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Estimation of Forest In & Around Dudhwa National Park Using Remote Sensing & Gis

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***Abstract*—The present study was conducted to assess land use / land cover change in Dudhwa National Park. Supervised classification was selected for calculating area statistics inside and outside the protected boundary of Dudhwa National Park. The land use / land cover changes were assessed using two satellite images dated 6/3/1977 and 15/3/2014. Images were geometrically and radiometrically corrected. It was found that for inside the study area boundary, the dense Sal forest decreased remarkably by 46% and agricultural land by 42%, mixed deciduous forest by 30% and teak plantation area by 15%. The supervised classification of images in year 1977 and 2014 outside the study area boundary shows there was a decrease in area of agricultural land, mixed deciduous forest, moderately sal forest and dense sal forest by 86%, 34%, 19% and 13%, respectively. However, percent increase in land use / land cover area for inside study area was observed to increase drastically in case of moderately sal forest and habitation, where former increased by 74% and later by 54%. Grass Land and water body were also observed to increased marginally by 9% and 6%, respectively. For outside the study area, drastic increase in area with 764 and 305% increased was marked in case of water body and settlement in 2014, respectively.**

I. INTRODUCTION

Forests are one of the most important components of the terrestrial ecosystems. They are the storehouse of biological diversity. In 1995, there were 3454 M ha of forest (including natural forests and forest plantations) worldwide (FAO, 1999). Between 1990 and 1995, the total area of forests decreased by 56.3 M ha the result of a loss of 65.1 M ha in developing and an increase of 8.8 M ha in developed countries (FAO, 1999). India's total geographical area about 328 Mha. It is estimated that India has lost 3.4 M ha of forest lands to dams, new croplands, roads and industries between 1951 and 1972. This means annual rate of deforestation is about 0.15 M ha. According to the Forest Resources Assessment 2000, world forest covers 3.9 Billion ha and spread on about 30 percent of the land. The net change in forest area was 9.4 M ha per year rate of deforestation is 14.6 M ha and expansion 5.2 M ha. On global basis, 52 percent of the total forest of the total forests 2800 M ha are tropical but in India tropical forests account for 86 percent 64.4 M ha of the total. Out of 64.4 M ha tropical forest in India, dry deciduous forests and moist deciduous forest account for a total of 65 percent. Presently, the recorded forest area in India is 76.54 M ha (FSI, 2001).

Remote sensing systems with its systematic, synoptic and repetitive coverage make potentially outstanding tools to support tropical forest management (Lillesand and Keifer, 1999). Remote sensing techniques have revolutionized the process of data gathering and map making offering the possibilities of conducting resources surveys over large areas rapidly, cost effectively and accurately. Such surveys can provide various levels of information to suit the desired intensity and quality of management planning requirement (Lillesand and Keifer, 1999). Satellite remote sensing has played an important role in generating information about forest cover, vegetation type and the land use changes (Malingreau, 1991 and Roy, 1993). Satellite data has been used to obtain the forest cover, forest cover change and other forest statistics information combined with forest inventory data. NDVI provides good information on canopy closure in evergreen/coniferous areas. It has been reported to vary with foliage activity in dry/moist deciduous forest areas (Roy and Ravan, 1994).

Remote sensing techniques have many advantages in aboveground biomass estimation over traditional field measurement methods and provide the potentials to

estimate above ground biomass at different scales. The characteristics of remote sense data, the scale of the study area, and the availability of economic support have important influences on the design of an above ground biomass estimation procedure.

The Dudhwa National Park, with Indo-Nepal International border constituting its northern boundary, covers an area of 1094.3 sq km and includes three large forest fragments amidst the matrix dominated by agriculture. Large fragments are Dudhwa National Park, Kishanpur Wildlife Sanctuary and Katernaighat Wildlife Sanctuary, Kishanpur. Thus, present study was done on Dudhwa National Reserve to determine the changes occurred inside and outside the boundary of Dudhwa National Park after it was declared as Dudhwa National Park and when it was undertaken as Protected Area.

