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Assessment of Seasonal Rabi and Zaid Crop Monitoring using GIS & Remote Sensing Technique over Selected Pamgarh & Nawagarh Tehsil in Chhattisgarh, India

Rupanarayan

Chhattisgarh Space Applications Centre (CGSAC), Chhattisgarh Council of Science & Technology Raipur (CCOST), Chhattisgarh, India

Abstract: ***Climate change has very significant impact on livelihoods and food security, a concrete plan with synergic approach including integrated watershed management and traditional ecological practices will help to fulfill crop water demand and maintain adequate soil moisture for the present and future crops, Chhattisgarh state is located in central India. Seasonal Rabi and Zaid crop is dependent on the irrigation system, Climate change is environmental phenomenon which can be of meteorological and hydrological depending upon its stage – rainfall level of impacts on hydrological cycle and agro-ecosystems. Agricultural is one of the most affecting economies in study area. Agricultural has been a recurrent phenomenon in many part of India. Remote sensing plays an important role for near-real time monitoring of the crop condition over large area. In the present study LANDSAT-8 data from 2013, 2014, 2017 and 2018 were used for seasonal Rabi and Zaid crop monitoring through NDVI based Vegetation condition index. VCI was calculated for whole study area. Results revealed that VCI could capture spatial pattern of vegetation condition and dryness within seasons and across different years, the results show that Janjgir-Champa district in selected Pamgarh & Nawagarh Tehsil in Chhattisgarh, India.***

Keywords: Seasonal Rabi and Zaid crop condition, LANDSAT-8, NDVI and VCI.

1. Introduction

Climate change and associated risk have significant direct/indirect impact on crop production and food security which offer tangible solution in term of resilience to farmers/ cultivators (Laxmi Goparaju et. al. 2019). Chhattisgarh state has a rich natural endowment of land, water forest and annual average rainfall of 1350 mm. There were innumerable ponds with tree groves the yielded fruits and other bio products. Chhattisgarh is primarily a mono crop area. Paddy is the principal crop, generally grown in Kharif season. This season starts from mid-June to mid-October. The Rabi crop is generally not taken due to various reasons. The principle factor influencing the issue is that the Rabi season, very little moisture is left in the root zone, temperature rises rapidly by mid-January and soils are light. The soils are reddish brown and devoid of many key nutrients. Rain fall is adequate for growing paddy. In many areas it is more than required. Excess rainfall leads to removal of top soils and nutrients. Due to excess rainfall, in few areas, the crop fails. This is defined as “Paniya Aakal” - drought due to excess rain. There are dry spells in the Kharif season. Due to these dry spells, the crop fails. This leads to drought (State IAG Chhattisgarh Joint Need Assessment Report on Drought in Chhattisgarh May 2016).

Satellite data are effective in regional estimation and also for early warning of seasonal crop. It gives spatial information which is necessary for regular monitoring of seasonal crop condition. Various satellite based indices are developed like Normalized Difference Vegetation Index NDVI, Vegetation Condition Index VCI (Kogan, 1997), Vegetation Temperature condition index (Z. Wang et. al. 2004) and many more are used for seasonal crop condition monitoring. With the availability of LANDSAT-8, NDVI data it is easy to monitor short term seasonal crop condition stress as it provides vegetation data.

2. Study area

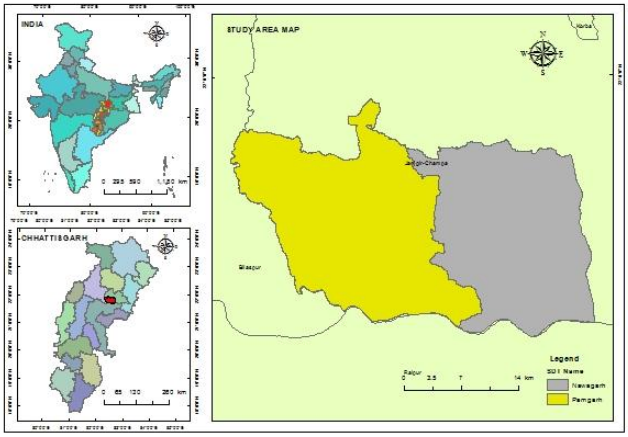


Figure 1: Location of study area

Study area is Janjgir-Champa district in selected Pamgarh & Nawagarh Tehsil Figure 1, in Chhattisgarh, India. Agro-Climatic /Ecological Zone, Agro Ecological Sub Region (ICAR) – Moderately To Gently Sloping Chhattisgarh Mahanadi Basin, Hot Moist/Dry Subhumid Transitional ESR With Deep Loamy To Clayey Red And Yellow Soils (11.0). Sources of Irrigation - Canals, Tanks, Open wells, Bore wells. Major Field crops cultivated Kharif and Rabi –

