

STRUCTURE AND DYNAMICS OF SHEEP SYSTEMS IN BOSNIA AND HERZEGOVINA

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Abstract

The paper presents the analysis of dynamics and structure of the sheep systems in Bosnia and Herzegovina assuming that they suffered a decrease of animal and farms consistency in the last 6 decades. Since 1991 neither a general nor agricultural censuses were made to provide information about the present state of sheep farming in the country. An analysis of the available statistical records of agricultural trends related to the sheep sector was performed. In addition, a depth questionnaire by consulting national experts was performed in order to obtain relevant information on the spatial distribution, consistency, feeding management, production and environmental impact on the present structure of sheep production systems. A decrease in sheep number was observed over the last six decades, but less than in other species. Six main sheep systems in three biogeographical regions were identified. Differences in animal spatial distribution, production purpose and other characteristics of the systems indicate that the environmental and socio-economic factors throughout the country strongly influence the choice of breeding methods and management. All consulted experts indicated the lack of support for sheep systems in relation to agro environmental management, landscape conservation and biodiversity preservation.

Key words: *Bosnia and Herzegovina, sheep systems, system characteristics, trends*

Introduction

With a centuries-long tradition sheep breeding has played a very important role in the livestock production in Bosnia and Herzegovina (B&H). According to official statistical data from the Agency of Statistics of B&H it is estimated that the total number of sheep in the country is around 1,005,000 heads. More detailed information on the number of sheep and sheep farms is unknown, especially for small private farms, because neither a general nor agricultural censuses have been made since 1991, which could provide a real picture of post-war farm structures (Karlogan-Todorović, 2012). Before the First World War there were round 2,000,000 sheep; thereafter their number decreased especially during the recent war (1992-1995) (Alibegović-Grbić, 2009). It is believed that overall sheep population has decreased by 30% after 1991 (Erbez and Rogić, 2010).

The lack of farm animals, especially small ruminants, led to the abandonment of grassland and scrubland utilised by pastoral activities. This decrease negatively affected the biodiversity and open surfaces became overgrown and non-usable for agricultural purposes (Sedić et al., 2014). The decrease of farm animals, on the other hand, allowed the existing farmers to extend over more fertile land which was abandoned, losing the need to depend on less favoured areas. In the past all wars led to a temporary hold of transhumance throughout the Balkan area. Excluding the wars, a key role in the reduction of farm animals was the reform of agriculture law denying the use and ownership of mountain pastures by peasants and farmers (Kazakova and Stefanova, 2010).

This study aims to analyse the dynamics of sheep production systems and the present state of sheep farming through biogeographical regions. The obtained results are expected to be used as starting point for assessing the relationship of sheep farming with biodiversity, landscape conservation and improvement of site conditions.

Materials and methods

For the purpose of this study two types of information were used. The quantitative data used for the trend analysis were obtained from statistical records listed in Table 1. General changes that occurred in the agricultural trends related to sheep production systems were analysed with a paired t-test (Garcia-Martinez et al., 2009) to compare differences between decades. Statistical analysis was performed in SAS 9.1.

Table 1. *Source of data for statistical analysis*

Source	Reference period
National First Release and annual reports for agriculture and livestock of Bosnia and Herzegovina	2005 to 2013
Statistical Yearbook of Yugoslavia	1950 to 1991
FAO stat online database	1950 to 2012
World Bank online database	1950 to 2012

A collaborative effort was requested to a group of 8 experts for collecting information for the sheep systems analysis according to their representative biogeographical region (2 Alpine; 4 Continental; 3 Mediterranean). The survey tools including a depth questionnaire (fact sheet), a detailed survey guideline and a geophysical map of the study area provided information on the sheep systems which remained after the Independence Declaration in 1992. The questionnaire was structured in six main sections (Caballero et al., 2009). The first section (expert's identification, biophysical conditions and organisation of agriculture land) was aimed at obtaining an overview of the analysed study area according to its environmental features. The second section (breeds used, breeding purpose and method, number of farms, number of animals, specific products, animals and land ownership) provided information about the scale and relevance of the addressed systems. The third section (annual feeding regime including feeding resources used and their yield, annual grazing cycle, grazing method, stocking density, herding, mobility, ownership of animals and facilities, grassland management) provided information about the resource base for feeding and management details during the grazing period. The fourth section (housing, technology, labour) was aimed at obtaining information about the level of innovations and technological advances applied in the system. The fifth section (consulting, co-operative aspect) provided information about the dependency of the farmers on other stakeholders.

