IDENTIFICATION DROUGHT EXTENT BASED ON NVSWI USING LANDSAT DATA: A CASE STUDY OF IAŞI COUNTY

Paul MACAROF[1], Florian STĂTESCU[1]

e-mail: macarofpaul@yahoo.com

Abstract

Climate change is one of the most significant issues facing the world because it is predicted to alter climate patterns and increase the frequency of extreme weather events, such as drought. Drought is one of the most widespread and least understood natural phenomena. Drought can be monitored using the climatic variables like rainfall and temperature. The droughts are the phenomena which affect large areas and remote sensing data covering large territory can be used to assess the droughts impact and their extent. In this study was used remote sensing images from the Landsat 8 Operational Land Imager (OLI), taken in august and November 2016 and april 2017. To evaluate drought in this paper, for Iasi county, Normalized Vegetation Supply Water Index (NVSWI), was used. This index is based on Normalized Difference Vegetation Index (NDVI) and on Land surface temperature (LST). This research has shown that NVSWI has more notable results in assessing droughts during seasons with a high degree of vegetation coverage, this is why the results for February were not taken into account because the results were not considered to be satisfying. Larger areas affected by moderate drought were reported for November, and for August and April prevailed areas of slight drought. It can be concluded that NVSWI is not recommended for the assessment of drought-affected areas during winter, because in obtaining the values of this index an important role is given by NDVI. In the same situation, Normalized Difference Drought Index (NDDI) is also found. Taking into account the results of this study and the characteristics of the study area, it is recommended that the Soil Moisture Deficit Index (SMDI) and the Standardized Precipitation Evapo-transpiration Index (SPEI) be used in the future for the analysis of drought-affected areas.

Key words: Drought, NVSWI, LST, NDVI

Drought is a stochastic natural phenomenon that appears from considerable lacking in precipitation. Among natural hazards, drought is known to provoke extensive damage and affects a important number of people (Wilhite, 1993). Drought is a lack of precipitation "normal" that, when a season or longer period of time extended over, is lacking to meet demands. This may result in social, economic and environmental impacts. It should be regarded a normal, recurrent feature of climate. This phenomenon is a relative, rather than absolute, condition that should be described for each region. Each drought differs in duration, intensity and spatial extent (Knutson et al., 1998). Drought is identified as part of the climate cycle with wet periods and occasionally floods separating two dry periods. However, drought, has different impacts on production systems and people because of the underlying conditions interacting with different vulnerabilities (Wilhite, 2000). Impactul secetei nu este uneori clar delimitat. Se răspândește pe zone geografice mai mari decât cele mai multe alte pericole naturale și este în mare parte nonstructural (Sivakumar, Wilhite, 2004). Wilhite reported, in 2000, that the onset and end, as well as severity are often hard to determine. Drought ranked as the principal among all natural hazards (Bryant, 1991). Drought is not only limit to arid and semi-arid regions but often visits potentially good rainfall zones. There is no universally acceptable and applicable definition for drought as yet. Many attempts to define drought have led to numerous definitions of the term (Nagarajan, 2003). In 2008, UNDP, defines drought as the naturally phenomenon happening that exists when precipitation has been meaningfully below normal recorded levels causing serious hydrological disequilibrium that adversely affect land resources production systems.

Remote sensing technology can be used to monitor effectively over large areas of drought. Satellite-borne remote sensing data gives a synoptic view of Earth surface, so can be used to evaluate drought occurrence spatially. Have been developed and applied, a few remote-sensed drought indices, which including duration, spatial extent, intensity, and severity. One of these, the Normalized Difference Vegetation Index (NDVI)

[1] „Gheorghe Asachi" Technical University of Iasi, Faculty of Hydrotechnical Engineering, Geodesy and Environmental Engineering, Iași

as been one of most usually used approaches to drought episode monitoring and as a probe for vegetation health. Combining vegetation index and temperature offer the possible to improve the approach. A mix of land surface temperature (LST) and NDVI provides strong correlation and offers useful information to description of agricultural drought as an early warning system.

