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## PRODUCTION OF MUTTON IN THE REPUBLIC OF NORTH MACEDONIA COMPARED WITH THE OTHER FORMER YUGOSLAV COUNTRIES

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**Abstract:** Sheep farming holds a significant position in livestock production, particularly thriving in hilly and mountainous areas. Compared to other domestic animals, sheep have a notable advantage in converting food into meat. Unlike non-ruminants, sheep meet most of their nutritional needs through grazing. Proper nutrition is a crucial factor influencing meat production in sheep. Lamb meat production primarily targets European markets, generating substantial revenue for the country.

This paper aims to analyze mutton production from 2012 to 2022 in Republic of North Macedonia compared to other former Yugoslav countries, including Republic of Serbia, Republic of Montenegro, Federation of Bosnia and Herzegovina, Republic of Croatia, and Republic of Slovenia. Data for this research was sourced from the Food and Agriculture Organization of the United Nations (FAO) website. During this period, Republic of Serbia emerged as the largest mutton producer among these countries, averaging 28,862.09 tons, while Republic of Montenegro was the smallest producer with 1,115.48 tons. The average mutton production in other former Yugoslav countries during this time was as follows: Republic of Croatia produced 5,284.09 tons, Republic of North Macedonia produced 3,936.45 tons, Federation of Bosnia and Herzegovina produced 1,399.34 tons, and Republic of Slovenia produced 1,374.82 tons.

To enhance mutton production, it is recommended that Agriculture and Rural Development propose long-term measures such as improving farming conditions, introducing food safety standards, enhancing animal welfare standards, and building and promoting a lamb meat brand.

**Keywords:** mutton, lamb, breeding, production

### 1. INTRODUCTION

Sheep farming is a crucial aspect of animal husbandry, providing meat, milk, and wool. Most of the income in mutton production comes from selling lamb meat (Teagasc, 2021; Farrell et al., 2021; Farrell et al., 2022). McGovern et al. (2020) highlight that achieving optimal lamb growth rate and carcass conformation is essential for the profitability of sheep farms.

Sheep can be sold as carcasses and halves if they meet the quality standards set by the Law on the Quality of Agricultural Products ("Official Gazette of the Republic of Macedonia" no. 140/10).

The classification of sheep is determined by their age at slaughter. There are two main categories:

- Lambs and Kids - Animals up to 12 months old, with no permanent incisors and not fully grown second molars.
- Sheep and Goats - Over 12 months old.

Lambs are further divided into:

- Light Lambs - Dairy lambs or fattened lambs of both sexes, not older than 5 months.
- Heavy Lambs - Fattened lambs aged 5 to 12 months.

If age data is unavailable, it is determined based on dental examination. Carcass classification is based on mass (for light lambs), meatiness (carcass conformation), and fat coverage (degree of fat coating). The Rulebook on the method of determining the categories of sheep and goats and classifying the carcasses ("Official Gazette of the Republic of Macedonia" no. 18/12) outlines these processes.

In slaughter facilities, sheep or lamb carcasses are classified after bleeding, evisceration, and skinning. Classification involves determining: age, weighing (for light lambs), and evaluating meatiness, and fat coverage.

Carcass profiles are classified into six classes for conformation and five classes for fat coverage:

Classes based on the conformation of the carcass:

- S - Extremely convex profiles, exceptional muscle development.
- E - Convex to super convex profiles, exceptional muscle development.
- U - Fully convex profiles, very good muscle development.
- R - Straight profiles, good muscle development.
- O - Straight to concave profiles, average muscle development.
- P - Concave to very concave profiles, poor muscle development.

Classes based on the fat coverage of the carcass

- 1 - None to weak fat coverage.
- 2 - Thin fat coverage, flesh visible almost everywhere.
- 3 - Medium fat coverage, thin deposits of fat in the thoracic cavity.
- 4 - High fat coverage, noticeable deposits of fat in the thoracic cavity.
- 5 - Very high fat coverage, significant deposits of fat in the thoracic cavity.

