

DYNAMICS OF STRAWBERRY PRODUCTION AND COMMERCIALIZATION IN BIHOR COUNTY: THE INFLUENCE OF SEASONALITY ON THE LOCAL MARKET

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REVIEW, RESEARCH ARTICLE –

Abstract

Strawberry production represents an important component of the horticultural sector due to its high economic value, strong consumer demand, and significant contribution to rural development. In Romania, and particularly in Bihor County, strawberry cultivation has experienced continuous development in recent years, supported by favorable pedoclimatic conditions, technological improvements, and increasing demand for locally produced fruits. However, the sector continues to face important challenges related to seasonality, price volatility, labor shortages, and the limited availability of storage and processing facilities.

The aim of this study was to analyze the dynamics of strawberry production and commercialization in Bihor County and to assess the impact of seasonality on the local market. The research was based on a quantitative approach using official statistical data collected from the National Institute of Statistics, Eurostat, FAOSTAT, and other relevant sources for the period 2015–2024. The analysis focused on the evolution of cultivated areas, total production, productivity levels, seasonal price variations, and the main marketing channels used by local producers. The results indicate a significant increase in both cultivated areas and production volumes during the analyzed period. Total strawberry production increased from approximately 1,320 tons in 2015 to over 2,470 tons in 2024, while average productivity improved considerably due to the adoption of modern cultivation technologies and higher-yielding cultivars. The study also revealed the strong influence of seasonality on market performance. Production is highly concentrated during May and June, resulting in temporary oversupply, declining prices, and reduced profitability for producers. Conversely, during the off-season, limited supply contributes to higher prices and increased dependence on imports.

The analysis of marketing channels showed that local agricultural markets remain the dominant distribution channel, followed by supermarkets and direct sales. The findings highlight the need for investments in protected cultivation systems, storage infrastructure, processing facilities, and diversified marketing strategies in order to reduce the negative effects of seasonality and improve farm profitability. The strawberry sector in Bihor County demonstrates favorable development prospects; however, sustainable growth requires continued modernization, technological innovation, and the implementation of strategies aimed at increasing competitiveness and reducing market vulnerability.

Keywords: (max. 5) strawberry production, seasonality, commercialization, horticulture, Bihor County, agricultural markets, competitiveness

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INTRODUCTION

Strawberry (*Fragaria × ananassa*) is one of the most important horticultural crops cultivated worldwide due to its high economic value, early fruit-bearing capacity, and strong consumer demand for both fresh and processed products. In recent decades, global strawberry production has expanded considerably as a result of technological advancements, the development of protected cultivation systems, and increasing consumer interest in healthy foods rich in bioactive compounds (9, 20). Within the European Union, strawberries occupy a significant position in the horticultural sector, with Spain, Poland, Germany, and Italy representing the leading producers and suppliers to the European market (10, 11).

In Romania, strawberry cultivation has experienced continuous growth, supported by favorable climatic conditions and increasing

demand for locally produced fresh fruits. The crop is particularly attractive for small and medium-sized farms due to its high profitability per unit area and the diversity of marketing channels available, including local markets, short supply chains, and modern retail networks (12, 16, 18, 22). Strawberry production also contributes to rural development by generating employment opportunities and providing additional income sources for agricultural households (2, 14, 21).

One of the defining characteristics of the strawberry market is its strong seasonality. In Romania, harvesting is concentrated mainly between May and June, resulting in a temporary oversupply that often leads to lower market prices. Conversely, during the off-season, limited availability increases prices and stimulates imports to satisfy consumer demand (1, 10, 19). This seasonal pattern significantly

affects farm profitability and market stability, making seasonality one of the major challenges facing strawberry producers (6, 17, 27).

In Bihor County, strawberry cultivation plays an important role within the regional horticultural sector. Favorable environmental conditions and proximity to urban markets, particularly the city of Oradea, create advantageous opportunities for production and commercialization. However, local producers continue to face challenges related to price volatility, imported competition, labor shortages, and increasing production costs (13, 18, 29). At the same time, growing consumer interest in local products and short supply chains, together with the expansion of online marketing and direct sales channels, offers new opportunities for improving the competitiveness of strawberry farms (4, 15, 22, 23).