The objective of the present study was (1) To classify the study area in and around the Dudhwa national park with respect to its land use and land cover. (2) To prepare the thematic and Normalized Difference Vegetation Index maps of the study area. (3) Compare the changes in Land Use / Land Cover between 1977 and 2014. Simulation Results

The complete procedure of compression is tested on test image Lena. The simulation results of DFrFT-V have been compared to DFrFT [17] which suggests that DFrFT-V provides minute improvement in the visual quality of the reconstructed images. In-order to achieve simulation simplicity, the value of a_1 and a_2 are taken similar and denoted by a_{opt}. The plot between fractional order and PSNR for different compression ratios shows that for a particular compression ratio, fractional order affects the PSNR of the reconstructed image. Table 1.compares the optimized parameters of DFrFT-V and DFrFT for Lena and Fig. 1 shows the reconstructed images of Lena using DFrFT-V. Effect of fractional order on the quality of the reconstructed image as been analyzed for compression ratios 10%-70% in Fig. 2 (a).

II. MATERIALS AND METHOD

2.1 Study Area

Dudhwa Tiger Reserve stretches mainly across two districts, Lakhimpur- Kheri and Bahraich of Uttar Pradesh, India (Fig.1). It is located on its northern side and shares north-eastern boundary with Nepal which is defined to a large extent by Mohana River. Study area covers an area of 490.3 sq km.The study area was declared as National Park in 1977.

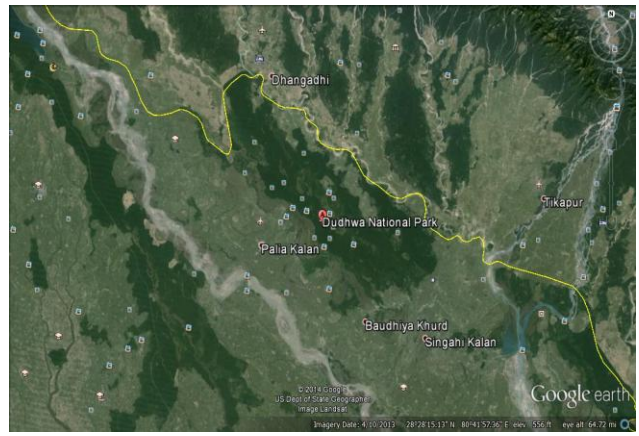


Fig 1. Google map of Dudhwa National Park

2.2 Data Used

2.2.1 Two Satellite Images dated 6/3/1977 (Landast MSS sensor) & 15/3/2014 (Landsat 8 OLI sensor) were used in the present study.

2.2.2 Study Boundary of Dudhwa National Park.

2.2.3 Create a 10 km buffer area outside the study area.

2.3 Methods

2.3.1 Radiometric Normalization and Supervised Classification of inside and outside the study area 1977 and 2014.

The radiometry of remotely sensed data acquired by satellite sensors is influenced by a number of factors, such as sensor irregularities, atmospheric noise (Yang and Lo, 2000; Du et al., 2002).In this study, band to band histogram matching has chosen as the most appropriate method.

In ERDAS imagine, supervised classification includes defining signatures and running the classification process with a selected method of grouping the pixel. In the present case Maximum likelihood was used for supervised classification inside the study area and outside the study area of 1977 and 2014.

A buffer of 10 km was created outside the study area boundary in order to identify the land use / land cover changes outside the study area. The outside area was also classified using supervised classification method.

2.3.2 Normalized Difference Vegetation Index (NDVI)

NDVI, which is a combination of red and NIR reflectance measurements, is one of the most widely used vegetation indices in the world (Ramsey et al., 2004).Values of the NDVI range between –1.0 and +1.0, but are usually positive for soil and vegetation.

The NDVI is expressed as:

$$NDVI = \frac{NIR - R}{NIR + R}$$

This formula indicates that NDVI is equal to the ratio of the difference between Near Infrared band and Red band to the sum of Near Infrared band and Red band.

2.3.3. NDVI Image Differencing

NDVI image differencing is one of the most frequently used method. In this method NDVI was calculated for both dates and then difference was calculated (Singh, 1986).

