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Table of content

Plenary session

Global Status and Future Outlook of Table Grapes.....	2
Arif Atak	

1 | Plant and Food Production

The effect of apical defoliation after veraison of Svrđlovina (<i>Vitis vinifera</i> L) grapevines on yield components and grape phenolic composition	11
Marina Anić, Mirela Osrečak, Matea Mamić, Marko Karoglan	
Enhancing early vegetative performance of white clover (<i>Trifolium repens</i> L.) through magnetic seed priming.....	22
Gordana Bukvić, Goran Herman, Vlado Guberac, Krunoslav Karalić, Antonija Strilić, Meri Engler	
Responses of sunflower to herbicide stress and post-treatment biostimulant application	27
József Csajbók, István Csaba Virág, Dániel Gaganetz, Erika Tünde Kutasy	
Preliminary evaluation of amino acid composition in selected soybean genotypes	32
Nina Cvenić, Aleksandra Sudarić, Tomislav Duvnjak, Ivica Liović, Daniela Horvat, Marija Babić Kovačević, Gordana Šimić, Ines Banjari, Maja Matoša Kočar	
Biocontrol potential of essential oils against <i>Colletotrichum acutatum</i>.....	37
Jelena Ećimović, Slavica Vuković, Sanja Lazić, Dragana Šunjka, Aleksandra Šušnjar	
Effects of mowing date and cutting height on biomass production and grain yield of dual-purpose winter oat	41
Fanni Zsuzsa Forgács, István Csaba Virág, József Csajbók, Erika Tünde Kutasy	
Mitigating clover sickness: Spent mushroom substrate and symbiotic recovery	46
Emmely Fritsch, Anika Zacher, Christel Baum	
Requirements of CPVO technical protocol for DUS testing in maize (<i>Zea mays</i> L.).....	50
Filip Horvat, Ivan Varnica, Luka Drenjančević, Marina Zorić, Zvonimir Lalić, Antonia Petrić	
Spent mushroom substrate: nutrient source or limitation in oilseed rape?	54
Nico Krüger, Anika Zacher, Christel Baum	
Ecotype x foliar nutrition interactions in oats: implications for climate resilience	58
Erika Tünde Kutasy, József Csajbók, István Csaba Virág, Bekir Bytyqi, Fanni Zsuzsa Forgács	

The impact of branding domestic agricultural products on the preferences of young people in the Republic of Croatia	413
Mate Budimir, Ljubomir Madunić, Zrinka Tolušić Sić	
Education of youth for successful agribusiness: Managerial and entrepreneurial competencies	418
Mate Budimir, Ljubomir Madunić, Zrinka Tolušić Sić	
Electricity Production Cost from the Anaerobic Digestion of Swine Manure	423
Robert T. Burns, Daniel Andersen, Robert Spajić	
The impact of label design on the branding of Dalmatian extra virgin olive oil: An empirical study of consumer perceptions.....	428
Marin Čagalj, Ivo Grgić, Marko Ivanković, Jernej Prišenk	
Apple Waste Recovery Potential: A Review of Available Databases.....	434
Mia Dujmović, Ivan Brandić, Anamarija Peter, Karlo Špelić, Jona Šurić, Jana Šić Žlabur	
Development of an AI-based system for detection of olive fruits and yield estimation.....	439
Josip Gugić, Toma Sikora, Vladan Papić, Mladenka Šarolić, Frane Strikić	
Consumer perceptions of influencer marketing in the agri-food sector: Attitudes, trust, and purchasing behaviour.....	444
Sanja Jelić Milković, Ružica Lončarić, Igor Kralik, Jelena Kristić, Lucija Pečurlić, Rebeca Todić	
Women who carry rural communities: Experiences of LAG and FLAG leaders	450
Tihana Kovačićek, Vlatka Šarić, Mateja Jež Rogelj, Ornella Mikuš, Aleksandra Perčin, Ramona Franić, Nataša Bokan	
Latest outlook on beef meat production in the Republic of Croatia	455
David Kranjac, Krunoslav Zmaić, Tihana Sudarić, Sanja Jelić Milković, Jelena Kristić, Ivana Starčević, Ana Crnčan, Marko Oroz	
Human resource management challenges in agribusiness under digitalisation and AI	460
Ljubomir Madunić, Mate Budimir, Zrinka Tolušić Sić	
Effects of using e-learning platforms in the education of agricultural producers in Croatia.....	466
Ljubomir Madunić, Mate Budimir, Zrinka Tolušić Sić	
Consumer awareness, attitudes and behavioural intentions towards agroforestry in Croatia.....	471
Tomica Marković, Kindineh Melaku, Marija Cerjak	
Perceptions of slow tourism among Croatian tourists.....	476
Marina Matačić, Ridu Varshini Lakshmana Kumar, Marija Cerjak	
Comparative analysis of the dairy sector: Slovenia and Croatia.....	481
Ben Moljk, David Kranjac, Boris Lukić	

