Crop Health Detection Using Multispectral Images

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Abstract: *Increasing human-led exploitation of natural resources and climatic changes have put the biodiversity of India under severe threat. This made the use of appropriate technologies necessary to formulate effective and sustainable management practices. The proper care should be taken to avoid serious effects on crops and due to which corresponding product quality, quantity, or productivity is affected. Health monitoring and disease detection on crops are very critical for sustainable agriculture. It is very difficult to monitor plant health manually. In this regard, remote sensing and geographic information system (GIS) play an important role in the field of conservation. The study aims to detect the health of crops with the help of Multi-spectral LANDSAT images using NDVI value. NDVI values has been used to examine the spatial distribution such as water bodies, built-up area, vegetation and dense vegetation. Hence, QGIS open source software has been used for image processing to detect crop health.*

Keywords: *Remote sensing, Multispectral image, NDVI, LANDSAT.*

1. INTRODUCTION

In agriculture, land use is going under more changes due to extreme weather conditions, social economic activities, and human interference in natural resources as well as capitalism and rural depopulation. Satellite remote sensing has been widely used in the agriculture field for crop mapping and monitoring crop [1]. To guarantee agricultural productivity, it is extremely important to assess the health of a crop as well as detecting the crop infestations. Farmer must mitigate stress on time after detecting it on the health of the crop like moisture deficiencies or fungal and weed infestations. It is important to note that the crop usually do not grow in equal proportions within the field that result in variations of crop yield. Such growth differences can result in nutrient deficiencies within the soil. By the application of remote sensing, farmer can identify areas in the field that are facing difficulties and therefore, he can use the correct type of fertilizer or pesticide. Therefore, with the help of remote sensing, the farmer not only increases the productivity, but also, he reduces the input costs within the farm (fertilizer, pesticide, etc.)[13]. The process (using remote sensing images) needs to be repeated frequently at specific intervals (at minimum, weekly) and the results should be provided to the farmer within 2 days for him to take actions.

1.1. About Remote Sensing

Remote sensing is the procedure which requires observation of objects, typically from a remote place, without the requirement of staying in contact with the object [10]. To obtain information about the earth and atmosphere, electromagnetic radiations are used. Remote sensing is the phenomenon to detect and acquire information about the properties of a land area by measuring the reflections. A camera can collect remote sensing imagery that will help us detect or sense various features of the land area selected. For instance, cameras on satellites can take pictures of the landmass of the earth being so far away and it can collect more information than what we usually observe being on the ground. In ships, sonar systems are used that are usually utilized to capture images of the ocean floor without the need of being in direct contact with the ocean floor. Satellite cameras can also be used to capture thermal images of the earth that can give us a basic idea of the temperatures in different regions. Lastly, forest fires and clouds can also be tracked to help us determine the weather or can predict volcano eruptions, etc.

1.2. Types of Remote Sensing

Remote sensing images has been characterized in two main types depending on resolution like [15]

Spatial Resolution:

Simply spatial resolution say that utilized number of pixels in construction of image. Images has in higher spatial resolution are composed with a greater number of pixels than those of lower spatial resolution. The number of pixels contained in a digital image and the distance between each pixel is known as the sampling interval, which is a function of the accuracy of the digitizing device. Spatial resolution is a measure of the smallest object that can be resolved by the sensor, or the ground area imaged for the instantaneous field of view (IFOV) of the sensor, or the linear dimension on the ground represented by each pixel [15]. Spatial is gives different resolution like Low resolution, higher resolution, medium resolution, high resolution, and very high resolution.

Spectral Resolution:

For fine wavelength interval get from spectral resolution. As well as spectral resolution has ability to define specific wavelength of spectrum. It defines classes with different feature and distinct wavelength. The spectral resolution gives the narrower the wavelength range of a particular channel or band. Rock type or water or tree these type classes not easy distinguishable using spectral resolution you can get finer wavelength. Spectral resolution has different type image resolution optical resolution image, thermal images, and SAR images.

