SANDY SOILS-GEOMORPHOLOGY RELATIONSHIPS IN JIANA PLAIN (SOUTH-WESTERN ROMANIA)

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Abstract. Jiana Plain, located in the west of Romanian Plain (Oltenia Plain sub-unit), is one of the areas in Romania where some of the worst transformations of the forestry and agricultural environment have been observed. Here, the lands have been under the pressure of several degenerative factors, such as: uncontrolled deforestation on sandy terrains or poor crop management. This study aims to make a spatio-temporal analysis starting with the identification of geomorphological processes in the areas where the forest-covered surface has been deforested, and continuing with the climatic or anthropogenic factors that have left their mark on the environment. The case study focused on Burila-type sand dunes in the north of Ţigănaşi village, and on Jiana-type dunes in the west of Pătulele village, where deforestation on sandy soils has led to visible soil transformations over the past 40 years. The changes of recent decades have been analyzed with the help of Landsat images, with the data being provided by the expert reports on landuse, as well as their validation through field visits and on-site measurements. For the analysis of land degradation, as a result of the aridization process, the current situation of the vegetation layer was taken into account by using the Normalized Difference Vegetation Index and the data extracted from the Corine Land Cover database between 1990, 2006 and 2018 using map overlay method. The results are clear and reveal the fact that under the influence of the climatic factor the soils were under additional pressure so, the geomorphological processes were amplified, especially where the vegetation is missing, and corroborated with the wind factor, led to the destabilization and movement of sand dunes.

1. INTRODUCTION

Jiana Plain, as a subunit of Oltenia Plain, is one of the territories in Romania which has dealt with a considerable problem and fragility since the 19th century when man intervened intensely, both on sandy terrains and swamps in order to obtain increased agricultural productions (Stănilă *et al.*, 2011). The human intervention in the balance of these three types of land use (arable, pasture and forest) made Rusescu (1907) state that the deterioration of the lands is serious and we must take measures against the overcrowding with animals of the pastures located on sands, as well as against the massive deforestation after the ownership reform of 1864.

Records dating back to 1880 indicate that sand movement was already acknowledged to some extent, as sand dunes threatened the villages within the Danube area of Jiana Plain. However, the situation here was less alarming than in the southern part of Băileşti Plain where the villages of Ciuperceni, Desa, Tunari, Piscu and Nedeia were moved further north in order to avoid the sand advance front (Ionescu-Șișești & Stanciu, 1958). This situation alarmed the population and the

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officials who initiated measures to restore the natural balance. In his paper, Drăcea (1937) stated that forest protective belts are the cheapest and most efficient way of retaining water in soil and planting forest bodies is the only way of combating winds and dust storms. After the Second World War, Ionescu-Șișești & Staicu (1958) showed that reducing wind speed under 5 m/s is essential in combating wind erosion and stopping the advancing of sand dunes.

By the end of the 1960s, Jiana Plain had a relatively large forest area, consisting mainly of mixed species of pubescent oak (*Quercus pubescens*), Turkish oak (*Quercus cerris*), Hungarian oak (*Quercus frainetto*), as well as pedunculate oak (*Quercus pedunculiflora*), Tartar maple (*Acer tataricum*) and on isolated areas, field maple species (*Acer campestre*) (Doiniţă, 1976). In addition, *black locust* forests have been of vital importance in reducing the negative effects of deflation, fighting soil degradation and maintaining soil environmental balance. The Canadian poplar (*Populus canadensis*) is one of the hybrid species, artificially brought in, especially for ecological purposes, more precisely as a substitute for the less productive native species, such as the silver poplar (*Populus alba*) and the black poplar (*Populus nigra*) (Nuţă, 2005).

During the communist period, Jiana Plain went through several evolutionary stages that led to the reduction in areas with ponds and swamps through drainage, channeling and dykeing for the expansion of agricultural areas (1965–1969), while at the same time ensuring that the land gained for agriculture was bolstered by forest protection belts, in order to stabilize the soil and protect crops against the wind (1970–1974 and 1979) (Arghiriade, 1977).

Unfortunately, following the 1989 revolution, there was a reversal of the 1970s and 1980s agricultural efficiency, and at the same time there was an acceleration of chaotic deforestation in both forests and protective belts due to the law of land restitution, destruction of the irrigation system, maladjustment of crop types to the nature of the soil etc. Consequently, 76,820 ha that used to be irrigated within the entire Blahnița Plain were out; in 2012 there was no system in place anymore. Just as many articles reported alarmingly on the south of Băileşti Plain and Romanați Plain, we try to raise awareness regarding Jiana Plain, as an integral part of the Oltenia problem, which is riparian to the Danube. All the articles and studies of the previous decade have only succeeded in raising some warning signs that have had the effect of reducing deforestation and few afforestation events in the context of the vulnerability to drought (Prăvălie *et al.*, 2014; Dumitrașcu *et al.*, 2018; Dogaru *et al.*, 2019; Angearu *et al.*, 2020).

