International Journal of Aquatic Science
ISSN: 2008-8019
Vol 12, Issue 03, 2021

Identification Of Rice Cropping Pattern Using Vegetation Index In Veeranam Catchment Area, Tamil Nadu, India

Priyanka[1], N. Manikumari[2]

[1]Research Scholar, Department of Civil Engineering, Faculty of Engineering and Technology, Annamalai University, Chidambaram, Tamil Nadu, 608002, India.
[2]Professor, Department of Civil Engineering, Faculty of Engineering and Technology, Annamalai University, Chidambaram, Tamil Nadu, 608002, India.

Email: [1]priyanganive@gmail.com,

Abstract: Rice has developed into a critical component of human nourishment, serving as a vital lifeline for Asian countries, especially India, where livelihoods are strongly reliant on rice commodities. Remote sensing has enormous promise in agriculture because it can infer the amount of soil and vegetation in a non-destructive manner. The crop pattern of the study area was determined using the NDVI vegetation index using remotely sensed Landsat 8 OLI imageries acquired in August 2020, October 2020, and April 2021. The Landsat 8 OLI data set contains four bands for vegetation monitoring: blue, green, red, and near-infrared. The analysis used three seasons: August 2020 before the monsoon season, October 2020 during the monsoon season, and April 2021 during the dry season. The villagers near the lake prefer August for agricultural cultivation due to the increased water inflow. After August, the Monsoon season begins each year, which adds another rationale for selecting August as the month for cultivation. The NDVI data indicate that the lake is overflowing with water in October due to the Monsoon and thoroughly dried in the Summer. The study shows that remote sensing through satellite is a valuable method for determining crop patterns. The authors argue that developing tailored remedies requires a fundamental understanding of water bodies. Individuals should understand that freshwater is a finite resource that must be managed wisely. Residents should investigate all feasible methods of water harvesting, restoration, and recycling. Policymakers should focus their efforts on discovering measures to improve the efficiency of irrigation water consumption.
Keywords: NDVI, Crop pattern, Remote sensing, Rice.

1. INTRODUCTION

Rice takes a leadership role in the foundation of world food security. It is the major one among the most widely cultivated crops with annual harvests of 2.5 billion tonnes and other cereals of maise and wheat (Reeves, Thomas, and Ramsay 2016). Rice has become an essential role in human nutrition, which is significantly the lifeline of Asian countries. It feeds reliably the poor as approximate three-quarters of a billion of the world's poorest people depend on rice (IRRI 2006). More than half of the world's population regard rice as a staple food resource as daily grain, and the Asia-Pacific region consumes about 90 per cent of the total quantity of rice produced in the world. The demand for rice production has risen dramatically due to the increase in the demographic rates in the region.

A recent study by International Food Policy Research Institute reveals that the demand for rice is increasing by about 1.8% per year. However, the consequential need for rice cannot be satisfied by increasing production as scarcity occurs to the land and water resources (Hossain 1997). Therefore, the global productivity of rice through cropping is highly required to analyse and meet the demand for rice. Remarkably, all aspects of rice science experience revolutionary advancements with the help of remote sensing and geographical information system. Crop distribution and acreage provide the essential information required for agricultural management and policy formulation. Extracted phenological parameters can be used to map crop areas. Phenology is critical for identifying factors that influence crop stress, Monitoring farming activity, crop damage disaster monitoring, analysing seasonal ecosystem carbon dioxide (CO_2) exchanges and a wide range of end-users, including government, farmers, and researchers.

The phenological stage can be determined by a farmer's observation in the field, but maintaining the same procedure over a vast region is complex. Remotely sensed time-series data are critical for estimating agricultural phenology phases across broad areas while still being cost-effective. Hence, the study points out the importance of understanding the phenological characters of the crops grown around Veeraanam lake. The main objectives of this study are identifying the rice cropping pattern using vegetation and water indices in the Veeranam area. In which for many years, NDVI has been frequently utilised for remote sensing of vegetation.

This index is calculated using radiances or reflectance from the red channel at around 0.66m and the near-IR channel at approximately 0.86m. The NDWI technique is being considered for distant sensing of vegetation liquid water. This is defined as (0.86m)-(1.24m) / (0.86m)+(1.24m) (Kozan et al. 2004).

