Spatio-temporal changes of forest and vineyard surfaces in areas with sandy soils from southern Oltenia

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ABSTRACT: The present study examines the spatial and temporal dynamics of forest and vineyard areas in the last three decades in areas occupied by sandy soils in southern Oltenia. Areas with sandy soils in this zone are considered vulnerable elements of the environment as a result of deflation phenomenon that occurs after the disappearance of vegetation. It is therefore necessary to analyse the current state of sandy soils covered by forest vegetation and vineyards, these two categories of vegetation playing a vital role in their stabilization. The results obtained show that in the last three decades forest areas decreased by approx. 2700 ha (11.6%) being replaced by sandy soils, while vineyards areas have diminished with 22% (1638 ha), with negative consequences of ecological, climatic and social nature.

KEY WORDS: forest surfaces, vineyards, dynamic, sandy soils, southern Oltenia

1. Introduction

Southern Oltenia is currently in a full process of aridization (Păltineanu et al., 2009, Stringer et al., 2009), the causes being related to the context of climate changes (IPCC, 2007), and to the change of land use at the local level (Prăvălie & Sîrodoev, 2013). Among the most important changes in land use with real impact in increased aridity phenomenon, it has been noticed the deforestation of forest ecosystems, this meaning the replacement of surfaces covered by forests with another land use category (Sasaki & Putz, 2009).

Maintaining the vegetation in southern Oltenia is vital considering that this area has the most extensive sandy soils in the country (Parichi & Oancea, 1984), following the presence of coarse sandy deposits in the region. These sandy deposits have determined over time a high socio-economic and ecological vulnerability due to phenomenon of wind deflation (Nuta, 2005).

Among the first major research on sandy soils in southern Oltenia in relation to vegetation are the ones from the first half of the twentieth century (Chiriţă & Bălănică, 1938). Present dedicated researches (Dumitraşcu, 2006, Ignat et al., 2009; Achim et al., 2011) have shown that the extinction of vegetation (forest areas and vineyards), in the context of anthropogenic deforestation, especially after political transition year of 1990, increased the effect of wind

deflation due to the destabilization of the sand dunes, the adverse consequences being social (the damage of layer soil and decreased agricultural production) and environmental (geographical landscapes degradation) dysfunctionalities.

2. Geographic particularities of sandy textured soils

Currently, out of approximately 330000 ha of sandy textured soils in Romania, representing 35% (approximately 116300 ha) are found in the study area (figure 1). In southern Oltenia, these coarse textured soils (mainly cambic chernozems over sands, generally found in the area between Jiu river and the Danube, and the extended psamosoils occupying large areas especially east from Jiu river) are found above some sandy deposits whose origin is closely linked to the synergistically context of the existence of sand sources in the river valley areas and the permanent action of local winds.