ORIGINAL SCIENTIFIC PAPER

Comparative analysis of the dairy sector: Slovenia and CroatiaBen Moljk¹, David Kranjac², Boris Lukić²¹*Agricultural Institute of Slovenia, Agricultural Economics Department, Hacquetova 17, Ljubljana, Slovenia (ben.moljk@kis.si)*²*Faculty of Agrobiotechnical Sciences Osijek, Josip Juraj Strossmayer University of Osijek, Vladimira Preloga 1, Osijek, Croatia***Summary**

The development of milk production in Slovenia and Croatia has been very similar for decades. This is not surprising given the politics and economic development of the former common state. The development of milk production remained comparable in the first two decades after independence, but in recent years there have been significant differences in production between the countries. In order to understand the developments on the milk market in both countries, we have conducted a brief comparative analysis of both sectors. We have sought explanations for the differences in key production indicators. The slower pace of structural change in Slovenia compared to Croatia appears likely to be the result of a combination of factors, including potentially more favourable socio-economic and infrastructural conditions, such as diverse employment opportunities in rural areas, better access to local markets, or specific national agricultural support policies that alleviate economic pressures on smaller farms. Further research is needed to quantify the relative impact of these factors on the observed deviation.

Keywords: dairy sector, Slovenia, Croatia, comparative analysis**Introduction**

Milk production had a great self-sufficiency and social importance on smaller farms for decades. In the former common state, market milk production was based on larger agricultural enterprises (in Slovenia also in cooperatives), while the private sector was fragmented and limited in production. After the collapse of the former state, significant structural changes began to occur in the field of agriculture, both in Slovenia and in Croatia, as also indicated by agricultural census data (SURS, DZS). At the same time, specialization of agricultural holdings also took place with considerable intensity in both countries (Zeleno poročilo, 2025, MPŠR, 2025). While the two sectors were similar at the end of the former state and for some time after independence, significant differences have emerged in the last decade. Thus, the purpose of this paper is to review trends in milk production in Slovenia and Croatia over the last two decades and to demonstrate the key causes of the changes that occurred and to explain them.

Material and Methods

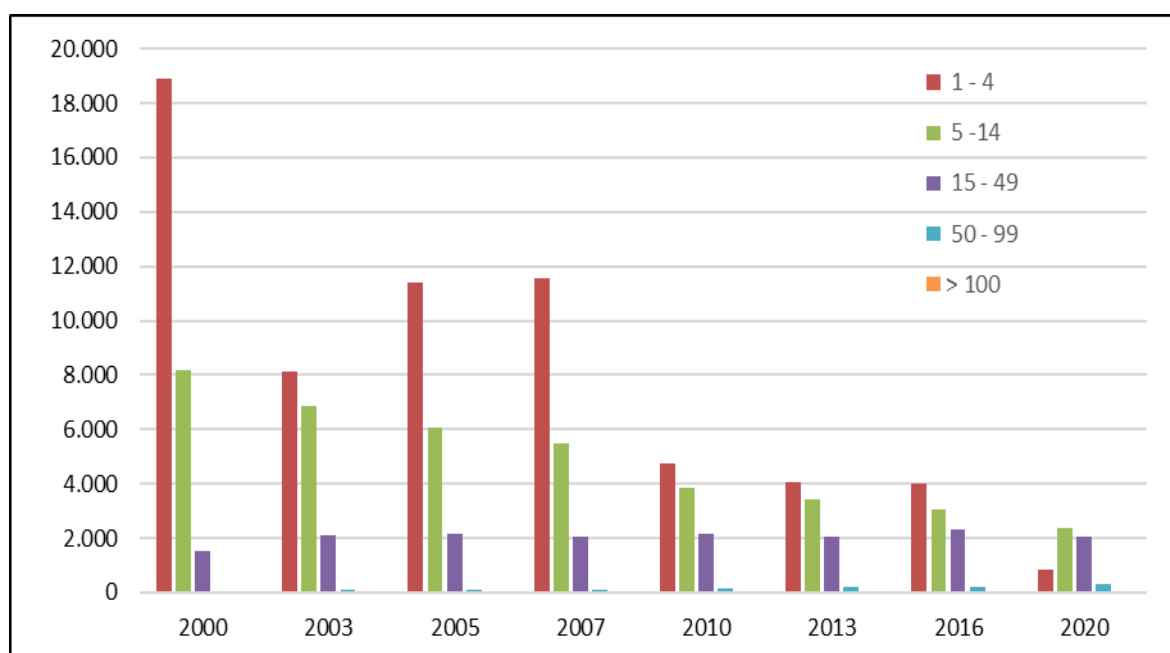
This comparative analysis uses available official statistics and reports from national statistical offices, agricultural ministries, and specialized agencies for the period 2000-2024. Data for primary production included dairy farm structure (number of holdings by size categories), dairy cow numbers, annual milk production levels, and average milk yield. Foreign trade analysis is focused on aggregated import and export volumes of milk and dairy products, and self-sufficiency rates. Trends were identified through descriptive statistical analysis, focusing on year-on-year changes and multi-year averages, to highlight convergences and divergences between the two countries.