Considering these aspects, the aim of this study is to analyze the dynamics of strawberry production and commercialization in Bihor County, with particular emphasis on the influence of seasonality on the local market. The research evaluates trends in cultivated areas and production volumes, examines seasonal price fluctuations, and identifies the main marketing channels used by local producers. Furthermore, the study seeks to highlight both the opportunities and constraints affecting the strawberry sector and to provide recommendations for improving its competitiveness and long-term sustainability.

Strawberry cultivation is characterized by several technological, economic, and commercial particularities that distinguish it from other horticultural crops. The most important of these is the highly seasonal nature of production, which strongly influences market supply, prices, farm profitability, and consumer behavior. Harvesting is concentrated within a relatively short period, requiring intensive labor input and efficient marketing strategies to prevent losses and maximize profitability. Additionally, strawberries are highly perishable fruits, requiring rapid post-harvest handling, refrigeration, and efficient distribution systems to maintain quality and market value.

To mitigate the negative effects of seasonality, producers increasingly adopt innovative technological and commercial solutions. These include the cultivation of early-, mid-, and late-season varieties, the use of remontant cultivars, protected cultivation systems such as tunnels and greenhouses, and

advanced hydroponic technologies that extend production periods and improve market timing. From a commercial perspective, fruit processing into jams, juices, syrups, frozen products, and confectionery ingredients enables producers to reduce post-harvest losses and diversify income sources. Moreover, direct marketing strategies, short supply chains, online sales platforms, and agritourism initiatives such as “pick-your-own” farms contribute to increasing added value and improving farm profitability. Through the integration of these technological and marketing innovations, producers can reduce the adverse effects of seasonality and enhance the long-term sustainability of strawberry production systems.

Materials and Methods

The present research aims to analyze the dynamics of strawberry production and commercialization in Bihor County, with particular emphasis on the influence of seasonality on the local market. The study adopts a quantitative research approach based on the analysis of official statistical data and economic indicators relevant to the horticultural sector. The investigation focuses on identifying the main trends regarding the evolution of cultivated areas, production volumes, productivity levels, and marketing mechanisms, while also highlighting the effects of seasonality on prices and producers' revenues.

The data used in the analysis were collected from official national and international sources, including the National Institute of Statistics (INS), the TEMPO Online database, the Bihor County Directorate of Statistics, the Ministry of Agriculture and Rural Development, Eurostat, FAOSTAT, and the Agency for Payments and Intervention in Agriculture (APIA). In addition, scientific articles, specialized reports, and recent studies concerning strawberry production and marketing at both the national and European levels were consulted to provide a comprehensive theoretical and empirical framework. The period under investigation covers the years 2015–2025, allowing the identification of recent developments within the sector and the assessment of changes generated by climate variability, technological innovation, and transformations in agri-food markets.

The analysis focused on the evolution of strawberry cultivated areas, total production, and average yields per hectare, as well as on the main changes observed in the

commercialization process. To evaluate development trends, descriptive statistical methods were employed, including the calculation of averages, growth rates, and percentage variations. Time-series analysis was also used to examine production dynamics and to identify periods characterized by significant increases or decreases in output.

To assess the effects of seasonality on the local market, monthly variations in prices and marketed volumes were analyzed. This approach enabled the identification of peak production periods, typically associated with abundant supply and lower prices, as well as off-season periods, when limited product availability leads to higher market prices. The seasonality analysis provides valuable insights into the way fluctuations in production influence market behavior and farm profitability.

Furthermore, correlation analysis was applied to evaluate the relationship between production levels and price dynamics. This method made it possible to determine both the strength and direction of the association between these variables. The results were interpreted in relation to findings reported in the scientific literature and to trends observed on the European strawberry market. At the same time, the study examined the principal marketing channels used by producers in Bihor County, including local agricultural markets,

retail chains, collection centers, and direct sales to consumers.