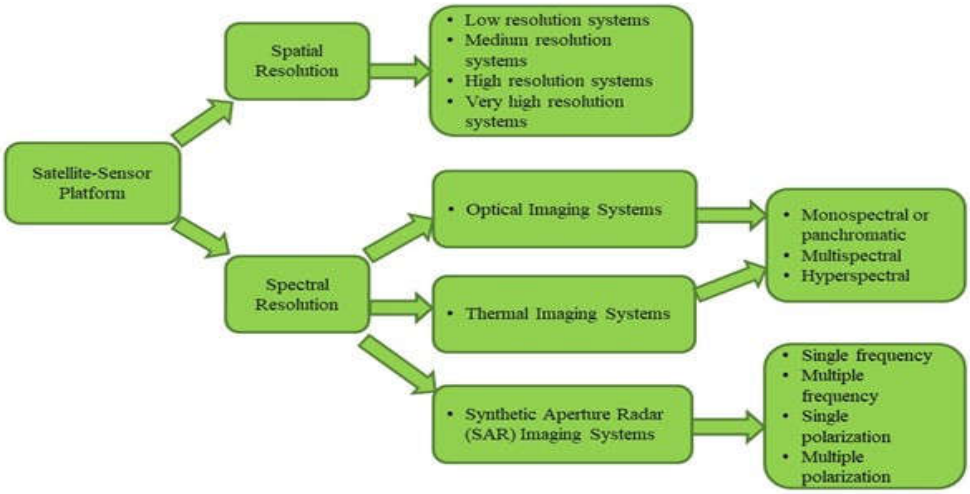

Figure 1. Types of Remote Sensing Images

II. LITERATURE REVIEW

Table1. Literature Review

Paper Name	Author	Year	Journal Name	Description	Technique Used
Real time Crop health monitoring using Remote Sensing and ancillary information	Gaurav Singhal 1 , Babankumar Bansod1 , Lini Mathew	2018	Esri India User Conference	The results shows the Estimation of chlorophyll concentration using remote sensing at a large scale with integration of satellite images, field data and regression models to monitor the crop growth	Find vegetation with the help of NDVI

using GIS				throughout the season	
Utilization of single-image normalize difference vegetation index (SI-NDVI) for early plant stress detection	Nicole S. Beisel Jordan B. Callaham Natasha J. Sng Dylan J. Taylor Anna-Lisa Paul Robert J. Ferl	2018	Arxiv.org	Compared to traditional NDVI or hyper-spectral imaging approaches, the dollar cost of implementing an SI-NDVI imaging system is low because SI-NDVI requires only one camera	Make use of two indices NDVI and SI-NDVI.
Remote Sensing: An Advanced Technique for Crop Condition Assessment	Karim Ennouri and Abdelaziz Kallel1	2019	Journal Hindawi	explain indices of remote sensing like Normalized Difference Vegetation Index (NDVI), Land Surface Water Index (LSWI), Temperature-Vegetation Dryness Index (TVDI), Soil Adjusted Vegetation Index (SAVI), Water Deficit Index (WDI)	Comparison of various indices has been included
Tree health mapping with multispectral remote sensing data at UC Davis, California	QINGFU XIAO, DavisE.	2015	Springer	They used multispectral remote sensing data and GIS calculate tree health index which is the ratio of healthy pixels to+E6 entire tree pixels within the tree crown.	Tree health index has been used
Remote Sensing of Crop Health for Food Security in Africa: Potentials and Constraints	Mutanga Onisimo , Dube Timothy, Galal Omer	2017	Science Direct	There are few studies that have focused on the use of very high spatial resolution for mapping and monitoring crop pests and diseases. We, therefore, conclude that more research is needed for future research to examine the utility of multispectral data and their potential for mapping and monitoring crop pests and diseases.	Using spatial resolution mapping crop health
Detection of Sugarcane Disease and Classification using Image Processing	Arpan Kumar	2019	Arxiv.org	The technique to detect leaf disease in sugarcane plant has been implemented	Use image processing for disease detection
NDVI derived sugarcane area identificatio	Md. Rejaur Rahman, A.H.M.H Islam and M.A.	2004		NDVI based technique has been used for identifying the area and condition of dense crop.	Find vegetation with the help of NDVI

n and crop condition assessment	Rahman				
Assessment of plant health status using remote sensing and GIS techniques	Oladejo Sunday Olukayode	2018	Springer	Cocoa plants health has been detected using various indices	Find vegetation with the help of NDVI and SAVI

III. METHODS AND MATERIALS

Study Area

Landsat 8 images of Charghat Thana was selected for the area of study which had total area of 15373 hectares [8]. It is situated between 24'' 14' and 24'' 22' North latitude and between 88'' 40' and 88'' 52' east longitude. Secondly, Charghat Thana is located in the floodplain of Ganga River and the region is flat and low lying [2].

