LAND USE IN THE DANUBE FLOODPLAIN AND TERRACES, GIURGIU-CĂLĂRAŞI SECTOR

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Land use in the Danube floodplain and terraces, Giurgiu-Călăraşi sector. The studied area is a sector of the Romanian Danube Valley where land use is predominantly agricultural. The area consists of two distinct relief units: the alluvial plain and the terraces. The aim of this paper is to show – based on Land Parcels Identification System and CORINE Land Cover data, as well as field investigations – the way land use reflects the particularities of each relief unit analysed.

1. INTRODUCTION

Landscape changes in the Lower Danube region are evaluated both from a natural and socio-economic perspective. After 1990, the transition from a communist system to the centralised market economy led to significant restructuring processes of agricultural land (e.g. changes of property, fragmentation of the former socialist farms into small properties), entailing a different type of land use, deterioration of irrigation systems and land degradation along some sectors of the alluvial Danube Plain. Starting with 2003, a new process of land amassing took place.

2. STUDY-AREA

The study-area covers about 276 km^2 of the Romanian Plain, inclusive of its lowland sectors, namely, Burnaz (between the Argeş and the Mostiştea Valleys) and South Bărăgan (between the Mostiştea Valley and the town of Călăraşi). The present analysis has focused on two distinct units: the Danube Floodplain and the Danube terraces (Fig. 1).

The Floodplain is a continuous stretch of land, radically changed by the land management works of the 1970s. It borders on the channel and is easily overflown; altitude decreases eastwards down to 15 m at the mouth of the Argeş River and 11 m in the Călăraşi area. Narrow sectors (3–7 km wide, at Giurgiu, Chirnogi-Oltenița, Spanțov and Călăraşi) alternate with larger ones (7–9 km on the site of the former Greaca Lake, 5–7 km at Ulmeni and 7–11 km west of Călăraşi).

Its complex basal structure consists of gravels and coarse sands of ever lower grain-size to the east; the upper sector, somehow thinner, is formed of fine sands, silts and silky clays not clearly delimited. The levees, close to the channel, have a surface underlain by silty and clayey material. The alluvial bed becomes ever thicker to the east, thickness being distinctively different, that is 20–25 m up to Mostiştea and approximately 30 m towards Călăraşi, the erosion bed is a few meters below alluvia throughout this sector (*Geografia României, V, 2005*).

The microrelief has a tallest portion, which is the main levee, decreasing on average to 2–3 m downstream the Argeş River; the median floodplain (boggy in part) presents small, vegetation-covered depressions; the marginal strip contains large, drained lacustrine depressions (e.g. Greaca and Călăraşi). Besides these longitudinal landforms stretching out between channel and terrace margin, secondary

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levees extend between the channel and the depressions, or the secondary branches; fans, holms, microdepressions, channels (active or deserted), abandoned meanders, dams, and the like, are also present (Fig. 2).

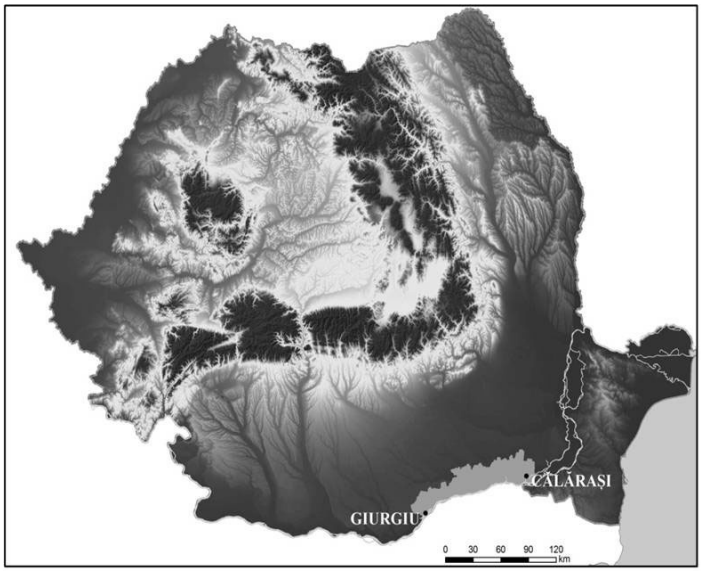

Fig. 1 – Geographical location of the study area in Romania.
(Source: http://www2.jpl.nasa.gov/srtm/)

