STUDIES REGARDING THE PRODUCTIVITY OF GRASSLANDS FROM AGROSILVOPASTORAL SYSTEM FROM GRECI VILLAGE, TULCEA COUNTY, ROMANIA

Teodor MARUȘCA[1], Daniyar MEMEDEMIN[2], Elena TAULESCU[3], Bogdan BĂJENARU[4], Viorel ROȘCA[5], Andreea C. ANDREOIU[6]

Abstract. *The most extensive agrosilvopastoral systems (ASPs) in Romania are found in Dobrogea where the climate is warmer, with less rainfall. Determination of agrochemical properties of the soil on the grasslands with trees revealed an increase of 40-100% of the fertilizing elements (N, P, K) compared to treeless grasslands. The participation of fodder species in the vegetal layer under trees is twice as high, the pastoral value more than 3 times and the fodder production more than 6 times higher than in the treeless grassland. Analyzes on feed quality showed an increase from 12 to 20% of crude protein and feed digestibility, from 38% in the open field to 65% under trees. Also, the optimal stocking rate for a 185-day grazing season is almost 1 Livestock Unit (LU) / ha under trees and 6 times lower on the treeless grassland. The results confirm the desirability of maintaining and expanding ASPs, in full accordance with global climate change approaches.*

Keywords: agrosilvopastoral system, floristic composition, permanent grassland productivity, feed quality

1. Introduction

The agro-forestry system for raising livestock, especially cattle, on meadows with rare trees, has been called "agrosilvopastoral system" (ASPs) or "silvopastoral system" or “agroforestry”. The system is implemented mainly on poor quality or non-agricultural land and aims at extensive animal husbandry [5, 2, 16].

[1]Assoc. Prof., Ph.D., Eng., Technical Director, Research and Development Institute for Grasslands Brasov, Romania, Corresponding Member of the Academy of the Romanian Scientists (e-mail: maruscat@yahoo.com).
[2]Lecturer, Ph.D., Eng., “Ovidius” University of Constanta, Faculty of Natural and Agricultural Sciences, Romania (e-mail: daniyar_memedemin@yahoo.com)
[3]Researcher, MSc., Eng., Research and Development Institute for Grasslands Brasov, Romania (e-mail: taulescuelena@yahoo.com)
[4]Biol., Macinului Mountains National Park, Romania (e-mail: bogdan_bajenaru@yahoo.com)
[5]Director, Ph.D., Eng., Macinului Mountains National Park, Romania (e-mail: director.apnmm@gmail.com)
[6]Chemist, Ph.D. Stud., Research and Development Institute for Grasslands Brasov, Romania (e-mail: andreea.andreoiu@pajisti-grassland.ro)

At the national level, more in - depth research on these systems has been carried out recently by Maruşca *et al*. [6, 9, 11, 12]and Mihăilă *et al*. [13].

The importance of this topic (ASPs) is also underlined by research projects and papers published worldwide [1, 3]. Researchers focus on maintaining, expanding and implementing ASPs with all the benefits they bring both economically and ecologically.

Advanced research are conducted mainly in Mediterranean countries with dry and hot climates and these include tree characteristics, grassland characteristics and improvement measures (fertilization, overseeding and reseeding), animal characteristics and stocking rate (for cattle, sheep, goats or pigs), environmental protection and biodiversity [14, 16, 4].

This paper presents an agrosilvopastoral system from northern Dobrogea, at the foot of the Macin Mountains, compared to a permanent treeless grassland nearby.

2. Materials and Methods

The case studies were carried out on Crucele area from Greci locality, Tulcea county. The wooded pasture (ASPs) has an area of 38.0 ha and is located at 120 m altitude.
The communal pasture Crucele of Greci village is located on a flat land and it has forest vegetation made up mainly of oriental hornbeam trees and different species of oak. Tree density, composition and arithmetic mean diameter are shown in Table 1.

Table 1. General data on ASPs with trees from Crucele

Species	Average composition per hectare		Average diameter (cm)
	Nr. of individuals	Percentage (%)	
Carpinus orientalis	182	59	23
Quercus pubescens	96	31	37
Quercus pedunculiflora	9	3	48
Tilia argentea	12	4	45
Fraxinus ornus	4	1	35
Prunus mahaleb	3	1	34
Acer campestre	1	1	48
TOTAL	**307**	**100**	**X**

Source: Own results.

Along with this ASPs, there are approximately 117 ha of treeless permanent grassland with production as priority function (PF).

In these two distinct locations, 5 floristic surveys were performed according to the Klapp - Ellenberg percentage method [7]. Soil and grass samples were also collected for laboratory analysis.

The productivity of treeless grassland and of the agrosilvopastoral system was evaluated according to the method based on floristic survey [7, 8].

