Scientific Papers Series Management, Economic Engineering in Agriculture and Rural Development
Vol. 19, Issue 3, 2019
PRINT ISSN 2284-7995, E-ISSN 2285-3952

THE MANAGEMENT OF FORESTS SITUATED ON FIELDS SUSCEPTIBLE TO LANDSLIDES AND EROSION FROM THE SOUTHERN CARPATHIANS

Lucian DINCĂ, Florin ACHIM

"Marin Drăcea" National Institute for Research and Development in Forestry (INCDS), 13 Cloșca Street, Brașov-500040, Romania; E-mail: dinka_lucian@gmail.com

Corresponding author: dinka.lucian@gmail.com

Abstract

The forests with special protection functions from the Southern Carpathians play an extremely important ecologic role. Forests situated on fields with lithological substratum very vulnerable towards erosion and landslides are situated in this wide category of forests and are occupying even large areas. They are followed by forests situated on sliding fields. These two stand categories are analysed in the present article, starting from a large number of data regarding their component species, as well as their age, consistency and altitude at which they are present. Among the tree species, the common beech is the most prevalent, followed by Norway spruce and alder. The stands have an equilibrated distribution on ages, while the altitude does not influence their spreading. The main consistency is situated at 0.8, but forests situated on lands vulnerable to erosion and landslides can reach the 0.9 consistency category. Specific management measures were analysed as they were applied to these forest categories. As such, it was determined that management measures are specific to the conservation regime in stands that have a high intensity protection function, while they become specific to the forest's regime in forests where the protection's intensity is more reduced.
Key words: *forest stands, landslides, Southern Carpathians, forest management plans*

INTRODUCTION

Soil humidity is a factor that can decisively influence soil productivity. However, in excess conditions, it can cause significant damages to fields from the mountain area. Due to this aspect, the monitoring of this parameter is extremely important [3], [8]. The soil humidity regime is influenced by rainfall, particle size distribution or other physical-chemical soil factors [5], [12]. Landslide is a phenomenon spread out in mountain areas [6], [14], [16], [17], [20], being also present in the Southern Carpathians [4].
Soil erosion is another phenomenon that affects soils from mountain areas [1], [7], [13], [15], [18], [21].
Soils from the Southern Carpathians are generally favourable to forest stands [9], [10], [11], but can lead in certain situation to the apparition of a negative phenomenon such as landslides and erosion.
Forests from this area are compiled of resinous species [19], mixtures of resinous and broad-leaved species and rarely of pure broad-leaved species.

MATERIALS AND METHODS

Forests from our country are grouped in two main categories (named functional groups), based on their functions: Group 1: Forests with special protection functions and Group 2: Forests with protection and production functions.
The first functional group is also divided in five sub-groups. Amongst them we can find the second sub-group entitled "Forests with soil and field protection functions" that includes twelve functional categories. Amongst them we mention: 1-2H category = "Forests situated on sliding lands" and 1-2L = "Forests situated on fields with substratum very vulnerable towards erosion and landslides". The purpose of this present article is to analyse the forests from the Southern Carpathians situated in these two functional categories.
The work material was represented by forest management plans from all the forest districts situated in the Southern Carpathians [2] from where were extracted the forests situated in

the 1-2H (345 stands) and 1-2L (15,412 stands) functional categories.

From the large database corresponding to these stands (approximately 20,000 stand elements), the following elements were extracted and analysed: occupied surfaces, species distribution, stand age and stand altitude. In addition, a synthesis of the proper management measures for these forests was also created.

RESULTS AND DISCUSSIONS

The distribution and characteristics of protection forests and field vulnerable to landslides and erosion from the Southern Carpathians

The forests that have an important soil protection function (namely the following categories: 1-2H= Forests situated on landslides; 1-2I= Forests situated on fields with permanent swamp formation, from ledges or inferior meadows; 1-2K= Forests situated on karst areas and 1-2L= Forests situated on fields with extremely vulnerable substratum towards erosion and landslides) occupy a surface of 60.320 ha. in the Southern Carpathians.

