Agricultural Field Analysis Using Satellite Surface Reflectance Data

Pranesh S. Kulkarni

1. INTRODUCTION:

In this project the spectral reflectance responses are used to analyze the crop health, moisture content, field vegetation, these spectral indices are calculated from spectral reflectance data taken by Landsat 8 sensors, the Landsat 8 satellite orbits the Earth in a sun-synchronous, near-polar orbit, at an altitude of 705 km (438 mi), inclined at 98.2 degrees, and circles the Earth every 99 minutes. The satellite has a 16-day repeat cycle. With the Landsat 8 helping, the spectral reflectance responses calculated are NDVI or basically known as Vegetative Index, MSAVI2 is the simplified version of the MSAVI algorithm. It was created to deal with the soil brightness problem, SAVI is short for Soil Adjusted Vegetation Index which brightness plays an important role such as in areas where vegetative cover is low and the soil is exposed, and the last index that we calculate is NDWI which is short for The Normalized Difference Water Index which measures the change in the water content of leaves by using the NIR and SWIR bands. So, after calculating the spectral indices the max, average values are calculated and are fed to a machine learning model which gives the quality of the field

2. Synthesis/Algorithm/Design/Method:

First we have developed web application to get a surface reflectance data of interested field by using Google Earth Engine Platform. We have imported USGS Landsat8 and CHIRPS dataset by using earth engine. Then We have developed python application to calculate Vegetation indices like NDVI, MSAVI, NDWI. We designed algorithms which will calculate average, maximum, latest parameters. These parameters will tell about current and past scenario of an agricultural field. Then we collected sample data for some random fields. Then we trained machine learning model using K-means clustering technique. That model will predict quality of field by analyzing 13 years' data. We have designed another tool water resource analyzer which will analyze water content in reservoir by using NDWI algorithm. We have created MYSQL database which stores the user's field data which can be helpful to increase the accuracy of future machine learning models and government and private agencies. In this way we have designed this software which can be helpful for analyst to analyze the agricultural field.

3. Spectral Indices

1)NDVI: - Stands for Normalized Difference Vegetation Index, a simple graphical indicator that can be used to analyse remote sensing measurements, typically, but not necessarily, from a space platform, and assess whether the target being observed contains live green vegetation or not. Users of NDVI have tended to estimate a large number of vegetation properties from the value of this index. Typical examples include the Leaf Area Index,

biomass, chlorophyll concentration in leaves, plant productivity, fractional vegetation cover, accumulated rainfall, etc. Such relations are often derived by correlating space-derived NDVI values with groundmeasured values of these variables. This approach raises further issues related to the spatial scale associated with the measurements, as satellite sensors always measure

radiation quantities for areas substantially larger than those sampled by field instruments. Furthermore, it is of course illogical to claim that all these relations hold at once, because that would imply that all of these environmental properties would be directly and unequivocally related between themselves.

$$NDVI =$$

$$(NIR - RED)\ (NIR + RED)$$

2)MSAVI2: - The modified soil-adjusted vegetation index (MSAVI) and its later revision, MSAVI2, are soil adjusted vegetation indices that seek to address some of the limitation of NDVI when applied to areas with a high degree of exposed soil surface. The problem with the original soil-adjusted vegetation index (SAVI) is that it required specifying the soil-brightness correction factor (L) through trial-and-error based on the amount of vegetation in the study area. Not only did this lead to the majority of people just using the default L value of 0.5, but it also created a circular logic problem of needing to know what the vegetation amount/cover was before you could apply SAVI which was supposed to give you information on how much vegetation there was. Qi et al. (1994a) developed the MSAVI, and later the MSAVI2 (Qi et al. 1994b) to more reliably and simply calculate a soil brightness correction factor.

$$MSAVI2$$

$$=$$

$$(2 * NIR + 1 - \sqrt{(2 * NIR + 1)2 - 8 * (NIR - RED)})\ 2$$

3)SAVI: - In areas where vegetative cover is low (i.e., < 40%) and the soil surface is exposed, the reflectance of light in the red and near-infrared spectra can influence vegetation index values. This is especially problematic when comparisons are being made across different soil types that may reflect different amounts of light in the red and near infrared wavelengths (i.e., soils with different brightness values). The soil-adjusted vegetation index was developed as a modification of the Normalized Difference Vegetation Index to correct for the influence of soil brightness when vegetative cover is low. The value of L is adjusted based on the amount of vegetation. L=0.5 is the default value and works well in most situations

$$SAVI =$$

$$(NIR - RED)\ (NIR + RED + L)$$

$$* (1 + L)$$

4)NDWI: - The Normalized Difference Water Index (NDWI) is a satellite-derived index from the NearInfrared (NIR) and Short-Wave Infrared (SWIR)

channels. The SWIR reflectance reflects changes in both the vegetation water content and the spongy mesophyll structure in vegetation canopies, while the NIR reflectance is affected by leaf internal structure and leaf dry matter content but not by water content. The combination of the NIR with the SWIR removes variations induced by leaf internal structure and leaf dry matter content, improving the accuracy in retrieving the vegetation water content. The amount of water available in the internal leaf structure largely controls the spectral reflectance in the SWIR interval of the electromagnetic spectrum. SWIR reflectance is therefore negatively related to leaf water content. $NDWI = (NIR-SWIR)\ (NIR+SWIR)$

4. CONCLUSION:

We have implemented machine learning technique K-means clustering to predict the quality of land. Our model has efficiency of 80%. Which can be enhanced by collecting more datasets. But we can get accurate NDWI, NDVI and MSAVI indices. We can obtain 13 years' old data with the help of this algorithms.