Identification and Estimation of Poplar Species Area in Haryana and Punjab State Using Geo-Informatics

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ABSTRACT

Poplar is a very prominent taxonomical group of tree species in plantation forestry in India. It occurs in natural forests also. However, its population in natural stands is small and is gradually declining. Bu1k of the plantations are composed of populous deltoids, an exotic species. The area coverage and productivity of this species is bound to increase further, due to concerted research and development efforts aiming at its genetic improvement. Indigenous poplars occur only in the mountains and are still to acquire greater role and share in afforestation/reforestation programmes and conservation. Poplar, the common name for trees of the genus Populous, is a common sight in forests along waterways, around agricultural lands, throughout the Northern Hemisphere. It is species of trees which is mainly used for wood production and also for paper production. Poplar species is found in the Northern region of India. Today Poplar is main component in the farmer's life of Punjab and Haryana state. Popular plantations are done in various aspects of farming. Income dependency of farmers life is depends on also agriculture based technology. To Identify Poplar species in Haryana and Punjab state, remote-sensing and GIS based technology is used. Identification of Poplar species is done through State level and district level. For district level LISS - 4 image is used. Poplar species mapping are prepared for the 4 districts of Punjab state i.e. Rupnagar, ShaheedBhagatsingh Nagar, Nawashahr and Ludhiana and 3 districts of Haryana i.e. Yamunanagar, Karnal and Kurushetra. For state level Sentinel-2 image is used.

Keywords: Liss-IV; Sentinal-2; GIS; Remote-Sensing; GPS; Erdas15.0; Arc-GIS; Poplar species

INTRODUCTION

Poplars (Populous deltoids) are one of the most commercially important, fast growing soft-wood deciduous trees in temperate areas of the world. Poplar species gain significance due to its fast growth rate and the potential of use for various manufactured products, except having high biomass. They supply raw material for industrial processing (e.g. pulp, paper, engineered wood products, pallets, furniture) and valuable non-wood products (e.g. livestock fodder or medicinal extracts). Moreover, as fast-growing plant, Poplars sequester carbon more rapidly than other woody plants, therefore play important role in mitigation of climate change effects. The total area of poplars in the world is 79.1 million ha and the total area of Poplar plantations is 5.3 million ha. In India, major poplar producing states are Haryana, Punjab, Uttarakhand, Uttar Pradesh, Himachal Pradesh, Jammu and Kashmir, Arunachal Pradesh and West Bengal. Generally most of the Poplar are grown in the Indo-Gangetic plains of India.

Poplar based agroforestry is being practiced on large scale in the Northern plains of India especially in Haryana and Punjab State. The farmer grow poplar because of its short rotation period, ease of regeneration, leaflessness during winters, soil enriching, easy availability of quality planting materials. There is a large industrial area of wood in different region of Haryana and Punjab state. The existing rate for Poplar depends upon the age of Poplar species. Generally, Poplar with an age of 4-5 years, with proper management of poplar-based agroforestry system, farmers are producing an average of 100 q of wood/acre/year resulting in income ranging from Rs.70,000 - Rs.80,000/acre/year. About 60% to 70% of farmers of Haryana and Punjab state used plantation systems for cropping. For fast growth and good production, Poplar plantations are grown with sugarcane. To enhance the productivity of Poplar, plantations are done through 5-6 feet distance (5 feet horizontal and 6 feet vertically line by line). Others vegetables such as potato, and sometimes wheat is also grown with poplar plantation. Mapping of Poplar species is necessary to know the ground reality of its area and

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production. The traditional techniques of mapping Poplar species is field surveying, which is extremely time consuming, cost effective and required labour. While, Remote-Sensing (RS) technology can efficiently provide key data for mapping Poplar species than traditional field survey. Present study also done field survey along with remote sensing to know the 20% ground truth. There are 22 districts in Punjab state and 22 districts in Haryana state. Filed survey was also done in 4 districts of Punjab and 3 districts of Haryana. During field survey other species such as Mango, Eucalyptus, Guava and Milea-dubia was also examined along with Poplar species. The identification of Poplar for state level is based upon the reflectance value of the Imagery Satellite (Sentinel-2 and 2-A). In case of districts, High Level Resolution Imagery satellite (Cartosat 2 and Liss-IV) was used. First Object Based Image Analysis (OBIA) techniques was used. In this technique first Agroforestry was analyzed, then agroforestry is further classified into separate species (Mango, Poplar and Eucalyptus) based on the GPS points.

