

SUSTAINABLE DEVELOPMENT MANAGEMENT OF THE GRASSLAND AGROECOSYSTEM IN THE CONTEXT OF BIODIVERSITY CONSERVATION AND IMPROVEMENT OF PERMANENT GRASSLAND

Pompilica IAGARU¹, Romulus IAGARU¹, Gligor CIORTEA¹, Nicu FLORESCU², Gheorghe CIUBOTARU²

¹Lucian Blaga University of Sibiu, 10 Victoriei, 550024, Sibiu, Romania, Phone: +40269216062, Fax:+40269216062, Mobile:+40729950222, Email: iagaru@gmail.com, gciorte@gmail.com

²Alma Mater University of Sibiu, 57 Somesului, 550003, Sibiu, Romania, Phone: +40269250008, Fax:+40269250008, Mobile:+40745032731, Email: gheorghe.ciubotaru@uamsibiu.ro, nflorescu56@yahoo.com

Corresponding author: iagaru@gmail.com

Abstract

The agricultural enterprise, seen from a sustainable development perspective, operates within an ecosystem, and aims to achieve a harmonious interpenetration and integration with it. The way in which this interpenetration and integration is realized depends on the level achieved by its performances, which requires the adoption of policies and strategies and the economic organization of biotechnical processes. The paper emphasizes an interdisciplinary approach to issues like management and sustainable development of the grassland agro ecosystem and shows that promoting ecological techniques in the grassland agro ecosystem can ensure its versatility. All these supported by obtaining appropriate pastoral values, namely biodiversity conservation and improvement of meadows, and knowing that Romania has a variety of floral structures with high biodiversity indices.

Key words: biodiversity, conservation, ecosystem, management, sustainable

INTRODUCTION

The chosen theme is topical and it is based on the premise that the sustainable development of the agriculture aims the increasing agricultural production in terms of maintaining the natural resource base, which means the adoption of a management facing the constantly changing needs of the people, amid to continue and/or to enhance the quality of the environment and the natural resources conservation [6]. The agricultural enterprise activity takes place within an ecosystem mostly artificial, which requires in the context of sustainability, its monitoring and directing followed by well-defined rules, so his bioproductivity remains steady or to grow [10]. The agricultural ecosystem is made up of specific subsystems, our attention being focused on the on the meadow agro-ecosystem and its main objective is to design and implement some viable economic measures

over a long period of time, able to ensure a high pastoral value, the conservation and the improvement of the biodiversity [3], [4], [7], [9], [12]. Economically viable measures are in addition to the specific agricultural management activities, and they are focused on boosting the biodiversity, ensuring an harmonious development and integrating the ecosystem in a friendly ambiental environment.

There is granted a decisive role in achieving a sustainable development of a meadow agro-ecosystem, regarding the permanent meadow diagnosis in order to capture its specificity and to design its economic sustainable measures in order to implement them over a long period of time, able to ensure a high pastoral value, concerning thus the conservation and the improvement of the biodiversity. It was organized a field research on the management of sustainable development of permanent grassland placed in Cindrel Mountains or

Sibiu Mountains, also known as Cibin Mountains or Sibiu Mountains belonging to Parâng Massive, of The Southern Carpathians. The name of Cindrel Massive is given after the highest peak, Cindrel, [1], [11] (2,245 m altitude). The grass vegetation of Cindrel Mountains differentiates four levels, according to the studies made by Anghel and his contributors, (1982) [2]: the grass field level (*Agrostis tenuis*); the red meadow level (*Festuca rubra*); the sheep meadow level (*Festuca ovina*); the horn and bulrush level (*Carex curvula* and *Juncus trifidus*).

MATERIALS AND METHODS

The experience was located atop the North-East of the Cindrel Mountains at an altitude of about 1438 meters, near the resort Paltinis, atop called Vălari in the floor of red meadow (*Festuca rubra*). The exhibition of the ground is southern, with a mild slope, about 5%. The area is surrounded by extensive forests of spruce and of expanses of natural meadows. Knowing that the meadows are used for hay and for pasture, too there have been carried out two similar experiences concerning their settlement, one for each mode of use. The research took place over a period of three years: 2010, 2011 and 2012 and they were focused on obtaining a high pastoral value, namely the preservation and improvement of the biodiversity through the promotion of some sustainable management measures with emphasis on fertilization.

The processing of the experimental results were done after current calculation methods, through the analysis of a trifactorial experience performed over the course of three years (2010-2012). The first experience that simulates the grazing, there were done three probe collections on a meadow of *Festuca rubra* when the plants have reached the height of grazing. The second experience is in the hay system, executing a scythe and a second cut hay. The dry matter is determined by the oven method.