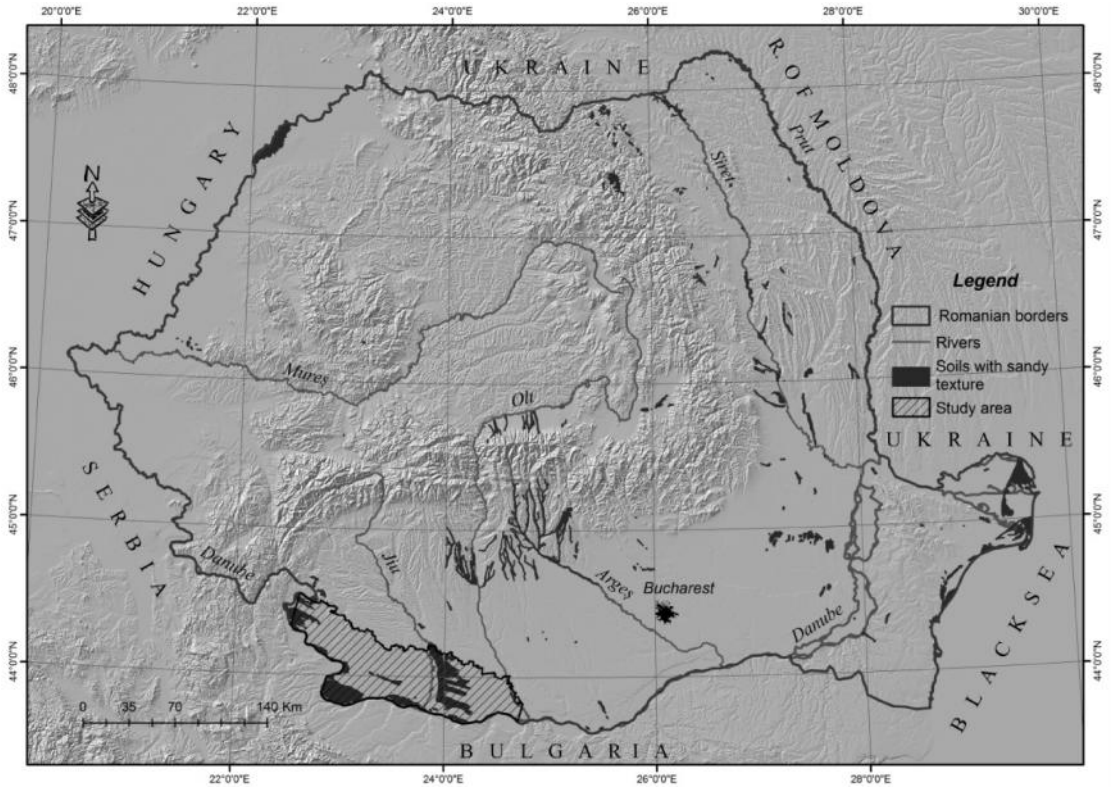

Figure 1. Sandy textured soils and position of the study area in Romania (ICPA data processing, Bucharest).

More specifically, sand deposits originate mainly in the foodplain areas of Jiu and Danube rivers through the wind deflation process (The Geography of Romania, Volume V, 2005), which is why they have an elongated shapes corresponding to the predominant direction of local winds. Thus, the greatest thickness of these deposits are found in the form of sand dunes either near the Danube meadow in the east, or near the Jiu meadow on its left side, where the deposits reach the greatest thickness in the entire study area (approximately 20 m thick). Under these

conditions it is necessary to constantly cover these deposits with vegetation, forest and vineyards areas playing an essential stabilizing role.

In terms of forest ecosystems, at the level of entire area, there are found many forest species such as *Quercus pubescens, Q. cerris*, *Q frainetto, Q. pedunculiflora, Acer tataricum*, etc (Pătroescu, 2005), but the most important forest species for the stabilization of the sandy textured soils is acacia (*Robinia pseudoacacia*). It was planted on large areas in the first half of the twentieth century as protection screen for preventing the extension of sand dunes towards the populated areas (Nuţă, 2005), but some forest areas have been cleared during second half of the twentieth century in order to expand the agricultural areas.

Sandy soils are currently fixed mostly with acacia forests, but it occupied areas that were significantly reduced in the last two decades, with destabilizing effects on sand dunes. It is also the case of vineyards that suffered great losses especially after the political transition year of 1990, the negative effects being of the same nature.

3. Methods

The present study attempts to analyse the spatio-temporal dynamics of forest and vineyards surfaces (types of vegetation with the key role of stabilizing the sandy deposits in southern Oltenia), in the area of sandy soils. Thus, in a first stage, there were selected and mapped the soils with the highest content of sand, namely the sandy textured and sandy-clayey textured soils (ICPA Bucharest).

The second stage consists in mapping the forest and vineyards areas from two different time periods, namely 1981 and 2006, using the topographic maps of the area, 1: 25 000, 1981 edition and the Corine Land Cover Database 2006 (EEA, 2006). The spatial analysis was performed using ArcGIS 9.3 software.

Finally, the spatio-temporal dynamics of the two land use categories was analysed in relation with the surfaces covered with sandy soils, evaluating the main spatio-temporal changes in the three areas where sandy textured soils occur, and in the relief subunits existing within these areas.

