest risk. This part of study also includes web analytics and methodology towards determining the efficiency to monitor various environmental issues. Remotely sensed data is also one of the geospatial data. GIS is a vital technology supporting the various phases of risk assessment.

### OBJECTIVES

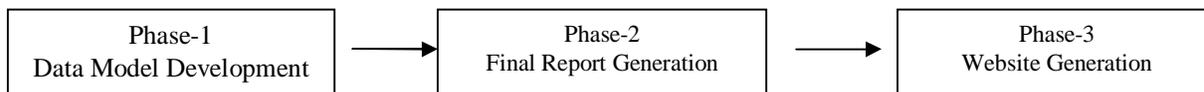
- ❖ Developing a prototype website for publishing and to access geospatial information.
- ❖ Development of GIS web based tool to integrate with remote sensing data that provides storing, retrieving, analyzing and presenting capability.
- ❖ To emphasize the user oriented services and metadata standards of the present study as well as other various analyzed reports.
- ❖ To design a web based repository for data archival.
- ❖ To investigate the delineation of trees outside forest cover in the study areas using ground truth information.
- ❖ To design and implementation of functional , explicit and user friendly menu screens for database maintenance, information query, information retrieval and query on spatial and non-database.
- ❖ To assess the effect of different land use systems on diversity of TOF.

## METHODOLOGY

### Materials Required:

Global Positioning System (GPS), ERDAS Imagine 9.3, Arc Map 9.2, Arc View 3.2, MS.Office-2007.  
 Software Requirements: JDBC, Apache Tomcat, Oracle, Microsoft Windows.

This methodology mainly includes three phases



CARTOSAT-1 is the first Indian Remote Sensing satellite capable of providing in-orbit stereo images. The images are used for Cartographic applications meeting the global requirements. Cameras of this satellite have a resolution of 2.5m (can distinguish even a small car). The CARTOSAT-1 provides stereo pairs required for DEM, Ortho image Products for various applications of GIS. This carries two panchromatic cameras that can take black and white stereoscopic pictures of the earth in the visible region of the electromagnetic spectrum. The swath covered by the high resolution PAN camera is 30km and their spatial resolution is 2.5m. The cameras are mounted on the satellite in such a way that near simultaneous imaging of the same area from two different angles is possible. This facilitates the generation of accurate three dimensional maps. The cameras are steerable

across the direction of the satellite movement to facilitate the imaging of an area more frequently. The images taken by Cartosat-1 camera compressed, encrypted, formatted and transmitted to the ground stations.

With the advent of new technologies like Satellite Remote Sensing, Global Positioning system, GIS revolutionary changes have been brought in handling the vast geographical data for better management of natural resources. For the trees classification, weight ages are assigned to each variable like tree cover density, type, and its proximity to road analyzed in the complex GIS environment to generate the final output. Generalization is performed by finally integrating with Web GIS and producing output by rescaling.

### Methods / Procedures used:

#### Geo-referencing:

Correlating the image to the real world co-ordinates with a specific projection and specified units. Unless until the images are geo-referenced, they cannot be arranged sequentially or overlaid one upon another for any further analysis. Rough geo-referencing can be done by addresses (Lat, Long) given in the accompanied data of image for four corner pixels and one central pixel. For refined geo-referencing, a projected map can be used while rectification (warping) of image and can be transformed specific projection of that map with specific datum and units.

#### Mosaicking:

The area of interest exists in more than one image; the images had to be joined after geo-referencing. Rectification can be done to original

images either before mosaicking or the mosaicked image afterwards.

#### Sub-setting:

Depending upon the camera and satellite, the area, width of the scene (swath) will change. Accordingly NRSC data centre produces the square of swath as full scene, 70 km<sup>2</sup> for PAN, 140km<sup>2</sup> for CARTOSAT-1. A full scene is divided into 42 sub scenes.

#### Classification:

Panchromatic classifications are the process of sorting pixels into a finite number of individual classes, or categories of data, based on their data file values. If a pixel satisfies a certain set of criteria, the pixel is assigned to the class that corresponds to that criterion. This process is also referred to as image

segmentation. An example of a classified image is a land cover map, showing vegetation, bare land, pasture, urban, etc.

