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INVESTIGATION OF ECOSYSTEMS IN THE PAZARDZHIK-PLOVDIV LOWLAND AREA

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Kamen Nam, Ilia Tamburadzhiev, Assen Assenov, Petko Bozhkov. INVESTIGATION OF ECOSYSTEMS IN THE PAZARDZHIK-PLOVDIV LOWLAND AREA

One of the most urbanized territories in Bulgaria is the Pazardzhik-Plovdiv lowland area. Therefore, with respect to the implementation of Action 5 of the EU Biodiversity Strategy to 2020, we consider it is relevant to carry out a mapping of ecosystems within this part of the Upper Thracian Plain.

For the purpose of the investigation, an already approved methodology for mapping ecosystems was used. It is based on the Mapping and Assessment on Ecosystems and their Services (MAES) typology, through preliminary differentiation of Land cover/Land use (LULC).

The research process is divided into two stages. The first stage is the determination of the CLC2018 land cover classes within the study area. The second stage comprises the differentiation of ecosystems in the Pazardzhik-Plovdiv lowland area by juxtaposition of the CLC2018 classes at level 3 with the ecosystem types at level 2 of the MAES typology.

Two categories of ecosystems of level 1 of the typological classification were differentiated – Terrestrial and Fresh water, including respectively 6 ecosystem types of level 2 in the first category and 1 ecosystem type of level 2 in the second category. The ecosystem types of level 2 are Urban, Cropland, Grassland, Forest and woodlands, Sparsely vegetated land, Wetlands, Rivers and lakes. The obtained results of the classification were visualized and cartographically formed using GIS. Results were also obtained regarding some spatial characteristics of the ecosystems in the study area.

Key words: ecosystems, mapping, MAES, LULC, CLC, Pazardzhik-Plovdiv lowland area.

INTRODUCTION

One of the most urbanized territories in Bulgaria is the Pazardzhik-Plovdiv lowland area. Intense and versatile anthropogenic activity in this part of the Upper Thracian Plain is a prerequisite for ecosystem degradation. Therefore, with respect to the implementation of Action 5 of the EU Biodiversity Strategy to 2020, we consider it is relevant to carry out a mapping of ecosystems within the Pazardzhik-Plovdiv lowland area.

The present study is an attempt to identify the types of ecosystems in the Pazardzhik-Plovdiv lowland area. This is done by juxtaposition of the existing types of land use and land cover in the study area with the types of ecosystems from the MAES classification.

The MAES classification is determined by the Working Group for Mapping and Assessment on Ecosystems and their Services (MAES), following Activity 5 of the EU Biodiversity strategy. Previous research in this field in Bulgaria has been done by Nedkov et al. (2017) and Grigorov and Assenov (2017).

The establishment of ecosystems in a given area is of essential importance for investigating the functioning and dynamics of the higher-level systems – the landscapes. The ecosystems are components (subsystems) of the landscapes, which gives us a reason to believe that the overall study of the regular manifestation of interaction between the natural and social processes in a given area goes firstly through determination of the nature and the structure of the ecosystems within the existing landscape units. It is the state of the ecosystems in a given landscape that is the main indicator of the degree of anthropogenic impact on the natural environment. That is why, when realizing a profound landscape-ecological research of a given territory, it would be good to study the different hierarchical levels in the organization of the systems – both landscapes and ecosystems, regardless of the perspective and focus of the study itself.

The present research represents both an initial stage in the process of a complete landscape-ecological investigation of the Pazardzhik-Plovdiv lowland area, and a basis for the further study of the ecosystems and the services produced by them in the investigated territory.

MATERIALS AND METHODS

The object of research are the ecosystems in the Pazardzhik-Plovdiv lowland area. According to Burel et al., 2003 (in Vranken, I. Quantifying…, 2015), ecosystems are one of the main organizational levels studied in the landscape ecology.

The aim of the present research is to identify the different types of ecosystems in the study area.

The study area covers the entire Pazardzhik-Plovdiv lowland area and has an area of 4017 km^2. A map of the study area is shown in Fig. 1.

