Walchand College Of Engineering, Sangli.

(An Autonomous Institute)

Department
Of
Computer Science and Engineering

TY CSE Mini Project- 2
Report
On

Vegetation Change Detection Analysis using GIS

Submitted by

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Under the Guidance
of

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2022-2023

Walchand College of Engineering, Sangli
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Of
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CERTIFICATE

This is to certify that the Project Report entitled, **"VEGETATION CHANGE DETECTION ANALYSIS USING GIS"** submitted by Mr. Prathamesh Raje, Mr. Samrat Jadhav, Mr. Raj Dalvi , to Walchand College of Engineering ,Sangli, India, is a record of bonafide Project work of course *" 5CS346" " Mini-Project-2"* carried out by them under my supervision and guidance and is worthy of consideration for the award of the degree of Bachelor of Technology in Computer Science & Engineering of the Institute.

Prof. N. L. Gavankar	**Dr. M. A. Shah**
Guide	Head Of Department
Computer Sci. & Engg. Dept,	Computer Sci. & Engg.Dept,
WCE, Sangli.	WCE, Sangli

Acknowledgement

Today on completion of this project report, the persons I would like to thank the most who have helped us throughout the making of this project and without whose help it would not have seen the light of the day. Primarily, I submit our gratitude and sincere thanks to my project guide Prof. N. L. Gavankar for his constant motivation and support during the course of the work in the last six months. I truly appreciate and value his esteemed guidance and encouragement from the beginning to the end of this work. I'm very thankful to our Head of Department Dr. M. A. Shah for their unwavering moral support and motivation during the entire work.

I would also like to thank our Director Dr. P. G. Sonawane who encouraged us and created a healthy environment for all of us to learn in best possible way.

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Declaration

I hereby declare that work presented in this project report titled **"VEGETATION CHANGE DETECTION ANALYSIS USING GIS"** submitted by us in the partial fulfillment of the requirement of the award of the degree of **Bachelor of Technology (B.Tech)** Submitted in the **Department of Computer Science & Engineering, Walchand College of Engineering, Sangli**, is an authentic record of my project work carried out under the guidance of Prof. N. L. Gavankar, Computer Sci. & Engg. Dept,WCE, Sangli.

Date : 07/12/2022

Place : Sangli

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1 Project title

Vegetation Change Detection Analysis using GIS

2 Abstract

Vegetation extraction from remote sensing imagery is the process of extracting vegetation information by interpreting satellite images based on the interpretation elements such as the image colour, texture, tone, pattern and association information. The vegetation maps are critical for understanding biodiversity management and planning from local to global scales. There are two essential elements of vegetation maps that are based on classification of vegetation and spatial attribution of that classification. The difference between these vegetation cover can be done with using remote sensing and GIS.

Vegetation Change Detection Analysis is a case study of change in vegetation of Sangli city over the last 7 years from year 2012 to 2019. This will help decision makers to make a good policy for the environment. It will be done using remote sensing and geographical information system (GIS).

Remote sensing is the Science and Art of acquiring information and extracting the features in form of Spectral, Spatial and Temporal about some objects, area or phenomenon, such as vegetation, land cover classification, urban area, agriculture land and water resources without coming into physical contact of these objects. The multispectral remote sensing images carry essential integrating spectral and spatial features of the objects.

The multispectral images of Sangli city will be used to calculate the percentage of versatile features such as vegetation, built up, water bodies, barren land are presented in this image, and to subsequently make these extracted features available to the public for further analysis in order to know about the changes in these features.

The study of vegetation change will be based on images downloaded from usgs earthexplorer of LANDSAT and LISS-III satellite. Further, ERDAS IMAGINE software will be used to configure the images. There are several indices for highlighting vegetation bearing areas on a remote sensing scene. NDVI is a common and widely used index. It is an important vegetation index, widely applied in research on global environmental and climatic change.

Machine learning (ML) is a subdivision of artificial intelligence in which the machine learns from machine readable data and information. It uses

data, learns the pattern and predicts the new outcomes. Its popularity is growing because it helps to understand the trend and provides a solution that can be either a model or a product. This study is carried out to perform various machine learning algorithms for vegetation classification using remote sensing and ancillary spatial data across a Sangli.

Through the study of this images generated, we are going to detect fluctuations in vegetation cover of Sangli city.

3 Introduction and Related work

Vegetation Change Detection Analysis using GIS, is associated with merits and application of remote sensing and geographical information (GIS). This also covers about the vegetation, remote sensing in vegetation and classification using advanced analytical techniques like machine learning algorithms.

