

TRACKING DOWN THE MODIFICATIONS OF THE RIGHT BANK OF THE PRUT RIVER IN THE TERRITORIAL ADMINISTRATIVE UNIT OF PRISACANI COMMUNE - IASI COUNTY

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Abstract

This article presents the change while following the right bank of the Prut River from territorial administrative unit of the Prisacani commune - Iasi County in the period 1985 - 2015, caused by erosion / deposition of sediments, highlighted by comparing the ground surface modification of Prisacani Territorial Administrative Unit (TAU) in the observed period of time. The reference terrain of Prisacani TAU was considered the one defined by the territorial-administrative boundary during the last cadastral demarcation and the cadastral right bank of the Prut river digitized on topographic maps at 1:25000 scale edited in 1985. The reference terrain of Prisacani TAU used to conduct the comparative study was determined on the basis of administrative territorial limits and the right bank of the Prut river, digitized based on the LANDSAT TM and ETM + satellite records dated 17 August 2000, 13 August 2010 and 4 March 2015. The surface comparison method allows not only to highlight and to measure separately the erosion and the sediment deposition for the entire study area, but also to view, to draft thematic maps and to analyze these phenomena.

Key words: change in time, river bank, surfaces, digitizing, satellite image.

As of 1948, Romania's state border with the Union of Soviet Socialist Republics and, later on, with Ukraine and the Republic of Moldova, was established on the Prut river, starting from the place where this river enters into Romania in the Oroftiana locality to its confluence with the Danube river.

Since the Prut river is considered a border river, access of individuals and carrying out of activities in the border area have a special juridical regime. The Treaty between the People's Republic of Romania and the Government of the Union of Soviet Socialist Republics on the Romanian – Soviet state border, cooperation and mutual assistance on border related issues (still enforced today in the absence of a treaty on the Romanian – Moldovan state border, cooperation and mutual assistance on border related issues between Romania and the Republic of Moldova) lays down strict rules on conducting the measures of the state border demarcation. This latter activity is performed only during Joint Border Commissions (the latest check of the state border line was conducted between 1972 - 1974). The above-mentioned enforced Treaty also lays down strict rules regarding the activities that the neighbouring countries are conducting on the banks of the Prut river. These rules were the reasons for which the

study of the progress of side riverbank erosion and evolution tendencies of its route was sufficiently conducted in the past 30 years.

This article presents the change while pursuing the right bank of the Prut river from the administrative territorial unit of the Prisacani commune - Iasi County in the period 1985 - 2015, due to erosion / deposition of sediments, highlighted by comparing the ground surface modification of TAU Prisacani in the analyzed period of time, using the ArcGis software.

MATERIAL AND METHOD

By georeferencing topographic maps at 1:25000 scale, planimetric rectangular Gauss coordinates of trapezoids corners and intersection points of the kilometric grid, have been transformed into planimetric rectangular Stereo -70 coordinates using the Matlab programming language. Given the fact that, in order to georeference one raster image, between 84 - 104 points have been used, third degree polynomial transformation method was used to optimize local accuracy (Imbroane A.M., 2012).

Satellite images dated 17th of August 2000, 13th of August 2010 and 4th of March 2015 released by the manufacturer, are referenced in UTM projection system with WGS84 datum. (www.earthexplorer.usgs.gov) They were transformed in Stereo – 70 projection system with „Dealul Piscului

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1970" datum by using the ArcGIS software (Imbroane AM, 2012).

The reference terrain surface of Prisacani TAU, was considered the one defined by the territorial-administrative boundary during the last cadastral demarcation and the cadastral right bank of the Prut river digitized on topographic maps at 1:25000 scale edited in 1985.

In order to highlight the right bank of the Prut river, maps of the normalized difference water index were created, based on the LANDSAT TM and ETM+ satellite records dated 17th of August 2000, 13th of August 2010 and 4th of March 2015 and using Raster Calculator tool from ArcGIS software.

The terrain surfaces of the Prisacani TAU used to conduct the comparative study, were determined on the basis of administrative territorial limits and the right bank of the Prut river, digitized based on maps of the normalized difference water index (NDWI) dated 17 August 2000, 13 August 2010 and 4 March 2015.

Surfaces thus created, were compared with the reference surface using Symmetrical Difference analysis function of the ArcGIS software.

RESULTS AND DISCUSSIONS

1. Creating the maps of the normalized difference water index (NDWI) based on the LANDSAT TM and ETM+ satellite records

dated 17th of August 2000, 13th of August 2010 and 4th of March 2015.