The obtained results were processed and presented through tables, charts, and graphical representations, facilitating the comparison of the analyzed indicators and highlighting the main trends characterizing the sector. The methodology adopted provides a comprehensive overview of strawberry production and commercialization in Bihor County and supports the formulation of relevant conclusions regarding the impact of seasonality on the local market and on the economic performance of producers.

Results and Discussion

The analysis of strawberry production dynamics in Bihor County highlights a generally upward trend throughout the period 2015–2024. The data presented in **Table 1** and **Figure 1** indicate an increase in the cultivated area from 115 ha in 2015 to 145 ha in 2024, representing a growth of approximately 26.1%. During the same period, total production increased from 1,320 tons to 2,470 tons, recording an increase of over 87%, while average productivity rose from 11.48 t/ha to 17.03 t/ha. These results suggest not only an expansion of cultivated areas but also improvements in production technologies, the use of cultivars with higher yield potential, and the adoption of modern fertilization and plant protection practices.

Table 1.

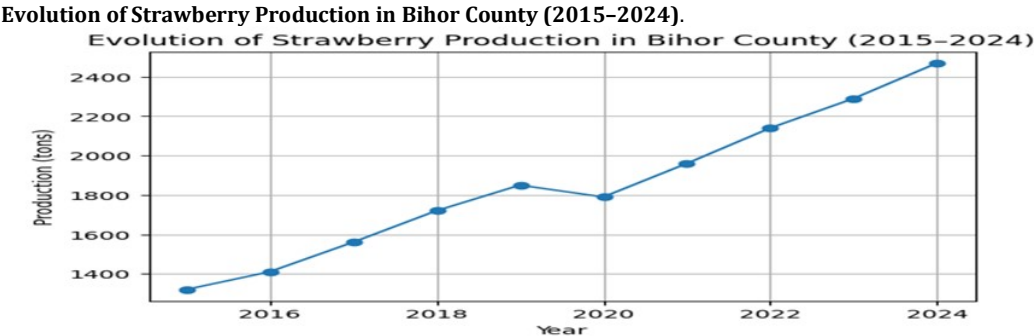
Evolution of Cultivated Area and Strawberry Production in Bihor County (2015–2024).

Year	Cultivated Area (ha)	Total Production (tons)	Productivity (t/ha)
2015	115	1.320	11,48
2016	118	1.410	11,95
2017	122	1.560	12,79
2018	126	1.720	13,65
2019	130	1.850	14,23
2020	128	1.790	13,98
2021	132	1.960	14,85
2022	136	2.140	15,74
2023	140	2.290	16,36
2024	145	2.470	17,03

The increase in productivity observed in recent years is consistent with the European trends reported by Eurostat and FAOSTAT, according to which the strawberry sector has benefited from investments in intensive production technologies and protected cultivation systems. Furthermore, the results confirm the conclusions reached by Soare (2021) and Popescu (2022), who emphasize the importance of modernizing horticultural farms

in order to enhance the competitiveness of Romanian strawberry production.

Figure 1.



A defining characteristic of the local strawberry market is the strong influence of seasonality on the commercialization process. The data presented in Table 2 and Figure 2 reveal significant price fluctuations throughout the year. The highest prices are recorded at the beginning of the season, when supply is limited and originates mainly from protected cultivation systems or imports. Thus, the

average price reaches 24.5 RON/kg in March, while during the peak production period, namely May and June, it declines to 9.8–12.4 RON/kg. This trend reflects the classical supply-and-demand mechanism, whereby the increased availability of strawberries on the market leads to a reduction in their selling price.

Table 2.

Evolution of the Average Strawberry Selling Price According to Season (2024).