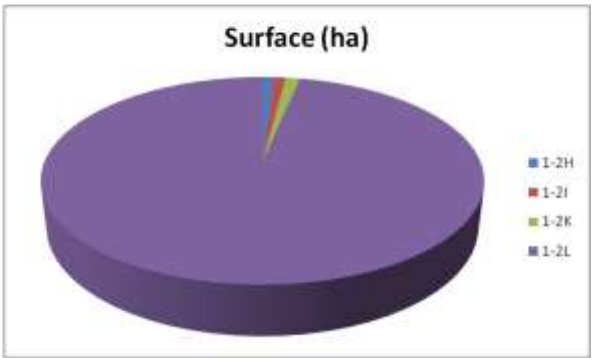

Fig. 1. Surfaces occupied by forests with soil protection functions from the Southern Carpathians
Source: original.

Amongst all the forests with soil protection functions from the Southern Carpathians, the ones situated on fields with extremely vulnerable substratum towards erosion and landslides occupy a significant percentage (97%), while the ones situated on landslide occupy only 1% (Fig. 1).

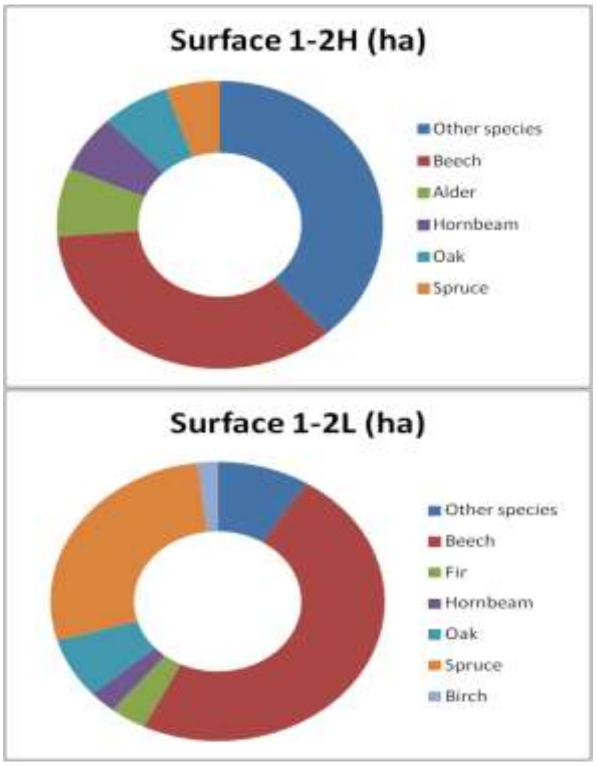

Fig. 2. Tree species from landslide fields (1-2H) and from vulnerable lithologic substratum (1-2L) from the Southern Carpathians.
Source: original.

Common beech (*Fagus sylvatica* L.) is the main species in both functional categories, while Norway spruce (*Picea abies* L., H. Karts.) occupies an important percentage in forests situated on vulnerable lithologic substratum fields (Fig. 2).

The low percentage of Norway sprue from landslides is caused by its root system that doesn’t permit the stabilization of these fields. On the other hand, alder (*Alnus glutinosa* (L.) Gaertn.) is present on these fields, especially on mountain meadows or on newly formed fields where it installs easily.

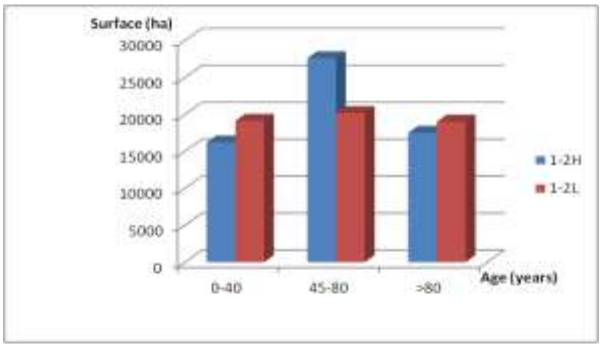

Fig. 3. Age distribution of stands from the 1-2H and 1-2L categories from the Southern Carpathians
Source: original.

Scientific Papers Series Management, Economic Engineering in Agriculture and Rural Development
Vol. 19, Issue 3, 2019
PRINT ISSN 2284-7995, E-ISSN 2285-3952

In order to compare them, the surfaces occupied by forests from landslide fields were multiplied with 100 (Fig. 3). It can be seen that forests situated on fields with vulnerable lithologic substratum have a balanced distribution on ages, while forests situated on landslide fields are dominated by forests with an average age. The explanation consists in the fact that old forests have a volume and a height that are too heavy to be sustained by landslide fields.