4. Results and discussions

Currently, in southern Oltenia there can be found three main areas with sandy soils: Jian-Punghina plain (west of the Drincea river) (a), the south of the Băileşti plain continued with the floodplain of Bistreţ (b) and plains of Dăbuleni and Leu-Rotunda, east of the Jiu river (c) (figure 2).

The total forest area in 2006, according to Corine Land Cover database, was 57745 ha, while the vineyards occupied an area of 15692 ha.

Forest and vineyards surfaces in sandy soil area are more reduced, occupying an area of 26585 ha (forests – 20684 ha, and vineyards - 5901 ha), which is approximately 23% of the total area of sandy soils (116300 ha). Thus, in 2006, less than a quarter of sandy soils were stabilized with vegetation.

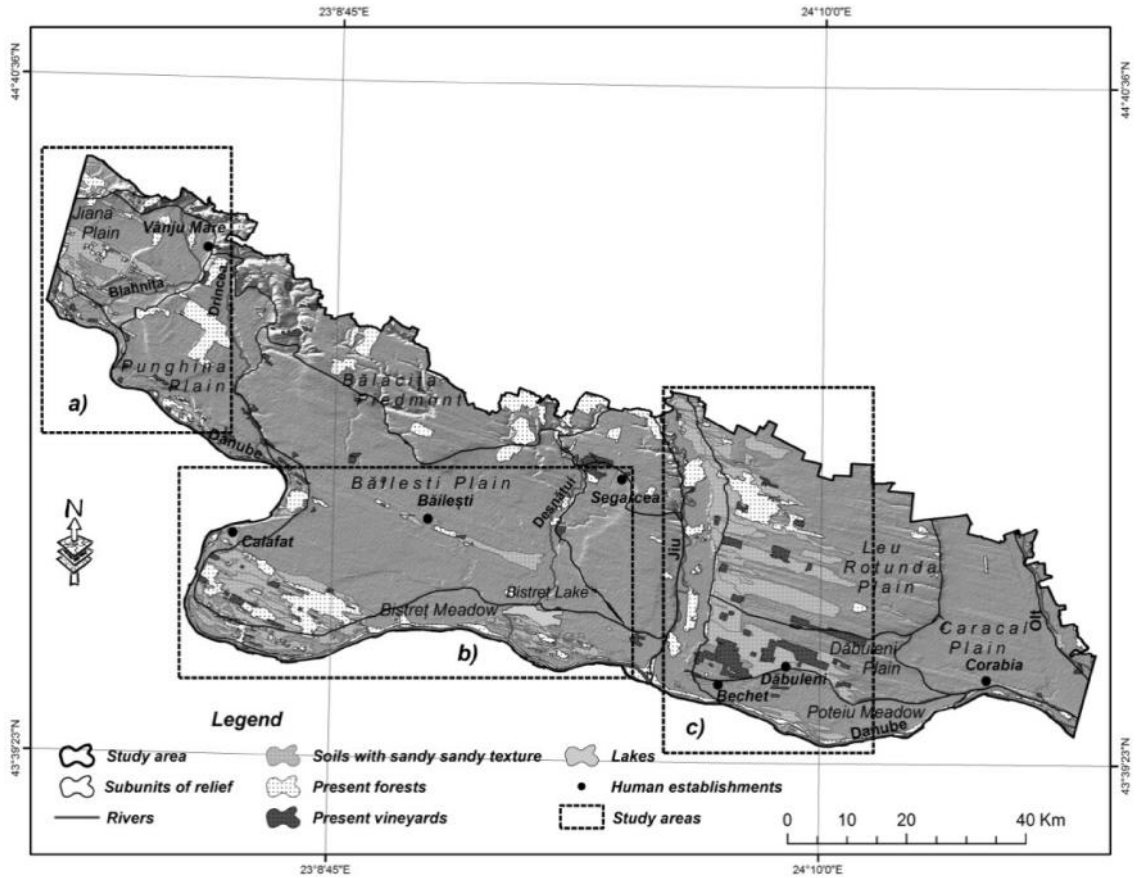

Figure 2. Areas with sandy dunes from southern Oltenia in Jiana – Punghina Plain areas (a), Băileşti Plain - Bistreţ Meadow(b) and Dăbuleni and Leu-Rotunda Plains (c).

