International Journal of Research (IJR)
e-ISSN: 2348-6848, p- ISSN: 2348-795X Volume 2, Issue 12, December 2015
Available at http://internationaljournalofresearch.org

Extraction Of Rice Cropping Activities Using Multi-Temporal Ndvi Data And Isodata Clustering: A Case Study Of Raichur District, Karnataka, India.

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Abstract:

Remote sensing data acquired during a cropping season can assist in assessing crop growth and development performance, and provide information for crop management. Delineating rice cropping is important for crop management and crop production estimation. In this study, we used time series MODIS data to delineate rice cropping activities in Raichur district. The data were processed using the ISODATA clustering, which is a method of unsupervised classification in which algorithm splits and merges clusters. The 250m MODIS NDVI (Normalized Differential Vegetation Index) images of temporal resolution 15 days were stacked and classified in to 100 classes using ISODATA clustering. From the analysis of classified NDVI data, we mapped 1) Crop and Non crop information. 2) Kharif, Rabi and Double crop information. 3) Rice crop information. The total area of Raichur is 8432.8081km^2 in which cropland covers area of 6873.89 km^2 and remaining 1558.9184 km^2 area is covered by non crop. Cropland classified in to, Kharif, Rabi and Double crop which covers an area 1773.4966 km^2, 3252.8635 km^2 and 1847.5296 km^2 respectively. Our study demonstrates potential of multi temporal images that were taken to differentiate and delineate rice cropping activities at a good level of accuracy in spite of the cloudy conditions.

Key words: NDVI; ISODATA; Rice crop; GIS

1. Introduction

Monitoring of crops is one of the important concepts in recent years, which helps to solve many problems related to crops. Monitoring can be done on field or through remote sensing. Remote sensing applications in agriculture helping many farmers and decision makers in recent decades. An attempt has been done to delineate the rice cropping activities through multi-temporal NDVI data with the help of Image processing and Geographic Information System(GIS). NDVI is one among many vegetation index which broadly used to identify the health of vegetation. The main advantage of using these images is the temporal aspect. Earlier it was difficult to get seasonal information, however, since 1998 and 2000, suitable temporal dataset coverage of SPOT-Vegetation and MODIS-Terra imagery, respectively, has been available to study and explore (de Bie et al. 2012) The Red and Near Infra-red portion is used to calculate this Index. NDVI reflects the greenness and helps to many decision makers to point out the problems and to take perfect decision. Generally NDVI is used to study the amount of chlorophyll content in the vegetation and it is one of the first remote sensed indices successfully used for monitoring vegetation condition and drought at regional scale(Parinaz et al. 2012) Normalized difference vegetation index (NDVI) has been widely used for qualitative and quantitative estimation of

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vegetation cover and growth activity(Zhong-Ze Zhan et al. 2012) The MODIS MOD13Q1 NDVI (Normalized Differential Vegetation Index) Images of the year 2012 with a spatial resolution of 250m and temporal resolution of 16 days were used in this study.

Clustering is an unsupervised classification of patterns into groups, clusters, or classes (Jain et al. 1999) Iterative Self-Organizing Data Analysis Technique (ISODATA) which derived from k-means clustering technique. In this technique, the user defines a threshold value and computer runs the algorithm with many iterations until a threshold is reached. In K-means clustering, the centroid being defined once and it is fixed which is not useful in these kind of studies where a stack of images has been used. In ISODATA, the clusters centre placed randomly and the pixels are assigned based on shortest distance and the centre is calculated by considering the distance between the clusters and standard deviation within the cluster. This classified image with suitable GIS operations and prior field information, the crop related information was extracted.

2. Study area

Raichur district exists between 15° 09’ and 16° 34’ N latitude and 75° 46’ and 77° 35’ E longitude in between two major rivers, the Krishna and the Tungabhadra (Figure 1). Agriculture is the primary source for living, and rice is the major crop grown. The district consists rice growing area of around 165000 hectare; the production is nearly 468464 tons, and the yield is about 2990 kg per hectare every year (Rajanna 2008). The district covers an area of 8433 km^2 in which agriculture covers 6874 km^2 (81.51%). The climate of the district is characterized by dryness for the major part of the year and a very hot summer.