Sangli district is one of the thirty-six districts of Maharashtra State. It is situated in the Southern part of the State, adjoining Karnataka and lies between north latitudes 16° 43' and 17° 38' and east longitude 73° 41' and 75° 41'. Satellite images were taken from the ISRO (Indian Space Research Organisation) Bhuvan website. Study area include the satellite image of area 16.75 N to 17.00 N and 74.50 E to 74.75 E which covers the part of the Sangli district. It comprises Sangli city, Miraj and other major villages from the Miraj , Tasgaon, Kavathe Mahankal tehsils.

Selected tile and surrounding area

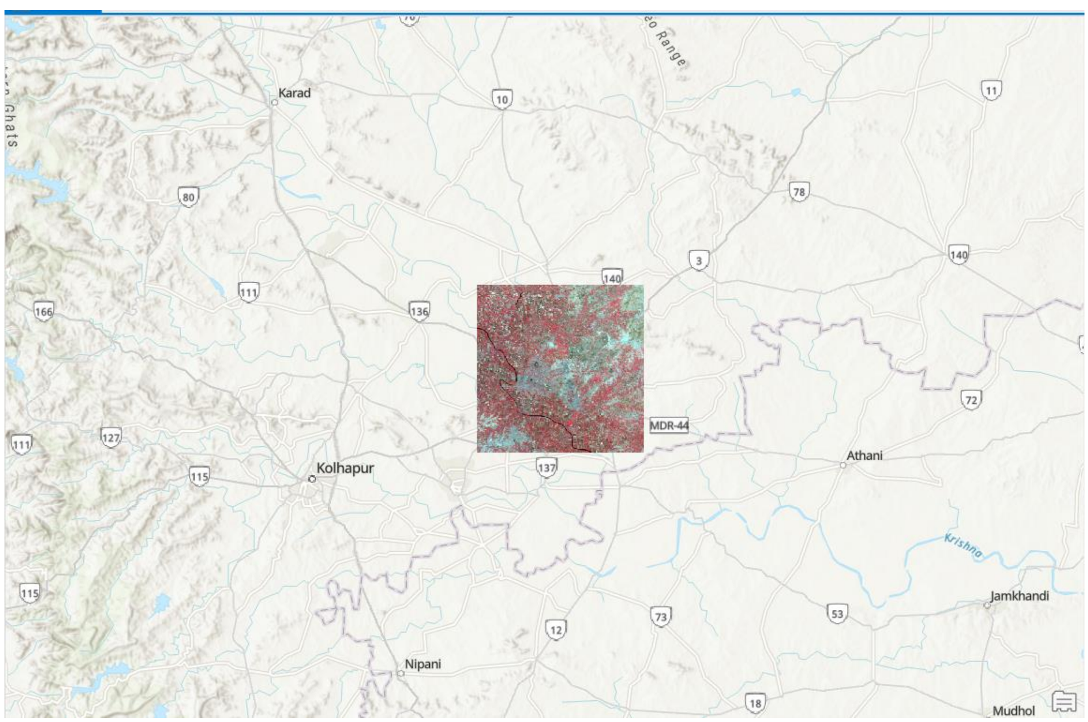


Figure 1. Selected Tile for study

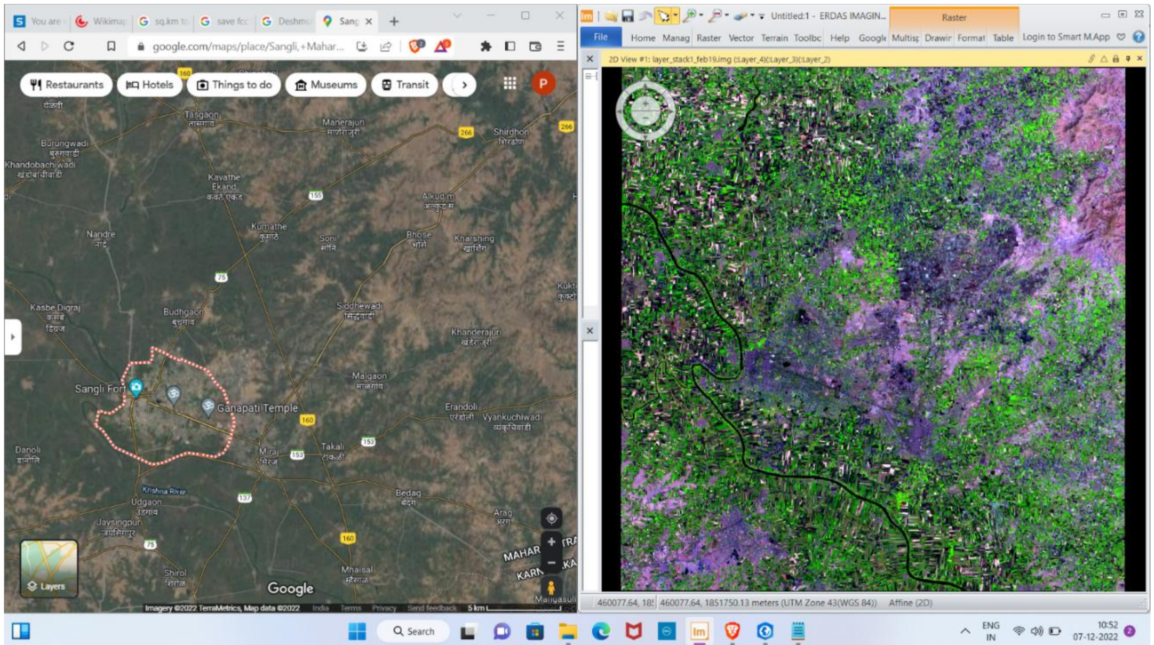


Figure 2. Satellite Image

SATELLITE AND SOFTWARE USED

DATA USED

LISS-III Resolution

The LISS – III Sensor provides Multispectral data in 4 Bands. The Spatial Resolution for visible is 2 bands, and Near-Infrared 1 band is 23.5 meters with a ground swath of 141 kms. The short wave infrared band is the 4th band, has a spatial resolution of 70.5 meters with a ground swath of 148 kms. The repetitivity of LISS – III is 24 days.

LISS-III Band Information

Band	Wavelength (micrometres)
Blue	–
Green	0.52 to 0.59
Red	0.62 to 0.68
NIR	0.77 to 0.86
SWIR	1.55 to 1.70

Software Used

The software packages used during the study are listed below:

a) ERDAS 2020.

b) ArcGis Pro 3.0.0

a) ERDAS IMAGINE:2020

