Application of Geospatial Technology for Drought Risk Mapping in Northern Malabar District, Kerala, India

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Introduction

Drought is a menacing hazard of Nature. It is referred to as a "creeping phenomenon". Its definition and impact varies from region to region and human activities can intensify the impacts of drought. Drought originates from a deficiency of precipitation over an extended period of time –from a week, season or more--resulting in a water shortage for some activity, group, or environmental sector. The Impacts due to Drought are Economic, Environmental and Social.

Relevance of Drought Risk Mapping and Assessment

Drought Risk Mapping can help organizations and farmers identify drought risk areas and be vigilant to identify the onset of drought. Information of Drought risk in a particular period in an area can help farmers to plan their production and crops. Drought is Expensive causing loss to man. Drought warning helps to fix prices in advance to regulate consumption and flow of Agricultural goods to market. Water would be used conspicuously for irrigation and daily life if warned early.

Objective

To investigate the risk of drought in North Malabar District – Kannur based on ground station data -Rainfall and Remote Sensed Satellite images.

Study Area

Kannur district, Northern Malabar district of Kerala State, is geographically situated in between 11˚ 40' and 12˚ 48' North latitudes and 74° 52' and 76° 07' East longitudes, covers an area of 2,996 KM^2.Fig 1.0.

Kannur district has a humid tropic climate with an oppressive hot season from March to the end of May. It receives heavy rainfall during the southwest monsoon. The annual average rainfall is 3438 mm.

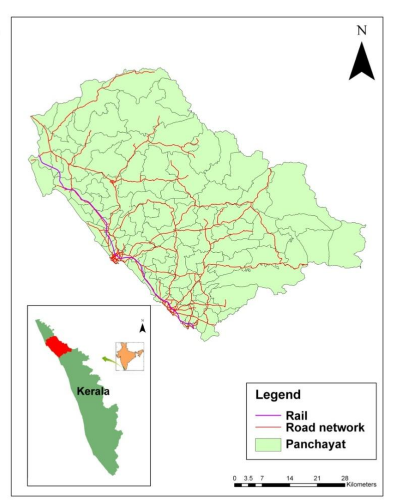

Fig 1.0. Study Area showing administrative boundaries of panchayats in Kannur district of Kerala

Resources and Tools

Free satellite data from TERRA–Product -MOD13Q1-,IRS 1D LISS 3 image for Land use Classification, Rainfall data from Rain Gauge Stations in Kannur district varying over 100 years from IMD and other Agencies, Open source Quantum GIS, Modis Reprojection Tool from NASA and SPI model from NDMC.

Method

1) Downloaded the 16 day composite 250m resolution Terra MODIS data [MOD13Q1] from year 2000 to 2011

2) Re-projected using NASA's MRT tool.

3) Extract the NDVI of the AOI from the re-projected data.

4) Calculate the mean NDVI of the area over the years 2000-2011 in the month of May

5) Calculate the anomaly in NDVI from the mean NDVI in the last five to six years. i.e. Years 2006-2011 is for the recent drought risk analysis.

6) Integrate the drought Anomaly over the recent years. i.e. 2006 to 2011 (during May) and identify the drought risk areas.

7) Areas showing the maximum negative anomaly are more prone to drought.

8) This information is segregated and distributed to the panchayath level where precautionary actions are taken

The equations used for calculation of Mean NDVI, Anomaly NDVI and Risk are

Mean NDVI $= (NDVI_1 + NDVI_2 + ... + NDVI_n)\ /n$

where, NDVIi is the NDVI of the same 16-day period over year 'i'.

Anomaly NDVIi $= (NDVI_i - \text{mean NDVI}) * 100/(\text{mean NDVI})$

where, Anomaly $NDVI_i$ is the NDVI Anomaly in the i^{th} period. $NDVI_i$ is the i^{th} NDVI and mean NDVI is the average of NDVI.

Risk $= \text{Min}(\text{Anomaly } NDVI_i\ ,\ \text{Anomaly } NDVI_{i+1}\ ..\ \text{Anomaly } NDVI_{i+n-1})$

where, Anomaly NDVIi is the NDVI Anomaly in year 'i'.

