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ANALYSIS OF THE FORESTRY AREA EVOLUTION IN IAŞI COUNTY

BY

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Abstract. The forest fund is the total area of forests, land under afforestation, and areas that serve the needs of crop, forestry production and management. In this paper the study area is the county of Iaşi with a total area of 5.476 km² of which the area occupied by forests represents approx. 17.82%, respectively 981.3 km² of the total area of Iaşi County. In this article we analyzed the evolution of the forest areas during 1985-2016. For a more accurate highlighting of this evolution, we applied satellite images for each year of study with Landsat program. The satellite image processing was performed in the ArcMap 10.1 Program provided by ESRI. We also designed for each year of study a map of forested areas. Map processing was done in AutoCAD by digitizing the contours of the wooded areas.

Keywords: analysis; evolution; forests; Landsat program; satellite imagery.

1. Introduction

The forest fund includes forests and other wooded land classified according to the type of forest and the availability of timber supply.

The most important factor contributing to the forest fund creation is forest management. Forest utilization rates (percentage cuts in annual net

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growth) vary considerably across European countries, but remain broadly below the "sustainability limit" of 100% (McRoberts *et al*., 2002).

Keeping cuts below the level of wood production growth is a necessary but insufficient condition for the sustainable development of forests. Deforestation is an important phenomenon that can create major imbalances in ecosystems (Andronache *et al*., 2016).

The presence and appearance of the forest is a hallmark of many climate zones, and its massive deforestation can lead to radical changes in microclimate and landform, the thermal and hydrological characteristics of the soils and a marked change in the environment as a whole. This is related to the great role the forest has in the development of the landform, the formation of the properties of the layer of air near the soil and the soil itself as well as in their preservation over long periods of time (Gislason *et al*., 2006).

Forests are crucial to biodiversity and the distribution of ecosystem services. They provide natural habitats for plant and animal life, protection against soil erosion and floods, carbon sequestration, climate regulation and have great recreational and cultural value. Ecological knowledge of forests, preoccupation with the ecological foundations of silvicultural measures and other management measures are the most effective means of directing interventions in order to avoid the gradual degradation of forest ecosystems by harvesting forest products, maintaining their mediogenic capacity and conservative environment (Mackey, 2007).

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2. Study Region

Iaşi county is located in the Moldavian Plain at latitude 46°48'–47°35'N and longitude 26°29'35–28°07'E. Neighboring county are Botoşani to the north, Neamț to the west, Vaslui to the south and Republic of Moldova to the east. Fig. 1. Represents the study area.

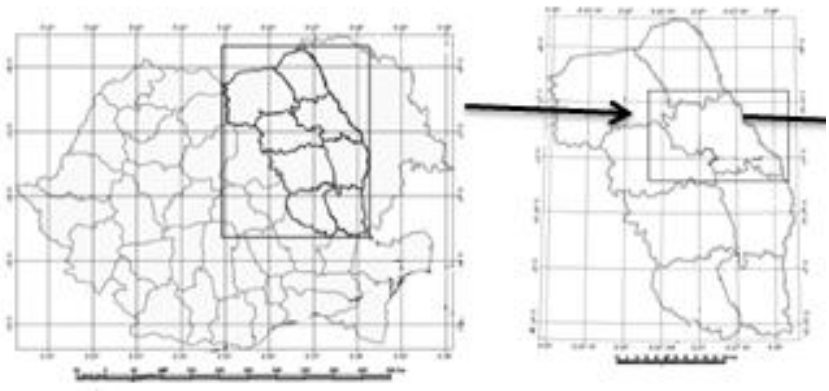


Fig. 1 *a* – Location of the studied area in North-East of Romania.

