Regional Remote Sensing Centre-Central,Nagpur NRSC, ISRO

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Application software development in Remote Sensing and GIS with advanced technologies like Deep Learning, Web GIS and IoT

OUR TEAM

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USE CASE Automatic extraction of Non Timber Forest Produce using Deep learning and Image processing techniques

Around Nagpur City

Pauni-Umred-Karhandla Wildlife sanctuary

Application: Forest/REDD

Location: In and Around Nagpur City, India

Products: Pleiades Neo Pan and MS Data

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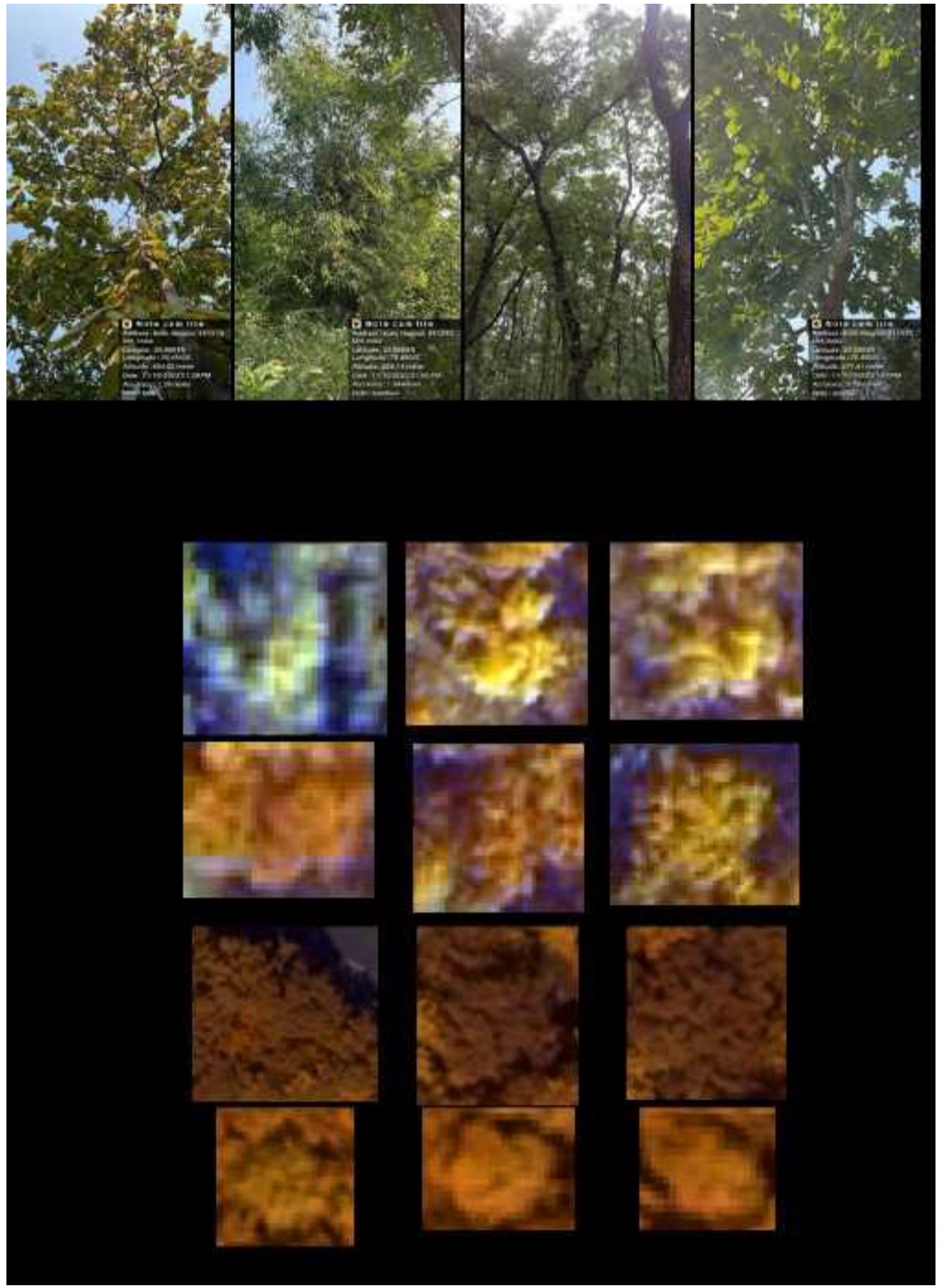
Challenge

Non-timber forest products (NTFPs) are made from tree species which are very important natural resources as far as Tribal welfare and sustainable development is concerned. The Tribal groups are dependent on these natural resources for sustaining their livelihood.

