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“Forest Mapping by using RS and GIS Techniques”

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Abstract - Forests have important and vital global ecological as well as socio-economic resources and they require a sustainable management. An attempt has been made in this research to monitor, record data as well as to have a systematic understanding of the forest map development and to map the existing forest coverage in context of cost effectiveness and time consumption. The aim of this study has, to map the existing forest, to identify unutilized land, to develop a plan to increase the existing forest coverage and carry out the related analysis. For this purpose, RS and GIS data have been compiled within the ERDAS and ArcGIS environments. The data acquired from Punjab Forest Department has been standardized and joined to spatial datasets produced to go for micro-level forest mapping, monitoring up gradation and plan development. It has been concluded that with the help of RS and GIS techniques one can perform spatial analysis and capable of highlighting issues and problems for planning, monitoring and management of forest system.

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I. INTRODUCTION

Forests and forestland have important natural resource in many part of the world and provide the raw material for a wide range of wood-based industries (Susilawati, S., and Weir, M.J., 1990) [12]. Deforestation has become a global problem in many developing countries and it has a direct correlation with population density, and forest resources have caused mainly by ever-increasing populations and some development activities (Gannzzorig, M., Enkhtuvshin, B., Amarsaikhan, D., and Tuglaa, H., 1994) [6].

Forest management requires reliable inventory data and the maps indicating current state of the forest area. (Hidalgo, D.M. and Kleinn, C. 2002)[7]

Forest helps to maintain the balance of nature and provides unlimited services for all living creatures on this planet. Environment which must be healthy and friendly is essential for every living being so it has been decided globally that every country of this globe must have 25% forest cover out of its total land cover. (Land Cover Assessment and Monitoring of Pakistan by ICIMOD under UNDP, 1998)[9]. Its 4.2 million hectare area is covered by the forest, which is equivalent to 4.8% of the total area, which is very low if compared with the world (State of Forestry in Pakistan, 1999/2000) [5].

The demand of Pakistan for forest and other natural resources are very high because it is a

developing country and its population is growing 2.3 % annually with relatively high industrial growth rate of 6% that contributes to the needs. The timber, fuel wood and other forest related needs are increasing. Forests also contribute 32% of total energy needs as fuel wood. 90% of rural and 60% of urban households use fuel wood and other forms of biomass as their primary source of energy (Forestry Sector Master Plan, Volume 6 Punjab, 1992) [10].

The forest cover of territories of Pakistan i.e. Sindh, Balochistan, Punjab, NWFP, Azad Kashmir and Northern areas are 0.92, 0.33, 0.69, 1.21, 0.42 and 0.66 millions hectare respectively .Rangelands comprising 28.50 million hectare includes 6.28 million hectare under Forest Departments which is 32% of the total area of Pakistan. (Statistical Hand Book of Punjab Forestry, Wild Life and Fisheries Department, 1999) [11].This study is conduct for the district of Toba Tek Singh which has area 5896.260 hectares under forest department.

RS and GIS techniques provide real time information on the status and condition of the forests. Integrating RS and GIS data with other traditional and ground truth

Information one can perform truth information through analysis and advise the forest managers for better planning (B. Enkhtuvshin, M. Ganzorig, D. Amarsaikhan, H. Tuglaa Informatics Centres)[2].

