



# Spatio Temporal changes of Hudhud Cyclone (pre and post Analysis) Using GIS Technology

Naveen Kumar N<sup>1</sup>, Swaraj J<sup>2</sup>, Manjula Vani K<sup>3</sup>

1.M.Tech, CSIT, JNTUH, Hyderabad 500038. India; Email: naveenk367@gmail.com

2.Research Scholar, Center for Environment, JNTUH, Hyderabad 500038; India: Email: jangalswaraj@yahoo.com

3.Professor, CSIT, JNTUH, 500038, India: Email : ronilekha@gmail.com

## Article History

Received: 08 June 2016

Accepted: 03 July 2016

Published: October - December 2016

## Citation

Naveen Kumar N, Swaraj J, Manjula Vani K. Spatio Temporal changes of Hudhud Cyclone (pre and post Analysis) Using GIS Technology. *Climate Change*, 2016, 2(8), 283-291

## Publication License



© The Author(s) 2016. Open Access. This article is licensed under a [Creative Commons Attribution License 4.0 \(CC BY 4.0\)](https://creativecommons.org/licenses/by/4.0/).

## General Note



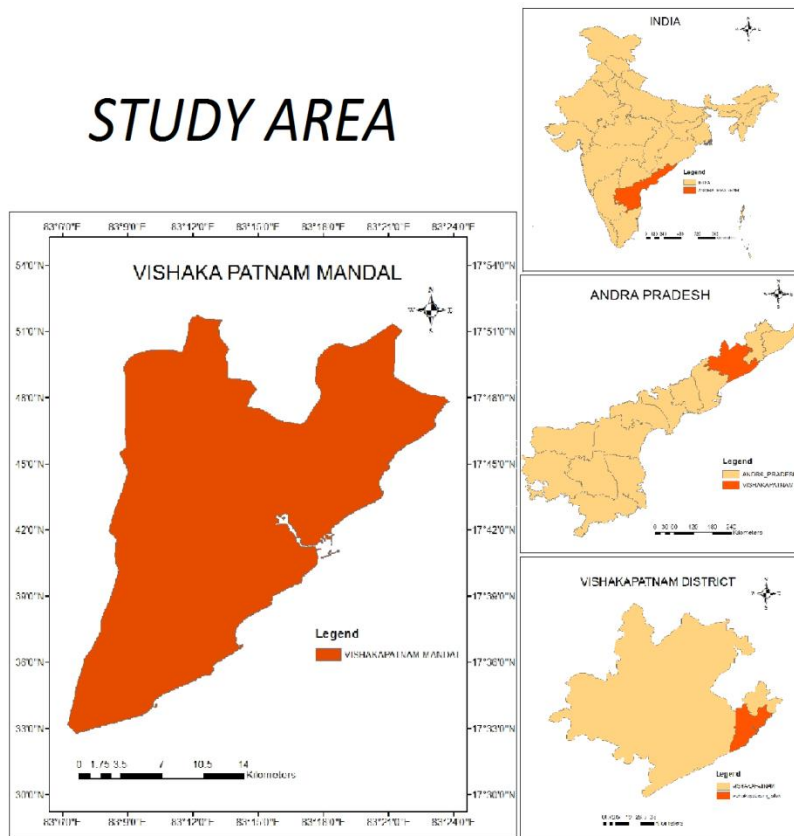
Article is recommended to print as color version in recycled paper. *Save Trees, Save Climate.*

## ABSTRACT

Developing countries are vulnerable to tropical cyclones due to climatic variability; climate is likely to increase the frequency and magnitude of some extreme weather and disaster events. Cities and towns situated along the coastal belt in Visakhapatnam district experienced severe damage because of HUDHUD cyclone, which occurred on the 12th of October, 2014; Areas around the city of Vishakhapatnam suffered huge damage. In rural areas, thousands of hectares of agriculture, horticulture plantations and roofs of huts were affected due to high wind speed. Urban and rural areas have suffered a lot of economic loss. The main objective of this research was to identify and quantify the damage to agriculture and vegetation caused by HUDHUD cyclone. In this study satellite datasets acquired before and after the cyclone have been used; image processing techniques need to be carried out to assess the changes of pre and post cyclone. Applying Image classification techniques is to assess the damage. Vegetation index techniques are being used with special reference to biomass quantification. Eventually HUDHUD cyclone has done significant damage to the rural and urban areas of Visakhapatnam.