ERDAS Imagine is an image processing software package that allows users to process both geospatial and other imagery as well as vector data. It use to collect, process, analyze and understand raw geospatial data, and ultimately deliver usable information. ERDAS can also handle hyperspectral imagery and LIDAR from various sensor. ERDAS is integrated within other GIS and remote sensing application and the storage format for the image can be read in many other application (.img files). ERDAS IMAGINE provides true value, consolidating remote sensing, photogrammetry, LiDAR analysis, basic vector analysis, and radar processing into a single product.

 User-friendly ribbon interface

 Spatial modelling with raster, vector and point cloud operators, as well as real-time results preview.

 A variety of change detection tools

 Ability to convert more than 190 image formats into all major file formats, including GeoTIFF,

NITF, CADRG, JPEG, JPEG2000, ECW, and MrSID.

b) ArcGis Pro 3.0.0

ArcGIS Pro is desktop GIS software developed by Esri, which replaces their ArcMap software generation. The product was announced as part of Esri's ArcGIS 10.3 release, ArcGIS Pro is notable in having a 64 bit architecture, combined 2-D, 3-D support, ArcGIS Online integration and Python 3 support.

Mainly used for making training data in our study.

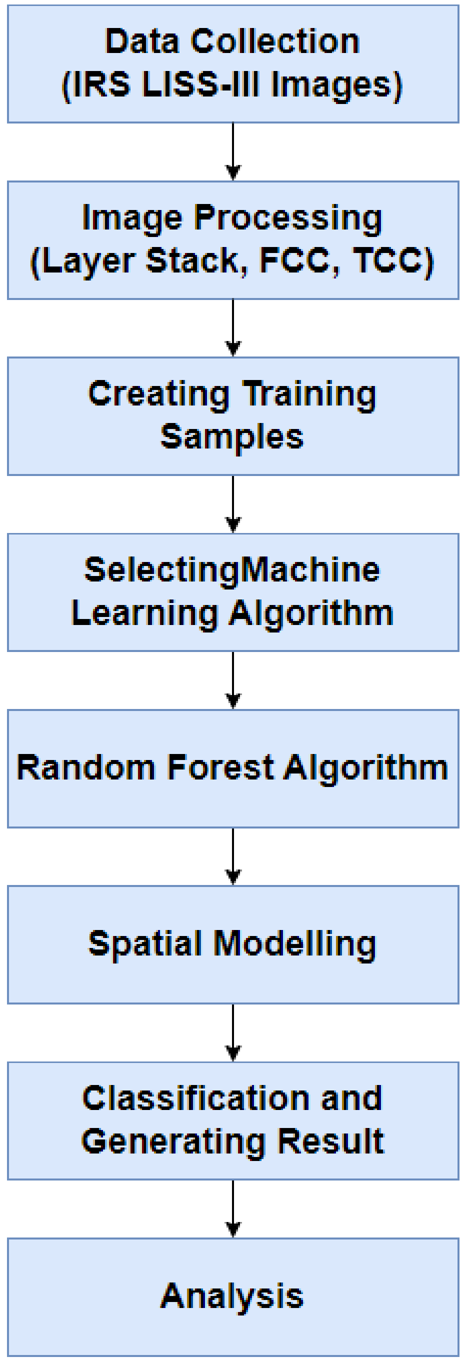
4 Problem statement

To detect the change in vegetation cover of Sangli City

5 Objectives

- Study of Remote Sensing and GIS technologies.
- Study of change in vegetation cover.
- Study of ERDAS IMAGINE 2020 features.
- Study of Machine Learning algorithm to detect change detection.
- Design a Spatial Model for generating the desirable information.

