

## AFFORESTATION OF SANDY SOILS OF OLTEНИA - A REVIEW -

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### **Abstract**

*Oltenia is the region in southwestern Romania facing significant challenges related to desertification, especially in Dolj County. Sandy soils from this area present specific characteristics due to the low water retention, low nutrient content and limited organic matter typically found in these types of soils. Afforestation could be an essential solution to prevent desertification in this region, which faces significant risks related to land degradation. Afforestation of sandy soils, however, requires a multifaceted approach, combining soil improvement techniques, careful species selection, water management and continuous monitoring. With the right strategies, it is possible to restore ecological functions and to improve fertility of these types of soils. The key to success lies in understanding the specific challenges of sandy soils and adapting techniques accordingly to promote the growth and sustainability of forested areas.*

**Key words:** afforestation, aridity, desertification, Oltenia region, sandy soils.

### **INTRODUCTION**

Afforestation is the process of planting trees on lands that were not previously forested. Key features of afforestation refer to the plantation of entirely new forested areas and often involve the use of native or fast-growing species. In the context of Oltenia, where there are challenges like sandy soils, desertification, and degraded agricultural land, afforestation could address land degradation and create new forest ecosystems in areas which became unsuitable for agriculture.

Agroforestry is also a technique which could be effective in the area because utilizes the integration of trees with farming systems to stabilize soils and improve livelihoods. This system has considerable potential to mitigate climate change (Doelman et al., 2020).

The afforestation projects of degraded terrains must be carried out in accordance with the technical norms issued by the ministry responsible for forest management. Afforestation can bring numerous ecological and economic benefits, contributing significantly to their stabilization.

Afforestation of sandy soils is an essential measure to combat desertification and stabilize affected lands. Oltenia is facing an alarming

phenomenon of desertification, which is seriously affecting which once were fertile soils. Oltenia is the region in southwestern Romania that encompasses a varied relief and diverse soils, influenced by specific climatic and geological conditions. This area is characterized by a combination of plains, hills and mountains, which significantly influences the types of soils and their use in agriculture. It is also home to the largest area of sands and sandy soils. These are arranged in longitudinal dunes oriented from west to east, in the direction of the dominant wind (Prioteasa, 2021). Yield potential of these soils is low and requires measures to stem deflation, increase in the content of humus in the soil, mineral and organic fertilizer application and preservation of forest areas (Stanila et al., 2020). Fertilization becomes essential for sandy soils, the main practice being inorganic fertilization, but also organic manures can supply nutrients in slowly available forms which improve soil physico-chemical properties. The incorporation of organic manures deeper into the soil or spreading a carpet-like layer (at least 1 cm thick) improves water storage, biological activity, and nutrient status (<https://www.fao.org/soils-portal>). Under current conditions (drought and extreme temperatures), fertilization combined with appropriate irrigation practices, becomes even

more important to ensure a constant supply of nutrients, thereby ensuring good crop development (Nițu et al., 2024). Another technique is applying mulch in order to reduce evaporation. Crop residues from the soil surface reduce evaporation losses, decrease the range between maximum and minimum soil temperature, and wind erosion. There are authors which sustain that mulching improves yield (ex. sweet potato) by maintaining soil temperature and moisture, increasing plant growth, and leading to higher tuber numbers and weight. Also, influence their quality, by increasing total soluble solids, starch, and vitamin C content in the tubers. But, the effectiveness of mulching can vary depending cultivar and mulch type (Dinu et al., 2022).

To combat the advance of sand and revitalize this type of soil, planting trees or forest curtains to stabilize them and create a favorable microclimate can be a solution. The implementation of new agricultural technologies based on reducing resource consumption contributes to reducing the impact of agriculture on the environment (Coca et al., 2020).

As in the specific context of Oltenia, afforestation is a key strategy to combat soil desertification, the purpose of this work is to present the advantages of this action and how it can help reduce the vulnerability to the drought and to the current or future climatic changes.

## MATERIALS AND METHODS

The sandy soils occupy a significant surface in Oltenia, especially in its south and have become difficult for agriculture due to the high permeability and the low water retention capacity. However, their afforestation can transform this useless land into some productive ones, income generators. The presentation of this process was carried out by consulting relevant materials, such as books, scientific articles, conference works, reports or online databases. The objectives of the documentation focused on identifying the context of desertification, the benefits and challenges of afforestation actions in the context of current climate change by attempting to address the following aspects:

- advantages;
- challenges;

- techniques;
- recommended trees.
- afforestation projects in Oltenia region.

## RESULTS AND DISCUSSIONS

### Advantages of afforestation action

- *Reducing soil erosion.* Forests help to fix the soil through tree roots, which hold soil particles together. This reduces the risk of erosion, a common phenomenon in areas with sandy soils, where wind and water can quickly carry soil particles (Akca et al., 2010). Erosion usually affects soil fertility because removes the fertile layers in the upper horizons, which contain a large amount of organic matter and nutrients (Bălan et al., 2024).