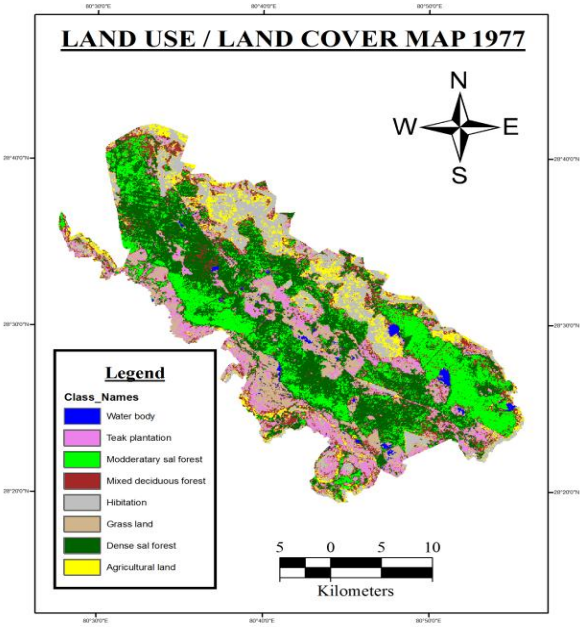
$$D_{NDVI} = NDVI_{t2} - NDVI_{t1}$$

Where, $NDVI_{t2}$ is NDVI image of time 2 and $NDVI_{t1}$ is NDVI image of time 1. In the present study, NDVI image was calculated for 1977 and 2014 year. After that NDVII image of 2014 was subtracted from NDVI image of 1977 and change image was created. All this process was carried out in ERDAS IMAGING 9.2. A number of threshold values (in percent) were used to distribute change pixel value (DN value).

III. RESULT AND DISCUSSION

1.1- Classification: Inside the boundary 1977 and 2014 Satellite Image

Landsat image of 1977 and 2014 was classified to obtain land use / land cover classes. The 1977 and 2014 land use map obtained using supervised classification is shown in fig. 2 and 3.



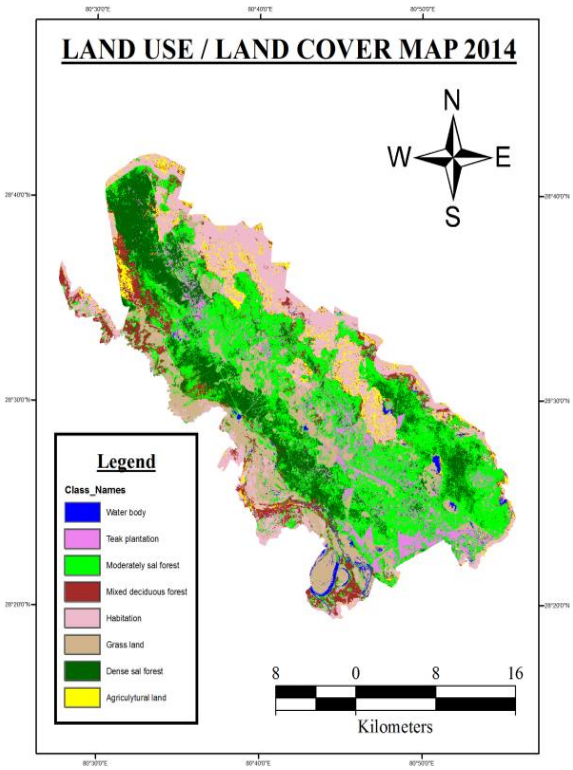


Fig 3 Land Use / Land Cover Map 20140

Fig 2 Land Use / Land Cover Map 1977

For land use **inside the boundary**, the first land cover class is *moderately sal forest*, which was found to **increase** remarkebly by 74%. The value in 1977 was *Habitation* was at second position with 54% increase in land cover, now spreading over 13,893 ha as 18% of total land. The figure was 9,002 ha as 12% of the total land in 1977.

The *grass land* stood at third position with 9% increase, now covering 10,776 ha which is 14% of the land increasing from 9,844 which was 13% in the year 1977.

In case of *water body* increase by 6% was observed covering 1% in during the study year with increased value from 775 ha in 1977 to 820 ha in 2014.

As regards **decrease in land area inside the boundary**, *dense sal forest* was found to decrease maximum by 46%, lowering from 22,445 ha that was 29% in 1977 to 12,038 ha which 15% is in 2014.

Agriculture land also showed a significant decrease in the value by 42% from 5,584 ha to 3,231 ha land with a

percentage decrease from 7% to 4% from study period 1977 to 2014.

Table 3.1 Land use land cover change between 1977 and 2014 inside the boundary

Land Use / Land Cover Classes	Change in Area (ha)	Change in Area (%)
Land Use / Land Cover 1	-10,407	46
Land Lse / Land Cover 2	10,581	74
Land Use / Land Cover 3	-2,660	30
Land Use / Land Cover 4	-1,029	15
agricultural land	-2,353	42
Grass land	932	9
Habitation	4,891	54
Land Use / Land Cover 5	45	6

3.2. Classification: Buffer area in 1977 and 2014 Satellite Image Landsat image of 1977 and 2014 was classified to obtain land use / land cover classes. The 1977 and 2014 land use map obtained using supervised classification is shown in fig 5 and 6

The change in total land area **outside the study boundary** was found to be maximum for *water body* which has found to **increased** by as high as 764%, which was merely 1% in 1977 covering 2,135 ha of land. The value is 18,439 ha with 11% of the total land in 2014.