Among of advantages of using remotely sensed data are the availability of high resolution, consistent and repetitive coverage and capability of measurements of earth surface conditions (Owen et. al, 1998). Many researchers showed that the surface temperature of the work confirmed from Landsat 5 TM and 8 OLI (Amiri, 2009; Mallick, 2012; Guo, 2012; Li et al. 2016; Avdan et al., 2016). Land Surface Temperature (LST), used to define the temperature distribution and the change in local or global scale, used in climate change models in particular. Determined from remote sensing data, LST, is used in many areas of science like: climate change, urban planning, forestry, agriculture, oceanography, hydrology etc. According to Orhan, obtaining surface temperatures and using them in different investigation is important to define the problem associated with the environment (Orhan *et al*. 2016).

NDVI can be determined using NIR (near-infrared) and R (red) radiation and has been most widely used for drought monitoring. Because when sunlight strikes a plant most of the red wavelengths in the visible range of the spectrum are absorbed by chlorophyll in the leaves and the cell structure of leaves reflects the majority of NIR radiation. Therefore, healthy plants reflect most near-infrared radiation and absorb much of the red light. Generally if there is most reflected radiation in the near-infrared (NIR) wavelengths than in the visible (Vis) wavelengths, the vegetation is likely to be healthy. The vegetation is probably unhealthy, if there is very little difference between the amount of reflected radiation in the visible and near-infrared wavelength (Quiring and Ganesh, 2010). In this study was used NVSWI to evaluated drought of Iasi county.

MATERIAL AND METHODS

Study Area

Study Area is geographically situated on latitude 47°12'N to 47°06'N and longitude 27°32'E to 27°40'E. Iași, the seat of Iași County, is the largest city in eastern Romania. The city is positioned on the Bahlui River, affluent of Jijia that flows into the Prut River. The local climate is continental with minimal rainfall and with large temperature differences between the seasons (www.wikivoyage.org).

Landsat Data

Landsat 8 measures different ranges of frequencies along the electromagnetic spectrum – a color, although not necessarily a color visible to the human eye. Each range is called a band. Landsat 8 has 11 bands. Two bands - can see heat, tenth and eleventh, which are in the thermal infrared (TIR). So, instead of to measure the temperature of the air, how weather stations do, they report on the ground itself, which is often hotter (N.A.S.A. Landsat Science).

Landsat data was offered free by USGS. Table 1 shows Landsat data that was used in this research.

Table 1. Landsat data

Nr. Crt.	Path	Row	Date
1	182	27	2016-08-05
2	182	27	2016-11-25
3	182	27	2017-04-02

Data processing

Land surface temperature (LST)

LST, determined from remote sensing data is used in a lot of circles of science, like: agriculture, climate change, hydrology, forestry, urban planning, oceanography, horticulture etc. Determining surface temperatures and using them in different studies is important to define the problem associated with the environment (Orhan et al. 2014).

In this paper, method used for modeling LST was proposed by Advan & Jovanovska and Orhan in 2016 (Advan, Jovanovska, 2016; Orhan *et al*., 2016).

Normalized Difference Vegetation Index

NDVI, according to Rouse, is a numerical indicator that uses the visible (Vis) and near-infrared (NIR) bands of the electromagnetic spectrum, and is adopted to analyze remote sensing measurements and assess whether the aim being observed contains live green vegetation or not (John Rouse, 1973). The NDVI algorithm subtracts the red reflectance values from the near-infrared (NIR) and divides it by the sum of them.

$$NDVI = \frac{(NIR - RED)}{(NIR + RED)}$$

Normalized Vegetation Supply Water Index (NVSWI)

The Vegetation Supply Water Index (VSWI) combines NDVI with the thermal image-based parameter land surface temperature (LST) and is regularly used to its simplicity and ability to illustrate two potential properties of vegetation stress in one index, but suffer from the misfit in time scales, since vegetation greenness is pretty stable in the short to medium term but temperature oscillate diurnally, and according to weather conditions as well as slope, aspect and terrain properties. VSWI is also characteristic to the land cover type and measurement time of the image

scene, and can not be used as an perfect measure of drought severity. So, attempts to normalize the VSWI have contextualized the index within a defined period of available records.