- Automatic extraction deep learning model of NTFP species is of great use as far as application of Image processing techniques is concerned.
- It is also linked to the **Sustainable Development Goals (SDG) 15** which aims to “protect, restore and promote sustainable use of terrestrial ecosystems, sustainably manage forests, combat desertification, and halt and reverse land degradation and halt biodiversity loss”.

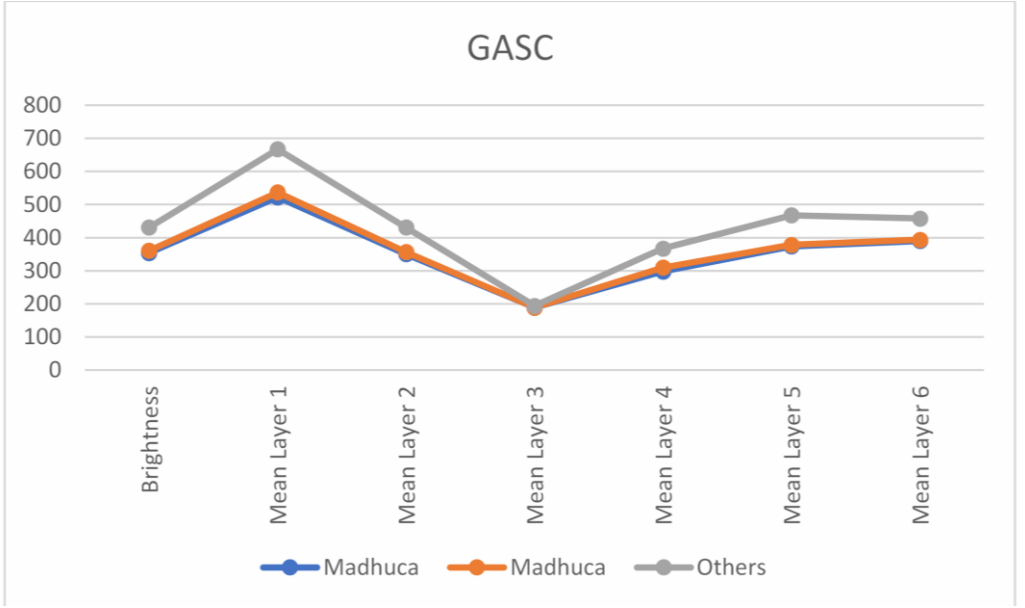


Object based Image Analysis

- Significant features of each tree species are key for their identification like Color, shape, size, textural patterns etc.
- Multiresolution segmentation was performed followed by Decision tree classification of objects.
- Graphical Analysis of spectral characteristics (GASC) was performed in order to arrive at invariant spectral features which are required for classifying segmented objects. These GASC invariants are different for different species and are generated by forming linear equations of more significant band values.
- Various other features were observed about the tree objects for modelling their identification process.

Feature	Mahua object 1	Mahua object 2
Brightness of all bands	353.8119	360.6943
GLCM Correlation (all dir.)	0.796478	0.840553
GLCM Dissimilarity (all dir.)	26.72984	23.03743
GLCM Entropy (all dir.)	8.09972	7.848015
GLCM Entropy (135°)	7.147088	6.969828
GLCM Mean (all dir.)	125.8535	126.569
GLCM StdDev (all dir.)	39.32437	38.40089
Mean Layer 1	522.0389	536.9528
Mean Layer 2	350.3766	356.5234
Mean Layer 3	189.0201	188.6067
Mean Layer 4	297.7872	309.7765
Mean Layer 5	373.7259	378.5438
Mean Layer 6	389.9226	393.7626
Roundness	0.47267	0.566484

