TIME SERIES DROUGHT VULNERABILITY MAPPING IN PALAKKAD DISTRICT, INDIA-USING GEOINFORMATION SCIENCE AND TECHNOLOGY

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ABSTRACT

Drought is one of the major environmental disasters, which have been occurring in almost all climatic zones and damage to the environment and economies of several countries has been extensive and death toll of livestock unprecedented. Drought damages are more pronounced or prominent in areas where there is a direct threat to livelihoods. The advanced technologies like remote sensing and geographical information system are very essential to identify the drought condition. Remote sensing and geographic information system have significantly aided identification of drought vulnerable areas in the recent past. Drought is one of the natural disasters having an impact on both the economy and the society, with its long-standing problems. Drought by nature is a result of inter-related parameters. The study is based on the concept that the severity of the drought is a function of rainfall, hydrological and physical aspects of the landscape. In the present study a Geographic Information Systems (GIS) and remote sensing based tool for drought vulnerability assessment at a micro level has been developed. Drought vulnerability is a concept which shows the likelihood of damages from hazard in a particular place by focusing on the system status prior to the disaster. Drought vulnerability has been viewed as a potential for losses in the region due to water deficiency at the time of drought. In this study the vulnerability of drought in Palakkad district (2008 to 2018) is investigated by providing vulnerability maps which demonstrates spatial characteristics of drought vulnerability.

Key words: *Drought, Geographic Information System, Remote Sensing, Vulnerability Maps*

INTRODUCTION

Drought is one the climatic as well as natural disasters common all over the world. Droughts have disastrous impact on the economy and can affect the largest segment of the society, which may last for months and in some cases several years (Reza, 2010). Drought is more often like a cancer on the land, mute but sure assaulter that seems to have no marked beginning or ending; a malaise slowly engulfing the community and often leaves just as gradually(Sergio,2007). Drought may be categorized as continuing disasters and as the time passes, the situation may further deteriorate. The continuing disasters include prolonged droughts and crop failure (Vasanthavigar et al, 2011). These continuing disasters or drought affects a very large area. The droughts may compound longstanding problems of deforestation, encroaching desertification, soil erosion, forced migration, malnutrition, epidemics and loss of life over

vast stretches of land for many years. Agriculture may suffer severe set back and large groups of affected population may have to migrate (Jerrod, 2016). In turn, it may cause pressure on urban centers, creating new demands and infrastructure. The meteorological causes of drought are usually associated with slow, prevailing, subsidizing motions of air masses from continental source regions (Jeyaseelan, 2001).

Drought is considered by many to be the most complex but least understood of all natural hazards, affecting more people than any other hazard (Abdel Aziz Belal ,2014). Drought risk is a product of a region's exposure to the natural hazard and its vulnerability to extended periods of water shortage (Nishadi,2015). Drought is a period of abnormally dry weather sufficiently for the lack of precipitation to cause a serious hydrological imbalance and carries connotations of a moisture deficiency with respect to man's usage of water. GIS is an information system that is designed to work with data referenced by spatial or geographic coordinates. GIS combined with MCE (Multi-Criteria Evaluation) can achieve measurable evaluation of drought risk. Karamouz et al, 2015, introduced Technologies for evaluating agriculture meteorological drought risk with GIS-MCE. The results indicated that technology of GIS-MCE can combine multiple source information associating with agriculture meteorological drought risk and achieve measurable result. Satellite remote sensing provides a synoptic view of the land and a spatial context for measuring drought Impacts, which have proved to be a valuable source of spatially continuous data with improved information for monitoring vegetation dynamics.

MATERIALS AND METHODS

Drought vulnerability has been viewed as a potential for losses in a region due to water deficiency at the time of drought. In this section, the development of drought vulnerability map is discussedThe data sources for the present study are the Survey of India toposheets, soil map, field data and Remote Sensing Data. The Survey of India Toposheets (1:50000) is used for the delineation of basic features of the study area. The IRS P6 LISS3 2006 and 2016 image was used to generate landuse pattern of the study area. From this landuse map Normalised Difference Vegetation Index was calculated (NDVI) by using image processing software (Weatherhead,2009). The drainage network of the study area is derived from the topographic sheets. Moreover the Drainage density is also derived from streams using spatial analyst of ARC GIS 10.3.Elevation and slope have a direct relation between the drought. Increased slope and elevation will positively contributed to the drought. The preparation of the drought vulnerable maps assesses the drought potential of any area. In the present study, drought vulnerable areas were generated by giving weightage to various parameters that influences the drought. The method for the drought vulnerable assessment used in this study is weightage factor model. The weightings assigned to each terrain parameter to reflect its importance in the occurrence of drought together with the rating for the individual classes, which denotes the degree of hazard represent.