Additional classification is based on the essential parts of the carcass (hindquarter, back, and shoulder) and the degree of fat coverage. For lamb carcasses weighing less than 13 kg, additional criteria include carcass/half mass, meat color at the *rectus abdominis* site according to a standardized color diagram, and fat coverage based on the classification scale criteria.

## 2. MATERIAL AND METHODS

The analysis utilized official data from the Food and Agriculture Organization of the United Nations (FAO) website, covering the period from 2012 to 2022. Mutton production in the Republic of North Macedonia during this time frame was examined and compared to that of other former Yugoslav countries (Republic of Serbia, Republic of Montenegro, Federation of Bosnia and Herzegovina, Republic of Croatia, and Republic of Slovenia). Various statistical methods were employed for the quantitative analysis of the data. These included determining the arithmetic mean ( $\bar{x}$ ) to establish average values, identifying the variation interval (the minimum and maximum values for a given area within the analyzed period), calculating the standard deviation (SD) and the coefficient of variation (CV), and computing the average rate of change (%) to show the percentage increase or decrease.

## 3. RESULTS AND DISCUSSION

Sheep farming in the Republic of North Macedonia has a long tradition, facilitated by its hilly and mountainous terrain and distinctive climatic conditions. This practice, characterized by the extensive use of natural hilly and high mountain pastures, serves as a viable economic activity for the rural economy, helping to reduce unemployment and poverty. Most lamb meat produced is intended for export, bringing in foreign deposits. Traditionally, lamb meat exports are directed to EU markets, especially Greece, Croatia, and Italy.

Unlike other livestock sectors (such as cattle, pig, and poultry farming), which are based on modern technologies, sheep farming in Republic of North Macedonia still relies on traditional labor and production methods. The use of modern zootechnics in sheep breeding is minimal, and sheep breeders require additional investments to modernize and introduce contemporary production standards. A significant challenge is the decreasing rural population and labor shortage, which are major limiting factors for the development of sheep farming.

As shown in Table 1, mutton production in Republic of North Macedonia peaked at 5,600 tons in 2012. However, production steadily declined, reaching its lowest point of 3,097 tons in 2021, marking a 44.73% decrease over the period. In 2022, mutton production increased to 3,992 tons, a 28.90% rise compared to 2021.

The Republic of North Macedonia can contribute to the development of sheep farming through a long-term strategic document that sets and implements goals, policies, and measures for agriculture and rural development. The National Strategy for Agriculture and Rural Development for the period 2021-2027 aims to address unfavorable trends and establish conditions for long-term sustainability and growth in this sector.

Recognized sheep breeding organizations need to adopt modern methods and improve breeding technologies to fully realize the genetic potential for meat production. This includes monitoring sheep breeding through pedigree bookkeeping and genetic selection, which will become the responsibility of these organizations following legal changes. Alongside enhancing the genetic potential of existing breeds, the introduction of highly productive sheep breeds will be supported, allowing breeders to co-finance these costs through rural development programs.

The National Strategy for Agriculture and Rural Development for the period 2021-2027 of the Republic of North Macedonia (2021) also emphasizes the need to improve cultivation conditions, introduce food safety standards, and enhance the economic performance of sheep farming operations. These improvements will be supported by co-financing investments for constructing new and renovating existing facilities on farms and breeding centers, improving feeding and watering systems, storing animal feed, and procuring machinery. Farms in high-mountain areas will receive support for utilizing renewable energy sources through investments in solar power centers and wind turbines.