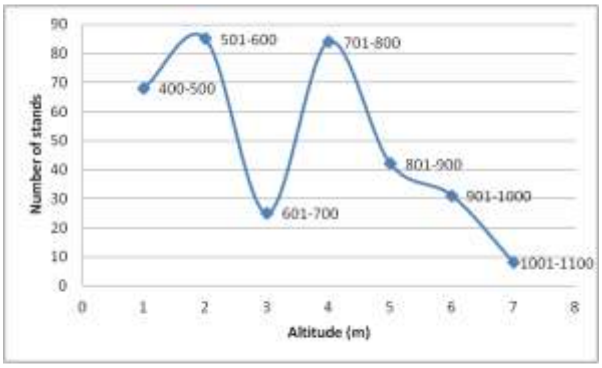

Fig. 4. Stand distribution on altitude for the 1-2H category from the Southern Carpathians
Source: original.

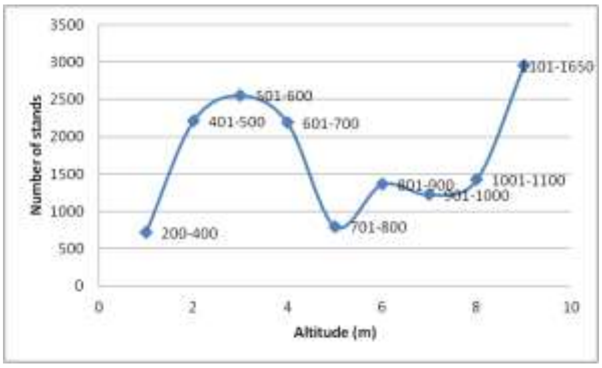

Fig. 5. Stand distribution on altitude for the 1-2L category from the Southern Carpathians
Source: original.

The distribution of stands on altitudes is irregular for both forests situated on landslide fields (Fig 4), as well as for fields with vulnerable lithologic substratum towards erosion and landslides (Fig. 5).

In regard with stand consistency, it can be seen that both functional categories register a consistency of 0.8 (fig 6, 7). However, forests situated on fields with very vulnerable lithologic substratum towards erosion and landslides (1-2L category) have a higher percentage for the 0.9 consistency.

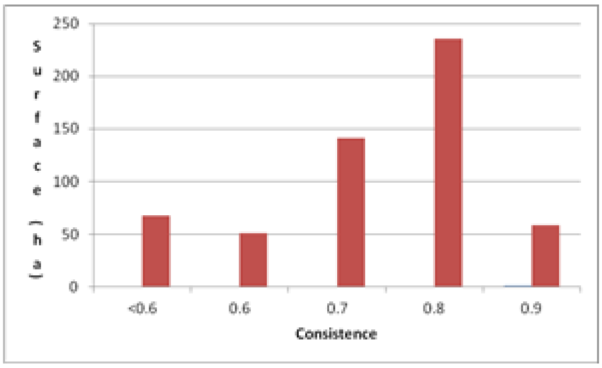

Fig. 6. Stand distribution on stand consistency for 1-2H category from the Southern Carpathians
Source: original.

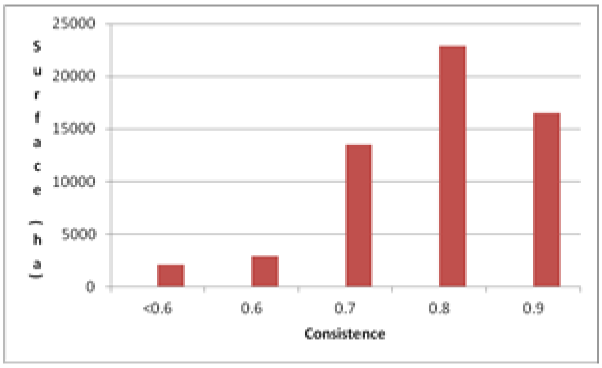

Fig. 7. Stand distribution on stand consistency for 1-2L category from the Southern Carpathians
Source: original.