Taking the advantage of panchromatic property of CARTOSAT-1 and high resolution of responding IRS PAN, a classification of TOF assessment has been developed. Firstly, the geo-referenced boundary of study area was supplied to NRSC to procure desired CARTOSAT-1. After acquiring the images, the PAN image was geometrically rectified as per the strategy adopted. The CARTOSAT-1 was co registered with the rectified PAN images. The boundary of forest area was digitized and forest area was masked. The remaining CARTOSAT-1 image apart from forest cover was left out for further classification. The classification enables to distinguish between tree cover and other dark areas PAN images. The remaining area on PAN data (pseudo image) represents only trees and agriculture and using the threshold gray value of PAN image corresponding to tree cover, image was classified. This classified image was visually analyzed with respect to Google earth for editing and refinement for inclusion and

### **Run the AML:**

AML is the native programming language of the Arc Info Work station in GIS software. AML is commonly used in 7X versions of Arc Info. Over 150 free AML scripts are available from ESRI's Arc Scripts page. Find AML scripts covering almost every spatial function. Choose "languages" from the drop down menu and select AML before you search for AML written to convert from raster to vector files to Arc Info format. Run the AML to convert classified raster image to vector shape file.

### **Accuracy Assessment:**

The converted vector shape formats of all the classified portions are then merged accordingly with their corresponding classifications. These classified vector coverage's are rectified using clean and build techniques that are a part of data management tools in Arc GIS. This feature helps to minimize errors of the polygons drawn with over shoots and under shoots at nodes, however to attain connectivity.

### **Slope map preparation:**

A measure of change in surface value over distance, expressed in degrees or as a percentage. Mathematically, slope is referred to as the first

omissions. Since cluster of trees having 0.1 Ha area or more is defined as Block plantation, pixels were clumped and cluster of pixels having area less than 0.1Ha were eliminated. Incorporating these collections final classified image was prepared having three classes in TOF areas, namely, Block, Linear, Habitation, and Scattered. This classification is dependent upon the data itself for the definition of classes. This method is usually used when less is known about the date before classification. It is then the analyst's responsibility after classification, to attach meaning to the resulting classes.

### **Raster to Vector Conversion:**

The classified raster image is converted into Arc/info coverage (vector format) using the ERDAS Imagine Raster to Vector conversion option. Coverage obtained will be pixel based and each class is given a specific grid code, using grid code the polygons of same grid code have to be dissolved. Coverage needs to be splinted in order to get smooth arcs.

### **Digitization of Contours:**

Contours of Prakasam Division are digitized using the SOI topo sheets of 1:150000 Scale are used (Contour Interval is 20m). First the topo sheets that fall under the study area are Gecoded in the Erdas Imaging. Then the contours are digitized giving elevation as parameter in the attribute table.

### **DEM (Digital Elevation Model):**

Digital Elevation Model is a raster representation of a continuous surface, usually referring to the surface of the earth. The accuracy of this data is determined primarily by the resolution (distance between sample points). Other factors affecting accuracy are data type (integer or floating point) and actual sampling of the surface when creating the original DEM. Digital Elevation models are typically used to represent terrain relief as this helps in association with sampling points, also referred to as 'Digital Terrain Model' (DTM). In the present study DEM is created using Arc/Info software's topo grid command. DEM produced by topo grid command is floating point grid inputs used are boundary of the district and contour coverage's.

derivative surface; slope identifies the maximum rate of change in value from each cell to its neighbors. As output slope grid can be calculated as percent slope or degree of slope.

### Slope Grid creation:

Slope grid can be derived from the DEM using grid tools surface analysis function. Slope grid derived by DEM is floating grid, it is converted into integer grid using float to integer conversion option provided by grid tool expression function. Then the slope grid is reclassified to five classes as per the modeling strategy.

### Slope Coverage:

Reclassified slope grid is converted into slope coverage using grid to poly conversion function provided by the command tools of Arc/Info software. Slope coverage assigned the slope index and multiplied with the internal weight ages using Arc View software according to the value in the modeling table.

### Modeling:

The various spatial layers can be integrated for modeling TOF. Integration of these layers would be done in a hierarchical scheme. Different layers

have different degree of contribution on TOF. According to pre field Observation report , reference points are generated with respect to relationship between spatial features. The accuracy of classification was assessed by taking average points in block, linear, habitation and scattered stratum. It is recommended that 50 or more points should be located for ground verification for each class done in post field work.