6 Methodology



Procedure:

1) Collection of Data

For performing the change detection we first require satellite images. Multi- temporal satellite data, LISS-III data of different sensors and acquisition dates are used in this study. Images are collected from Bhuvan website of National Remote Sensing Centre, ISRO, India. Indian Remote Sensing (IRS-P6) satellite gives LISS-III (Linear Imaging and Self Scanning Sensor) data. The LISS – III Sensor provides Multispectral data in 4 Bands. The Spatial Resolution for visible is 2 bands, and Near-Infrared 1 band is 23.5 meters with a ground swath of 141 kms. The short wave infrared band is the 4th band, has a spatial resolution of 70.5 meters with a ground swath of 148 kms. The repetitivity of LISS – III is 24 days. The wavelength ranges of band are Green(0.52 to 0.59), Red (0.62 to 0.68), NIR(0.77 to 0.86), SWIR(1.55 to 1.77).

2) Image Preprocessing

1. Layer Stack image is formed using tool in Erdas Imagine which combine four bands into a single image.
2. The quality of remote sensing data is increased by of its spatial, spectral, radiometric and temporal resolution.

   Spatial resolution: The pixel size which is recorded in a raster image.

   Spectral Resolution: The wavelength of different frequency bands recorded – usually, this is related to the number of frequency bands recorded by the platform.

   Radiometric Resolution: The number of different intensities of radiation the sensor is able to distinguish. It depends on the instrument noise.

   Temporal Resolution: The amount of time needed to revisit and acquire data for the exact same location.
3. Performance of radiometric and geometric correction on the downloaded data for better image interpretation.
4. Formation of TCC and FCC

   True Colour Composite (TCC) is one in which Red band – Red; Green band – Green; Blue band – Blue. False Colour Composite (FCC) is Any other combination of colours. E.g., Blue band – Red; Red band – Green; Green band – Blue.

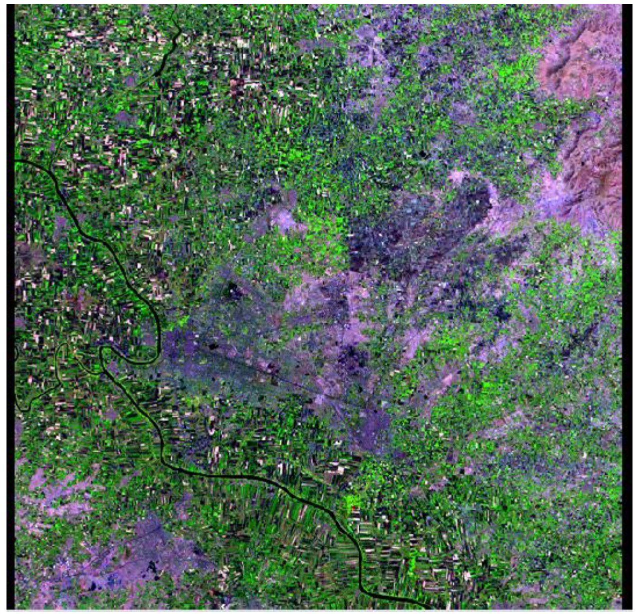


Figure 3. True Color Composite

5. Erdas Imagine will be used to generate the false colour composite, by combing near infrared, red and green which are bands 4, 3, 2 together for both images. This will be done for vegetation recognition, because chlorophyll in plants reflects very well to near infrared than the visible.

