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RESEARCH ARTICLE

Determining the Vegetation Indices (NDVI) from Landsat 8 Satellite Data.

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Abstract

A step-wise calculation approach was employed in ArcGIS 10.2.2 to identify the apple area, viz. (i) delineation of non-vegetation classes using NDVI threshold (ii) unsupervised classification to Delineate forest plantation and (iii) supervised classification for the identification of apple orchards. A non-vegetation classes like wastelands, water bodies, settlements has been masked using Vegetation Index (VI) derived using remote sensing data. Vegetation has a distinctive spectral signature that is characterized by low reflectance in visible region of solar optical spectrum as well as high reflectance in infrared (IR) spectrums. The combination of these two spectral regions allows classification of vegetation. In the present study normalized difference vegetation index (NDVI), Where NIR is the reflectance in near infrared band and R is the reflectance in red band of satellite data. NDVI indicates the vigor of vegetation. Higher NDVI indicates higher amount of green vegetation on ground. NDVI of non-vegetation classes are generally lower than vegetation classes.

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Introduction:-

The Normalized Differential Vegetation Index (NDVI) is a standardized vegetation index which allows us to generate an image showing the relative biomass. The chlorophyll absorption in Red band and relatively high reflectance of vegetation in Near Infrared band (NIR) are using for calculating NDVI. (ESRI)

“An NDVI is often used worldwide to monitor drought, monitor and predict agricultural production, assist in predicting hazardous fire zones, and map desert encroachment. The NDVI is preferred for global vegetation monitoring because it helps to compensate for changing illumination conditions, surface slope, aspect, and other extraneous factors” (Lillesand 2004).

Observing the force and the thickness of the green vegetation development should be possible utilizing the reflection from the red band and the infrared band. Green vegetation reflects more vitality in the close infrared band than in the unmistakable extent. It watch red band more for the photosynthesis procedure. Leaves reflect less in the close infrared district when they are focused on, infected or dead. Highlights like Clouds, water and snow indicate better appearance in the unmistakable range than the close infrared extent, while the distinction is just about zero for rock and exposed soil.

Yield of the NDVI strategy makes a solitary band dataset that exclusive shows greenery. Values near zero speak to shake and exposed soil and negative qualities speak to water, snow and mists. Taking proportion or distinction of two groups makes the vegetation development signal separated from the foundation signal. NDVI strategy was produced by the NASA researcher prevalently known as Normalized Difference Vegetation Index (NDVI). By taking a proportion of two groups drop the qualities between - 1 to +1. Table underneath demonstrates the red and infrared groups reflectance estimations of elements and their NDVI values. Water has NDVI esteem under 0, exposed soils somewhere around 0 and 0.1, and vegetation more than 0.1. Increment in the positive NDVI esteem implies greener the vegetation.

Materials and Methods:-

Landsat 8 Satellite Data and ArcGIS 10.2.2.Were Used In The Study.

Table.1:-shows the Spectral characteristics of Landsat 8

Landsat 8 Operational Land Imager (OLI) and Thermal Infrared Sensor (TIRS)	Bands	Wavelength	Resolution
	Band 1 – Coastal aerosol	0.43 – 0.45	30
	Band 2 – Blue	0.45 – 0.51	30
	Band 3 – Green	0.53 – 0.59	30
	Band 4 – Red	0.64 – 0.67	30
	Band 5 – Near Infrared (NIR)	0.85 – 0.88	30
	Band 6 – SWIR 1	1.57 – 1.65	30
	Band 7 – SWIR 2	2.11 – 2.29	30
	Band 8 – Panchromatic	0.50 – 0.68	15
	Band 9 – Cirrus	1.36 – 1.38	30
	Band 10 – Thermal Infrared(TIRS) 1	10.60 – 11.19	100 * (30)
	Band 11 – Thermal Infrared(TIRS) 2	11.50 – 12.51	100 * (30)

(Obtained from USGS)

Step 1:- Calculating Reflectance value from the Satellite data

OLI spectral radiance data can also be converted to TOA planetary reflectance using reflectance rescaling coefficients provided in the landsat8 OLI metadata file. The following equation is used to convert DN values to TOA reflectance for OLI image:

$$\rho_{\lambda}' = M \rho_{\text{cal}} + A \rho$$

Where:

ρ_{λ}' = TOA planetary reflectance, without correction for solar angle. Note that ρ_{λ}' does not contain a correction for the sun angle.