Rice, Maize, Wheat, and Millets its. (State: Chhattisgarh Agriculture Contingency Plan for District: Janjgir 2012). Janjgir-Champa district in yearly rainfall 2012 - 1153.5mm, 2013 - 1282.6mm, 2014 - 1273.7mm, 2015 - 987.6mm, 2016 - 1197.0mm, 2017 - 925.8mm, 2018 - 987.3mm, 2019 - 1108.9mm.(Directorate Agriculture, Chhattisgarh Raipur).

3. Materials and Methodology

3.1 Data Acquisition

Data has been acquired from sources: NDVI derived from satellite sources (04 years – Seasonal Rabi and Zaid) Satellite data LANDSAT-8 satellite data was downloaded through distribution server: www.usgsearthexplorer. The data is Rabi and Zaid season composite NDVI for India from which Chhattisgarh Tehsil was extracted for 2013, 2014, 2017, and 2018. This data is used for calculating vegetation condition index for crop monitoring. Its image has a constant resolution of 30 meter.

3.2 Methodology

Here is an idea of methodology used in study area. The flow chart mentioned below Figure 2 explains about the methodology adopted for this research work. VCI was calculated from NDVI image on basis from 2013, 2014, 2017 and 2018. These indices were then used for NDVI and VCI for detecting the impact of crop monitoring.

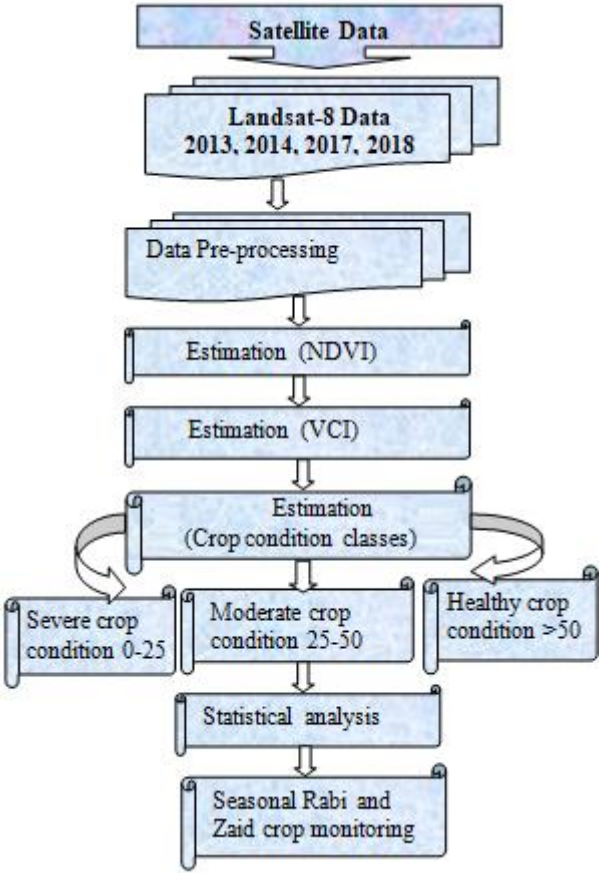


Figure 2: Methodology of study area

3.3 Index Calculation

Under this part various indices (satellite) are explained.

Normalized Differential Vegetation Index (NDVI)

The seasonal Rabi, Zaid crop condition and crop area severity analysis was done on temporal basis for 2013,2014,2017,2018 years. The NDVI was used to estimate the vegetation condition on basis as given in this equation.

$$NDVI = (NIR-R) / (NIR+R)$$

Where NIR is reflectance in near infrared band and R is reflectance in red band. Its value ranges between -1 to +1. Negative value indicates weak vegetation and positive indicates healthy vegetation.