In his comprehensive study on the dunes of Oltenia Plain, Ionescu-Balea (1923) classified the dunes in Blahnița Plain into three categories (Fig. 1):

– *Jiana-type dunes* – consisting of floating sands, isolated, in the form of barchans or very little interlinked, covered in sparse vegetation, consisting of *willow* and *thistles*. Their structure includes quartz sands with mica and no loess. The high mobile and semi-mobile dunes between Izvoarele and Jiana villages have no vegetation or are covered in rare specimens of *Secale silvestre*, *Kochia arenaria*, *Tragus recemosus* etc.
– *Burila-type dunes* – are spread in the north-western part of Jiana Plain (Burila, Ţigănaşi – extending to Gogoşu) and appear in the form of long high waves and isolated barchans. In some places they have been consolidated and have a superficial layer of soil. The vegetation that covers them includes *black locust and willows*. For this type of dunes, there is an upper horizon consisting of yellow-greyish sands, with small grains.
– *Punghina-type dunes* appear in the form of low and wide waves. They are made of sands mixed with loess. They have, on the surface, a soil with a thickness of up to 50 cm, and the vegetation is rich and varied, including cultivated plants. Punghina-type dunes are fossil dunes and have yellow-reddish sand in the lower horizon.

Within Blahniţa Plain, the dunes appear as a result of the intensification of the wind modelling factor, which is, in fact, the main factor that triggers the movement of dunes (Enciu *et al.*, 2014). The air must travel at least 24 km/h to transport sand grains (Liu *et al.*, 2021). The sand particles from the moment of their detachment by the wind until the deposition phase have to go through certain stages: detachment, the actual movement, transport, sorting and depositing (Maleki *et al.*, 2016). The duration of these stages is conditioned both by the intensity and duration of the wind that moves the sand particles, as well as by the vegetation – either spontaneous or cultivated – that the particles cross during the movement.

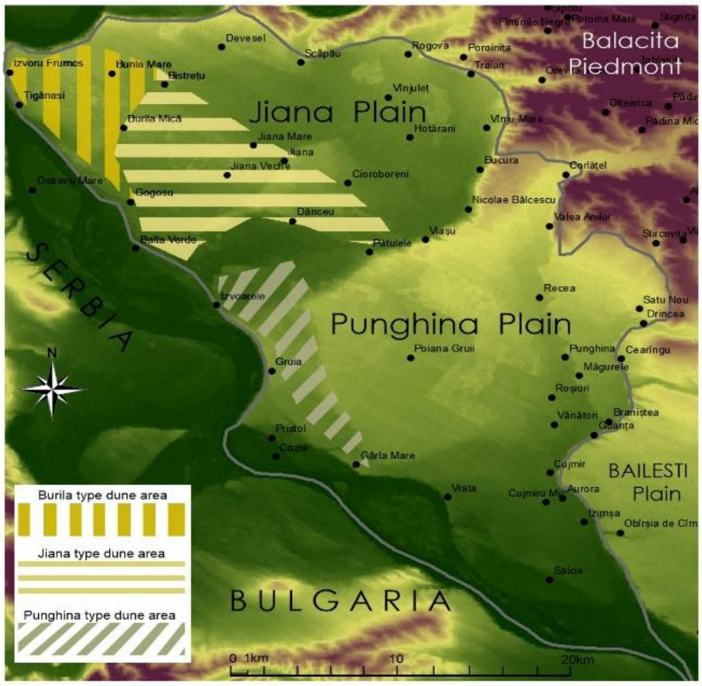

Fig. 1 – The distribution of dune types throughout Jiana Plain.