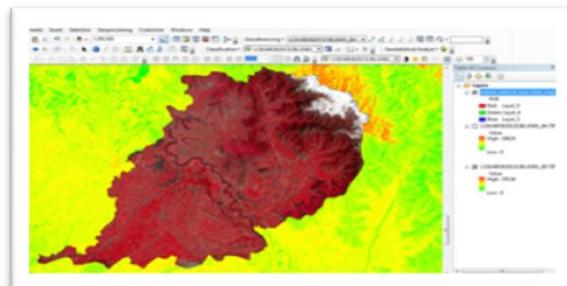
$M \rho$ = Band-specific multiplicative rescaling factor from the metadata (Reflectance_Multi_Band_x, where x is the band number)

$A \rho$ = Band-specific additive rescaling factor from the metadata (Reflectance_Add_Band_x, where x is the band number)

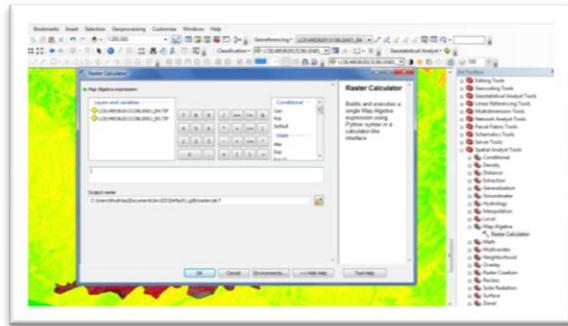
Q_{cal} = Quantized and calibrated standard product pixel values (DN).

(Metadata means the .txt file which is along with the data)

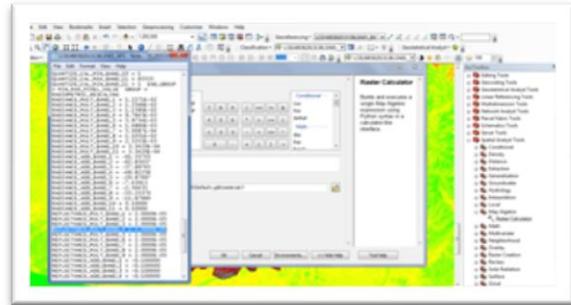
- ❖ Open Arc Map and add satellite images band 4 and band 5 for calculating NDVI



- ❖ Open Arc toolbox in ArcMap
- ❖ From the Arc toolbox open Raster calculator (Arc toolbox > Spatial Analyst tool > Map Algebra tool > Raster Calculator tool)

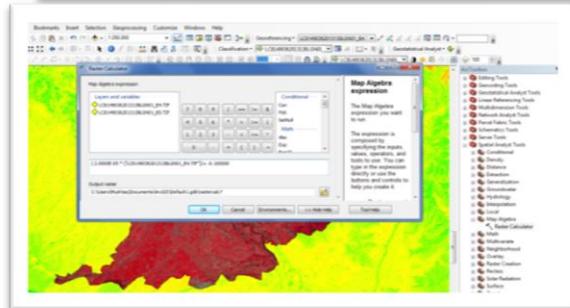


- ❖ Find **M_p** Band-specific multiplicative rescaling factor from the metadata (Reflectance_Mult_Band_x, where x is the band number)



- ❖ **A_p** Band-specific additive rescaling factor from the metadata (Reflectance_Add_Band_x, where x is the band number)

An example of where the **M_p** Band-specific multiplicative rescaling factor from the metadata (Reflectance_Mult_Band_x, where x is the band number) is found within the metadata file Apply and perform values in Raster calculator for both RED and NIR bands (4 and 5 bands)



Band 4 reflectance= (2.0000E-05 * ("sub_tif_Band_4")) + -0.100000

Reflectance_Mult_Band_4 = 2.0000e-05

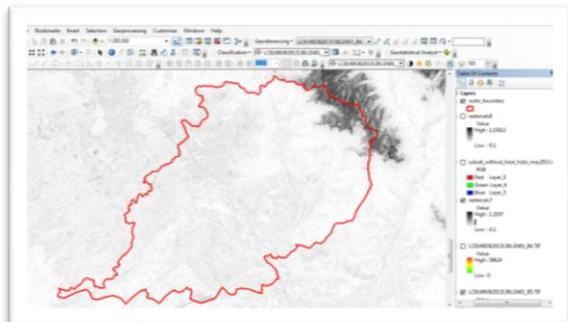
Rflectance_Add_Band_4 = -0.100000

sub_tif_Band_4= 4th band (Red band)

Set the output folder and file name then click "OK"

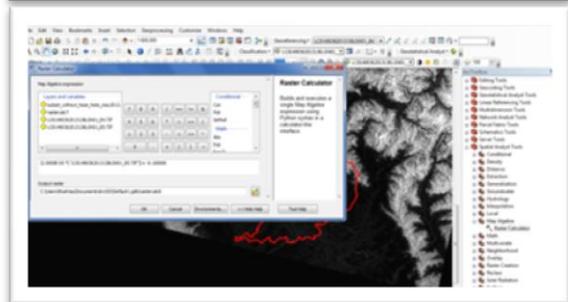
Raster Calculator function to perform reflectance calculation:-

- Reflectance calculated for band 4



Calculating the Reflectance of band 5th by using the same method.