3.3.1 Vegetation Condition Index (VCI)

It is a pixel wise normalization of NDVI over some time period, developed by Kogan (1995, 1997) to make a relation statement of changes in the NDVI signal by filtering out the contribution of local geographic resources to the spatial variability of NDVI. The VCI is computed as.

$$VCI = (NDVIi – NDVImin) / (NDVImax- NDVImin)$$

Where, NDVIi is the smoothed weekly NDVI, NDVImax, and NDVImin are maximum and minimum NDVI, respectively, for that pixel and monthly period from multiyear smoothed NDVI data and i define the monthly interval. Its value ranges from 0 to 100.It is measured as percent. VCI with 50% value reflects fair vegetation condition, 50-100% indicates above normal. When VCI is 100% it suggests that NDVI value of that month is equal to NDVImax which indicates the optimum condition for vegetation.

Crop condition classification criteria in VCI are shown below

The VCI crop condition classes in three type's classification**.** Healthy crop condition= (> to 50), Moderate crop condition= (20 to 50), Severe crop condition = (0 to 20).

4. Results and Discussion

This chapter discusses about the total study area that evaluate the crop stress in study area using Satellite derived index VCI, VCI for getting the idea that which approach is best for monitoring crop condition using LANDSAT-8 NDVI data. The data of 2013, 2014, 2017 and 2018 is considered as the time period for seasonal Rabi, Zaid crop condition and crop area monitoring.

Analysis of satellite based NDVI monitoring: Normalized Differential Vegetation index has been computed for study area. NDVI has been computed for the year 2013, 2014, 2017 and 2018.The results of monitoring NDVI during seasonal Rabi and Zaid crop during 2013, 2014, 2017 and 2018 show the NDVI, which are a series of maps indicating

the stress condition in each monthly period. The Figure 3 depict that the low values of NDVI shows severe crop condition and high value of NDVI shows the healthy crop condition.

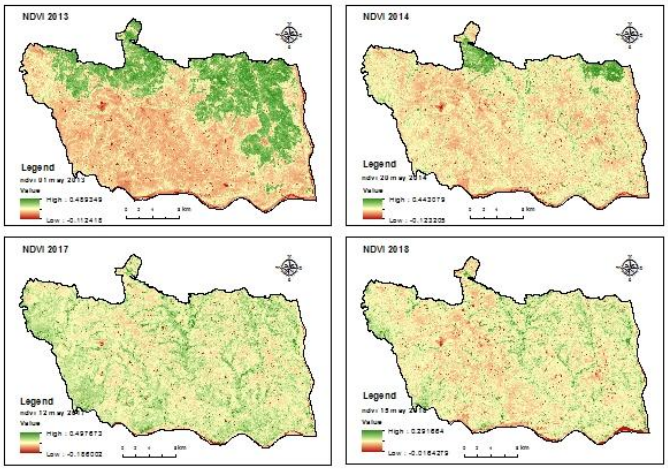


Figure 3: NDVI year 2013, 2014, 2017 and 2018

4.1 Analysis of satellite based VCI monitoring

Vegetation Condition Index (VCI), it is a pixel wise normalization of NDVI over some time period, developed by Kogan (1990, 1995) to make a relation statement of changes in the NDVI signal by filtering out the contribution of local geographic resources to the spatial variability of NDVI. The VCI is computed as satellite based agricultural crop monitoring in study area was carried out using VCI. The results of monitoring crop condition during seasonal Rabi and Zaid 2013, 2014, 2017 and 2018 show the agricultural crop condition, which are a series of maps indicating the stress condition in each monthly period. The Figure 4 depict that the low values of VCI shows Agricultural severe crop condition and high value of VCI shows the healthy crop condition.