In order to highlight the Prut river and, implicitly, its right bank from the study area, the normalized difference water index was calculated using the following formula:

$$NDWI = (NIR - G) / (NIR + G) = (B4 - B2) / (B4 + B2) \quad (1)$$

This index is also useful for mapping bodies of water, for visualisation of turbidity differences and vegetal content of water, alluvial soils or for differentiation of water content from vegetation. It also using green and near-infrared spectral bands. Dark gray levels (close to -1) expresses the water surface, bright gray levels (close to one), dry land and intermediate gray levels (close to 0), land containing intermediate moisture (Herbei M., 2013).

Based on the satellite image LANDSAT ETM dated 17th of August 2000, the NDWI was calculated using the ArcGIS software. The result was a raster with pixel values between -1 and 1 (NDWI_2000) (*figure 1*).

In a similar way, normalized difference water indexes have been calculated for the satellite images LANDSAT ETM dated 13th of August 2010 and 4th of March 2015.

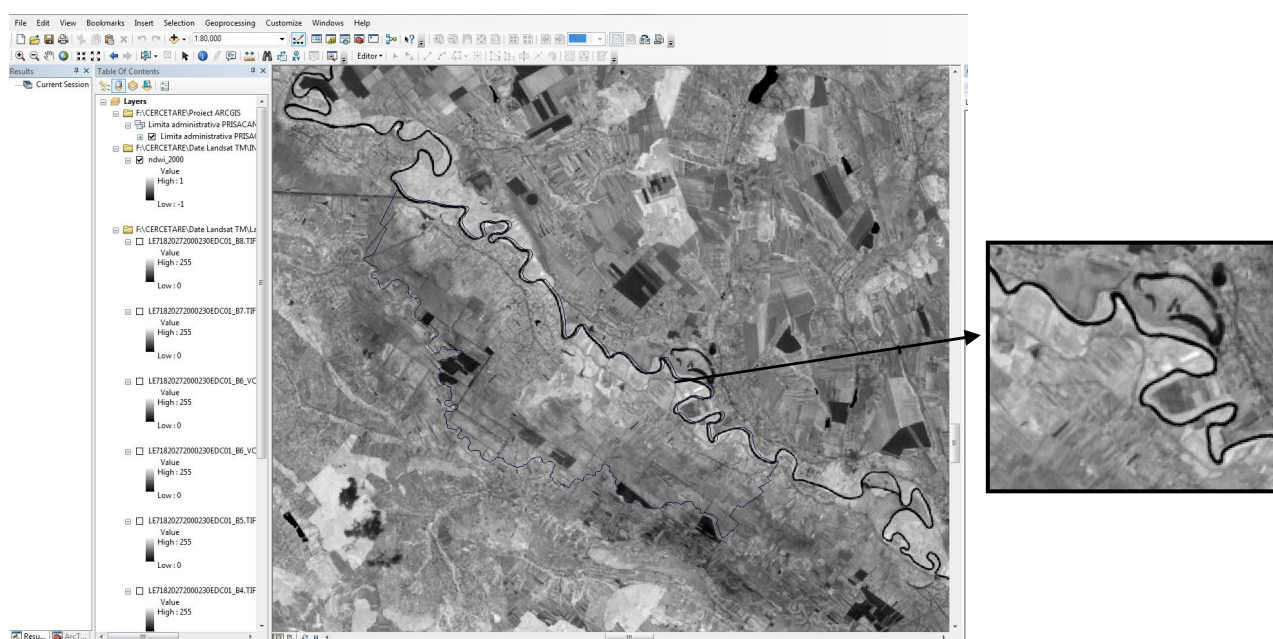


Figure 1 NDWI_2000 map of the study area

2. The digitization process of land surfaces for the TAU of Prisacani for 1985, 2000, 2010 years and comparing these surfaces

Given the evolution in time of the right bank of the Prut river during the analyzed period of time, marked both by erosion and the sediment deposition, it was analyzed the evolution in time of

the ground surfaces belonging to the Prisacani territorial administrative unit.

The reference terrain surface of Prisacani TAU, was considered the one defined by the territorial-administrative boundary during the last cadastral demarcation and the cadastral right bank of the Prut river digitized on topographic maps at 1:25000 scale edited in 1985 (*figure 2*).

