CHARACTERIZATION OF A TERRITORIAL ADMINISTRATIVE UNIT BASED ON REMOTE SENSING IMAGES

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Abstract *Remote sensing, regardless of the nature of the applications, uses electromagnetic radiation to obtain images of bodies from a certain altitude (plane, satellite, balloon, helicopter) because in this way, the image can be used to obtain maps and plans, and interpretation of objects is optimal and easy. The remote sening (RS) techniques are used in a lot of studies, in the dynamics of changes in the cover of the vegetal carpet, in forecasting studies, in various fields such as: agriculture, environmental protection, forestry. Remote sensing systems are developing rapidly and support the decision-making process due to the effectiveness of remote sensing images that can provide useful spectral information. The present research had as its main purpose the study of the dynamics of entire UAT Satchinez, based on the spectral information obtained from Ladsat 8 satellite images and processed with specialized GIS and remote sensing programs namely ERDAS Imagery and ArcGIS, on the basis of which thematic maps were created with various combinations of spectral bands and 3 normalized indices of differentiation, useful in monitoring and analysis processes of the territory. It was downloaded and processed a satellite scene from the LANDSAT 8 remote sensing system, who receives satellite images in 11 spectral bands. Based on the spectral bands, various differentiation indexes useful in territorial analysis can be calculated: NDVI, SAVI, NDMI. These indices are calculated based on mathematical formulas that use the spectral bands of the remote sensing system used.*

Keywords*: Landsat 8, band combination,remote sensing,NDVI, SAVI, NDMI*

INTRODUCTION

Remote sensing is of interest for the study and characterization of the vegetation and agricultural crops for their monitoring and the creation of predictive models regarding their dynamics and making decisions in real time (CALINA ET AL., 2020; CALINA ET AL., 2018, BERTICI ET AL., 2012; TARAU ET AL., 2013).

The present research had as its main purpose the study of the dynamics of an entire UAT, based on the spectral information obtained from Ladsat 8 satellite images and processed with specialized GIS (ONCIA ET AL., 2013; POPESCU ET AL., 2017) and remote sensing programs (BEGOV UNGUR ET AL., 2016; FILIP ET AL., 2016).

Remote sensing is the technical field that deals with the detection, measurement, recording and visualization in the form of images of electromagnetic radiation emitted by objects and phenomena on Earth or in the Universe, from a distance, without having direct contact with them (HERBEI ET AL., 2015, SALA ET AL., 2015; SIMON ET AL., 2021).

Remote sensing, regardless of the nature of the applications, passive or active, uses electromagnetic radiation to obtain images of bodies from a certain altitude (plane, satellite, balloon, helicopter) because in this way, the image can be used to obtain maps and plans, and interpretation of objects is optimal and easy.

The electromagnetic spectrum is a physical model, which presents the known and measured electromagnetic radiations, depending on their wavelength and specific energy level, representing the totality of electromagnetic radiations existing in the Universe.

MATERIALS AND METHODS

The present study was carried out within the Satchinez UAT in Timis county. Satchinese is a commune in Timis county, Romania, made up of villages Barateaz, Hodoni and Satchinez (residence). The town of Satchinez is located in the north of Timiș county, about 25 km from Timisoara. It borders to the north with Gelu, to the east with Barateaz, Calacea and Carani, to the southeast with Hodoni and to the southwest with Biled.

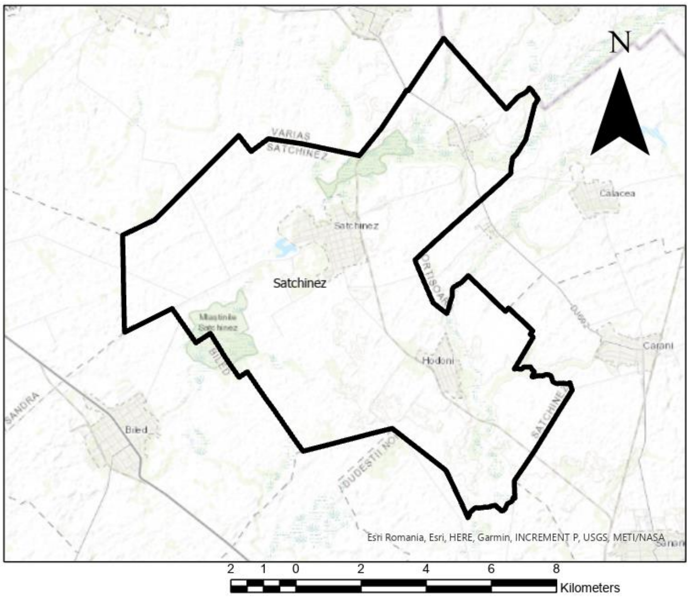

Figure 1.Delimitation of the studied area

In this study, a satellite scene from the LANDSAT 8 remote sensing system was downloaded and processed. The Landsat 8 system receives satellite images in 11 spectral bands. Landsat 8 has the following spectral bands:

Table 1

Landsat 8 – Spectral Bands

Band 1 Visible Coastal Aerosol	(0.43 - 0.45 µm)	30-m
Band 2 Visible Blue	(0.450 - 0.51 µm)	30-m
Band 3 Visible Green	(0.53 - 0.59 µm)	30-m
Band 4 Red	(0.64 - 0.67 µm)	30-m
Band 5 Near-Infrared	(0.85 - 0.88 µm)	30-m
Band 6 SWIR 1	(1.57 - 1.65 µm)	30-m
Band 7 SWIR 2	(2.11 - 2.29 µm)	30-m
Band 8 Panchromatic (PAN)	(0.50 - 0.68 µm)	15-m
Band 9 Cirrus	(1.36 - 1.38 µm)	30-m
Band 10 TIRS 1	(10.6 - 11.19 µm)	100-m
Band 11 TIRS 2	(11.5 - 12.51 µm)	100-m

This study used a remote sensing scene taken from the Landsat 8 system on the www.earthexplorer.com portal from 11.05.2021

The retrieved images were processed using specialized remote sensing and GIS programs, namely ERDAS Imagery and ArcGIS.

The following combinations of spectral bands were made:

- Natural colors: 4,3,2
- Color Infrared (CIR): 5,4,3
- False Color (Urban): 7,6,4
- Agriculture: 6,5,2
- Geology: 7,6,2
- False Color (vegetative Analysis): 6,5,4
- Shortwave Infrared: 7,5,4

RESULTS AND DISCUSSIONS

➢ The combination of spectral bands 4-3-2

The image in natural colors uses a combination of Red (Band 4), Green (Band 3) and Blue (Band 2) spectral bands. In this combination of spectral bands, all the details that can be observed with the human eye are reproduced. The healthy vegetation is expressed in green tones and the unhealthy in brown tones. The urban objectives are represented in white and gray, and the gloss of the water in dark blue or even black. This is a close to "True Color" combination. The disadvantage of this combination of spectral bands is that it can be affected by atmospheric interference.

➢ The combination of spectral bands 5-4-3

This combination of bands is also called composite near infrared (NIR). In this combination, the Near Infrared (Band 5), Red (Band 4) and Green (Band 3) spectral bands are used.

Because the chlorophyll reflects Near Infrared, this band combination is very useful in order to monitor the vegetation. Dark areas means water bodies and urban areas are coloured in white. It is very useful in analyzing the differences between types of vegetation in the analysis of agricultural crops and wetlands.

➢ The combination of spectral bands 7-6-4

This combination uses Short Waves InfraRed SWIR-2 (Band 7), SWIR-1 (Band 6) and Red (Band 4) spectral bands. This band combinations represent vegetation in shades of green. Darker shades of green represent denser vegetation and sparse vegetation is represented in lighter shades. The urban areas are represented in colours of blue and the soils are represented in various shades of brown.

Because this band combination uses both SWIR bands, the resulting image is much sharper than band combinations that use shorter wavelength bands, which are more susceptible to fog.

➢ The combination of spectral bands 6-5-2

In this combination of spectral bands, the SWIR-1 (Band 6), Near Infrared (Band 5) and blue (Band 2) bands are used. It is commonly used for crop monitoring due to its use of shortwave and near-infrared. Healthy vegetation appears dark green. But bare earth has a magenta hue.

➢ The combination of spectral bands 7-6-2

The combination is useful for geological studies because it uses the SWIR-2 (Band 7), SWIR-1 (Band 6) and blue (Band 2) bands. This combination of bands is particularly useful for identifying geological formations, lithological features and faults.

➢ The combination of spectral bands 6-5-4

This combination uses the spectral bands SWIR-1 (Band 6), Near Infrared (Band 5) and Red (Band 4) and is very useful in vegetation analyses.

