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Article

Pasture spatial variability in floodplain areas of Northeastern Romania

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Abstract. Detecting grassland spatial variation has become a major step for a correct assessment and suitable management of the grassland ecosystem. With the global concern to halt land degradation and biodiversity loss, grassland sensitivity has become a subject of intensive research. Regarding our study region, following, on one side, the historical and politico-administrative evolution, and, on the other side, the landform structure, grasslands are spread as patches along the cuesta hillslopes and floodplains. Starting from that, we have established a biogeomorphological grassland classification which includes two main types: hilly grassland and floodplain grassland. In our attempt to identify the major land use changes impacting the grassland areas, we have identified the floodplain grasslands as the most exposed to successive variability and irreversible changes in many ways. Floodplains are unique biomes with many biological, ecological, and hydrological functions, mainly covered by grassland and used for animal grazing or periodic mowing. Even so, the anthropogenic impact has been marked through various changes in the matter of land use and land cover. To assess this dynamic, we have intended a complex analysis based on historical maps, and remote sensing data, collected between 1920 and 2018. Some of the major changes have been recorded during the inter-war and the communist eras, as a direct result of economic and political variability. The pastureland was mainly gained from wetlands and substituted by cropland during the big inter-war crisis, and reconverted afterward, due to the communist land use planning program. In an attempt to identify the real cost of land use changes in the floodplain areas, we have investigated all the changes that occurred. In some cases, the applied measures were meant to protect a territory or a land use class, even if the result was quite the opposite, as is the case of urban areas affected by floods, in the '60-'70s.

Our study aims to identify the floodplains' land cover dynamics during the last century, as the land cover assessment has become a subject of global interest because of the urgent necessity of

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food security and supply. Raising the problem at this level, accurate management of land use could be achieved only with a complete understanding of past changes and errors.

Keywords: grassland, spatial variation, land use, land use changes, floodplains

Résume. La détection des variations spatiales des prairies est devenue une étape importante pour une évaluation correcte et une gestion adaptée de l'écosystème des prairies. La sensibilité des prairies fait l'objet de recherches intensives dans le cadre de la préoccupation mondiale visant à mettre un terme à la dégradation des sols et à la perte de biodiversité. En ce qui concerne notre région d'étude, suite à l'évolution historique et politico-administrative, d'une part, et à la structure du relief, d'autre part, les prairies sont réparties en parcelles le long des pentes des collines de la cuesta et de la plaine d'inondation. À partir de là, nous avons établi une classification biogéomorphologique des prairies qui comprend deux types principaux : les prairies de collines et les prairies de plaines inondables. Dans notre tentative d'identifier les principaux changements d'utilisation des terres ayant un impact sur les zones de prairies, nous avons identifié les prairies de plaine d'inondation comme étant les plus exposées à la variabilité successive et aux changements irréversibles d'une manière ou d'une autre. Les plaines d'inondation sont des biomes uniques dotés de nombreuses fonctions biologiques, écologiques et hydrologiques, principalement couvertes de prairies et utilisées pour le pâturage ou le fauchage périodique. Malgré cela, l'impact anthropogénique a été marqué par divers changements en matière d'utilisation et d'occupation des sols. Pour évaluer cette dynamique, nous avons prévu une analyse complexe basée sur des cartes historiques et des données de télédétection, collectées entre 1920 et 2018. Certains des principaux changements ont été enregistrés pendant l'entre-deux-guerres et l'ère communiste, en conséquence directe de la variabilité économique et politique. Les pâturages ont été principalement gagnés sur les zones humides et remplacés par des terres cultivées pendant la grande crise de l'entre-deux-guerres, puis reconvertis par la suite, en raison du programme communiste d'aménagement du territoire. Afin d'identifier le coût réel des changements d'utilisation des terres dans les zones inondables, nous avons étudié tous les changements qui se sont produits. Dans certains cas, les mesures appliquées visaient à protéger un territoire ou une classe d'occupation des sols, même si le résultat a été tout à fait contraire, comme dans le cas des zones urbaines touchées par les inondations dans les années 60 et 70.

Notre étude vise à identifier la dynamique de l'occupation du sol des plaines inondables au cours du siècle dernier, car l'évaluation de l'occupation du sol est devenue un sujet d'intérêt mondial en raison de la nécessité urgente d'assurer la sécurité et l'approvisionnement alimentaires. En soulevant le problème à ce niveau, une gestion précise de l'utilisation des terres ne peut être réalisée qu'avec une compréhension complète des changements et des erreurs du passé.

Mots-clés: prairies, variation spatiale, utilisation des sols, changements d'utilisation des sols, plaines d'inondation

Introduction

Grassland represents one of the most common land use types globally (Ali et al., 2016; Hardy et al., 2021), with continuous dynamics, mainly triggered by climatic variability and land use changes (Afuye et al., 2022, 2021; Jong et al., 2012; Tucker et al., 2001). Occupying almost a quarter of the land surface, grassland is seen as one of the most widespread terrestrial ecosystems (Gang et al., 2014, 2016; Liu et al., 2019; Scurlock and Hall, 1998a), with significant impact on soil quality, by regulating the carbon cycle (Ali et al., 2016; Scurlock and Hall, 1998b), soil and water conservation (Wu et al., 2021), erosion reduction (Smit et al., 2008), and biodiversity management (Bergman et al., 2008; Pokluda et al., 2012; van Swaay, 2002), being the habitat of over 8 hundred million human beings (Pereira et al., 2017) and the main source of herbivores feed (Serrano et al., 2021). Grassland ecosystems are variable in the matter of species composition, biodiversity, productivity, management (Wijesingha et al., 2020), and spatial distribution.

Historically speaking, grasslands have been an area of expansion for land use (White et al., 2001; Dixon et al., 2014), the most fertile lands being converted to crops, mixed farming, or artificial pastures (Suttie et al., 2005).

At the European level, grasslands cover more than a third of the agricultural area (FAO, 2006) being considered the most in-danger ecosystem, with the highest level of sensitivity (Janssens et al., 1998; Silva et al., 2008; Goret et al., 2021), specifically due to land use changes, abandonment, overgrazing and reforestation (Goret et al., 2021; Habel et al., 2013; Peeters, 2009).