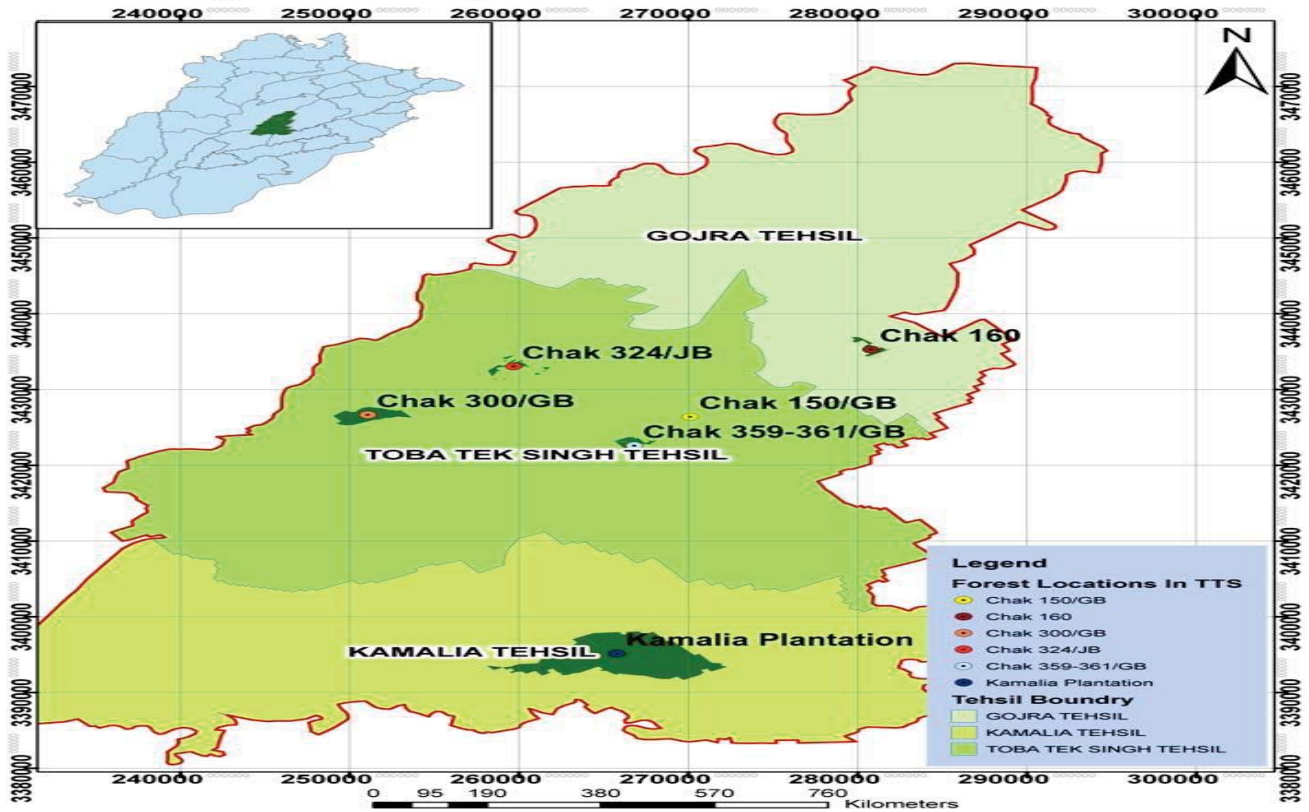
II. STUDY AREA

Toba Tek Singh is a district in the Punjab province of Pakistan. It is located between 30°33' to 31°2' Degree north latitudes and 72°08' to 72°48' Degree longitudes. It comprises of 3 tehsils, 82 union councils and 579 villages. It has an area of 325900 hectare and 5896.260 hectare is under forest. It is divided into three tehsils and the area of each tehsils is as under

Name OF Sub Division	Total Area (Hectatre)
Toba Tek Singh	129300
Kamalia	111500
Gojra	85100
Total	325900

Table 1: Total area of each Tehsil of T.T.Singh

Map of Study Area With Forest Locations



Map 1: Showing study area with forest locations

(<http://tmatobateksingh.com/.html> 05-12-2008[8]. <http://www.tobateksingh.gov.pk/>

III. METHODOLOGY

It is supported by the intensive use of geoinformation technologies of (i) Remote Sensing (RS), for its capability to collect accurate information over extensive areas at a repetitive basis, and (ii) Geographic Information Systems (GIS) for spatial analysis, statistics and mapping (Eduard WESTINGA) [4].