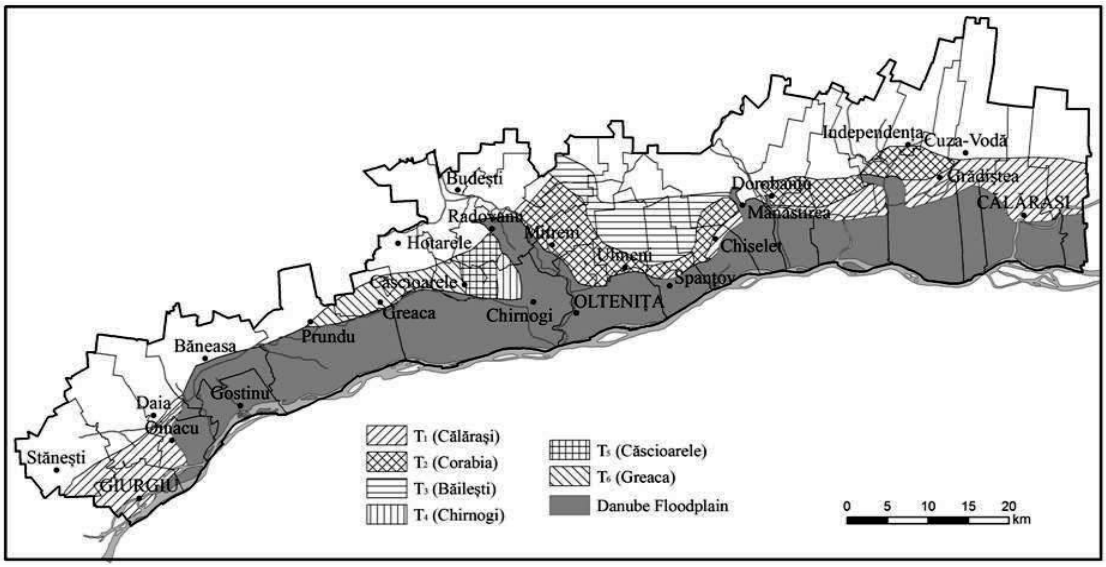

Fig. 2 – The Danube Floodplain and terraces, Giurgiu-Călăraşi Sector.
(Source: Geografia Văii Dunării Româneşti – Annexe, 1969).

The height of well-developed terraces between the Argeş and the Mostiştea decrease to the east. The six terrace levels, identified by Niculescu and Sencu (*Geografia Văii Dunării Româneşti, 1969*), are distributed as follows: t_6 at Greaca; t_4 between Valea Popii and Chirnogi (terrace of the Argeş); t_3 east of the Argeş, decreases down to 25 m, being lost in the fields after reaching the Mostiştea Valley; t_2 on the lefthandside of the Argeş (continues as Argeş terrace), and extends farther between Independența

and Grădiştea settlements; t_1 at Giurgiu, is a fragmentary occurrence from the Argeş to the Mostiştea and in the Mostiştea-Călăraşi sector (10–12 km wide).

The climate is temperate-continental with shades of aridity in the Bărăgan Plain; hot dry weather in summer, cold winters, occasionally severe snowstorms; annual mean temperature 11ºC, precipitation 500–550 mm/year.

There are four major soil classes, most of them very fertile (protosols/undeveloped soils; chernosols/ mollisols; hydrosols/hydromorphic soils; salsodisols/halomorphic soils). The north of the area is rich in cereal crops (wheat, barley and maize), industrial and technical plants obtained on alluvial-clay and cambic chernozems. Floodplain alluvia and alluvial soils are propitious to the cultivation of a variety of plants (e.g. maize, sugar-beet, fodders and sun-flower). Easy to irrigate, these soils are suitable to the growth of vegetables.

The zonal vegetation (steppe and sylvosteppe), which corresponds to the Danube terraces, was replaced by arable land. The intrazonal vegetation consists of riverside willow and poplar coppices developed on narrow strips of land; floodplain meadows, very much reduced and degraded, have been replaced by farm land.