Overall, the main cause of the grassland global loss remains the conversion to cropland (Michalk et al., 2019). The main affected areas of Eastern Europe, because of land use transitions, are the lowlands, due to their high degree of accessibility (Török and Dengler, 2018). The main common conversion of the grasslands is in cropland, forest, and settlements (Török et al., 2020).

As a result of these changes, over the last 200 years, 50% of the grassland areas have disappeared (Török and Dengler, 2018), the loss being quantified in grassland territories, but also in grassland types (Biró et al., 2018).

Concerning a correct assessment of grassland spatial variation, it becomes necessary to acknowledge the main grassland types. Since in Eastern Romania, the usage and type of grassland are often unclear, the gap must be filled to be able to identify the future possible ecosystem threats and the right way to manage them properly. A classification has been adapted for the Moldavian Plateau starting from the European and Eastern European classifications, well presented in the literature, synthesized in Table 1 (Dengler and Tischew, 2018; Hejcman et al., 2013; Schils et al., 2022; Török et al., 2020, 2016). We may mention that in some sort of ways an original footprint has been established.

Table 1. Grassland typology for Moldavian Plateau – adaptation from the international literature

Temperate grassland of Moldavian Plateau	Non-Stepic Grassland	Natural Non-Stepic Grassland	Halophyte Grassland
			Sandy and Löessoid Grassland
			Rocky Grassland
		Semi-Natural Non-Stepic Grassland	Dry and Semi-Dry Grassland (located on the slopes)
			Mesic to Wet Grassland (located on the floodplains)
		Anthropic Grassland	
	Stepic Grassland	Natural Stepic Grassland	
		Semi-Natural Stepic Grassland	

A very important thing to be established for this present study is the difference between *grassland* and *pasture*. The term grassland has been used specifically for describing all the herbaceous vegetation, regardless of how this is used. Pasture is seen as a specific land use type, dedicated to herbivores' feed, through grazing and periodic mowing. Pastures are seen as a main component of grassland, with a very specific utility and importance inside the whole ecosystem.

Another barrier imposed in the way of a correct analysis has been the equivalent of the terminology in the Romanian language, where the term pasture (ro: *pășune*) is used generically for any type of grassy land cover, except the protected areas characterized by natural or seminatural grassland called *pajiști (natural grassland)*. In terms of usage, the Romanian grasslands are dedicated to grazing – rangeland (*ro: islaz*); mowing – pastureland (*ro: fâneață*), or both - meadow/floodplain (*ro: luncă*). To eradicate any sort of confusion, we will use the term grassland when we refer generally to any grassy land cover, and the term pasture when we refer to the grassy type landscape used for any agricultural purposes, or precisely to the land use class.

In our study, we aim to highlight a sort of typical characteristic of the Moldavian Plateau region in terms of grassland pattern, following, on one side, the historical and politico-administrative evolution, and, on the other side, the landform structure. Starting from that, we have tried to classify the grassland in a biogeomorphological sort of way.

Grasslands are spread as patches along the cuesta hillslopes and floodplain areas due to (i) their inappropriate landform characteristics, to be used as croplands, (ii) successive or unpredictable floods, and (iii) the perception regarding grasslands, as spare land areas (Văculișteanu et al., 2022).

Therefore, from a biogeomorphological point of view, we classify the Moldavian Plateau grasslands as *hilly (slope) grassland* and *floodplain grassland*, with definitory characteristics for each. The influence of landforms/geomorphology on the distribution and development of plants has been well established once with the concept development of biogeomorphology (Viles, 2020)

Various elements related to the slope have consequences on vegetation development. For instance, the slope aspect affects vegetation structure (Badano et al., 2005), species composition (Gong et al., 2008), and soil properties (Kölbl et al., 2011). Apart from the topographic influence, soil, and climate are the main driving forces of grassland perpetuation. Originally speaking, steppe-like grassland is considered climatogenic grassland which appears in climates that are too dry to sustain forests (Dengler et al., 2014), being converted once with human development, in cropland, due to their soil fertility (mostly chernozems) (Török et al., 2016). As a direct result of past conversions, nowadays, grassland occurs in areas where intensive cultivation is not possible due to unfavorable conditions, such as waterlogging, steep slopes, or aridity (Gibon, 2005; Reinermann et al., 2020; Suttie et al., 2005). These are the cases of steep slopes or hilly tops, where much of the natural grass vegetation has been conservated, and the floodplain areas, which are exposed to high water levels and a greater frequency and duration of flooding (Brotherton et al., 2019).

Floodplains hold a profound significance when viewed through the lens of land cover changes, as they play a pivotal role in shaping the landscape and influencing both natural and human-driven transformations (Chakraborty, 2021). Floodplains are unique and vital ecosystems. They support unparalleled levels of biodiversity (Tockner and Stanford, 2002) and are among the most productive landscape types. Human encroachment of natural floodplains has resulted in altered floodplains through land use and levee development, disconnecting and nullifying many of the ecosystem benefits (Rajib et al., 2023). Land-cover changes in and around the floodplains of major rivers are a permanent subject of scientific discussion since those areas have considerable economic and ecological importance and were continuously affected by human activities in the course of historical development (Karpack et al., 2020).

Human modifications to floodplains include changes in land use from activities such as urbanization, agriculture, industry, and mining. In response to that, land cover change assessment in floodplain areas has become a subject of interest in many scientific fields, such as agriculture, spatial planning (Kucsicsa et al., 2015), ecology (Vijulie et al., 2019, Xu et al., 2017) and natural hazards (Hohensinner et al., 2021).

Most floodplains are usually composed of a mosaic of land uses including natural habitats and cultivated lands, being considered multifunctional ecosystems (Felipe-Lucia and Comín, 2015; Posthumus et al., 2010; Tockner and Stanford, 2002). Unfortunately, recent studies indicated that approximately 80–90% of floodplains across Europe have been intensively cultivated (Rajib et al., 2023, Xu et al., 2017).

Iasi County, located in the North-east part of Romania, is drained by the biggest rivers from Eastern Romania: Prut, Siret, and Moldova, each one with its tributary rivers. Over time, Romania experienced frequent hydro-climatic disasters such as flooding. After the catastrophic flood in 1932, the authorities began to implement flood defense solutions. These were continued in the communist period (especially after the 1970-1980 floods) through the implementation of hydro-technical solutions and measures: regularization of river courses, drainage of river beds, and construction of reservoirs (Doru, 2018). These measures were the major premise in the radical change of the land use structure along the floodplains.

