AGRICULTURE AND CROP ASSESSMENT STUDIES USING REMOTE SENSING AND GIS TECHNOLOGY

[1]Jeeva.K, [2]Mekala.T, [3]Nandhini.S, [4]Saranya.C, [5]Veerakumar.S ,[6]K.Kasthuri
[1,2,3,4]UG scholar, [5]Assistant Professor, [6]Software Engineer
[1]jeeva6886@gmail.com, [2]mekalatirupathy1995@gmail.com, [3]nandhusj29@gmail.com, [4]saranyachinnanan@gmail.com, [5]svkece@kiot.ac.in
[1,2,3,4,5]Department of Electronics and Communication Engineering
Knowledge Institute of Technology, Salem-637504, Tamilnadu, India
[6]Robert Bosch Engineering and Business Solutions Pvt Ltd, Coimbatore

ABSTRACT

Agriculture is one of the essential factor in the economic world. It is affected directly or indirectly due to climatic changes .The suitable crops should be cultivated according to the type of soil and climate. Though many techniques are available for increasing the crop productivity by scrutinizing the soil type and to map the variety of crop cultivation and their yield .To enhance throughput, the vulnerability in agriculture have to be determined based on Standardized Precipitation Index, Normalized Difference Vegetation Index, and Normalized Difference Water Index.These parameters can be analysed by using the software Arc GIS10.3 version.This proposal is about reducing the agriculture vulnerability using Geographical Information System.

KEYWORDS: ***Normalized Difference Vegetation Indexand Normalized Difference Water Index, Standardized Precipitation Index, Vulnerability in agriculture.***

I INTRODUCTION

Geographic Information Systems are exceedingly helpful in agriculture which is used to map and fluctuations in precipitation, temperature, crop cultivation and yield. By mapping geographic and geologic features of farmland farmers can work to create more effective and efficient farming techniques, this could increase food production in parts of the world that are struggling to produce enough for the people. GIS can inspect soil data combined with historical farming practices to determine which crop is suitable for cultivation, and how to maintain soil nutrition levels to best benefit the plants. The agriculture is indirectly affected due to changes in soil, water, pests, and diseases making agriculture more vulnerable.

The main factor that leads to agriculture vulnerability is drought. Drought is caused due to the lack of precipitation, but may affect soil moisture, streams, groundwater, ecosystems and human beings. The vegetation is changed due to the occurrence of drought and it can be viewed through satellite images. Drought affects almost all climatic regions and more than one half of the earth is susceptible to drought each year. Since rainfall varies significantly among different regions, the concept of drought may differ from places to places. In order to assess the drought phenomena, the Standardized Precipitation Index is recommends to monitor the severity of drought events. It determines how much the amount of rainfall deficit for certain range of area over a period of time. The Normalized Vegetation Index is the measure of greenness produced by the ratio of infrared and red light that is reflected from the surface and is easy to calculate from a wide range of different image souces.The water content in leaves can be monitored by Normalized Water Index.

II STUDY AREA

The study area namely Dharmapuri District , PennagramTaluk is situated between 11° 47’ &12°.33` north latitude and 77°.28 ' &76°.48`east longitude. It has an area of 4497 square kilometers. It has an average elevation of 503meters above mean sea level. Pennagram receives scanty rainfall with an annual average of 895.56mm .According to the 2011 census; PennagramTaluk had a population of 234,406 persons with 123,101 males and 111,305 females. The Taluk had a literacy rate of 57%. The population in the age group below 6 was 13,967males and 12,370 female children.