The sixth section (management comparison, large scale and biodiversity aspect) was aimed at obtaining information about competitiveness, environmental and biodiversity impacts related to the management practices. The sections contained from 4 to 25 questions being either qualitative with multiple choice answers, or quantitative, requesting a single answer. Section one contained 2 qualitative and 8 quantitative variables; section two, 7 qualitative and 5 quantitative variables; section three, 7 quantitative and 3 qualitative variables, section four, 5 qualitative and 1 quantitative variable; section five, 3 qualitative and 1 quantitative variable; section six, 24 qualitative and 1 quantitative variable.

The systems identified by the experts have been analysed according to their location in the main biogeographical regions of B&H (EEA 2002a,b,c): Alpine, Continental and Mediterranean.

Results and discussion

The analysis of agricultural and livestock trends related to sheep production systems resulted in values with statistically significant differences between the averages of the observed decades (Table 2).

Table 2. *Agricultural trends in Bosnia and Herzegovina*

Variable	50s	% difference between decades					Total
		50-60s	60-70s	70-80s	80-90s	90-2000s	50-2000s
Sheep	1,882,585	13.6**	-26.8**	-11.9*	-31.6**	4.5	-52.3**
Ewes	1,216,030	18.4**	-21.8**	-9.4*	-8.6	20.4**	-41.8**
% LU sheep/LU total	20.5	11.0**	-16.3**	-1.4	3.2	40.9**	37.4**
TAA	2,575,344	1.7	-1.3	-1.2	-12.1	-4.7	-17.6**
Arable land	1,692,610	-0.8	-3.8	-0.6	-27.9**	-1.8	-34.9**
Grassland	1,321,873	1.7	3.0	2.4	-17.4**	-13.0**	-23.3**
% Grassland/TAA	51.3	0.1	4.2**	3.5**	-2.9	-10.9**	-6.2**
% Forage Crops/Grassland	2.7	3.5**	4.8**	2.7**	-0.1	-0.2	10.8**
LU sheep/Grassland	0.26	11.0*	-26.8**	-12.1*	-20.4**	13.6*	34.8**
LU total/TAA	0.62	0.3	-7.9	-9.1*	-43.5**	9.0*	-51.1**
Population	2,847,790	24.1**	12.7**	15.1**	-16.6**	0.5	35.7**
Agricultural Population	2,721,216 ¹	NA	-8.0	-6.4	-3.6	-4.9	-22.9**

LU-Livestock unit; TAA-Total agriculture area; *P<0.05; **P<0.001
¹Average value for 60s used as base

A decrease of most observed variables occurred over the last six decades. Four of the twelve chosen variables showed increasing trends, with increases up to 35%. An increase of sheep LU in proportion to LU from other farm animals (cattle, sheep, goats, horses) is present, yet the decrease of the total number of sheep and ewes hints to an even bigger decrease of LU from other farm animal species, resulting in the proportional increase of sheep LU in the total LU. The relationship of forage crops and LU of sheep in relation to available grassland increased as well (10.8 and 34.8%, respectively). The total population increased by 35.7%, leading to a bigger need for food supply. Agricultural population did not decrease significantly per decade, but the total difference has significant importance comparing the present state to the 60s. Various authors indicate that the socio-economic

changes during the past led to emigration towards central Europe and other neighbouring countries and partly related to this is de-ruralisation which occurred during economic crisis in the 90s.

After consulting the available statistical records and literature, present sheep production system was analysed according to Caballero et al. (2009). Experts were able to locate the present sheep production systems in the corresponding biogeographical regions (Figure 2). Even if potential and actual area affected by sheep production systems may differ greatly, hot spots in the corresponding national map indicate locations where identified sheep systems are most concentrated.