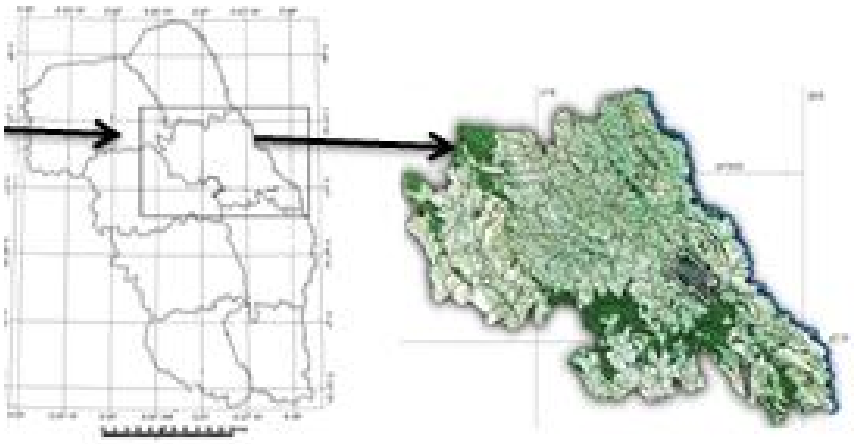


Fig. 1 *b* – Study area.

The county of Iasi has a total area of 5.476 km², of which the area occupied by forests represents approx. 17.82% of the total area of Iaşi County, respectively 99.67% of the forest fund of Iaşi County (Sîrbu-Rădăşanu *et al.*, 2012).

3. Additions

In this study, raw data, topographic materials and maps, as well as satellite remote sensing images were used. The topographic maps required for this research are made in the National Stereographic Projection System – 1970, at the scale of 1:100000 in 1985, and their nomenclatures are presented in Table 1, Fig. 2 representing the distribution of maps on the territory of Iasi County.

Table 1
Map Indicative

No.	Indicative
1	L-35-18
2	L-35-19
3	L-35-20
4	L-35-30
5	L-35-31
6	L-35-32
7	L-35-33
8	L-35-43
9	L-35-44
10	L-35-45

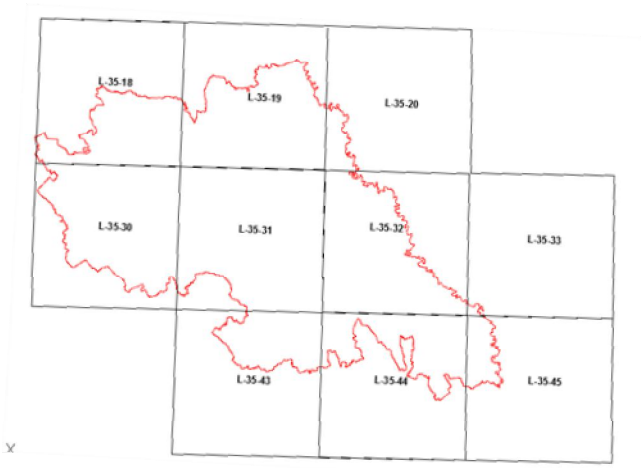


Fig. 2 – Map distribution at 1:100000 scale for Iași County.

Based on the Landsat program, satellite images needed for this study were obtained. Satellite images provided by 3 Landsat satellites were used, namely:

– Landsat 5, launched on 1 March 1984;
– Landsat 7, launched on 15 April 1999;
– Landsat 8, launched on 11 February 2013.

The characteristics for each band when using one of the three satellites listed above are shown in Tables 2.a, 2.b and 2.c shown below.