2. STUDY AREA

Veeranam Lake is located in the Cuddalore district, around 25 kilometres west of Chidambaram. This lake is one of Tamil Nadu's oldest and most significant bodies of water. During the Chola dynasty, King Paranthagacholan built this lake between 907 and 955 AD. This lake has 19.42 km² and a shoreline length of 43.64 km with development of 0.63 km. Veeranam Lake is located between $11^{0}10'$N and $11^{0}25'$N latitudes and $79^{0}10'$E and $79^{0}25'$E longitudes. The lake's maximum length is 14.63 kilometres, its full width is 3.67 kilometres, with a mean width of 1.32 kilometres. The average depth of 6 m³ is 3.38 m, with a 1.86 per cent slop. The lake has a total capacity of 1465 million cubic feet (mcft), a diverse aquatic plant community, and floating and emergent species. All the waters are the lake is vital in delivering water to the megacity of Chennai, giving roughly 50-180 MLD of water every day (Vijayakumar et al., 2013). As a result of these factors, the chosen research area is relevant for understanding the rice crop pattern with the help of the vegetation index. The location map of the study area is depicted in figure 1.

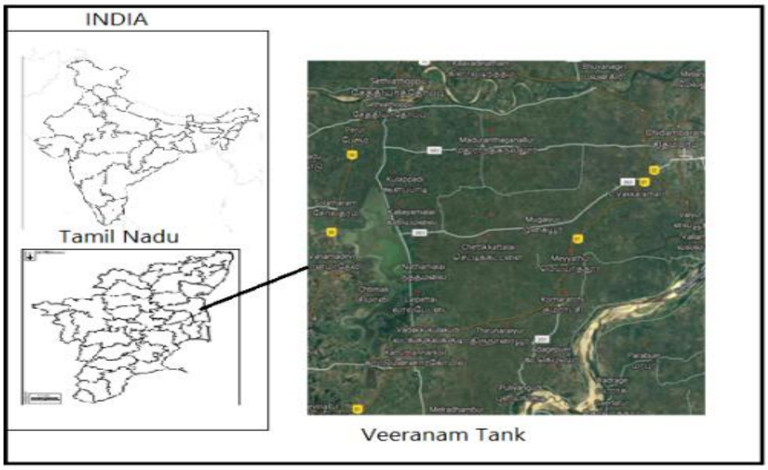

Figure 1. Location map of the study area

3. MATERIALS AND METHODS

Remote sensing is the science and art of getting information about an object by analysing data obtained by a device, not in physical touch (Lillesand and Keifer 1994). Remotely sensed Landsat 8 OLI imageries obtained in August 2020, October 2020 and April 2021 were used in this study to get the crop pattern of the study area from the NDVI vegetation index. Landsat 8 OLI data include four bands for monitoring vegetation: blue, green, red, and near-infrared. The data were collected before the rice harvest and after the harvest alongside the pre-harvest ground sampling.

The Normalised Difference Vegetation Index (NDVI) was adopted in the study because it has been the commonly used vegetation index (Kriegler et al. 1969). The NDVI classification clearly distinguishes vegetation from other land coverings (Pagare N S et al. 2021). This index ranges from -1 to 1. It is computed as follows:

NDVI = NIR-red / NIR-red

Based on the calculated NDVI, the study area's crop pattern maps were created for August 2020, October 2020 and April 2021. The classification of the NDVI value was based on the following table (Sahararini and Wibowo 2020).

Table 1. NDVI values based on rice density after Sahararini and Wibowo 2020

NDVI values	**Rice density**
-0.096 - 0.036	Water
0.036 - 0.240	Very Low
0.240 - 0.456	Low
0.456 - 0.652	Moderate
0.652 - 0.884	High

4. RESULTS AND DISCUSSION

Rice is the major crop dominated in the Veeranam catchment area of the Cuddalore district. Three seasonal data have been taken for the analysis: August 2020 Pre - Monsoon, October 2020 during Monsoon, and April 2021 during the dry season. Unfortunately, the January and February, and March satellite images are of poor quality. As a result, this study used only satellite images from April 2021 to determine the NDVI values of rice in the dry planting period. The NDVI values obtained are dependent on the quality of cloud-free data.