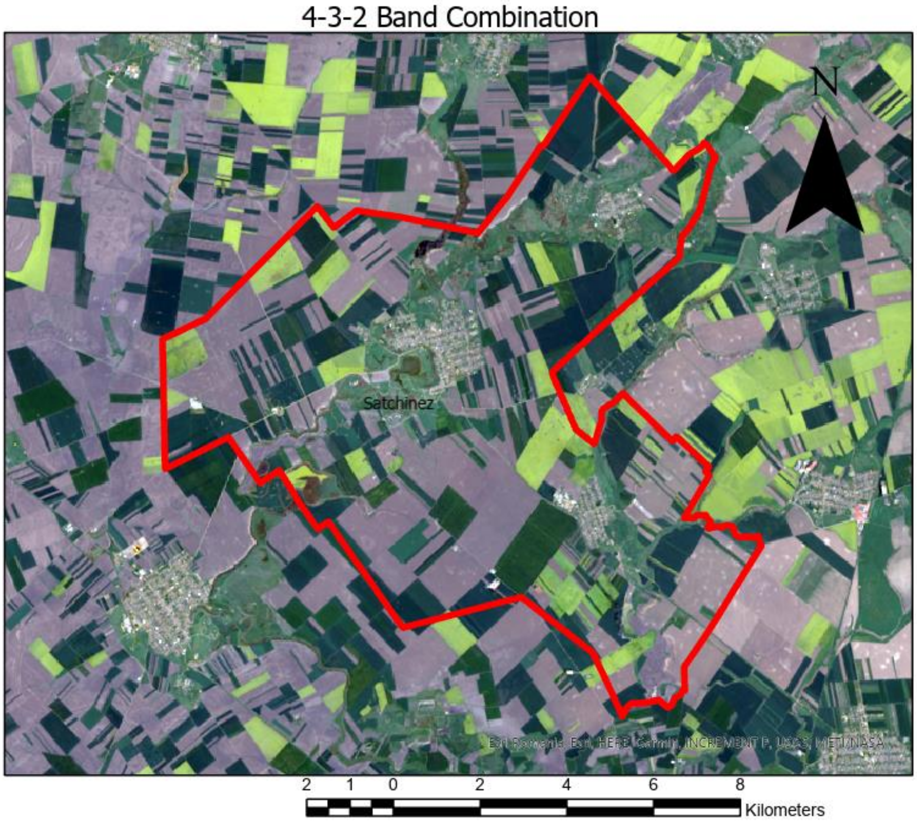

Figure 2. Combination of spectral bands 4 – 3 - 2

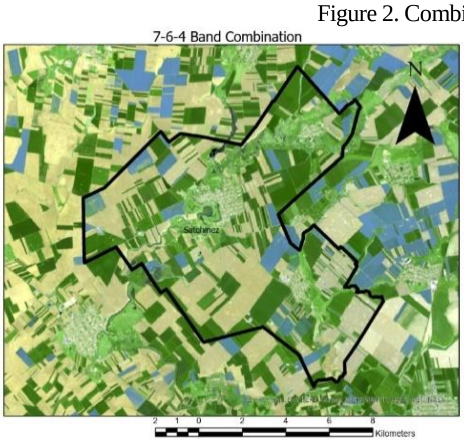

Figure 3. Combination of spectral bands 7 – 6 - 4

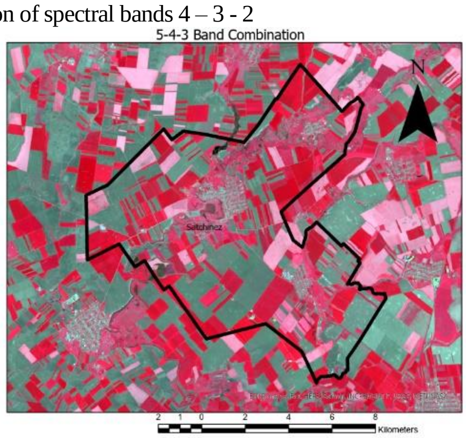

Figure 4. Combination of spectral bands 5 – 4 - 3

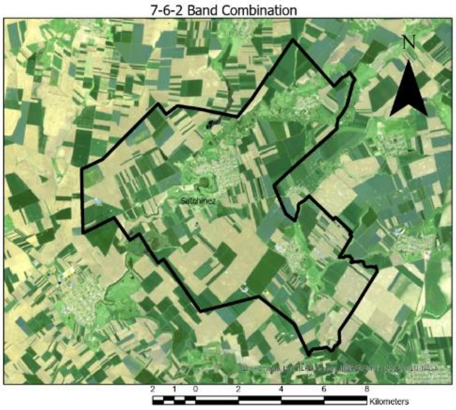

Figure 5. Combination of spectral bands 7 – 6 - 2

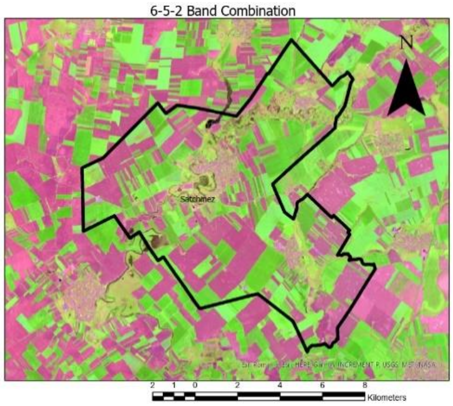

Figure 6. Combination of spectral bands 6 – 5 - 2

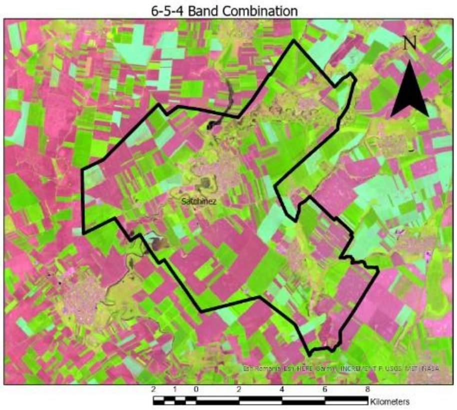

Figure 7. Combination of spectral bands 7 – 6 – 2

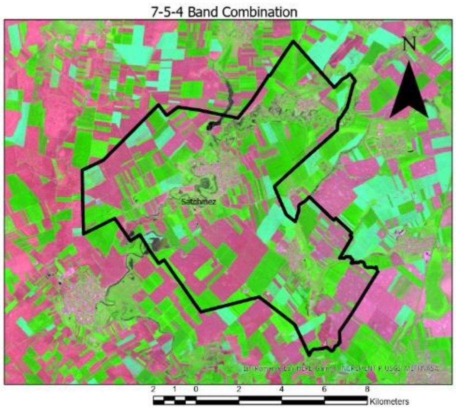

Figure 8. Combination of spectral bands 6 – 5 – 4