## 1. INTRODUCTION

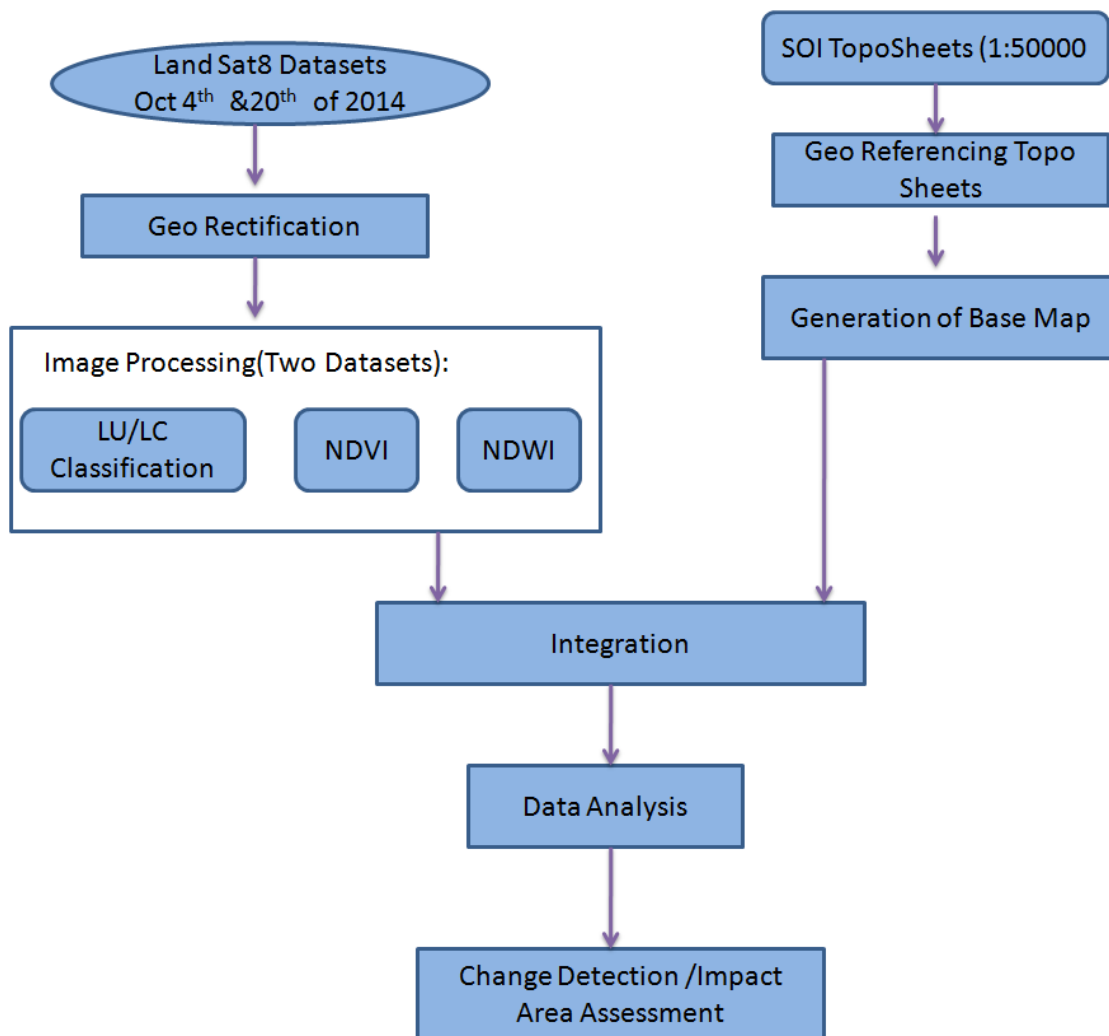
A Geographic information system (GIS) has a graphic database of geo-referenced information system, which is linked to the descriptive database. It uses high-powered graphic and processing tools that are equipped with procedures and applications for inputting, storing, analyzing and visualizing geo-referenced information. GIS and remote sensing (RS) are very useful and effective tools in disaster management. Various disasters like cyclones, floods, earthquakes, tsunamis and other natural hazards that kill lots of people and destroy property, infrastructures every year. Remotely sensed data can be used very efficiently to assess the severity and impact of damage due to these disasters. In the disaster relief part, GIS, grouped with global positioning system (GPS) is extremely useful in search and rescue operations in areas that have been devastated. Remote sensing is emerging as a popular means of map preparation while GIS can be used for storage, analysis and retrieval. Under remote sensing techniques, maps can be prepared using satellite data or aerial photographs and then digitized and stored on computers using GIS software. GIS and remote sensing technologies have been the object of substantial interest for all countries and bodies concerned with space and in exacting emergency services and disaster management. In disaster management, the objectives of the disaster experts are to monitor the situation, simulate the complicated disaster occurrence as accurately as possible so as to come up with better prediction models, suggest appropriate contingency plans and prepare spatial databases. Remotely sensed data can be used very effectively for quickly assessing severity and impact of damage due to cyclones and other disasters. Disaster maps generally show risk zones as well as disaster impact zones. These are marked areas that would be affected increasingly with the increase in the magnitude of the disaster.



