PERSPECTIVES ON FIELD PROTECTIVE SHELTERBELTS: AN ESSENTIAL COMPONENT FOR AGROFORESTRY SYSTEM EXPANSION ACROSS ROMANIA

Cristian Mihai ENESCU

University of Agronomic Sciences and Veterinary Medicine of Bucharest, 59 Marasti Blvd, District 1, Bucharest, Romania

Corresponding author email: mihaienescu21@gmail.com

Abstract

Protective shelterbelts in agricultural fields are pivotal for expanding agroforestry systems in Romania. However, the current state of shelterbelts in the country is not as good as it used to be six decades ago. The decline is attributed to deforestation in the latter half of the previous century and a combination of limited investments and bureaucratic hurdles. The objective of this study was to gauge the perceptions of the public in Romania regarding the necessity and significance of field protective shelterbelts. A questionnaire comprising ten open and closed questions was created using Google Forms, primarily focusing on the roles of key stakeholders in this domain. The survey was disseminated on the "Pădurile din România" Facebook page, resulting in a collection of 319 responses over a three-day period (December 2nd, 3rd and 4th, 2023). The participants in the survey also provided several valuable proposals.

Key words: agroforestry systems, field, forest, opinion, shelterbelt.

INTRODUCTION

A shelterbelt, a key element of the agroforestry systems, alternatively known as shelter forest, windbreak, or protective forest, is a planted forest managed primary to fulfill certain ecological services, functions and/or benefits for humans, their activities, and crops (Cadar et al., 2015; Li et al., 2022; Mușat et al., 2022; Potashkina & Koshelev, 2022).

Field protective shelterbelts are linear arrangements of trees and/or shrubs strategically planted to provide protection to crops, livestock, and the environment in agricultural fields (Zheng et al., 2016; Ungurean et al., 2017; Corochii et al., 2019; Zhu & Song, 2021). The shelterbelts serve as windbreaks, helping to reduce wind and soil erosion, conserve moisture, and create micro-climates that benefit crops (Lampartová et al., 2015; Mușat et al., 2021; Wang et al., 2024).

In the present scenario of climate change, linked to pollution, deforestation, or alterations in the landscape, which leads to a growing trend of aridification (Li et al., 2024), protective shelterbelts assure a crucial role for humanity worldwide, and in Romania (Giurgiu, 2012), where several afforestation projects

were proposed in the last decades (Doniță & Radu, 2013; Enescu 2020).

Particularly, this phenomenon is evident in Romania, where one third of the territory is affected by soil erosion process (Constandache & Nistor, 2014), and 10% of the area is threatened by desertification (Vorovencii, 2015), and where over the past few decades, the impact of global climate change has heightened the process of aridization, especially in the southern-western part of the country (Pravalie et al., 2014).

Therefore, field protective shelterbelts have been extensively employed since the 20th century as a defensive measure against climate adversities and for soil protection against erosion (Vasilescu & Tereșneu, 2006; Vijulie et al., 2013).

Romania has a rich tradition in afforesting various types of lands. The afforestation projects, including the ones aimed at establishing forest shelterbelts, are done according to the technical norms which are approved by normative acts (Enescu, 2015). A diverse range of both native (autochthonous) and non-native (allochthonous) shrub and tree species were used in the afforestation of various degraded lands (Enescu, 2014; Enescu

et al., 2015; Enescu 2018a; Enescu 2018b; Enescu 2020; Enescu 2022). Black locust stands out as one of the frequently employed tree species in land reclamation in Romania, mainly due to its low ecological requirements (Nuță & Niculescu, 2011; Ciuvăț et al., 2013; Enescu & Dănescu, 2013; Enescu, 2019).

In certain instances, a shift is expected to be done by the foresters, with the possibility of replacing black locust with native and drought tolerant oak species like pubescent oak (*Quercus pubescens* L.) and Italian oak (*Q. virgiliana* Ten.), two closely related oak taxa (Enescu et al., 2013; Apostol at al., 2016).

Recently, Romanian Academy thought its foundation managed to establish more than 155 hectares of shelterbelts between 2017 and 2022, spanning over 107 kilometers in length with an average width of 15 meters (Dolocan et al., 2022).