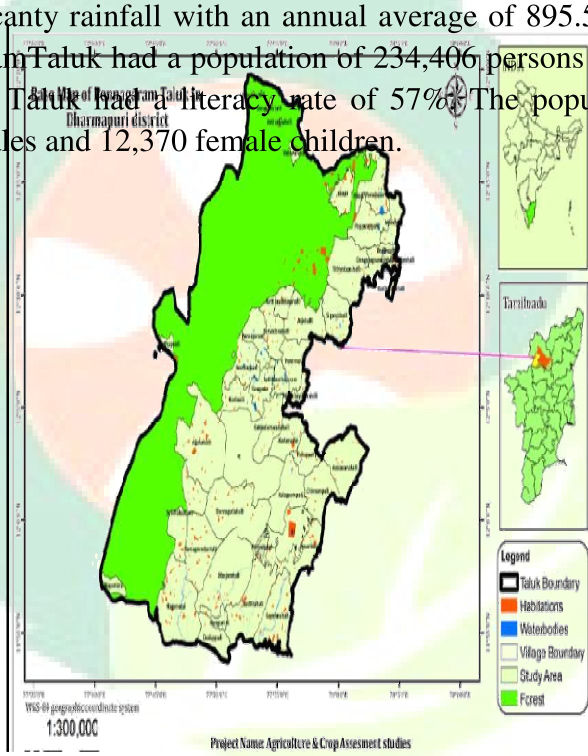

Fig 1: Base map of pennagramtaulk in dharmapuri district

III METHODOLOGY

Standardized Precipitation Index (SPI):

The Standardized Precipitation Index is a tool which was developed primarily for defining and monitoring drought. In simple terms, SPI is a normalized index representing the probability of occurrence of an observed rainfall amount when compared with the rainfall climatology at a certain geographical location over a long-term reference period.

Negative SPI values represent rainfall deficit, whereas positive SPI values indicate rainfall surplus. Intensity of drought event can be classified according to the magnitude of negative SPI values such that the larger the negative SPI values are, the more serious the result would be. The SPI value can be calculated by the following equation,

$$\mathbf{SPI = (Xij - Xim) / \sigma}$$

Where, Xij is the monthly precipitation at the ith rain-gauge station and jth observation, Xim is its long-term precipitation mean and σ is its standard deviation.

SPI VALUE	PRECIPITATION INTENSITY
2.00	Extremely wet
1.0 to1.49	Moderate wet
-0.99 to 0.99	Near normal
-1.5 to -1.99	Very dry

Table 1: Refers the general standardizedprecipitation value

The initial step in calculating the Standardized Precipitation Index (SPI) is to determine a probability density function that describes the precipitation series under analysis. Once this probability density function is determined, the cumulative probability of an observed precipitation amount is computed. The inverse normal function is then applied to the cumulative probability. However, it should be kept in mind that SPI is based on probability and several researchers have reported that SPI underestimates the severity of drought.

Normalized Difference Vegetation Index (NDVI):

The normalized difference vegetation index is a simple graphical indicator which is used to analyze remote sensing measurements, also to assess whether the target being observed contains live green vegetation or not. To determine the density of green on a patch lands of the distinct colors (wavelengths) of visible and near-infrared sunlight reflected by the plants have to be observed. The pigment in the plant leave, chlorophyll, strongly absorbs visible light (from 0.4 to 0.7µm) for use in photosynthesis. The cell structure of the leaves, on the other hand strongly reflects near-infrared light (from 0.7 to 1.1 µm). Vegetation appears very different at visible and near-infrared wavelengths. In visible light, vegetated areas are very dark, almost black, while desert regions are light. At near-infrared wavelengths, the vegetation is brighter and deserts are about the same. By comparing visible and infrared light, the relative amount of vegetation can be measured,

The NDVI value is formulated as,

NDVI= (NIR-RED/NIR+RED)

Where RED and NIR correspond to band 3 and 4 respectively.

Normalized Difference Water Index (NDWI):

The Normalized Difference Water Index is a remote sensing based indicator sensitive to the change in the water content of leaves using microwave methods [1] This formulation of NDWI produces an image in which the positive data values are typically open water areas while the negative values are typically non-water features (i.e. terrestrial vegetation and bare soil dominated cover types). This NDWI was utilized because the output appears to be cleaner with less apparent noise.