According to a recent study by Văculișteanu et al., (2022), the main land use type characteristic of floodplain areas in the Moldavian Plateau is pasture.

Floodplain pastures have been specific to the eastern part of Romania since the socialist period when land use planning involved appropriate management following soil properties and topographic accessibility, the floodplains being reconverted from cropland (as they were converted during the inter-war period) in their initial state of natural vegetation – pastures (Văculișteanu et al., 2022).

Floodplain pastures are wetlands with an enormous ecological importance and biological diversity (Toogood et al., 2008), defined by plants and associated biodiversity adapted to particular hydrological regimes (Brotherton et al., 2019), with species considered indicators of hydrological changes, providing nutrient cycling, pollution removal, carbon sequestration, and flood attenuation (Toogood et al., 2008). The value of this precious ecosystem has been degraded or in some cases destroyed in recent decades as a result of land use intensification, mainly due to flood control and drainage, and the conversion to cropland (Toogood et al., 2008).

Some of the most important land use changes have occurred at the floodplain level during the last century (Văculișteanu et al., 2022). We will focus in this paper on investigating the impact of the land use changes on pasture evolution and usage.

Study area

Iași County (5477 km^2) is situated in the northeastern part of Romania in a hilly region, known as the Moldavian Plateau (Figure 1), with an altitudinal range of 30 to 580 m above sea level. The study area overlaps several physiographic units, which have a strong influence on the evolution of land use and land cover changes. The main units are the Jijia Hills (Niculiță, 2020), the Central Moldavian Plateau, the Suceava Plateau, and the main river floodplains (known as corridors): Moldova, and Siret in the west, Bahlui, Jijia, and Miletin in the center part and Prut in the east. The floodplains are around 3 to 6 km wide, especially the Siret and Prut Corridors.

Data

To assess the land use and land cover changes of floodplains in Iasi County, we have used eight land use datasets, that were labeled as follows: 1920, 1960, 1980, 1990, 2000, 2006, 2012, and 2018. The land cover data from 1920, 1960, and 1980 were extracted from historical topographical maps available for the study area. The Moldavian Topographic Atlas (1:50,000—Cassini projection) and the Army plans (1:20,000—Lambert-Cholesky projection), where the floodplains are marked as wetlands or pastureland by conventional signs, were used to create the 1920 database. The 1960 and 1980 datasets have been created based on topographic maps: First edition: 1960-1962 and Second edition: 1972–1981 at scale 1:25,000. To increase the accuracy of the acquired database, Corona high-resolution imagery, aerial imagery from 1950, 1960, and 1970, and Landsat 5 satellite imagery were used. The DEM data (LiDAR and SRTM) was used to validate the floodplain extension from a geomorphometric point of view (Doru, 2018).

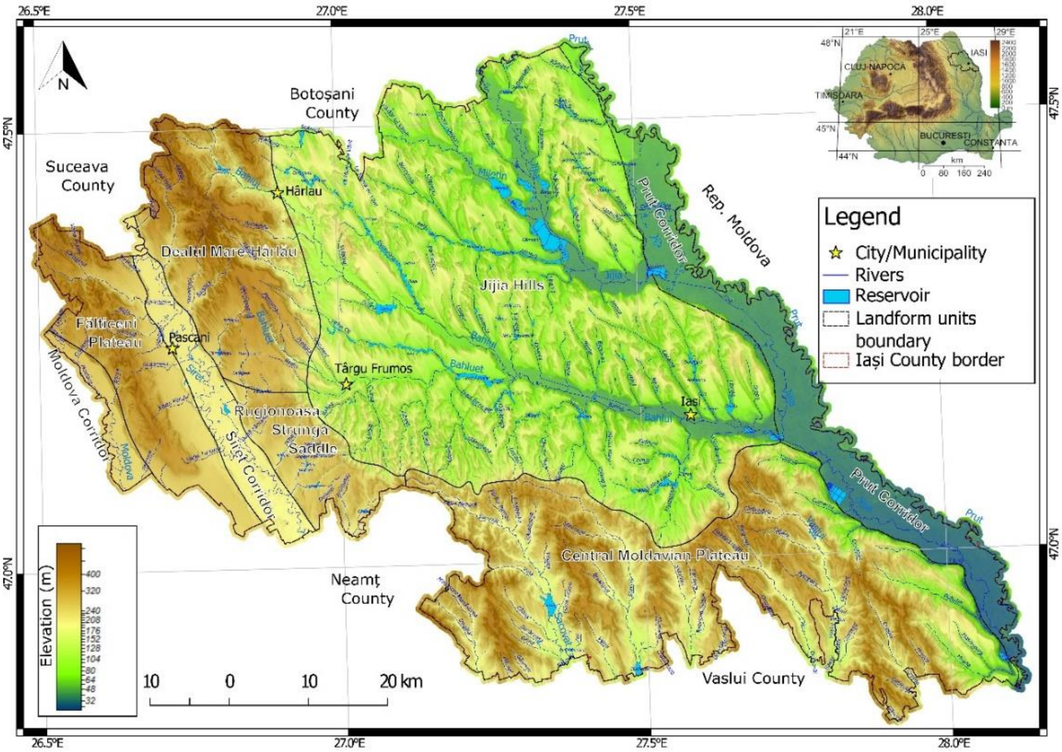

Figure 1. The geographic localization of the study area
Source: authors

The CORINE Land Cover database (1990, 2000, 2006, 2012, and 2018) was used as a backup, being verified against satellite/ aerial imagery and field surveys to check the errors and improve the accuracy. Particular attention was offered to floodplains, where whenever to correctly distinguish between pastureland and cropland, multiple sources of information were needed.

Some other detailed information related to data sources and methodology was published also by Doru (2018) and Văculișteanu et al., (2022).

Methodology

The land cover databases have been integrated into a GIS environment, the classes being merged to obtain the land use database (Doru, 2018; Văculișteanu et al., 2022). As a result, 6 main land cover classes were defined: (1) Urban and built-up - cities, villages, and other built-up areas; (2) Cropland - arable land and/or areas where agriculture is practiced, (3) Pastureland - areas used as pastures or meadows, (4) Forest and woodland - areas covered by forest or forest vegetation, (5) Wetland - areas covered by water or hydrophytic vegetation, flood zones, recorded on maps and (6) Water – watercourses and adjacent areas, reservoirs and ponds.