- Reflectance calculated for band 5



Step 2: Correcting the Reflectance value with sun angle

Reflectance with a correction for the sun angle is then:

Where:

$$\rho\lambda = \rho\lambda \cdot \cos\theta_{SZ} = \rho\lambda \cdot \sin\theta_{SE}$$

$\rho\lambda$ = TOA planetary reflectance

θ_{SE} = Local sun elevation angle. The scene center sun elevation angle in degrees is provided in the metadata (Sun Elevation).

θ_{SZ} = Local solar zenith angle; $\theta_{SZ} = 90^\circ - \theta_{SE}$.

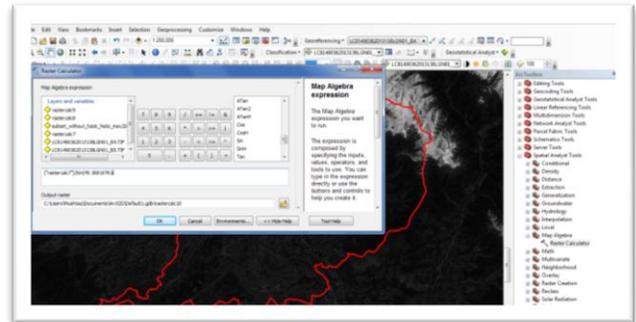
- Find Sun Elevation from the metadata
Apply and perform the values in Raster calculator for both RED and NIR band reflectance values (4 and 5 bands)

Where:

$$\text{Band 4 Corrected Reflectance} = (\text{4th_Rflect}) / \sin(49.36816761)$$

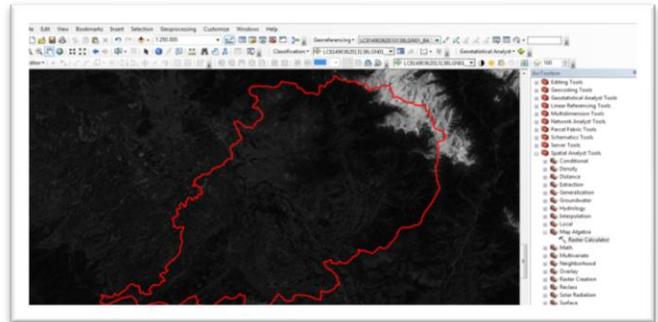
Where:

Sun_Elevation = 49.36816761
4th_Rflect = Uncorrected Reflectance
Set The Output Folder And File Name Then Click "Ok"



Raster Calculator function to perform sun angle corrected reflectance:-

Sun angle corrected reflectance for band 4th



- Calculating the Reflectance of band 5th by using the same method

Sun angle corrected reflectance for band 5th

Step 3: Calculating NDVI from 4th and 5th bands

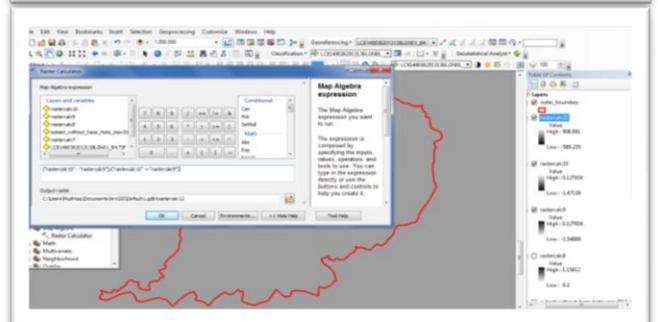
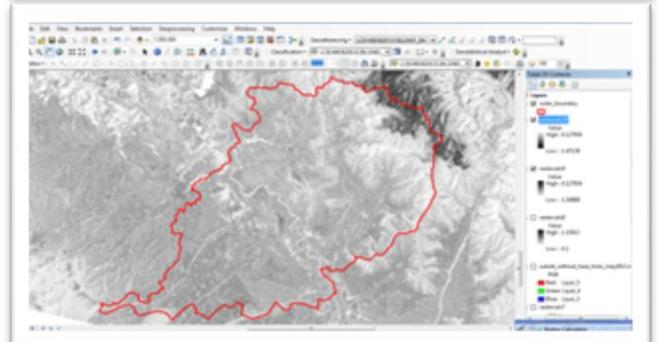
As we discussed earlier to find NDVI we use the formula of

$$NDVI = \frac{(NIR - RED)}{(NIR + RED)}$$

Here band 4= RED and band 5=NIR

- Open Raster calculator and apply this formula and execute the program as follows

$$NDVI = \frac{\text{Band 5 corrected} - \text{Band 4 corrected}}{\text{Band 5 corrected} + \text{Band 4 corrected}}$$