NDWI is computed by following equation,

NDWI =(NIR-SWIR)/(NIR+SWIR)

where NIR and SWIR are the reflected radiations in near infrared and shortwave infrared spectral bands respectively. High values of NDWI (in blue) correspond to high vegetation water content and to high vegetation fraction cover. Low NDWI values (in red) correspond to low vegetation water content and low vegetation fraction cover.

IV AGRICULTURAL VULNERABILITY

The present study of agricultural vulnerability in pennagramtaluk is attempted by overlaying the SPI, NDVI and NDWI using ARCGIS 9.3 version. The integrated map shows the index of agricultural vulnerability during various periods.

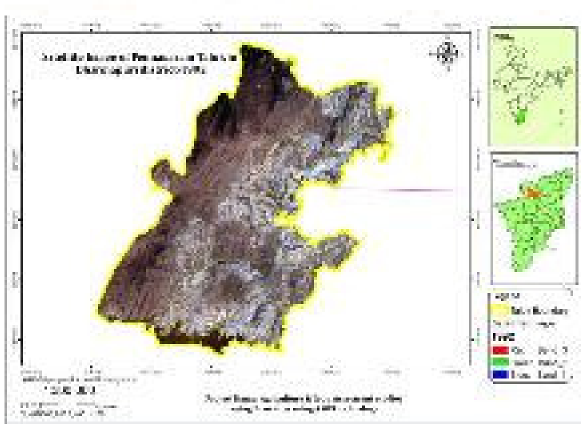

Fig 2: Satellite image of pennagramtaluk indharmapuri district in 1992

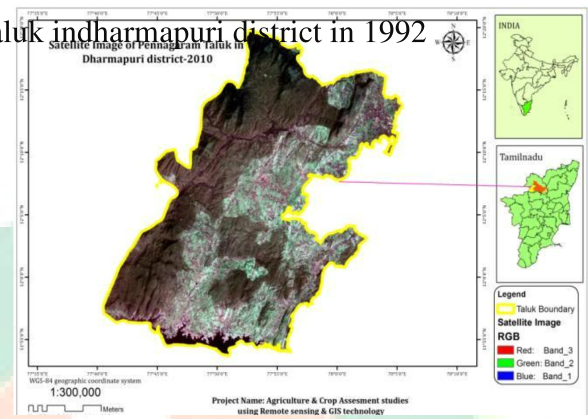

Fig 3: Satellite image of pennagramtaluk indharmapuri district in 2010

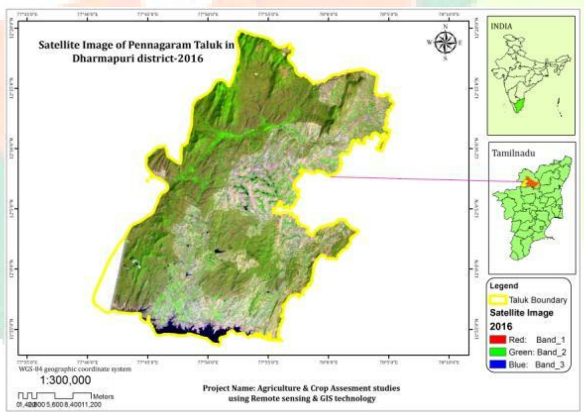

Fig 4: Satellite image of pennagramtaluk indharmapuri district in 2016

V RESULTS AND DISSCUSION

The result of the present study of agricultural vulnerability in pennagramtaluk is discussed. Finally from the study of agricultural vulnerability, the villages are near pennagram enhanced in this proposal and in the villages with low values of agricultural vulnerability are predominantly under reserve forest, plantation and water bodies. The other villages with moderate agricultural vulnerability are mostly under cropland.

VI CONCLUSION

From the above study it can be concluded that SPI, NDVI and NDWI are very useful for early detection of agricultural vulnerability and hence should be a better methodology for remote sensing based vulnerability assessment studies. The NDWI also showed a very good and consistent relation with current rainfall at regional scale. Rather NDVI showed a lagged relationship with rainfall. This studyconcludes that real time satellite data can be well utilized for reducing regional level agricultural vulnerability which increases the productivity.

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