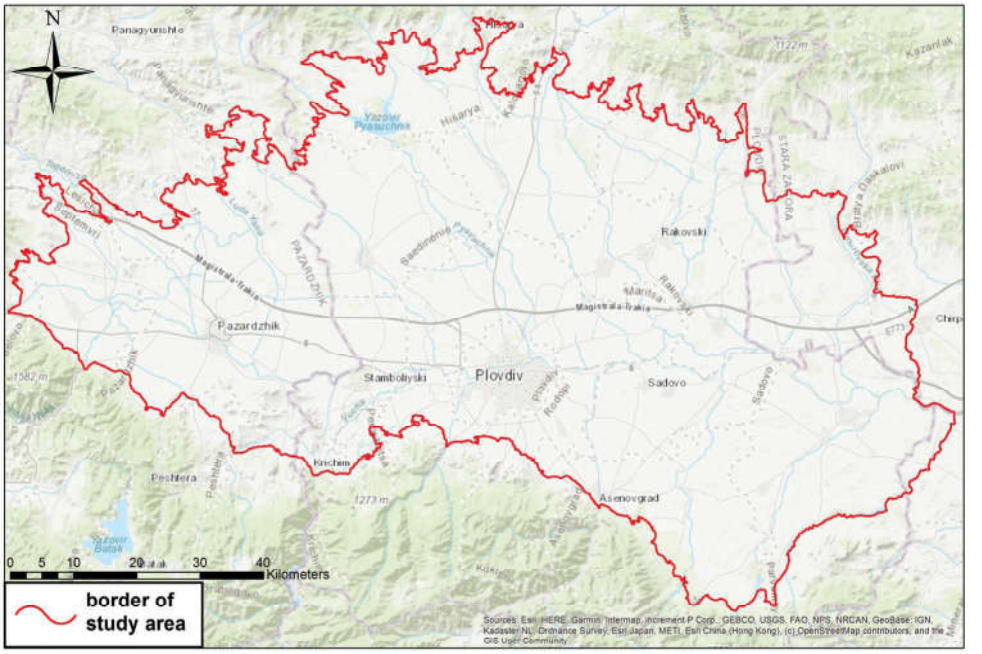

Fig. 1. Study area

The study area is part of the Upper Thracian graben. The lithological foundation is composed of alluvial and proluvial-deluvial deposits, and in places, mainly in the range of the internal hills, volcanic, sedimentogenic and metamorphic rock complexes are revealed on the surface. The territory is mostly lowland, with slight horizontal and vertical segmentation of the relief. The altitude varies from over 300 m in the contact zones with the foothills of the surrounding mountains, to less than 100 m in the eastern part of the lowland area. According to the principles of the European landscape classification (Mucher et al. 2010), as well as on the basis of previous studies of the region, it has been determined that the Pazardzhik-Plovdiv lowland area is a „lowland" in terms of the hypsometry and the relief segmentation. The climate is transitional continental. The hydrological features of the territory are related to the main hydrographic axis of the lowland area – the Maritsa River, its tributaries, as well as the presence of significant amounts of groundwater accumulated in the alluvial and proluvial-deluvial deposits.

For the purpose of the study, the CORINE Land Cover 2018 dataset is used (https://land.copernicus.eu/pan-european/corine-land-cover/clc2018). The focus is on label 3 of the CLC 2018 typology. The CLC 2018 label 3 classes are presented in Table. 1.

Table 1

Corine Land Cover 2018 Categories in the Pazardzhik-Plovdiv lowland area

CLC_ CODE	LABEL3	CLC_ CODE	LABEL3
111	Continuous urban fabric	242	Complex cultivation patterns
112	Discontinuous urban fabric	243	Land principally occupied by agriculture, with significant areas of natural vegetation
121	Industrial or commercial units	311	Broad-leaved forest
122	Road and rail networks and associated land	312	Coniferous forest
124	Airports	313	Mixed forest
131	Mineral extraction sites	321	Natural grasslands
141	Green urban areas	324	Transitional woodland-shrub
142	Sport and leisure facilities	331	Beaches, dunes, sands
211	Non-irrigated arable land	333	Sparsely vegetated areas
213	Rice fields	411	Inland marshes
221	Vineyards	511	Water courses
222	Fruit trees and berry plantations	512	Water bodies
231	Pastures		

Based on this information, a cartographic image was generated, visualizing the types of land cover in the studied area, presented in Fig. 2. Mapping and Assessment of Ecosystems and their Services (MAES) was used, which is an analytical framework for ecosystem assessments under Action 5 of the EU Biodiversity Strategy to 2020. After that, a juxtaposition was carried out between the CORINE Land Cover 2018 classes at label 3 and the MAES ecosystem types at level 2, which is presented in Table. 2. The analytical process is carried out with the help of GIS.