The drainage network is fully tributary to the Danube which forms a ca. 130 km-long southern boundary of the area. The Argeş and the Mostiştea are the only rivers crossing this sector. A string of lakes – Mostiştea, Călăraşi, Gălățui and Ciocăneşti (protected natural areas) – lie in the eastern extremity of the area. Ground waters are found in floodplain and terrace deposits down to 10–12 m deep in the loess-like deposits and in the Frăteşti Gravels (to 40 m deep).

The settlement network is formed of 28 communes (74 villages) and four towns (Călăraşi, Giurgiu, Oltenița and Budeşti). Călăraşi and Giurgiu (57,118 and 53,260 inhabitants, respectively in 2011) are the capitals of homonymous counties; Călăraşi is the largest town of South-Muntenia Development Region; Giurgiu is the second important river port and border point with Bulgaria. Total population of this sector: nearly 590,000 inhabitants (National Institute of Statistics 2011; www.insse.ro), by some 11% fewer than in 1990. In terms of demographic size, it is the settlements with 3,000 – 5,000 people that prevail (37.5%).

3. DATA AND METHODS

Land-use assessments are based on the Land Parcels Identification System data (LPIS) supplied by the Agency for Payment and Interventions in Agriculture (APIA) which pertains to the Integrated Administration and Control System (IACS), the administrator of all direct payments to farmers. The system relies on orthophoto images, cadastral maps and/or satellite images of 1 m precision, scale 1: 5 000. Initially intended to payments for agriculture, LPIS has grown into a source of information on the management of rural terrains which cover 90% of the EU surface-area. The data supplied by the system consist in agricultural physical blocks (see *LPIS guide-book, http://www.apia.org.ro/*), representing unbroken land areas used by one or several farmers, and having external linear and stable bounds (roads, railways, water courses, channels, dams, etc.) and one or several parcels, cultivated or not.

The extent of land fragmentation in agriculture was analysed with the help of a tool developed by the Center for Land Use Education & Research – CLEAR, in collaboration with a firm specialised in producing GIS tools (Placeways LLC – Boulder, Colorado). The Landscape Fragmentation Tool – LFT (*http://www.clear.uconn.edu/*) uses raster-type data – CORINE Land Cover, 1990, 2006 – in this case (*www.eea.europa.eu*), integrated in ArcGIS 9.3 by ArcToolbox employed to quantify land fragmentation. The data were turned from vector format into raster format and reclassified as follows: a) No Data – categories excluded from analysis (e.g. water); b) 0 – categories involved in fragmentation (e.g. settlement expansion); c) 1 – fragmented category (e.g. farm lands).

The analysed pixels were grouped in a window (N) in terms of land-use resolution raster (r) and minimum fragmentation distance between a non-fragmented cell and the closest fragmented cell (d) – N=1+(2d/r). In this way, farm land-associated pixels (Pa) and their connexion grade (Paa) could be determined. Pa is calculated as ratio between pixels classified as agricultural per standard area (5x5 pixels) and total pixels (25), Paa designates the connection of each pixel with neighbouring pixels: *Core* (Pa=1.0) – compact agricultural area; *Perforated* (Pa>0.6 and Paa-Pa<0) – built-up areas in the agricultural surface; *Edge* (Pa>0.6 and Paa-Pa>0) – agricultural surface alongside a non-agricultural area; *Transitional* (Pa<0.6 and Pa>0.4) – agricultural surface extending within a non-agricultural area; *Patch* (Pa<0,4) – isolated agricultural area. The results obtained were verified on the ground in some farms of Chiselet, Dorobanțu, Grădiştea and Modelu communes (Călăraşi County).

4. LAND USE IN THE POST-COMMUNIST PERIOD

The post-communist period featured two important phases for agriculture and land use, namely, of transition (1990–2003) and post-transition (2003 – to date). Transition from co-operative property to private property during 1990–2003 was followed by the adoption and implementation of the Common Agricultural Policies (CAP). As Land Law 18/1991 came into effect, completed with legal regulations (169/1997 and 1/2000), private property expanded and became the dominant form of ownership in agriculture. As a result, the excessive fragmentation of land turned out to be a major drawback to practicing modern, competitive farming (Bălteanu, Popovici 2010).