Results and Discussion

In Slovenia, milk production is the most important agricultural sector (Zeleno poročilo, 2025). It contributes around 15% to the total value of agricultural production in recent years, and 34% to the value of livestock farming.

Due to its natural conditions, the structure of agricultural production in Croatia is quite different from that in Slovenia. Due to the large share of arable land, the production of cereals and oilseeds has the largest share in the value structure of agricultural production (DZS, 2026), while milk production, according to the Economic Accounts of Agriculture, represented just under 6% of the total value of agricultural production, and within livestock production, just under 14% of the value. As recently as 2010, milk production represented around 12% of the value of agricultural production, and around 31% of the value of livestock production. The significant decrease in the share in fifteen years indicates structural changes and contraction of the sector, which is also confirmed by other statistical data.

Studies concerning the farm structure in Slovenia indicate that structural adjustments within the dairy sector have been the most pronounced across all livestock sectors over the past decade, particularly since 2007. There has been a significant reduction in the number of holdings specializing in dairy farming; by 2020, approximately 8% of all farms were involved in milk production. The most substantial decrease in dairy operations occurred in the size categories with fewer than 14 cows.



Graph 1. Dairy farm structure; Slovenia, 2000-2020

Source: SURS

Structural changes have also been occurring in Croatia, becoming most evident over the last decade. As shown in Table 1, the number of dairy herds with up to 10 animals has decreased rapidly, while the decline in the 11–30 cow category was significantly less intense. This indicates the income viability threshold for smaller herds; however, these are not specialized operations and they supplement their income with other revenue sources.

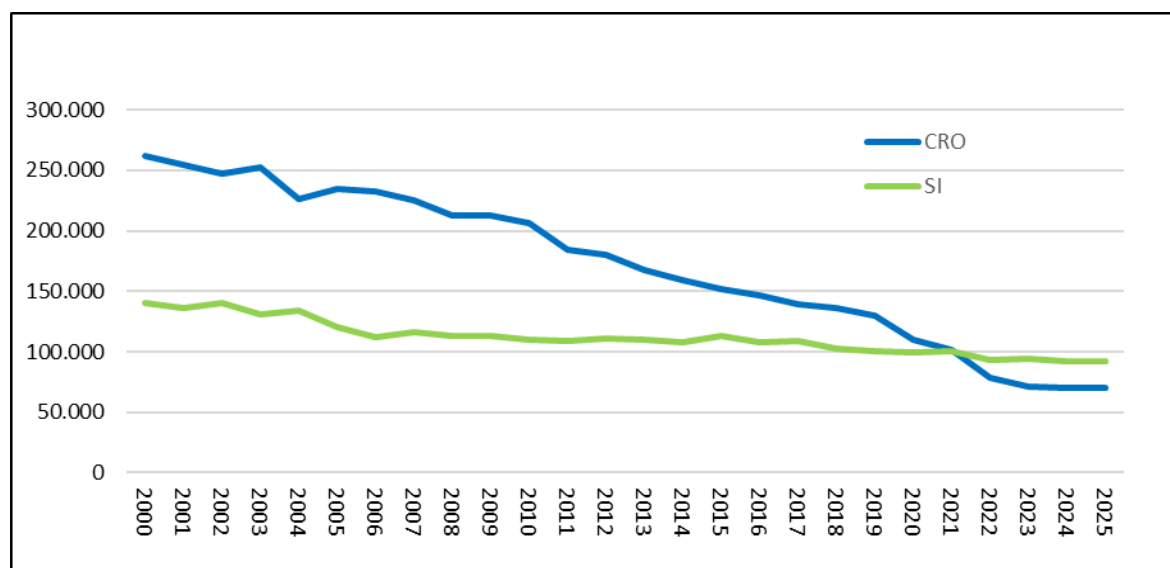
Table 1. Dairy farm structure; Croatia, 2020-2024