**Figure 1** Showing the study area (Vishakhapatnam and Anakapally mandals, AP, India)

During the disaster prevention stage, GIS is used in managing the huge levels of data required for vulnerability analysis and hazard assessment. It is useful mainly because of its capacity to build models or representations of the real world from information in databases. It is therefore important for aiding hazard prevention and for simulating the damage that would be caused in the event of a natural disaster. GIS can also be used to interpret information by creating thematic maps that show the spatial distribution of the information. These maps show spatial patterns, trends or relationships, making it easier to analyze the information. This is the case in the various successive stages of the process of assessing the damage caused by a disaster. In the disaster 54 preparedness stage, it is a tool for planning evacuation routes, designing emergency operations centres and for the

integration of satellite data with other relevant data in the design of disaster warning systems. In the disaster rehabilitation stage, GIS is used to organize the damage information and post-disaster information and in the evaluation of sites for reconstruction. Natural hazard information should be included routinely in developmental planning and investment projects preparation. They should include cost/benefit analysis of investing in hazard mitigation measures and weigh them against the losses that are likely to occur if these measures are not taken. The application of remote sensing and GIS has become a well-developed and successful tool in disaster management. It allows for the combination of the different kinds of spatial data with non-spatial data, attribute data and use them as useful information in the various stages of disaster management.