Table 2.a
Bands in Landsat 5 Satellite

Band number	Description	Wavelength	Resolution
Band 1	Visible blue	0.45 to 0.52 µm	30 meter
Band 2	Visible green	0.52 to 0.60 µm	30 meter
Band 3	Visible red	0.63 to 0.69 µm	30 meter
Band 4	Near-infrared	0.76 to 0.90 µm	30 meter
Band 5	Short-wave infrared	1.55 to 1.75 µm	30 meter
Band 6	Thermal	10.4 to 12.3 µm	120 meter
Band 7	Short-wave infrared	2.08 to 2.35 µm	30 meter

Table 2.b
Bands in Landsat 7 Satellite

Band Number	Description	Wavelength	Resolution
Band 1	Visible blue	0.45 to 0.52 µm	30 meter
Band 2	Visible green	0.52 to 0.60 µm	30 meter
Band 3	Visible red	0.63 to 0.69 µm	30 meter
Band 4	Near-infrared	0.76 to 0.90 µm	30 meter
Band 5	Near-infrared	1.55 to 1.75 µm	30 meter
Band 6	Thermal	10.4 to 12.3 µm	60 meter
Band 7	Mid-infrared	2.08 to 2.35 µm	30 meter
Band 8	Panchromatic	0.52 to 0.90 µm	15 meter

Table 2.c
Bands in Landsat 8 Satellite

Band 1	Coastal / Aerosol	0.433 to 0.453 µm	30 meter
Band 2	Visible blue	0.450 to 0.515 µm	30 meter
Band 3	Visible green	0.525 to 0.600 µm	30 meter
Band 4	Visible red	0.630 to 0.680 µm	30 meter
Band 5	Near-infrared	0.845 to 0.885 µm	30 meter
Band 6	Short wavelength infrared	1.56 to 1.66 µm	30 meter
Band 7	Short wavelength infrared	2.10 to 2.30 µm	60 meter
Band 8	Panchromatic	0.50 to 0.68 µm	15 meter
Band 9	Cirrus	1.36 to 1.39 µm	30 meter
Band 10	Long wavelength infrared	10.3 to 11.3 µm	100 meter
Band 11	Long wavelength infrared	11.5 to 12.5 µm	100 meter

Satellite images downloaded from the three previously announced satellites were downloaded, these being made in the UTM projection based on the WGS84 data, in different years, this being presented in Table 3.

Table 3
Satellite Imagery

Nr. crt.	Indicative		Date	Satellit
	Path	Raw		
1	182	27	06.08.1993	Landsat 5
2	183	27	06.08.1993	Landsat 5
3	182	27	05.10.2000	Landsat 7
4	183	27	05.10.2000	Landsat 7
5	182	27	25.07.2006	Landsat 7
6	183	27	25.07.2006	Landsat 7
7	182	27	17.07.2009	Landsat 7
8	183	27	17.07.2009	Landsat 7
9	182	27	28.08.2016	Landsat 8
10	183	27	28.08.2016	Landsat 8

Note that only the wooded areas whose surface exceeds 10,000m^2 (1ha) have been considered. The distribution of forest areas for the county of Iaşi at the time of 1985, 1993, 2000, 2005, 2009 and 2016 is shown in Fig. 3.