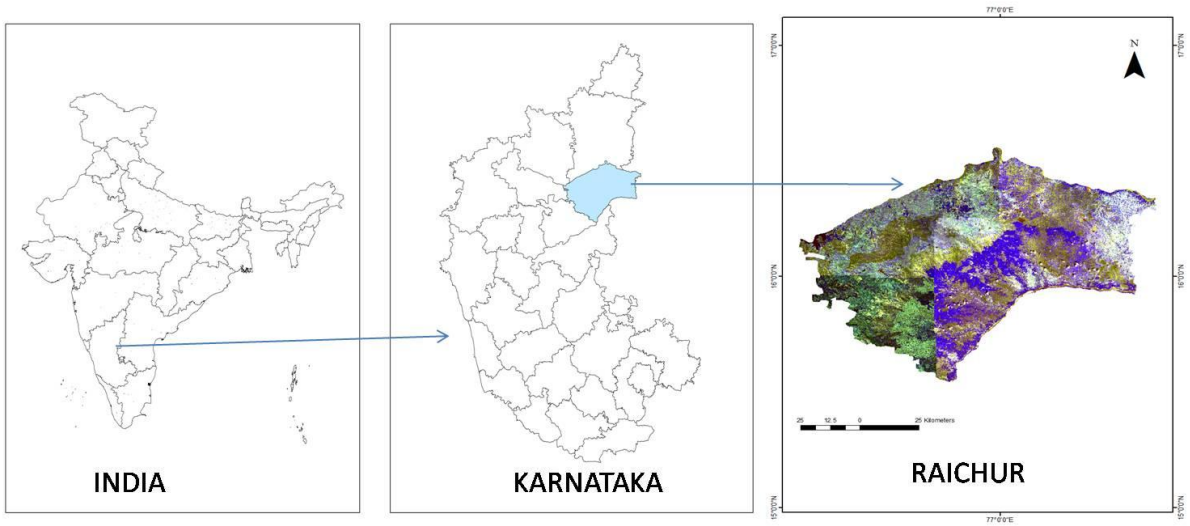

Figure 1. Location of the study area

3. Materials and methods

3.1. MODIS MOD13Q1 NDVI

Global MOD13Q1 gives NDVI images of 16 days temporal resolution and 250-meter spatial resolution as a gridded level-3 product in the Sinusoidal projection. Many times vegetation indices are used to monitor the health of vegetation and changes on land use land cover. These data may also use to study surface biophysical properties, and many studies proved that, it is very well correlates with leaf area index(LAI). The value of NDVI ranges between

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-1 to +1. The images consist of 256 grey shades which converted to -1 to +1 range by using formula, NDVI = (NDVI-100)/100. The values range +1 to +1.5 reflects the healthy natural vegetation. These values then assigned to +1 to maintain the exact range.

3.2. Methods

3.2.1 Clustering

The continuous NDVI data were stacked to a one image. This stacked image consists of 23 NDVI layers seasonally arranged and the ISODATA clustering technique was applied. Total 100 classes were created. The Unsupervised classified image consist of 100 grey shades which belongs to the 100 clusters. These clusters holds the information regarding variability of the vegetation with respect to both space and time. Other techniques like PCA etc can also be used to create the clusters but the techniques which depends on the training sites given by user can cause a error in these type of studies where a stack of images is used as input.

3.2.2 Classification

The clusters derived consist of vegetation information and its variability. The main aim is to extract the rice fields for that the crops and non crops areas were extracted based on the cluster values and field information. Later the crop related level 1 classification was done in which Kharif, Rabi and Double crop classes were separated. The final rice areas were delineated with the help of GIS technique and cluster value.

4. Results

4.1. ISODATA Clustering of NDVI stack

As mentioned, the temporal resolution is 16 days and there were total 23 images in a year. every month consists of two images but the month November consist only one image. Hence, the total images were 23. The stacking of these 23 images was done by Layerstack operation in the ERDAS Imagine software. Figure 2 shows the unsupervised classification image of 100 clusters. Each clusters varies in temporal and spatial distribution of vegetation, which influenced by NDVI profile at particular time. The MODIS 250m spatial resolution suits the study area as it covers 8433 km^2 of large area. The final image consists of 100 classes separated by different strength boundaries.