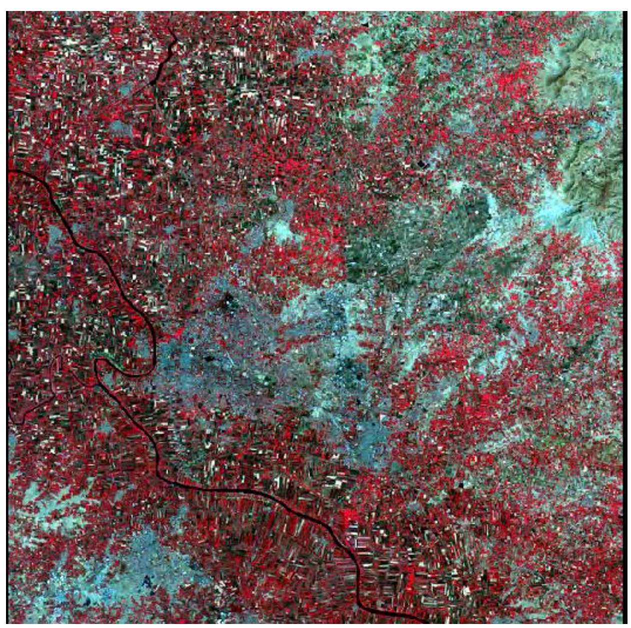


Figure 4. False Color Composite

3) Creating training samples

A set of circles or polygons was created to collect training sample data by using ARCGIS Pro toolbox. The training data were manually sampled in composited RGB imagery of IRS LISS-III. To enhance the accuracy of training samples, others dated data imagery was used to reference. Different sizes of circles may differ in the number of pixels per land cover class. The vegetation type with LU/LC classes of selected area is divided into 4 classes.

Classes:

- Water
- Vegetation
- Built-up Area
- Barren Land

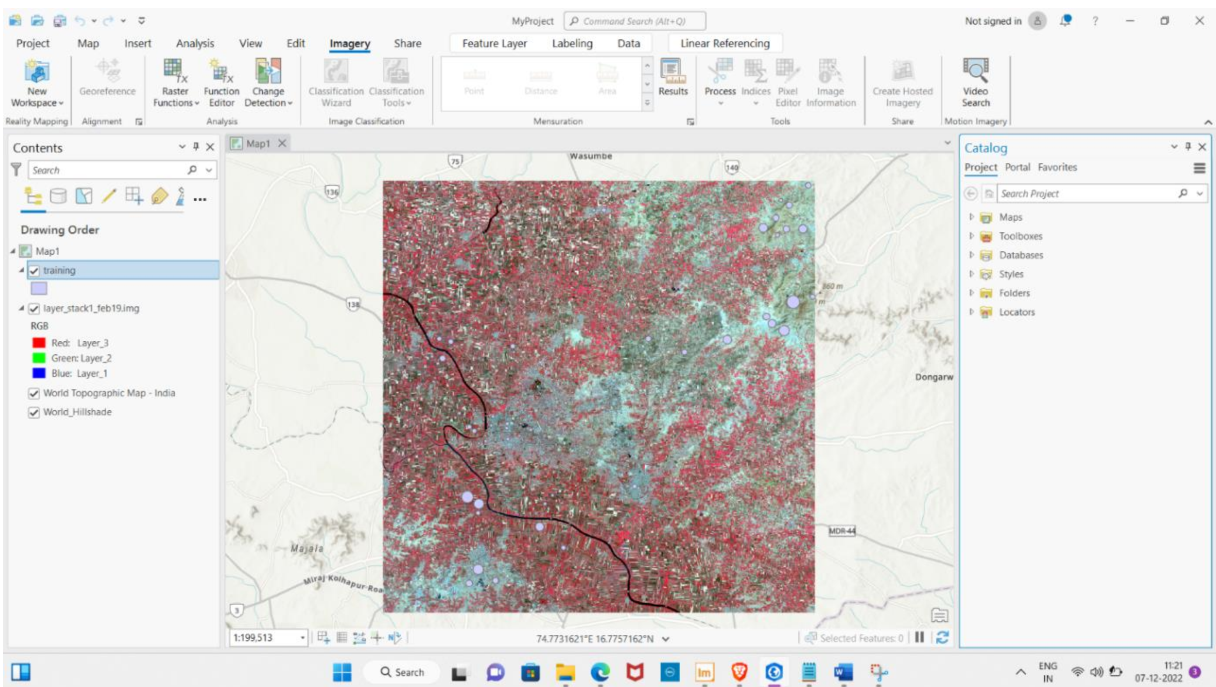


Figure 5. Training data

4) Machine Learning Algorithm

Spatial modeller allows to build a flow chart that contain operators strung together logically to produce output results. The collected labelled training samples was used for classification of vegetation type and used to run the spatial modeller in ERDAS software. Spatial modeller is extremely effective way to produce and analyse raster data. To each algorithm, raster input and vector input are given. Feature input are given as the training samples(polygon) and raster input is given as the satellite imagery. To the raster statistics mean is calculated and id value is given for the selected attribute. To each output layer, folder is connected and output are collected.