The **Alpine biogeographical region** of B&H makes 5% of Europe Alpine biogeographical region (EAA 2002a, b, c), and according to Čengić and Cabaravdic (2005), 51% of the country is mountainous. In this region 70% of the total surface is covered by forests, only 25% is agriculture area, and up to 75% of the agriculture area is grassland. Around two thirds of the available agricultural area in the region is being utilised.

Two main sheep systems were identified by the consulted experts in the Alpine region: a dairy (**1a**) and a meat (**1b**) dominant oriented system (Fig. 1 and Table 3).

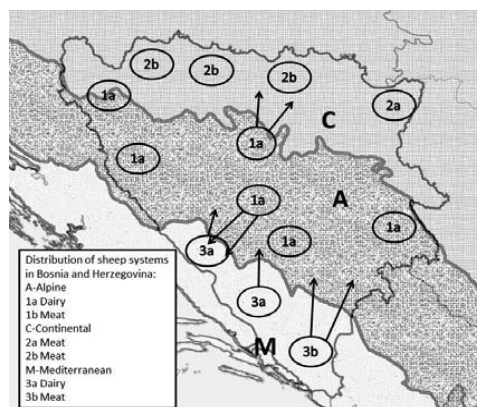


Figure 1. *Distribution of sheep production systems in the biogeographical regions of Bosnia and Herzegovina (arrows highlight mobility areas of the flocks).*

1a - The Alpine dairy sheep system involves approximately 350,000 out of the 750,000 animals expected to be present in this region (Table 3). Both sedentary and transhumant flocks are spread over various altitudes over the region. From the movements performed in the past, just few remained, partly because of the decreased animal number, partly due to the banning of transhumance starting from the '40s to prevent diseases spreading and damages on winter cereals in plain areas. Remaining movements are local and the distances are reduced to few kilometres from the farmstead. Present movements include migrations from the Kupres area towards Livno County and from Vlačić Mountain towards the continental area in the north of B&H. Grazing periods and the use of forage crops through farms in this system are provided in Figure 2. Milking of animals is performed after weaning of lambs, and the most common way of utilising obtained milk is conversion into various types of cheese labelled according to the place of origin (e.g. Vlačićki cheese).

1b - The Alpine meat system is rather dispersed and spatial distribution is nearly impossible to define, but about 40% of the sheep of the region are located in this system (Table 3). The feeding is adapted to the available local resources, while the low stocking

Table 3. Characteristics of the sheep systems in Bosnia and Herzegovina.

System identification code	Production purpose ¹	Mobility ²	Number of farms	Animals in the region (%)	Animals in the system (% of animals in the region)	Breeds used ³	Animals per farm	Self-sufficiency-feeding (%)	Self-owned land (%)	Grazing length (days)	Stocking density (L/ha)	Ownership of the grazing facilities ⁴	Flock size during grazing	Labour dependence (animals per worker)
1a	D	S, V	4500	75	60	DP, KP, PP, XP	80	>75	40	240-365	1.0	M	80	>100
1b	M	S, V	2500		40	DP, KP, HP, XP	80	>75	40	240-365	1.0	M	200	>100
2a	M	S, H	100	15	20	XP, TX, R, IF	50	>75	40	270	1.5	P	40	30-50
2b	M	S, H	900		80	XP, JSO, IF, WB	25	>75	40	365	1.5	P	25	10-30
3a	D	S	150		30	XP, DP, KP, HP	60	<75	50	240	0.5	P	60	50-100
3a	D	V	30	10	20	XP, DP, KP, HP	60	>75	50	365	0.5	M	400	>100
3b	M	S	150		30	XP, DP, KP, HP	60	<75	50	240	0.5	P	60	50-100
3b	M	V	20		20	XP, DP, KP, HP	60	>75	50	365	0.5	M	400	>100

¹Production purpose: D-Dairy; M-Meat.

²Mobility: S-Sedentary; V-Vertical; H-Horizontal.

³Breeds: XP-Pramenka crosses; DP-Duboka Pramenka; KP-Kupreška Pramenka; HP-Hercegovska Pramenka; PP-Privorska Pramenka; R-Romanov sheep; WB-Wirtenberg; IF-II de France; JSO-Jezersko Solčavska sheep; TX-Texel.