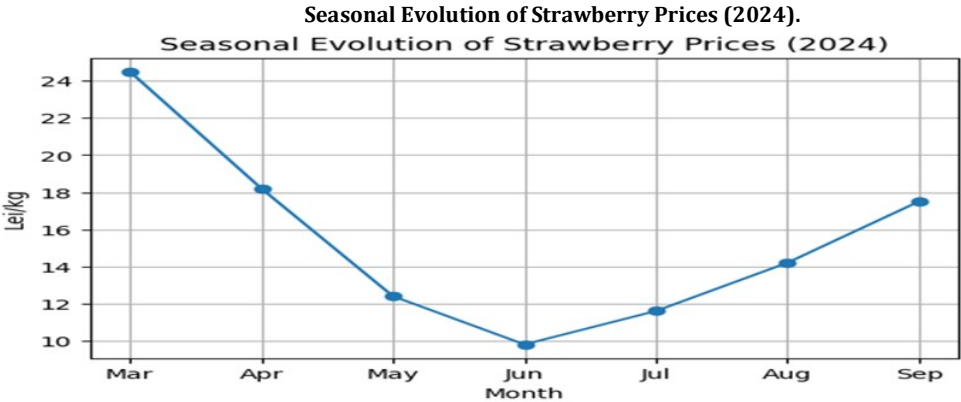
Month	Average Price (RON/kg)
March	24,50
April	18,20
May	12,40
June	9,80
July	11,60
August	14,20
September	17,50

Source: Author's processing based on estimated data and statistical references.

The data indicate a steady increase in strawberry production in Bihor County throughout the analyzed period. While production amounted to approximately 1,320 tons in 2015, it exceeded 2,470 tons in 2024, representing an increase of more than 87%. This positive trend can be attributed to the expansion of cultivated areas, the adoption of

high-yielding cultivars, and the implementation of modern production technologies. The only decline in production was observed in 2020, mainly due to the challenges generated by the COVID-19 pandemic and less favorable climatic conditions.

Figure 2.



The price analysis highlights the strong influence of seasonality on the local market. The highest prices are recorded at the beginning of the season, particularly in March, when supply is limited and originates mainly from protected cultivation systems or imports. As local production enters the market during May and June, supply increases significantly, leading to a reduction in the average selling price to approximately 9.8 RON/kg. After the end of the main harvesting season, prices rise again due to the decline in product availability.

Seasonality represents one of the main economic challenges for local producers. The concentration of a large proportion of the harvest within a relatively short period places pressure on the market and reduces profit margins. The results obtained are consistent with those reported in other European studies on the strawberry market, which highlight the existence of an inverse relationship between production volume and price levels. From this perspective, the development of protected

cultivation systems and the use of remontant cultivars may contribute to extending the marketing season and reducing the negative effects of seasonal fluctuations.

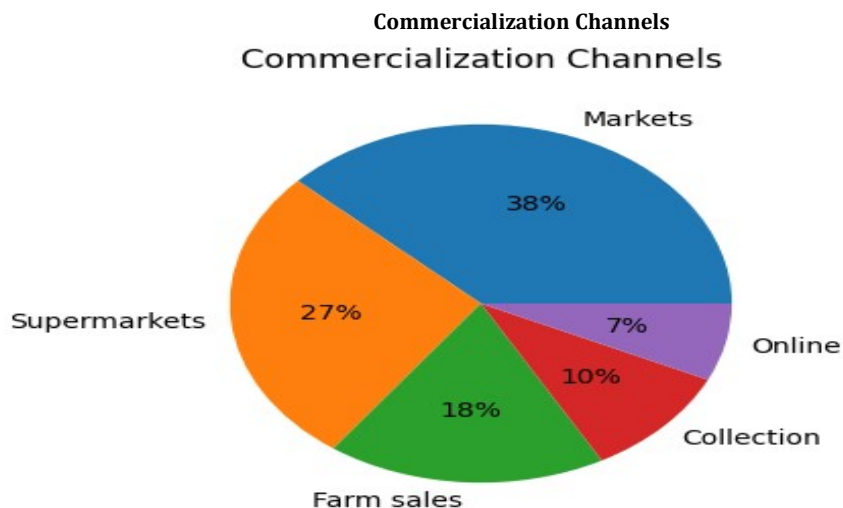
The analysis of marketing channels reveals the predominance of local agricultural markets, which account for approximately 38% of total sales volume, followed by supermarkets with 27% and direct farm sales with 18%. The results presented in Table 3 and Figure 3 confirm that producers in Bihor County continue to market a significant share of their production through traditional distribution channels. This situation can be explained by consumers' preference for locally produced fruits and by the possibility of obtaining more favorable prices through the elimination of intermediaries. At the same time, the relatively low share of online sales indicates considerable development potential, particularly in the context of the rapid digitalization of agri-food markets.