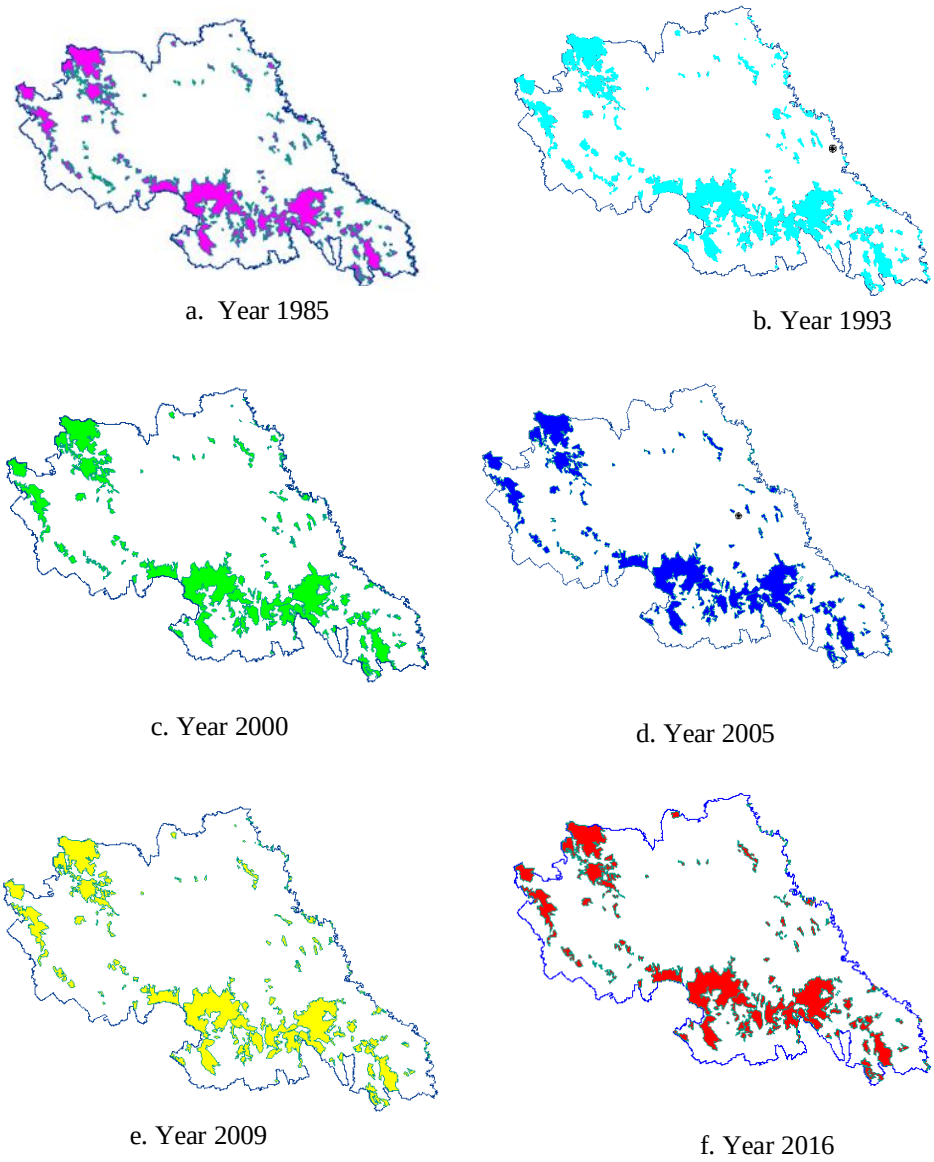
Map processing was done in AutoCAD by digitizing the contours of the wooded areas.

The processing of satellite images was performed in the ArcMap 10.1 Program provided by ESRI. Within the program, based on the functions offered by the ArcMap program, for bandwidth bridging, a map of the NDVI (Normalized difference vegetation index) was created for each moment of the satellite imagery (1985, 1993, 2000, 2005, 2009, 2016).

Theoretically, NDVI values are represented as a ratio ranging in value from –1 to 1 but in practice values around zero represent bare soil, extreme negative values represent water, and values over 0.6 represent dense green

vegetation (Holme *et at*., 1987). After evaluating the NDVI distribution maps obtained within the program, the value ranges for each surface were observed. Considering that the analysis is performed for forest areas, the NDVI values for them are presented below:

– blend forests – 0.49 – 0.59;
– deciduous forests – 0.60 – 0.77.



a. Year 1985 b. Year 1993

c. Year 2000 d. Year 2005

e. Year 2009 f. Year 2016

Fig. 3 – Distribution of forest areas for Iasi County from 1985 (a), 1993 (b), 2000 (c), 2005 (d), 2009 (e) and 2016 (f).

A graphical analysis of the evolution of the forested areas for Iasi County between 1985 and 2016 is presented in Fig. 4, and in Table 4, the surface of forest areas at the moments taken in the analysis.