Software used

QGIS 3.14
Microsoft word 2013
Microsoft excel 2013

Methods used in the Study

Landsat 8 images has been downloaded from free open source repository USGS Earth Explorer, downloaded images were uploaded in open source QGIS software, Preprocessing has been done on image which include clipping of image in area of interest and surface reflectance, then training input has been created and ROI of each class has been generated using NDVI values which range from -1 to 1[11].NDVI values greater than 0 indicate vegetated area and below o as non-vegetated. And at last classified image has been generated.

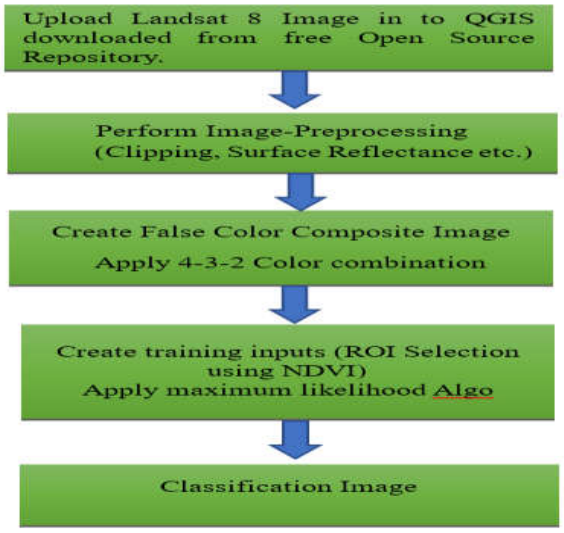

Figure 2. System Flow Diagram

IV. RESULTS AND DISCUSSIONS

Results shows the Natural, FCC (false color composite) and classified image of Charghat Thana. Classification has been done for three different years i.e. 2013, 2015 and 2017.In result we can see change in vegetation for three different years. In 2015 vegetation get decreased where as in 2017 it is increased so we can say health of crop is good in 2017 compared to 2015.

Figure 3. Classified Image of 2013-07-24

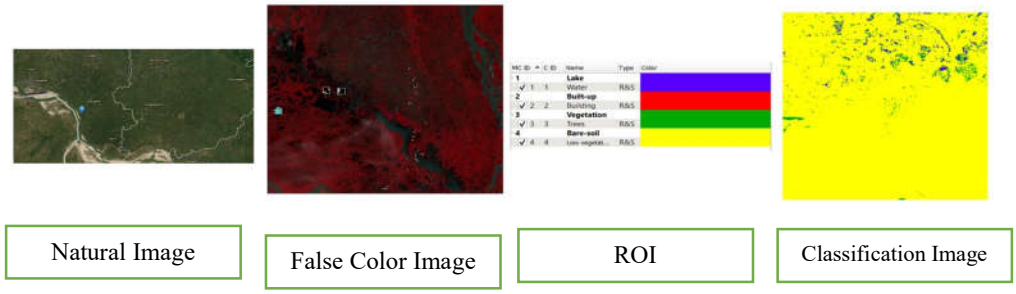

Figure 4 Classified Image of 2015-07-30

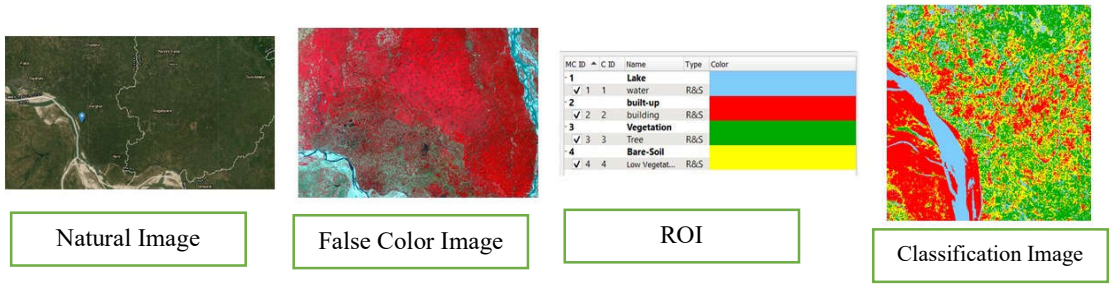

Figure 5. Classified Image of 2017-04-14

V. CONCLUSION

The study has showed that the Remote sensing and GIS technique is very effective and can be used in assessing plant health status or the level of stress in plants. In this study LANDSAT 8 images were used to assess plant health. The NDVI maps and values of the study area shows the variation in the plant health status for the three years of study (2013, 2015, 2017).From the results we come to know vegetated area are is less in 2015 compared to 2013 and it increased in 2017 compared to 2015 so we can assess the crop health efficiently and effective with normalized difference vegetation index value of LANDSAT image.

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