4.1 Before Monsoon

The Veeranam lake is supplied with water from the Kollidam River via the Vadavaru River (Department of Tourism 2021). Water released from the Mettur dam would also provide sufficient inflow into the Veeranam Lake via Kollidam and Lower Anicut. In April, the lake had adequate inflow to serve the city for three months. The lake nearly reached its storage capacity due to the Cauvery tributaries Bhavani and Amaravathi during the heavy rains in the Western Ghats.

The August 2020 data has been selected as before monsoon data, and the NDVI map has been produced from that data and depicted in figure 2. The NDVI results show that the lake is packed with water during August because of the inflows from the Cauvery tributaries. The resulted map indicates that the Rice pattern is Moderate near the lake area because of the sufficient water flow and the early stages of the rice growth.

The dwellers near the lake prefer August month for crop cultivation because of the water inflow. After August, the Monsoon will be expected every year, so choosing the month for cultivation is another reason.

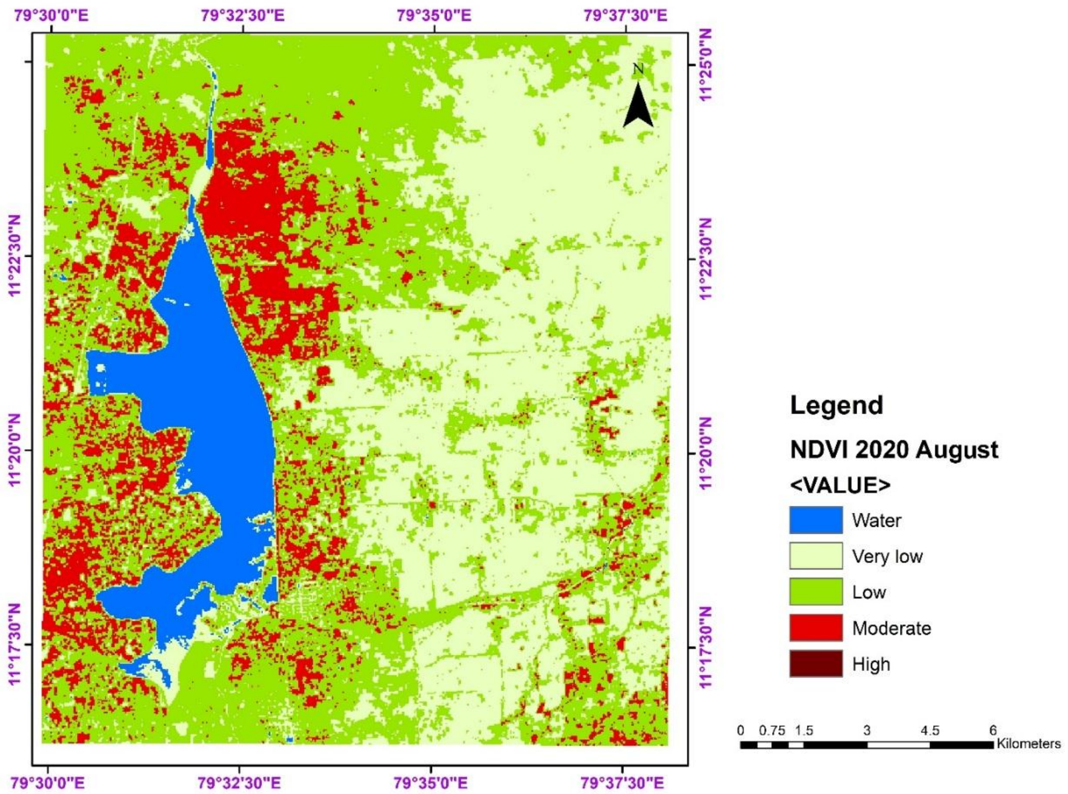

Figure 2. NDVI map for August 2020

4.2 During Monsoon

October 2020 data were chosen as during monsoon data, and the NDVI map represented in figure 3 was created using those data. The NDVI data indicate that the lake is overflowing with water in October due to the Monsoon. The study area is found full of paddy fields; hence the district receives a good amount of rainfall and the perfectness of the lake's channel system.