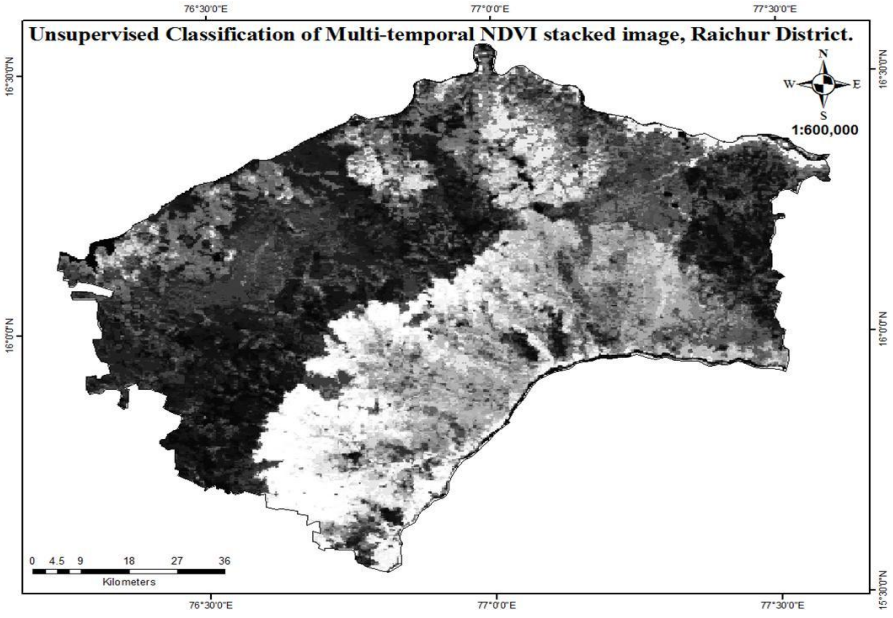

Figure 2. ISODATA classification.

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4.1. Delineating Rice crop activities

The major part of the study area is covered by agriculture and first task performed was to separate these as new image. The figure 3 shows the classification of crop and non-crop areas based on the temporal and spatial profile of NDVI. figure 4 shows the level 1 crop related classification which completely based on the season. With considering all these information as well as prior information about study area, the final rice crop areas were delineated and its showed in the figure 5.

The total area of Raichur district is 8432.8081 km^2 in which cropland covers area of 6873.89 km^2 (81.51%) and remaining 1558.9184 km^2 (18.49%) area is covered by non crop. Cropland classified in to, Kharif covers an area of 1773.4966 km^2 (25.80%), Rabi covers an area of 3252.8635 km^2 (47.32%) and double crop which covers an area of 1847.5296 km^2 (26.87%). The delineated rice cropping areas covers an area of 1920.014 km^2. Rice crop areas covers 27.93% of total crops and 22.76% of total Raichur district.

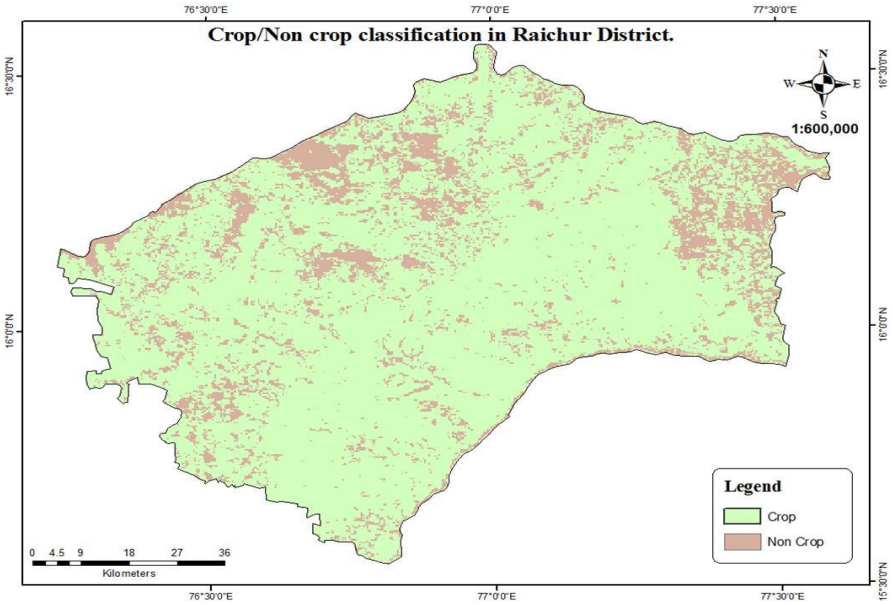

Figure 3. Crop/Non crop classification.