No. of dairy cows	2020	2021	2022	2023	No. of dairy cows	2024
<6	14.777	142.41	11.542	10.553	<6	9.535
6-10	2.626	2.402	2.019	1.911	6-10	1.853
11-30	2.486	2.436	2.239	2.198	11-30	2.102
31-100	636	635	638	626	31-100	649
101-250	71	77	69	66	101-1.000	96
>250	33	32	30	32	>1.000	5

Source: MPŠR, HAPIH

The trend of decreasing the number of dairy farms in Slovenia continued after 2020 (CPZ Govedo, 2026), and the number of dairy cows also decreased. Thus, in 2015, there were over 110 thousand dairy cows in Slovenia, while in recent years there have been barely over 90 thousand (SURs). On the contrary, average milk yield increased. From around 5.500 kg/cow, it increased by 1.300 kg/cow in a decade (SURs), and an even greater increase in milk yield is shown by data from cows in milk yield control (CPZ Govedo, 2026).

The reasons are not only in better management of dairy cow nutrition, selection and changes in breed structure, but also in the fact that dairy cows, which were characterized by lower milk yield, are no longer in breeding (Zeleno poročilo, 2022).

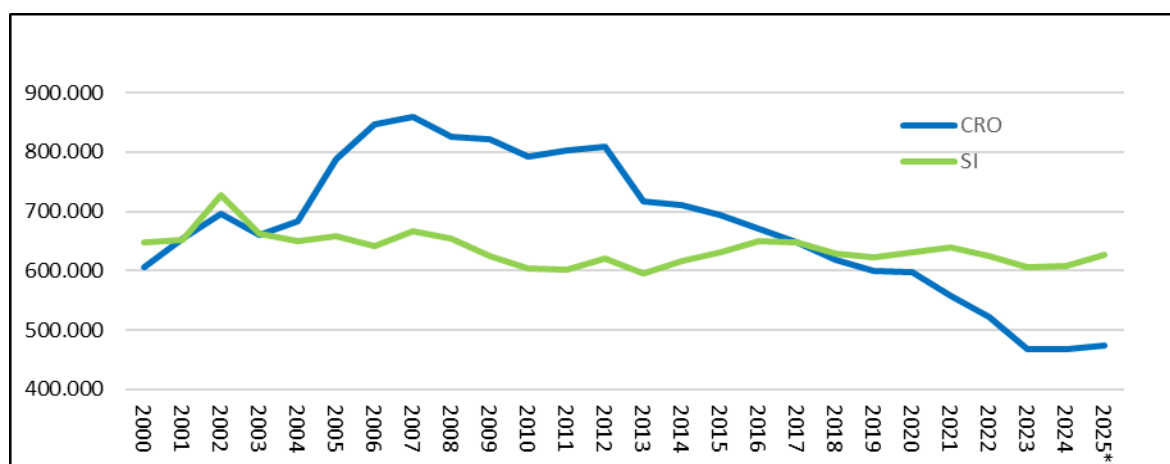


Graph 2. Number of dairy cows; Croatia*, Slovenia, 2000-2025

* estimation for period 2021-2025

Source: SURs (SI), DZS (CRO)

The number of dairy cows in Croatia has more than halved since 2000, when there were 262,200. In 2020, there were only 109,800, which is around 10 thousand more than in Slovenia, and in 2021 the number of dairy cows was similar to that in Slovenia. A significant drop in the heifer population occurred in 2022, when there were only around 79 thousand dairy cows in breeding, and in 2025 there were only around 71 thousand.