The determination of floristic composition was made through the method of double meter for each of the groups of identified vegetation and it analyzes the grass vegetation through

the linear topographic map of the vegetation.

RESULTS AND DISCUSSIONS

The design and implementation of some measures aimed at restoring the grasslands in order to introduce them into the economic circuit and to ensure its multifunctionality, stressing the need for the conservation and for the improvement of the biodiversity as a starting point for diagnosing the condition of vegetation and of the productive potential which characterizes the grassland - subject to this study. Thus, it has been proceeded to the determination of the floristic composition, through the drawing up of floristic reports using the double meter method.

The floristic composition highlights the fact that the largest contribution belongs to the graminces (67%) within which the rule belongs to the *Festuca rubra* species, when speaking of the formation of the production and also of the celery layer. The proportion of fodder plants belonging to the family Fabaceae is a low one (17%) and it is realized by species such as: *Trifolium repens*, *Trifolium pratense*, *Trifolium alpestre*, respectively *Lotus corniculatus*, to which we add *Genista tinctoria*. The plants of other botanical families own a small percentage in the floristic composition and they are represented by: *Achillea millefolium*, *Alchemilla vulgaris*, *Taraxacum officinale*, *Leontodon autumnalis*, *Plantago lanceolata*, *Plantago media*. We can also meet worthless fodder plants, fodder, weak or even harmful plants in the grasslands. The woody vegetation in the form of shrubs is represented by *Vaccinium myrtillus*, *Vaccinium vitis-idaea*, *Juniperus sibirica*, *Pinus mugo* and so on and so forth. In conclusion, the floristic composition is poor and represented by species, with little forage value (Table 1) which amounts to a total number of 23 species of which 10 belong to the Poaceae family, five belonging to the Fabaceae family and 8 plant species that belong to other families.

This shows that although the pastures are an important forage resource, they are in a state of disrepair due to the possibility of a defective management in recent years and

there is the need to adopt a sustainable management leading to a raised pastoral value, namely to the conservation and to the enhancement of the biodiversity.

Table 1. The calculation of pastoral value

Species	% PC	IC	PC x IC
Gramineae	67.0		
<i>Festuca rubra</i>	30.0	3	90.0
<i>Antoxacum odoratum</i>	7.0	1	7.0
<i>Agrostis rupestris</i>	5.0	1	5.0
<i>Agrostis capillaris</i>	4.0	3	12.0
<i>Briza media</i>	4.0	1	4.0
<i>Cynosurus crestatum</i>	3.0	3	9.0
<i>Phleum alpinum</i>	3.0	2	6.0
<i>Poa pratensis</i>	2.0	3	6.0
<i>Nardus stricta</i>	6.0	X	X
<i>Festuca rupicola</i>	3.0	1	3.0
Leguminous			
<i>Trifolium repens</i>	17.0	4	12.0
<i>Trifolium pratense</i>	3.0	4	12.0
<i>Trifolium alpestre</i>	3.0	2	10.0
<i>Lotus corniculatus</i>	5.0	4	16.0
<i>Genista tinctoria.</i>	4.0	X	-
Other families	16.0		
<i>Achillea millefolium</i>	5.0	2	10.0
<i>Alchemila vulgaris</i>	2.0	2	4.0
<i>Taraxacum officinale</i>	2.0	2	2.0
<i>Leontodon autumnalis</i>	1.0	1	1.0
<i>Plantago lanceolata</i>	2.0	2	4.0
<i>Plantago media</i>	2.0	2	4.0
<i>Veronica chamaedris</i>	1.0	X	-
<i>Runex acetosela</i>	1.0	X	-
TOTAL	100		216
The pastoral value	X	X	43
The appreciation of pastoral value		middle	

The pastoral value of the analysed grassland was assessed as medium and it requires the application of certain works in order to bring an extra value to it and to conserve and improve the biodiversity of the grassland. The involved work consisted of the destruction of anthills and the removal of woody vegetation, autumn and spring fertilization, it is known the fact that "on mountain meadows the fertilization increases the proportion of grasses both by grazing exploitation and also by mowing, and the legumes increase in the mowing exploitation [5]".

