Journal of Agrometeorology 16 (1) : 112-115 (June 2014)

Use of NDVI variations to analyse the length of growing period in Andhra Pradesh

KAUSHALYA R., M. GAYATRI, V. PRAVEEN and J. SATISH

Central Research Institute for Dryland Agriculture, Hyderabad- 500059

Email: kausalya@crida.in

ABSTRACT

Satellite data based Normalized Difference Vegetation Index (NDVI) was used to assess state of agriculture in Andhra Pradesh. Public domain NDVI data from NOAA-AVHRR (1982-2006) was used to analyse LGP variations in various agro-ecological sub-regions (AESR) in Andhra Pradesh. Study indicated that there was an increasing trend in LGP in all AESR in the state. However, drought occurrence like in 1994-95 showed a sharp decrease in LGP across the state. Study indicated that agriculture was vulnerable in AESR 3.0, 8.3 and 6.2 covering Anantapur, Chittoor and large parts of northern Telengana and relatively safe in AESR 7.2 covering southern Telengana and 6.3 including parts of Adilabad. Agriculture would be marginally vulnerable in AESR 7.1 covering Kurnool and Kadapa and in 7.3 and 18.3 covering coastal districts of Nellore, Prakasam, Guntur and Krishna.

Key words : LGP, NDVI, Vulnerability, Crop Phenology, Start of season, End of season

Information from satellite data can indicate vegetation vigour and dynamics which can in turn indicate regional agriculture vulnerability. There are several types of vegetation index (VI) that are used to study crop/plant vigour and growth. Defries *et al*. (2000) established the use of AVHRR (8km) for vegetation mapping. Both AVHRR and MODIS have been the main workhorses for studies on vegetation across the globe (Celis *et al.,* 2007; Heumann et al., 2007; Jain et al., 2009; Sehgal *et al.,* 2011).

Besides this, multi-scale geo-statistical analysis have been used to estimate and monitor global terrestrial vegetation for climate change modelling from various platforms (Tarnavsky *et al,* 2008). For topographically complex terrain like the Himalayan ranges in Jammu & Kashmir and in Arunachal Pradesh in India, downscaling of real-time vegetation dynamics by fusing multi-temporal MODIS and LANDSAT NDVI was recommended (Hwang *et al.,* 2011).

For the present study we used the concept of NDVI for evaluating the state of agriculture over a time period in order to assess the need of NRM interventions like watershed development program for backstopping agriculture in the rainfed regions. A study was undertaken using time-series satellite data to study vegetation vigour in various rainfed AESR in Andhra Pradesh. This paper describes the concepts used to analyse vegetation vigour in the state in addition to evaluation of various AESR for requirement of NRM interventions like watershed development program to support rainfed agriculture.

MATERIALS AND METHODS

LGP using temporal NOAA-AVHRR (15-day, 8km) NDVI data composite

AVHRR-NDVI composite data were downloaded from respective website (http://www.glcf.umd.edu/data/gimms/) for 1982-2006. Crop information were extracted from NDVI composite using NDVI threshold values, identified for each agro-ecological sub-regions (AESR), based on NDVI of three normal years (1986, 1991 and 1999). For identifying start of season (SOS) and end of season (EOS) dates, NDVI (reflectance coefficient) of 0.5 was initially used to estimate the dates. This value was used to study temperate and alpine vegetation of state of Montana in USA that has a higher NDVI value compared to the semi-arid and dry sub-humid regions in the Indian sub-continent (White *et al* 1997). Hence, we generated our own typical NDVI (reflectance coefficient) for each AESR in Andhra Pradesh (Vrieling *et al* 2008). The least NDVI value of the 15-day composite of the corresponding season was taken as Threshold Value for each AESR (Table 1). Fig.1 depicts the AESR covering AP.

Methodology for analysing LGP using NDVI

To identify LGP, crop phenology (stage) information is required. To identify crop phenology stage, i.e. Start of Season, NDVI threshold value was identified. For this purpose, we estimated average NDVI value based on *Kharif* and *Rabi* seasons NDVI data for three normal years (seasons) for each AESR. Start / Onset of season