- *Improving soil quality and structure.* Afforestation helps improve soil structure and fertility. Fallen leaves and organic matter in the forest decompose, enriching the soil with essential nutrients and increasing its water-holding capacity. Tree roots help form a dense root system, which can improve the texture of sandy soil by creating channels for water and other components.

- *Regulation of the hydrological cycle.* Forests positively influence the local hydrological regime. They contribute to increasing soil moisture and reducing flood risks by absorbing excess water. This is crucial in areas with sandy soils, which have a low water retention capacity.

- *Creating a favorable microclimate.* By shading the land and through plant transpiration, forests contribute to creating a more stable microclimate, which can favor the development of other plant and animal species. This microclimate helps maintain humidity and reduce extreme temperatures. Forests contribute to better infiltration of water into the soil, which helps prevent droughts and improve the availability of water for crops and other plants.

- *Diversification of fauna and flora.* Planting tree species contributes to creating a habitat for various animal and plant species, increasing local biodiversity (Jorge et al., 2022).

- *Carbon sequestration.* Forests are essential in sequestering carbon, thus contributing to combating climate change. Through the process of photosynthesis, trees absorb carbon dioxide from the atmosphere, which helps reduce greenhouse gases.

- *Economic and social benefits.* Afforestation can generate economic opportunities through the development of eco-tourism and sustainable forestry activities. Local communities also benefit from the creation of jobs in forest management and sustainable agriculture (Akca et al., 2010). Afforestation of degraded land is not an end in itself but a national necessity (Crăciunescu et al., 2014).

### Challenges regarding afforestation

- *Low precipitation.* Oltenia is characterized by a low annual precipitation rate, which has been recorded as low as 262.7 mm in certain years.

- *Water scarcity.* Sandy soils typically have low water retention capacity, making it challenging to sustain newly planted trees during dry periods. Effective water management practices are essential for success (Mingyuan, 2024).

- *Drought sensitivity.* In southern Romania, frequent droughts can affect the success of tree planting and development, necessitating additional irrigation and seedling protection strategies. Oltenia region is highly sensitive to drought conditions, which are exacerbated by climate change.

- *Soil characteristics.* Sandy soils in Oltenia are prone to erosion and have poor nutrient retention capabilities. These factors make it challenging for trees to obtain the necessary nutrients for growth, leading to higher mortality rates among afforested species.

- *Long-term maintenance.* Continuous monitoring and management are required to ensure the health of afforested areas, especially in terms of pest control and competition among species (Jorge et al., 2022).

- *Conflict with agricultural land use.* In areas where sandy lands are used for agriculture, afforestation may conflict with economic interests related to crops.

- *Lack of funds and infrastructure.* Afforestation projects can be expensive and require considerable financial resources for implementation and long-term maintenance.

Recently, the Ministry of Environment has launched initiatives to expand the forested area in southwestern Romania, with the aim of combating desertification and improving the local ecosystem.

Afforestation of the sands in this region can bring numerous ecological, economic and social

benefits, essential for combating desertification and improving living conditions in the region.

As afforestation techniques, the following can be used:

- **planting on degraded lands:** in the plain regions of southern Romania, it is essential to plant forest species on lands degraded due to erosion or excessive exploitation. Planting should be done in a way that maximizes the success of the seedlings (e.g., using irrigation systems, protecting the seedlings from strong winds);

- **silvopasture:** this involves combining forest with animal grazing, with the aim of conserving the soil and efficiently using natural resources. Also, in some areas, to increase the efficiency of afforestation, methods such as mixed plantations (using combinations of tree and shrub species to create a stable and diversified ecosystem) or the use of local species (in some cases, native plants are preferred to ensure better adaptation to the ecological conditions in Oltenia) can be used;

- **Miyawaki method:** this technique involves planting a dense mix of native species in a small area, which helps create a self-sustaining forest ecosystem quickly. The method emphasizes biodiversity and can improve soil quality rapidly;

- **patch planting:** instead of uniform planting, creating patches of vegetation can help gather surface runoff and improve local moisture levels, facilitating better growth conditions for the trees (Mingyuan, 2024).

### Tree species suitable for afforestation of sandy soils

For the afforestation of sandy soils, several species of trees and shrubs are recommended that adapt well to the specific conditions of these soils. These are:

- *Acacia (Robinia pseudoacacia)* is a drought-resistant species that grows well on sandy soils and helps fix nitrogen in the soil.

- *Oak (Quercus robur)* is a hardy tree that can help stabilize soils and can grow on poorer soils. In the Oltenia Plain the Turkey Oak occupies 10061.9 ha, and the Hungarian Oak 4655.0 ha (Cojoacă et al., 2020).