The second major increase was found in *settlement* area which was 19,205 ha as 11% of land in 1977 increasing up to 77,840 ha with 45% covered area, showing an increase by 305% in land use.

The land use / land cover change was drastic in *agriculture land* area, that has **decreased** from 36% to remaining merely 5%, a decrease by 86%. The total land area is now only 8,865 ha which was 63,256 ha in 1977.

Mixed deciduous forest has also shown a considerably lowered value. It was 18% of the total land with 31,190 ha which has decreased to 20,490 ha covering only 12% of the total land. It shows a decrease percent of 34%.Statistics of land use / land cover obtained from classified Landsat image of 1977 and 2014 is describe below in fig 7. Negative bar indicates that there was a decrease in the area of that land use / land cover classes in 2014 compared to 1977.

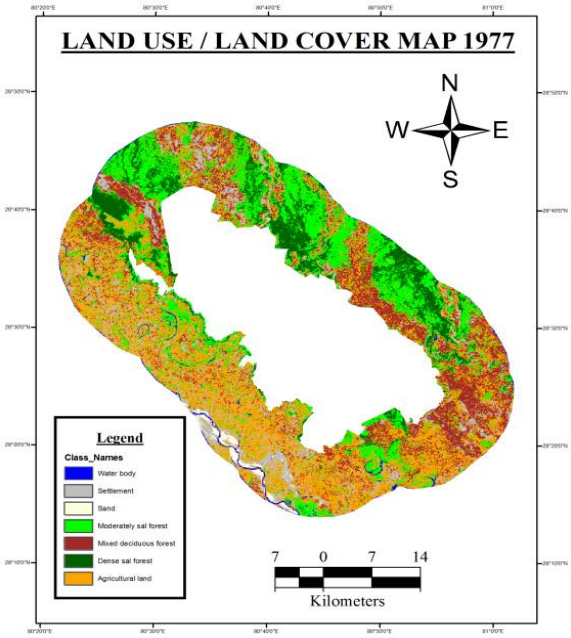
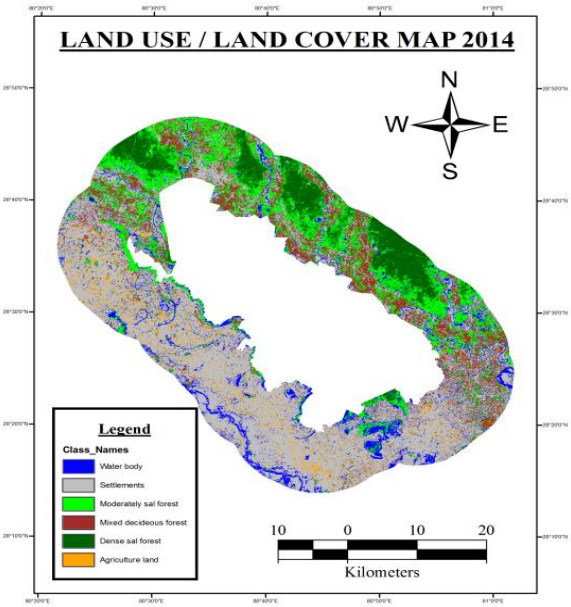


Fig 5. Land Use /Land Cover Map of



6. Land Use /Land Cover Map of outside the boundary 2014

Table 3.2 Land use land cover change between 1977 and 2014 Outside the boundary (10 Km buffer)

Land Use / Land Cover Classes	Area (ha)	Area (%)
Dense sal forest	-2,412	13
Moderately sal forest	-7,436	19
Mixed deciduous forest	-10,700	34
Agricultural land	-54,391	86
Settlement	58,635	305
Water body	16,304	764