Object Features of Madhuca longifolia or Mahua



Graphical Characteristic curve of Madhuca Longifolia or Mahua

Deep Learning Model

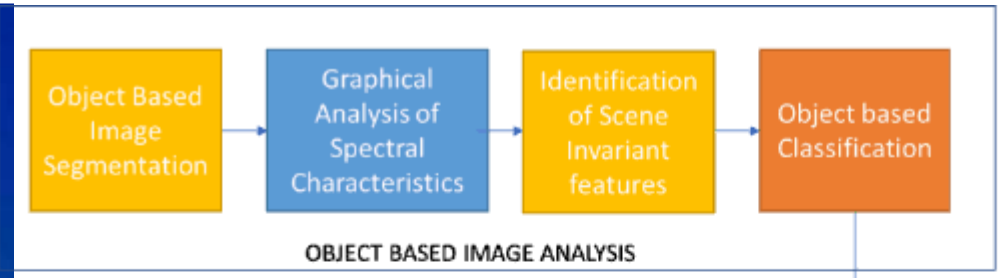
DEEP LEARNING MODEL

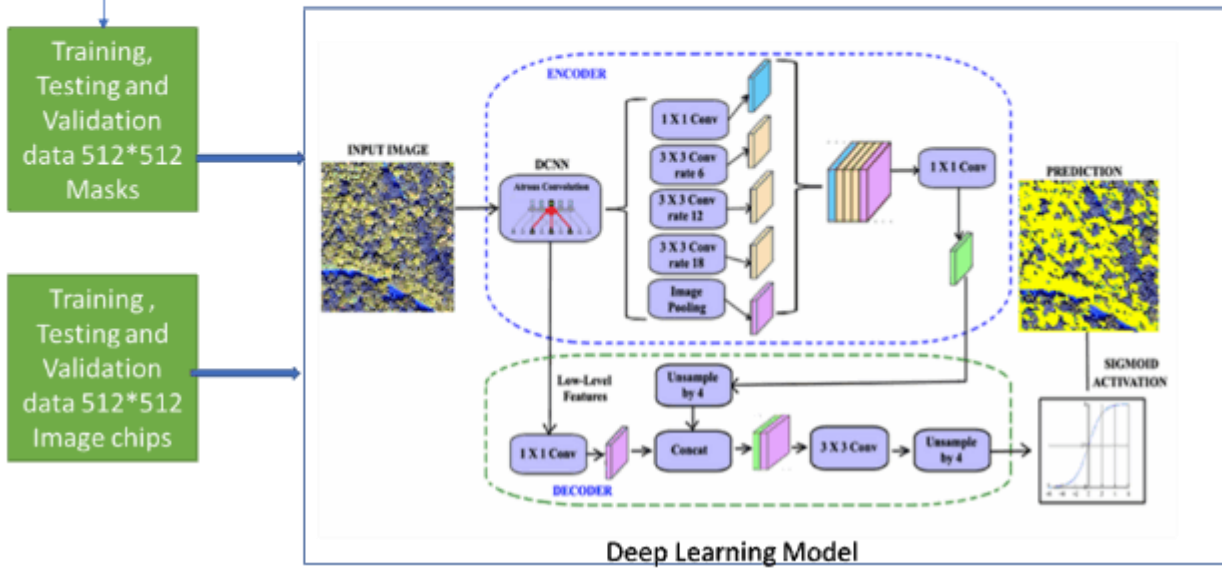
- Training data consists of 353 image chips of size 512 x 512 Pléiades Pan Sharpened - 6 bands REFLECTANCE - 16bits GEO and CARTO Product.
- The training labels for each image chip has been semi-automatically created using ***Object based classification***.
- The data augmentation is done both during training data creation and internally by the architecture.
- The dataset was divided into 60% for training and 40% for validation.
- The network consists was trained for 500 epochs. Each epoch is trained with one image per batch.
- The DL model gives (0.806654) in terms of IoU.

Pléiades Neo Imagery helped to:

- **Automatically extract the NTFP tree species**
- **Useful for Supporting Tribal Welfare by providing locational information of useful NTFP species in their area.**