- *Poplar (Populus spp.).* Poplars are often used in reforestation projects in lowland areas

because they grow quickly and can tolerate sandy soils.

- Pine trees (*Pinus* spp.). Various species of pine are well-suited to sandy soils due to their deep root systems and drought tolerance. Research from Turkey demonstrates that afforestation of sand dunes with pine (specifically Stone Pine, *Pinus pinea*), along with other species, increases soil organic matter, phosphorus content, and socio-economic value within several decades. Pines not only stabilize sandy soils and reduce erosion but can also serve as sources of timber, nuts, and other products, benefiting local communities (Akca et al., 2010). Planting trees such as *Pinus sylvestris* and *Ulmus pumila* has been shown to enrich soil nutrients in the surface layers, improve soil structure, and reduce bulk density, which enhances overall soil health (Guo et al., 2024).

- *Casuarina* spp. (Sheoak). These trees are drought-resistant and can fix nitrogen, improving soil quality.

- *Hakea* spp. An Australian native that adapts well to sandy soils and is drought-tolerant.

- *Grevillea* spp. Another Australian native that flourishes in sandy conditions, known for its unique flowers and deep root system.

- Olive Tree (*Olea europaea*). Drought-tolerant and well-adapted to nutrient-poor soils, making it ideal for sandy environments.

- *Telopea* spp. (Tree Waratah): Known for vibrant flowers and hardiness in poor soil conditions.

- Bald Cypress (*Taxodium distichum*): Thrives in wet or dry sandy conditions and is known for its resilience.

- Sand grass or perennial grass species - they can be used as short-term cover plants to help stabilize the soil until the trees become mature enough.

In addition to these, a number of other species can also be used such as: juniper, sea buckthorn, willow, weeping willow, etc., and shrubs that can also be used for the afforestation of degraded lands (Enescu, 2015, 2018). Among best shrubs or other plants:

- *Lavandula angustifolia* (Lavender): Excellent for sandy soils due to its drought resistance and ability to thrive in poor nutrients.

- *Rudbeckia* spp. (Black-Eyed Susan): A flowering plant that does well in full sun and sandy conditions.

- *Salvia* spp.: These plants are hardy and can tolerate dry, sandy soils.

- *Buddleja* spp. (Butterfly Bush): Thrives in sunny, dry locations with sandy soil.

- *Juniperus* spp. (Junipers): Adaptable shrubs that can withstand drought and poor soil.

Choosing the right species for afforestation in sandy soils is essential for ensuring successful growth and sustainability of the forest ecosystem. The mentioned species are well-suited to cope with the challenges posed by sandy environments, making them ideal candidates for afforestation projects (<https://www.rhs.org.uk/plants/for-places/sandy-soils>).

The lands from the Oltenia area were gradually subjected to changes induced by intensive agricultural use, so that on large areas of forest it was intervened in numerous stages of afforestation and deforestation (Iordache & Ciuinel, 2013). In the last three decades over 4300 hectares of forests and vineyards areas in sandy dunes perimeter were lost (Prăvălie, 2013). The absence of irrigation and the uncontrolled deforestation of protection belts accelerated the extension of desertification of sandy soils, leading to depleted arable-land productivity and, in time, abandonment of these lands (Bălteanu et al., 2013). The impact of climate change in the sandy soil areas of Sadova, Bechet, Corabia, Apele Vii, etc. led to intense aridity phenomena and tends to enhance desertification on larger surfaces. Therefore, there is an urgent need to cover and protect the soil from Apele Vii, Mârșani, Daneți, Celaru, Castranova, etc. communes which also falls into the high drought-affected sandy soils of the Leu-Rotunda Plain. Recent studies suggest that the combination of black locust (*Robinia pseudoacacia*) and bird cherry (*Prunus padus*) is optimal for afforestation in this region. These species are favored due to their rapid growth rates and ability to stabilize shifting sands within five years. They are also economically viable, as their seedlings are easy to produce and affordable (Enescu, 2019; Răduca et al., 2022). Black locust is an important non-native tree species used mostly for sandy soil and sterile dump afforestation for its ornamental role, but also for its wood (lumber, poles, firewood) and honey production (Buzatu-Goanță et al., 2020).

Few years ago, in Radovan (medium fertility soil), Tâmboiu (sandy soil, irrigation) and Ișalnița (anthropomorphic soil formed from coal ash), an experiment with SRC willow crop of was initiated considering the species a sustainable source of biomass because of its potential to fix carbon (C) in the soil and also, short-term crops could be an option for solving the demand for bioenergy (Păniță et al., 2017). *Salix* genus includes many species with various uses - wood production, biomass, animal feed, source of salicylic acid, land reclamation, biofuel, etc. (Corneanu et al., 2022).