Field protective shelterbelts are also recognized as essential components within agroforestry systems, a global focus due to the numerous benefits they offer, not only for landowners but also for the environment, and especially to neighboring crop lands (Popovici et al., 2018; Mihăilă et al., 2022; Budău et al., 2023).

The woody components of agroforestry systems can provide a diverse array of non-wood forest products including forest fruits and seeds, medicinal and aromatic plants, edible mushrooms, tree sap, and even hunting-related products, that could serve as an additional source of income for landowners or land managers (Enescu, 2017; Enescu & Hălălișan, 2017; Cioacă & Enescu, 2018; Cântar et al., 2019).

Considering the numerous benefits of field protective shelterbelts, the objective of this study was to evaluate the perceptions of the public in Romania regarding their necessity and significance.

MATERIALS AND METHODS

In order to assesses the perceptions of the public in Romania a questionnaire comprising ten open and closed questions was created using Google Forms. The survey was disseminated on the "Pădurile din România" Facebook page over a three-day period (December 2nd, 3rd and 4th, 2023). Data on gender, place of residence (urban or rural) and age were also gathered.

The list of the ten questions consisted in:

Q1. Do you think there is a need for larger areas of field protective shelterbelts? (with the possibility to choose between: to a very large extent, to a large extent, to a small extent, this is not the case, they are enough or other free answer);

Q2. In which region of the country do you believe it is essential to establish additional protective forest shelterbelts? (open question);

Q3. In your opinion, what are the main benefits of establishing field protective shelterbelts? (with the possibility to choose between: increasing agricultural yield, increasing the level of biodiversity of the agroforestry system, timber supply, increasing and diversifying fruit and seed production, carbon sequestration, reducing soil erosion processes, increasing the fertility of agricultural soils, increasing game populations, creating a beautiful landscape or other free answer);

Q4. Who should establish the field protective shelterbelts? (with the possibility to choose between: Ministry of Environment, Waters and Forests, Ministry of Agriculture and Rural Development, National Forest Administration ROMSILVA, private-owned forest districts, the farmers, the landowners, City Hall/Local Council, firms for the design and execution of land improvement works in forestry, NGOs, multinationals, through their CSR campaigns or other free answer);

Q5. Who should finance the establishment of protective forest shelterbelts? (the options were similar with the ones from previous question, with the addition of citizens, by creating a national investment fund);

Q6. If you were the owner of agricultural land and wanted to establish a field protective shelterbelt, with funding secured (from various sources), what would be the main species of trees and/or shrubs you would adopt? (free answers);

Q7. In the hypothesis that you were the owner of agricultural land, and you would like to establish a forest protection shelterbelt, the financing being secured (from various sources), in what proportion would you introduce shrub species in the composition of the shelterbelt? (with the possibility to choose between: 10%,

20%, 30%, 40%, 50%, I would not introduce shrub species, only trees or other free answer);

Q8. If we compare the situation in Romania with that of Bulgaria or other European countries, we find that the area of protective shelterbelts is lower. What would be the main cause in your opinion? (with the possibility to choose between: fragmentation of agricultural land, the low level of knowledge of the benefits provided by the shelterbelts by land owners, the low level of knowledge of the benefits provided by the shelterbelts by farmers, the lack of a coherent policy and a national action plan, weak promotion of examples of good practices, very low involvement of central and/or local public authorities, the logistical challenges of establishing forest shelterbelts, lack of coherent and predictable financial instruments or other free answer);

Q9. Considering that many of the agricultural lands are privately owned, and the degree of their degradation is accentuated, you consider that it would be appropriate for the State to intervene by expropriating these areas in order to establish protective shelterbelts, financed from the state budget? (with the possibility to choose between: Yes, on a maximum of 5% of private surfaces, without compensation; Yes, up to 10% of private areas, by granting compensations; No. The owner does what he wants with his lands or other free answer);

Q10. Regarding communicating the benefits of establishing protective forest shelterbelts, who should carry out information and awareness campaigns? (with the possibility to choose between: Ministry of Environment, Waters and Forests, Ministry of Agriculture and Rural Development, Town halls and local councils, National Forest Administration ROMSILVA, NGOs, higher education institutions with an agricultural/forestry profile, the televisions, farmers / farmers' associations, The Government of Romania, or other free answer).