2. STUDY AREA

The landscape of Jiana Plain is explained by its position between the Bălăciţa Piedmont and the Danube River, following the general direction of the Danube corridor. This position determines a unique arrangement of the sandy soil types, in two parallel strips, on a NW–SE direction, well-defined and clearly separated. This is explained by the influence of air masses that consistently enter the Danube's Gorge. Compared to the general direction of the wind in the Romanian Plain, from two opposite sectors, here we are dealing with the property of the sands of intensely heating up (Vlăduţ & Licurici, 2020). Thus, due to the high radiation, thermal convection currents are formed, which induct horizontal movements of the air (Marinică & Marinică, 2014). Regarding the winds above the sandy terrains from the south of Jiana Plain, there is a high frequency from the west and low speed of these winds (meteoromania.ro). From the analysis of the data registered by the National Meteorological Administration (ANM) for the 1961–2021 period, values were calculated for the precipitation of 600 mm/year and a wind intensity average speed of over 2.1 m/s. Winds over 24 km/h, capable of dislocating and transporting sand, are recorded for short periods of time – 10% of the windy period (Prăvălie, 2013) (Fig. 2). The average annual temperature within Jiana Plain is 11.5ºC, which is considered the critical threshold temperature beyond which black locust forests are thermally affected (Dragotă *et al.*, 2011).

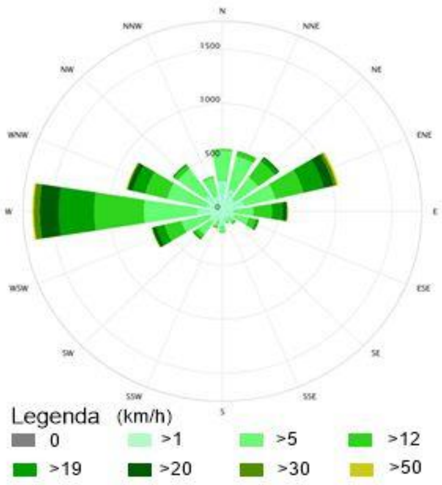

Fig. 2 – Wind increases at Vânju Mare during 1990–2020 period.
(Source Meteoblue – accessed August 7, 2019).

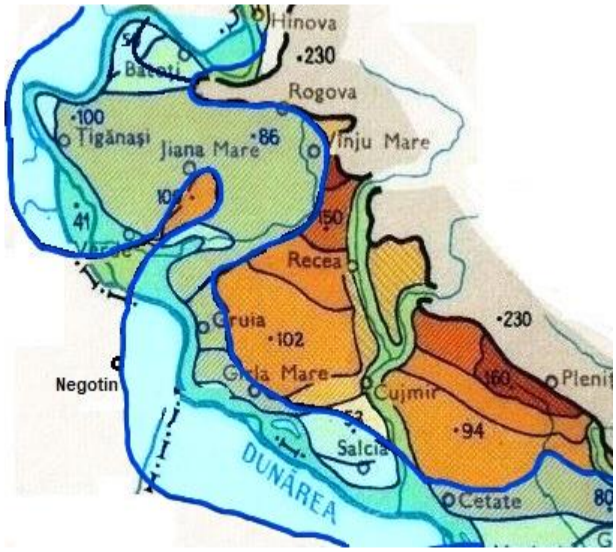

Fig. 3 – The Danube route at the level of the T4 terrace.
(Processing after Niculescu & Sencu, 1969).

The half of Jiana Plain towards the Danube has a mosaic soil cover, a mix of reddish, preluvosols, cambic, psamic, gleyic, typical cambic chernozems, psamic phaeozems and eutric and molic psamosols. The depression areas have gleyic chernozems, mollic gleysols and, in some places, erodosols (Grigoraș & Simulescu, 2012).

These types of soils are formed on sandy and loamy deposits and have a predominantly coarse and medium texture. For the depression areas, they have a fine texture, while in the floodplain they have a mixed one (Simulescu & Grigoraș, 2016). All of them are developed on an aeolian landscape where the dunes are mostly linear on a NW–SE direction, with unclear or blurred lines, flat shapes, and very reduced slopes. Their maximum height reaches 10–15 m, towards the front of the terraces, and 3–4 m at the base. At Deveselu, the dune field begins to take shape, so near Burila Mică it reaches heights of 8–10 m in the form of waves. Burila-type dunes have a wavy appearance due to the fact that they are peneplenized for a long time with a width of up to 800 m, and the depressions between them (200–300 m) are taken up by small ponds and swamps – especially during winter and spring. The structure of these dunes has a honeycomb-like appearance, where the unconsolidated sands alternate with the reinforced sands arranged in reddish stripes. Although in the direction of the advance of the dunes, the erosion remains from Jiana – Dănceu are transversely interposed, sloping on a 5% average inclination, and the sand is still carried over when the wind intensity exceeds 50 km/h.

Jiana Plain was shaped by the Danube, which carved its eight terraces in the south of the Getic Piedmont, as it gradually descended to the south, thus defining one of the peculiarities of this plain – that at the level of the fourth terrace on which is located, the Danube made a reverse advance, looping north, destroying the upper terraces (Fig. 3) (Coteţ, 1957; Răducă *et al.*, 2019), characterized as a flood (Boengiu *et al.*, 2003). This event led to the formation of high banks both north toward the Piedmont and east toward the higher plain of Punghina.