⁴Ownership of the grazing facilities: P-Private; M-Mixed includes private and public.

densities of the region allow for a large source of feedstuff during the year (Fig. 2). Flock sizes and breeding methods are adapted mostly to the capacities of the farmers themselves, with lambs being the main production output. Young animals are sold mostly during April and May and during the tourist season with desirable live weights of around 25 kg. Adult animals are mostly sold and slaughtered during the Kurban Bajram holiday whose date varies by year.

The **Continental biogeographical region**, including Prijedorско field, Semberija, Posavina and Lijevče field covers around 30% of the national surface. More than 75% of the total surface is an agricultural area, 40% of the TAA is utilised and 25% is grassland.

An intensive (2a) and extensive (2b), mainly meat-oriented systems, were identified by the consulting experts in this region (Fig. 1 and Table 3).

2a – The Continental intensive meat system is located in the north-eastern part of B&H, with 100 farms, being one of the smaller systems inside the country (Table 3). A particular feature of this system is the breed structure which includes, except Pramenka strains, high productive meat breeds and crosses. The grazing period is shortened compared to other systems, at the same time including silage during the feeding period (Fig. 2).

2b – The Continental extensive meat system (Table 3) is located in three main plain areas of the continental area of north B&H (Prijedorско field, Semberija and Lijevče field). Due to being an area suitable for cereal and forage production this system has a short grazing period (Fig. 2), with rare to none movements either vertical or horizontal. Single farms extend the grazing period throughout the whole year if the climate conditions allow it. The area in which this system is present is being used as destination for flocks from the Alpine region during winter (1a dairy systems).

The **Mediterranean biogeographical region** in Bosnia and Herzegovina covers an area of approximately 10,000 km², which corresponds to 20% of total country surface. The region is mostly located in Herzegovina and south-west Bosnia. Less than 75% of the TAA is covered by agricultural area. Of the total agricultural area, less than 25% is utilized, and up to 75% of the TAA is covered by grassland.

Two main sheep systems were identified by the consulting experts in the Mediterranean region: a dairy (**3a**) and a meat (**3b**) dominant oriented system (Fig. 1 and Table 3).

3a - The Mediterranean dairy system involves approximately 50% of the total 80,000 animals expected to be present in this region (Table 3). It includes both sedentary farms with vertical and horizontal movements on a daily base, and transhumant farms with various flock sizes; during transhumance around 10% of total farms mobilize 30-40% of the total sheep population present in the system. Flocks during transhumance extend from 300 up to 1,000 animals. Trans-border movements from Dalmatia towards Herzegovina ceased to exist after the recent independence of the former Yugoslavia countries; the remaining transhumant movements involve migrations from lower areas (lower Herzegovina) to Blidinje Park, flocks from Livno towards Cincar Mountain and flocks from Stolac, Čapljina, Ravne and Rudine are migrating towards Treskavica Mountain.

Transhumant movements in this region are a result of environmental constrains, the drought period forces farmers to migrate towards higher altitude levels to satisfy the demand of the animals for feed (Fig. 2). The production of traditional sheep cheese (Kupreški cheese, Livanjski cheese, 'sir iz mješine') is commonly present inside this system.

3b - The Mediterranean meat system (Table 3) is similar to the Alpine meat system dispersed throughout the region, having an epicentre in the area of Ljubinje and Stolac.

The harsh environmental conditions and karst topographic features resulted in smaller animals being better adapted to the poor feeding supply and drought period. The feeding is fully adapted to the environment, and grazing on scrublands and grasslands serves as the main source of feedstuffs for the animals (Fig. 2). In this system the smallest Pramenka strain is present.