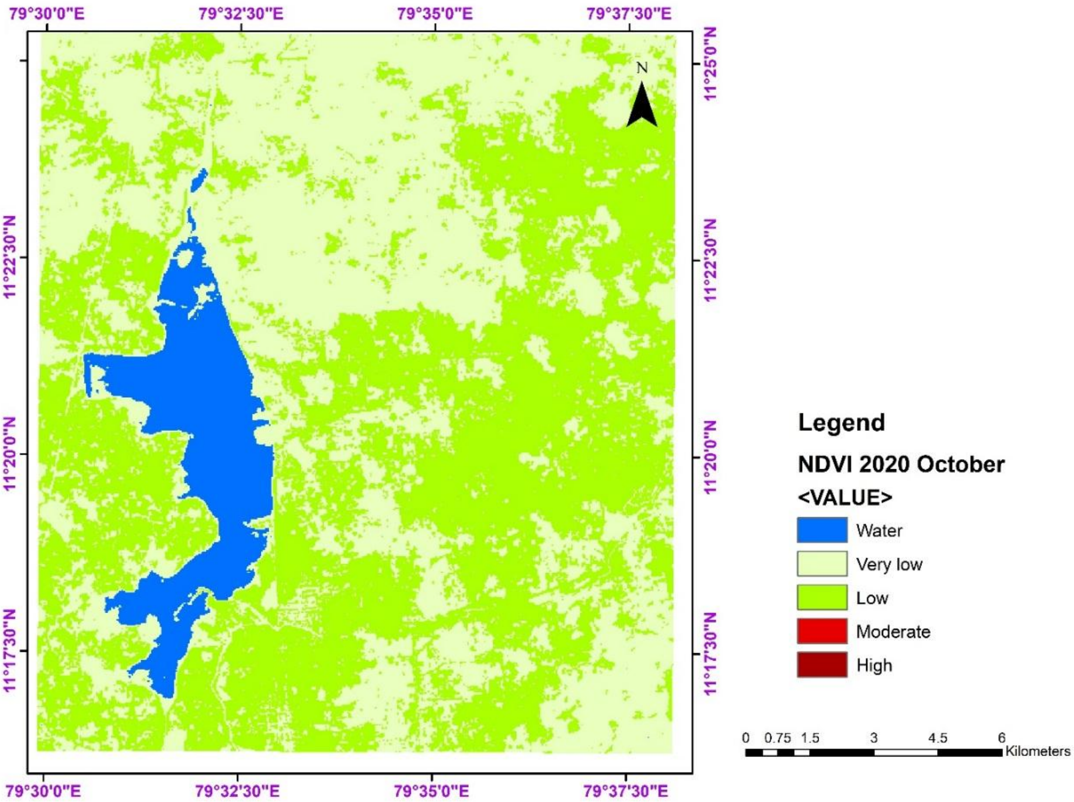

Figure 3. NDVI map for October 2020

4.3 During dry season

April 2021 data were chosen to simulate the dry season, and the NDVI map seen in Figure 5 was created using those data. Figure 4 indicates that the lake has been dried during the summer period because of less water inflow. In April, the lake itself was covered with vegetation. The surrounding places also dried out, and those greenery locations on the map were not the paddy fields (Figure 4). The field survey confirms that the areas were not the paddy fields. In 2021 the lake dried after three years because of the no inflow from the river Cauvery