The fourth terrace of the Danube in this part of Oltenia Plain has a binary structure, which starts at the base with a rugged complex, over which stands a complex of sands. These come from the alluvia that was deposited by the Danube and the Blahniţa River, and are remodelled by being scattering to the east by the Austru, a dry wind that blows from the west. These are followed by dusty sands that cannot be distinguished from the terminal part of the alluvia (Enache, 2006).

Taken as a whole, Jiana Plain looks like a flat plain, slightly inclined from NW to SE; the uniformity of this relief is interrupted by the erosion remains between Jiana and Dănceu, which rise to the level of the 5th terrace of the Danube, to which, in fact, it belongs. The energy of the relief of Jiana Plain has minimum values, being imposed by the altitudinal differences between the ridges of the dunes and the depressions between them, oscillating between 85.3 m/km^2 and 108 m/km^2. Topographic cross-sections made between the localities of Burila Mare and Pătulele (Fig. 4) and between Rogova and Izvoarele (Fig. 5) show how the altitudes of the plain descend, following the direction of the Danube's retreat.

In the general NW–SE direction, respectively in the direction of the profile between Burila Mare and Pătulele, over a distance of approximately 13.5 km, the altitudes descend in steps from the Burila Mare – Devesel alignment to the base of the Jiana – Dănceu erosion, a remnant of the 5th terrace of the Danube. The cross-section then has an ascending evolution, reaching a maximum of 103 m, on the sandy plateau of the Jiana terrace. Towards Pătulele the altitudes decrease, reaching in Blahnița valley values of approximately 70 m.

Analysing the resulting cross-section, one may note that the altitudinal difference between Burila Mare and Pătulele is approximately 40 m (Fig. 4). On the NNE–SSW, Rogova – Izvoarele direction, there is a slope with a smooth decrease of 20 m at 7 km (2.85‰) up to the appearance of the Jiana erosion remains. After this, the slope continues its gentle decrease to Izvoarele with a drop of about 15 m at 5 km (3‰). The Jiana erosion remains plateau is relatively flat, but there are also sectors with slopes of up to 6 degrees (Fig. 5).

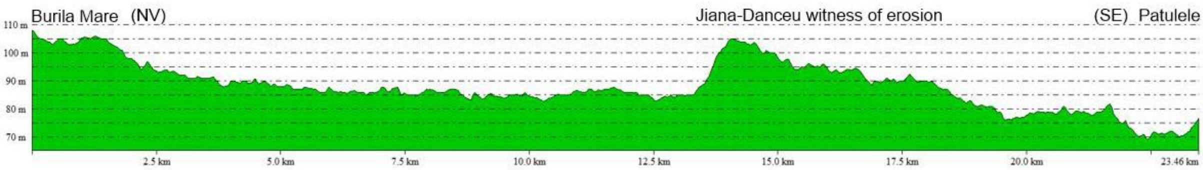

Fig. 4 – Topographic cross-section between Burila Mare and Pătulele (Global Mapper 19 processing).

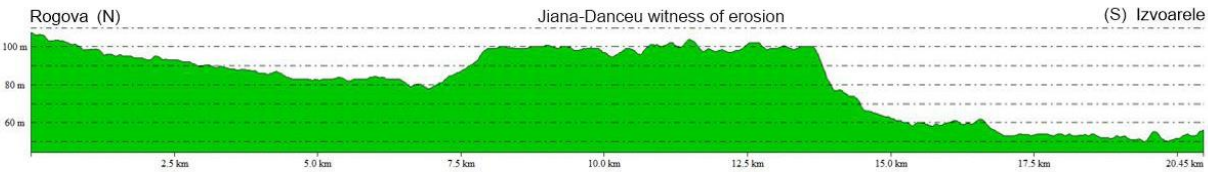

Fig. 5 – Topographic cross–section between Rogova and Izvoarele (Global Mapper 19 processing).

The surface on which we focused our attention is in the south of Jiana Plain, between the localities of Burila Mare – Jiana – Pătulele – Balta Verde – Ţigănaşi. In this case study, observations and measurements were made on the dunes north of Ţigănaşi village and west of Pătulele village, these being the surfaces that have suffered deforestation in the past 40 years and where the dynamics of the sandy soils has registered a remarkable mobility.