$$VSWI=\frac{NDVI}{LST}$$

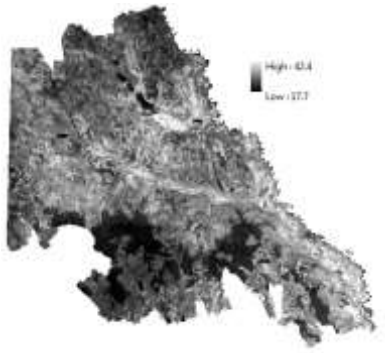
$$NVSWI=\frac{(NSWI-VSWI_{\min})}{(VSWI_{\max}-VSWI_{\min})}\times 100$$

NVSWI range from 0 (driest) to 100 (wet) with next five drought classes: severe dry (0-20), moderate drought (20-40), slight dought (40-60), normal (60-80), wet (80-100).

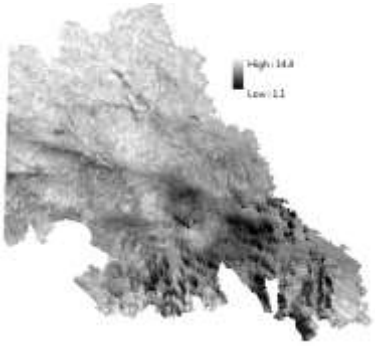
RESULTS AND DISCUSSION

Figure 2 shows LST, NDVI, VSWI and NVSWI maps.

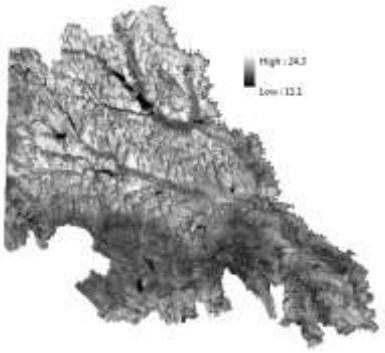
For August, the LST values range from 17.7^{0}C to 42.4^{0}C, and the parameter "mean" of NDVI is 0.33, which shows a high degree of vegetation coverage. For November the maximum NDVI value is 0.46 and the mean LST is 9.5^{0}C. Spring temperatures rise and peak NDVI in April reaches 0.6, while maximum temperature exceeds 20^{0}C. Larger areas affected by moderate drought were reported for November, and for August and April prevailed areas of slight drought.