Figure 4. Dried Veeranam lake

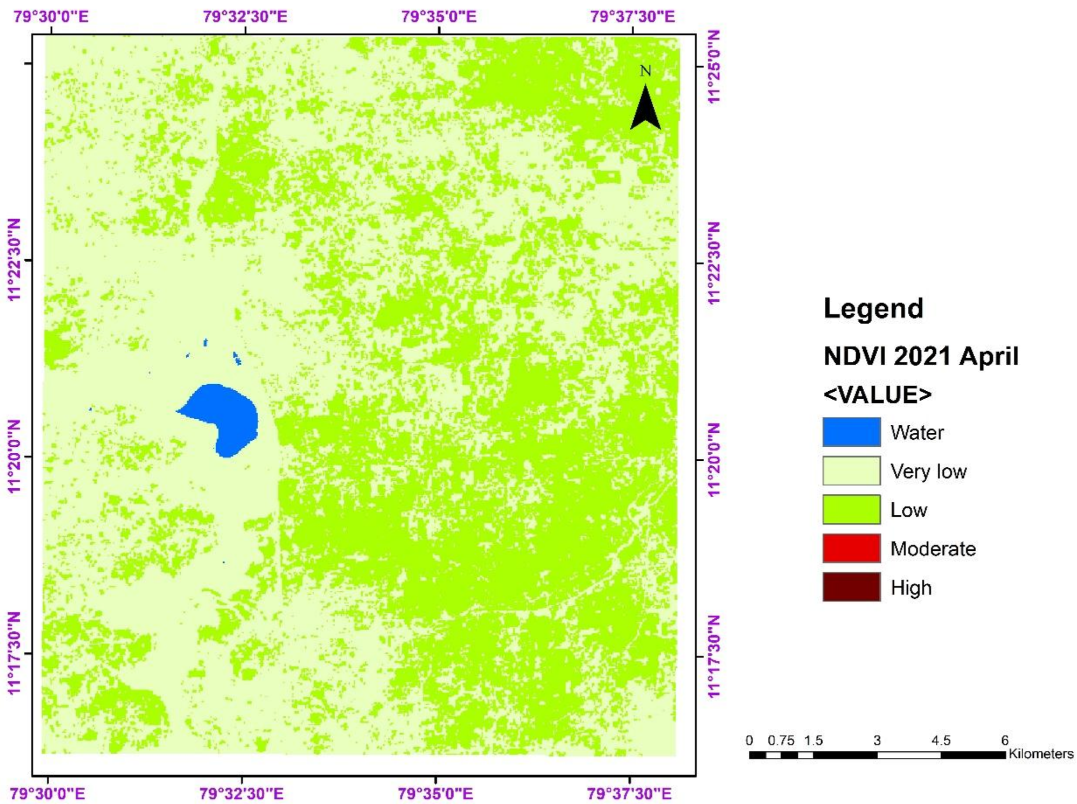

Figure 5. NDVI map for April 2021

5. CONCLUSION

The study concludes that the Satellite remote sensing is an excellent tool for identifying the cropping pattern. The authors request that a fundamental understanding of water bodies is required to develop targeted solutions. People should recognise that freshwater is a finite resource that must be used prudently. Residents should explore all available methods for harvesting, restoring, and recycling water. The policymakers should concentrate their efforts on identifying strategies to increase irrigation water use efficiency.

6. REFERENCES

[1] Department of Tourism, Tamil Nadu. 2021. "Veeranam Lake." *Tourist places Cuddalore district*. https://cuddalore.nic.in/tourist-place/veeranam-lake/.

[2] Kozan, O, K Tanaka, S Ikebuchi, and M Qian. 2004. "Landuse and Cropping Pattern Classification Using Satellite Derived Vegetation Indices in the Huaihe River Basin." In *Proc. of the 2nd International Conference on Hydrology and Water Resources in Asia Pacific Region*, , 732–40.

[3] Kriegler, F J, W A Malila, R F Nalepka, and W Richardson. 1969. "Preprocessing Transformations and Their Effects on Multispectral Recognition." In *Proceedings of the 6th International Symposium on Remote Sensing of Environment*,.

[4] Lillesand, T M, and R W Keifer. 1994. "Remote Sensing and Image Interpretation. United States of America: John Willey & Sons."

[5] Pagare N S et al. 2021. "Mapping the Wetlands of Mumbai and Surrounding Area Using Remotely Sensed Sentinel-2b Data." *Turkish online journal of qualitative inquiry* 12(7): 6964–80.

[6] Sahararini, A F, and A Wibowo. 2020. "Estimation of Rice Productivity Using Sentinel-2 Imagery with NDVI Algorithm in Cariu Sub-District, Bogor, West Java." In *IOP Conference Series: Earth and Environmental Science*, IOP Publishing, 12056.