An overall picture of agricultural terrains (ca. 80% of the study area) had in view land-use categories, number of parcels and legal status of the farm. In conformity with LPIS, agricultural surfaces include: arable land, permanent pasture-lands, vine-yards, permanent crops – other than vineyards (orchards, etc.) and mixed land-uses/others (vegetable gardens). The first category (nearly 212,000 ha) contains arable land proper, vegetable gardens, rice cultures, cropped pasture-lands (cereals, technical/ industrial plants), solariums, and also lands fallowed temporarily. Pasture-lands, natural or artificial, that is produced or improved by sowing (over 8,000 ha), are left uncropped for five-year periods, used as grazes and/or fodder grounds. Next, are vine-yards and wine plantations (1,848 ha) and permanent cultures (orchards, fruit-trees, vine nurseries – no larger than 235 ha) (Fig. 3).

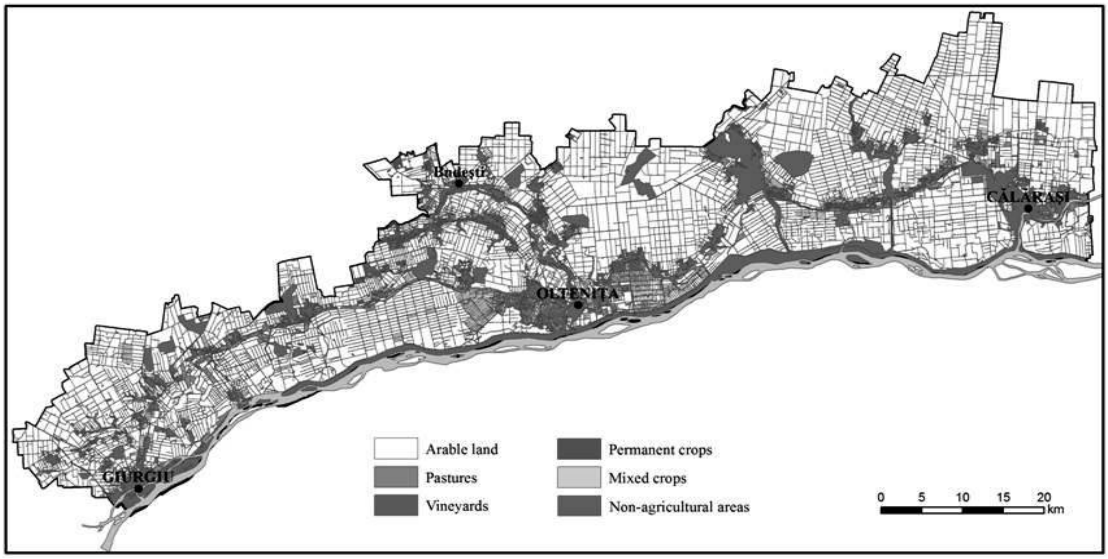

Fig. 3 – Land use according to Land Parcels Identification System (LPIS).

In the Giurgiu-Călăraşi sector there are over 8,900 parcels: 7,708 – arable land; 905 pasture-land; 248 – vine-yards; 90 – permanent cultures and 6 – mixed cultures (5,171 – less than 10 ha; 2,411 – 10–50 ha and 1375 – more than 50 ha). Noteworthy, parcelling is not necessarily synonymous with fragmentation; it has this connotation only if the terrain is no longer used for agriculture, but for other purposes (Fig. 4).

Fig. 4 – Agricultural area: a) compact; b) parcelled, non-fragmented; c) parcelled and fragmented (Source: orthophoto images – 2005 – (a, b) and Google Earth (c) in the north of Călăraşi town; http://geoportal.ancpi.ro/geoportal/viewer/index.html, http://www.google.com/earth/index.html).

Landscape fragmentation, connected also with the transport infrastructure and built-up areas, has significant effects on the environment. During the last 20 years, the rate of land fragmentation has continued to increase and many more new transport infrastructure projects have been planned (*Landscape fragmentation in Europe, 2011*).