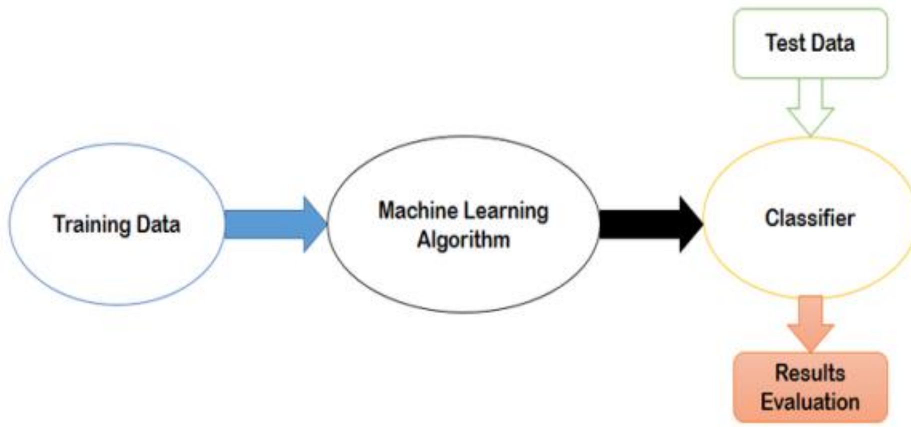


Figure 6. Machine Learning Workflow

5) RANDOM FOREST (RF)

Random Forest (RF) is a classification and regression tree technique invented by Breiman. A RF randomly and iteratively samples the data and variables to generate a large group, or forest, of classification and regression trees. The classification output from RF represents the statistical mode of many decision trees achieving a more robust model than a single classification tree produced by a single model run. Random forest randomly selects observations, builds a decision tree and the average result is taken. It doesn't use any set of formulas

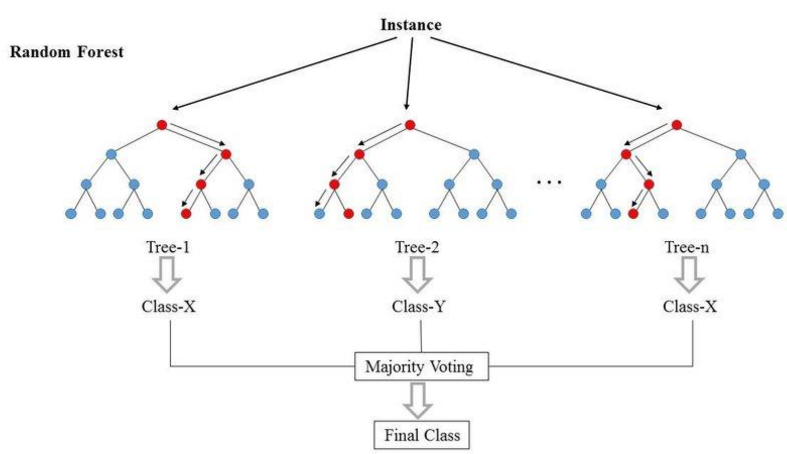


Figure 7. Random Forest Algorithm

6) Spatial Modelling

Feature Input:
One of the most important tasks in building model is to collecting training data. In feature input data, its feature schema contains attribute fields whose name match with non-geometry attribute fields of training data used for training the machine intellect. Manually digitized rectangular boxes (polygon) in the image are taken as feature input which is in .shp format

Raster input:
Raster input is taken as satellite image (FCC) which is in image imagine format.

Raster statistics fer feature:
In raster statistics per feature, the operators compute with statistics on pixel of input raster that are inside a feature. The computed statistical value is added as attribute to the feature stream. By default, mean is computed. The constructed attribute name matches with the name of existing field and the existing field is overwritten.

Select Attribute:
In the select attribute, the given id, class, or value is used to initialize random forest. The select attribute operator is used to tailor the training data's attribute scheme before the training data is used in the initialize random forest operator.

Initialize random forest:
In the initialize random forest it selects attribute operator is used to tailor the training data's attribute scheme. The operator defines and trains a random forest classifier which is used as an input or classifying data using classifying machine learning operator.

Machine intellect output:
It saves machine intellect data to file, which is saves in. miz format.

Machine learning input:

The saved output file is again taken as machine intellect input that is used in classifying using machine learning operator.

Classifying using machine learning:
This operator performs classification on input data using trained classifier specified on the machine intellect port.

Raster Output:
Saves raster into a file, by default properties of a output are determined from raster in. It saves the output file with .img format, in a given folder with a specified name.

Random forest is an ensemble of decision tree. In random forest it generates multiple trees with different solution of training samples. Each tree in the forest gives a vote and an object is assigned/ classified to the class that has most votes.