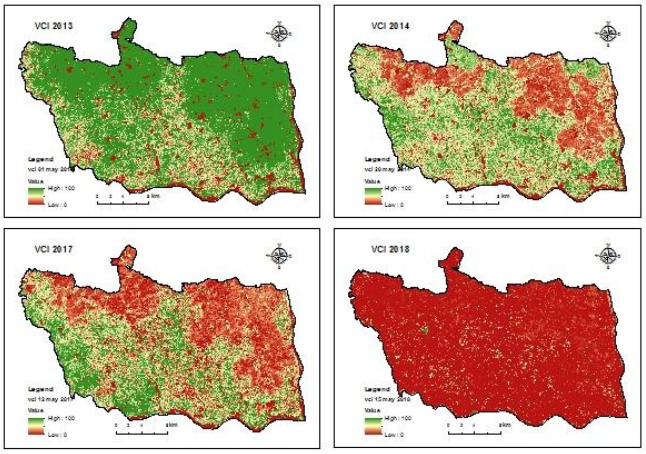


Figure 4: VCI year 2013, 2014, 2017 and 2018

4.2 Satellite based VCI Agricultural crop condition classes monitoring

Satellite based agricultural crop condition classes monitoring in study area were carried out using VCI. The results show the agricultural crop condition classes during seasonal Rabi and Zaid crop during 2013, 2014, 2017 and 2018 which are a series of maps indicating the crop condition classes. Three types of crop condition classes are defined as Healthy crop condition = (> to 50), Moderate crop condition = (20 to 50), Severe crop condition = (0 to 20). The Figure 5 shows the crop condition classes.

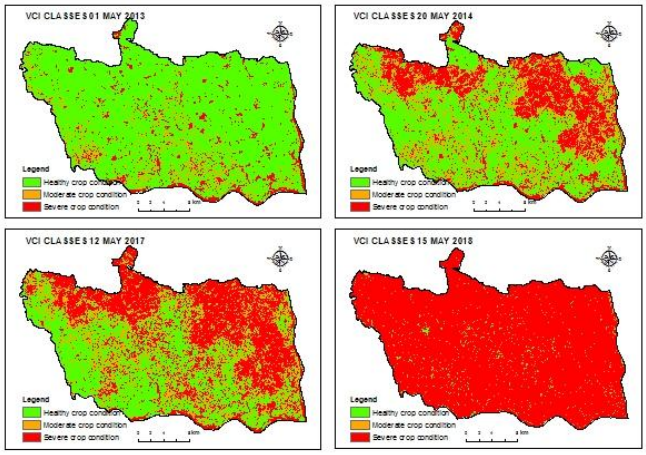
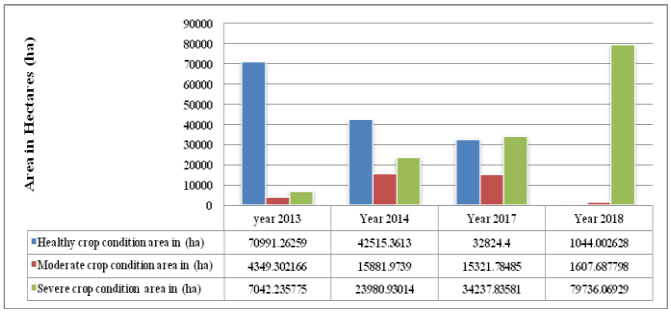


Figure 5: Crop condition Classes year 2013, 2014, 2017 and 2018

4.3 Comparison between (VCI) crop areas

Climate change direct/indirect impact on crop production and food security. The Inter - annual variability crop area in Hectares (ha). The Figure 6 shows the study area had maximum healthy crop condition area in hectares 70991.26259 (ha) in the Year of 01may in 2013 and minimum 1044.002628 hectares 15 may 2018. In case of Moderate crop condition maximum 15881.9739 (ha) in the yare of 20 May 2014 and minimum 1607.687798 (ha) 15 may 2018. In case of severe crop condition maximum 79736.06929 (ha) in the yare of 15 May 2018 and minimum 7042.235775 (ha) 01 may 2013.



	year 2013	Year 2014	Year 2017	Year 2018
Healthy crop condition area in (ha)	70991.26259	42515.3613	32824.4	1044.002628
Moderate crop condition area in (ha)	4349.302166	15881.9739	15321.78485	1607.687798
Severe crop condition area in (ha)	7042.235775	23980.93014	34237.83581	79736.06929

Figure 6: Crop area (ha) year 2013, 2014, 2017 and 2018

5. Conclusion

This section discusses about the extract derived from the results of the various different method used in this study for satellite based seasonal Rabi, Zaid crop condition and crop area monitoring.