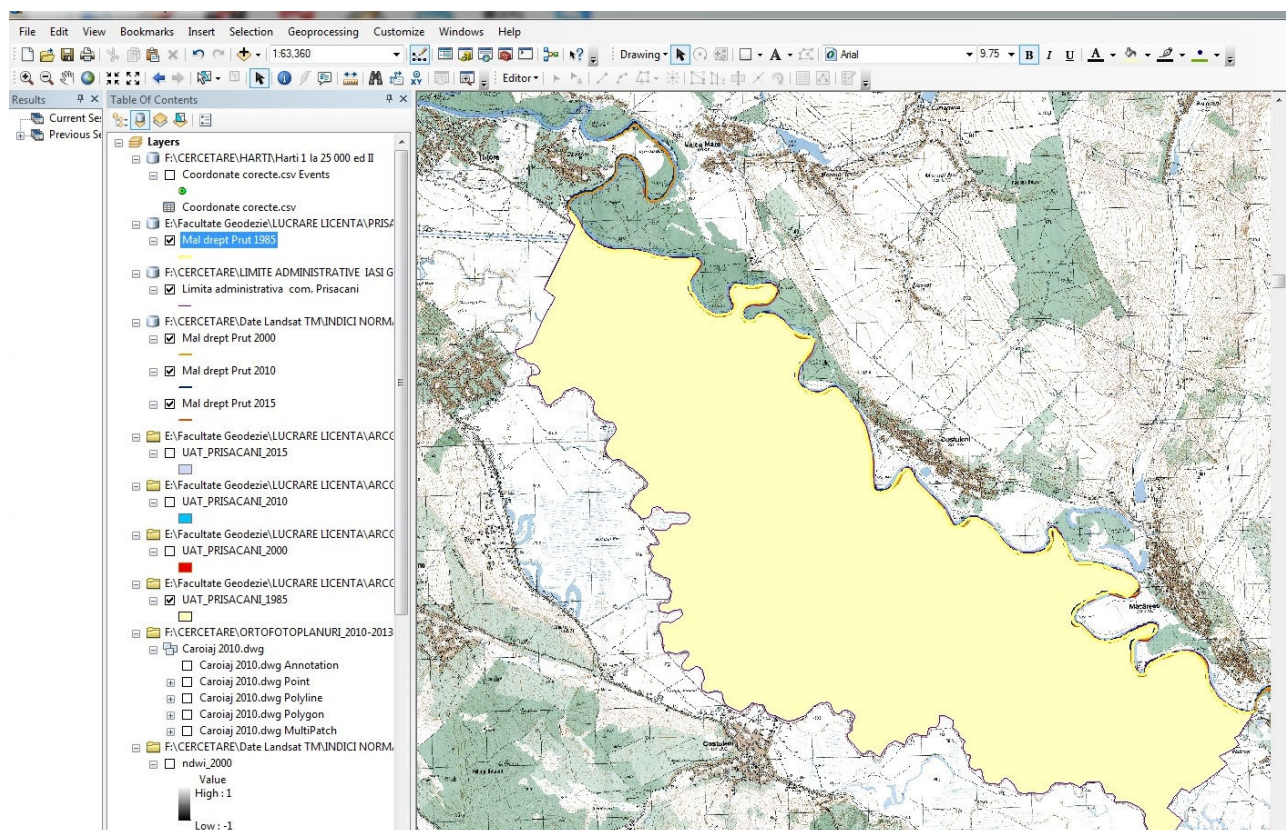


Figure 2 Digitization result of the Prisacani TAU from 1985 year

By using the ArcGis software, there were created reports regarding surfaces resulting from digitization. Surface areas are presented in *table 1*:

Table 1
Terrain surface of the Prisacani TAU in the analyzed period of time

No.	Year	Surface area of TAU Prisăcani (m ²)
1	1985	59,070,800.00
2	2000	59,271,200.00
3	2010	59,183,100.00
4	2015	59,044,500.00

In order to highlight erosion / sediment deposition, Symmetrical Difference tool from ArcMap was used, in order to calculate the difference between two polygon type vector layers.

One by one, differences have been calculated between vector data on UAT_PRISACANI_1985 layer and the ones from UAT_PRISACANI_2000, UAT_PRISACANI_2010 and UAT_PRISACANI_2015 layers. The software created a new layer for each difference using the result of the respective tool, polygon type vector data, each one divided into two categories: extra surfaces as a result of sediment deposition phenomenon and missing

surfaces as a result of erosion phenomenon. For each of these differences reports have been created which emphasise the evolution in each time stage of the right river bank of Prut river in the territorial-administrative unit of Prisacani commune, highlighting and quantifying in the same time the eroded surfaces and the ones newly created (*table 2*).