**Flow chart 1** Showing the methodology

### Objectives

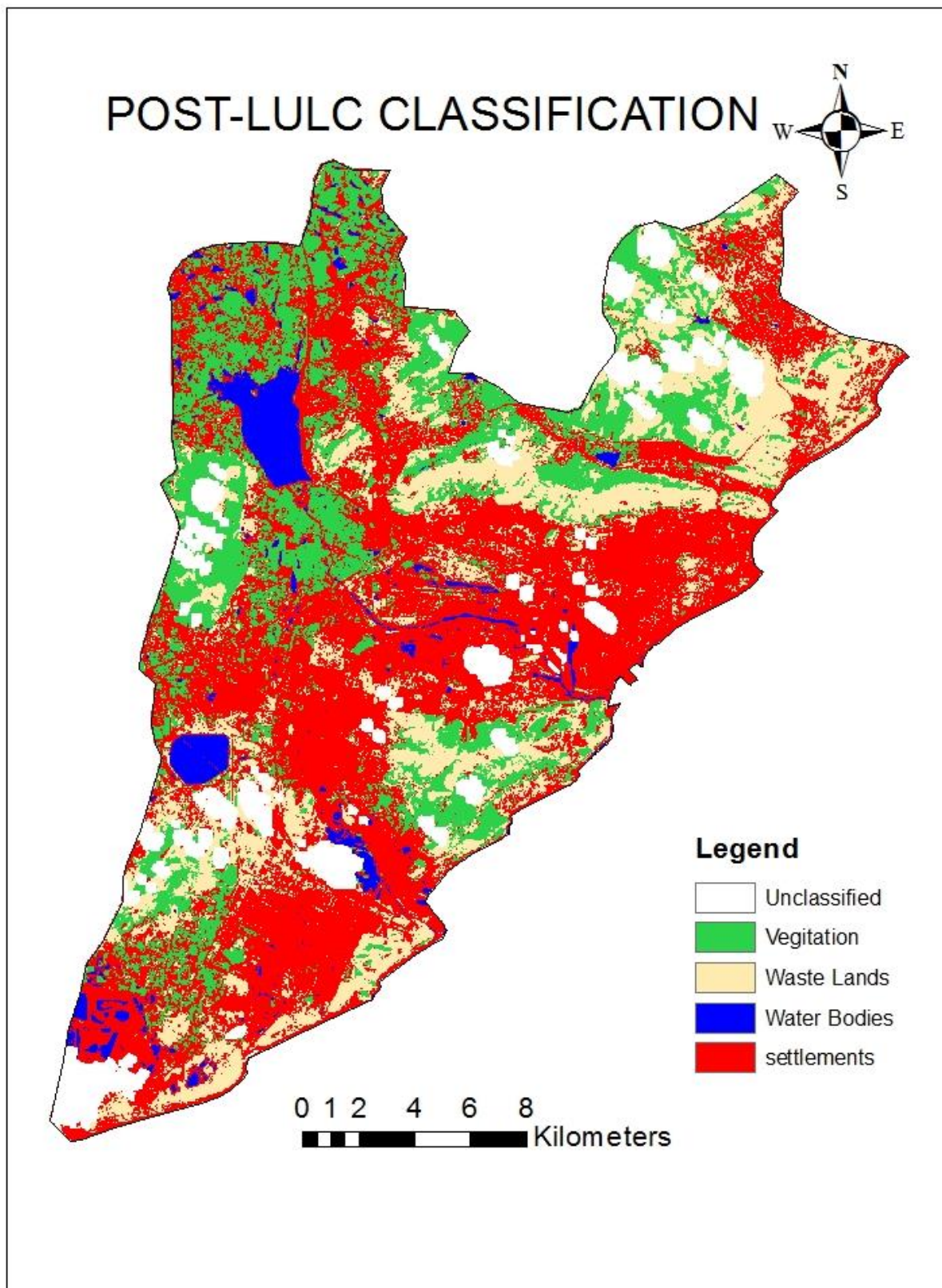
To generate the land use land cover maps during the pre and post event of Hudhud cyclone.

To generate NDVI and NDWI observe the changes after the effect.

### Study area

The study area includes regions of Vishakhapatnam and Anakapally mandals, lying within the geographic coordinates of latitude 17° 52' N to 17° 30' N and longitude of 82° 58' E to 83° 24' E.

The area falls in the survey of India (S.O.I) topographical map numbers 65K13, 65K14, 65O1 to 65O6.