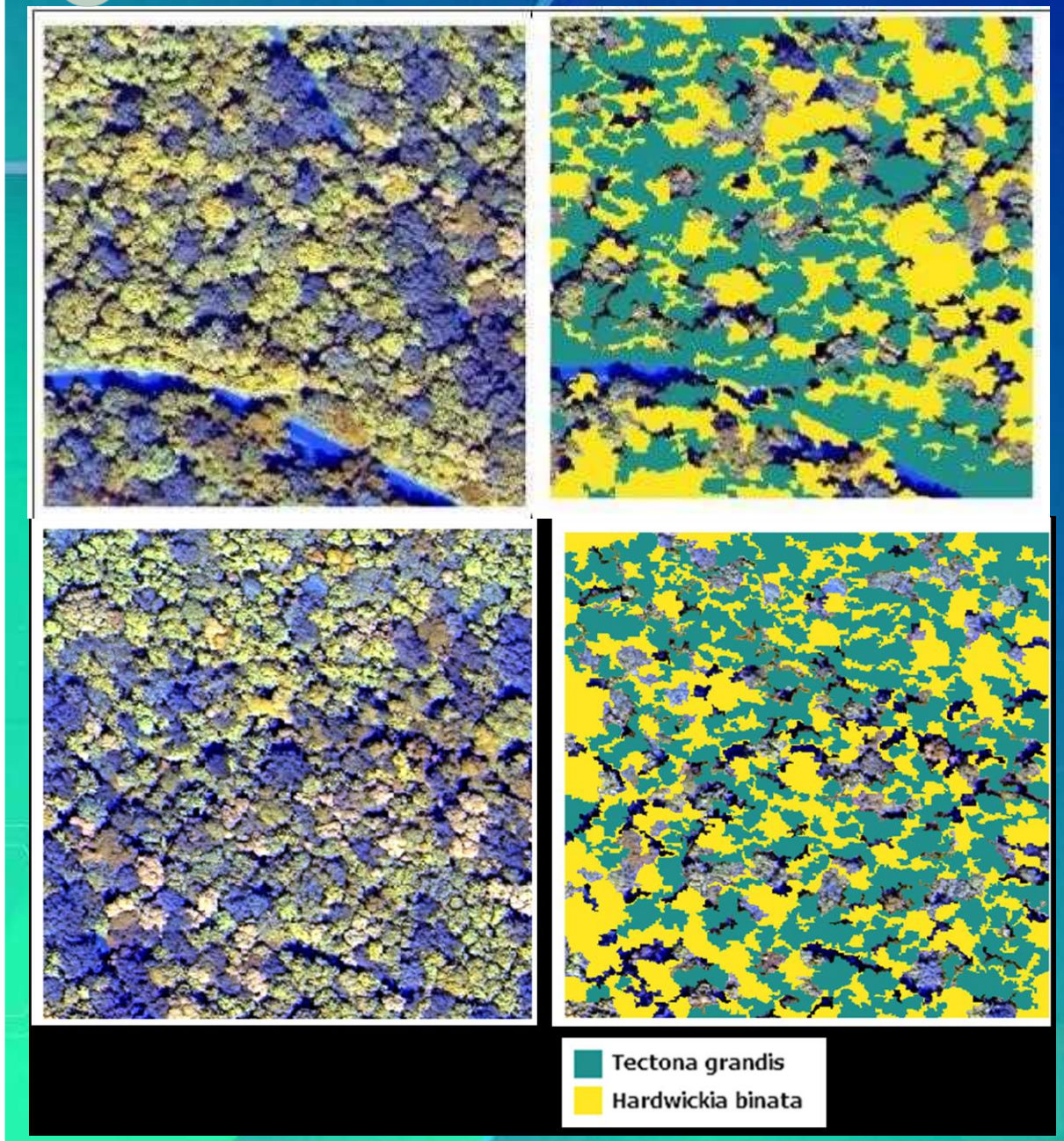
Methodology



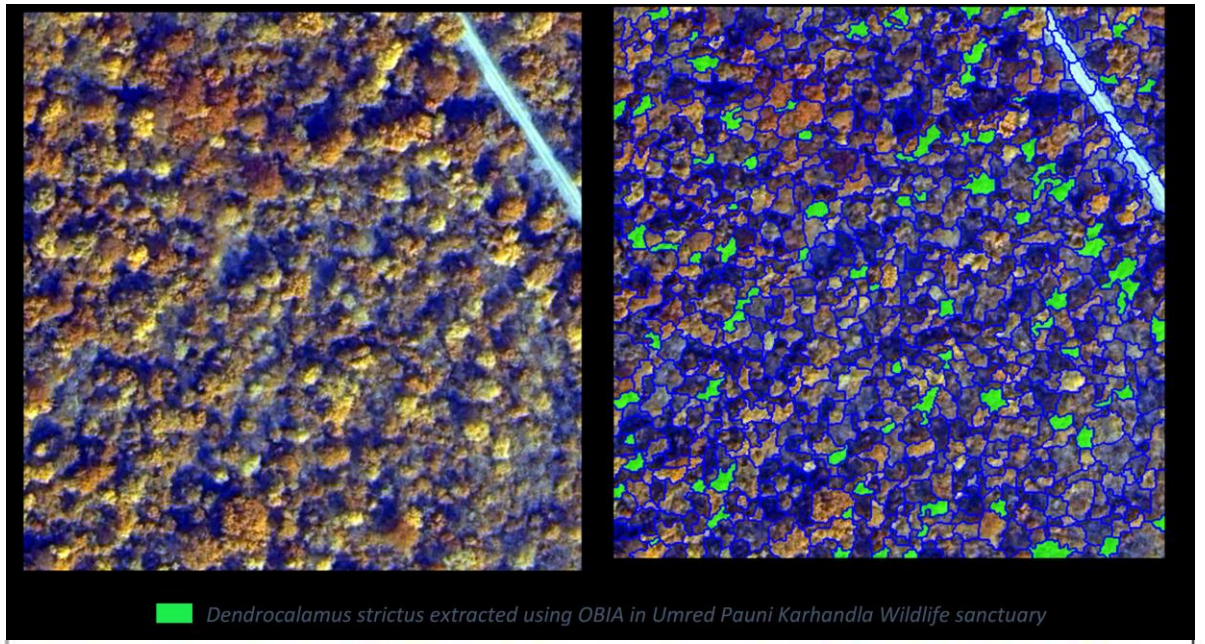


1. DeepLabV3+ is an architecture used for semantic segmentation which has two phases- encoding and decoding.
2. During encoding process, Deep convolutional Neural Network (DCNN) is applied. DCNN consists of many hidden which are a combination of convolution and pooling alternatively.
3. The DeepLabV3+ is used for recovering the object boundaries by incorporating a decoder module.
4. The DeepLabV3+ is made suitable to work with four classes in this study.
5. Xception65 architecture is used as the backbone architecture. The loss is calculated as binary cross entropy function along with sigmoid activation function.