RESULTS AND DISCUSSIONS

In total, 319 questionnaires were filled out, and 27% of the respondents were females, and 73% were males, respectively.

139 respondents originated from rural areas, and 180 originated from urban areas, respectively.

For the first question (Q1. Do you think there is a need for larger areas of field protective shelterbelts?), 84.6% of the respondents considered the need to be to a very large extent, and 14.7% to a large extent, respectively. Only one respondent considered the need to be to a small extent.

Almost half of the respondents (49%) believe that the forest shelterbelts are needed especially in the southern part of Romania, in Dolj and Olt counties. One quarter of the respondents wish to establish forest shelterbelts across the country. The rest of the answers were targeting certain area from Romania, most of them in plan regions.

Regarding the main benefits of the forest shelterbelts (Q3), for 27.9% of the respondents reducing the soil erosion processes was considered the main benefit. Similar results were recorded for "increasing the level of biodiversity of the agroforestry system" (21.9%), and "increasing agricultural yield" (19.7%), respectively. Carbon sequestration was considered an important feature of the forest shelterbelts for 8.5% of the respondents, while 6.6% of the participants to the survey considered that the shelterbelts play a crucial role in increasing the fertility of the agricultural soils. For only 2.2% of the respondents the forest shelterbelts are mainly regarded as a base for creating a beautiful landscape.

The importance of above-mentioned services and functions provided by the forest shelterbelts were significant higher in comparison with the products that these tree lines could provide, fruit and seed production being important for only 1.3% of the respondents, while timber for a event lower share (0.6%), respectively. 11.3% of the received answers were very diverse, being mainly a combination of the ones highlighted above.

Regarding the main entities that should establish the protective shelterbelts, 42% of the respondents pointed the Ministry of Environment, Waters and Forests, and 14.4% the Ministry of Agriculture and Rural Development. 11.3% of the respondents considered that the National Forest Administration Romsilva should be the key entity, while in the opinion of 9.1% of the respondents the landowners should do it. The

local councils and the farmers received only 5.6% and 3.8% of the answers, respectively. 13.8% of the responses were a mix of the above-mentioned ones (Figure 1).

Similar answers were received for Q5 (Who should finance the establishment of protective forest shelterbelts?), three quarters of the answers targeting the main public authorities, namely the Ministry of Environment, Waters and Forests (54.5%), and the Ministry of Agriculture and Rural Development (21.3%), respectively.

- Ministry of Environment
- Ministry of Agriculture
- Romsilva
- Land owners
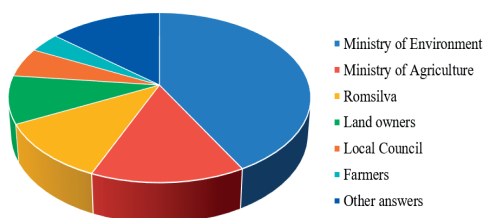- Local Council
- Farmers
- Other answers

Figure 1. The entities that should establish shelterbelts

As regards the desired tree and shrub species in the composition of the forest shelterbelts, almost half of the respondents opted for cultures having black locust (*Robinia pseudoacacia* L.) as the main tree species. This answer is not surprising taking into consideration that black locust is a fast-growing tree species that provide several services and both wood and non-wood products, being able to grow up to 8 meters in less than 8 years, in most of the cases (Figure 2).

Figure 2. A eight-year-old shelterbelt with black locust

In the scenario in which the participants of the survey are landowners and they will have the

chance to choose the shares of the shrub species in the composition of the protective shelterbelts, while receiving money from various sources, more than half of them will choose between 20% and 30% (Figure 3), which could be related with the perception that bigger trees provide a better shelter, which is not always the case.