The CLC 1990 - 2018 datasets were checked and corrected based on several available cartographic materials: orthophoto imagery (data description), satellite imagery (data description – Landsat Sentinel, vegetation indices), and Google Earth imagery. This step was mandatory due to misinterpretation of land cover classes or poor thematic accuracy. The digitized maps were transformed into raster files with a cell size of 5 m x 5 m. We used R version 3.1.0 (R Core Team) to compare the surface and the changes in the land cover structure. A graphic representation of the results has been processed with Package 'waffle' (Rudis 2023) which provides a better overview of the data.

In the process of floodplain delineation, a DTM of 30x30m was used to mark the separation between the floodplain zone and the terraces. This process involved the necessity to find the threshold between these two geomorphological landforms (Rajib et al., 2023, Necula and Niculita 2023).

Results

In Figures 2 to 9, the spatial distribution of six classes of land use generalized from the land cover data is shown for the floodplains of major rivers of Iași County: Prut, Siret, Moldova, Jijia, Bahlui, Bahluieț and Miletin. The accurate analysis of the floodplain land use dynamic has revealed an interesting pattern in the 1920s when almost all the floodplain areas were considered wetlands (Figure 2). Mostly triggered by the climatic conditions, the period post-1920, the wetlands decreased due to a dry period reported between 1950 and 1960 (Pelin, 2015) when the annual average precipitation was below 500 mm in most of the years. In Figure 10 are the waffle plots on which the overall evolution of land use data can be grasped visually. The graphical results clearly show the overall extension of the pastures in the 1920 to 1960 period (almost three-fold), followed by a decrease to almost 30% in 1980 triggered by the communist regime's ascension. The hydrographic management which involved some floodplain drainage measures, led to conversions from areas with excess moisture into arable land or pasture. On the other side, the construction of reservoirs, especially after 1960, led to the replacement of arable land and pastures with water surfaces, mainly represented by ponds (Dorna, Recea, Alexandru cel Bun I and II, La Moara, Cerchezoaia, Rădeni, Stângăceni, Ureche I, and II, Cârjoaia I and II, Savia I and II, Cicadaia, Boureni, Podişu, Dobre, Mădârjeşti).

After this period a small decline is registered up to 1990. After 1990 there is an increase to a little more than 30%, together with general growth of built-up areas in floodplains through pasture conversion. Following the 2000s, a slow decrease in the pasture was registered, up to 26%.