The maps of fragmentation, drawn up with the Landscape Fragmentation Tool, have revealed slight amassing of land in 2006, when the compact farming surface increased by almost 2%, versus 1990 (Fig. 5). Although differences between 1990 and 2006 are not significant, yet they did exist with each fragmentation category (Core, Perforated, Edge, Transitional and Patch). A slight increase (1.84%) registered the compact agricultural surfaces (Core), covering 204,609 ha (in 2006), that is nearly 90% of the analysed area. That same year, categories like Perforated, Edge, Transitional and Patch, which encompassed smaller surfaces than in 1990, indicate that agricultural lands in the study-area tend to become less fragmented.

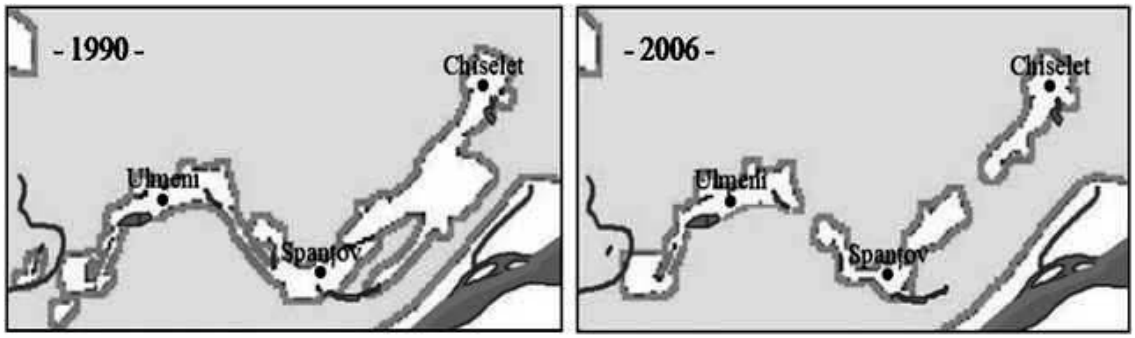

Fig. 5 – Samples of farm land fragmentation in Spanțov-Chiselet area.

Farms are represented by individual households, mostly peasant-held, and units with juristic person status (agricultural companies/associations, commercial companies, public administration units, co-operative units, etc.). The smallest size on LPIS record is 1 ha, although some parcels can be under 0.3 ha/0.1 ha (vine-yards, orchards, fruit-trees, etc.). Most individual farms practice subsistence agriculture, the average farm-size being extremely low although a mild increasing trend has obviously reduced the total number of such farm. This process, based on the inevitable annual disappearance of small, economically inefficient farms, was accelerated as Western markets had the capacity to offer jobs and sources of income in various branches to people who gave up farming (Tofan 2005).

5. AGRICULTURAL LAND DISTRIBUTION

The analysed area includes 32 administrative units pertaining to Giurgiu and Călăraşi counties. Nearly half of team (Budeşti, Căscioarele, Chirnogi, Chiselet, Curcani, Greaca, Hotarele, Luica, Mânăstirea, Mitreni, Oltenița, Radovanu, Spanțov, Şoldanu and Ulmeni) representing 39.18% of the area, fall into the Metropolitan Area of Bucharest Municipality. The position of settlements in the two relief units is shown on the graph (Fig. 6).