- 10%
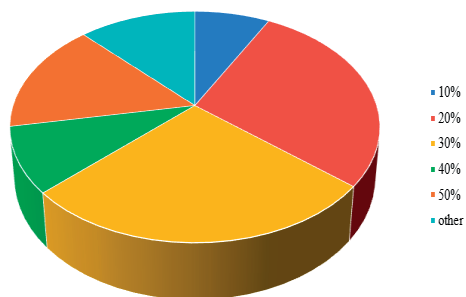- 20%
- 30%
- 40%
- 50%
- other

Figure 3. Share of shrub species in the composition of the forest shelterbelt

Regarding the main causes of the very low area covered with protective shelterbelts across Romania, 34.2% of the respondents think that the lack of a coherent policy and a national action plan is the main cause. 25.1% believe that there is a low level of knowledge of the benefits provided by the shelterbelts by farmers, while 12.5% of the respondents pointed the very low involvement of central and/or local public authorities. Fragmentation of agricultural land was considered also a main reason by 9.1% of the respondents.

Considering the private-owned agricultural lands which are affected by erosion, 60.8% of the respondents consider that the state should establish protective shelterbelts on these lands up to 10% of the area, but to provide compensations to the owners. In the opinion of 15.4% of the respondents the state should intervene up to 5% of the area, but without granting compensations. Another 15% of the participants to the survey pointed out that the state should not intervene on private-owned land.

Regarding the entities that should communicate to the public about the benefits of the shelterbelts, the central authorities (*i.e.* Ministry of Environment, Waters and Forests and Ministry of Agriculture and Rural Development) should have the main role in the

opinion of more than two thirds of the respondents. Local councils and the National Forest Administration Romsilva are regarded also as key entities that should communicate more about the benefits of the shelterbelts, in the opinion of the 10% and 5% of the respondents, respectively.

CONCLUSIONS

Even if in Romania there is a strong legal framework related to the establishment of protective shelterbelts since more than twenty years (*i.e.* Law no. 289 from 2002 regarding the protective forest shelterbelts), little was done in this field, and when it was done (*e.g.* more than 200 km along the highway from București to Constanța) the communication was almost lacking. One of the main challenges is related with the fact that the targeted lands for establishing the protective shelterbelts are private-owned, and the state must intervene through expropriation. But this is not the case for the private-owned lands where the owner, in most of the cases, don't have restrictions. Moreover, currently, in Romania, the state is financing these projects through the National Recovery and Resilience Plan.

In general, the public is very interested in establishing protective shelterbelts, but in most of the cases, the concrete information is lacking and therefore the perception of the participants of this survey is not the correct one in several perspectives, mainly in ones related with the ownership of the land.

In the perspective of contemporary climate change, which is concretized by an increasing air temperature, especially in plain areas across Romania, it is expected that the importance of protective shelterbelts to increase and more and more farmers to start to establish them on significant areas in order to compensate the aridization effects on their crops through creating or extending the existing agroforestry systems.

ACKNOWLEDGEMENTS

REFERENCES

Apostol, E.N., Dinu, C.G., Apostol, B., Ciuvăț, A.L., Lorenț, A., Pleşca, I., Postolache, D., Leca, Ș., Enescu, C.M. (2016). Importance of pubescent oak (*Quercus pubescens* Willd.) for Romanian forests in the context of climate change. *Revista de Silvicultură și Cinegetică*, 21(39), 29–33.

Budău, R., Apăfăian, A., Caradaică, M., Bratu, I.A., Timofte, C.S.C., Enescu, C.M. (2023). Expert-Based Assessment of the Potential of Agroforestry Systems in Plain Regions across Bihor County, Western Romania. *Sustainability*, 15, 15724.

Cadar, N., Chisăliță, I., Merce, O., Turcu, D.O., Cântar, I.C., Crăciunescu, A., Vișoiu, D. (2015). The establishment of shelterbelt against the snow cover of national roads in Arad County. *JOURNAL of Horticulture, Forestry and Biotechnology*, 19(1), 186–192.

Cântar, I.C., Enescu, C.M., Dincă, L. (2019). Application of the Analytic Hierarchy Process in selection of the most important Non-Wood Forest Products in Dolj County. *Annals of the University of Craiova - Agriculture, Montanology, Cadastre Series*, 48(2), 50–57.

Cioacă, L., Enescu, C.M. (2018). Trends in the evolution of harvesting of non-wood forest products in Romania. *Research Journal of Agricultural Science*, 50(4), 82–86.

