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ELABORATION THE SUBSTANTIATING STUDIES FOR THE NECESSITY OF FOREST SHELTERBELTS TO PROTECT THE FIELD, PREMISE FOR OBTAINING FUNDS FOR THEIR REALIZATION

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Abstract

Forest shelterbelts are the most widespread and efficient type of agroforestry system in Romania used for the crops protection. Following the contracts signed with the Ministry of Agriculture between 2005-2006, substantiation studies for the establishment of forest shelterbelts were carried out for seven counties from Romanian Plain and Dobrogea. At different stages of the Nucleus Program, funded by the Ministry of Research, in the period 2011-2021 studies were conducted to substantiate the need of realisation of forest shelterbelts to protect the field in other nine counties located in the mentioned area. The aim of these studies was to establish: the land areas occupied by the forest shelterbelts; the network of forest shelterbelts using GIS techniques, current rectified aerial images and detailed pedological maps; the afforestation compositions; the number of forest seedlings and to estimate the costs necessary for their installation and maintenance, until the canopy is close. For practical reasons, it was established that the width of the curtains should be 10 m, thus resulting in a percentage of occupation of the agricultural land with forest vegetation of approximately 2%.

Key words*: agroforestry system, forest shelterbelts, GIS techniques, the afforestation compositions, forest seedlings.*

INTRODUCTION

The aridity process is directly generated by the oscillations of climatic factors, but also indirectly by human activity, resulting in the degradation of land, soil, vegetation and water resources. For this reason, many countries have environmental concerns, the agroforestry systems, which involve combining agricultural and forestry crops, being successfully used to protect agricultural land, its crops, communication routes, socio-economic objectives and human settlements. The forest shelterbelts are considered the most efficient types of agroforestry systems used in this respect, having a rich tradition in our country (Popov et al., 2017; Costăchescu et al., 2018).

As a signatory to the Convention on combating Desertification (1994), due to the fact that areas potentially affected by desertification are registered in Romania, our country must contribute to achieving its main objective, therefore, to combat desertification and reduce the effects of drought in countries with serious drought and/or desertification problems through effective measures at all levels to help achieve sustainable development in the affected areas. Droughts are caused both by climate imbalances and by the sharp reduction in the area of forest vegetation in the lowland and low-hill regions. Priority must therefore be given to building forest shelterbelts networks in areas affected by frequent, long periods of drought. The introduction of forest vegetation into agricultural land has consequences not only in terms of protecting and preserving environmental conditions, but also in terms of increasing agricultural production or at least maintaining it at a relatively constant level, even in the context of significant climatic oscillations (Giurgiu, 2012).

As regards the studies on the basis of the need for the establishment of forest shelterbelts, these were carried out, in accordance with the provisions of the law (laws 289/2002 and 213/2011), by the Institute for Forestry Research and facilities (ICAS - through the Technological Development Department), in the first stage at the level of Olt, Dolj, Mehedinți and Teleorman counties, and in the second stage at the level of Ilfov, Tulcea and Constanţa counties (Adam et al., 2012;

Costăchescu & Dănescu, 2005; Costăchescu & Dănescu, 2006; Mihăilă, 2006; Greavu et al., 2012; ICAS - through the research compartment). As a result, during the period 2004-2007, studies were carried out to establish the necessity for 7 counties in the Romanian plain and in the Dobrogea Podișul, therefore for about 37% of the total surface on which the establishement of the forest shelterbelts network is required in the first emergency. For the localities in Olt, Dolj, Mehedinti and Teleorman counties, the technical and economic documents (feasibility studies and technical projects) were drawn up in accordance with the provisions of Law 289/2002.

Since 2015, in the framework of projects included in the National Nucleus Program, studies have been carried out on the basis of the necessity for the establishment of forest shelterbelts for field protection and for the counties of Buzau, Ialomița, Calarasi, Giurgiu, Brăila, Galaţi, Dâmbovița, Vrancea, Prahova, currently the study for Arges County (Danescu, 2015; Comaster chescu, 2018; Danescu & Coplay, 2019), work carried out by National Institute for Research and Development in Forestry (INCDS) - through the Research Department.

MATERIALS AND METHODS

For the establishment of the network of forest shelterbelts for protection of crops at the level of the counties exposed to the aridity in the Romanian Plain, only arable land and pastures were taken into account, by means of vectorization to the orthorectified plans scale 1: 5000, the orchards, vineyards, the intravillan of localities and, of course, the land occupied by forest vegetation were excluded from the beginning. The river's waterside areas which run through the area under consideration, delimited and addressed in this respect in previous projects, have been excluded, only the possibility of connecting forest shelterbelts networks located in the river's waterside areas with the county forest shelterbelts networks for the protection of the field itself will be considered. This resulted in the total area of agricultural land analyzed for the location of the forest shelterbelts network.