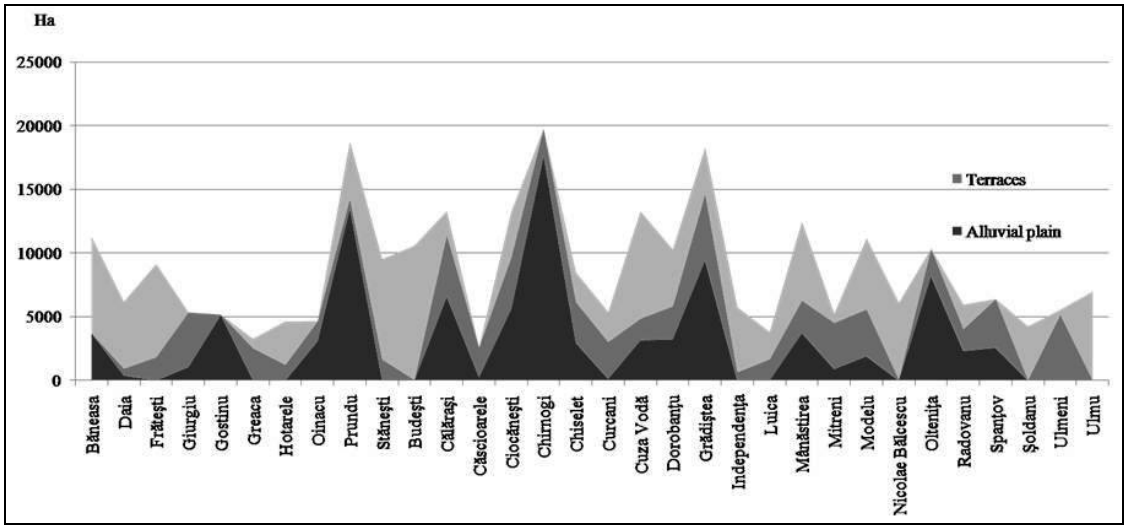

Fig. 6 – Administrative-territorial units in the Danube Floodplain and terraces.

Floodplain arable lands (ca. 67,000 ha) come up to over 31% of all arable lands in the study-area and nearly 25% in this sector. Over 13,500 ha belong to Chirnogi, which hosts important companies cultivating cereals and oleaginous seed plants. Agro Chirnogi Firm (10,651 ha), founded in 1991 and privatised in 2002, owns last-generation tools and equipment, buys agricultural products from the counties of Giurgiu and Călăraşi and sells them in the domestic and foreign markets. Pasture land (2,866 ha) is equally divided between Băneasa and Oltenița (400 ha each). Vine-yards (212 ha) occupy small areas in the settlements of Radovanu, Prundu, Chirnogi, Spanțov and Ulmeni (Fig. 7).

Likewise in the floodplain, terraces have mostly arable land (ca. 52,000 ha), basically about 25% of the overall arable land and 19% of the whole sector, cultivated largely with maize, sun-flower and vegetables. Pasture land (2,500 ha) is found in very moist or sandy areas, the majority belonging to the settlements of Ciocăneşti, Modelu, Giurgiu, Grădiştea and Greaca. Vine-yards (565 ha) are concentrated around Greaca farm and the wine plantations of Ulmeni, Radovanu and Spanțov (Fig. 8)

