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Effect of Wind Farms in Crop Production of Kanyakumari District

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Abstract

This paper describes how the wind farms effect the crop production of Kanyakumari District. Remote sensing technology along with GIS has been used here for finding the NDVI values. Paddy yield data were also used for finding the effect of wind farms. Along with the NDVI values, we use temperature, humidity and Rainfall data for finding the Crop production rate. Erdas imagine 8.3 along with ArcGis have been used as the software for image and geo-information analysis.

Keywords: ArcGIS, Crop Yield Assessment, Erdas, Kanyakumari, NDVI

1. Introduction

Tamil Nadu is the state having large number of wind farms in India. Wind farms having greater impact on crop production. There should be variation in the parameters such as temperature, humidity and rainfall near to wind farms and it affects the crop production.

The aim of this work is to find the effect of wind farms in crop production of Kanyakumari district by finding the NDVI values:

- To select the two satellite images of Kanyakumari district of 1992 and 2006 having wind farms.
- Find the NDVI values and identify the vegetation and prepare maps.
- Compare the crop yield data with the NDVI values.

Many parameters having higher impact on crop production. Temperature, Soil data, Rainfall is some of the Parameters that affect the yield of the crop. Normalized difference vegetation index is the parameter used to identify the vegetation area and NDVI ranges should be in between -1 and +1.

2. Study Area

Kanyakumari is situated in the southern most part of India with an area of 1672 square km occupies 1.29% of the total extent of Tamil Nadu (Usha A.[1]). In the case of literacy the district is ranked first when it is compared to other districts in Tamil Nadu in Figure 1. The district is situated between 77° 15' and 77° 36' east and 8° 03' and 8° 35' to the North Longitudes. Kanyakumari is having one peculiarity is that it is surrounded by three oceans Indian

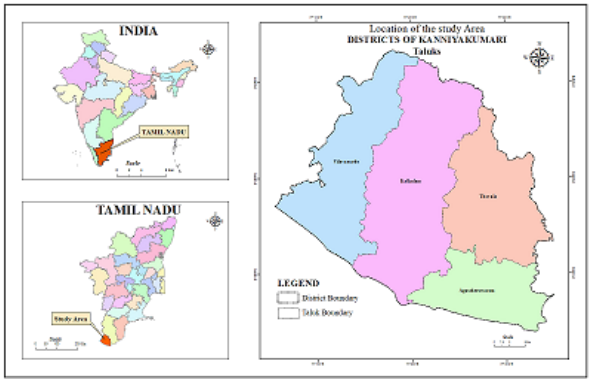

Figure 1. Study area.

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ocean, Arabian sea and Bay of Bengal and Western Ghats in the northern most side. The major food crop of Kanyakumari is paddy. The other crops produced in the district are rubber. The district is having many tourist attractions. Another advantage of Kanyakumari is that it is having large number of wind farms.

3. Data used and Methodology

3.1 Data used

Satellite images used are LANDSAT ETM+ of 1992 and 2006 of Kanyakumari district in Figure 2 (a) and (b). ERDAS IMAGINE and Arc GIS 10.0 are the software used for geo information analysis and processing of the images. Topographic maps, 1:250000 scale land maps were used in the study. Digital image processing techniques are used for processing the satellite data. NDVI values are thus calculated for the years 1992 and 2006 to identify the crop production (Kazadi Sanga-Ngoie[6]).

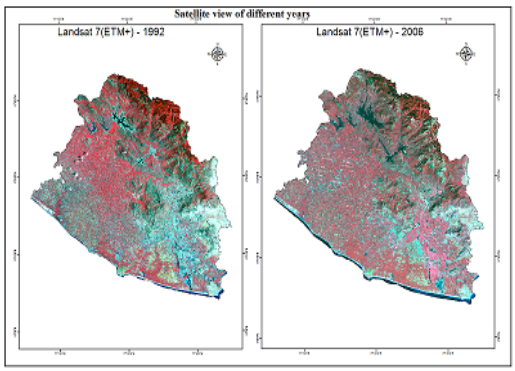

Figure 2. (a) Satellite view of Kanyakumari in the year 1992; (b) Satellite view of Kanyakumari in the year 2006.

3.2 Methodology

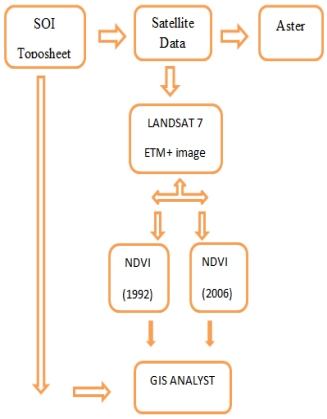

Figure 3. Methodology used.

4. Results and Discussion

Wind farms are the most important energy resource in the country. Wind farms are having greater impact on the crop production. Wind farms are rotating continuously there should be the variation in the Normalized Difference Vegetation Index (NDVI) (Wei Zhang[7]).