In order to establish technical solutions for the development of forest shelterbelts, it was necessary to define the territory from ecological site conditions point of view. The dominant soil types were thus established at the level of all municipalities, with the indication that the preliminary classification was made on the basis of the information provided by the scale 1: 200000 pedological map, drawn up by ICPA (Institute for Pedology and Agrochemistry Research), over which the administrative boundaries of the localities overlap. For this purpose, the pedological map was georeferenced, using the orthorectified aerial images.

Afforestation solutions have been established by soil types and groups of soil types close to the environment, linking the ecological requirements of the species to the ecological characteristics of the soil. The transposition of afforestation solutions into plans has therefore been achieved by linking them to the soils already highlighted on the work maps.

Over these successive layers of information (geographical, hydrographic, pedological, afforestation, administrative, infrastructure, etc.) the network of forest shelterbelts for field protection has been located, using GIS techniques (Figure 1). The network was performed by vectorization on the orthorectified plans 1:5000 scale, and the GIS database was completed.

RESULTS AND DISCUSSIONS

In our country the activity of studying and installing forest shelterbelts has a rich tradition, the development of these agroforestry system beginning in the early years of the 20th century, this issue having both periods of boost and decline (Lupe, 1952; Neșu, 1999).

Summing up the evolution of their development it can be said that there was a first phase that started with the early years of the 20th century and lasted until the years 1960 when forest shelterbelts were installed on about 10,000 ha (Popov et al., 2017).

The second phase lasted from 1960 to 2000 and is characterized by deterioration, destruction, regression in terms of forest shelterbelts, and a return in the last years of the period through studies that reassessed their importance.

Finally, the period from 2000 to the present date, which is marked by the promulgation of the law on forest protection curtains in 2002 and characterized by the carrying out of many studies and projects to install forest protection curtains and to a lesser extent by their establishment.

Using the way of working presented in chapter Material and methods, within the Research Department of INCDS, the forest shelterbelts networks for all counties of the Romanian Plain and Dobrogea were vector-based on the orthorectified plans (not previously covered with such works) (Figure 2).

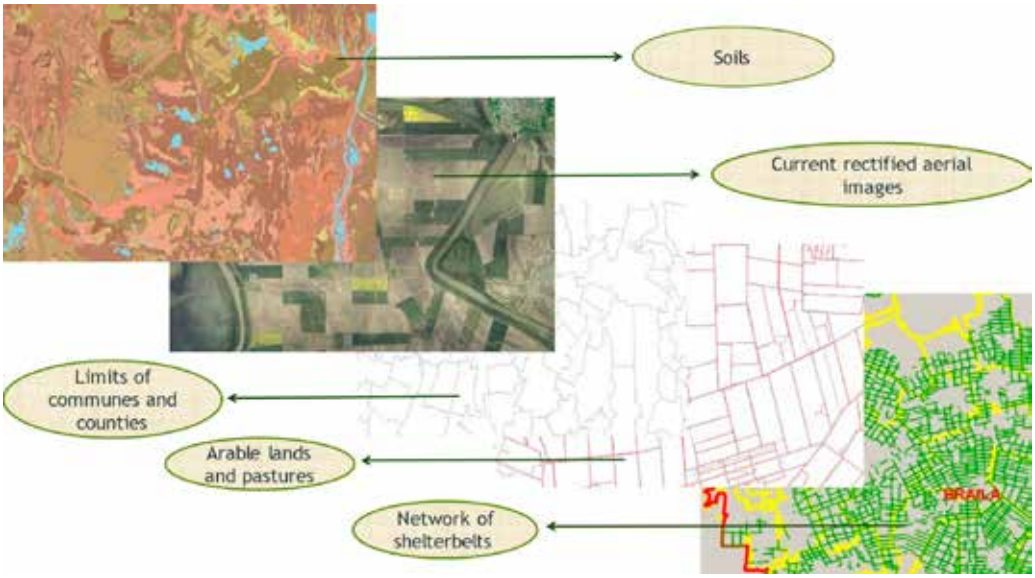

Figure 1. The successive layers of diverse information (geographical, hydrographical, pedological, administrative) over which the network of forest shelterbelts was placed