3. MATERIALS AND METHODS

In our study, we focused on the 1980–2020 period in order to better highlight the transition to decentralized agriculture after the fall of communism. We chose this period since it included significant changes, not only of the socio-economic characteristics (including agriculture and land use) but also in terms of climate change. For the study of the temporal evolution of these sandy terrains affected by aridity, we used: Szathmari's map of 1864, the Physical Map of Romania of 1964, the Atlas of the S. R. of Romania (Doinţă & Roman, 1976), the Topographic 1:50.000 scale map of 1979, the Hydrogeological 1:100.000 scale map of 1981, the Topographic 1:50.000 scale map of 1992 and the Topographic 1:50.000 scale map of 2000. When studying the current situation of sand dune areas, we used satellite images accessed free of charge through Google Earth PRO, data from the European Environment Agency, as well as data obtained from field observations and measurements of the actual landscape modelling stage (Sherwood *et al.*, 2010). The study methodology consisted of highlighting important landmarks in the coordinates of topographic maps (Grzywna & Nieścioruk, 2016) which were processed in the Global Mapper (with Esri maps) program (Zhao *et al.*, 2019).

The CORINE Land Cover database (1990, 2000, 2006, 2018, and 2020 maps overlay) and the SRTM Global mapper (1-arc-second Resolution, STRM Plus V3) were also used. To assess the evolution of the degradation of forested areas, satellite images (Landsat4 1982–1992 and Sentinel2 2015–2022) were used in order to obtain digital data specific to the vegetation analysis index (NDVI) (Peptenatu *et al.*, 2013; Gao *et al.*, 2022). It has the major benefits of being relatively easy to calculate while providing qualitative information on the condition of the vegetation layer over large areas. It is particularly important in the analysis of the biomass' quality and productivity and, therefore, it is very useful in the analysis of degraded forested areas (Kirilenko & Sedjo, 2007; Veron & Paruelo, 2010). The normalized difference vegetation index has been used successfully in various studies regarding the degradation of forest ecosystems in various parts of the world that are suffering from aridity/desertification (China – Lizhuang, 2017; Argentina – Blanco, 2008; Spain – Bussay, 2012).

Finally, for the evolutionary stages of the sandy terrains between Burila – Jiana – Pătulele – Izvoarele, we used the scientific papers that revealed the transformations of the agricultural lands following the human intervention classified in four historical periods: the second part of the 19th century; the first part of the previous century; the period of communist constructions after the Second World War and the period after the 1989 revolution (Grigorescu *et al.*, 2012). The study of the evolution of sandy terrains in the north of Ţigănaşi and the west of Pătulele, in Jiana Plain, is mainly based on direct observations over 4 years (2018–2022), on the interpretation of cartographic materials, the extraction of digital data and on the in-field validation of the obtained results.

4. RESULTS AND DISCUSSIONS

After the processing of the digital map of Romanian soils, a 1:200.000 scale map, and after the corroboration with the vegetation index map (NDVI) obtained from processing the Landsat 8 satellite images, we estimated that out of approximately 450 km^2 of sandy terrains within Blahnița Plain, about 300 km^2 are found in Jiana Plain. These soils with high permeability and poor content of organic elements are a major problem both in terms of retaining water resources and in terms of maintaining ecological balance.

In the western extremity of Jiana Plain, the lands are mostly sandy mixed with small amounts of loess, have been left uncultivated in the past 40 years, with just a few small areas around the localities still being cultivated. This led to the covering of the sands in a thin layer of perennial vegetation of small grass species, which later got rooted. Over time, this thin layer of vegetation has led to an improvement in the stabilization of the dunes and a decrease in their advancement. The slow evolution can be observed in the area of Burila Mare – Ţigănaşi, where the dunes appear in the form of low, long waves on which the erosion processes have attenuated dynamics (Fig. 6).

Fig. 6 – The evolution of the crest of the dune from the south of Burila:
2012 – Google Street View (left) and March 2022 (right).

From the analysis of the Ţigănaşi dune (2.5 km long and 200 to 670 m wide), which looks more like a barchan combined with a linear dune, if we follow the 97 m isohypse, the differentiated evolution of the terrains is revealed, both in the north and in the south parts of the forest-covered area (Fig. 7). In the north, at the foot of the dune, an altimetric difference of 1.5 m is observed between the arable surface and the edge of the forest. From the image it can be seen how an inadequate agriculture leads to a degradation of the vegetal layer and to an acceleration of deflation (Fig. 7A). In case of a wind with an intensity of 18 km/h (February 12, 2022) the sand particles are immobile but any external mechanical action triggers their movement (Marinică and Marinică, 2014; Angearu *et al.*, 2020) (Fig. 8). In the southern part we encounter the same situation, but in recent years, crops have led to a stabilization of the sands (Fig. 7B).