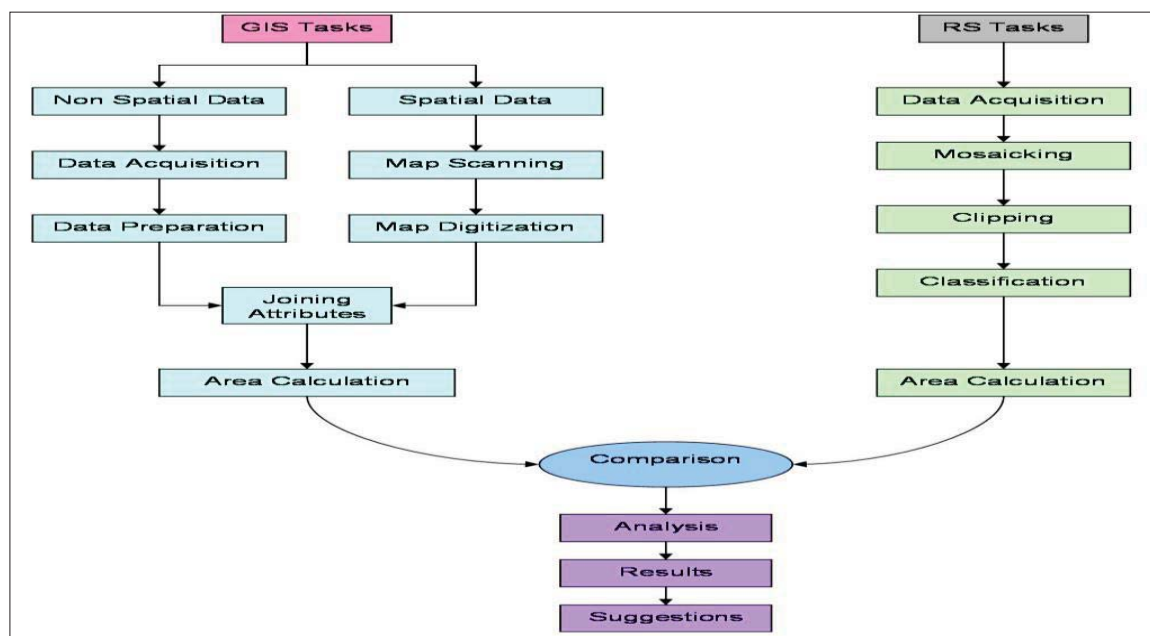


Figure 1:Flow Chart

Source maps of Toba Tek Singh at the village level have obtained from census department and used to make the district map at village level along with major features like river, canals, railway tracks, roads etc. Forest boundary maps and compartment inquiry files of the forest have acquired from the provincial, divisional and district forest departments and scanned at 300 dpi to make maps of Toba Tek Singh to locate forest at Union Council and village level.

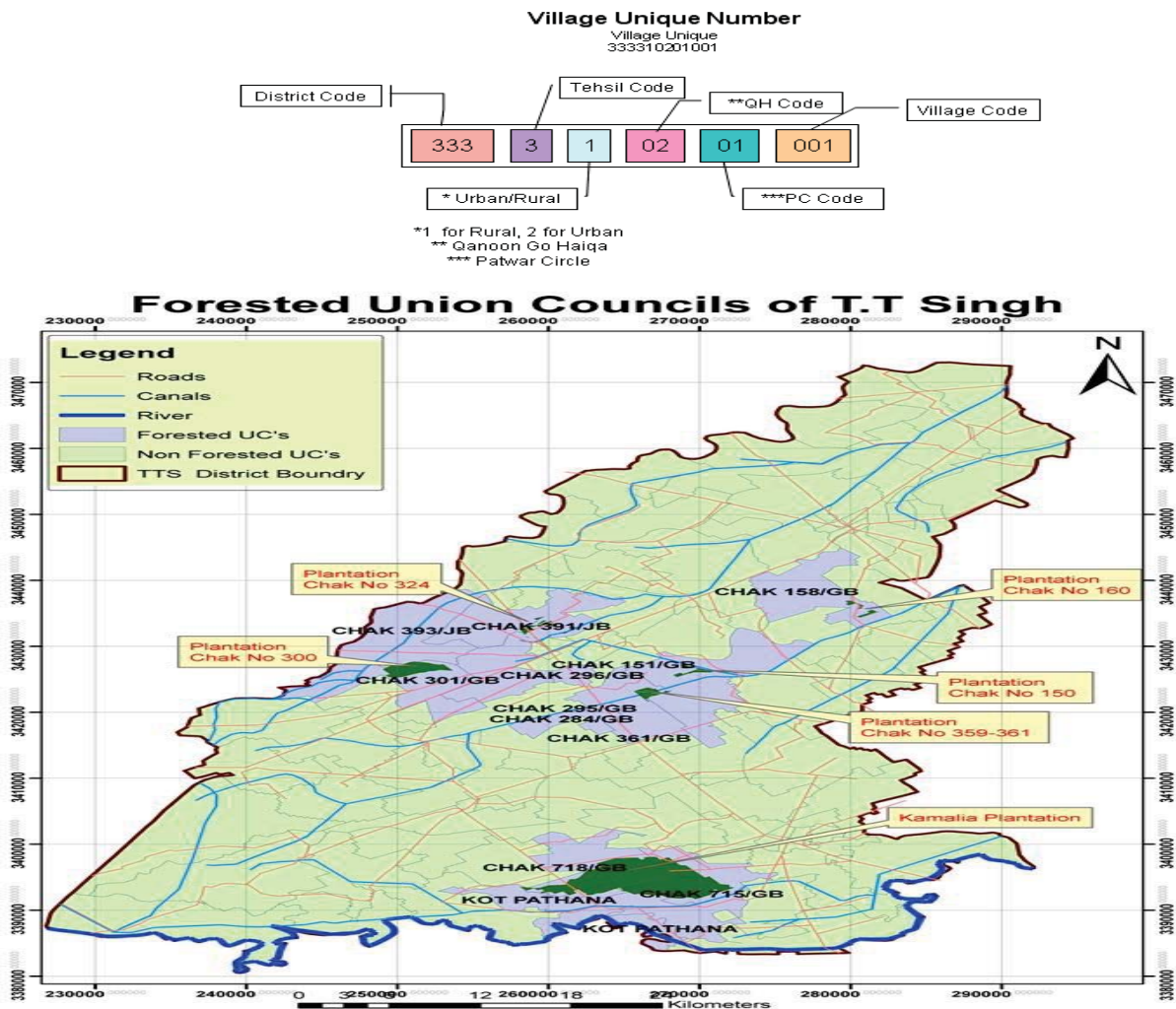
Raster map of Punjab province obtained from JICA (Japan International Cooperation Agency) is first geo-referenced, then projected. The scan map digitize at district boundaries, and study area digitized at tehsil level boundaries. Shape files of village boundary and forest boundary were converted to KML to find the locations on the Google Earth in order to see the present status of the forest. In order to calculate areas and for correct placement of scale bar all the shape files have first converted to Universal Transverse Mercator (UTM). For the sake of joining attributes to the village