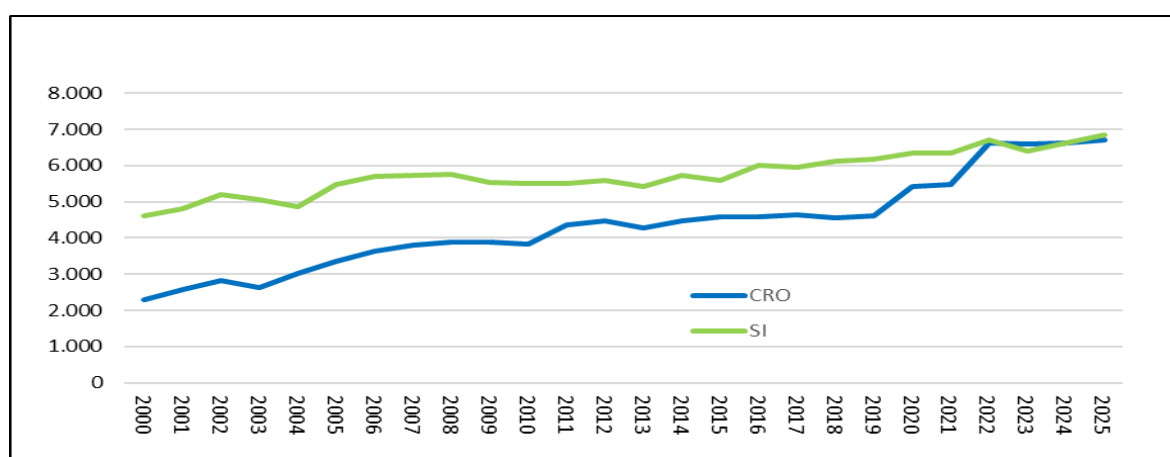


Graph 3. Milk production; Croatia, Slovenia, 2000-2025 (ton)

* estimation for year 2025

Source: SURS (SI), DZS (CRO)

In line with the decrease in the number of dairy cows, significant changes in Croatia are also reflected in the amount of produced milk. In 2000, it amounted to 605 thousand tons, and just under 25 years later, it was 468 thousand tons (in 2024), or 23% less. Since the decrease in the total amount of produced milk is less intense than the decrease in the number of dairy cows, it means that the average milk yield has been increasing rapidly. The calculation for year 2000 shows an average milk yield of 2.300 kg/dairy cow, while in 2024 it is almost 3 times more. Similar to Slovenia, during the initial period of recording dairy cows, there were numerous cows from subsistence farms, where milk production was at a level typical of suckler cows. Also Croatia, the increase in average milk yield clearly confirms the intensive structural changes. Smaller farms have abandoned milk production for various reasons. In addition to economic reasons, this is certainly also a consequence of generational leaps. In Croatia, the contraction of the so-called small family farms is more noticeable than in Slovenia.

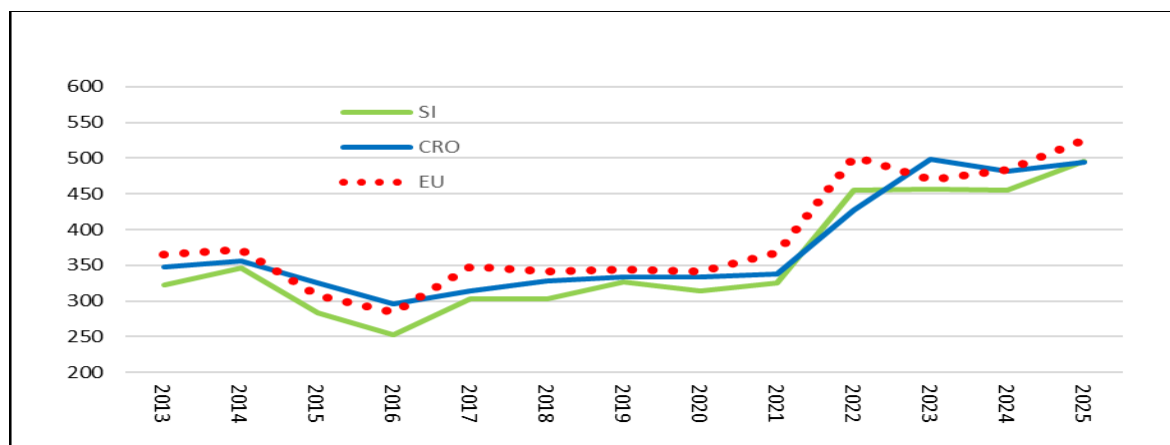


Graph 4. Average milk yield; Croatia, Slovenia, 2000-2025 (kg/dairy cow)

* estimation for period 2021-2025

Source: SURS (SI), DZS (CRO)

Prices of raw milk in Slovenia and Croatia are flexibly adapting to the conditions on the European dairy market, but prices are significantly influenced by regional markets, especially in Italy. Milk prices in Croatia have been consistently higher than in Slovenia, but in both countries they are below the European average.