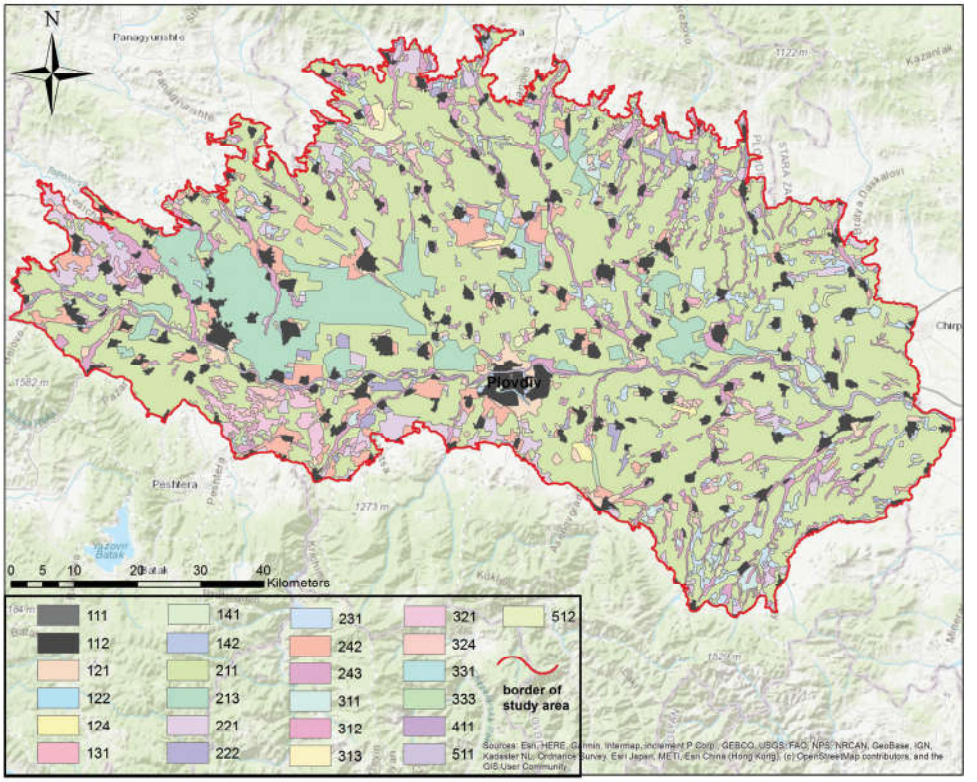

Fig. 2. CORINE Land Cover 2018 for the Pazardzhik-Plovdiv lowland area

RESULTS

Based on the descriptions of ecosystem types presented by Maes et al. (2013), a comparison was made between CORINE Land Cover 2018 classes at level 3 and the MAES ecosystem types at level 2, CLC2018 classes Continuous urban fabric, Discontinuous urban fabric, Industrial or commercial units, Road and rail networks and associated land, Airports, Mineral extraction sites, Green urban areas, Sport and leisure facilities are identified with the ecosystem type Urban. CLC2018 classes Non-irrigated arable land, Rice fields, Vineyards, Fruit trees and berry plantations, Pastures, Complex cultivation patterns, Land principally occupied by agriculture, with significant areas of natural vegetation are identified with the ecosystem type Cropland. CLC2018 class Natural grasslands is assigned to the ecosystem type Grassland. CLC2018 classes Broad-leaved forest, Coniferous forest, Mixed forest, Transitional woodland-shrub are identified with the ecosystem type Forest and woodlands. CLC2018 classes Beaches, dunes, sands, Sparsely vegetated areas are identified with the ecosystem type Sparsely vegetated land. CLC2018 class Inland marshes is identified with the ecosystem type Wetlands. CLC2018 classes

Water courses and Water bodies are identified with the ecosystem type Rivers and lakes. The results of the comparative analysis are visualized in Table. 2. It is noteworthy that the largest number of CLC2018 classes (7 out of 23) are assigned to Cropland ecosystems. The share of CLC2018 classes (6 classes), assigned to Urban ecosystems, is also high. These results are directly related to the intensive agricultural and urbanization processes in the Pazardzhik-Plovdiv lowland area, determined primarily by the natural conditions of the region and its cultural, historical and economic specifics.

Table. 2.
Juxtaposition between the CORINE Land Cover 2018 classes at level 3 and the MAES ecosystem types at level 2.