Ciuvăț, A.L., Abrudan, I.V., Blujdea, V., Marcu, C., Dinu C., Enescu, M., Nuță, I.S. (2013). Distribution and peculiarities of black locust in Romania. *Revista de Silvicultură și Cinegetică*, 18(32), 76–85.

Constandache, C., Nistor, S. (2014). Preventing and control of soil erosion on agricultural lands by antierosional shelterbelts. *Scientific Papers. Series E. Land Reclamation, Earth Observation & Surveying, Environmental Engineering*, III, 29-36.

Corochii, M., Păcurar, I., Dîrja, M., Hoble, A. (2019). Characterization of the stable aggregates of the soil specific to the northern plateau of the Republic of Moldova. *Agricultura*, 3-4(111-112), 7–19.

Dolocan, C., Mușat, M., Ciceroi, R., Argatu, G., Mușat, I.B., Petcu, M. (2022). Aspects regarding the shelterbelts establishment in Bărăgan Plain. *Scientific Papers. Series A. Agronomy*, LXV(2), 54–60.

Doniță, N., Radu, S. (2013). Increasing the area covered by wooden vegetation (forests, shelterbelts, thickets), ecological imperative and economical need for the improvement of the environmental factors and prevention of climate change effects. *Revista Pădurilor*, 128(3), 19–23.

Enescu, C.M., Dănescu, A. (2013). Black locust (*Robinia pseudoacacia* L.)-an invasive neophyte in the conventional land reclamation flora in Romania. *Bulletin of the Transilvania University of Brașov. Series II: Forestry ● Wood Industry ● Agricultural Food Engineering*, 6(55), 23-20.

Enescu, C.M, Curtu, A.L., Șofletea, N. (2013). Is *Quercus virgiliana* a distinct morphological and genetic entity among European white oaks? *Turkish Journal of Agriculture and Forestry*, 37, 632–641.

Enescu, C.M. (2014). Sea-buckthorn: a species with a variety of uses, especially in land reclamation. *Dendrobiology*, 72, 41–46.

Enescu, C.M. (2015). Shrub and tree species used for improvement by afforestation of degraded lands in Romania. *Forestry Ideas*, 21(1), 3-15.

Enescu, C.M., Loghin, C., Ștefan, V. (2015). Wild privet (*Ligustrum vulgare* L.): a multipurpose species with an important role in forest land reclamation. *JOURNAL of Horticulture, Forestry and Biotechnology*, 19(1), 70–73.

Enescu, C.M. (2017). Collection and use of birch sap, a less known non-wood forest product in Romania. *Scientific Papers Series Management, Economic Engineering in Agriculture and Rural Development*, 17(1), 191–194.

Enescu, C.M., Hălălișan, A.F. (2017). The economic contribution of hunting products to the turnover of the forestry units in Romania. *Agriculture & Forestry*, 63(3), 147–153.

Enescu, C.M. (2018a). Russian olive (*Elaeagnus angustifolia* L.): a multipurpose species with an important role in land reclamation. *Current Trends in Natural Sciences*, 7(13), 54–60.

Enescu, C.M. (2018b). Which shrub species should be used for the establishment of field shelterbelts in Romania? *Scientific Papers. Series A. Agronomy*, LXI(1), 464-469.

Enescu, C.M. (2019). Sandy soils from Oltenia and Carei Plains: a problem or an opportunity to increase the forest fund in Romania? *Scientific Papers Series Management, Economic Engineering in Agriculture and Rural Development*, 19(3), 203–206.

Enescu, C.M. (2020). Allochthonous tree species used for afforestation of salt-affected soils in Romania. *Scientific Papers. Series A. Agronomy*, LXIII(1), 74-79.

Enescu, C.M. (2022). Which woody species should be used for afforestation of household dumps consisting of demolition materials mixed with organic materials? *Scientific Papers. Series A. Agronomy*, 65(2), 375–380.

Giurgiu, V. (2012). Protection shelterbelts - restriction and prospects. *Revista Pădurilor*, 127(6), 7–18.