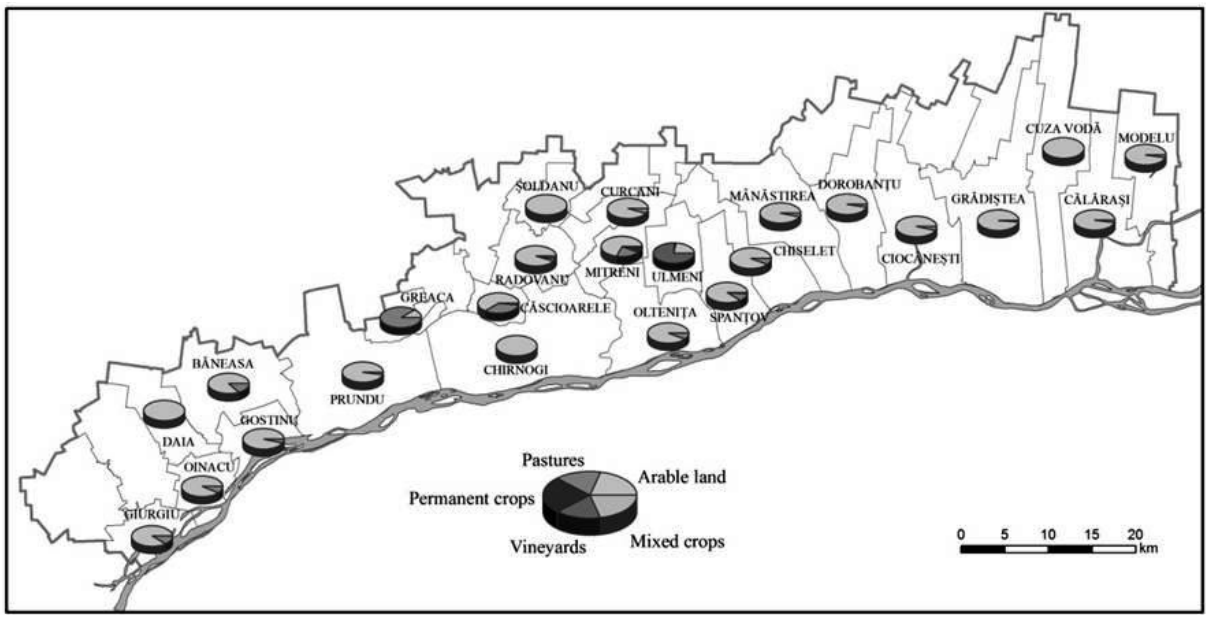

Fig. 7 – Distribution of agricultural land and uses in the Danube Floodplain.

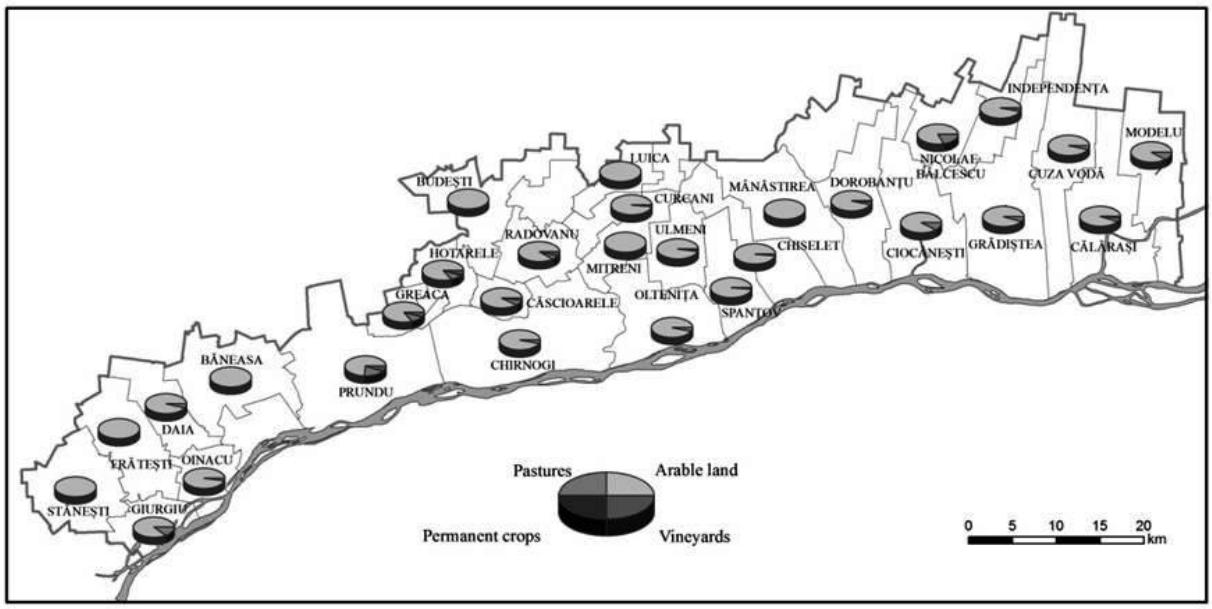

Fig. 8 – Distribution of agricultural land and uses in the Danube terraces.

6. CONCLUSIONS

The study-area, typical lowland dominated by agricultural terrains, has been deeply influenced by the post-communist socio-economic and political conditions and also by intense climate change over the past few years, associated with extreme phenomena (drought, desertification and floods), so that some floodplain terrains have actually been abandoned.

The excessive fragmentation of agricultural terrains, the large number of traditional households practicing subsistence farming, as well as deficient services in agriculture, coupled with the destruction of irrigation systems, have contributed to land-use changes and degradation.

In the post-communist period, the concentration of agricultural production in medium-sized and large associations and farms has proven beneficial to this sector, making it more efficient and suitable to sustainable development.

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