points, same coding technique was used as in census 1998.

Already obtained statistics in the form of tabular data format were assigned unique values to villages names in the excel sheet and the same values were also assigned to the attributes of the village boundaries and points in the shape file to join on spatial attributes to the spatial attributes. These attributes have been used to form the maps by using symbology and queries.

The UTM projected shape files have used to calculate areas in acres.

The next step is to mark the forest locations of the entire district. For this purpose, the union councils were assigned unique forest codes to represent forest locations at UC level and then the villages are assigned forest codes to represent forest location at village level. These forest codes have used to filter out the UC and Village location respectively.



Map 2: Showing forested Union Councils

The color scheme has used to represent forests at different levels. After all these processes, the final digital map of the districts Toba Tek Singh is ready to give all the information that a digital map shows. In digital map, the scale used to indicate the base map was 1:50000. Thematic maps have used to highlight the areas of interest.

In this research Land Sat Enhanced Thematic Mapper (ETM), sensor data with spatial resolution of 30m has been used. The area of interest (Boundary of Toba Tek Singh) obtained by creating a subset of the data in ERDAS Imagine 9.2. The satellite image and the shape files are transformed on the same projection i.e. Geographic Coordinate System. Our study area falls in two images of land Sat, so both images are cut at the district boundary of Toba Tek Singh.