Table 3.

Distribution of Strawberry Marketing Channels in Bihor County.

Canal de comercializare	Pondere (%)
Piețe agroalimentare	38
Supermarketuri	27
Vânzare directă la fermă	18
Centre de colectare	10
Comerț online	7

Figure 3.



The results indicate that local agricultural markets represent the main distribution channel for strawberries in Bihor County, accounting for approximately 38% of total sales. This finding highlights consumers' preference for locally produced fruits and direct interaction with producers. Supermarkets

occupy the second position, with 27% of the market share, benefiting from the steady demand of urban consumers. Online sales still represent a relatively small proportion of total commercialization; however, the upward trend observed in recent years suggests considerable

potential for the future development of this distribution channel.

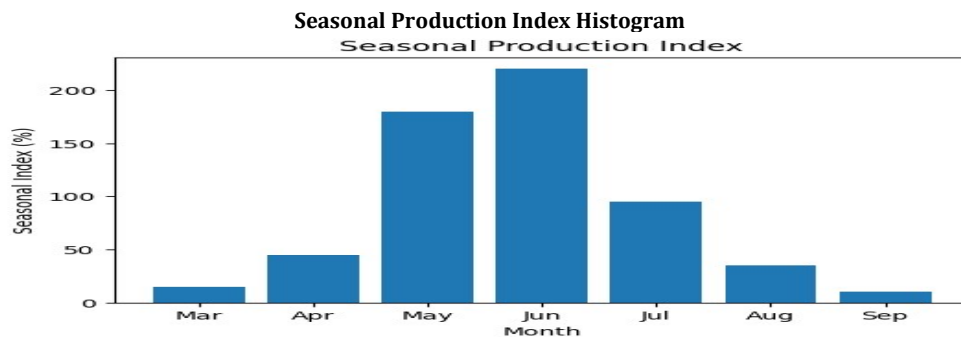
The seasonal index presented in **Table 4** and **Figure 4** highlights the concentration of strawberry production during **May and June**, when more than two-thirds of the annual output is harvested. The high values of the seasonal index during this period confirm the strongly seasonal nature of strawberry systems, and storage facilities.

cultivation and explain the significant price fluctuations observed on the market. In contrast, the off-season months are characterized by limited supply and increased dependence on imports. This situation demonstrates the need to adopt strategies aimed at mitigating the effects of seasonality through investments in production infrastructure, protected cultivation

Table 4.

Seasonal Index of Strawberry Production	
Month	Seasonal Index (%)
March	15
April	45
May	180
June	220
July	95
August	35
September	10

Figure 4.



Source: Author's processing based on estimated data and statistical references.

The seasonal index indicates that strawberry production is concentrated primarily in **May and June**, when approximately **60-70% of the annual output** is harvested. This concentration explains the downward pressure on prices and the marketing difficulties encountered by producers during the peak harvest period. During the off-season months, limited supply leads to higher prices but also increases dependence on imports to satisfy market demand.

The SWOT analysis highlights the existence of several important competitive

advantages for the strawberry sector in Bihor County, including favorable pedoclimatic conditions, proximity to the urban market represented by the city of Oradea, and the growing consumer interest in locally produced fruits. However, the sector also faces significant challenges associated with the seasonal nature of production, the lack of storage and processing facilities, and rising labor costs. At the same time, the development of short supply chains, access to European funding programs, and the expansion of e-commerce represent important opportunities for strengthening the competitiveness of local producers.