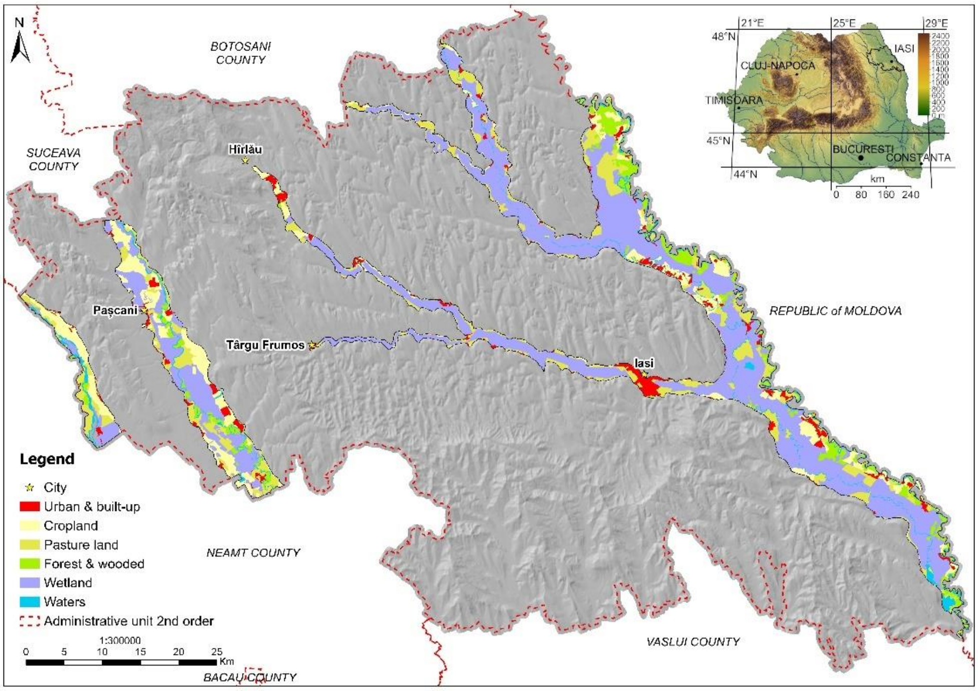

Figure 2. The 1920 floodplains land-use dataset for Iasi County
Source: authors

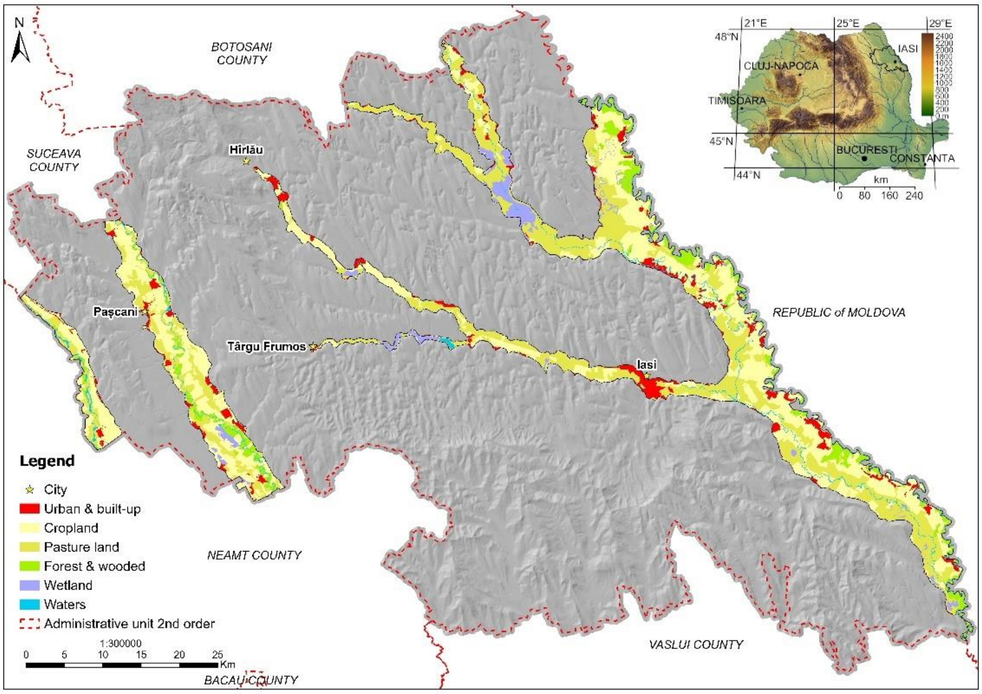

Figure 3. The 1960 floodplains land-use dataset for Iasi County
Source: authors

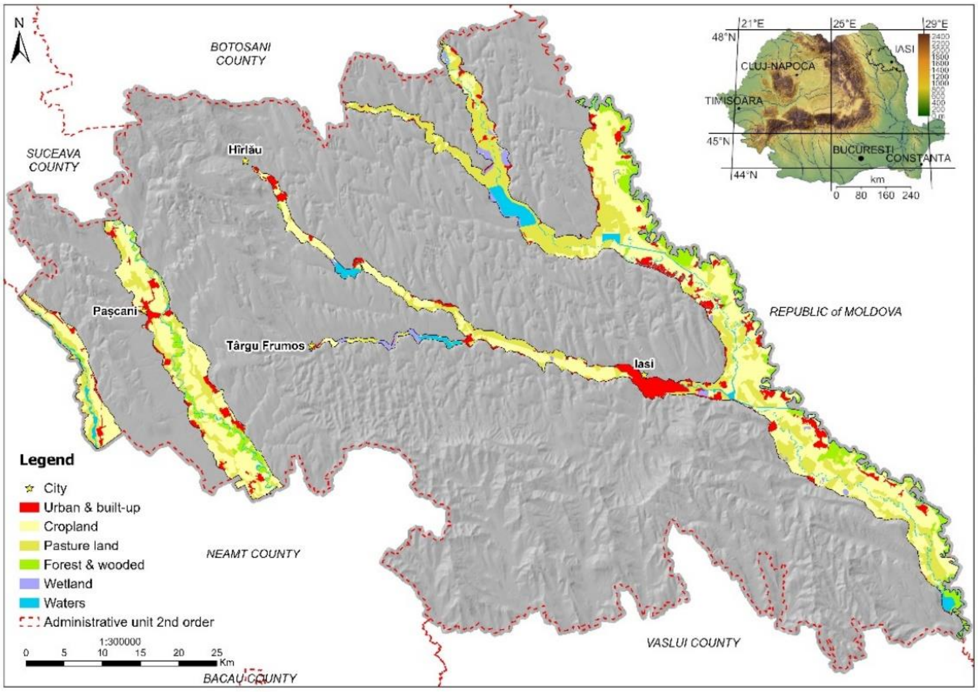

Figure 4. The 1980 floodplains land-use dataset for Iasi County
Source: authors

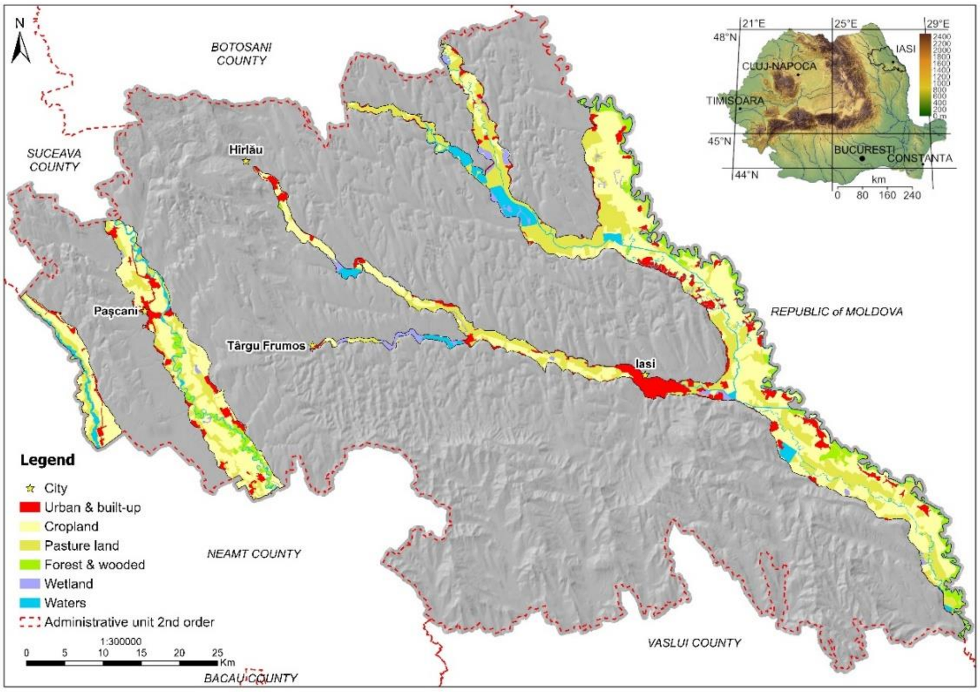

Figure 5. The 1990 floodplains land-use dataset for Iasi County
Source: authors

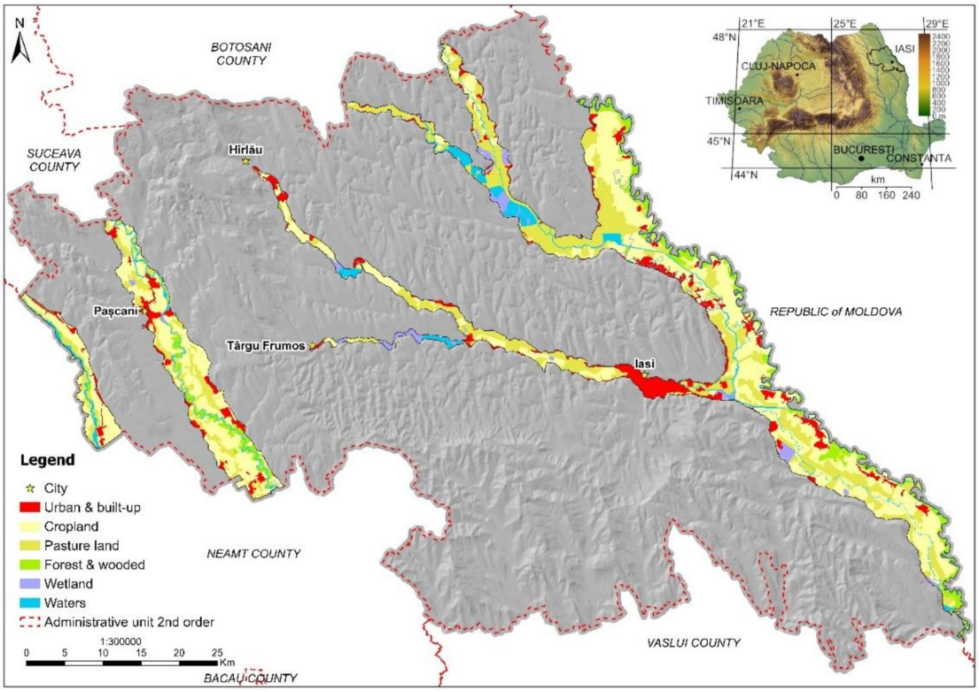

Figure 6. The 2000 floodplains land-use dataset for Iasi County
Source: authors

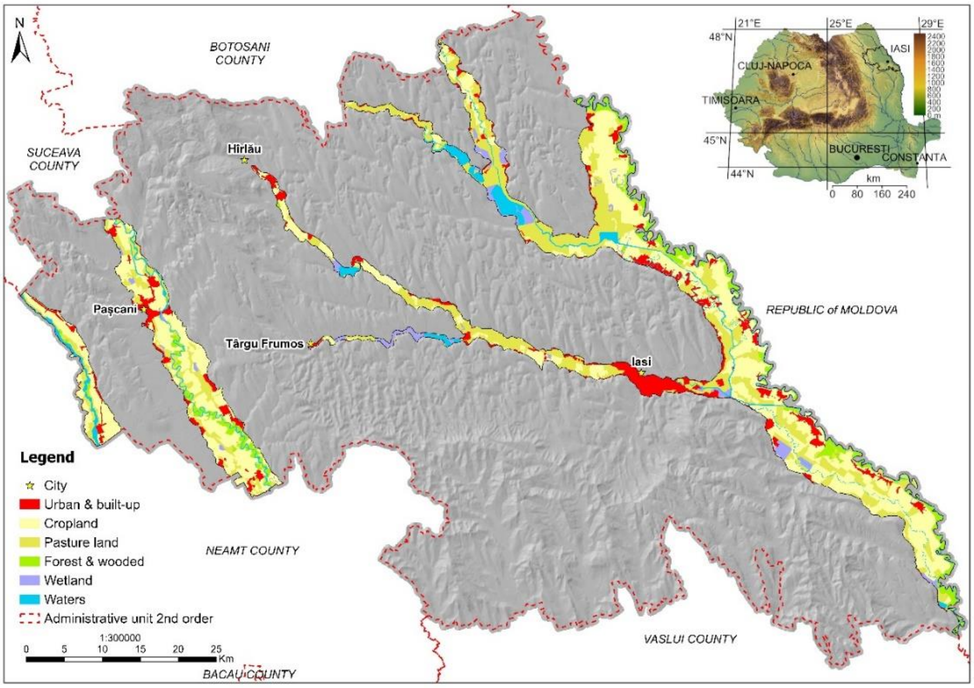

Figure 7. The 2006 floodplains land-use dataset for Iasi County
Source: authors

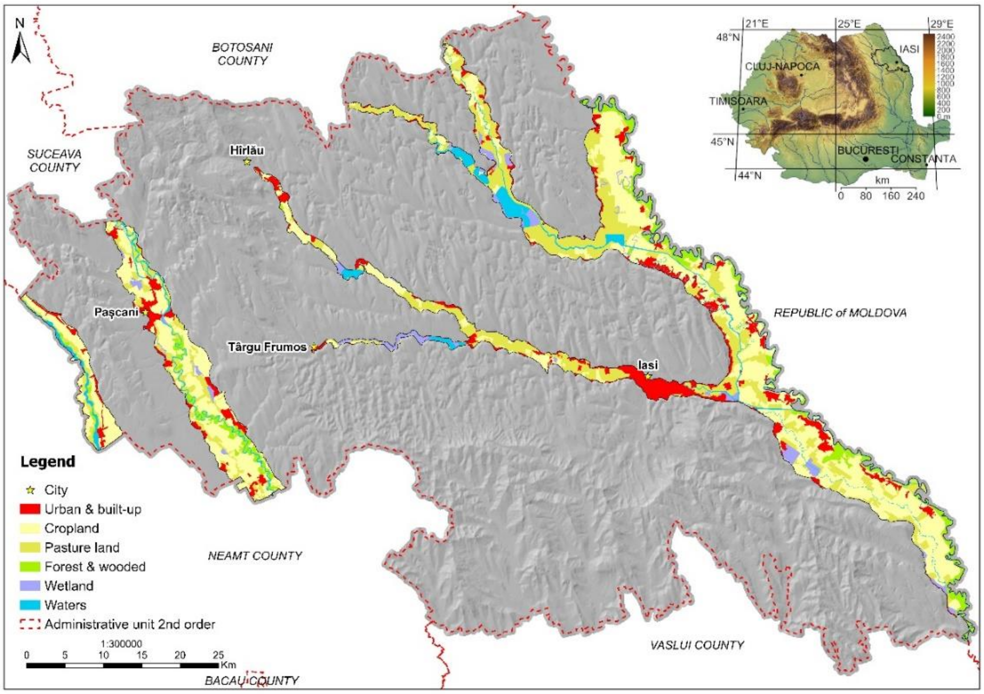

Figure 8. The 2012 floodplains land-use dataset for Iasi County
Source: authors

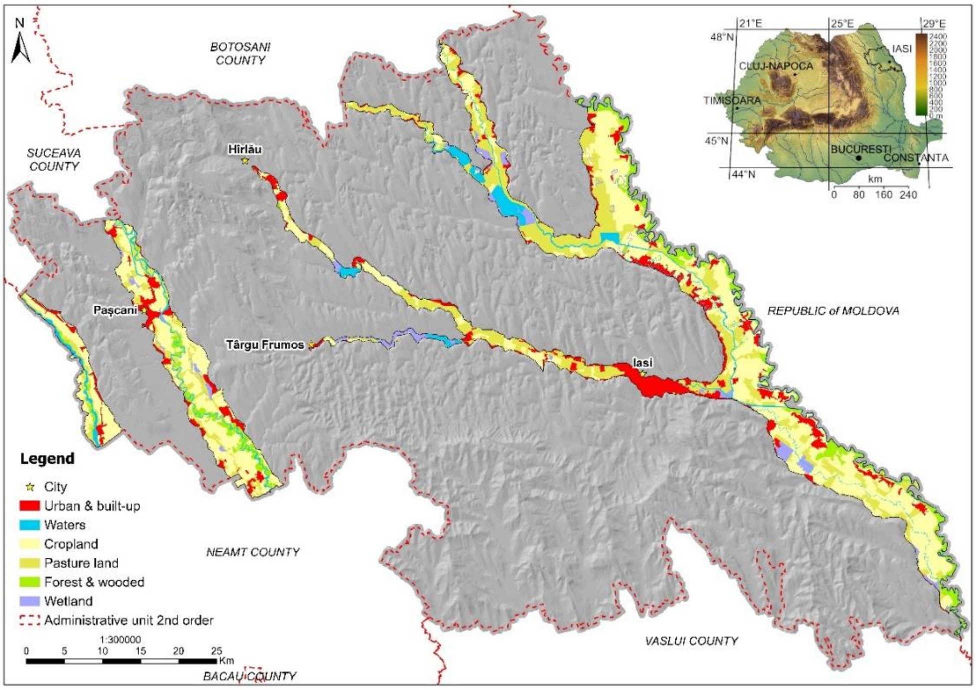

Figure 9. The 2018 floodplains land-use dataset for Iasi County
Source: authors

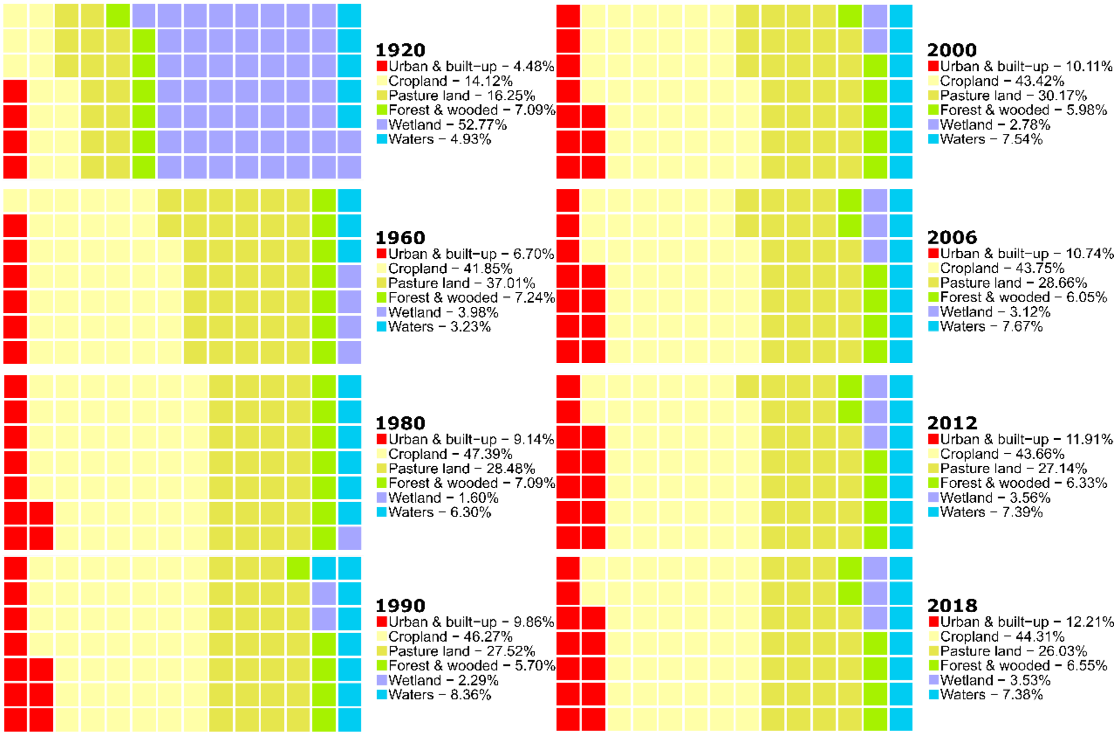

Figure 10. Floodplains land use classes (%) for the 1920-2018 period

Source: authors

Discussion