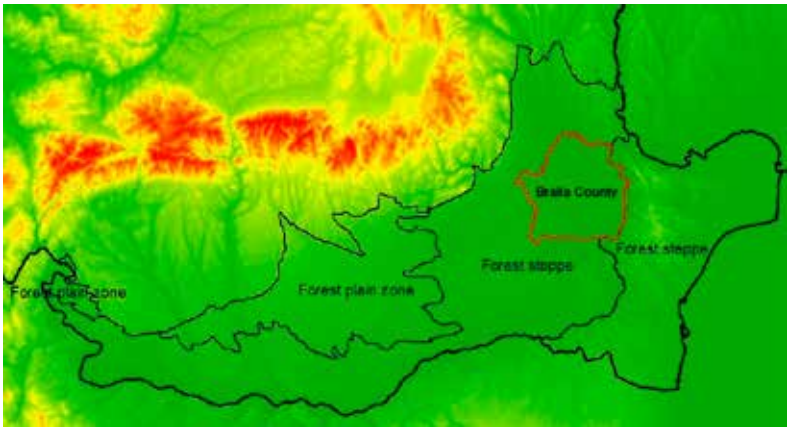

Figure 2. Romanian Plain and Dobrogea Tableland

The diversity of the stational conditions and the combination of the ecological site condition factors within the Romanian Plain and Dobrogea also determines the diversity of the forest solutions recommended for the achievement of forest shelterbelts for protection of field. In order to choose the species indicated for the development of the forest shelterbelts network, a detailed analysis of the natural environment within the geographical unit,

including a description of the ecological site conditions factors, which by variation, their distribution and mode of association determine the composition and the diversity of afforestation solutions to be adopted in order to achieve the objective (Costăchescu et al., 2010). In particular, the resistance to unfavourable stational conditions in which such protective forest crops are to be developed, the longevity of the species and the value of their products have been taken into account (Stănescu et al., 1997; Dănescu et al., 2010).

As regards the actual installation of forest shelterbelts for protection of crops, the tree and shrubs species were established and the main characteristics of forest shelterbelts (location in the field, orientation, width, distances and planting schemes).

The implementation by means of a vectorization approach on the orthorectified plans of the forest shelterbelts network for the protection of crop in the Romanian Plain and Dobrogea, allowed us to accurately determine the area to be occupied by it, the requirements of the seedlings and the costs of the actual realization of the forest shelterbelts networks, both at the local level, and at the county level.

Maps of the distribution of the forest shelterbelts network and of afforestation solutions for territorial and administrative units and at county level were drawn up for better illustration (Figure 3).

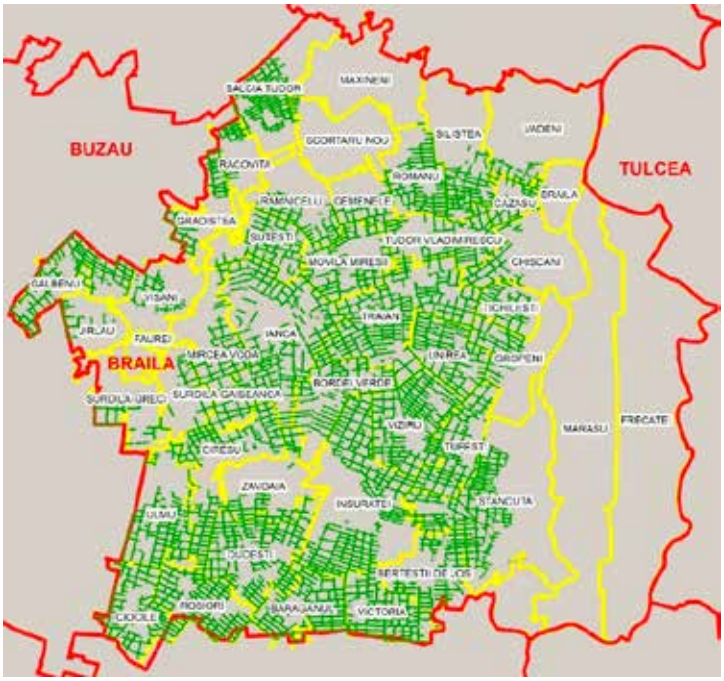

Figure 3. Location of the forest shelterbelts network for field protection in the localities within a county (Braila)

The main factors that were considered for the location of forest shelterbelts on the administrative surface of the locaties in the project were: microrelief, the form of agricultural land units, soil, local hydrographic conditions, spontaneous and cultivated woody vegetation, as well as the network of irrigation or drainage channels, railways, roads and roads of general interest.