In Dolj county there is a natural forest in Bratovoiești, which occupies a large part Oltenia Plain, of the Valley Jiu with three types of natural habitats and plant communities rich in mesophylic, mesohygrophilous and hygrophilous species (Cojoacă & Niculescu, 2018).

*Juglans regia* L. is also a species which is growing well in temperate climate areas. Oltenia is a region known for walnut diversity because its various eco-geographical areas (Cosmulescu & Botu, 2012).

The challenges of afforestation of Oltenia region necessitate careful planning and the selection of drought-resistant tree species for afforestation projects. Strategies must include efficient water management practices and soil improvement techniques to enhance the viability of afforestation efforts in this vulnerable region.

The zoning and micro-zoning of the potential forest vegetation can be the base of the selection of species that optimally harness the stationary potential in the case of the extension of the forest land to the agricultural land unfit for agricultural use, and the extension of forest protection curtains in territories where their design has not been carried out (Bercea & Dinuță, 2018).

### **Recent afforestation initiatives**

The increase of areas covered by forest vegetation and the necessity to take actions against drought, aridity and land degradation is a priority of the national strategy for preventing and control of these (MMPA, 2008).

Romania has implemented several afforestation programs, such as the "National Afforestation Program", which encourages the rehabilitation of degraded lands, including sandy soils in the south of the country. These projects are carried out in collaboration with local authorities and

environmental organizations and aim to protect soils and improve ecosystems.

MMPA (2017) emitted a National Forest Strategy for 2018-2027 was published, putting an emphasis on sustainable management of the national forest fund.

Generally, funding is a problem of afforestation in Romania. Along time, afforestation projects were supported mainly through different funding mechanisms: Special Accession Program for Agriculture and Rural Development (SAPARD) (Law no. 316/2001), the Environmental Fund (Law no. 73/2000, completed by Government Emergency Ordinance no. 196/2005 and the European Union funding instruments implemented through the National Program for Rural Development (PNDR) actions (Government Decision no. 1.284/2008 for 2007-2013 and no. 226/2015 for 2014-2020) (PNDR, 2017) (Palaghianu & Dutca, 2017).

Afforestation projects implementation is hindered by the lack of cadastre and funds. Also, to the population and the landowners it must be explained the importance of forest protection belts for the improvement of environment and living conditions, for the gradual diminishing of drought effects and for the enhancement of agricultural production (Achim et al., 2012).

PNDR, 2014-2020, through Measure 8.1 for afforestation by the concept of transferable carbon credits could potentially contribute to increasing forest area in Romania and carbon sequestration projects such as PCF, could represent viable opportunities for future afforestation (Palaghianu & Dutca, 2017).

123 Measure "Increasing the added value of agricultural and forestry products" has as general objectives to increase the competitiveness of agrifood and forestry processing enterprises by improving the general performance of enterprises in the processing and marketing sector of agricultural and forestry products, through better use of human resources and other factors of production (Vladu et al., 2018).

A large part of the budget for afforestation funds from the National Plan for Recovery and Resilience (PNRR) is being allocated to the south of the country, where it is most needed. 70 hectares of sand from the Oltenia Sahara were afforested with acacia, elm and mulberry.

Another 2500 hectares of sandy land will be afforested to protect localities and crops.

In 2023, Romania added 3,159 hectares of new forests, bringing the total forested area to 6.45 million hectares. This increase is largely due to reforestation efforts on pastures, afforestation of degraded lands, and inclusion of new areas in the national forest fund.

Key contributors to this growth include:

- Government and EU-funded initiatives focusing on afforestation and reforestation.
- NGOs and private projects, such as the Tomorrow's Forest Foundation and Mossy Earth, which restore forests and combat illegal deforestation. Their projects in Dolj County, for instance, aim to restore ecosystems and support local communities. There were also some reforestation initiatives made by students, teachers and volunteers' communities in order to contribute to climate change mitigation efforts. Afforestation efforts are increasing, but deforestation still poses challenges, especially in areas affected by illegal logging or land-use changes. Sustainable forest management remains a key priority. The afforestation of degraded sandy soils is seen as a valuable opportunity to expand the national forest fund, providing ecological benefits and supporting local communities.

## CONCLUSIONS

Oltenia is a region with significant agricultural potential due to the diversity of its soils. However, the challenges related to desertification require innovative solutions to maintain the viability of agriculture in this area. Adapting agricultural techniques to local conditions will be essential for the future of the region.

Afforestation of sandy soils helps stabilize them, but also contributes to improving the quality of the environment, having a positive impact on biodiversity. Also, can be a viable solution for ecological restoration and sustainable land management. By carefully selecting appropriate species, employing effective planting techniques, and managing resources wisely, it is possible to transform degraded sandy landscapes into productive ecosystems that benefit both the environment and local communities.

For the afforestation of sandy soils, species capable of stabilizing the soil, reducing erosion and contributing to improving environmental quality are recommended.

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