**Figure 2** Post – LULC classification

## 2. METHODOLOGY

Land use/land cover pattern for the Pre Hud Hud and Post Hud Hud are classified by the use of satellite imageries with different ground resolution. First off all, each satellite image is classified using unsupervised classification with maximum likelihood classifier, which is an appropriate classification method. The major LU/LC classes are; settlements, barren land, forest, dry land, plantation, water bodies and others. The Landsat satellite data from Pre Hud Hud and Post Hud Hud could not be checked against the ground truth but the available historical evidence were used to validate the interpretation made. Field survey was performed for Post Landsat data for each land use/land cover class included in the classification scheme throughout the study area. ERDAS 2014 and Arc GIS 10.1 software were utilized for image processing, image classification and map layout respectively. Methodology was shown in flow chart 1.

### NDVI Classification

In the present study, in order to monitor the vegetation condition/vigor and assess the biomass productivity, Normalized Difference Vegetation Index (NDVI) was computed using the Infrared and Red bands of satellite data.

$$\text{NDVI} = (\text{IR} - \text{R}) / (\text{IR} + \text{R})$$

## 3. RESULTS AND ANALYSIS

The study area has to be classified to identify the changes in vegetation and agriculture with aid of pre and post cyclone computed results. Due to cyclone huge volume of vegetation and agriculture was damaged. Statistics of data and graphs between Damaged Area, relative change in LULC classes can be drawn.