*Table 1. Overview of mutton production in former Yugoslav countries from 2012 to 2022 (in tons)*

	Republic of North Macedonia	Republic of Serbia	Republic of Montenegro	Federation of Bosnia and Herzegovina	Republic of Croatia	Republic of Slovenia	
<b>2012</b>	5,600	22,107	1,070	2,270	5,400	1,405	
<b>2013</b>	4,725	29,593	1,708	1,468	5,600	1,310	
<b>2014</b>	4,727	26,816	824	1,484	5,300	1,339	
<b>2015</b>	3,980	28,884	970	1,366	5,000	1,359	
<b>2016</b>	3,737	32,519	1,909.63	1,278	4,971	1,307	
<b>2017</b>	3,422	28,689	1,048.90	1,304	4,704	1,423	
<b>2018</b>	3,446	31,030	957.10	1,444	5,270	1,440	
<b>2019</b>	3,392	32,476	1,088.60	1,393	5,340	1,370	
<b>2020</b>	3,183	29,520	850	926	4,960	1,400	
<b>2021</b>	3,097	27,604	922.42	1,332	5,610	1,410	
<b>2022</b>	3,992	28,245	921.61	1,127.71	5,970	1,360	
<b>Average 2012-2022</b>	<b>3,936.45</b>	<b>28,862.09</b>	<b>1,115.48</b>	<b>1,399.34</b>	<b>5,284.09</b>	<b>1,374.82</b>	
<b>Variation interval</b>	<b>Min</b>	3,097	22,107	824	926	4,704	1,307
	<b>Max</b>	5,600	32,519	1,909.63	2,270	5,970	1,440
<b>SD</b>	746.69	2,761.95	339.19	316.12	345.59	42.57	
<b>CV (%)</b>	18.97	9.57	30.41	22.59	6.54	3.10	
<b>Average rate of change (%)</b>	-3.33	2.48	-1.48	-6.76	1.01	-0.32	

(source: FAOSTAT database)

To increase the competitiveness of Republic of North Macedonia lamb in foreign markets, especially European ones, it is crucial to build and promote a recognizable brand. Support will also be provided to lamb meat exporters to explore and access new, non-traditional markets, such as those in the Near and Far East, through the establishment of free trade agreements.

As shown in Table 1, the Republic of Serbia is the largest producer of mutton among the former Yugoslav countries, with an average production of 28,862.09 tons from 2012 to 2022. It is followed by the Republic of Croatia with 5,284.09 tons, the Republic of North Macedonia with 3,936.45 tons, the Federation of Bosnia and Herzegovina with 1,399.34 tons, and the Republic of Slovenia with 1,374.82 tons. The smallest producer is the Republic of Montenegro, with 1,115.48 tons of mutton.

The Federation of Bosnia and Herzegovina experienced the largest average rate of decline in mutton production over this period, at -6.76%. The Republic of North Macedonia followed with an average decline rate of -3.33%, then the Republic of Montenegro at -1.48%, and the Republic of Slovenia at -0.32%. Conversely, a positive trend in mutton production was observed in the Republic of Croatia, with an average growth rate of 1.01%, and in the Republic of Serbia, with an average growth rate of 2.48%.

In the strategy for agriculture and rural development for the Federation of Bosnia and Herzegovina for the period 2021-2027 (2024), it is highlighted that sheep farming in the country primarily relies on extensive production methods, utilizing natural pastures. A key goal is to co-finance investments for constructing new and renovating existing sheep breeding facilities, alongside implementing measures to enhance productivity and improve sheep farming conditions.

Additionally, a detailed program is needed to conduct a comprehensive census of sheep breeds and accurately determine their numerical status. Establishing breeding centers is also crucial, where new technologies and approaches can be applied to selection and control of livestock breeding value, aiming to enhance production characteristics and performance.

Further efforts should focus on educating growers through training sessions, workshops, and other initiatives to ensure they are well-equipped with the latest knowledge and techniques in sheep farming.

The strategic plan for agricultural policy of the Republic of Croatia for the period 2023-2027 (2022) highlights that sheep farming in Republic of Croatia is predominantly practiced on islands, in coastal karst areas, and mountainous regions, often with relatively small flocks. To ensure the sustainability of pastoral production, several interventions are necessary to address economic, social, environmental, and climate challenges.