Generally, floodplains have been transited by various land-use types, especially due to human interventions. The Eastern European countries have phenomena typical setting, different from the Western European countries, mainly related to the political transitions and the imposed land reforms (Văculișteanu et al., 2022).

According to the existing scientific literature, during the time, the floodplains from the Moldavian Plateau evolved through some specific processes:

- the occurrence of frequent flooding, especially in the spring season, or during torrential rains, (Sevastos, 1908) when the runoff occurs with the highest frequency (47%) (Pantazică and Schram, 1967);
- the drying of the small river channels during summer, as is the case for some of the tributaries of Jijia (Miletin) or Bahlui (Bahluieț);
- the presence of the pond basins, flooded only when the situation imposed, characterized along with time, through thick sedimentary deposits and excess moisture (Martiniuc et al., 1956; Pantazică and Schram, 1967);
- the existence of oxbow lakes, especially in the joint Jijia-Prut floodplain (Sevastos, 1908);

- the presence of "honeycombs" surfaces ("coșcove") that appear on the plain sectors of the floodplain, with clayey or loamy deposits that contain salts, and which consist of a micro-relief of ovoid depressions with lengths of up to 3 m, widths of up to 2 m and depths of up to 50 cm (Bucur, 1960); these microforms persistence is due to excess moisture triggered by rainwater stagnation on flat surfaces with poor drainage;
- the existence of mud volcanoes, which in the Moldavian Plateau have a circular shape like a depression of 1-10 m in diameter filled with water or mud from which CO_2 emerges, being surrounded by areas with muddy and salty crusts; the natural gas source is related to the decomposition of organic matter accumulated at certain levels of the alluvial material or of the Sarmatian geological deposits, within the floodplain or some geological deposits; these microforms are located in the Jijia floodplain at Țigănași, the Bahlui floodplain at Ceplenița, the floodplains of the tributaries of Nicolina on Şesul Bârca – Ciurbești and at Vocotești, and the Cacaine floodplain at Cârlig (Băcăuanu, 1966).