### Pre- LULC Classification (4th October 2014) Area(hectares)

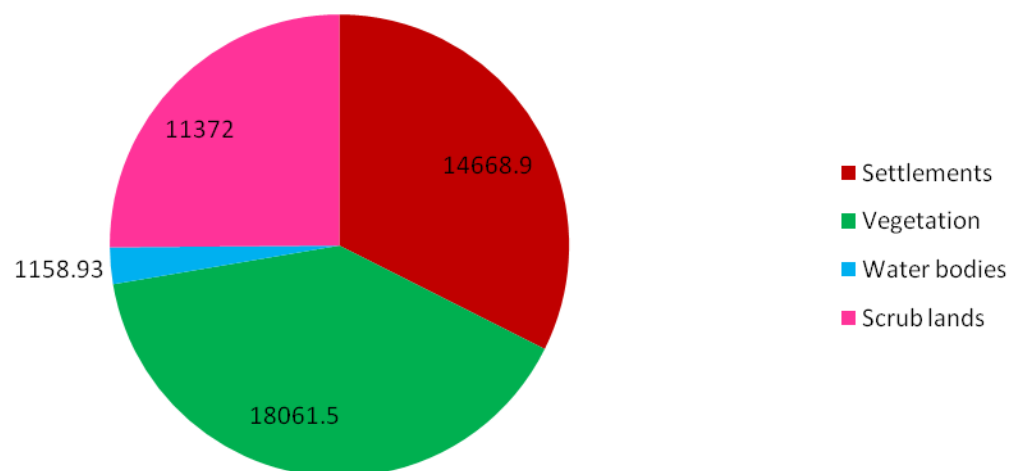


Figure 3(a) Pie Chart of Pre LULC classification

## Post- LULC Classification (20th October 2014) Area(hectares)

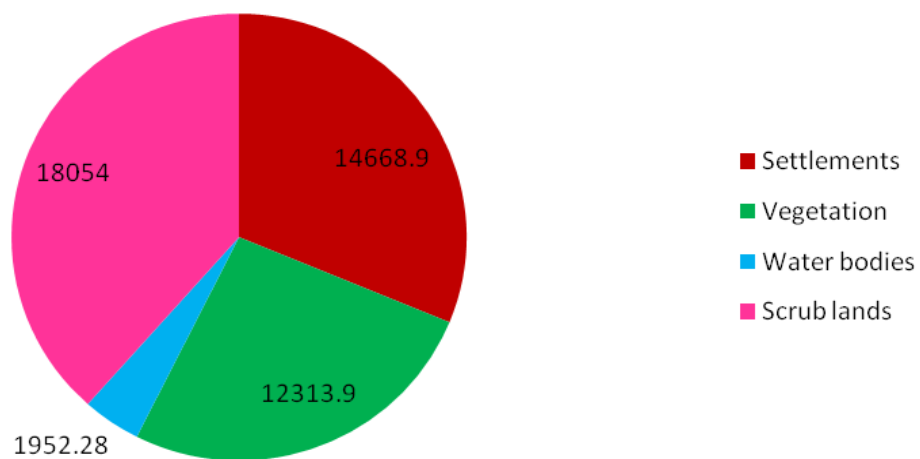
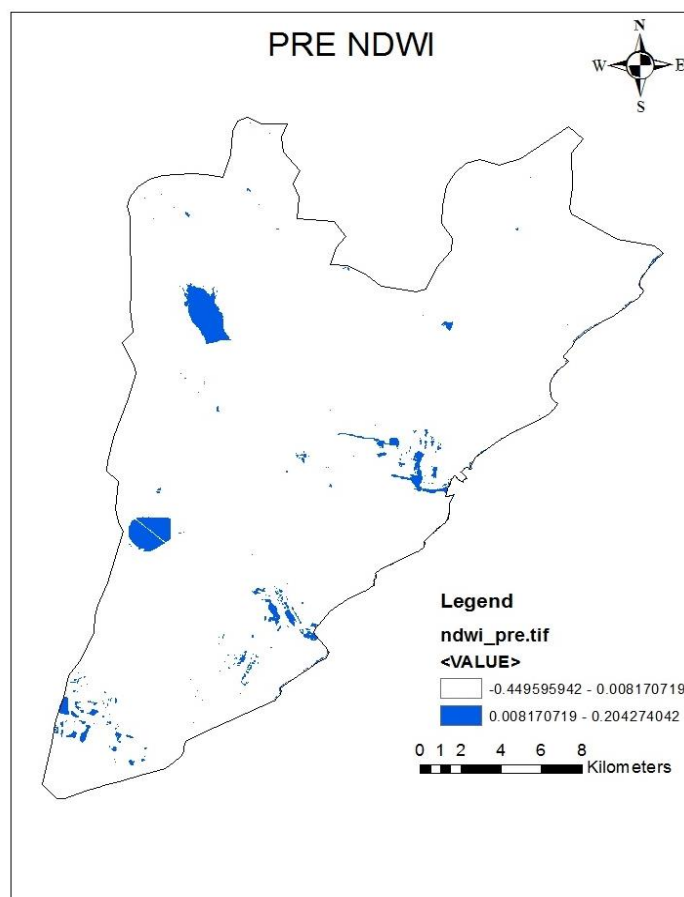


