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USING MULTI-TEMPORAL DATA FOR ASSESSING FOREST COVER CHANGE IN MAHAMAYA CITY FOREST OF JAMMU (J&K)

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ABSTRACT : *The study was carried out at Mahamaya City Forest in Jammu, aimed at assessing the forest cover change using multi-temporal Google Earth Data. Post classification change detection was applied on temporal forest cover class datasets obtained by unsupervised classification technique with maximum likelihood algorithm. The overall change analysis indicated a significant increase in forest cover. Statistics on selected landscape metrics were generated to quantify the change in spatial structure.*

KEYWORDS : *Multi-temporal data, Mahamaya City Forest, forest cover change, change detection study, Erdas Imagine, Arc GIS.*

RESEARCH PAPER

INTRODUCTION

Mahamaya City Forest was developed during early 90's, a lush green park was developed just one km away from Mahamaya temple by plating ornamental trees like Silver Oak , Kathal and other flowering trees. Besides flowering trees two Sandalwood trees were also planted in the park. A natural trail from Mahamaya temple to Mahamaya City Forest was developed in between the lush green forest which adds the beauty to this picturesque site.

Mahamaya City Forest is surrounded by River Tawi from one side and Bahu Fort from other side , nature trails from Har-Ki-Podi to Interpretation Centre is an excellent site for morning walkers, students and researchers.

The Mahamaya City Forest was developed with the objective to serve as green lungs of Jammu City. It has variety of flora and fauna, especially indigenous trees growing all over the forest. An excellent park was developed at a place where one can see the full view of whole Jammu city with meanders of River Tawi.

During the year 2019-20 chain link fencing was done all along the path followed by plantation of ornamental trees.

The track leading to Mahamaya Temple is planted with flowering plants so that devotees can enjoy the beauty of nature. It is an excellent place for students and researchers who want to study flora and fauna of Jammu city.

The Mahamaya City Forest is situated all around Mahamaya temple. A number of pilgrims visit the temple to pay obeisance to Goddess Mahamaya , it has been seen a common practice that the pilgrims feed the monkies on regular basis due to which monkey has become menace for the flora and fauna of forest. When one can pass through the Highway monkies could be seen all along the road waiting for food. Due to feeding of monkies their population has also increased many times.

In Mahamaya area, Tawi Herbal Eco-park is a project is under taken by J&K Forest Department, which is in operation since 2011-12 in vicinity of Jammu city. Its basic mandate is to develop 133 Ha area out of 363 hact area of Mahamaya city forest to attract Tourists, nature lovers, birders and locals. The whole area is fenced with chain link fencing. The tiled path within the herbal park has also been constructed covering whole of the herbal park, which is being used by morning & evening walkers,

school children during picnic etc. One Nakshatra garden and Nav-grah Vatika is also established in the Tawi Herbal Eco-park. Jakranda Park having thatched roof view point and water harvesting structure is also a point of attraction for tourists visiting the herbal eco-park. The eco-park is very rich in both flora and fauna. A huge variety of herbs, medicinal and ornamental species of plants can be seen here. Also a large number of local species of birds and small animals inhabits this eco-park. Several groups of morning & Evening walkers, tourists, nature lovers, birders and locals visit this eco-park on regular basis.

The Forest of Mahamaya was highly infested with lantana and other obnoxious weeds before it was developed as City Forest. In order to calculate the change in forest cover of Mahamaya City Forest, change detection study was conducted by using photo interpretation of different time scale images.

Methodology In compliance with the defined objectives, a suitable Remote Sensing GIS based Methodology was adopted. The entire methodology of the present work have been categorized in the following two stage (a) Pre-field work, (b) Post field work. All these stages are elucidated below:

Pre-field work: The satellite data worked out in the present study were Google earth Pro images with a spatial resolution of 5.0 m. After geometric correction in ERDAS IMAGINE 9.1 software by taking ARCMAP 10.5 base map as reference, the satellite images were subset. ARCMAP 10.5 was used for visual interpretation of unsupervised images. After geometric correction all the time period images were analyzed for NDVI in ERDAS IMAGINE 9.1 and then the image were classified through Iterative self-organized data (ISODATA) classification algorithm into 05 odd classes. False colour composite (FCC) image of the study area was visually interpreted for spectral properties of various features like vegetation, water and other non-forest land covers, to classify the 05 pixel classes into various forest cover classes as well as water and non-forest classes by assigning a colour code to each of these classes.