Major ecosystem category (level 1)	**Ecosystem type for mapping and assessment (level 2)**	**CLC2018 classes (label 3)**
Terrestrial	Urban	111, 112, 121, 122, 124, 131
	Cropland	211, 213, 221, 222, 231, 242, 243
	Grassland	321
	Forest and woodlands	311, 312, 313, 324
	Sparsely vegetated land	331, 333
	Wetlands	411
Freshwater	Rivers and lakes	511, 512

Within the scope of the Pazardzhik-Plovdiv lowland area are presented 7 types of ecosystems from the MAES classification, divided into two categories. These are urban (348 km^2), cropland (3398 km^2), grassland (39 km^2), forest and woodlands (159 km^2), Sparsely vegetated land (3 km^2), wetlands (1 km^2) in the terrestrial category and rivers and lakes (69 km^2) in the freshwater category. The share of the types of ecosystems in the studied area is shown in Fig. 3, and their spatial arrangement is visualized on the map of Fig. 4.

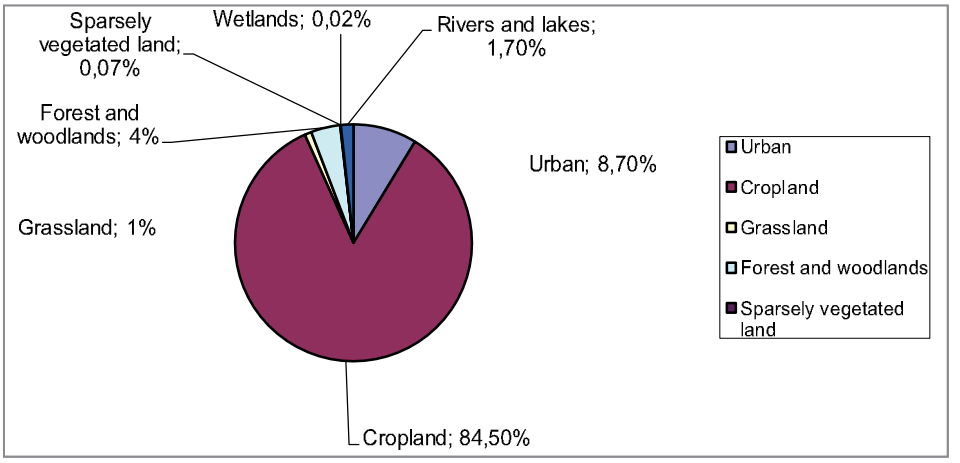

Fig. 3. Distribution of the MAES ecosystem types at level 2 in the Pazardzhik-Plovdiv lowland area

Cropland ecosystems have the largest share in the Pazardzhik-Plovdiv lowland area. They occupy 84,5% of the study area. They are characterized by a significant variety of agricultural crops and are evenly distributed. Favorable geomorphological, hydro-climatic and soil conditions determine the successful development of agriculture on almost the entire territory of the Pazardzhik-Plovdiv lowland area. The main crops cultivated in the area are cereals (rice, wheat, corn), industrial crops (sunflower, *Gallicanae*, lavender), vegetables and fruits.

In second place, with 8.7%, are Urban ecosystems. They are represented by urban and rural settlements. In the study area is the second most populous city in Bulgaria – Plovdiv – which has significant demographic and economic potential. Other big urban settlements in the study area are Pazardzhik, Stamboliyski, Parvomay, Rakovski, as well as the cities located in the peripheral contact zone with the foothills such as Asenovgrad, Krichim and Hissarya. The predominant part of the rural settlements is characterized by a relatively large built-up area, which is associated with a relatively larger number of inhabitants. On the other hand, the settlement network is less dense compared to the mountainous areas, which is a reflection of the geomorphological features of the territory and the opportunities for agricultural development.

Forest and woodlands ecosystems occupy 4% of the territory of the Pazardzhik-Plovdiv lowland area. They are represented by separate, small in area and strongly anthropogenically transformed forest massifs of *Quercus pedunculiflora*, *Quercus robur*, in places mixed with *Acer campestre* and *Quercus cerris*. Separate massifs of *Ulmus minor*, *Alnus glutinosa*, *Salix*, *Populus nigra* and *Populus alba* are found along the Maritsa River and its tributaries, mainly in the eastern part of the lowland area. In the southeastern part of the Pazardzhik-Plovdiv lowland area there are separate forest massifs of *Quercus frainetto*, *Quercus pubescens* and *Quercus virgiliana*, and in some places – *Carpinus orientalis*.

Rivers and lakes ecosystem type occupy 1,7% of the area of the Pazardzhik-Plovdiv lowland area. They are represented mainly by the Maritsa River, as well as by the dams and micro-dams in the region, the largest of which is the Pyasachnik Dam.