Figure 3(b) Pie Chart of Post LULC classification



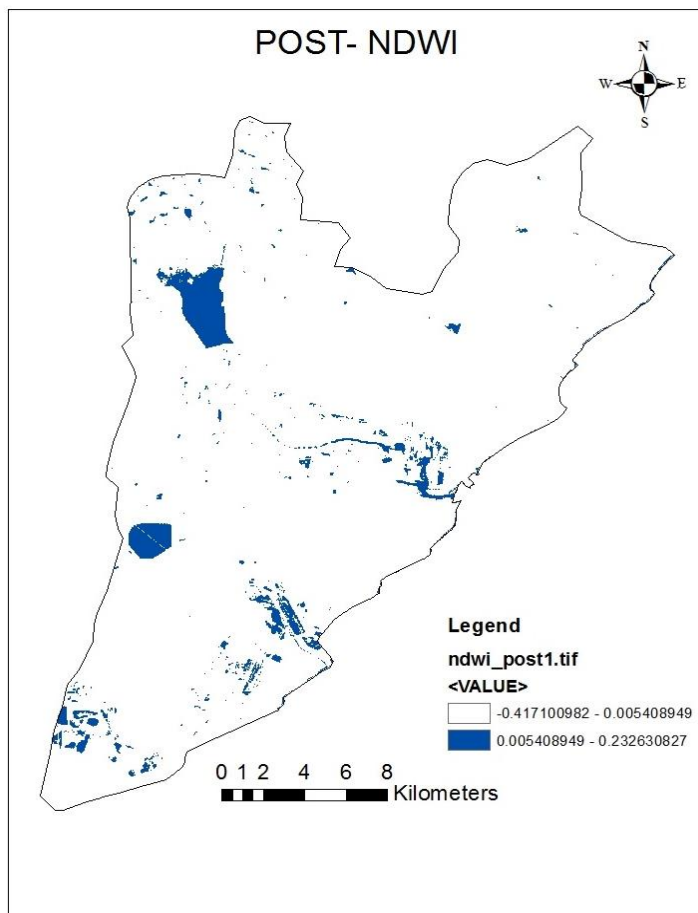
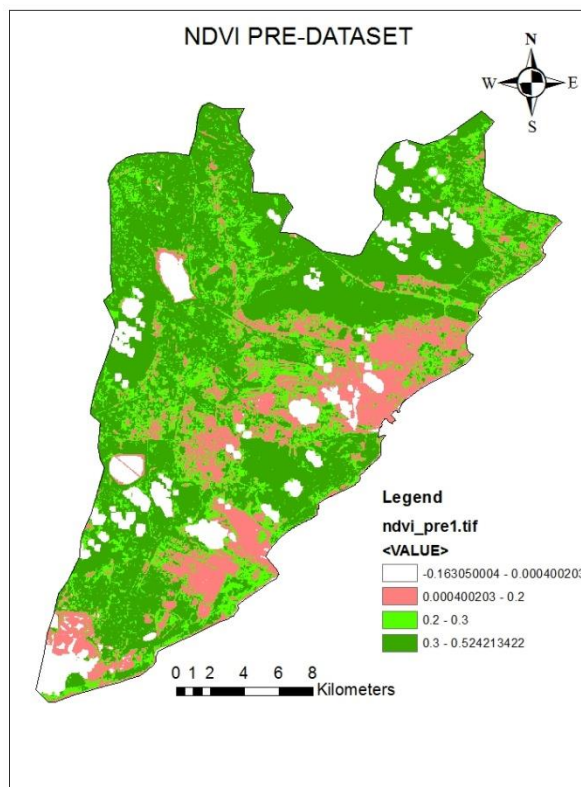
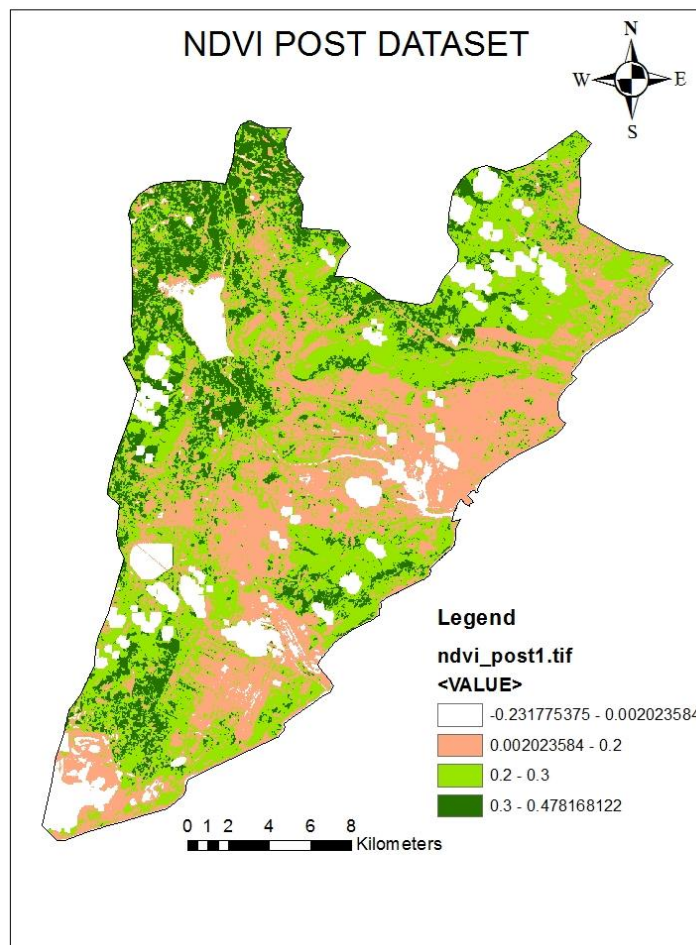