Based on the spectral bands, various differentiation indexes useful in territorial analysis can be calculated. These indices are calculated based on mathematical formulas that use the spectral bands of the remote sensing system used.

In this work, 3 differentiation indices were determined (Rouse et al., 1973; Gitelson, 2004; Qi J. et al., 1994), namely:

- Normalized Difference Vegetation Index (NDVI)

The NDVI - Normalized Difference Vegetation Index is an index that allows to generate an image displaying relative biomass (Fig. 9).

$$NDVI = (NIR - R)/(NIR + R) \quad (1)$$

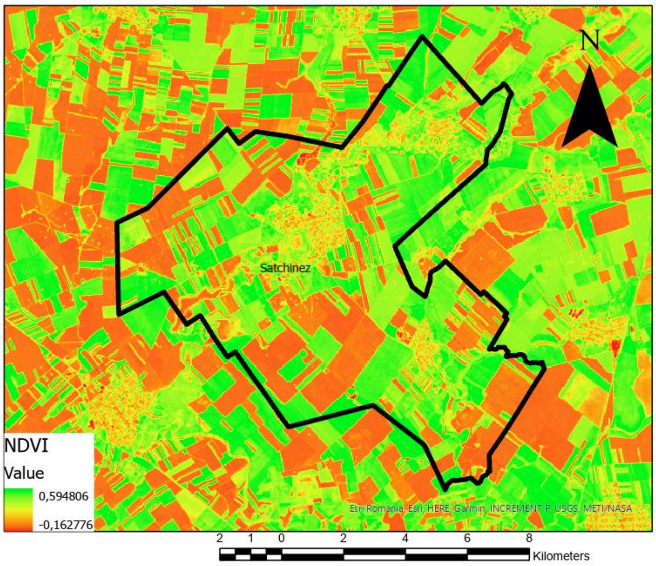

Figure 9. Map of the NDVI index

- Soil Adjusted Vegetation Index (SAVI)