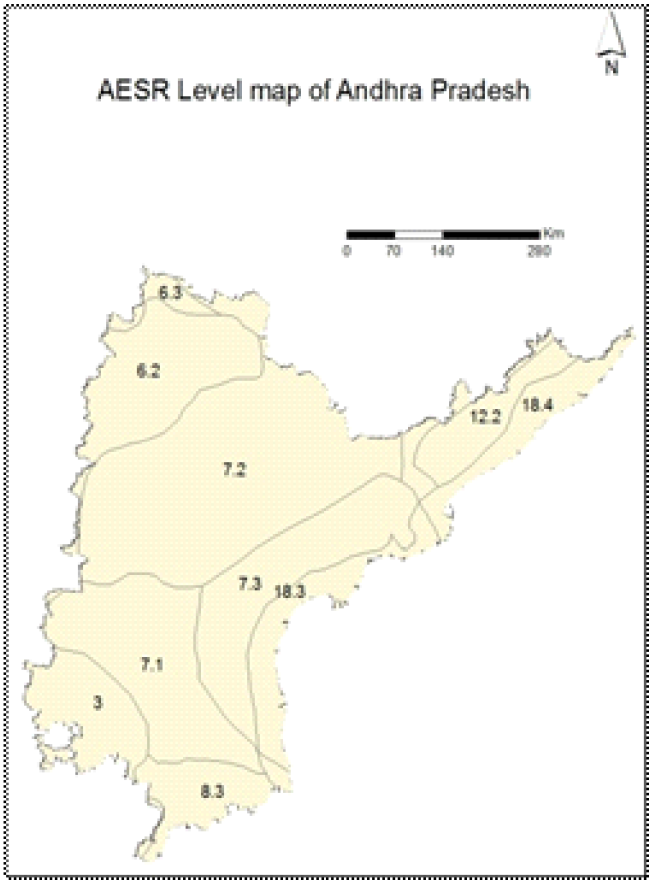

Fig.1: AESR map of Andhra Pradesh

(SOS) were considered when NDVI crosses the threshold value (TV) and continues in an upward trend. End of Season (EOS) is identified as the period when NDVI falls below the threshold value and continues a downward trend. To identify TV of SOS for *Kharif* season, 15-day NDVI composite from June to October of each year was extracted, stacked and imported into *ERDAS Imagine* software.

As NDVI data is only available as a 15-day AVHRR composite, the *Kharif* season data was stacked and a pixel - wise sum of NDVI was derived. This value was multiplied with 15, i.e., number of days of NDVI composite, in order to arrive at LGP in number of days (Fig. 2).

RESULTS AND DISCUSSION

Trend in LGP in various AESR

Variations in LGP was mapped for various AESR in AP. The LGP ranged from <60 days in southwest and central region covering Anantapur, Kadapa, Kurnool, Chittoor, Mahabubnagar and Nalgonda districts in the state to 150 days in Northern AP and in districts of Coastal Andhra.

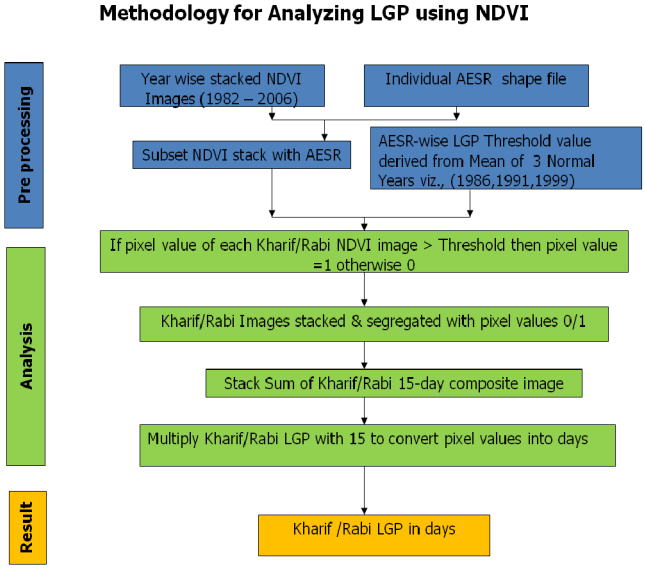

Fig. 2: Methodology for determining LGP

Trend in spatial extent under various LGP

Extent of area under various LGP categories with different cropping systems in various AESR in AP was estimated. Fig.3 indicates the trend in extent under various LGP classes in number of days, viz., <60, 60-90, 90-120 and 120-150 days. Trend analysis was performed to assess variability in various LGP classes. Fig.3 indicates that LGP class <60 days shows a declining trend. Extent under classes 60-90 & 90-120 days seem stable. However, LGP class 120-150 days showed an increasing trend. Further analysis is required to verify these trends.

The comparison between the LGP derived from NDVI and reported by NBSSS & LUP (1999) in different AESR is indicated in Table1. LGP/ Greenup Phase is usually 2 to 3 weeks shorter at the stage of sowing compared to LGP estimated meteorologically. Satellite data is able to sense crop germination only after a sufficient time-lag of 2-3 weeks after date of sowing (DOS).