4.1 Normalized Difference Vegetation Index

NDVI or the Normalized difference vegetation index is the quantity which is used to predict the crop health hence the crop yield. NDVI values should always in the range from -1 to +1. For the rocks, sand etc. having the range of very low NDVI value that is 0.1 or below and the areas of sparse vegetation have values in between 0.2-0.5 having moderate NDVI. For dense vegetation areas like forest have NDVI values in between 0.5-0.9. Theoretically we can calculate the NDVI using the formula as,

NDVI = (NIR-VIS) / (NIR+VIS)

Where NIR is the spectral reflectance of the near infrared and that of the visible region is VIS. NDVI values are calculated by processing the images using Erdas imagine software (Thomas[3], Punithavathi[2]).

As mentioned earlier, when the wind farms are gradually rotating there should be a change in different parameters and as a result of that NDVI values are also changed in Figure 4 (a) and (b). As the wind farms are rotating the sequestrated carbon content increased or decreased based on that vegetation also changed. Wind farms generated power in the year 1992-1993 as 71.223 M.U and that in

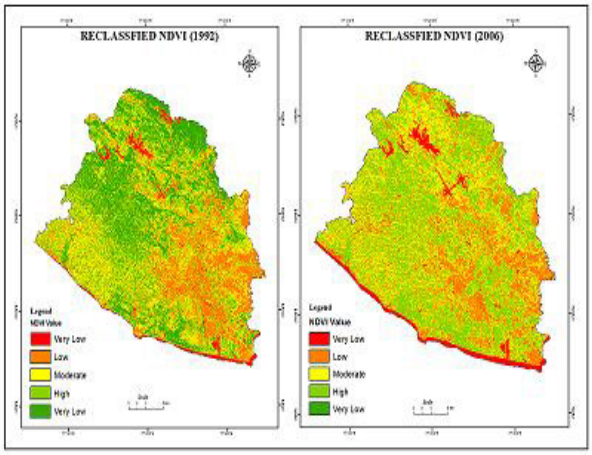

Figure 4. (a) Vegetation map of 1992 (NDVI); (b) Vegetation map of 2006 (NDVI).

2005-06 as 3444.281 M.U as shown in the records. From this data it is identified that there is sudden increase in the case of wind farms and thus vegetation areas are gradually decreased.

Table 1. Comparison of histogram values of NDVI of years 1992 and 2006

NDVI Values	Histogram values of 1992	Histogram values of 2006
-1 to -0.8	0	450
-0.8 to -0.4	0	50400
-0.4 to -0.1	730296	3545100
0 to 0.3	1845340	6640200
0.3 to 0.7	153272	2335725
0.7 to 1	0	8550

This paper taken into account that the datas of two years of Kanyakumari having large number of wind farms are compared. NDVI values are grouped according to their range. From the above in Table 1 we can come to the conclusion that that the NDVI values are high for 1992 and it indicates that the crop health is more in that period. In 1992 the value of histogram is low and it reflects vegetation is high and in 2006 it shows high values and shows lower vegetation. Also compared the paddy crop production rate of both of the years and identified that the paddy productivity is more in the year 2006 compared to 1992. When compared to 1992 wind farms are more in 2006. From this it is clear that wind farms helps to improve the crop production.

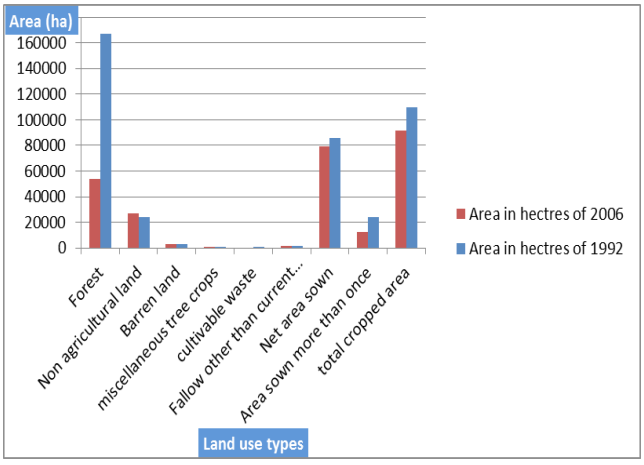

Figure 5. The land use pattern of Kanyakumari district for the years 1992 and 2006.

For this the change detection is performed and understood that the forest area is more in the year 1992 and having more sequestrated carbon and it help for the crop production in Figure 5. When the forest is converted into cultivable land the carbon content decreased, hence it effects the crop production.

Table 2 shows the details of paddy yield and when wind farms are installed it increases the carbon sequestration and improves the crop yield.

Table 2. Rice production and productivity rate for 1992 and 2006 of Kanyakumari District

Year	Area (ha)	Productivity(kg)
1992-93	5.59	1940
2006-07	2.63	2431

5. Conclusion

On comparing the two images it is clear that vegetation is high in the year 1992 than 2006, pointing towards the conclusion that wind farms effect the crop production of a particular area. As the wind farms continuous to rotate there is a change in the vegetation, and is found out with respect to the NDVI values.

The paddy crop yield data reveals that the yield increases from 1992 to 2006. Installation of wind turbines in the middle of the paddy fields is good for their production rate as well as their yield. Kanyakumari district having lot of wind farms and the crops of the district are paddy, corn etc. and this study concludes that wind farms helps in such crop production. Also the scope and development of finding the sequestration content of carbon is more. Creating some models for finding the sequestration rate is the on-going research work but it is more complex.

6. Acknowledgements

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