The analysis of spatio-temporal changes of the two types of vegetation highlights important differences. In a general context, in the year 1981, from the total forest area of 62058 ha, 37% (23415 ha) are found exclusively on the sandy textured soils. While in 1981 approximately 20% of the sandy soils were stabilized with forests (made up mainly of acacia plantations), in 2006 the forest areas decreased to 20684 ha (17.8% of the sandy soils).

In 1981, vineyards occupied a total area of 31800 ha and 7553 ha in the perimeter of sandy soils. Thus, in 1981, 6.5% of the sandy soils were stabilized by vineyards, while in 2006 the percentage dropped to 5% (5901 ha).

In particular, the analysis of spatio-temporal dynamics in the three main areas emphasizes important changes (figure 3). In the case of the area located west of the Drincea river (Jiana Plain - Punghina Plain) (figure 3a), forest and vineyards areas in sandy-textured soil perimeter decreased during the 25 years by almost 40% (2237 ha), respectively from 5850 ha in 1981 to 3613 ha in 2006. Of the two types of vegetation, the forests recorded the biggest loss of surface, respectively from 5401 ha in 1981 to 3560 ha in 2006.

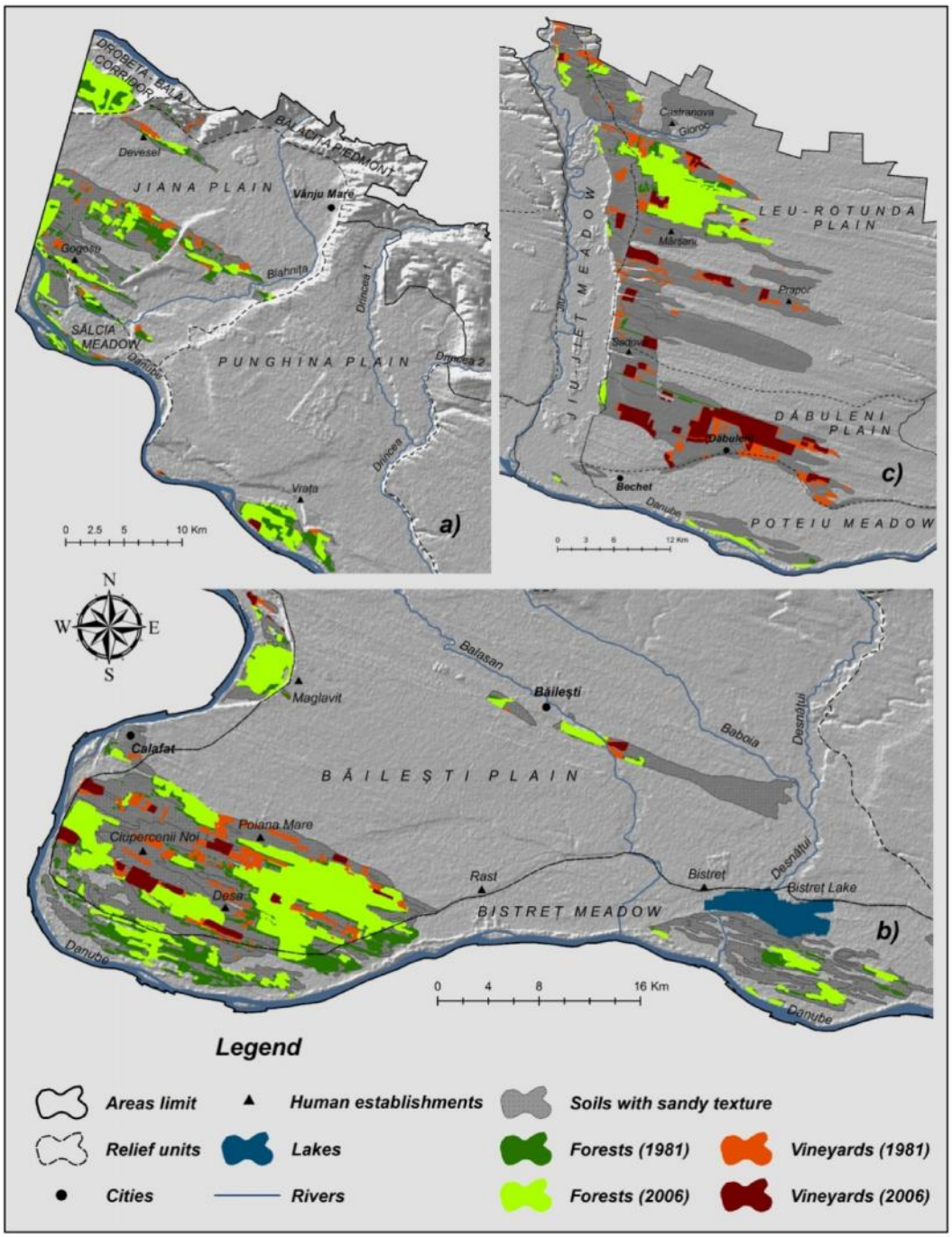

Figure 3. Spatio-temporal dynamics of the forest and vineyards surfaces in areas with sandy soils: Jiana - Punghina (a) Băileşti – Bistreţ Meadow(b) and Dăbuleni and Leu-Rotunda (c). This figure is available in colour online at www.georeview.ro.