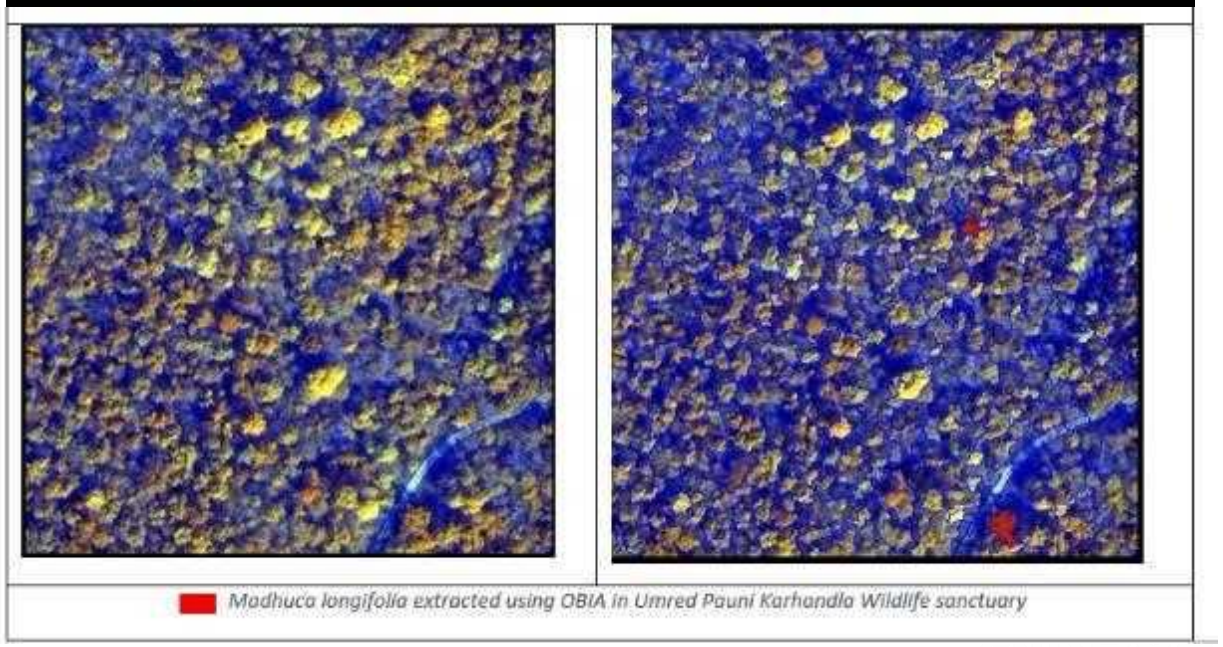
Results



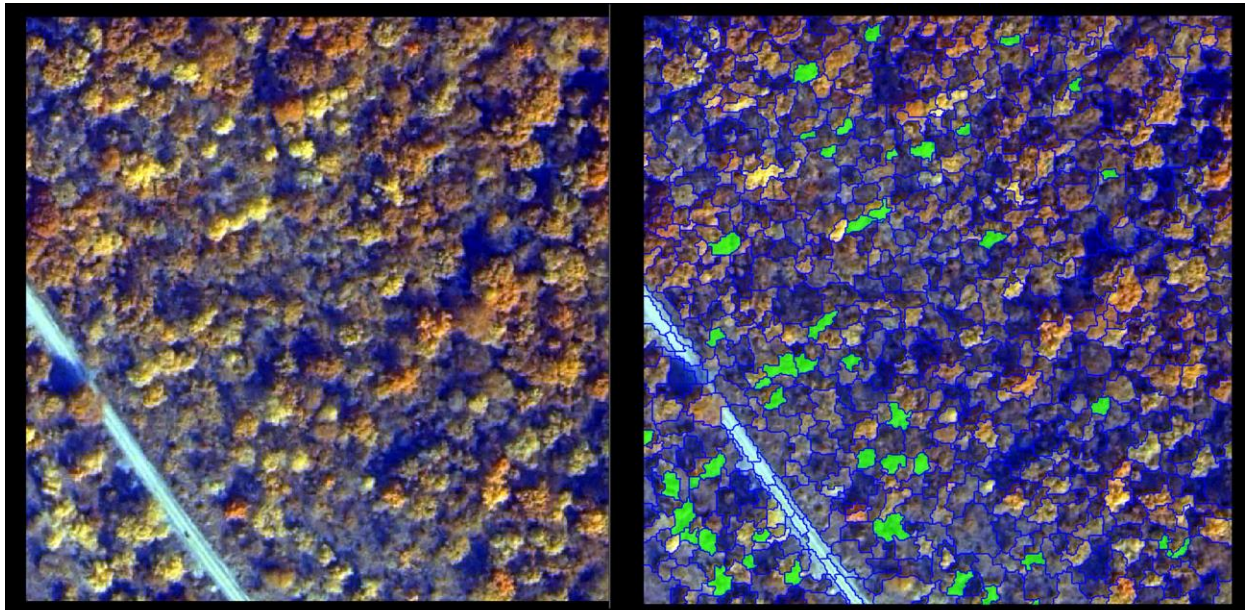
Classification of Tectona grandis and Hardwickia binata



Dendrocalamus strictus extracted using OBIA in Umred Pauni Karhandla Wildlife sanctuary