Forest shelterbelts for protection of field have generally been placed on the edge of agricultural land in the immediate vicinity of their boundaries.

The principle was that the network should consist of main forest shelterbelts spaced at 600 m (or 500 m) and secondary forest shelterbelts, which intersect the main forest shelterbelts at a distance of 1200 m (or 1000

m), the dimensions 600 x 1200 m (or 500 x 1000 m) being the most common dimensions of agricultural land.

For practical reasons relating in particular to the need to simplify the design and subsequent execution of the forest shelterbelts network, a single forestry shelterbelts width of 10 m has been adopted, leading to a theoretical percentage of agricultural land occupancy of around 2%.

The location of forest shelterbelts has taken account of the fact that they fragment agricultural areas as little as possible and that existing wood vegetation is integrated into the created network.

The forest shelterbelts network was interrupted at the points of intersection with major communication routes (railways, highways, national roads and county roads), with water (rivers, lakes, pools) or with high-voltage power lines.

The area of the network of forest shelterbelts on localities, categories of use and afforestation solutions resulted from the overlap of the network over the above mentioned information layers, on this basis being determined the need for afforestation material (Figure 1).

Taking into account the large area on which the afforestation works are to be carried out and the high degree of spread of the works, the amount of afforestation material to be produced and the nursery area required for the production of the seedlings were also determined.

It was estimated the financial effort necessary for the realization of the network of forest shelterbelts for the protection of the crops at the county level, taking into account the cost of the actual execution of the work from the installation to the dense stand, the cost of the technical and economic documentations on the localities, the cost of obtaining the necessary legal approvals and the cost of the documentations regarding the application of the procedure for the award of the execution contracts.

For each county, the areas that will be occupied by the forest shelterbelts for crop protection (at the level of localities and at the county level), the composition of the forest shelterbelts according to the identified ecological site conditions, the need for seedlings by species have been determined and the costs of actually achieving the forest shelterbelts for crop protection have been estimated. The results obtained shall be summarised in Table 1.

Table 1. The compositions of forest protection curtains for the counties of Campia Romana, the area occupied by them, the needs of juveniles and the estimated cost of producing them

Nr. crt.	County	The surface of forest shelterbelts network (ha)/ number of localities	The composition of the forest shelterbelts	The area occupied by the composition (ha)	Total need for seedlings (thousands of seedlings)	Estimated cost for actual achievement (thousand €)
1	Braila	3,830 / 40	40Stb 20Ult 20Sl 20arb	3,830	19,150	38,300
2	Buzau	4,376 / 54	40Stb 20Ult 20Sl 20arb	1,587	7,935	43,760
			40Stb 20Ult(Tea) 20Pă 20arb	2,688	13,440	
			40Stb20Tea(Ju) 20Pă 20arb	101	505	
3	Calarasi	6,405 / 55	40Stb 20Ult 20Sl 20arb	2,588	12,940	64,050
			40Stb 20Ult(Tea) 20Pă 20arb	3,273	16,365	
			40Stb20Tea(Ju) 20Pă 20arb	544	2,720	
4	Constanța	3,800 / 52	20Stb 20Stp 20Ult 20Sl	2,390	19,000	38,000
			40Stp 20Ult 20Sl 20arb	590	2,950	
			40Stb 20Mj(Pă) 20Sl 20arb	820	4,100	
5	Dambovita	2,053 / 53	40Stb(St) 20Pa(Tea) 20Cd 20arb	2,053	10,265	20,530
6	Galati	2,124 / 40	40Stb 20Ult 20Sl 20arb	1,020	5,100	21,240
			40Stb 20Ult(Tea) 20Pă 20arb	1,104	5,520	
7	Giurgiu	3,509 / 53	40Stb 20Ult 20Sl 20arb	384	1,920	35,090
			40Stb 20Ult(Tea) 20Pă 20arb	683	3,415	
			40Stb20Tea(Ju) 20Pă 20arb	706	3,530	
			40Stb(St) 20Pa(Tea) 20Cd 20arb	1,721	8,605	
			40Ce(Gi) 30Pe 30arb	15	75	
8	Ialomita	5,466 / 63	40Stb 20Ult 20Sl 20arb	2,896	14,480	54,660
			40Stb 20Ult(Tea) 20Pă 20arb	2,417	12,085	
			40Stb20Tea(Ju) 20Pă 20arb	153	765	