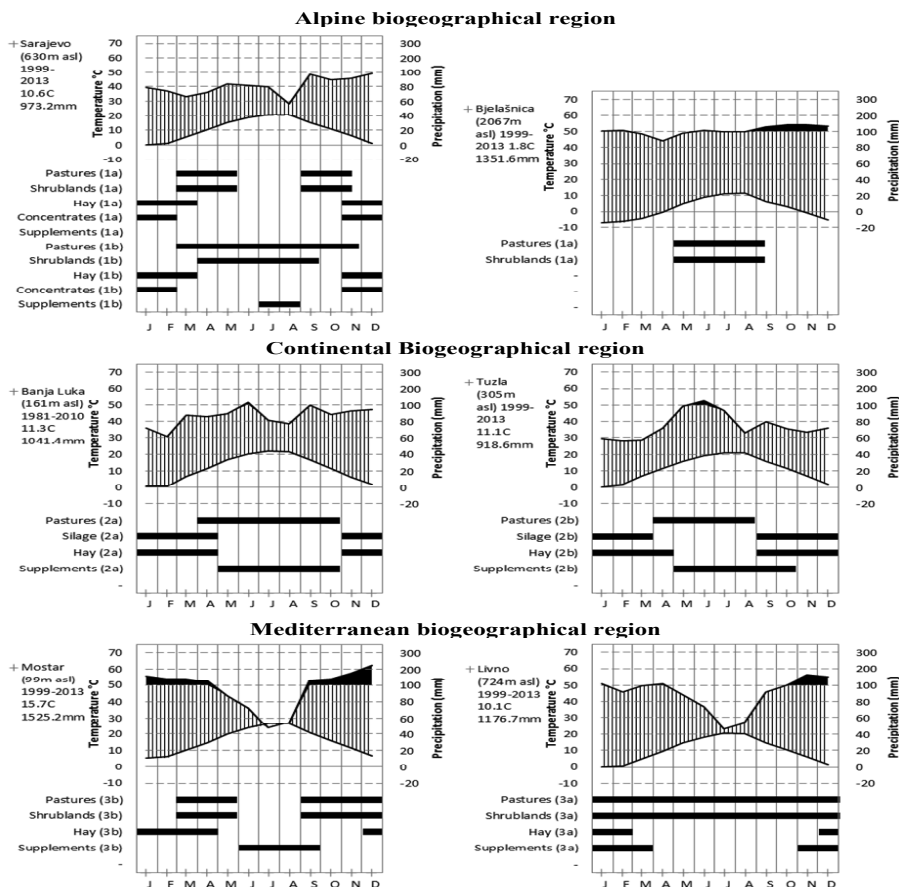


Figure 2. Feeding resources used in different sheep systems (between parenthesis the system identification code is indicated) according to the climate of the biogeographical regions (Walter-Lieth climate diagrams were derived by the data of the Federal and Republic Metrological Institutes of B&H).

Common features of the whole sheep sector, including all systems, are dominant presence of Pramenka breed strains, dominant adoption of continuous stocking and absence of rotational stocking. Regardless the biogeographical or administrative region they belong to, all systems receive two main types of support, namely financial, through subsidies per head of registered adult animal, and consulting, from various administrative bodies. Marketing and organisation types of support are absent in the sheep sector, on which all consulted experts agreed. Unions of farmers exist mainly to influence strategic planning and measures to be applied in the agriculture sector. Marketing, selling and distribution of

sheep products is pulverised; dairies and small household processing plants convert milk to various types of cheese and sell it either from the doorstep (household made) or in the shops and supermarket chains. Market for adult animals is secured through processing by traditional drying and smoking of sheep carcasses, resulting in a nationally recognised product whose name varies from 'sheep stelja', 'sheep pastrma' to 'sheep dried meat'. Sheep systems depends heavily on labour in terms of herding during the grazing season, especially in cases in which the sheep breeding is a part time activity rather than the full time occupation of the farmer.

The sixth section of the survey tool revealed that sheep production systems are not properly considered as a tool for maintaining the landscape and biodiversity. Despite the present rules which allow transhumance and mobility of farm animals by meeting particular conditions (e.g., use of lorries, renting grazing land, etc.), expectations are that the remaining transhumant flocks are not sufficient to prevent landscape changes and biodiversity loss in areas which were a common destination for pastoralists.

Conclusion

Because of the decrease in sheep number over the last six decades and the increase of population, an increasing demand of sheep products is present. Considering the features of the biogeographical regions present in the study area all collaborators pointed out that a big potential for the development of sheep systems exists.

Differences in animal spatial distribution, production purpose and other characteristics of the present state of sheep systems indicate that the environmental and socio-economic factors throughout the country strongly influence the choice of breeding methods and management.

The lack of support for sheep systems in relation to environment, landscape and biodiversity conservation, as indicated by all the consulted experts, underlines the need of policies to address these gaps.

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