In an attempt to properly assess the floodplain evolution and transition, we have clustered the analysis period into four main phases: (i) the inter-war period (1920-1945), (ii) the communist period (1945-1989), (iii) the post-communist period (1990-2003), and (iv) the post-transition period (pre- and post-accession to UE: 2004-present).

During the (i) inter-war period, some of the most important land use transitions were registered from wetlands to pastures and from pasture to arable land, as a consequence of natural climate dryness and the emergent necessity for food, recorded at that time (Văculișteanu et al., 2022).

Representing a transition land between terrestrial and aquatic ecosystems, wetlands are valuable natural resources with enormous benefits for the environment (Mahdavi et al., 2018), characterized by significant spatial and temporal variability (Gallant, 2015; Moser et al., 2016). Globally, around 57% of the wetlands have been converted to crops and settlements (Mahdavi et al., 2018), or have disappeared (Davidson, 2014).

Wetland areas are large units with gentle slopes, reporting long-term periods of water stagnation. Precisely, by reference to our study region, the wetlands have been characterized by a distinguished dynamic. Most of the wetlands are found along the main floodplains of Prut, Jijia, Bahlui, and Siret, and locally along smaller river channels. Naturally, during wet cycles, the wetland expands, while during dry cycles, it naturally becomes grassland, followed in some cases by the conversion to pasture or cropland. According to the data extracted from the cartographic materials from 1920, wetlands represented approximately 10% of the Iași County surface.

The second period was marked by the most significant losses of wetlands that occurred during the (ii) communist period, through the development of drains, levees, dams, reservoir construction, and the regularization of the river channels.

Overlaid with a dry period, the 1960s brought alongside a reduction of wetlands and the threat of being integrated into the agricultural circuit. According to the literature, waterbodies have faced unprecedented pressure through land use changes (Bi et al., 2019), which is typical for floodplain areas, and with a strong dependency on both climate and human interventions. The main transitions were directed to pastures, followed by arable land.

The reservoir construction was one of the major changes recorded during the communist period. With an unreplaceable role in the drainage system, the reservoirs imposed some land improvement measures, carried downstream, with drainage ditches that allowed agricultural practice on the former marshy lands. Within the study area, the main example was represented by the Stânca Costești reservoir (built on the Prut River, in 1978), and some other reservoirs built on Jijia, Miletin, and Bahlui Rivers (Minea, 2009). Through this, a set of land use classes like pasture or built-up areas have disappeared at the expense of water bodies.

On the other side, a significant number of ponds disappeared from use, firstly due to dam construction (Balta Rotunda, Balta lui Panait, Lacul în Suta de Fălci, Bulhacu Mare, Balta Vladnic de la Cristești, Lacul Brateșul de la Bosia, Balta Trestioara, Bahna lui Chiriac, Balta Vetricea Mare, Balta Dumbrava, Bahna Cilibiul, Balta Bocșoaia, Balta Fântâna Surdului, Balta Rața, Balta Dascălului, Balta Cărbunari), and secondly through lake decreasing surface or dammed enclosures (Balta Vladnic reduces its surface and becomes Lake Gorban), followed in some cases by sediment filling and the dam breakage (Minea, 2009). Those areas were predominantly converted into pastures, but before 1960 they corresponded to the waterbodies class. A different situation is in the case of the dry reservoirs, which are filled only during floods, like Bârca (built in 1981), Ciurea (1981), Cornet (1981) on the Nicolina River, Cârlig (1981), Vânători (1982), on the Cacaina River, and Vămăşoaia on the Vămăşoaia River. During the dry season, the detention basins were used as pasture, or not used at all, being naturally encroached by grassy species.

Conversions from the waterbodies class to other land use classes, and vice versa were conditioned by the erosion and accumulation processes from the river channels. Due to reservoir construction and sediment filling, an amount of terrain could be gained, firstly operating as unproductive land and consecutively becoming pasture through natural vegetation growth and afterward, cropland. Through erosion, losses could be generated to the detriment of pastures, forests, or arable land. In the tributary hydrographical basins of the Siret and the Prut Rivers, the river channel dynamics are reduced (on the background of low discharges and hydro-technical works).

Following that, even if the 1980 decade was wet, the wetland class did not extend. During the (iii) post-transition period, the climatic dryness favored the decline of the wetlands and waterbody land use types. As a result of that, floodplains have experienced a forthcoming change, becoming a targeted region for forage production through periodic mowing or animal grazing. With favorable characteristics, the floodplains offered accessibility, due to their topographical localization; and moisture, suitable for vegetation growth. Even if the regions are continuously exposed to the flooding risk, it occurs quite rarely, favoring grassland distribution along the floodplains.

Recently, following (iv) the post-transition period, the grassland ecosystem has been impacted by agriculture intensification, leading to the conclusion that the key to maintaining the balance in grassland ecosystems is to rely on traditional agricultural practices, including the reforestation of too degraded pasturelands. Agricultural land abandonment and its impacts on landscape features have been a striking characteristic of many Romania rural areas over the last decades (2000-2018). The most common driving force of the landscape trajectory was the absence of land management where secondary succession processes led to semi-natural landscapes and few returned to different agricultural uses after abandonment.

Conclusion

The main land use conversion event at the floodplain level in Northeastern Romania, as we show for the Iasi County was the draining of wetlands. This conversion happened due to natural causes (dry climate), but predominantly due to anthropic interventions regarding the hydrotechnical works performed during the communist period. The main target of these works was the extension of cropland, but the relatively low fertility of the floodplain soils was limiting this conversion, with many croplands being abandoned and becoming pastures. After the communist period, there was an increase in built-up areas to the detriment of pastures.

In the context of the need for land use planning for sustainable development, the study of past land use changes is a must for understanding and explaining the recent land use and arguing for future decisions.

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