Lampartová, I., Schneider, J., Vyskot, I., Rajnoch, M., Litschmann, T. (2015). Impact of protective shelterbelt microclimate characteristics. *Ekológia (Bratislava)*, 34(2), 101–110.

Li, H., Wang, Y., Li, S., Askar, A., Wang, H. (2022). Shelter Efficiency of Various Shelterbelt Configurations: A Wind Tunnel Study. *Atmosphere*, 13, 1022, https://doi.org/10.3390/atmos13071022.

Li, Q., Ye A., Wada Y., Zhang Y., Zhou J. (2024). Climate change leads to an expansion of global drought-sensitive area. *Journal of Hydrology*, 632, 130874.

Mihăilă, E., Drăgan, D., Marcu, C., Costăchescu, C., Dănescu, F., Cojoacă, F.D. (2022). Elaboration the substantiating studies for the necessity of forest shelterbelts to protect the field, premise for obtaining funds for their realization. *Scientific Papers. Series E. Land Reclamation, Earth Observation & Surveying, Environmental Engineering*, XI, 240–246.

Mușat, M., Ciceoi, R., Dolocan, C., Argatu, G., Cioroianu, I. (2021). Increasing the productive potential of agroecosystems affected by climate change using shelterbelts, in southeastern part Romania. *Romanian Agricultural Research*, 38, 1–11.

Mușat, M., Ciceoi, R., Dolocan, C., Argatu, G., Mușat, I.B., Petcu, M. (2022). The suitability of southeastern areas of Romania for the establishment of shelterbelts. *Scientific Papers. Series A. Agronomy*, LXV(2), 111–117.

Nuță, I.S., Niculescu, M. (2011). The influence of forest belts on tobacco crops in hydroameriolative Sadova - Corabia System. Analele Universității din Craiova, seria Agricultură - Montanologie - Cadastru, XL(1), 210–214.

Popovici, L., Mihăilă, E., Costăchescu, C., Constandache, C. (2018). Can agroforestry systems be ordinary practices in Romania? *Lucrări Științifice Seria Horticultură, USAMV Iași*, 61(1), 263–268.

Potashkina, Y.N., Koshelev, A.V. (2022). Impact of Field-Protective Forest Belts on the Microclimate of Agroforest Landscape in the Zone of Chestnut Soils of the Volgograd Region. *Forests*, 13(11), 1892, https://doi.org/10.3390/f13111892.

Pravalie, R., Sîrodoev, I., Peptenatu, D. (2014). Changes in the forest ecosystems in areas impacted by aridization in south-western Romania. *Journal of Environmental Health Science & Engineering*, 12, 2.

Ungurean, C., Adorjani, A., Davidescu, Ș., Tudose, N., Davidescu, A., Crivăț, M. (2017). Observations on the influence of roadside forest shelterbelts over the thickness of the snow layer. *Revista de Silvicultură și Cinegetică*, 22(41), 24–30.

Vasilescu, M.M., Tereșneu, C.C. (2006). Observations regarding the influence of forest shelterbelts on the thickness of snow layer. *Revista Pădurilor*, 121(2), 41–47.

Vijulie, I., Tîrlă, L., Manea, G., Achim, E. (2013). Change of Land-use Patterns by Planning Field Shelterbelts on Farming Lowlands Vulnerable to Water Scarcity (Romania). *Geographica Pannonica*, 17(2), 37–45.

Vorovencii, I. (2015). Assessing and monitoring the risk of desertification in Dobrogea, Romania, using Landsat data and decision tree classifier. *Environmental Monitoring and Assessment*, 187, 204.

Wang, J., Patruno, L., Zhao, G., Tamura, Y. (2024). Windbreak effectiveness of shelterbelts with different characteristic parameters and arrangements by means of CFD simulation. *Agricultural and Forest Meteorology*, 344, 109813.

Zheng, X., Zhu, J., Xing, Z. (2016). Assessment of the effects of shelterbelts on crop yields at the regional scale in Northeast China. *Agricultural Systems*, 143, 49–60.

Zhu, J., Song, L. (2021). A review of ecological mechanisms for management practices of protective forests. *Journal of Forestry Research*, 32, 435–448.