Figure 4 Showing various NDVI classified images





**Figure 5** showing various NDVI classified images

The Normalized Difference Vegetation Index (NDVI) maps were generated for the study area. The study area was classified into different biomass levels like Dense, Open, Degraded and No vegetation, the area under each class was calculated. It is important to understand how plant communities have changed during the study period in response to climatic and other changes to understand the potential impact on biodiversity and ecosystem functional processes. Spatial distribution of different biomass levels in the watershed changes during Pre Hud Hud and Post Hud Hud is represented in figure-4. The reduction in the area under degraded and no vegetation were 195.77 ha. and 105.33 ha. Pre Hud Hud and Post Hud Hud, which is attributed to dense vegetation in 2011. The field work was carried out along with concerned line department officials. The field details were collected and discussing with farmers as well as officers concerned in the watershed. The implementation works under watershed developmental activities are taken up by the officials.

#### 4. CONCLUSION

The outputs which are derived using GIS and Remote sensing technologies are experimental and rapid damage assessment was carried out. In this study, remote sensing data and techniques provided by GIS have proven their usefulness in disaster management plan especially in mapping the new situation after the disaster which helps in updating the geographical database. This can be used for the reconstruction of the damaged area. GIS helped to interpret information by creating satellite based thematic maps that show the spatial dimension of the affected areas. This will ease information analysis for successive stages of the process of assessing the damage caused by the disaster especially re-building damaged facilities and infrastructure. Insurance companies shall use this updated spatial information to settle claims. Landsat images with its resolution proved usefulness for pinpointing locations and the degree of damages. Moreover, Landsat images can be used as reference maps to rebuild bridges, washed-out roads, homes and facilities.

## REFERENCES

1. Augusta Ayotamuno, Akuro Ephraim Gobo. The effect of climatic changes on land use and land cover in spatial development in Port Harcourt: Nigeria. *Climate Change*, 2016, 2(7), 223-234
2. Banger S. K.: Remote Sensing and Geographical Information System for Natural Disaster Management: GISdevelopment.net
3. Kundu A, Denis DM, Patel NR. Evaluation of the meteorological drought over the Bundelkhand region using geo-spatial techniques. *Climate Change*, 2015, 1(4), 418-424
4. National Disaster Management Guidelines: Management of Cyclones. 2008. National Disaster Management Authority, Government of India.
5. Neha Singla, Ankit Rattan, Navrit Bhandari. GIS: an effective tool to develop resilience to climate change. *Climate Change*, 2015, 1(4), 404-410
6. Rishma C, Katpatal YB, Jasima P. Assessment of Enso Impacts on Rainfall and Runoff of Venna River Basin, Maharashtra Using Spatial Approach. *Discovery*, 2015, 39(178), 100-106
7. Time-Series analysis of MODIS NDVI data along with ancillary data for Land use/Landcover mapping of Uttarakhand by Sandeep Kumar Patakamuria, Shefali Agrawalb, and M. Krishnaveni.
8. Using remote sensing and GIS for damage assessment after flooding, the case of Muscat, Oman after Gonu tropical cyclone 2007: Urban planning perspective Lotfy Kamal Azaz (Ass.Prof. Dr. Lotfy Kamal Azaz, GIS and Urban and Regional Planning Divisions, Geography Department, College of Arts and Social Sciences, Sultan Qaboos University, Oman.
9. Very Severe Cyclonic Storm, PHALIN over the Bay of Bengal (08-14 October 2013): A Report. (October 2013), India Meteorological Department, New Delhi.