### Sampling Method:

This stratification having done with the help of appropriate sampling design optimum number of plots can be randomly selected in every stratum. Since the variability in each stratum is expected to be different demanding different sample and plot sizes, pilot studies were conducted to ascertain this so that the variability of the stratum can be properly addressed. In this pilot study, 0.1 Ha, 0.2 Ha and 0.3 Ha plots were considered for natural and habitat stratum. Desired number of sample points was randomly generated in each stratum, separately and the data on pre decided variables were collected on designed formats.

## STUDY AREA

Prakasam District

Forest Circle- Prakasam;

Revenue District- Nellore, Gudur, Kavali

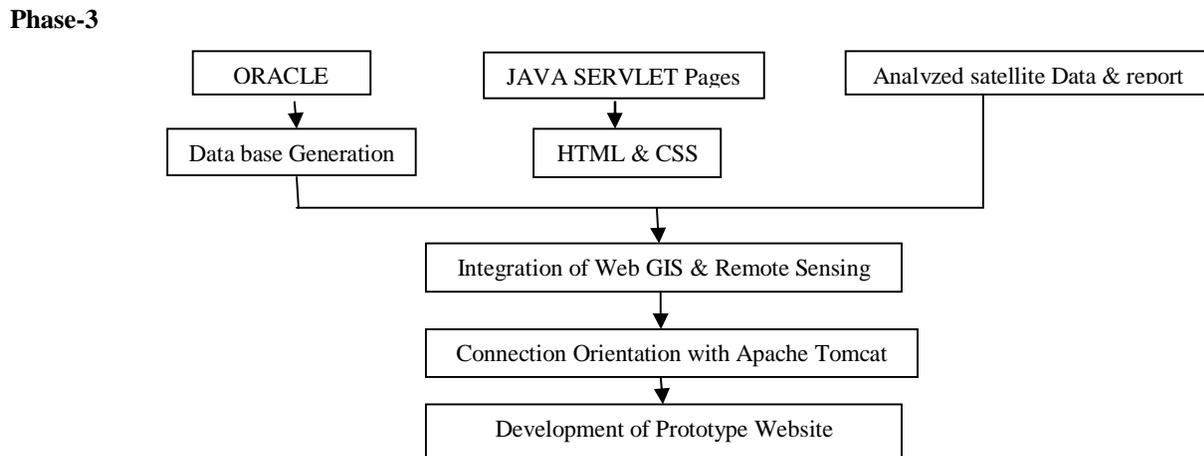
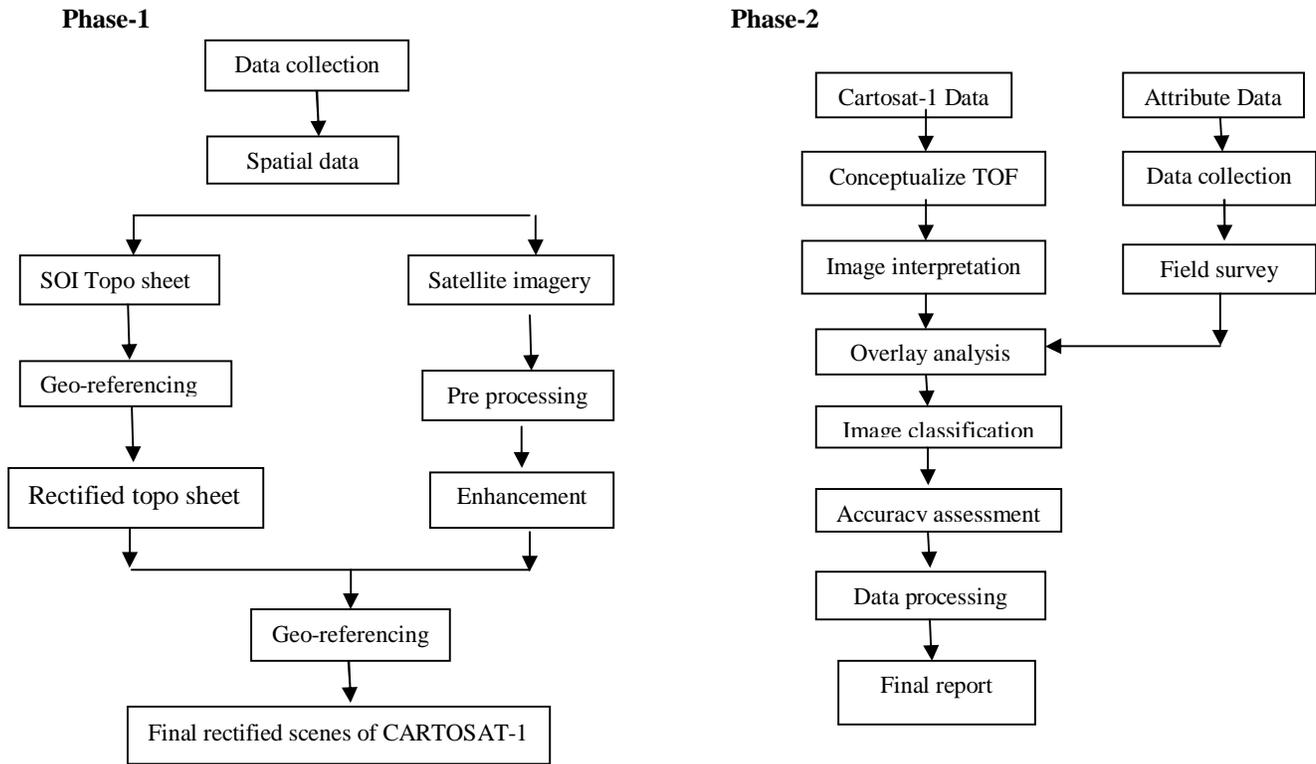
State – Andhra Pradesh