Madhuca longifolia extracted using OBIA in Umred Pauni Karhandla Wildlife sanctuary



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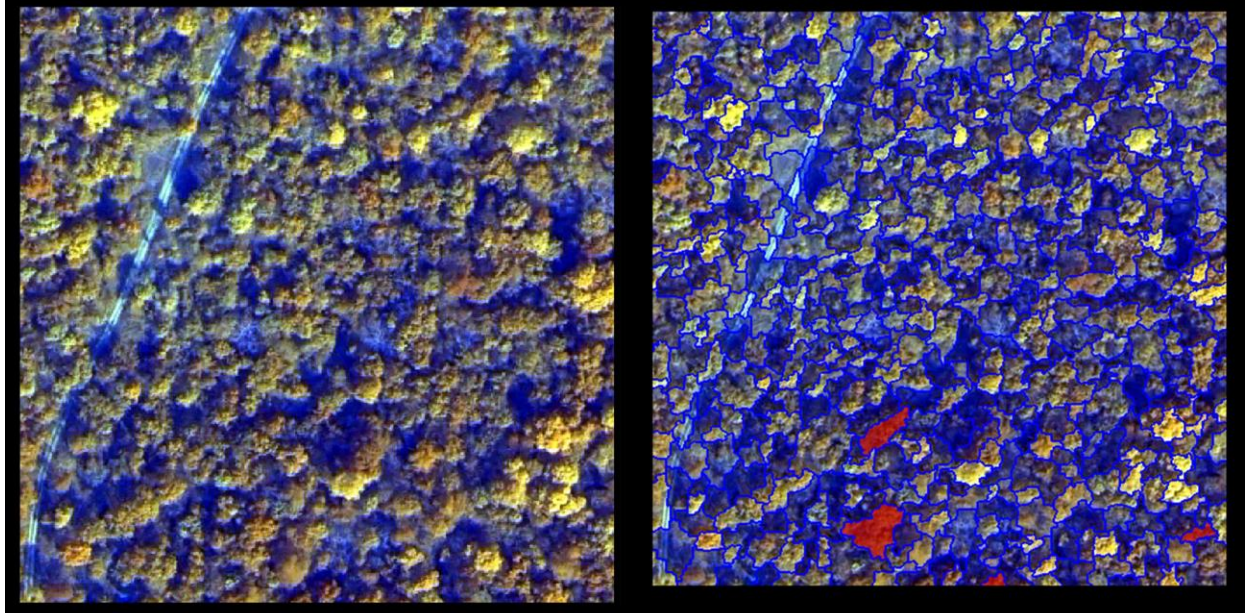