Although in the case of Băileşti Plain-Meadow Bistreţ area (figure 3b) there were large areas (14229 ha) of forests and vineyards on sandy soils were in the year 1981, the spatio-temporal dynamics of the next 25 years is not very significant compared to other situations. In this period

of time, the surface of the two categories decreased by 12.7% (1807 ha). However, in detail, the situation is uneven, forest areas being reduced by 9% (from 12422 ha in 1981 to 11294 ha in 2006) and the vineyards by 37.5% (from 1807 ha in 1981 to 1,128 ha in 2006).

In the case of the last analyzed area, namely Dăbuleni and Leu-Rotunda Plains (figure 3c), the dynamics was the lowest. The forest and vineyards decreased by 3% (319 ha), respectively from 10867 ha in 1981 to 10548 ha in 2006, being replaced by uncovered sandy soils. Contrary to previous situations, the forest areas increased in sandy soils perimeter by 4.3% (from 5585 ha in 1981 to 5828 ha in 2006). Vineyards followed downward trend in area, from 5282 ha in 1981 to 4720 in 2006 (decrease of 10.6%).

To capture the variation of spatio-temporal changes of forest and vineyards surfaces in the main subunits of relief, an analysis was conducted on the 10 existing subunits (after Posea and Badea, 1984) which intersect sandy textured soils (figures 4 and 5), these being found in areas taken as case studies.

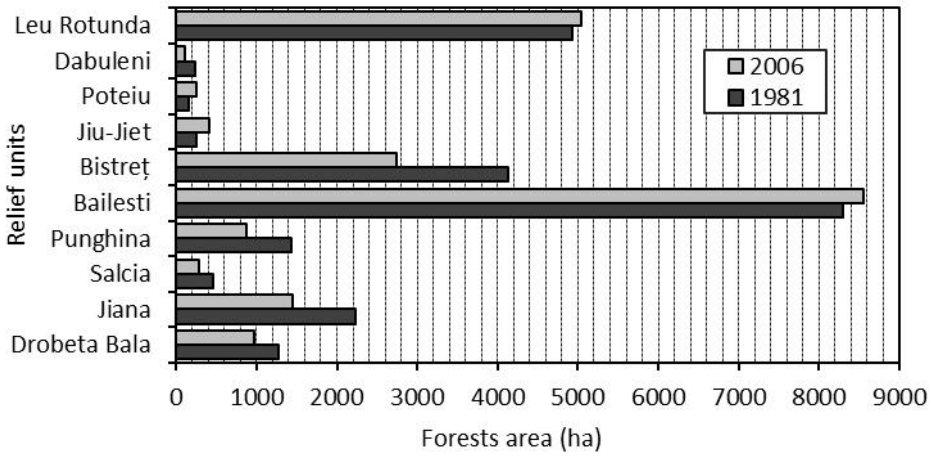

Figure 4. Temporal dynamics of forest areas (1981-2006) in the southern Oltenia relief subunits, in the area of sandy soils.