Variability analysis indicated higher growth rate (GR) for category 60-90 days (GR 0.70). LGP category 120-150 days also showed higher variability (GR 0.50). No variability was seen in category 180-210 days of LGP (GR -0.00).

Analysis of variability of LGP in various AESR in AP indicates that it was highest in case of Anantapur (AESR 3.0) and Nellore (AESR 18.3) and least in Srikakulam (AESR 18.4) and Warangal (AESR 7.2). It is interesting to note that while Anathapur anad Nellore are

Table 1: Comparative differences between LGP in different AESR of AP

S.No	AESR Nomenclature	Threshold value of NDVI	Normal LGP (NBSS & LUP,1999)	NDVI derived Green-up phasebased on AVHRRdata (1982-2006)	Trend
1	3	0.23	60-90	45-90	0.702
2	6.2	0.25	120-150	55-80	0.501
3	6.3	0.26	120-150	50-70	0.100
4	7.1	0.28	90-120	35-50	0.400
5	7.2	0.33	120-150	45-65	0.200
6	7.3	0.33	150-180	55-85	0.400
7	8.3	0.36	120-150	65-95	0.501
8	18.3	0.26	150-180	85-115	0.400
9	18.4	0.31	180-210	65-95	-0.000

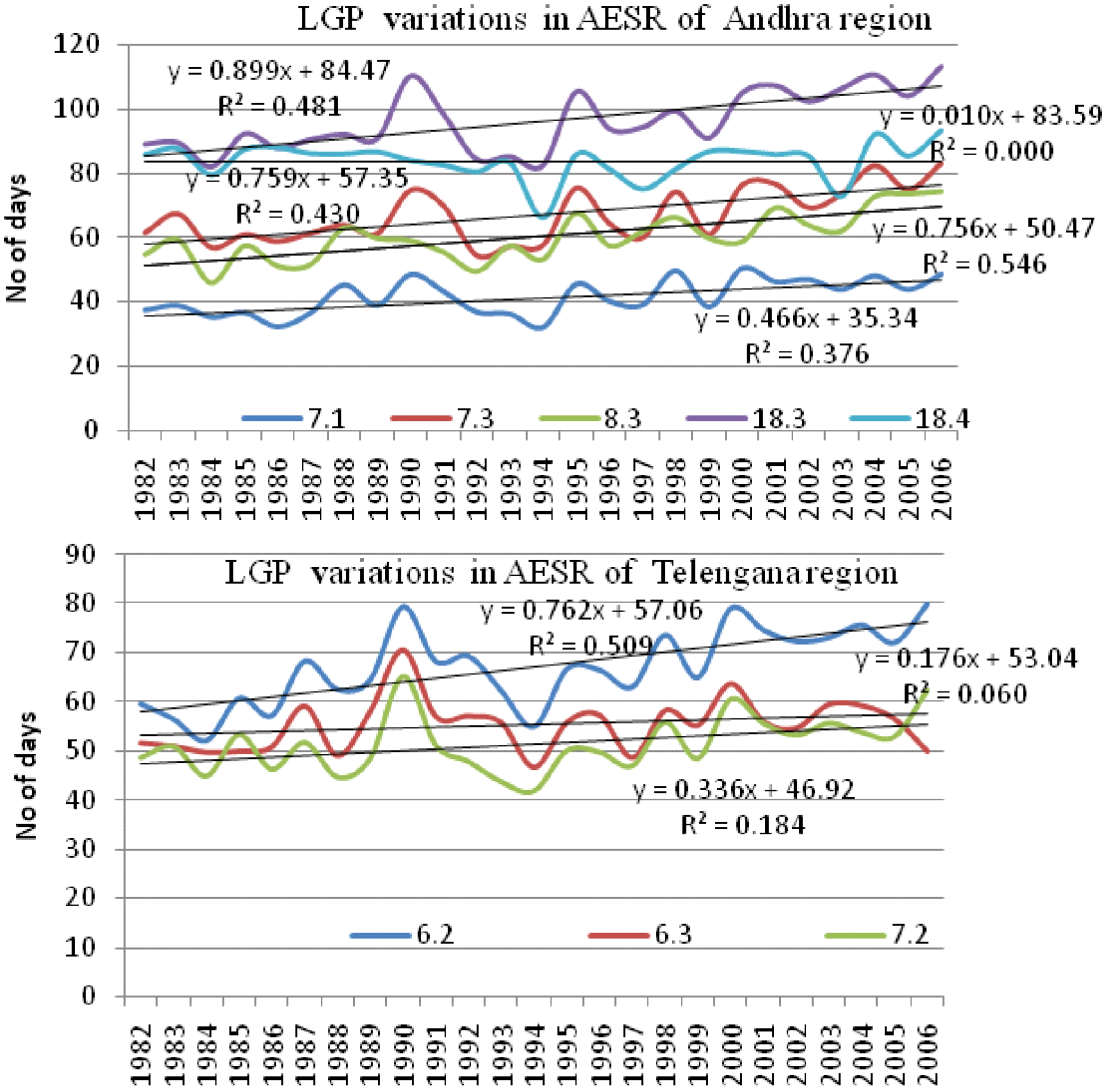

Fig. 3: Trend of LGP under different AESR in Andhra Pradesh (1982-2006)