The analyzes of the soil samples were performed at the Office of Pedological and Agrochemical Studies (OSPA) Brașov according to the usual methodology. Plant samples were evaluated in the laboratory of quality measurements from the Research - Development Institute for Grasslands Brașov, according to the Near Infrared Reflectance Spectroscopy (NIRS) method.

3. Results and Discussions

Soil agrochemical analyzes revealed a higher content of fertilizers in ASPs than in treeless grassland, as presented recently by Marușca & Memedemin [10], with 40% more nitrogen (N), 70% more phosphorus (P) and almost double for potassium (K), (Table 2).

Table 2. Agrochemical soil values of ASPs and FP grasslands at 10 cm depth

Specification	Unit	ASPs	FP	Diff. +; -	%
pH reaction in H_2O	ind	6.7	6.6	- 0.1	99
Hydrolytic acidity (Ah)	me/100g	3.5	3.8	+ 0.3	109
Sum of bases (SB)	me/100g	22.7	28.5	+ 5.8	126
Base saturation (V)	%	86.6	88.2	+ 1.6	102
Humus	%	5.46	7.58	+ 2.12	139
Total Nitrogen (N)	%	0.273	0.380	+ 0.107	139
Mobile Phosphorus (P)	ppm	37.2	62.7	+ 25.5	169
Mobile Potassium (K)	ppm	192	378	+ 186	197

Source: Own results.

The other indicators, such as soil reaction (pH - slightly acid) and degree of base saturation (V - eubasic soil), have almost the same values, with 1-2% difference, being therefore very well correlated for both variants studied (ASPs and FP).

Soil trophicity, better under trees due to animal manure, and protection from sunlight in ASPs, positively influenced the floristic composition of the vegetal layer and the productivity of grasslands (Table 3), as shown also by Păcurar [15].

Table 3. Floristic composition, productivity and optimal stocking rate from FP and ASPs

Species	Participation %			%	Indices	
	FP	ASPs	Diff. + -		F	M
Cover	94.9	89.3	-5.6	94	x	x
Poaceae	**51.8**	**61.3**	**+9.5**	**118**	**x**	**x**
Botriochloa ischaemum	30.2	0.1	-30.1	0	3	0
Festuca valesiaca	13.4	0.1	-13.3	1	5	3
Setaria viridis	4.3	1.5	-2.8	35	6	3
Cynodon dactylon	2.7	2.9	+0.2	107	6	2
Bromus secalinus	0.6	-	x	x	3	0
Stipa capillata	0.4	-	x	x	3	0
Bromus sterilis	0.2	0.6	+0.4	300	3	0
Lolium perenne	-	40.1	x	x	9	8
Hordeum murinum	-	11.9	x	x	5	3
Poa angustifolia	-	3.6	x	x	7	5
Digitaria sanguinalis	-	0.2	x	x	3	0
Elymus repens	-	0.2	x	x	6	7
Setaria verticillata	-	0.1	x	x	6	3
Fabaceae	**4.0**	**9.2**	**+5.2**	**230**	**x**	**x**
Trifolium campestre	3.5	8.3	+4.8	237	7	2
Trifolium arvense	0.5	0.9	+0.4	180	4	2
Other families	**39.1**	**18.8**	**-20.3**	**48**	**x**	**x**
Filago arvensis	12.5	3.7	-8.8	30	3	0
Torilis arvensis	4.1	-	x	x	3	0
Eryngium campestre	2.9	-	x	x	3	0
Echium vulgare	2.5	-	x	x	4	3
Achillea millefolium	1.6	3.1	+1.5	194	6	4
Berteroa incana	1.6	-	x	x	3	0
Chondrilla juncea	1.4	-	x	x	3	0
Cichorium intybus	1.4	0.1	-1.3	7	5	6
Potentilla argentea	1.2	0.6	-0.6	50	4	2
Artemisia austriaca	1.0	1.0	0	100	2	0
Carduus nutans	1.0	1.0	0	100	2	0
Crepis foetida	1.0	0.1	-0.9	10	3	0
Caucalis platycarpos	0.8	-	x	x	3	0
Galium humifusum	0.8	-	x	x	3	0
Petrorhagia prolifera	0.8	-	x	x	3	0
Centaurea solstitialis	0.6	-	x	x	3	0
Cuscuta campestris	0.6	0.1	-0.5	17	3	0
Teucrium chamaedrys	0.6	-	x	x	3	0
Carthamus lanatus	0.5	0.2	-0.3	40	3	0
Plantago lanceolata	0.5	0.2	-0.3	40	6	1
Centaurea diffusa	0.4	0.4	0	100	4	4
Rosa canina	0.4	-	x	x	3	0
Daucus carota	0.3	-	x	x	6	5
Convolvulus arvensis	0.1	-	x	x	7	6
Erodium cicutarium	0.1	1.1	+1	1100	3	0