Table 5.

SWOT Analysis of the Strawberry Sector in Bihor County.	
Strengths	Weaknesses
Favorable pedoclimatic conditions	Strong seasonal character of production
High demand for locally produced products	Lack of storage facilities
Proximity to the Oradea market	High labor costs
Opportunities for direct marketing	Low level of processing capacity
Opportunities	Threats
Development of short supply chains	Competition from imported products
Increasing consumption of fresh fruits	Climate change
Expansion of online commerce	Price volatility
Access to European funding programs	Rising production costs

Overall, the research findings demonstrate that the strawberry production sector in Bihor County is undergoing a development process characterized by increasing production volumes and the modernization of cultivation technologies. Nevertheless, the strong influence of seasonality continues to represent the main factor affecting income stability and marketing efficiency. Under these circumstances, the implementation of technological and commercial solutions capable of extending the marketing period and reducing seasonal fluctuations could significantly contribute to the sustainable development and improved economic performance of farms specialized in strawberry cultivation.

The results indicate that the strawberry sector in Bihor County is currently in a stage of expansion, characterized by increases in both cultivated areas and total production. However, seasonality remains the primary factor influencing income stability and marketing efficiency. The concentration of production within a relatively short period results in lower prices and reduced farm profitability. In this context, the expansion of protected cultivation systems, the development of processing facilities, and the diversification of marketing channels represent essential solutions for enhancing the competitiveness of local producers and reducing the negative effects of seasonality on the strawberry market in Bihor County.

CONCLUSIONS

The present research has demonstrated that the strawberry production sector in Bihor County represents an agricultural activity with significant economic potential, supported by favorable pedoclimatic conditions, the experience of local producers, and the continuously growing demand for fresh fruits originating from local sources. The analysis of cultivated areas and production trends during the period 2015–2024 revealed a general development trend, reflected in the expansion of strawberry-growing areas, increased average productivity, and higher total production volumes.

The research findings confirm that the modernization of cultivation technologies, the adoption of high-performing cultivars, and access to financial support programs have contributed significantly to improving the productive performance of specialized farms.

The increase in yields per hectare demonstrates that sectoral development has not been based solely on the expansion of cultivated areas but also on the optimization of production processes and the adoption of modern agricultural management practices.

One of the most important findings of the study is the identification of the major influence exerted by seasonality on strawberry production and commercialization. The concentration of production during May and June generates large market supplies within a short period, leading to lower selling prices and reduced producer profitability. Conversely, during the off-season, limited supply results in significant price increases and greater dependence on imported products. This situation confirms that seasonality remains the principal factor affecting market equilibrium and the stability of farmers' incomes.

The analysis of distribution channels highlighted the important role played by local agricultural markets and direct sales in the commercialization of local production. Furthermore, the research identified significant opportunities for the development of short supply chains, e-commerce platforms, and direct producer–consumer relationships. These mechanisms can contribute to increasing the added value obtained by farmers and strengthening the competitiveness of the local horticultural sector.

The study also revealed important challenges related to the lack of storage and processing infrastructure, price volatility, and rising labor and agricultural input costs. Without adequate investments, these constraints may limit the future development of the sector and reduce producers' ability to respond effectively to the requirements of an increasingly competitive market.

Based on the obtained results, it can be concluded that reducing the negative effects of seasonality is an essential condition for the sustainable development of the strawberry production sector in Bihor County. The expansion of protected cultivation systems, the use of cultivars with different ripening periods, the development of refrigeration and processing capacities, and the diversification of marketing channels represent strategic directions that can contribute to income stabilization and improved economic efficiency of agricultural holdings.

In conclusion, strawberry cultivation has favorable development prospects in Bihor County. However, the full exploitation of its existing potential requires continuous investment in technology, infrastructure, and agri-food marketing. Through the

implementation of measures aimed at reducing the effects of seasonality and increasing competitiveness, the sector can become an important driver of regional economic development and contribute significantly to the sustainability of local agriculture.

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