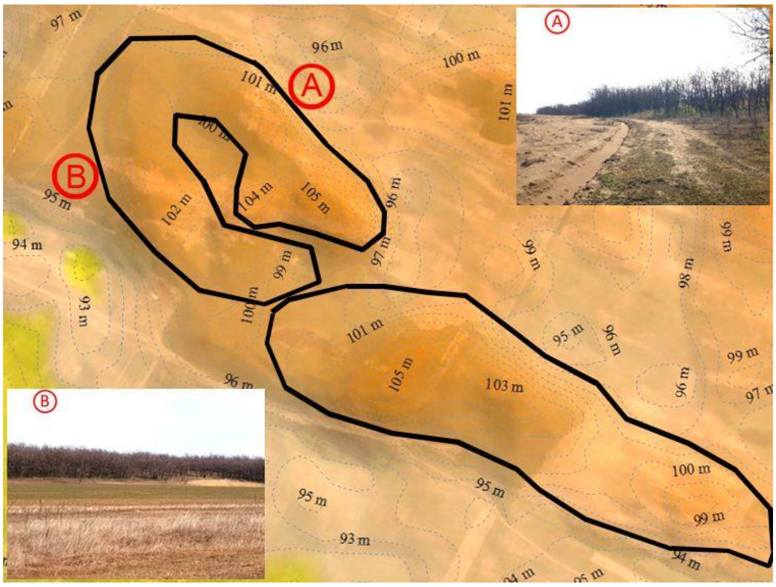

Fig. 7 – The contour of the Ţigănaşi dune and the contact with the agricultural land: A. Northern limit; B. Southern limit.

Overall, the dune is well fixed due to afforestation, but there are also some areas where forest vegetation is lacking, as is the case on the ridge in the centre-north and the eastern part of the dune.

However, the soil layer is rather protected by the scarce vegetation cover, the altimetric differences being reduced here by 50–60 cm (Fig. 9). Thus, the dune becomes accessible even for agricultural vehicles.

Fig. 8 – Burila sand dune displacement at 18 km/h (February 12, 2022).

Fig. 9 – The altimetric difference on the ridge of the Ţigănaşi dune; forest land vs. baregroud (July 5, 2021).

In recent years, Romsilva and the Burila Local Council have made decisions in favor of environmental sustainability and protective management for sandy terrains. We noticed a good example at the entrance to the Ţigănaşi forest, from Burila Mare, on the right side, where in 2018, 8 ha of dry forest were cleared, and in its place a fast-growing black locust seedling was planted. Today, after 4 years, this patch of land is well stabilized and the forest regenerates relatively quickly (Fig. 10). To the east of Burila Mică and Gogoşu localities, the sandy terrains become more and more unstable, entering the area of Jiana-type dunes with isolated or very little linked longitudinal forms, rarely with barchan forms. They are covered in sparse vegetation, consisting of willows and thistles. Their structure includes quartz sands with little-to-no loess. Between the dunes, there are ponds and lakes.

Fig. 10 – Deforestation (A – 2018) and afforestation (B – 2022) of 8 ha at the entrance to into Ţigănaşi forest from Burila Mare.

The high mobile and semi-mobile dunes between Izvoarele and Jiana have hardly any vegetation on large areas or are only partially covered with rare specimens of *Secale silvestre*, *Kochia arenaria*, *Tragus recemosus* etc. The erosion remains of Gogoşu and Burila Mică confirm the deflation intensity during the pastast half century, at the contact of the Burila dune type (with a certain consistency) with the Jiana type. In Gogoşu, the tripod field marking, built 50 years ago on a psamic preluvosol base, currently has its foot against the wind direction suspended (N: 44°23´15″ – E: 22°33´47″). The sandy material was carried to the Rotunda and Ontolea ponds and swamps from the Blahniţa floodplain. At Burila Mică we find another confirmation of the evolution and intensity of the land degradation process under the influence of the aeolian factor, seen in the elevation of the base of the metal electricity poles fixed on the sandy terrians in the southern part of Jiana Plain. Compared to the pillars in the areas with stable ground, their base was uncovered, rising up to 2 m as can be seen at the entrance to Burila Mică from Bistreţu (Fig. 11) (N: 44°25´30″ – E: 22°35´35″).