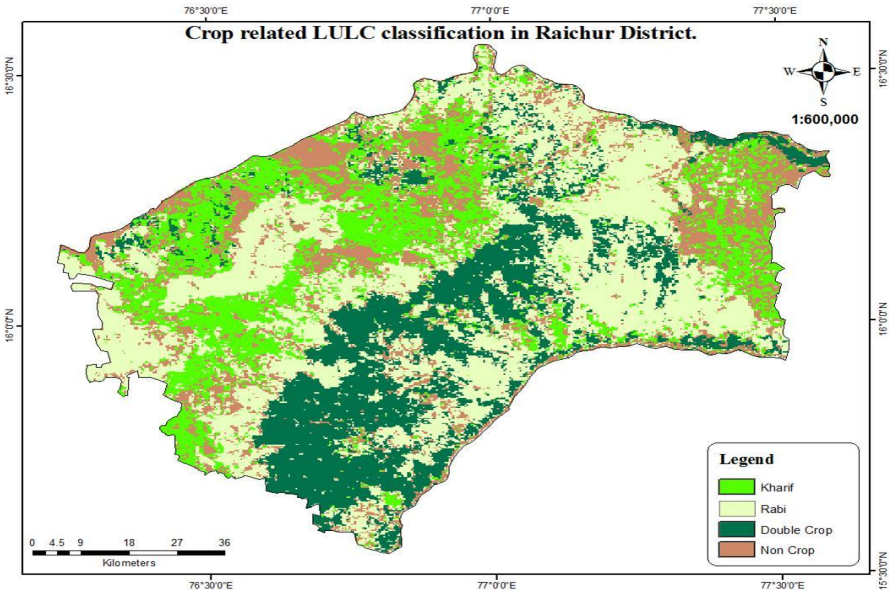

Figure 4. Crop related LULC classification.

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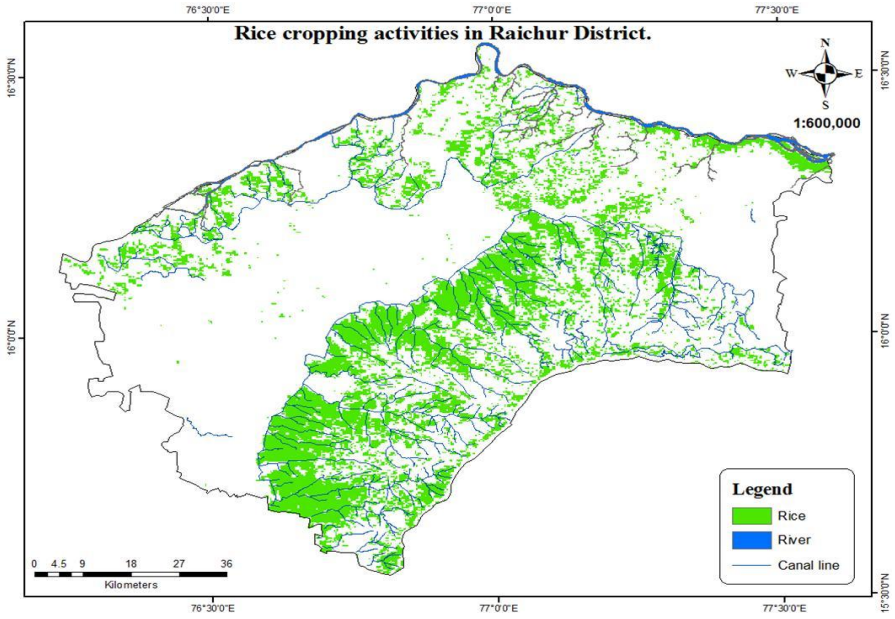

Figure 5. Rice cropping activities spatially correlated to river and canal line.

5. Discussion

Remote sensing is having huge applications in agriculture because of less time consuming, large aerial extent and sufficient support in ground studies. The information associated with time will always gives hidden information which wonders the analysts. The importance of using temporal information is to extract the information on different seasons. An attempt has been done to Rice crops using Multi-temporal data and classification technique. The normal approach of extracting vegetation information is taking seasonal data separately and classify and repeat for other seasons. But in this study, a stack of all the season images were used that helped accurate identification of crops spatially and temporally. The extracted rice fields are spatially correlated with river and canal line and its clearly shown in the figure 5. This work reflects the use of temporal images and image processing techniques in dynamic attributes like crops.

6. References

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