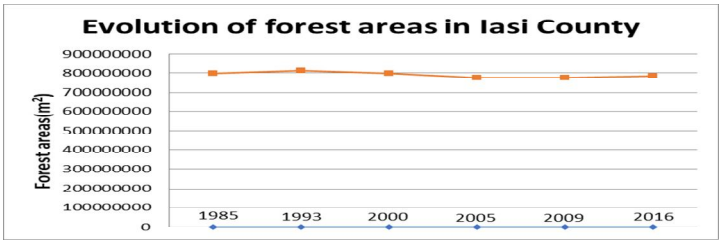


Fig. 4 – Evolution of forest areas in Iaşi County.

Table 4

Areas of Forest Areas at the Moments Taken In The Analysis

Year	1985	1993	2000	2005	2009	2016
Surface (m^2)	798.204.255	812.589.458	797.039.627	775.594.484	774.913.127	784.331438

Further graphic representation was made, which implies the percentage determination of the occupancy of the forest areas in Iasi county at the moments taken in the analysis. The charts are shown in Fig. 5.

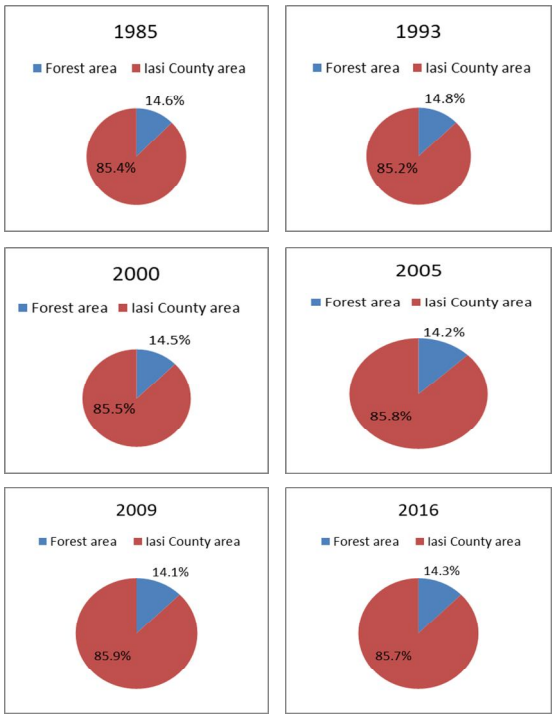


Fig. 5 – Representation of the forest areas for Iaşi county.

4. Conclusions

Analyzing the distribution of the areas of the forest areas in 1985 it is observed that there is a total of 79,820.4 ha, representing 14.76% of the total area of Iaşi County.

Analyzing the evolution of the areas of the forest areas it is noticed that there is an increase of them in 1993 reaching 81,258.9 hectares, followed by a successive decrease until 2009 when a total of 77,497.3 ha of forest areas is recorded. For 2016 there is a slight increase, with an area of 78,433.1 ha.

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ANALIZA EVOLUȚIEI SPAȚIULUI FORESTIER DIN JUDEȚUL IAŞI

(Rezumat)

Fondul forestier este suprafața totală a pădurilor, a terenurilor aflate în împădurire şi a zonelor care servesc nevoilor culturilor, producției şi gestionării forestiere. În această lucrare zona de studiu este județul Iaşi cu o suprafață totală de 5 476 km² din care suprafața ocupată de păduri reprezintă cca. 17,82%, respectiv 981,3 km² din suprafața totală a județului Iaşi.

În acest articol am analizat evoluția zonelor forestiere în perioada 1985-2016. Pentru o evidențiere mai precisă a acestei evoluții, am aplicat imagini satelitare pentru fiecare an de studiu cu programul Landsat. Procesarea imaginilor prin satelit a fost efectuată în programul ArcMap 10.1 furnizat de ESRI. De asemenea, am proiectat pentru fiecare an de studiu o hartă a zonelor împădurite. Procesarea hărților a fost făcută în AutoCAD prin digitizarea contururilor din zonele împădurite.