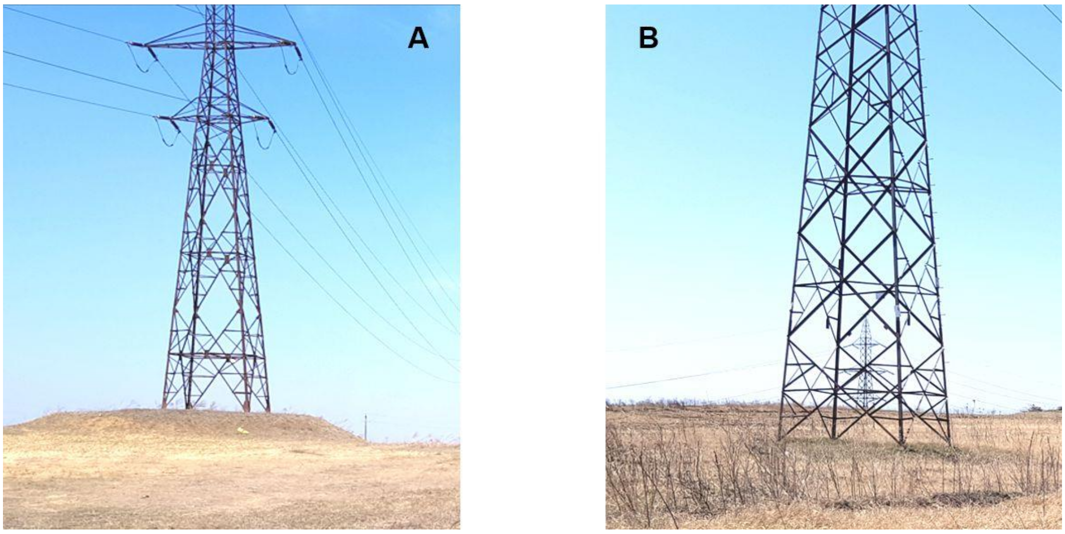

Fig. 11 – The effects of differentiated wind erosion in Blahnița Plain (March 23, 2019).
A) Land without vegetation (Burila Mică); B) Land covered in sporadic vegetation (Gruia).

The amounts of sand carried by winds from W–NW to E–SE were deposited and fixed in the forest bodies and in the crops between Burila Mică, Jiana and Pătulele, as well as within the localities in this area. Another part connected with the sand coming from the deforested or uncultivated areas over the past two decades, advanced, reactivating some dunes such as those in the southern part of Jiana Veche, east of Pătulele, and north of Izvoarele (Fig. 12).

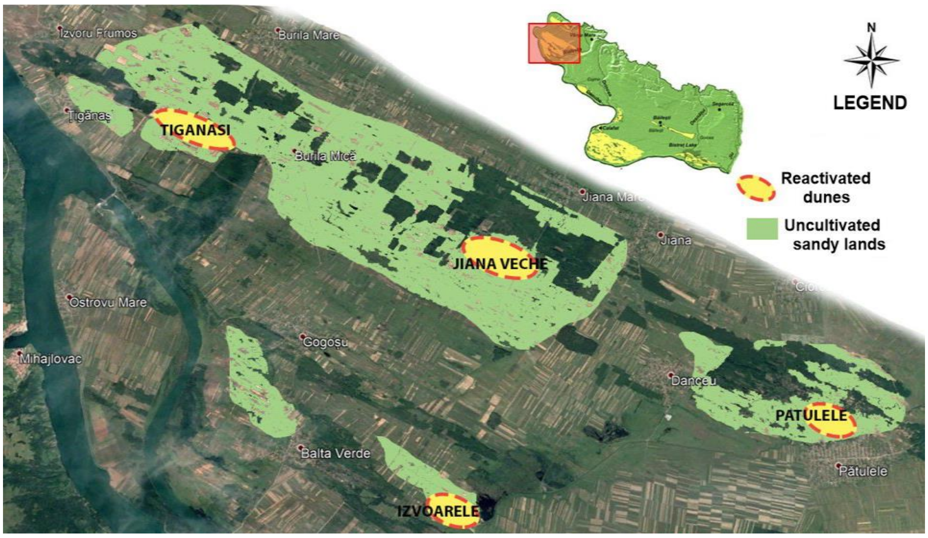

Fig. 12 – Location of reactivated dunes on sandy soils covered in temporary weak scarce vegetation.
(Processed based on Google Earth images and field observations from August 2021).