Grassland ecosystems are distributed mainly in the area of the Besaparski ridges, representing only 1% of all types of ecosystems in the study area. Xerothermic grass formations Dichantieta ischaemi, Poaeta bulbosae, Chrysopogoneta grylli and Ephemereta are typical.

Sparsely vegetated land and wetlands occupy respectively 0,07% and 0,02% of the studied area of the Pazardzhik-Plovdiv lowland. Sparsely vegetated lands are characteristic of separate sections of the Besaparski ridges. Wetlands may have occupied a larger area in the past, but after the intensification of agricultural activity and the need to drain wetlands and to free more arable land, their area has decreased significantly. It is not at the expense of the wetlands that in the present study rice fields are considered as part of cropland ecosystems because they are indisputably one of the main types of agricultural landscapes, i.e. have a markedly anthropogenic structure.

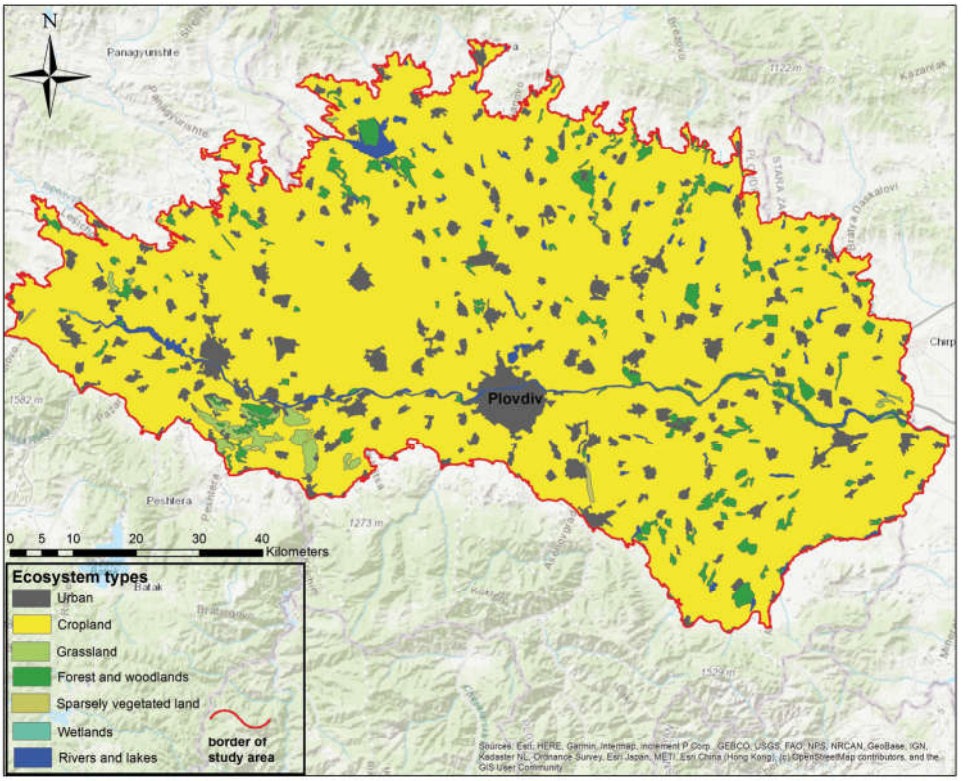

Fig. 4. Ecosystem types in the Pazardzhik-Plovdiv lowland area

CONCLUSIONS

Seven ecosystem types from the MAES typology have been identified in the Pazardzhik-Plovdiv lowland area, divided into two categories – urban, cropland, grassland, forest and woodlands, sparsely vegetated land, wetlands from the terrestrial category, and rivers and lakes from the freshwater category. Croplands have the largest spatial distribution – 84,5%. Wetlands have the smallest share – 0,02%. Cropland and urban are relatively evenly distributed over the study area, while grassland and sparsely vegetated land are distributed mainly on the Besaparski ridges. Rivers and lakes are represented by the Maritsa River, as well as the dams and micro-dams in the lowland area. Forest and woodlands are fragmentarily distributed and their concentration is more significant in the northeastern and southeastern part of the Pazardzhik-Plovdiv lowland area, as well as in the contact zone with the surrounding mountain massifs.

Ecosystem mapping is a fundamental and initial step in the process of complete assessment of their condition. The present research can be useful as a basis for the

development of future research processes related to the assessment of ecosystem services in the Pazardzhik-Plovdiv lowland area.

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