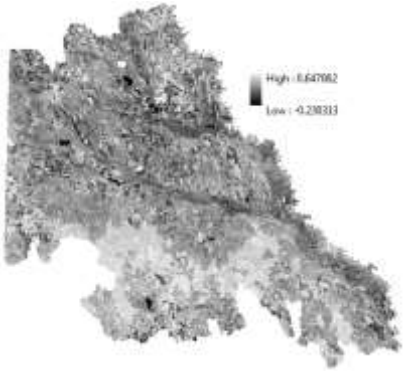
LST-05.08.2016



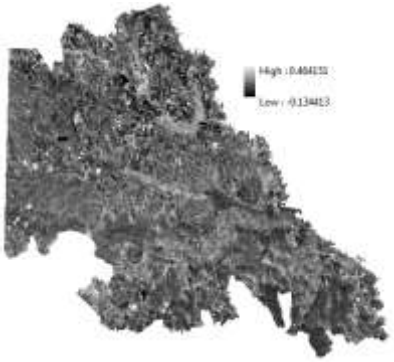
LST-25.11.2016



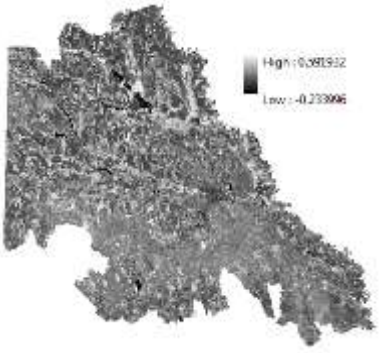
LST-02.04.2017



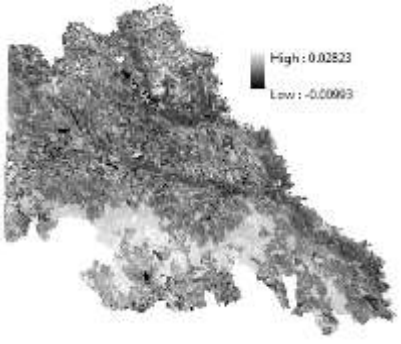
NDVI-05.08.2016



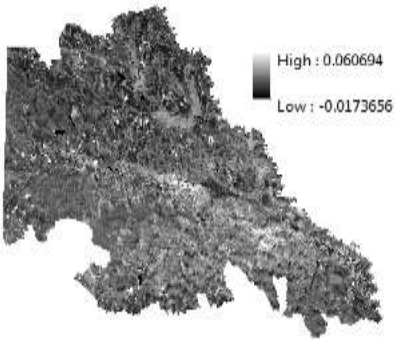
NDVI-25.11.2016



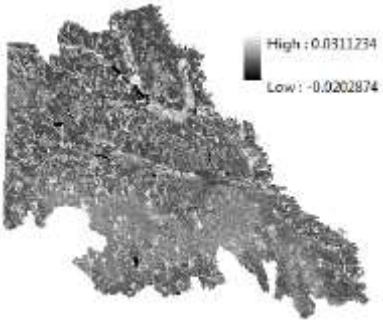
NDVI-02.04.2017



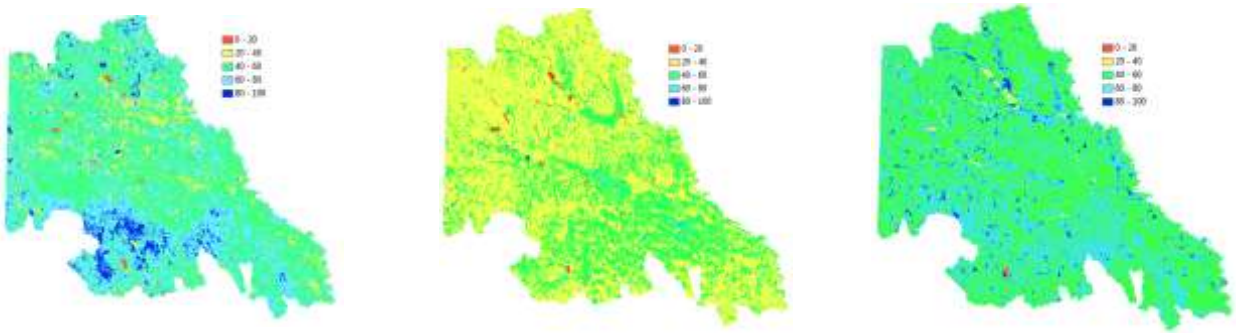
VSWI-05.08.2016



VSWI-25.11.2016



VSWI-02.04.2017



NVSWI-05.08.2016 NVSWI-25.11.2016 NVSWI-02.04.2017

Figure 2 **LST, NDVI, VSWI and NVSWI maps**

CONCLUSIONS

In this paper was evaluate drought, for Iasi county, using Normalized Vegetation Supply Water Index (NVSWI). We discovered that this index can be successfully used for determine the spatiotemporal extent of agricultural drought. This research has shown that NVSWI has more notable results in assessing droughts during seasons with a high degree of vegetation coverage, this is why the results for February were not taken into account because the results were not considered to be satisfying. Larger areas affected by moderate drought were reported for November, and for August and April prevailed areas of slight drought. It can be concluded that NVSWI is not recommended for the assessment of drought-affected areas during winter, because in obtaining the values of this index an important role is given by NDVI. In the same situation, Normalized Difference Drought Index (NDDI) is also found. Taking into account the results of this study and the characteristics of the study area, it is recommended that the Soil Moisture Deficit Index (SMDI) and the Standardized Precipitation Evapotranspiration Index (SPEI) be used in the future for the analysis of drought-affected areas.

