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A Review on Rice Crop Identificationusing Vegetation Indices of Satellite Remote Sensing Images

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Abstract-Rice is one of the world's major staple foods and paddy rice field account for approximately 15% of the world's arable land. Rice has always been relevant to global food security and socio-economic stability. Rice field areas have been the most traditional land use and the main economic variable that has historically shaped social relations. It is the major food grain grown in almost all states in India mainly during Kharif season (June to October). It is a heat and water favorite crop. Satellite remote sensing has been widely accepted as a powerful and effective tool for identifying agriculture crops. Image classification uses the spectral information represented by digital number (DN) in one or more spectral band and attempt to classify individual pixel based on this spectral information. Vegetation indices calculated from satellite image give good presence of vegetation. The overview of this study is to classify rice crop with different methods using vegetative indices of various spectral characteristics.

Keywords: Rice Crop Identification, Classification, Vegetation indices

I. INTRODUCTION

Rice, a major food and cash crop, is cultivated in many countries throughout the world. It is reported that paddy rice is cultivated on about 15% of the world's total arable land[1]. According to Food and Agriculture organization of the United States(FAO), with an annual global paddy production of about 769.9 million tons during 2018.More than three billion people in the world use rice as their primary food source. *i.e.*, ~180.5 million hectares of land was under rice, while the total arable land was~1547 million hectares. It is usually grown almost everywhere in the World, and its production in2018 was ~510.6 million tones [2]. Rice hasprovided ~19% of the global dietary energyand its annual average consumption *per capita* during2016-2017 was ~54 kg [2, 3].Rice field areas have been the most traditional land use and the main economic variable that has historically shaped social relations. It is the major food grain grown in almost all states in India mainly during Kharif season (June to October) [4]. It is a heat and water favorite crop. Satellite remote sensing has been widely accepted as a powerful and effective tool for identifying agriculture crops.

Crop identification is a subject of intensive research and is still, in a development stage. Remote sensing (RS) can provide information on important crop growth variables on a regional scale [5]. Vegetation indices derived from satellite data acquired at maximum vegetative growth stage are indicative of crop growth, vigor and potential grain yield. Factors include weather parameters, aromatic practices, which vary from area to area affect crop yield in a given region [6] According to, [7], and the simple morphology consists of roots, culms, and leaves, which form tillers. Later on, when the rice seeds mature, an inflorescence is produced as a panicle. The International Rice Research Institute classifies three growth phases: (1) the vegetative phase from germination to panicle initiation, (2) the reproductive phase from panicle initiation to flowering, and (3) the ripening phase from flowering to mature grain rice growth monitoring methods based on field checking are still used for collection of rice paddy production information.

The objective of this study is to classify rice crop with different methods using vegetative indices of various spectral characteristics.

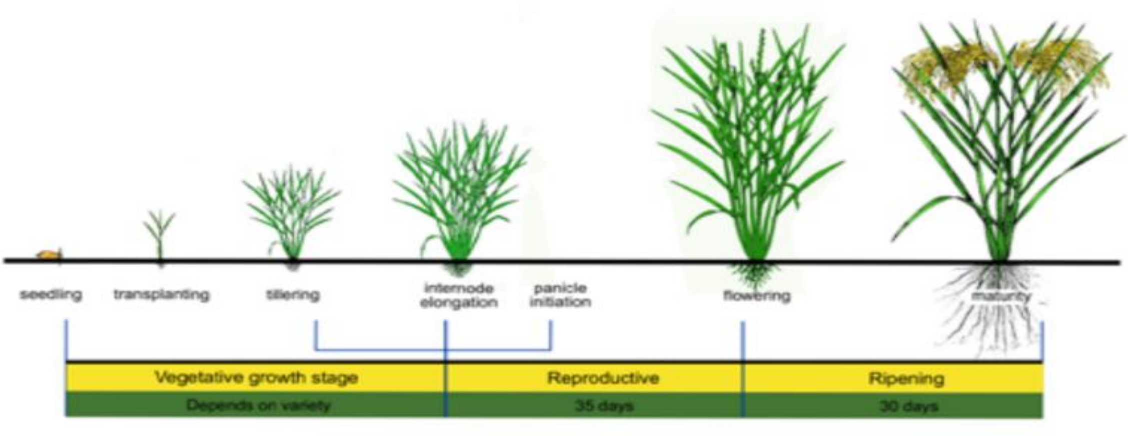

Fig1. Growing Stages rice crop and their associated greenness conditions [6].