Raster Calculator function to perform NDVI

- **Normalized Differential Vegetation Index** The value of NDVI is always between 1 and -1

Results Analysis and Conclusion:-

Table.2 shows typical reflectance values in the red and infrared channels, and the NDVI for typical cover types. Water typically has an NDVI value less than 0, bare soils between 0 and 0.1 and vegetation over 0.1. Here we are using the Landsat image acquired from USGS Earth Explorer. The data is in GeoTiff format with 16 bit radiometric resolution (ranges from 0-65535). Landsat 8 Operational Land Imager (OLI) and Thermal Infrared Sensor (TIRS) images consist of nine spectral bands with a spatial resolution of 30 meters for Bands 1 to 7 and 9. The resolution for Band 8 (panchromatic) is 15 meters. In addition it also have two Thermal IR bands with a spatial resolution of 100m (later resampled into 30 m). Before calculating the NDVI the DN data must be converted to reflectance using the equations given in their website. Here the IR and NIR bands are 4 and 5 respectively.

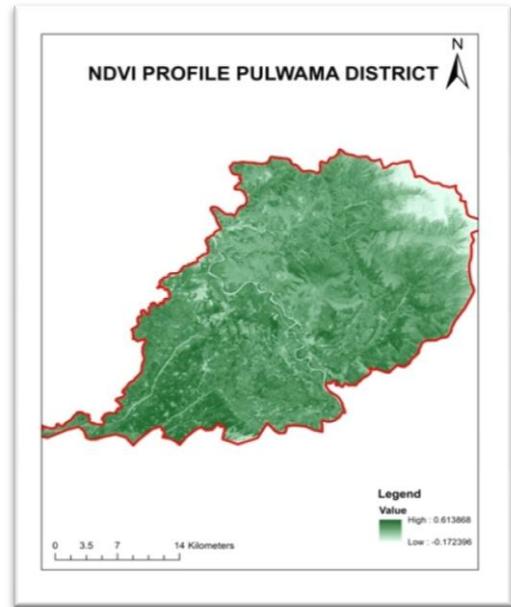


Table 2:-

COVER TYPE	RED	NIR	NDVI
Dense vegetation	0.1	0.5	0.7
Dry Bare soil	0.269	0.283	0.025
Clouds	0.227	0.228	0.002
Snow and ice	0.375	0.342	-0.046
Water	0.022	0.013	-0.257

NDVI (Normalized Difference Vegetation Index) was computed for orchard classes from NIR and Red bands. NDVI is dimensionless indicator and ranges between -1 to 1. NDVI indicates the vigor of vegetation and is higher for dense healthy vegetation and lower for sparse vegetation. The range of NDVI obtained for apple orchards in all the 4 Tehsils was used to generate three ranges viz. dense, moderate, and sparse indicating density of apple orchards. The “Dense” class is assigned for which the NDVI is higher than 0.45, “moderate” 0.30-0.45 and “sparse” to NDVI lower than 0.30. Crop production forecasting consists of identification of crops, acreage estimation and forecasting their yield. Crop identification is based upon the fact that each crop has a unique spectral signature. The typical spectral response of crop shows absorption due to pigments in the visible region (0.4-0.7 μ m), high reflectance in the near infrared region because of internal cellular structures of the leaves and absorption at 1.45, 1.95 and 2.6 μ m spectral bands due to the water content.

References:-

1. <http://landsat.gsfc.nasa.gov/?p=3186>
2. http://hydrology1.nmsu.edu/teaching/soil698/greenseeker/what_is_ndvi.htm
3. http://www.pvts.net/pdfs/ndvi/3_3_ndvi.PDF
4. http://wiki.landscapetoolbox.org/doku.php/remote_sensing_methods:normalised_difference_vegetation_index
5. Muhammad Hasan Ali Baigab, LifuZhanga, Tong Shuaiab&QingxiTonga- “Derivation of a tasselled cap transformation based on Landsat 8 at satellite reflectance” (2014) Remote Sensing Letters
6. <http://www.tandfonline.com/loi/trsl20>
7. Grant J. Firl, Lane Carter” Calculating Vegetation Indices from Landsat 5 TM and Landsat 7 ETM+ Data”(2011)
8. <http://grindgis.com/wp-content/uploads/2015>.