MATERIALS AND METHODS

The study area is located in Punjab and Haryana state is located in the Northern part of India. Punjab is situated within as along 31.1471° N longitude and 75.3412° E latitude and while Haryana is situated along 29.0588° N longitude and 76.0856° E latitude.

Poplar Species types are as follow

Indigenous species

Indigenous species of poplar occur in the Himalayan region in northern part of India. P. ciliata: The species is distributed from Kashmir to Arunachal Pradesh at an altitude range of 1300 to 3000 m above MSL altitude. This is the most widespread species of native poplars and mostly Trees usually occur on the banks of water courses. P. gamblei: This is the southernmost species of poplar in India and occurs at 600 to 1100 m altitude in Arunachal Pradesh. Poplar jacquemontii var glauca It is distributed in Tonglo in Sikkim and Eastern Nepal at an altitude range of 2500 to 2900 m. It has bisexual flowers. Poplar rotundifolia It is distributed in Bhutan Himalayas close to Indian border at 2300 to 3050 m altitude. Poplar Euphratica It occurs in Ladakh region of Jammu and Kashmir and extends to the Punjab and Sindh (Pakistan), Tibet, Afghanistan, Iran, Iraq and Turkey. Poplar alba It occurs in Pooh division in Kannaur, Himachal Pradesh and parts of Kashmir and Laddakh[1].

Exotic species

Poplar deltoides this is the most widely planted species of poplar

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in India. It and was introduced in India in the late 1950s. It is planted in plains of North-West India, i.e., Western Uttar Pradesh, Punjab and Haryana and to some extent in the outer plains/ valleys of Uttaranchal and Himachal Pradesh. Poplar nigra this occurs in avenue plantations in Kashmir valley. Inspector General of Forests, Ministry of Environment and Forests, Government of India [2].

Other species/hybrids

Poplar euramericana and Poplar berolinensis were introduced in India in 1950. Clones of Poplar canescens, Poplar maximowiczii, Poplar trichocarpa, Poplar simonii, Poplar szechuanica, Poplar yunnanensis, etc. were introduced in the subsequent years. Poplar deltoides performed better than all other exotic poplars in the plains of North India, and relegated most other exotic poplars to the status of anonymity in India. In the hills, Poplar yunnanensis and Poplar xeuramericana 'Robusta' proved better than other species [3].

GPS Survey and ground truth

In this survey 4 districts of Punjab and 3 districts of Haryana are surveyed under the species of Poplar, Eucalyptus, Mango, Miliea-Dubia, Guava and other species. In Punjab state Poplar are mainly found in Nawashahr and Hoshiarpur districts and in Ludhiana districts poplar are found in River belts. In Haryana State Poplar species mostly found in Yamunanagar district. It is mentioned in the Figure Brown points shows the GPS Point data and Yellow square shows the tracks of Poplar and other species plantation (Figure 1).

Methodology

For District level survey is done through the 4 districts in Punjab i.e. Rupnagar, ShaheedBhagatsingh Nagar, Nawashahr and Ludhiana and 3 districts in Harvana state i.e. Yamunangar, Karnal and Kurushetra. In survey of Punjab districts Poplar is mostly found across the canal and near about the Sutlej River. The Poplar are good of Punjab state as compared to the Haryana state due to Mountain region in Punjab state. For district level identification Liss-4 Image purchase from NRSC. Then process in GIS Software for composite band. After that process in Erdas 15.0 Imagine Software. For Objected Oriented Classification in OBIA Module first training samples are given for theextraction of trees in Liss-IV image. Raster Pixel Processor are done (RPP). It means that it takes only selected features and process only on those pixels after that Raster Object Creator is done (ROC) means only selected objected will be created. and Raster Object Operator (ROO) is operated than Raster to Vector process is done (R2V). Than further process