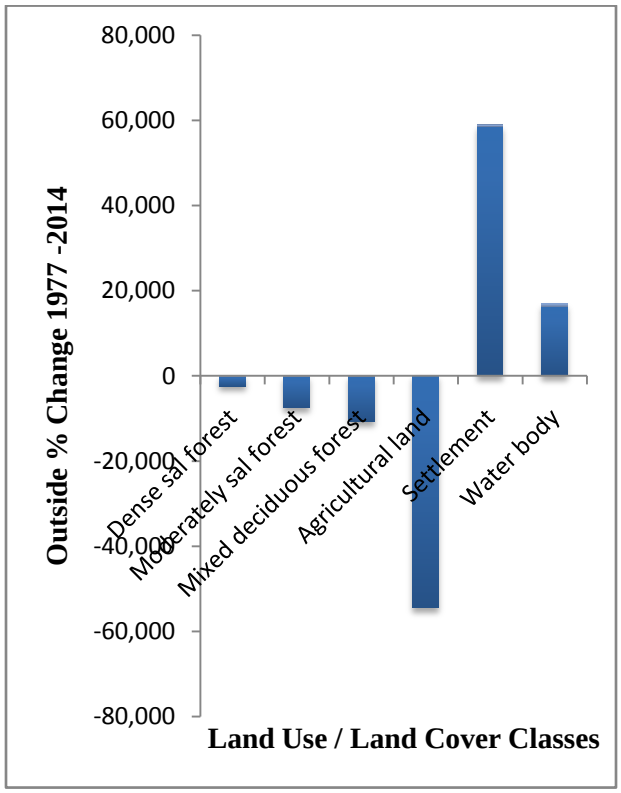


Fig3.7. Statistics of land use / land cover changes outside the Boundary

3.3. Normalized Differencing Vegetation Index

NDVI image for 1977 and 2014 were also developed to further analyze the land use / land cover changes between 1977 and 2014 (Fig. 8 and 9). Satellite images used in supervised classification were also utilized for NDVI generation

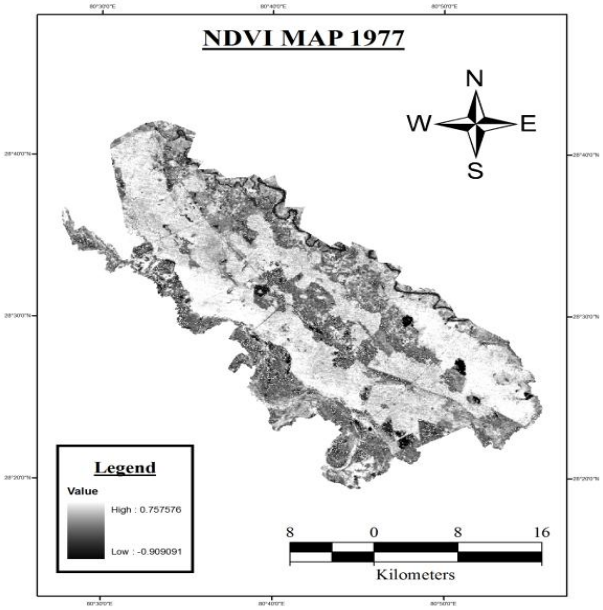


Fig 8 NDVI MAP 1977

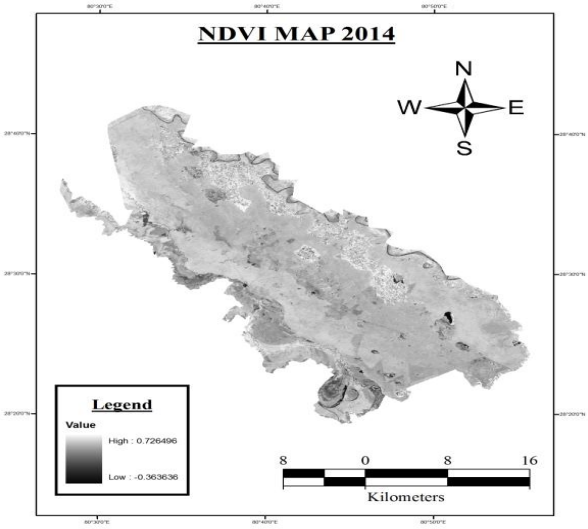


Fig 9 NDVI MAP 2014

3.4. Image Differencing

In the present study, we performed Image differencing of respective NDVI images of 1977 and 2014. The process was carried out in ERDAS IMAGING 9.2. Several thresholds were tested in positive (area that have increase in digital number) and negative (area that have decrease in digital number) radiance change of the digital number (DN) to obtain the reliable "change/ no change" image