Satellite Data

In the year 2006, large areas in Kannur were found to be drier than during other years in the period of study i.e. 2000-2011. Fig 2.0.

In 2010, North Western and North Eastern parts of Kannur experienced moderate drought

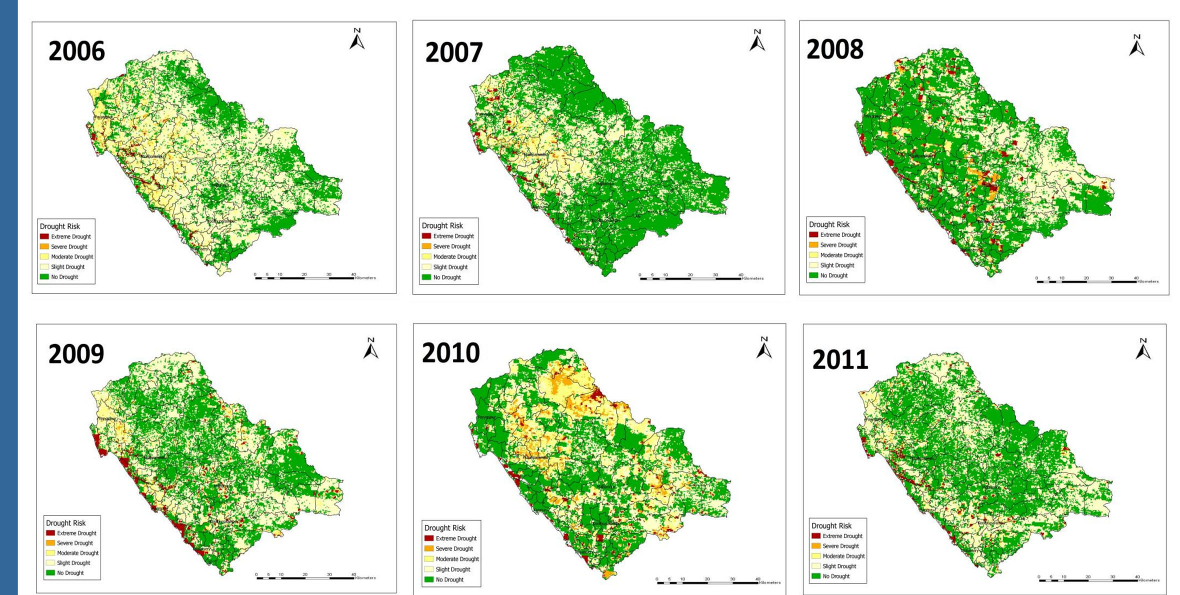

Fig 2.0. NDVI Anomaly in the years 2006 to 2011 during May

From the NDVI anomaly maps the drought risk map for the Kannur district was prepared

Areas exhibiting high NDVI anomaly are more prone to drought.

The coastal region shows high negative anomaly and is due to human settlements, sandy beaches and sparse vegetation. Hence risk does not exist in coastline areas of Kannur district. Fig 3.0.