Temperature and rainfall were collected from IMD (Indian Meteorological Department) and where analyzed using geo statistical analyst in GIS. The interpolation method used for the analysis is Kriging : "An interpolation technique for obtaining statistically unbiased estimates of spatial variation of known points such as surface elevations or yield measurements utilizing a set of control points". The spatial variation is quantified by the semi-variogram. Increased temperature and decreased amount of rainfall favors the drought.

Drought influencing factors such as NDVI, landuse, , soil drainage, soil slope, drainage density, temperature, rainfall, are ranked and weighted according to their assumed or expected importance in causing drought. This is normally based knowledge available to experts on various causes of drought in the area of investigation. For application of the WeF model, numerical values were assigned to each of the each classes of each factor. A numerical weight is attributed for each instability factor and then an overall score (drought index) is determined by the use of the following multiplicative model (Subin,2012). Overall drought index (DI) = a1 * F1 + a2 * F2 + a3 * F3 + a4 * F4 + a5 * F5.Where a1, a2… a5 are the numerical weights and F1, F2… F5 are the factors as thematic layers that were taken into account to the drought mapping. Drought vulnerable map of 2008 and 2018 were prepared. Vulnerability has been divided into several categories. In the end a weight has been assigned to each categories and finally all seven categories maps have been overlaid and a unique drought vulnerability map has been developed.

RESULTS AND DISCUSSION

Droughts are one among the most devastating natural hazards in the world, claiming more lives and causing extensive damage to agriculture, vegetation, human and wild life and local economies. In this study, a drought vulnerability map has been created for Palakkad district based on 9 parameters. The result of the study shows that GIS and remote sensing could be successfully employed in identification of drought vulnerable areas in Palakkad district. The general trend observed in the present study is increase in the drought risk area due to the decrease in the forest cover. The drought vulnerability scenario developed by combining all the seven criteria's indicated that very high and high chances of drought vulnerability is more pronounced across hilly region and comparatively lesser in low area and forested areas. The drought prone map shows that the study area is divided into four zones based on the severity of drought; these are very high, high, moderate and low. The drought vulnerability map of 2008 is prepared based on 2008 data and other parameters and the drought vulnerability map of 2008 is prepared based on 2018 data and other parameters. The drought vulnerability map of 2008 to 2018 shows that there is large increase in drought severity. In the regions of low drought severity drainage density is very high and the land use pattern is mainly forest. In low drought severity region the temperature is low and rainfall is high compared to other region this is because of the elevation of that region. In low drought prone area the vegetation index is high that means it near to one. The high vegetation index value shows that the vegetation vigor of that are is high. And this provides moisture to the environment. Soil drainage of the low drought area is imperfectly drained compared to others. In very high drought vulnerable area the vegetation index is very low, soil is well drained, temperature is high, the availability of rainfall is low, land use is mainly agriculture and soil slope is moderately steep.

CONCLUSION

India being a tropical country with hot and humid climates and high temperature conditions. Delay in the monsoons as well as high evaporation rate of the surface water bodies is making some of the regions into drought areas. As the drought is dynamic in nature, which builds over a time, timely and reliable information is essential for effective drought monitoring and management. Satellite remote sensing provides multi-spectral, multi spatial and multi temporal data useful for drought monitoring, assessment and management. The present study is a comprehensive evaluation and integrated analysis of drought, which has been carried out by using satellite based remote sensing and GIS techniques. Adverse climatic conditions may further convert these high drought prone areas to severe drought

areas. Some action plans comprising of drought proofing works, employment generation programmes and social security programs were discussed for managing the drought prone areas.