A practical approach was developed in the study for seasonal Rabi, Zaid crop condition stress and crop area monitoring in study area. The approach was based on

Normalized Differential Vegetation Index and Vegetation Condition index from LANDSAT-8 satellite data. Assessment of crop condition stress was then establishes from the correlation VCI year 2013, 2014, 2017 and 2018.

The first conclusion which is made from this research is that method for seasonal Rabi, Zaid crop condition and crop area monitoring as they account for satellite data. They give better results in real time vegetation condition and crop area monitoring. VCI provides good information spatially for crop condition and crop area monitoring.

The correlation between satellite indices suggest that NDVI and VCI give better information about vegetation because it does not only describe the land use but also depicts the impact of weather on crop condition. VCI is a good indicator for detecting crop on seasonal basis.

The main study area in this research deals with NDVI and VCI. The overall outcome of the work is that for monitoring seasonal Rabi, Zaid crop condition and crop area spatially VCI give better results.

References

[1] Laxmi Goparaju & Firoz Ahmad (2019), seasonal (kharif, Rabi and Zaid) precipitation, potential evapotranspiration and aridity index with respect to various agro ecological zones of india.
[2] Department of State: Chhattisgarh,Agriculture Contingency Plan for District: Janjgir,2012.(http://www.crida.in/CP-2012/statewiseplans/Chattisgarh%20(Pdf)/CHH8-Janjgir-%2030.11.2012.pdf)
[3] Department of Directorate Agriculture, Chhattisgarh Raipur (https://agriportal.cg.nic.in/agridept/AgriEn/Rainfall.html)
[4] Department of State IAG Chhatisgarh Joint Need Assessment Report on Drought in Chhattisgarh, May 2016. (https://sphereindiablog.files.wordpress.com/2016/09/jna-report-chhattisgarh-drought.pdf)
[5] Dutta, Dipanwita, Patel N.R., S.K. Saha, A.R. Siddiqui (2015).Assessment of agricultural drought in Rajasthan (India) using remote sensing derived vegetation condition index (VCI) and Standardized Precipitation Index (SPI).
[6] Rupanarayan, Patel N.R. (2018).Drought assessment using satellite based vegetation condition index and rainfall anomaly index over Bundelkhand region, India.
[7] Z. Wang, P. Wang, et al. (2004).”Using MODIS Land Surface Temperature and Normalized Difference Vegetation Index Product for Monitoring Drought in the Southern Great Plains, USA. International Journal of Remote Sensing pp, 61-72.
[8] Kogan, F.N., (1995). Droughts of the late 1980s in the United States as derived from NOAA polar-orbiting satellite data. Bull. Am. Meteorological. Soc., 655-668.
[9] Kogan, F.(1997) Globle drought watch from space. Bulletin of the Americal Meteorological Society, 78: 626-636pp
[10] Mishra, A. K., & Singh, V. P. (2010). A review of Drought concepts. Journal of Hydrology , 202-216.
[11] Nalbantis, I., & Tsakiris, G. (2009). Assessment of Hydrological Drought Revisited. Water Resour Manage , 881-897.
[12] Tadesse, T., Brown, J.F. & Hayes, M.J.(2005). A new approach for predicting drought-related vegetation stress: Integrating satellite, climate, and biophysical data over the U.S. central plains. ISPRS Journal of Photogrammetry and Remote Sensing, 59(4), 244-253.

Author Profile

Born on Jun 25, 1988 in Kherud, Dist-Balod in Chhattisgarh, **Shri Rupanarayan** obtained his B.A. from Govt. College Arjunda, Dist Balod, Chhattisgarh 2010, Diploma in Computer Application from Dr.C.V.Raman University, Bilaspur (C.G.) 2009. M.A. Geography from Govt. V.Y.T.P.G. Autonomous College, Durg (C.G.) 2012, Affiliated to Ravishankar Shukla University, Raipur Chhattisgarh. P.G. Diploma in Remote Sensing & GIS from Indian Institute of Remote Sensing, (***iirs***), Indian Space Research Organization (ISRO), Department of Space, Government of India, Dehradun-248001. **Shri Rupanarayan** a Junior Research fellow (JRF), Chhattisgarh Space Application Center (CGSAC), Council of Science and Technology (CCOST), Department of Science and technology, Government of Chhattisgarh India. Experience of teaching 03 years and research more than 03 years, He has 04 published in peer reviewed International Journals.