II. CROP IDENTIFICATION

The crop discrimination/mapping using space data is carried out either by visual or digital interpretation techniques. Visual techniques generally are based on standard FCC (False Color Composite) generated using green, red and near-IR bands assigned blue, green and red color. [10] Demonstrated that a color composite formed by best three bands (TM bands 3, 4 & 5) gave better discrimination in comparison to standard FCC over a study site in Imperial valley, California. The digital techniques are applied to each pixel and use full dynamic range of observations and are preferred for crop discrimination. A multi-temporal approach is used when single date data does not permit accurate crop discrimination.In this case, the procedure employs following three stages: (a) preprocessing, (b) data compression, and (c) image classification.Some study isbased on different methods to identifyAccording to [8], rice identification has special significance to India, as rice is the staple grain and accounts for 42% of the rice crop yield for this country. As crop yield is essential for management planning and one of the identification methods is through the use of remote sensing from space. Multi-date data acquired at critical bio-window of the crop growth was used to identify and classify rice fields with high accuracy. According to [9], the potential use of Synthetic Aperture Radar (SAR) satellite data in rice monitoring has been scientifically supported by numerous researchers who have demonstrated that there is a high correlation between radar backscatter and rice biomass and have established that fields under rice production can be accurately mapped based on temporal variation in radar backscatter. In this review, the relationship between rice growth and radar backscatter was utilized in an integrated approach of change detection and neural network to identify rice fields and to assess the yield of the province of Nueva Ecija. Many successful research [9, 17] etc., study on the basis ofrice crop identification using satellite radar imagery were completed in various rice-growing Asian countries. According to [16], the high accuracy obtained in the evaluation indicates that the methodology is efficient in the mapping of areas cultivated with any crop and can also be analyzed individually, from the analyses of the errors. [12]This study is to evolve some methods and algorithms for the development of such spectral library using multispectral (ASTER) and hyper spectral (EO-1, Hyperion) satellite data in place of ground-based tools. Ground truth information provided by the Institute of Remote Sensing Application was used to classify land use and identify Rice crop and developed a classified image for mapping the rice crop in the remote area and allows researchers to make decisions with the relevant detail in an efficient timeframe.

III. SPECTRAL FEATURES FOR CROP CLASSIFICATION

Spectral characteristics of green vegetation have very noticeable features two valleys in the visible portion of the spectrum are determined by the pigments contained in the plant. Chlorophyll absorbs strongly in the blue (0.4-0.5um) and red (0.68 um) regions, also known as the chlorophyll absorption bands. Chlorophyll is the primary photosynthetic pigment in green plants. This is the reason for the human eye perceiving healthy vegetation as green. When the plant is subjected to stress that hinders normal growth and chlorophyll production, there is less absorption in the red and blue regions and the amount of reflection in the red waveband increases [12].

The spectral reflectance signature has a dramatic increase in the reflection for healthy vegetation at around 0.7 um. In the near infrared (NIR) between 0.7 um and 1.3 um, a plant leaf will naturally reflect between 40% and 60%, the rest is transmitted, with only about 5% being adsorbed. For comparison, the reflectance in the green range reaches 15%–20%. This high reflectance in the NIR is due to scattering of the light in the intercellular volume of the leaves mesophyll. Structural variability in leaves in this range allows one to differentiate between species, even though they might look the same in the visible region. Beyond 1.3 um, the incident energy upon the vegetation is largely absorbed or reflected with very little transmittance of energy. Three strong water absorption bands are noted at around 1.4, 1.9, and 2.7 um and can be used for plant water content estimation [11, 10] the spectral signatures of crop canopies in the field are more complex and often quite dissimilar from those of single green leaves measured under carefully controlled illumination conditions. Even when leaf spectral properties remain quite constant throughout the season, canopy spectra change vigorously as the proportions of soil and vegetation change and the architectural arrangement of producers.