Graph 5. Price of raw milk - delivered; Croatia, Slovenia, EU, 2013-2025 (EUR/ton)

Source: Market Information System, EC

Slovenia is a net exporter of milk and dairy products. The foreign trade balance has averaged around 150 thousand tons over the past decade. Despite occasional fluctuations, the volume of foreign trade is increasing and, according to the latest available data, amounted to 711 thousand tons in 2024.

Table 2. Foreign trade with milk and dairy products, self-sufficiency; Slovenia, Croatia

SLOVENIA	2020	2021	2022	2023	2024
Export (000 tons)	400.115	418.944	395.517	405.775	424.624
Import (000 tons)	244.289	248.192	238.046	263.114	285.897
Self-sufficiency (%)	133,2	135,5	133,9	130,7	129,0
CROATIA	2020	2021	2022	2023	2024
Export (000 tons)	61.045	56.751	62.175	58.867	65.390
Import (000 tons)	262.403	276.382	298.156	311.788	325.103
Self-sufficiency (%)*	60	55	48	40-42	43-45

* estimation

Source: SURS (SI), DZS (CRO)

In contrast, Croatia is a net importer of milk and dairy products. The trade deficit in 2020 amounted to just over 200 thousand tons, and in the period 2021-2024 it increased due to increasing imports of milk and dairy products, which coincides with a noticeable decline in domestic milk production. Exports of milk and dairy products ranged between 60 and 66 thousand tons in 2020-2024.

Conclusion

Changes in the dairy sector in Slovenia and Croatia have taken place at different rates. The economics of milk production are certainly a reason for the abandonment of production on small farms. In Slovenia, the process has been slower, which can probably be attributed to socio-economic and infrastructural factors, such as employment opportunities outside agricultural activities, short distances to market routes, etc. In Croatia, by contrast, milk production is increasingly concentrated and based mainly on large agricultural enterprises. The observed structural changes, in particular the decrease in milk production on smaller farms, are likely the result of a complex interaction of economic pressures, the political environment and socio-demographic factors.

References

- Brečko J., Zagorc B., Hiti Dvoršak A., Pucihar Š., Moljk B., Bele S. (2025). Pregled po kmetijskih trgih. Poročilo o stanju kmetijstva, živilstva, gozdarstva in ribištva v letu 2024. Ljubljana. Slovenija. Kmetijski Inštitut Slovenije. 159.
- CBS (2026). PC-Axis baze podataka. Poljoprivreda, lov, šumarstvo i ribarstvo.
- CPZ Govedo. (2026). Centralna podatkovna zbirka Govedo. <https://www.govedo.si/cpz-govedo/> (1.4.2026)
- HAPIH (2025). Govedarstvo. Godišnje izvješće 2024. Hrvatska agencija za poljoprivredu in hranu. Osijek. 168.
- HAPIH (2024). Govedarstvo. Godišnje izvješće 2023. Hrvatska agencija za poljoprivredu in hranu. Osijek. 190.
- HAPIH (2023). Govedarstvo. Godišnje izvješće 2022. Hrvatska agencija za poljoprivredu in hranu. Osijek. 172.
- HAPIH (2022). Govedarstvo. Godišnje izvješće 2021. Hrvatska agencija za poljoprivredu in hranu. Osijek. 146.
- HAPIH (2021). Govedarstvo. Godišnje izvješće 2020. Hrvatska agencija za poljoprivredu in hranu. Osijek. 130.
- MPŠR (2024). Godišnje izvješće o stanju poljoprivrede u 2023. Ministarstvo poljoprivrede, šumarstva i ribarstva. Zagreb. 134.
- SURS (2026). Podatkovna baza SiStat. Kmetijstvo, gozdarstvo in ribištvo.
- Travnikar T., Bedrač M., Bele S., Bleiweis A., Brečko J., Kožar M., Moljk B., Telič V., Zagorc B. (2025). Zeleno poročilo za leto 2024. Poročilo o stanju kmetijstva, živilstva, gozdarstva in ribištva v letu 2024. Ljubljana. Slovenija. Kmetijski Inštitut Slovenije. 299.

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