The on-screen visual image interpretation involves various image interpretation keys such as colour, Tone, texture, pattern, association and position with inputs from toposheets(1:15000), ground truth information from earlier work and high spatial resolution Google Earth imagery. Forest density classes were sliced from the vegetation class of classified image, based on the tone and texture of the vegetation cover in the FCC (Dark red tone with coarse texture= VDF, Medium dark red tone with relatively less coarse texture=MDF and Light red tone with smooth or very less coarse texture=OF). Classified image raster attributes were recoded to assign a specific no. to each class was the next step of pre-field work. To remove “salt and pepper effect” from the classified maps “Clump” (connected neighbors=4) and “Eliminate” functions (with a patch of minimum 1 ha. area) were used over the recoded

classified image. The output of this step was the preliminary forest cover map which we were planning to integrate with forest type group five after post-field corrections but forest type map (from FSI) of the study area were having various forest type group presents in it.

As our interest was increase in forest cover over a period of time so different time period images of Google Earth Pro was analyzed for unsupervised classification. The images were classified into 05 color codes. Three time period images were analyzed 2006, 2012 and 2020. The cloud free high resolution images obtained Google Earth Pro were used for analysis of vegetation cover. As the area of interest was very small so only high resolution images were used. As the Mahamaya City Forest was developed during early 90's every effort was made to obtain high resolution image of 90's time period on USGS Earth Explorer , Google earth Explorer and Bhuvan explorer, the images available on all these sites were of 27.0 meter resolution which will not give accurate result so it was decided to analyze the high resolution images of 2006 to 2020. The data obtained from unsupervised classification shows significant change in forest cover. 2006 image shows undergrowth of bushes and other weeds with very few canopy cover. The area in Tawi Herbal Eco-Park is also seen unforested at most of the places when the image of 2012 was analyzed significant change has been observed in the area near Mahayama Temple the weeds were seen diminishing with the increase in crown cover but when 2020 image was analyzed , it was observed that weeds are almost absent from the forest area , the crown cover has been significantly increased. 100 % canopy cover is seen in areas near Har-ki Poudi slopes and Rajadhnai Pond area. The area near Jacaranda Park has also shown increase in forest cover .

Post-field Work:

On the basis of available data and knowledge, the finalization of forest cover mapping work was done and further analysis was carried out. Incorporation of more information in the forest density map from ground has made it more accurate. Both the thematic data layers i.e. Forest type and Forest cover were subjected to the matrix function of the ERDAS Imagine 9.1 to create a composite layer having distribution of density. The output of matrix function was density map.