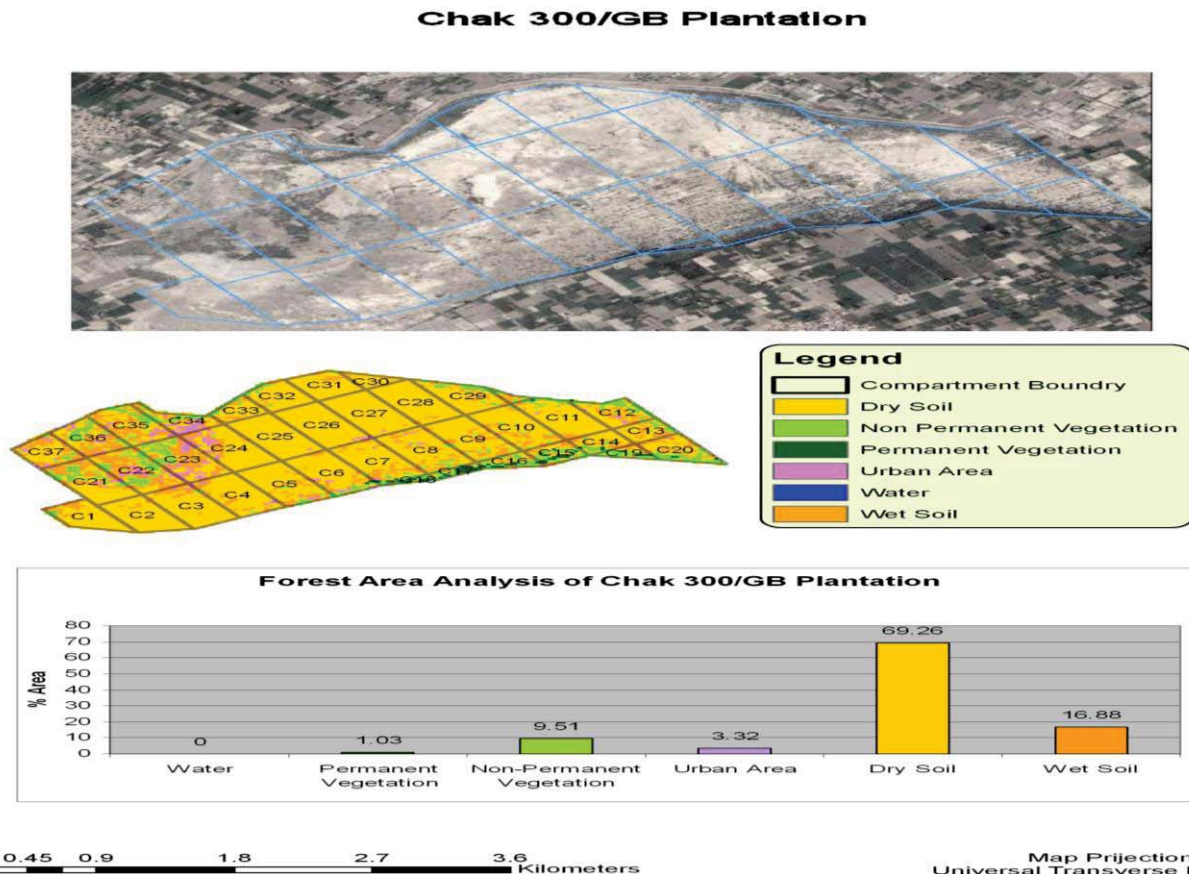
After this appropriate band combination, necessary contrast enhancement has applied to make image interpretable. These subsets are used for the classification purpose. The unsupervised classification is performed separately on the two-subset images. Image is classified into 200 classes in order to get accurate results. The classes have assigned groups very accurately based on visual interpretation and spectral signature. Six classes of the major land covers are formed in both subset images. I.e. Permanent

vegetation, non-permanent vegetation, water, urban area, dries soil and wet soil. The classified images are mosaicked for same projection, equal number of layers and stacked in the same order of the bands. The images are re-projected to UTM to calculate area in acre of the classified image for the each class and areas of the subsets of the each forest boundary are calculated

IV. RESULTS AND ANALYSIS

The results and analysis we presented in the tabular form, bar charts and in form of thematic maps. For this purpose, different tables are converted into Microsoft Excel and bar charts are formed at district, tehsil and chak plantation levels.

The forest locations in the district of Toba Tek Singh are irregularly distributed in all its three tehsils. The forests are named on the basis of the name of the village near by it and which is named on the name of the canal passing by or through the village. Each of the chak plantations area is separately calculated and discussed in order to get the accurate forest coverage from micro scale to macro scale, i.e. from compartment to village, village to tehsil and tehsil to district level e.g. as shown in the figure



District Toba Tek Singh has a total area of 325900 hectares (805287 acres) from which area allotted to the forest department for irrigated plantation is 5896.260 hectares (14569.46 acres), which is 1.8% of the district

area. This area is distributed in the three tehsil. The Kamalia has 1.4132%, Toba Tek Singh has 0.3393% and Gojra has 0.0334% proportions.



Figure 5: Showing total allotted district area

After comparing both the areas extracted from RS and GIS techniques the existing forest coverage in the three tehsils of study area is in such a way that Kamalia has

0.5913%, Toba Tek Singh has 0.04278% and Gojra has 0.01402%.