Table 2
Surface areas as a result of erosion phenomenon / sediment deposition phenomenon in the Prisacani TAU for the analysed period of time

No.	Time frame	Surface area (m ²)	
		Erosion	Sediment deposition
1	1985 - 2000	69,266.00	269,655.00
2	1985 - 2010	139,165.00	251,493.00
3	1985 - 2015	266,936.00	240,972.00

For an expressive representation of the modification process in time of the right bank of Prut river, three thematic maps have been created using the ArcMap module in order to compare the situation from 2000, 2010 and 2015 years, using as reference the 1985 year. Figure 3 presents the thematic map regarding the evolution of the right

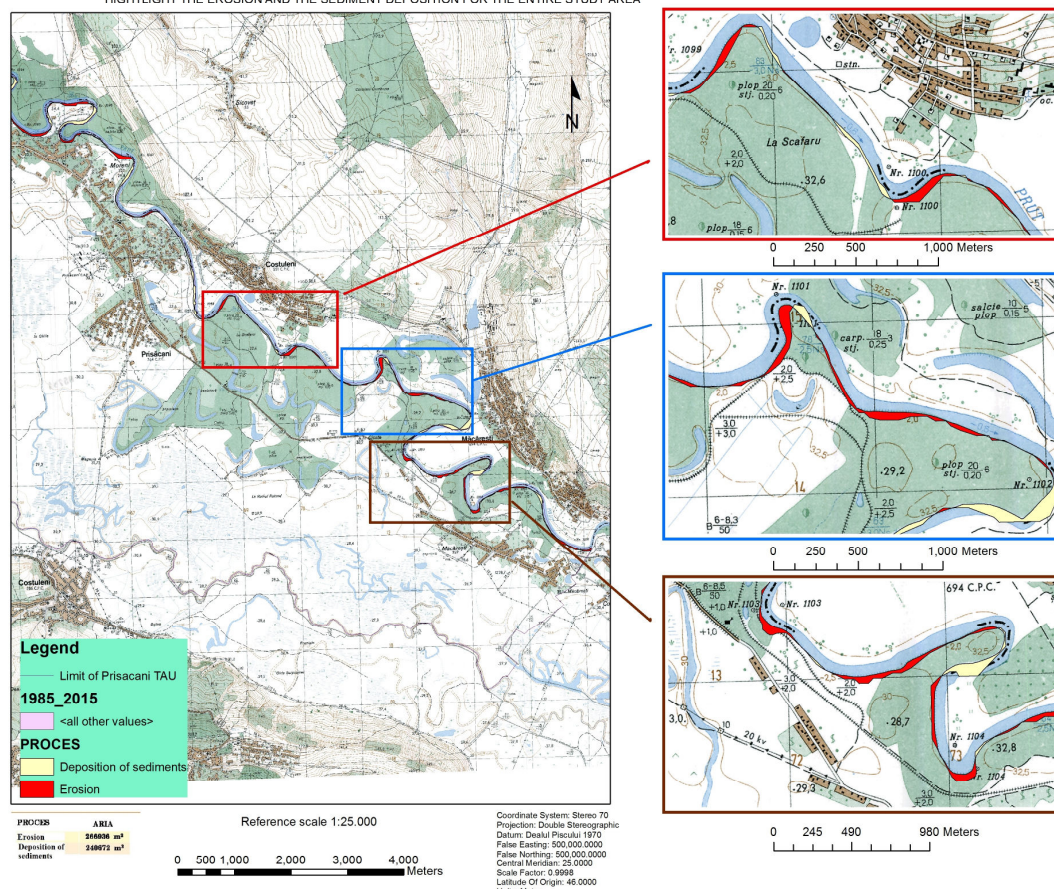
river bank of Prut river between 1985 and 2015 in

the Prisacani TAU.

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THE RIGHT BANK OF THE PRUT RIVER IN THE PERIOD 1985 -2015

HIGHLIGHT THE EROSION AND THE SEDIMENT DEPOSITION FOR THE ENTIRE STUDY AREA



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Figure 3 Thematic map representing the evolution of the right river bank of Prut river between 1985 and 2015 years

CONCLUSIONS

Regarding the satellite data, as a part of the cartographic base, the LANDSAT TM and ETM+ images offer just an approximate estimate of the modifications of the right river bank of Prut river. The relatively low resolution of 30 meters, does not allow us to conduct precision measurements. In order to conduct high precision studies on extended areas, like the minor riverbed of Prut river, SPOT 5 data, IKONOS data, QuickBird data or aerial images may be used.

While analysing the erosion phenomenon for the whole period between 1985 and 2015 years we reached the conclusion that a surface of 266,936.00 m² has been lost while a new surface of 240,672.00 m² has been created. We find out that the erosion phenomenon is more pronounced between 2010 and 2015 when 127,771.00 m² have been lost from the national territory. This lost surface from the Prisacani TAU is almost double when compared to the one lost between 1985 and 2015 years.

These things happened due to climatic changes manifested through dry years followed by

very rainy or normal years from a hydrological point of view, but also due to the lack of improvement measures applied to the riverbed of Prut river in order to control the soil erosion in the study area.

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