IV. DIFFERENT VEGETATION INDICES USED TO IDENTIFY RICE CROP

Vegetation Indices (VI) derived from the satellite sensor data have been used to estimate vegetation cover, Normalized Difference Vegetation Index (NDVI) is most widely used vegetation quality (health condition) and spread area (quantity). NDVI algorithm based on the vegetation phonology as the green vegetation reflects less in visible light and more in NIR, where sparse vegetation reflects a great portion of visible and less portion of NIR[14]. Enhanced vegetation index (EVI) include a factor for correcting background effects and partiallycompensatingfor major atmospheric disturbances [13].NDFI (normalized difference flooded index) is used to detect the surface water in flooded rice area, modified for optimizing the performance of indices for mapping paddy rice cultivations [18].To minimize the soil brightness influences in spectral vegetation indices a transformation technique is developed called as Soil Adjusted Vegetation Index (SAVI). In this index the red and NIR spectral wavelengths are used and the graphically transformation is carried out. It can nearly eliminate the soil influences in vegetation indices [15]. RGVI (Rice growth vegetation index) is used todevelop a rice plant mapping [12]and GRVI (Green red vegetation index) reflects more energy in near infrared band than in visible range it observes more than the green band [16].The principle method of this research was prediction of rice productivity using pattern value of NDVI, EVI and LSWI of rice plant before harvest in vegetative and generative growth stage, because both in vegetative and generative growth stage were important phase of rice growth.
The values of NDVI and LSWI are applied to the equations of multiple linear regression models that have been made. Land Surface Water Index (LSWI), were used to identify rice fields during the flooding/ transplanting and ripening phases. Different formula for vegetative indices for crop monitoring and identification during maturity stage.

V. IMAGE CLASSIFICATION USING DIFFERENT METHOD WITH ACCURACY ASSESMENT

Some several studies, accuracy assessment are an important part of any classification project. It compares the classified image to another data source that is considered to be accurate or ground truth data. According to [4], paddy rice classification using multi-sensor fusion (optical sensor and SAR) and multi-temporal data through machine learning approaches Support Vector Machine(SVM) and Random Forest (RF);development of a paddy rice mapping index (PMI) while considering spectral and phonological characteristics; and, paddy rice classification using Google Earth Engine based on the PMI approach over larger areas.However, the accuracy of SVM was slightly higher (~1–3%) than that of RF at both of the sites. The producer's accuracy (PA) and user's accuracy (UA) of SVM were also higher than RF. The classification accuracies for site A (95% (0.93) in multiclass classification, 100% (1.00) in binary classification) were higher than those for site B (88.67% (0.86) in multiclass classification, 99.33% (0.98) in binary classification.According to [13],the image classification process,the data was prepared for entry into a custom computer program ("PaddockId", compiled in C Program language). The PaddockId program had three input files. The firstprocesscontaining the average values of the classes. The second process for each paddock, containing the number of pixels in each of these classes. The program also required a training dataset. About one third of the field areas for each crop type recorded in the ground-truthing were used as "training data", which was used to "learn" the characteristics of the crops and their variation with time. These were called the "known field areas".The prediction results achieved were entered in a matrix table and errors of omission, commission, and normalized overall accuracy were calculated. [17],a threshold classification method was developed to identify rice growth area and retrieving rice growth parameters from radar images. Advanced Synthetic Aperture Radar (ASAR) data for identifying based on the ground experiment data and differential GPS records, backscatter behavior of different land surface objects was analyzed, especially for the paddy rice; [9], by decision classification method, a process that is well suited for the integration and utilization of the methodologies for rice monitoring using radar data.

VI. CONCLUSION

This study reviewed some methods for identifying the rice cropwith various spectral characteristics. A classified image for rice crop in the remote area allows researchers to make decisions with the relevant detail. Since during the period of rice, there may be crop mixing of rice crop with others crops due to their phonological characteristic like nitrogen, chlorophyll, water etc., Since the reflectance value of these components may be different in the different spectral regions, therefore different vegetation indices may be used to differentiate the rice crop and its varieties among the different crops on the bases of chemical variables and their composition.

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