Management measures regarding forests vulnerable to erosion and landslides

Forests that are vulnerable to landslides and erosion require a distinct system of management measures, based on the level of functional intensity assigned to each stand. As such, stands situated in the 1.2H and 1.2I functional categories fulfil high intensity protection functions (TII functional type) and are managed differently in M units – forests open to a distinct conservation regime. In this management unit, stands are lead towards optimal structures that can fulfil their assigned functions through conservation works. The structures that are intended to be realized in these stands are closely connected to the ones belonging to natural forests. They are obtained through conservation works in which the extraction of trees is reduced (up to 10%) and related to the stand's ecological and functional characteristics. In addition, the protection exploitability is adopted for stands with high intensity protection functions (TII), without establishing protection exploitability ages.

Conservation works are provided for mature stands and are intended to maintain the forest and covered field so that the stand's protection effect will be maximum.

At the same time, the regeneration of stands is also taken into account as an objective, by creating regeneration nuclei. The new stands will assume over time the protection functions of the replaced stands.

In stands with low and average ages (un-exploitable and pre-exploitable stands) an entire system of maintenance works will be applied (release cuttings, cleanings, thinning, hygiene cuttings).

On the other hand, in stands situated in karst areas or on fields with very vulnerable lithologic substratum towards erosion and landslides, with slopes up to 35^0, the management measures are different than the ones applied for high intensity protection stands (TII). These stands fulfil both protection and production functions, being situated in management units in which the wood production process is regulated. In addition, the stands fulfil functions with lower intensity, being situated in the TIII (stands situated in karst areas) and TIV (stands situated on fields with very vulnerable lithologic substratum towards erosion and landslides) functional categories.

Even though the purpose in these stands is to obtain structures similar with natural stands, the means through which they are obtained differ. As such, stands are managed through intensive treatments (selection systems, quasi-selections and group shelterwood systems), based on the present stand structure, forest formation and field slope. They are lead up to the protection exploitability age, defined as the moment in which the average of the maximum protective stand effects decreases. Species with high anti-erosion and hydrologic value are used in regenerating stands as they are capable to vegetate in those site conditions.

In young and average-aged stands, the maintenance works are realized by taking into account the protection functions fulfilled. Tree consistency must not be reduced so that their protection capacity is not affected, a reason for which most of the works are prudent.

The possibility for main products established for stands with soil protection functions situated in TIII and TIV categories takes into account bypassing the adoption of high value possibility indicators that can affect these functions. In addition, in the case of management units with an excess of exploitable stands, the excess will not influence the level of possibility.

As such, applying treatments in these stands will be realized through wood exploitation technologies that will not affect soil and water quality.

CONCLUSIONS

The Southern Carpathians contain forests with soil protection functions. Amongst them, the ones situated on fields with very vulnerable lithologic substratum towards erosion and landslides are prevalent (97%). Even though they occupy a very small surface (1% of the total forests with soil protection functions), forest situated on landslides play an extremely important role in stopping this negative natural phenomenon.

Common beech is the main species for the two above-mentioned field categories, while the Norway spruce has a reduced presence on landslide fields due to its root system. The alder is also present on these fields due to its adaptability on newly formed lands with superior humidity.

Forests from all age categories are spread out in a balanced manner on fields with vulnerable lithologic substratum. On the other hand, old-age forests are not present on landslide fields due to their large mass that cannot be sustained by these fields. The altitude does not influence in any way the spreading of forests on the two functional categories.

Forest consistency for both categories is of 0.8, even though a high consistency can be found in forest situated on fields with very vulnerable lithologic substratum towards erosion and landslides. This fact can be explained through the field's nature that suppresses intense silvicultural interventions in order to protect them (if the consistency is reduced, namely if some trees are eliminated, negative phenomenon can occur – landslides – cancelling the purpose for which this category was created).

The management of forests vulnerable towards landslides and erosion is different, taking into consideration the intensity level of protection functions assigned to each stand. As such, in stands with high intensity protection functions (situated in the TII functional category), the management measures are specific to the conservation regime and stands are sustained up to the age at which they can fulfil their assigned protection functions. The switch from one generation to the other is realized on a longer time period through conservation works.

In stands with a more reduced protection intensity (situated in the TIII and TIV categories), the management measures are specific to the forest regime and stands are lead up to their exploitation age in which intensive measures are applied in order to ensure an optimum growth of the structures that can ensure the protection of soils.

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