Figure 1: GPS and Tracks in Punjab and Haryana State.

pixel probability is done and range is given between 60 to 70. And finally selected object i.e. trees is comes in the form of vector (Shape file) form. Further it may takes post classification. And at last check the accuracy assessment. Similarly a different method is used to identify Poplar species by Sentinel 2and 2A image throughout the State. Firstly all the sentinel image of Haryana and Punjab state downloaded from the USGS, Earth explorer website. And after that process in QGIS 2.5 software for extracting TOA (Top of Atmospheric reflection). hen there is some noise i.e. comes through atmosphere, clouds or by sensors problems than this method of TOA is use (Figure 2).

Firstly all sentinel image are in the form of DN (Digital numbers) values i.e. it ranging from 0 to 255. The numeric digital counts (CN) of each pixel image (i,j) and each spectral band (k) are converted in TOA reflectance (ρ). This conversion takes into account the equivalent extra-terrestrial solar spectrum (E_s), the incoming solar direction defined by its zenith angle (θ_s) for each pixel of the image and the absolute calibration (A_k) of the instrument MSI [4].

The conversion equation is:

 $p_{k}(\mathbf{i}, \mathbf{j}) = \frac{\pi \times CN_{K,NTDI}(\mathbf{i}, \mathbf{j})}{A_{k,NTDI} \times E_{S} \times d(\mathbf{t}) \times \cos(\theta_{s}(\mathbf{i}, \mathbf{j}))}$



- CNk,NTDIis the equalized numeric digital count of the pixel
- (i,j) with NTDI, the number of SENTINEL-2 TDI lines.
- Es is the equivalent extra-terrestrial solar spectrum and depends on the spectral response of the SENTINEL-2 bands
- The component d(t) is the correction for the sun-Earth distance variation (see Equation 2). It utilises the inverse square law of irradiance, under which, the intensity (or irradiance) of light radiating from a point source is inversely proportional to the square of the distance from the source [5].

 $d(t) = \frac{1}{(1 - 0.01673 \times \cos(0.172 \times (t - 2)))^2}$

It is the Julian Day corresponding to the acquisition date (reference day: 01/01/1950).

0.01673 is the Earth orbit eccentricity.0.0172 is the Earth angular velocity (radians/day). The parameters A_k and E_s are provided by the GIPP and are also included in the ancillary data of the Level-1 products. The sun zenith angles are determined at this level too. A sun angle grid is computed by regularly down-sampling the target geometry (Level-1C tile). The cosine of the zenith angle θ_i is



Figure 2: Methodology for Liss IV Data and Sentinal 2 Data





Figure 3: Poplar Species in Yamunanagar, Haryana and Kurushethra, Haryana



Figure 4: Poplar Species in Ludhiana, Punjab and Karnal, Haryana



Figure 5: Poplar Species in Roopnagar, Punjab and Hoshiarpur, Punjab.





Figure 6: Poplar species in Haryana and Punjab states. Results - After applying all these process results will come and overall find the accuracy assessment.

S.No.	State	Total Geographical Area	Poplar Species	Poplar Percentage
1	Punjab	4909550.75	276789.89	5.63%
2	Haryana	4288070	204665.79	4.77%

defined at each point of the grid using the ground coordinates and the dotation of the corresponding pixel acquisition. The azimuth angle is not processed here (Figures 3-6) [6].

RESULT AND DISCUSSSION

Poplar is good for wood production and farmer's income but government has to be fixed price rate of Poplar production such as MSP (Minimum Support Price). The MSP of sugarcane is fixed every year by the government of India, so by this study the valuable MSP of other plantation such as Mango, Teak, Guava, and Eucalyptus Species may have to fix their MSP in future. By this Study we can know how Probably Poplar wood production is done and what their growth rate is in future.

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