A worrying situation was recorded in the Jiana – Pătulele area where, following the comparative analysis between the topographic maps of 1979 and 1981, corroborated with satellite data from 1984 until 2020 taken from Google Earth Pro (historical images), forest areas were reduced by 37% (1,666 ha) from 4,502 ha in 1979 to 2,836 ha in 2020. The analysis of the dynamics of the areas occupied by forests is very important considering the existence of extended sandy terrains in these areas. It should be mentioned that alongside deforestation, climatic pressures (long droughts in past decades, regional heat stress) have been an important cause even for the complete disappearance of forest bodies, by drying and, subsequently, by the forest care cuts made by the local forestry associations. The disappearance of forests has led to the intensification of deflation and reactivation of dune mobility in the Jiana – Pătulele vecinity, the area occupied by sand dunes extending by almost 50%, from 98 ha in 1981 to 196 ha in 2021.

The Pătulele locality is bordered by dunes on its entire northern side, highlighted through three long ridges separated by two interdunes. The Northern dune is the best afforested of the three, 500–700 m wide and 3 km long. The southern dune has similar dimensions, stretching between the villages of Dănceu and Pătulele, being the least covered in vegetation. The central dune is the most imposing, 4.5 km long and up to 800 m wide, being the only one that extends beyond the Blahniţa River near the Pătulele – Viaşu road. The interdunes are 200 to 400 m wide, hosting water accumulations only in winter and spring.

The southern part of the central dune has suffered the most important transformation as a result of deforestation and the destruction of the silkworm farm nearby. This has led to the appearance of a dune whose development, in recent decades, has been almost 30 ha. It has the appearance of a classic dune with sand wrinkles, sand mounds and geomorphological processes typical of the Saharan regions, but on a much smaller scale (Livingstone, 2007). On this dune, a wind of 5 m/s lifts the finest sand particles, transports them over short distances and deposits them on the slope behind the wind front, causing the sand to slip and run under its own weight. The sands of this dune flow into the Blahniţa river, its advance stopping abruptly on the western bank of the river (Fig. 13) (N: 44°21´09″ – E: 22°46´57″).

Although the administrative measures taken by the local authorities in Pătulele village, including asphalting roads and offering new residence construction permits, can be considered measures to protect the northern flank of the locality against the extension of reactivated mobile dunes, the lack of afforestation of these sandy terrains has led to the periodic invasion of sands inside the locality during periods of drought and strong winds.

Fig. 13 – Sand dune aspects and the course of the Blahnita river at Pătulele (February 12, 2022).

5. CONCLUSIONS

Within Jiana Plain, factors such as the increase in air temperature and, consequently, the increase of soil temperature by 1ºC during the last half of the century (ANM, 2021), together with the reduction in rainfall (10% – European Environment Agency in the latest IPCC report), led, under the influence of the wind, to the inbalance in sand stability. If we consider also the deforestation (37% in the past four decades) and the inadequate crops, we can understand the concern of the locals for the movement of the sands towards the residential area of their villages and for sand dunes replacing cultivated lands and, hence, their crops.

The results of this study show how the sandy terrains within Jiana Plain (some 300 km^2, i.e., two thrids of the surface of Blahniţa Plain) have a different dynamic determined by: climatic factors, the nature of the soil layer, the low degree of the vegetation cover and, most importantly, the anthropic factor. Consequently, the evolution of dunes during the past 40 years has been presented according to their type and human intervention on the vegetation cover.

In conclusion, in the northwestern part of Jiana plain there are Burila-type dunes, whose evolution is described in the analysis of the Ţigănaşi dune. On the one hand, the crops in the northern part of the dune expose the sands to the winds; on the other hand, the crops in its southern part are well cared for, better protecting the sandy terrains. Although this type of dune is accessible to agricultural machinery, if the crop is not suitable for this type of soil, the sand is exposed and moved by winds to the forest patches, to the interdunes and the localities in the southeast. As a result, the altimetric differences are visible at the edge of the forest patches, but also at the base of electricity pillars and land markings.

This study shows that the evolution of the Jiana-type dunes is defined by the evolution of the dune at Pătulele. The triggering causes of the reactivation and advancement of the sands in the north of this locality are essential in this analysis. Our previous research, which showed that the dune advanced rapidly, creating a Saharan landscape over an area of 30 ha, was completed by field observations over the past 4 years on the dune front at the meeting with the residential area of Pătulele settlement and with Blahniţa river, highlighting the fact that the right bank is raised by more than 2 m due to the accumulation of sands.

The final conclusion of the study is given by the fact that all these negative aspects of the mobility and expansion of the sandy terrains in Jiana Plain can be combated only through concrete afforestation measures. Thus, an environmental management is required, its aim being the stabilization of sands and the fight against soil aridity, not only through field crops suitable for this type of soil (wheat, corn, vines, sunflowers, early potatoes etc.) but also through fruit tree plantations (peach, apricot, walnut etc.) or vegetable solaria.

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