Location –

Latitude 14<sup>0</sup>57'0.49"N to 16<sup>0</sup>17'51.74"N

Longitude 78<sup>0</sup>45'23.78"E to 80<sup>0</sup>25'53.48"E

Land use	Area in Ha	%
Total geographical area	1762600	
Forest including scrub	442598	28.42
Agriculture	990841	51.14
Gross irrigated area	72.86	36.36
Fallow lands	155900	0.89
Grasslands	0.49	0.02
Settlements	20.80	0.83
Vegetation outside forest	75.75	3.03
Water bodies	24682	1.05



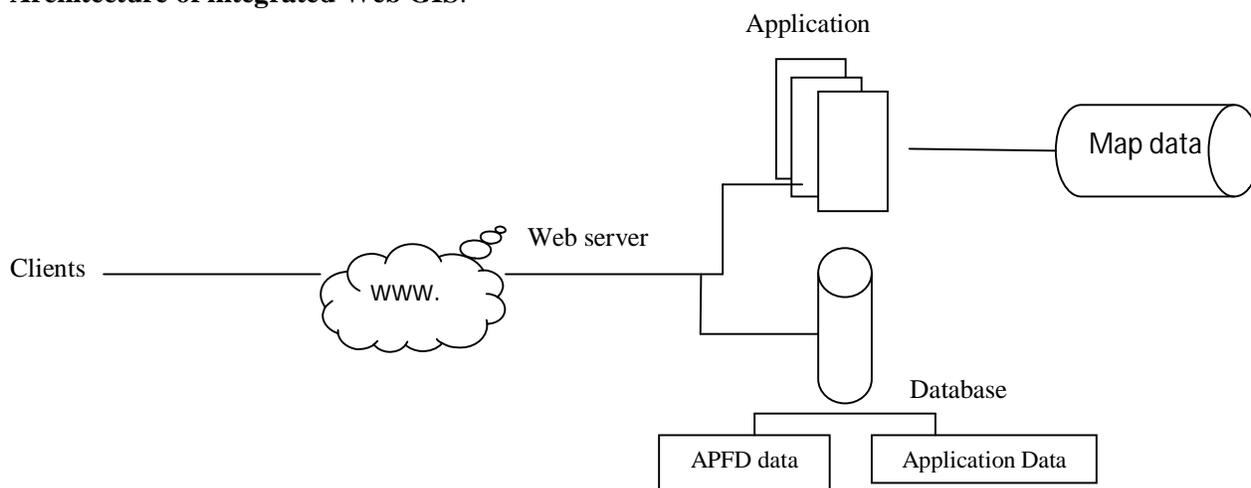
**Final Report Generated**

Showing the stratum wise areas in Ha, distributed in the district

S.No	Stratum	Area in Ha
1	Natural Forest	63558.77
2	Habitation	18021.90
3	Linear	5027.92
4	Scattered	9044.69

## Web Design & Development:

### Architecture of integrated Web GIS:



### Conclusion

This prototype website online forest portal is very much useful for various applications like assessment of the natural resources, evaluation of LULC patterns, understanding environmental clearance, geology and topography. This sort of design can be used as a platform for publishing any other projects. It is also useful for industrial estate developers, environmental professionals and researchers have several advantages to get faster results.

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