9	Ilfov	241 / 7	20St20Tep20Ju40Arb	113	565	2,410
			20St20Tep20Ju40Arb	128	640	
10	Prahova	2,288 / 42	40Stb 20Ult 20Sl 20arb	284	1,420	22,880
			40Stb 20Ult(Tea) 20Pă 20arb	740	3,700	
			40Stb20Tea(Ju) 20Pă 20arb	81	405	
			40Stb(St) 20Pa(Tea) 20Cd 20arb	642	3,210	
			40Stb 20Ult(Mj) 20Ju 20arb	541	2,705	
11	Tulcea	1,157 / 35	20Stb 20Stp 20Ult 20Sl	500	5,785	11,570
			40Stp 20Ult 20Sl 20arb	457	2,285	
			40Stb 20Mj(Pă) 20Sl 20arb	200	1,000	
12	Vrancea	2,608/33	40Stb 20Ult 20Sl 20arb	698	3,490	26,080
			40Stb 20Ult(Tea) 20Pă 20arb	466	2,330	
			40Stb20Tea(Ju) 20Pă 20arb	149	745	
			40Stb 20Ult(Mj) 20Ju 20arb	1,295	6,475	
Total		**37,857 / 527**		**37,857**	**189,285**	**378,570**

Note:
Stp = *Quercus pubescens*, pubescent oak;
Stb = *Quercus pedunculiflora,* greyish oak;
St = *Quercus robur*, pedunculate oak;
EC = *Quercus cerris,* Turkey oak;
Gâ = *Quercus frainetto,* Hungarian oak;
Ult = *Ulmus pumila*, Siberian elm;
Mj = *Fraxinus ornus,* flowering ash;
Pă = *Pyrus pyraster*, wild pear;
Tea = Tilia *tomentosa,* silver lime;
Sl = *Eleagnus angustifolia,* oleaster;
Pa = *Acer platanoides,* Norway maple;
Ju = *Acer campestre*, Field maple
CD = *Prunus cerasifera*, cherry – plum;
arb= shrubs.

It is found that in the case of the 12 counties for which the substantiation studies of the necessity of achievement the forest shelterbelts for the protection of field have been carried out, the area occupied by them is 38,000 ha that will be carried out on the lands of 527 territorial - administrative units (localities). At the level of a locality, the average area occupied by forest shelterbelts is 72 ha, the need for seedlings is about 360,000 copies, and the cost of actually achivement forest shelterbelts is 720,000 euros.
The presented values are useful for sizing and distributing the production capacity of the afforestation material.
Considering the very large area on which the afforestation works are to be carried out, the high degree of spread of the works, as well as the very large amount of afforestation material to be produced, it is estimated that such a work must be distribute over a period of at least 5 years.
Taking into account the above values regarding the area of the network of forest shelterbelts, the total number of seedlings required and this minimum period of production of afforestation material and the execution of the work, it follows that the production of the necessary seedlings can be carried out on an area of approximately 125 ha of nursery, which must be available at least one year before the start of the installation works and must be distributed relatively uniformly at the level of the counties concerned, proportionally to the area of forest shelterbelts for each county.
Therefore, for the production of afforestation material involved in the creation of the network of forest shelterbelts for crop protection, the area of nurseries required at county level is on average about 10.5 ha.

CONCLUSIONS

Currently, specialists in agronomy, hydrology, climatology, environment and, of course, forestry are in full consensus on the need to move as urgently as possible to the establishment of the national system of forest shelterbelts for field protection, as a basic measure in preventing and combating the drought and aridity phenomena that affect especially the south and east of Romania, but also to protect the environment, to increase agricultural production and save water resources, which is, however, a very important step forward.
As regards the technical way of approaching it, the establishment of the national system of forest shelterbelts for crop protection must be carried out in stages and in a succession that takes into account the urgency of implementation, the existing technical and financial possibilities and other practical aspects involved in an action of this magnitude

and the aim pursued (maximum protective effect in the shortest possible time).
To achieve the forest shelterbelts network at the level of the two main geographical units, which amounts to about 38,000 ha (5,000 ha in Dobrogea and 33,000 in Romanian Plain) the necessary amount is 380,000,000 euros.
Whereas it is clear that the expenditure involved in setting up forest shelterbelts at national level is high, preceded by the expenditure required for the technical and economic documentation (which is in addition to the costs of implementation), the entire financial effort should be made, the technical and execution shall be phased over a period of at least 5 years as part of a national plan for the implementation of the national system of forest shelterbelts for crop protection.
Since, in the current economic context, funding from the national budget for this large-scale plan is unlikely, we believe that there is sufficient information and arguments to request funding from one of the programs carried out within the European Union.

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