Model Inputs and Outputs

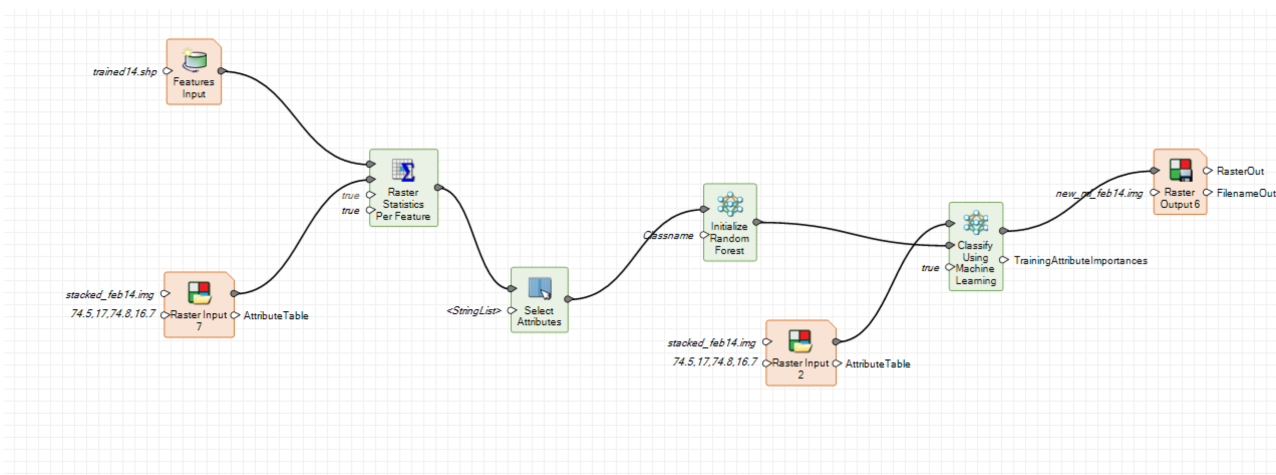


Figure 8. Machine Learning Spatial Model

7) RESULTS OF IMAGE CLASSIFICATION OF AN ALGORITHM

Processed and machine learning classified images of February 2014 and February 2019 are as follows:

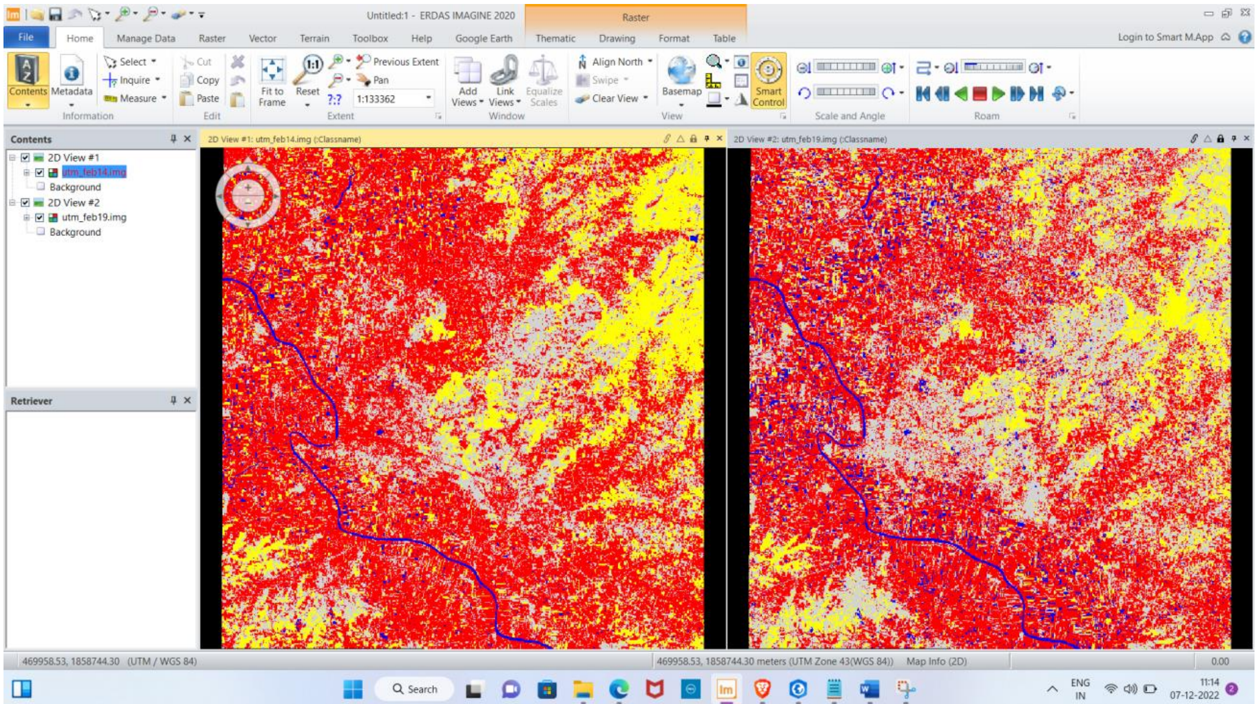


Figure 9. ML Classified Images

Attribute table of each map image after applying reprojection for area calculation:

Feb 14 Attribute Table:

utm_feb14.img : Classname

Row	Color	Red	Green	Blue	Opacity	Class_Names	Histogram	Area
0		0	0	0	1	Background	5442	801.786
1		1	1	0	1	Barren Land	218832	32241.2
2		0.827	0.827	0.827	1	Built-Up	360773	53153.8
3		1	0	0	1	Vegetation	720435	106144
4		0	0	1	1	Water	25750	3793.82

Feb 19 Attribute Table:

utm_feb19.img : Classname

Row	Color	Red	Green	Blue	Opacity	Class_Names	Histogram	Area
0		0	0	0	1	Background	5442	801.786
1		1	1	0	1	Barren Land	163316	24061.8
2		0.827	0.827	0.827	1	Built-Up	474664	69933.7
3		1	0	0	1	Vegetation	623904	91921.6
4		0	0	1	1	Water	63906	9415.46

7. Analysis

Vegetation Change Analysis of Sangli Using GIS

Class	Area(in acres)		Change(in acres)	Comment
	Feb 2014	Feb 2019		
Barren Land	32241.2	24061.8	8179.4	Decreased
Built-Up	53153.8	69933.7	16779.9	Increased
Vegetation	106144	91921.6	14222.4	Decreased
Water	3793.82	2983.64	810.18	Decreased

Tile Specifications:

Geogfraphical Location: Southern part of the State Maharashtra, adjoining Karnataka in Sangli district

Latitude: 16.75 N to 17.00 N

Longitude: 74.50 E to 74.75 E

Total Area of Tile = 195332.56 acres

Ground truths:

Year	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	Average Rainfall (mm)
Sangli	409	529.3	642.8	467.6	656.8	600.1	485.6	973.4	962.6	801.9	652.9

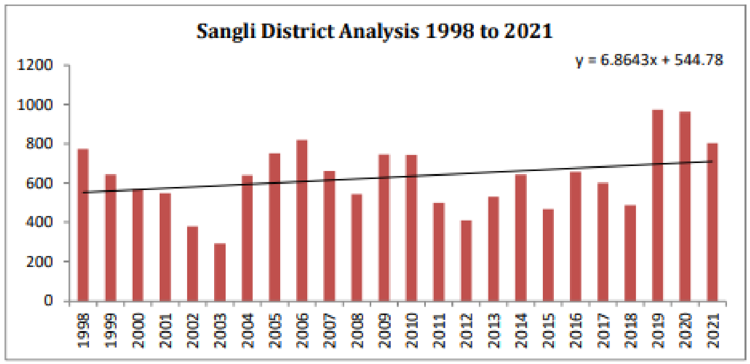


Fig.10 Ground Truth Average Rainfall

Reference:

CENTRAL GROUND WATER BOARD

Government of India

Ministry of Jal Shakti

Department of Water Resources,

River Development& Ganga Rejuvenation

AQUIFER MAPS AND GROUND WATER

MANAGEMENT PLAN

SANGLI DISTRICT, MAHARASHTRA

AAP 2021-22

http://cgwb.gov.in/AQM/NAQUIM_REPORT/Maharshtra/NAQUIM%20Sangli_FINAL%20MAHARASHTRA.pdf

8. Results and Conclusion

The study concludes that ML techniques are an efficient approach to map different land use and land cover classes, including different vegetation types and demonstrated that Random Forest algorithm performs best. Supervised Classification performed by manually selecting the pixel as training data (in the form of signature file) is good but the errors can get introduced while manually selecting the sample pixel. Study of various of ERDAS IMAGINE made easier to perform the case study.

Using the Random forest algorithm for the classification of satellite image in the classes i.e Vegetation, Built up, Barren land and Water bodies the results are more accurate than the supervised classification. After the analysis and study of the classified images generated by random forest algorithm. We reached to the conclusion that the vegetation cover in the study area has been decreased. There is considerable increase in the built up area. Decrease in the barren land can be interpreted as the more land gets under the cultivation

9. References

[1] "LULC Classification by Sentinel-2B Data using Machine Learning Techniques in Virajpet Taluk" Souparnika H Koppal1 , Student, Dept of Geoinformatics, Karnataka State Rural Development and Panchayat Raj University Gadag. Ravi Jadi1 , Faculty, Dept of Geoinformatics, Karnataka State Rural Development and Panchayat Raj University Gadag. Smt. Shivam Trivedi2 , Scientist/Engineer 'SE', RRSC-South, Dept of Space, ISRO Bengaluru - 560 037.

[2] https://www.esri.com/en-us/what-is-gis/

[3] https://bhuvan.nrsc.gov.in/home/index.php

[4] https://earthexplorer.usgs.gov/