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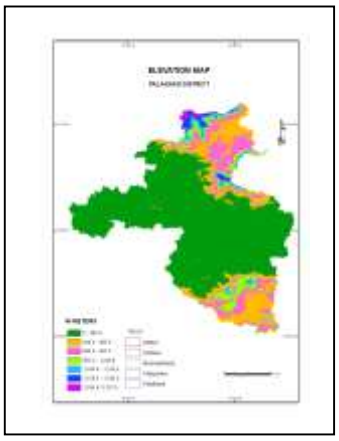
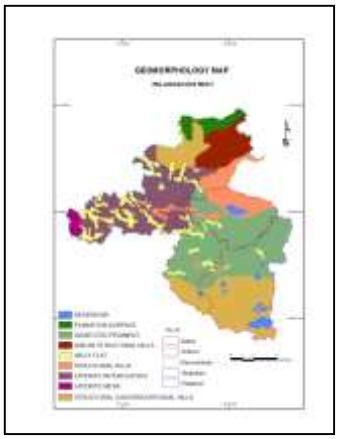
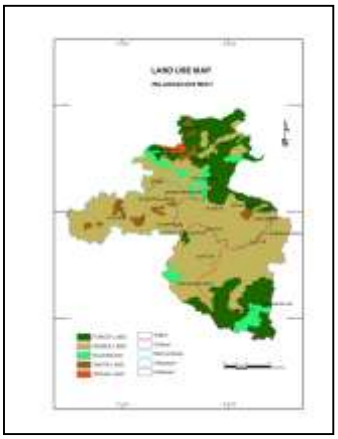
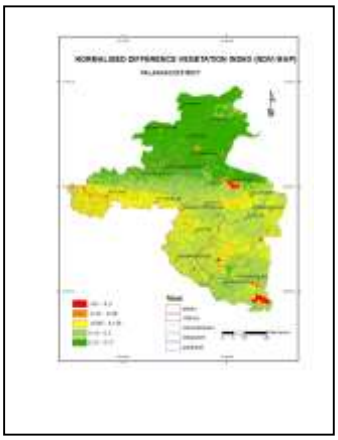
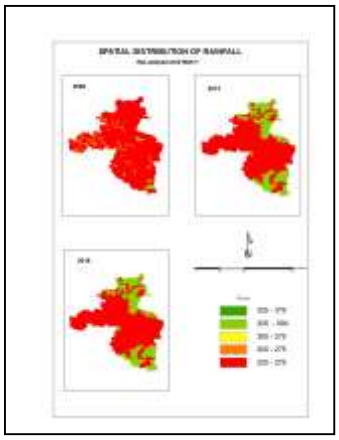
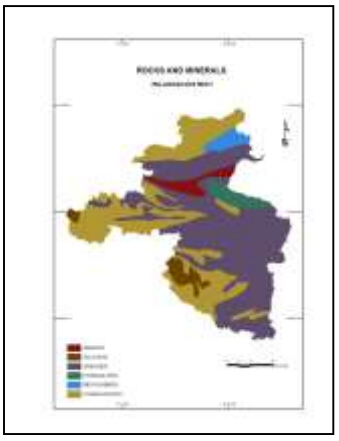


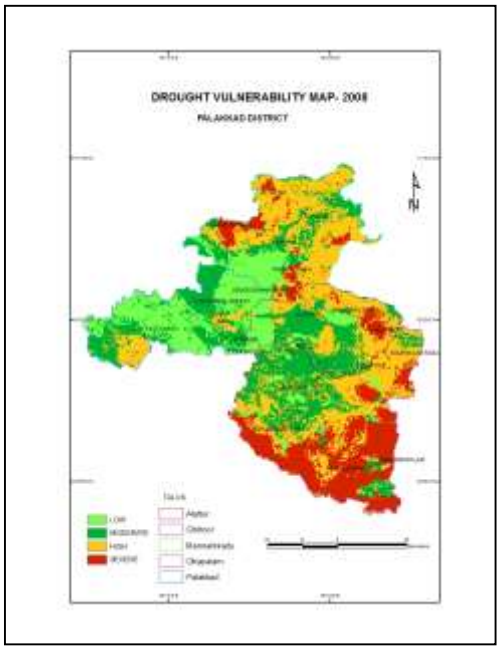


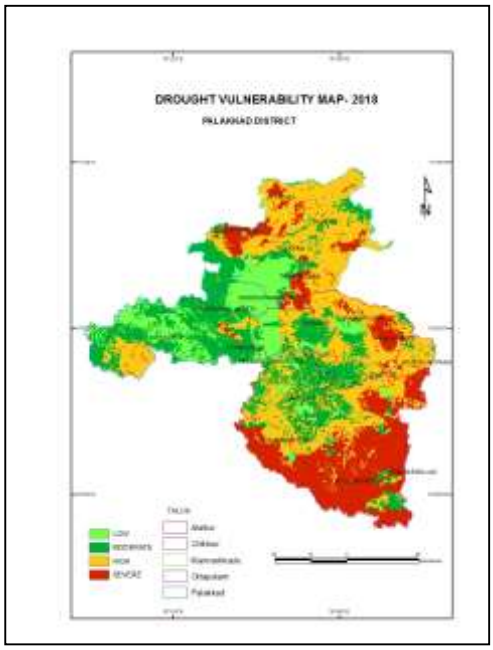









DROUGHT VULNERABILITY MAP- 2008
PALAKKAD DISTRICT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