The Soil-Adjusted Vegetation Index - SAVI index is a vegetation index that minimize soil brightness influences by using a soil-brightness correction factor and it outputs values between -1.0 and 1.0 (fig. 10).

$$SAVI = (NIR - Red)/(NIR + Red + L) * (1 + L) \quad (2)$$

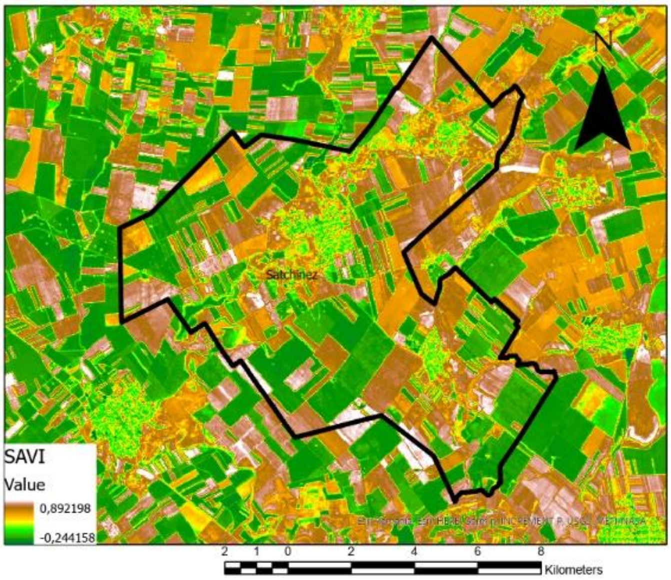

Figure 10.SAVI index map

- Normalized Difference Moisture Index (NDMI)

The NDMI - Normalized Difference Moisture Index is very sensitive to the moisture levels in vegetation. It is used to monitor droughts and fuel levels in fire-prone areas. It uses NIR and SWIR bands to create a ratio designed to mitigate illumination and atmospheric effects (fig. 11).

$$NDMI = (NIR - SWIR1)/(NIR + SWIR1) \quad (3)$$

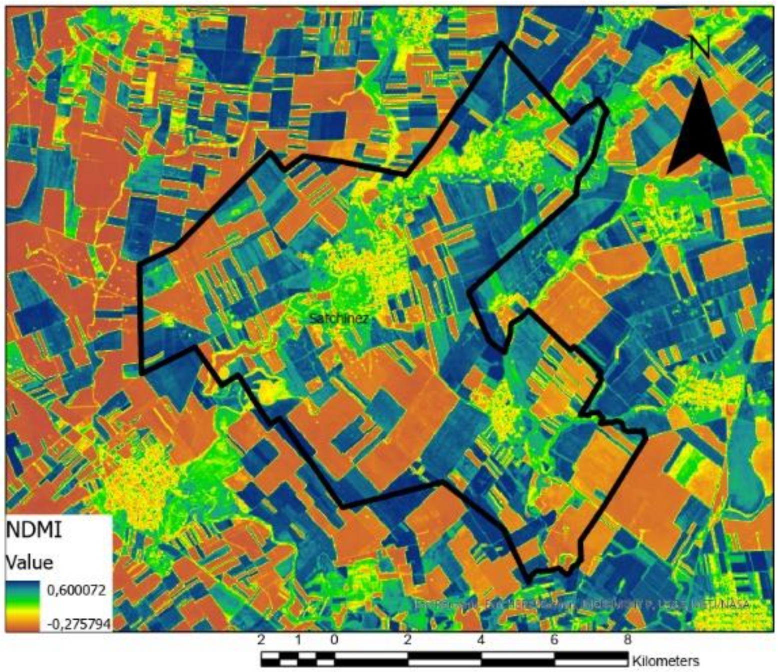

Figure 11.Map of the NDMI index

CONCLUSIONS

The remote sensing techniques are increasingly used in the analysis and monitoring of the territory, in the dynamics of changes in the cover of the vegetal carpet, in forecasting studies, in various fields such as: agriculture, environmental protection, forestry. Remote sensing systems are developing rapidly and support the decision-making process due to the effectiveness of remote sensing images that can provide useful spectral information.

This study presented an efficient and fast way of using Landsat 8 remote sensing images in the analysis of a UAT from Timis county, Romania. A Landat 8 image was used, on the basis of which thematic maps were created with various combinations of spectral bands and 3 normalized indices of differentiation, useful in monitoring and analysis processes of the territory.

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