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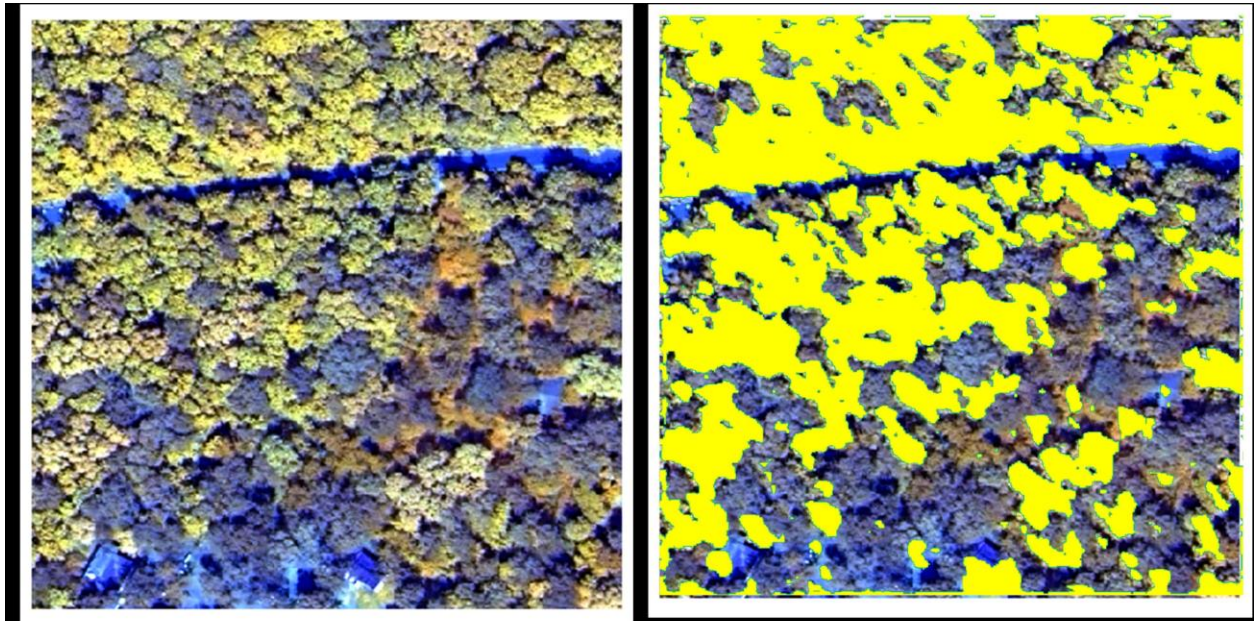