Table 2. The calculation of pastoral value

Species	V1 = nefertilizat			V2 = manure 20 t/ha			V3 = N50:P30:K100		
	%PC	IC	PCxIC	%PC	IC	PCxIC	%PC	IC	PCxIC
Gramineae	67.0			62.0			70.0		
<i>Festuca rubra</i>	30.0	3	90.0	27.0	3	81.0	32.0	3	96.0
<i>Antoxacum odoratum</i>	7.0	1	7.0	3.0	1	3.0	4.0	1	4.0
<i>Agrostis rupestris</i>	5.0	1	5.0	6.0	1	6.0	4.0	1	4.0
<i>Agrostis capillaris</i>	4.0	3	12.0	8.0	3	24.0	9.0	3	27.0
<i>Briza media</i>	4.0	1	4.0	1.0	1	1.0	2.0	1	2.0
<i>Cynosurus crestatum</i>	3.0	3	9.0	2.0	3	6.0	3.0	3	9.0
<i>Phleum alpinum</i>	3.0	2	6.0	3.0	2	6.0	4.0	2	8.0
<i>Poa pratensis</i>	2.0	3	6.0	6.0	3	18.0	5.0	3	15.0
<i>Nardus stricta</i>	6.0	X	x	1.0	x	X	2.0	x	X
<i>Festuca rupicola</i>	3.0	1	3.0	2.0	1	2.0	2.0	1	2.0
<i>Trisetum flavescens</i>	-	-	-	3.0	4	12.0	-	-	-
<i>Poa annua</i>	-	-	-	-	-	-	3.0	2	6.0
Leguminous	17.0			21			12		
<i>Trifolium repens</i>	3.0	4	12.0	6.0	4	24.0	5.0	4	20.0
<i>Trifolium pratense</i>	3.0	4	12.0	4.0	4	16.0	2.0	4	8.0
<i>Trifolium alpestre</i>	5.0	2	10.0	4.0	2	8.0	1.0	2	2.0
<i>Lotus corniculatus</i>	4.0	4	16.0	6.0	4	24.0	3.0	4	12.0
<i>Genista tinctoria.</i>	2.0	X	-	0.5	x	X	1.0	x	X
<i>Oxalis acetosela</i>	-	-	-	0.5	x	X	-	-	-
Other families	16.0			17			18		
<i>Achillea millefolium</i>	5.0	2	10.0	4.0	2	8.0	6.0	2	12.0
<i>Alchemila vulgaris</i>	2.0	2	4.0	2.0	2	4.0	3.0	2	6.0
<i>Taraxacum officinale</i>	2.0	2	2.0	3.0	2	6.0	3.0	2	6.0
<i>Leontodon autumnalis</i>	1.0	1	1.0	1.0	1	1.0	1.0	1	1.0
<i>Plantago lanceolata</i>	2.0	2	4.0	2.0	2	4.0	2.0	2	4.0
<i>Plantago media</i>	2.0	2	4.0	1.0	2	2.0	1.0	2	2.0
<i>Veronica chamaedris</i>	1.0	X	-	1.5	x	X	0.5	x	X
<i>Runex acetosela</i>	1.0	X	-	1.0	x	X	0.5	x	X
<i>Potentilla erecta</i>	-	-	-	1.5	1	1.5	0.5	1	0.5
<i>Campanula abietina</i>	-	-	-	0.5	x	X	0.5	x	X
<i>Luzula luzuloides</i>	-	-	-	0.5	x	X	-	-	-
TOTAL	23	216		28	259.5		26	247.5	
Pastoral value	43			51.9			49.5		
The appreciation of pastoral value / UVM*ha⁻¹	Middle	1.12		good	3.02		middle-good	2.9	

An over seeding followed in order to achieve a mixture of forage plants that is suitable for a mixed operation because in this way it is achieved a considerable reduction in losses through leaching. In the practice of a sustainable management a particular attention

is paid to the biological resources and to the use of organic materials, insufficiently exploited resources [8].

The impact of these works on the explored grassland highlights an improvement of the pastoral value (Table 2.).

The floristic composition's evolution throughout the experimental period both in the explored variant, which was operated through hay and also cultivated through grazing, it highlights that "poaceele" hold the share between the groups of participating species, followed by fabacee and finally the group of plants from other botanical families

CONCLUSIONS

The process of sustainable development of the agro-ecosystem meadow is a complex and long one and it requires the application, in an organised way, of a complex number of measures and works, ensuring the protection of the soil and the sustainable reconstruction of degraded lands.

The diagnosis of permanent grassland is a prerequisite for a sustainable development of a meadow agro-ecosystem because it captures its specificity and it contributes decisively to the design of some viable measures from an economic point of view, capable of providing a high pastoral value for the conservation and the improvement of the biodiversity.

The recovery way has a decisive contribution to the sustainable development of a grassland, highlighting the joint recovery through the use of a mix of suitable forage.

The rebuilding measures implemented in the grassland which is the subject of the study, led to the modification of the natural productivity through the implementation of some viable economic measures.

The fertilizing with manure has proven to be an adequate management technique for conserving and enhancing biodiversity.

The changes in floristic composition stresses that the application of improvement measures of the natural permanent grasslands contribute to conserving and enhancing biodiversity acting both in the conservation plan and the improvement of the natural heritage and also

for improving the quality and profitability of the grassland production.

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