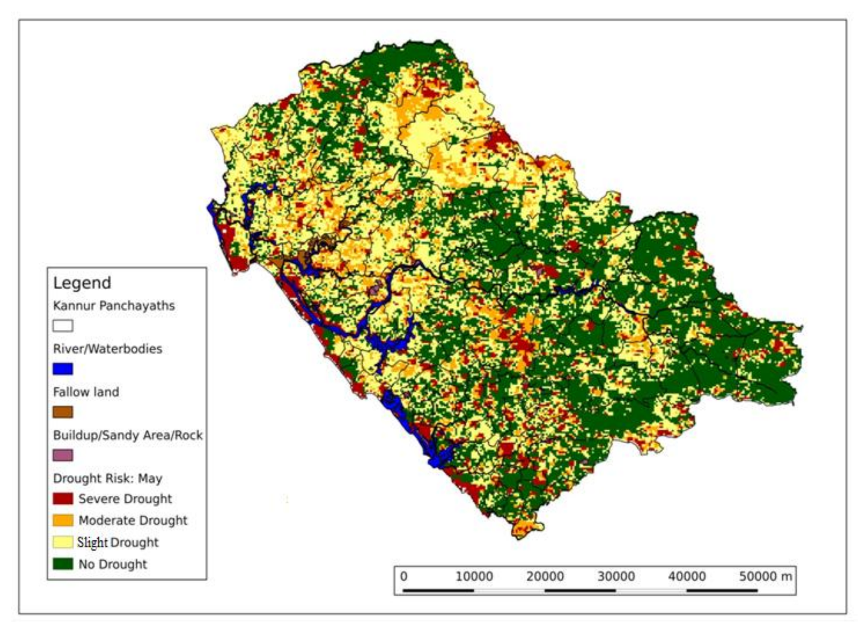

Fig 3.0. NDVI based Drought Risk Map

Automated NDVI Map

Automated the processing of daily NDVI map for Malabar area and uploaded the NDVI map in the Web Server present in the organization intranet. Fig 4.0.

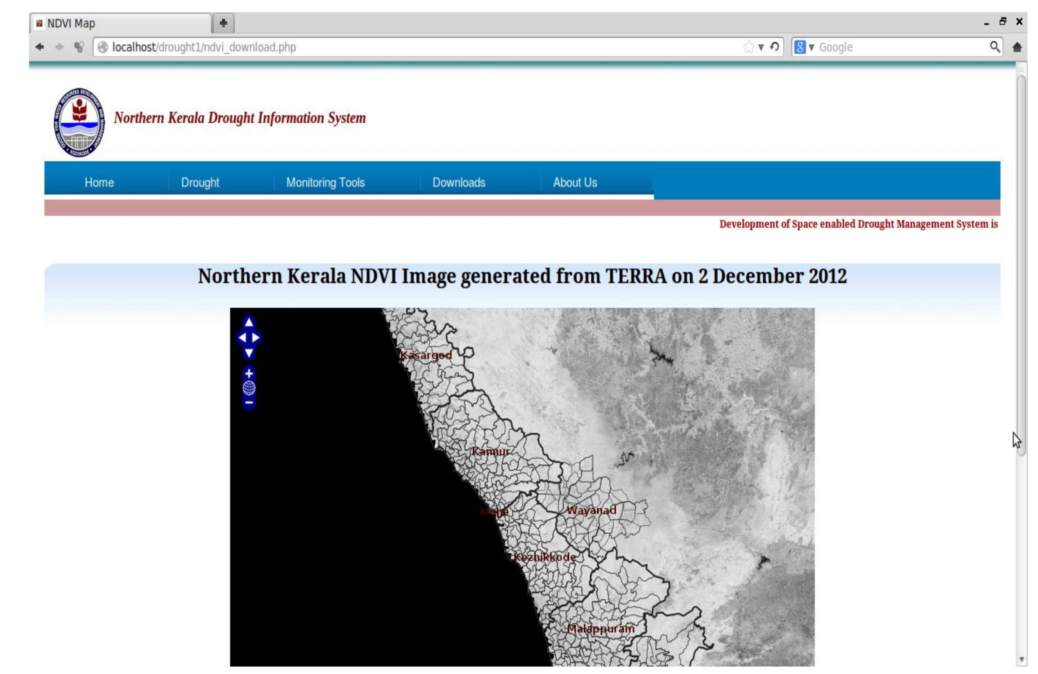

Fig 4.0. Daily NDVI Image for Malabar area

Conclusion

Maximum NDVI negative anomaly areas are more prone to drought. This study helped in identifying the drought risk areas in Kannur district. From the NDVI based drought risk map, panchayaths such as Kankole - Alapadamba, Kadannapalli-Panapuzha, Keezhallur, Mattannur, Koothuparamba, Pattiom, Mokeri, Northern part of Naduvil, Boundary of Alacode showed extreme drought risk during the month of May. Free satellite data services from TERRA satellite and open source GIS software were utilized in this study. Drought risk mapping of imperative areas can be prepared by applying the techniques used in this study. Geospatial Technology plays a vital role for drought risk mapping and has been successfully utilized in this investigation.

Acknowledgements

We are thankful to the Executive Director, CWRDM for providing the facilities and Ministry of Water Resource (MoWR) for providing the financial assistance for conducting this study.