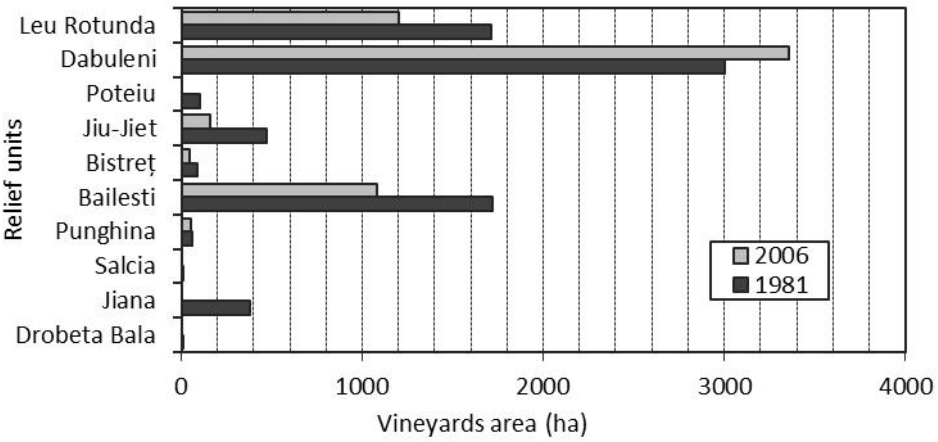

Figure 5. Temporal dynamics of vineyards areas (1981-2006) in the southern Oltenia relief subunits, in the area of sandy soils.

The causes that led to the drastic decreases (in most cases) of forest and vineyards surfaces in sandy soil perimeter are diverse. In the case of forest ecosystems, the most important causes are related to anthropogenic deforestation which occurred in two different contexts. In the period 1981-1990 the forests have been cleared to expand agricultural areas, while after 1990 some of them have disappeared due to cuts by the land owners as a result of Law 18/1990 of allotment of lands. Other causes are related to global climate changes, which led locally to the fading of forest species, the species of acacia (*Robinia pseudoacacia*) and poplar (*Plopus canadensis*) existing in the sandy soils area being most affected (Dumitraşcu, 2006).

In some cases, synergistic context of anthropogenic causes and climate changes led to the disappearance of forest areas. This is the situation of Dăbuleni and Leu-Rotunda Plains area (figure 3), where forest ecosystems, built as protection curtains, were cut mostly, but also degraded and fragmented after prolonged drought in the last decades (Nuţă, 2005). The situation of increases of the forest surfaces in sandy soils area, such as Dăbuleni and Leu-Rotunda Plains (figure 3), can be explained by the actions of reforestation in recent years in the Dolj County, county considered deficient in terms of forest areas (National Afforestation Program). Another explanation is the regeneration of some forest areas (species of willow) in sectors of the Meadow of Danube and Jiu River, areas with low anthropogenic influence.

In terms of vineyards surfaces, these areas suffered losses especially after the political transition year of 1990, when a portion of agricultural lands were returned to owners due to the Law 18/1990. Their poor maintenance in the following years and the abandonment of large areas by the owners, are the main causes of the disappearance of vineyards areas with vital role in fixing sandy dunes (Prăvălie & Sîrodoev, 2013).

5. Conclusions

The losses in the last three decades of over 4300 hectares of forests and vineyards areas in sandy dunes perimeter caused locally serious imbalances at social, economic and environmental level. Wind erosion, soil degradation, reduction of local water resources following deforestations and cutting of vineyards areas are some negative consequences of the disappearance of vegetation.

One of the most viable solutions to solve this ecological crisis in southern Oltenia is the reinstalling forest belts where are extensive areas of sand dunes (the example of Dăbuleni Plain) or reforestation in the form of bodies of forest in the degraded areas. A new strategy for revival and expansion of vineyards areas in sandy areas is essential, in this case the benefits being both environmental and economic.

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