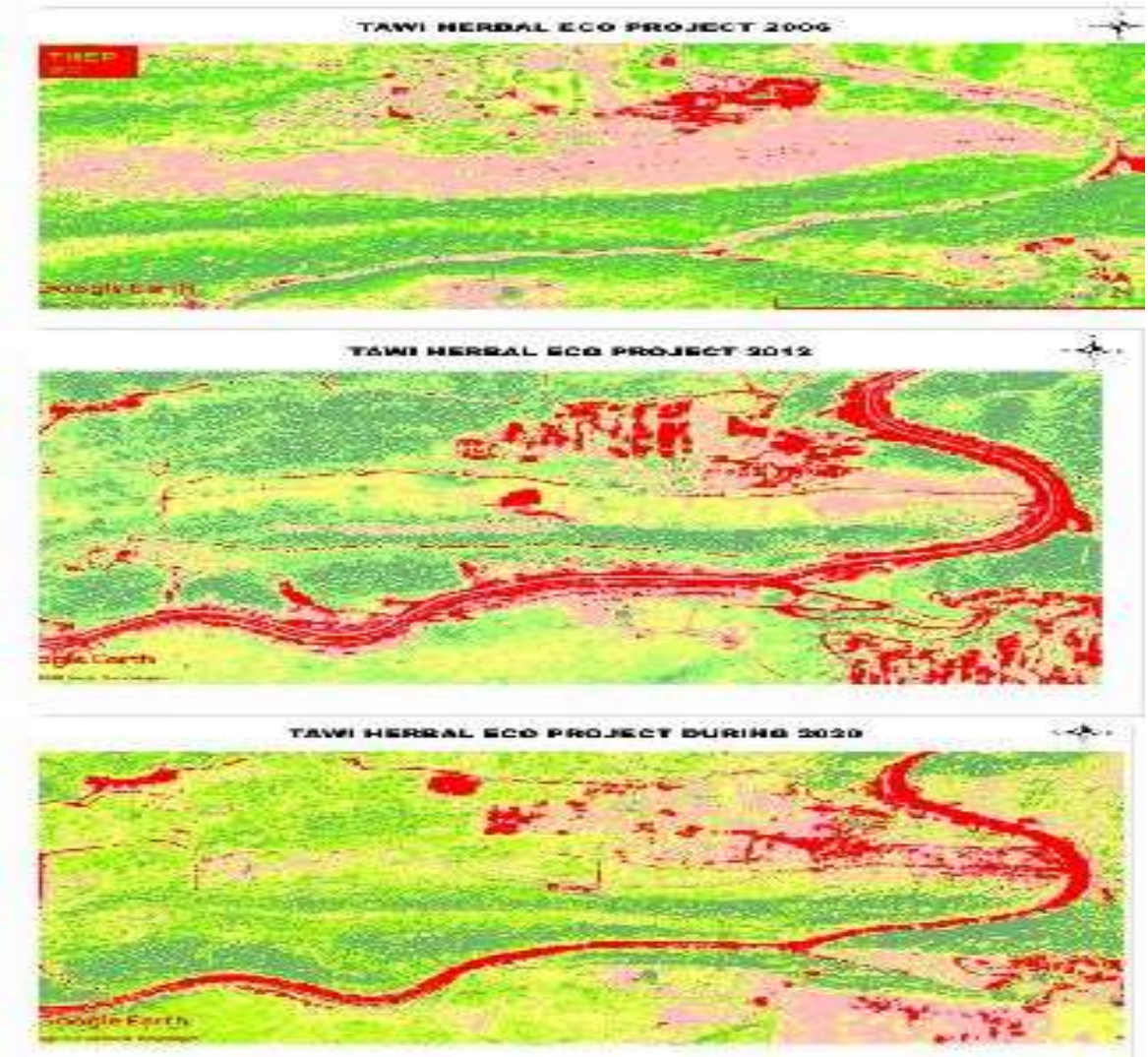

Table showing change in forest cover from 2006 to 2020.

S.No.	Type of Forest	Interpretation on 2006 Image	Interpretation on 2012 Image	Interpretation on 2020 Image
1	Open Forest	75 %	60%	10%
2	Dense Forest	15%	20%	10%
3	Very Dense Forest	10 %	20%	80%
		Base Image	Image after 06 Years	Image after 14Years

Visual interpretation of images shows very significant change in forest cover. The images were assigned 06 color classes depending on the features of color coding two color codes were merged to obtain exact classification of images. The following table shows the coding pattern of image :

Conclusion:

It has been observed that the forest of 2006 have least area under Very Dense category of Forest, only 10 % area of Mahamaya City Forest has been observed as Very Dense Forest where as Dense Forest was slightly more than Very Dense Forest i.e., 15% and rest of the area was under Open Forest category. The area under Open Forest has been observed infested by *Lantana camara* . Huge chunk of the forest was observed to be infested by *Lantana camara*.

The interpretation of 2006 image shows slight change in forest cover near Mahamaya temple and Tawi Herbal Eco Park. The density of forest was increased in dense and very dense forest category. New plantations have come up on the slope near Mahamaya temple. The Southern aspect has shown more increase in forest cover as compared to northern aspect. *Leucenia* Spp. replaced *Lantana camara* on Southern aspect.

The interpretation of 2020 image shown drastic change in forest cover, the area near Interpretation center and cafeteria was shifted from dense forest to very dense forest. There was significant decrease in *Lantana camara* as under growth. The patches of *Lantana camara* are replaced by *Leucenia* and Bamboo plants. Other local species have also come up and made the forest very dense near Har-Ki-Poudi, Mahamaya Temple, Interpretation centre and cafeteria. A patch of forest near main gate of Tawi Herbal Eco Park measuring about 60 kanal was under encroachment which was vacated and planted with herbal plants. That open area has now become dense forest, the canopies of trees are now touching each other. Very few patches of *Lantana* are observed in the image of 2020 .

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