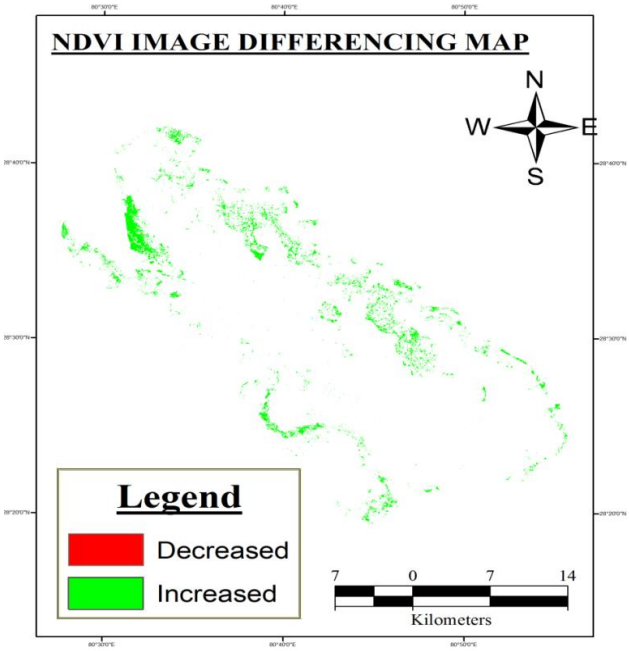


Fig 10 NDVI Image Differencing Map

These threshold values were determined for the each band difference. This was further compared to identify the best band depicting the changes as shown in fig 10.

IV. CONCLUSION

The present study was conducted to identify land use / land cover change in Dudhwa National park between 1977 and 2014. The present study also identified the changes in land use / land cover in the area outside the Dudhwa National park (10 km buffer) between 1977 and 2014. Supervised classification was performed in order to obtain land use and land cover information for 1977 and 2014.

In the study area, an increase was observed for moderately sal forest, grass land, habitation and water body in 2014 compared to 1977. However, a decrease in the total land area was observed for dense sal forest, mixed deciduous forest, teak plantation and agricultural land in 2014 compared to 1977. The decrease in dense sal forest, mixed deciduous forest and teak plantation can be due to deforestation over the year. The decrease in agricultural land can be due to remarkable increased in habitation.

In the study area, an increase was observed for settlement and water body in 2014 compared to 1977. However, a decrease in the total land area was observed for dense sal forest, moderately sal forest, mixed deciduous forest and agricultural land in 2014 compared to 1977.

The decrease in dense sal forest, moderately sal forest and mixed deciduous forest can be due to deforestation over the year. The drastic decrease in agricultural land can be due to significant increased in settlements.

REFERENCES

De R. 2001. Management Plan of Dudwa Tiger Reserve. 2000-2001 to 2009-2010, Wildlife Preservation Organization, Forest Department, Uttar Pradesh.

Du, Y., Teillet, P. M. & Cihlar, J. (2002). Radiometric normalization of multitemporal high-resolution satellite images with quality control for land cover change detection. Remote Sensing of Environment, 82, 123–134.

FAO, 1999, State of the World's Forests 1999. FAO report (Rome, Italy: FAO).

Forest Survey of India, Report, 2001.

Lillesand, T.M. and Keifer, R.W. 1999, Remote Sensing and Image interpretation. New York: John Willy and Sons.

Malingreau, J.P., 1991, Remote Sensing for Tropical Forest Monitoring: an overview: *Remote Sensing and Geographic Information Systems for Resource Management in Developing Countries* (Eds) A. S. Belward and C.R. Valenzuela. Dordrecht: Kluwer), 253-278.

Ramsey RD, Wright Jr DL, McGinty C., 2004 *Geocarto Int,*. 19: 39-47.

Roy, P. S., 1993 Remote Sensing for Forest Ecosystem analysis and management: Environmental studies in India (Eds.) M Balakrishnan, New Delhi: Oxford and IBH, pp. 335-363.

Roy, P. S. and Ravan, S. A., 1994, Habitant management for biodiversity maintenance using aerospace remote sensing, Tropical Ecosystems: A Synthesis of Tropical Ecology and Conservation (Eds.) M Balakrishnan, R Borgstrom and S. W. Bie, New Delhi: Oxford and IBH, 309-345.

Singh, A. (1986). Change detection in the tropical forest environment of North-eastern India using Landsat. In Remote

Sensing and Tropical Land Management (New York: John Wiley and Sons), pp. 237–254.

Yang, X. & Lo, C. P. (2000). Relative radiometric normalization performance for change detection from multi-date satellite images. Photogrammetric Engineering and Remote Sensing, 66, 967–980.