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RESEARCHES REGARDING THE INFLUENCE OF DISTANCE BETWEEN ROWS ON THE STEM AND FIBER YIELDS AT SOME MONOECIOUS HEMP VARIETIES UNDER THE CENTER OF MOLDAVIA PEDOCLIMATIC CONDITIONS

Alexandra LEONTE[1], Simona-Florina ISTICIOAIA[1], Alexandra-Andreea BUBURUZ[1], Adina Cătălina DRUŢU[2]

e-mail: andra29nt@yahoo.com

Abstract

Hemp is part of the textile plants group with high-value for human and industrial use. Hemp has over 25,000 uses, ranging from food, paints and fuels to clothing and building materials.
Hemp is currently considered to be a plant of increasing importance for Europe, being used for fiber and oil extraction and as medicinal plant. Hemp fibers are the most resistant plant fibers and as such, in the past, they were the most prized raw material of the textile industry worldwide.In this paper we present the results regarding the evolution of monoecious hemp crop on the production of stems and fiber, under the pedoclimatic conditions of the Center of Moldova, between 2012 – 2015. The biological material used was represented by three varieties created at A.R.D.S. Secuieni, respectively, Denise, Diana and Dacia and were sown at a distance of 12.5 cm, 25 cm respectively 50 cm between rows. The obtained results revealed that the studied factors influenced to a great extent the production of stems, which varied widely, ranging from 8113 kg / ha to the Denise variety at a distance of 12.5 cm in 2015 (agricultural year characterized as very dry from pluviometric point of view), and the highest yields were obtained at the Denise variety of 15683 kg / ha, at a distance of 25 cm in 2013 (agricultural year characterized as normal from rainfall point of view). On average, for the four years studied, the highest obtained production of fiber was achieved by Dacia variety, at 12.5 cm, of 3388 kg / ha, and the lowest yield of 2546 kg / ha was achieved by Denise variety at a distance of 50 cm between rows.

Key words: monoecious hemp, yield, distances, stems, fiber.

Hemp is a multipurpose crop with a specificity in the textile industry, with the ramifications of its use expanding in the technical, cosmetic, medical and even food industry (Callaway, 2004).

Hemp is considered to be a plant of increasing importance for Europe (Ranalli, 2004) being used for extracting fibers, oil and as medicinal plant (Șandru I. *et al*, 1996). Hemp fibers are the most resistant vegetable fibers, and as such they used to be the world's most prized raw material in the past (Forgo, 1957).

The technological properties of the fibers as strength (traction, torsion, friction, rotting), extensibility (elastic and plastic), spinning capacity and long length (Șandru, 1996) determine the use in very varied fields such as the manufacture of quality paper, braids and fabrics, fine fabrics, molded plastic products (Small and Marcus, 2002), fiber - reinforced cement (Zhijian *et al*, 2004), thermal insulation.

In recent years, the hemp processing industry has grown a lot, especially in the textile field. However, actual cultivation and processing of hemp is still mainly carried out in China and Eastern Europe (Gibson, 2006).

This paper presents results regarding the influence of the distance between rows on stem and fiber production in some varieties of hemp.

MATERIAL AND METHOD

At A.R.D.S. Secuieni, during 2012 – 2015, a bifactorial experience of the type A x B was established, located in the experimental field according to the subdivision parcel method, in three rehearsals. The A factor was represented by the variety used with three graduations (a_1 - Denise, a_2 – Diana, a_3 - Dacia), and the B factor by the distance between rows with three graduations (b_1 – 12.5 cm, b_2 – 25 cm and b_3 – 50 cm).

The experience was placed on a typical Cambic faeosis soil type with a pH in water of 7.05,

[1] Agricultural Research – Development Station Secuieni
[2] Agreco RF