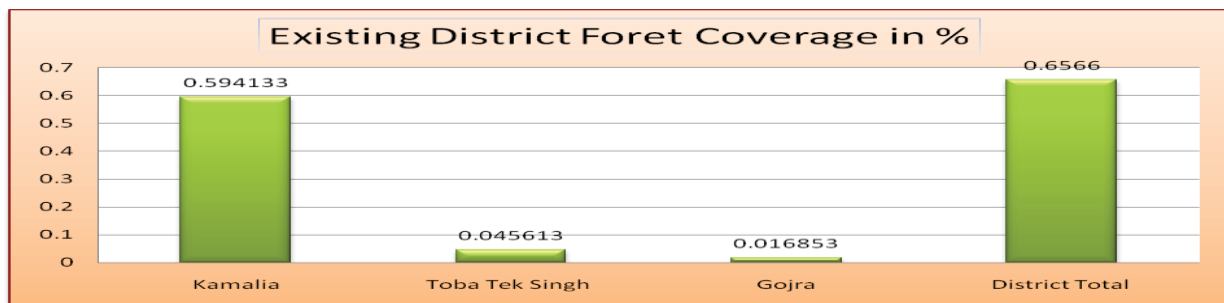


Figure 6: Showing Existing Forest Coverage in district

Finally the existing forest area is 2140.0131 hectares (5287.9 acres) which is 0.6566% of the district area and the remaining area is unutilized barren land and in the form of open area. According to millennium goal it is required to increase the forest coverage up to one percent at provincial and national levels .It could be achieved by considering the district forest coverage at first. For this purpose our study can be considered as model district for 5 years.

In first existing forest coverage can be improved and secondly concepts of agro forestry must be implemented, if it is required to increase in the area of districts and provincial level. Simply to increase the number of trees in an acre so more area form agricultural land will be available if farm forestry taken into account.

But only 2140hectares (5287 acres) under forest which is 0.6566% of the district total area. If we increase the forest coverage hundred percent in the area allotted to the forest department in district Toba Tek Singh which is 5896.260 hectares (14569 acres). Then the total forest coverage increases up to 1.80922% in the district Toba Tek Singh.

If forest department need to increase forest coverage 1% in the district Toba Tek Singh then the

forest department must facilitate water supply, suitable tree types, management, monitoring and other necessary irrigation resources. The water supply is arranged from canals, tube wells and other natural and un-natural resources. e.g. Forest coverage must be increased in areas near to the canals like Kamalia plantation, Chak 160 and Bhagat plantations.

Reforestation is too much difficult than the Aforestation. Because the land which remained already forest loss its fertilizer and ability to re-grow forest. So the forest department searches new sites for healthy forest.

Agro forestry can play a major role to increase the forest coverage in the district. So forest department convince the farmers to grow forests on their lands.

The future of the forests in Pakistan depends upon the agro forestry.

V. DISCUSSION

This study focuses the district of Toba Tek Singh. The capacity for conducting this study as well as survey of model forest comprising compartments has also been developed and will benefit the forest, food, agricultural and many other planning departments in the up coming years. The achievement of all objectives and

verified results of about 0.6566% is a remarkable achievement through this research, it was proved that simple and spatial criteria of forest mapping and planning based on GIS and RS techniques.

In this research we have introduced a method or criteria to identify the site for new forests based on provided information and other important parameters i.e. sectioned area, distance from main canal, available unnatural irrigation resource and soil quality.

As RS and GIS technologies are widely used, forest resource investigation method is improved highly, the scope of investigation is wider and wider, and the cycle is shorter and shorter, abundant of information has been obtained. RS and GIS techniques have strong function of managing and analyzing spatial data. Moreover, provides a simple and prompt way to browse the models and relations of resource information. RS and GIS techniques being used in forest resource management realizes modern forest space-time adjusting, predicting, decision, inspecting, mapping and evaluating, which provide a scientific foundation for realizing forest resource development and classification management.

VI. CONCLUSION

The study has indicated the potential use of remote sensing and non spatial data in the environments of RS and GIS techniques for studying forest area calculation, planning and development. GIS techniques integrated in this study has proved beyond doubt its capabilities of spatial analysis. In this study LANDSAT images were used satisfactorily for the identification of utilize, unutilized land and area calculation. In conclusion for detecting changes in areas based on a subject e.g. population increase, vegetation etc, over a period of years both spatial and in quantitative way, integrating remote sensing data and GIS techniques will be useful.

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