These interventions aim to stabilize income in the sector, implement agricultural practices that reduce greenhouse gas emissions, improve animal welfare, and enhance meat quality. Ensuring economic and social sustainability involves stabilizing producers' incomes and securing market access for sufficient quantities of meat through direct payments that support mutton production.

Additionally, strengthening the competitiveness and income of sheep farmers will address existing difficulties. Interventions are also required to conserve and breed indigenous sheep breeds with significant genetic potential.

The strategic plan for Republic of Slovenia's agricultural policy for the period 2023-2027 (2023) outlines several key goals for the sheep farming sub-sector, focusing on expanding production and increasing the scale of sheep breeding. To achieve these goals and ensure flexible, competitive production, the plan emphasizes the importance of:

- Stable and Adequate Incomes: Ensuring that agricultural producers have reliable and sufficient income.
- Higher Competitiveness: Enhancing the sector's overall competitiveness.

The plan includes various interventions, particularly for small business owners, such as:

- Basic Income Support: Providing fundamental support to maintain operations.
- Redistributive Income Support: Offering additional income to promote sustainability.
- Productivity and Technology Investments: Boosting productivity through technological development and digitization of agricultural farms.
- Collective Investments: Supporting joint efforts for preparing agricultural products for the market and developing robust food value chains.
- Organic Farm Development: Investing in the competitiveness and market orientation of organic farms.
- Processing and Marketing Investments: Enhancing the processing and marketing of agricultural products.
- Welfare Standards: Investing in adaptations to meet above-standard welfare requirements for livestock.

These measures aim to enhance productivity, competitiveness, and sustainability within the sheep farming sector.

In the Republic of Serbia, sheep farming has a long tradition with a distinct regional characteristic. The production is primarily concentrated in hilly and mountainous areas, particularly in the eastern and southern regions, at altitudes over 300 meters above sea level. The strategy for agriculture and rural development in Republic of Serbia for the period 2014-2024 (Official Gazette of the Republic of Serbia, no. 85/2014) emphasizes several key areas for improvement:

- Increasing the Foundation Flock: Expanding the number of foundational breeding animals.
- Improving Facilities: Enhancing accommodation and breeding facilities for sheep.
- Enhancing Animal Welfare: Implementing measures to improve the welfare of the animals.
- Improving Meat Quality: Focusing on the quality of the meat produced.

These initiatives are aimed at strengthening the sheep farming sector and addressing existing challenges.

Mutton production in the Republic of Montenegro relies on semi-extensive and extensive farming systems, predominantly in the higher regions of the country. According to the strategy for the development of agriculture and rural areas of Republic of Montenegro for the period 2023-2028 (2023), there are several key focus areas:

- Utilization of Science: Leveraging scientific advancements to enhance agricultural practices.
- Farmer Education: Investing in the education of farmers to improve their skills and knowledge.
- Improvement of Agricultural Practices: Enhancing the overall methods and techniques used in agriculture.
- Animal Welfare: Placing a strong emphasis on the well-being of animals.

These strategies aim to advance mutton production by integrating scientific knowledge, improving practices, and ensuring high standards of animal welfare.

#### **4. CONCLUSION**

From the analyzed data, it is clear that mutton production has a long-standing tradition in the countries of the former Yugoslavia, with sheep breeding predominantly occurring in the hilly and mountainous regions. This production is characterized by semi-extensive and extensive farming systems.

Among these countries, the Republic of Serbia stands out as the largest producer of mutton for the period from 2012 to 2022, while the Republic of Montenegro is the smallest producer. Additionally, a trend of decreasing mutton production is observed in the Federation of Bosnia and Herzegovina, the Republic of North Macedonia, the Republic of Montenegro, and the Republic of Slovenia.

To address these challenges and improve production levels, it is essential to continuously set and refine goals, policies, and measures. Each country is undertaking various initiatives through their National Strategies for Agriculture and Rural Development to boost mutton production and tackle the sector's issues. The production of lamb meat plays a particularly important role as it ensures a flow of deposits into the country, underscoring its economic significance.

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