located at roughly similar latitude at two southern extremes of the state, Srikakulam and Warangal are also similarly located at two extremes at smilar latitude in northern part of the state. It would be fascinating to analyse whether these geographical controls have a role in the resultant variability in LGP.

CONCLUSIONS

It may be concluded that LGP is showing an increasing trend in all AESR in the state especially in AESR 18.4 covering Vizianagaram and Srikakulam. However, drought event as in 1994-95, could sharply reduce the LGP across the state. Study indicated that agriculture was vulnerable in AESR 3.0, 8.3 and 6.2 covering Anantapur, Chittoor and large parts of northern Telengana and relatively safe in AESR 7.2 covering southern Telengana and in AESR 6.3 including parts of Adilabad besides large areas in neighbouring state of Maharashtra. Agriculture would be marginally vulnerable in AESR 7.1 covering Kurnool and Kadapa and in AESR 7.3 and 18.3 covering coastal districts of Nellore, Prakasam, Guntur and Krishna.

ACKNOWLEDGEMENTS

The authors acknowledge the research grants provided by ICAR as National Fellow scheme to first author and as NICRA project to CRIDA. They also thank Director CRIDA for providing facilities to carry out the research study.

REFERENCES

Celis D., Pauw E. D. and Geerken, R. (2007). Assessment of Land Cover and Land Use in Central, West Asia and North Africa – Part 1: LULC – Base Year 1993. ICARDA

Defries, R. S., Hansen, M. C. and Townshend, J. R. G. (2000). Global continuous fields of vegetation characteristics: A linear mixture model applied to multi-year 8km AVHRR data. *Int. J. Remote Sens.,* 21 (6 & 7): 1389-1414.

Heumann, B.W., Seaquist, J.W., Eklundh, L. and Jonsson, P. (2007). AVHRR derived phenological change in the Sahel and South Africa (1982-2005). *Remote Sens. Environ.* 108:385-392.

Hwang, T., Song, C., Bolstad, P. V. and Band, L. E. (2011). Downscaling real-time vegetation dynamics by fusing multi-temporal MODIS and LANDSAT NDVI in topographically complex terrain. *Remote Sens. Environ*. 115: 2499-2512.

Jain, S. K., Keshri, R., Goswami, A., Sarkar, A. and Chaudhry, A. (2009). Identification of drought-vulnerable areas using NOAA AVHRR data. *Int. J. Remote Sens.,* 30 (9-10): 2653-2668.

NRSC (2011). Land Use Land Cover Atlas of India (Based on Multi-temporal satellite data of 2005-06). LUD-RS & GIS Applications Area-NRSC (ISRO), Hyderabad, p 128.

Sehgal, V. K., Jain, S., Aggarwal, P. K. and Jha, S. (2011). Deriving crop phenology metrics and their trends using times series NOAA-AVHRR NDVI data, *J. Indian Soc. Remote Sens.* DOI 10.1007/s12524-011-0125.

Tarnavsky, E., Garrigues, S. and Brown, M. E. (2008). Multi-scale geo-statistical analysis of AVHRR, SPOT-VGT, and MODIS global NDVI products. *Remote Sens. Environ.,* 112: 535-549.

Vrieling, A., Beurs, K.M.D. and Brown, M.E. (2008). Recent trends in agricultural production of Africa based on AVHRR NDVI time series. Remote Sensing for Agriculture, Ecosystems and Hydrology X. In *Proceedings SPIE,* 7104 71040R: 1-10.

Velayutham, M., Mandal, D.K ., Mandal, Champa and Sehgal, J. (1999). Agro - ecological sub-regions of India for Planning and Development. NBSS&LUP, Nagpur, India. Pub.35, p.372.

White, M.A., Thornton, P.E. and Running S.W. (1997). A continental phenology model for monitoring vegetation responses to inter-annual climatic variability. *Global Biochemical Cycles*, 11(2): 217-234.

Received : August 2013 ; Accepted : May 2014