Figure 1.Deep Learning based Extraction of Teak with IoU=0.806654

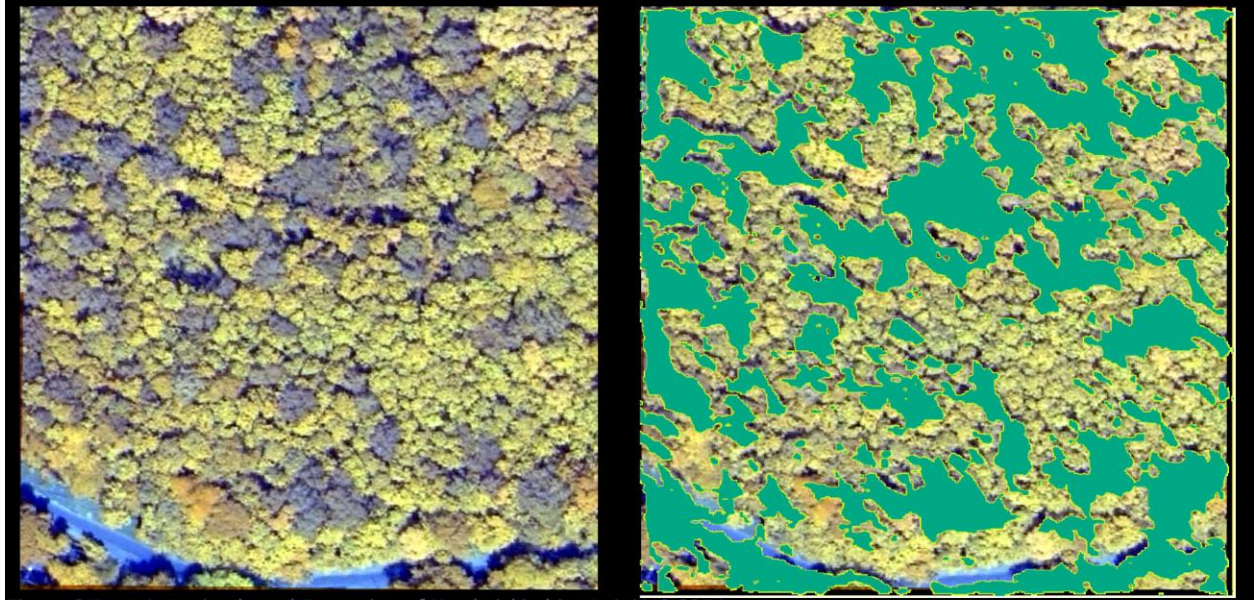


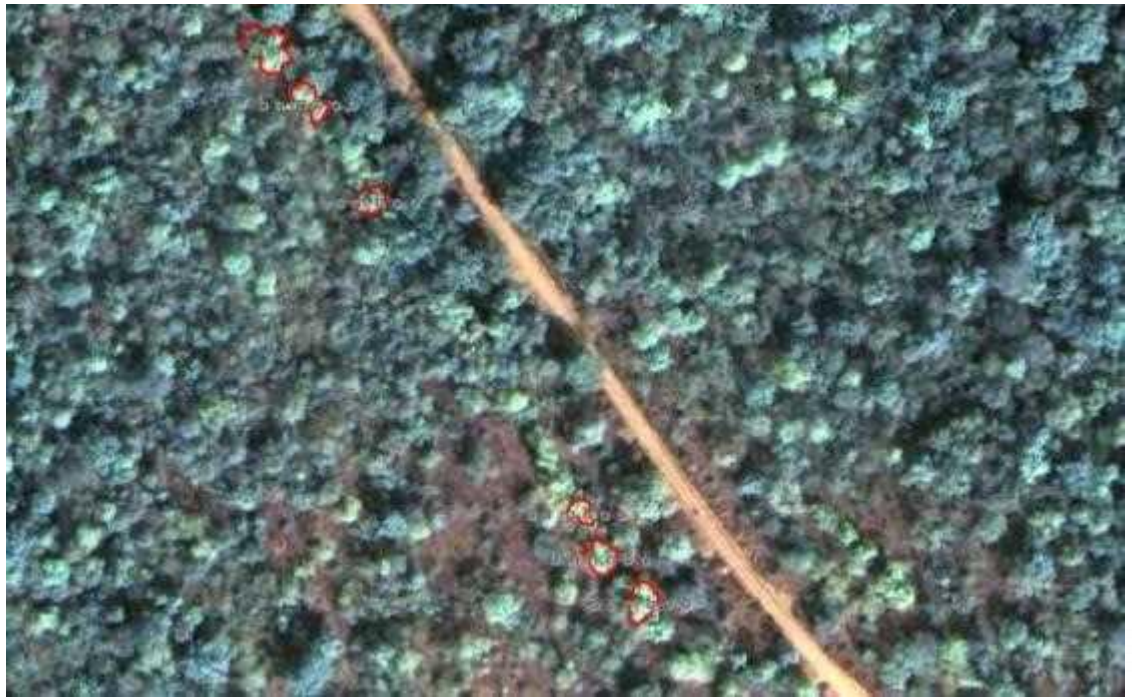
Figure 2.Deep Learning based Extraction of Hardwickia binata IoU=0.8054

Benefits

- With the use of the deep Learning method, the entire model can be used to fully automate the Tree species extraction.
- With the use of Object based Image analysis, it has been observed that generation of training dataset for semantic segmentation has been simplified. Object based feature extraction is a semi – automatic process, but it is faster than manual method of training dataset generation.
- The developed methodology will provide an add-on to the existing deep learning models like Deep Forest in the Forestry Applications for automatic extraction of Tree Species.

Organisation Involved:

इसरो isro nrsc




Hardwickia binata
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THANK YOU
hardwickia binata
Boswellia Serrata

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