Herniaria glabra	0.1	-	x	x	3	0
Polygonum aviculare	0.1	1.2	+1.1	1200	5	3
Sanguisorba officinalis	0.1	-	x	x	7	5
Taraxacum officinale	0.1	-	x	x	7	3
Amaranthus albus	-	0.8	x	x	3	0
Amaranthus retroflexus	-	0.8	x	x	3	0
Chenopodium album	-	0.7	x	x	3	0
Malva neglecta	-	0.7	x	x	3	0
Carpinus orientalis (juv.)	-	0.6	x	x	3	0
Agrimonia eupatoria	-	0.3	x	x	3	0
Ballota nigra	-	0.3	x	x	3	0
Conyza canadensis	-	0.3	x	x	3	0
Euphorbia maculata	-	0.2	x	x	1	0
Fallopia dumetorum	-	0.2	x	x	3	0
Heliotropium europaeum	-	0.2	x	x	3	0
Xanthium spinosum	-	0.2	x	x	2	0
Berteroa incana	-	0.1	x	x	3	0
Cirsium vulgare	-	0.1	x	x	2	0
Echium italicum	-	0.1	x	x	3	0
Lactuca serriola	-	0.1	x	x	3	0
Potentilla reptans	-	0.1	x	x	3	0
Vincetoxicum hirundinaria	-	0.1	x	x	1	0
Xantium strumarium	-	0.1	x	x	2	0
Total species (nr.)	**38**	**45**	**7**	**118**	**x**	**x**
From wich: - fodder	**16**	**16**	**0**	**100**	**x**	**x**
- not fodder	**22**	**29**	**7**	**132**	**x**	**x**
Participation of fodder species	**32.7**	**66.0**	**+33.3**	**202**	**x**	**x**
Participation of harmful species	**62.2**	**23.3**	**-38.9**	**37**	**x**	**x**
Bare soil	**5.1**	**10.7**	**+5.6**	**210**	**x**	**x**
Pastoral Value (PV)	**19.5**	**62.9**	**+43.4**	**323**	**x**	**x**
Phytomass index	**0.97**	**4.25**	**+3.3**	**443**	**x**	**x**
Fodder production (GM t/ha)	**1.8**	**11.2**	**+9.3**	**622**	**x**	**x**
Optimum stocking rate for 185 grazing days	**0.15**	**0.93**	**+0.78**	**620**	**x**	**x**

Source: Own results.

Thus, non-valuable forage species such as *Botriochloa ischaemum* [10, 15] with 30% participation, *Filago arvensis* (12.5%), *Torilis arvensis* (4.1%), *Eryngium campestre* (2.9%) and other weeds from the treeless grassland were replaced in the ASPs by forage species such as *Lolium perenne* (40%), *Trifolium campestre* (8.3%), *Poa angustifolia* (3.6%) and other valuable species.

Finally, the participation from the vegetal layer of fodder species from ASPs is 2 times higher than in FP, the pastoral value is over 3 times higher and the production of green fodder and the optimal stocking rate are over 6 time higher.

For the plant samples collected from the ASPs and from the treeless grassland (FP), the following chemical parameters of feed quality were analyzed: crude protein (CP); crude fiber (CF); ash (ASH); fibrous fractions: acid detergent fiber (ADF), lignin detergent acid (LDA) and neutral detergent fiber (NDF); dry matter digestibility (DDM); digestibility of organic matter (OMD) (Table 4).

Table 4 presents information about each chemical component contained in the feed, analyzed independently. The average for each variant (FP and ASPs) and the differences between them are presented.

Table 4. The quality of the grassland fodder from FP and ASPs

Specification	FP	ASPs	Diff. +; -	%
CP	11.7	20.1	+ 8.4	172
ASH	7.4	10.8	+ 3.4	146
CF	40.0	29.9	- 10.1	75
ADF	45.0	35.7	- 9.3	79
LDA	6.6	3.8	- 2.8	58
NDF	74.8	61.7	- 13.1	82
DDM	38.1	65.1	+ 27.0	171
OMD	38.0	60.7	+ 22.7	160

Source: Own results.

In ASPs the crude protein content it is over 70% higher than in treeless grassland and the crude fiber 25% lower than in FP, which ultimately leads to 70% higher digestibility in ASPs than in FP.

All these data confirm the obvious superiority of the agrosilvopastoral systems [9 – 12] that must be maintained and expanded given the new trends in global warming.

Conclusions

(1) The agrosilvopastoral system (ASPs) from Greci, located at the foot of the Măcin Mountains, is representative for northern Dobrogea.
(2) The pastoral value of ASPs is 63 times higher, and the production of green fodder mass of 11 t / ha is 6 times higher than the nearby treeless meadow.
(3) The results reveal the superior productivity of agrosilvopastoral systems that need to be maintained and expanded, as a complex ASPs can more easily overcome a period of global warming than a simple pastoral system with treeless grasslands.

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