

STUDY ON THE ROMANIAN GARLIC MARKET FROM 2010 TO 2023

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Abstract

The study presents the main trends on Romanian garlic market from 2010 to 2023. The indicators analyzed were collected from domestic and international databases and they are: the cultivated area, total garlic production, average production per hectare, basic price, average growth rate of indicators and the trade balance also (import, export). Based on these data, the average of the period, standard deviation and coefficient of variation were calculated. The analysis highlighted that the area cultivated with garlic has continuously decreased, the decrease being -31.6% in 2023 compared to 2010. Also, total production of garlic decreased with 31.8% in 2023 compared to 2010. The annual growth rate was negative for all indicators, the reasons being both economic (price fluctuations, high costs with the inputs, etc) and technological (lack of planting material, temperature fluctuations, diseases and pest attack). Regarding the average price of garlic in Romania, in 2023 it reached the value of 18.8 lei/kg, registering an increase of 48.38% compared to 2010. The trade balance was negative for the entire period both in value and quantity. The results obtained from the research can contribute to the consolidation of the production and marketing strategies for the crop of garlic in Romania.

Key words: *Allium sativum*, cultivated area, production, annual growth rate, trade, Romania

INTRODUCTION

Garlic is a species belonging to *Liliaceae* family and has been cultivated for thousands of years for its culinary and medicinal properties. This species belongs to the genus *Allium*, it is the second most widespread after onion (*Allium cepa* L.) of the 750 known species of this genus [1]. The adaptability of garlic in agriculture, culinary uses, cosmetics, production of nutraceuticals or in biological pest control, underscores its importance as a valuable crop [24]. It is one of the most abundant sources of total phenolic compounds among frequently consumed vegetables and has been highly regarded in terms of the contribution of phenolic compounds to the human diet [14]. Garlic is also rich in vitamins (Vitamin C), antioxidants, flavonoids and minerals [8]. In addition, garlic and its bioactive components have antioxidant, antimicrobial, antifungal, anti-inflammatory properties [4, 21]. According to some studies, garlic notably decreases the risk of developing

cardiovascular conditions, obesity, diabetes or cholesterol [5, 13]. Moreover, garlic and its bioactive compounds are seen as potential functional foods or nutraceuticals for preventing and treating various diseases [21]. Mainly, garlic production is used fresh, dehydrated or after processing in the form of oil, extract or powder.

Global garlic consumption grew steadily from 2009 to 2016 by +3.2% per year, reaching 26,5 million tons in 2016 and is estimated to exceed 31.1 million tons by 2025 [11]. China is the global leader in garlic consumption per capita with 14.3 kg per person per year, followed by Korea (6.2 kg/person), Bangladesh (2.6 kg/person), Russia (2.2 kg/person), Indonesia (1.8 kg/person), Brazil (1.5 kg/person) and India (1.1 kg/person) [20].

In Romania, between 2015 and 2020, the consumption of agrifood products for fruits and vegetables is in decline for potatoes, cereals and other products, reflecting the fact that the population is oriented towards a healthier diet [18]. Average annual

consumption of vegetables per capita increased by + 6.28%, from 182.9 kg in 2014 to 194.4 kg in 2020 [19].

In 2017, garlic consumption in Romania was 43,603 tons/year, respectively annual garlic consumption/capita representing 2.2 kg [3]. China is also the largest producer, exporter and consumer of garlic in the world [23]. After China, the major garlic producing countries are India, Bangladesh, South Korea, Egypt, Spain, Uzbekistan, Ukraine and Myanmar [6]. In countries like China, India, Egypt and Spain which are global garlic producers, production decreased from 67,215 t in 2010 to 27,259.2 t in 2020 [17].

Romania holds an important place in garlic production in the European Union [10], so that according to an EC report in 2018, production in Romania was 28,770 tons, ranking third in the EU after Spain and Italy [21]. However, the national area cultivated with garlic decreased 2.46 times in 2020 compared to 2010, and garlic production decreased from 67,215 t in 2010 to 27,259 t in 2020 [17].

Spain plays a significant role as an exporter to European Union countries and the United States. This is due to the varieties protected by designations of origin which have enabled it to secure a strong position in these competitive markets, where there is a high demand for quality and traceability [25].

The Romanian garlic crop has a high economic potential, being in great demand on the market, the population preferring its taste and aroma [1]. This species occupies a special place in the traditional agricultural system in Romania due to its adaptation to climatic conditions, consumer preference in food or its medicinal properties.

In order to ensure a continuous market for garlic, the Ministry of Agriculture and Rural Development decided to grant “minimis” starting with 2019 in the amount of 1,000 euros, which was insufficient for the expenses related to the technology of obtaining garlic, which imposed an increase in value to 3,000 euros per hectare cultivated with garlic starting with 2020 [2]. From this point of view, producers’ interest in this crop has increased in recent years with financial support offering higher profits. Garlic cultivation requires

financial and human working capital, educating producers about the specific requirements of garlic cultivation for the profitability of the crop [1, 12, 5].

The general purpose of the research was to analyze the trend in the garlic market at the national level and by region in terms of area, production and trade balance during the period 2010-2023.

MATERIALS AND METHODS

In order to conduct the research, statistical data for the period 2010-2023 were collected from the National Institute of Statistics and TradeMap, based on which the following indicators were analyzed: cultivated area, total production (t), price, export (t and thousands \$), import (t and thousands \$) and trade balance.

The data were processed in Excel, calculating descriptive statistics (mean, standard deviation, coefficient of variation) and annual growth rate.

The results obtained are presented in tables and figures.

The standard deviation indicates how much the values are dispersed from the mean.

The codified indicators used in the presentation of the descriptive statistics are:

σ = standard deviation;

x_i = values of the data series over a number of years;

n = number of years considered.

Coefficient of variation:

$C = \sigma / \bar{X} * 100$. Its values can be between 0 and 100%.

Between 0-10% indicates a higher degree of homogeneity of the series, between 10-20% is medium variation; over 20% - high variation.

Annual growth rate indicates the annual increase of the analyzed indicator:

$R (\%) = \frac{(\text{Ending Value} \div \text{Beginning Value})^{(1 \div \text{Number of Periods})} - 1}{1}$

RESULTS AND DISCUSSIONS

The evolution of garlic cultivated areas in Romania during 2010-2013 indicates a decreasing trend, recording total average figures of 12,803 ha in 2010 and just 8,713 ha in 2023, representing a decline of 31.6%. These figures show that Romania has relatively small areas dedicated to garlic cultivation compared to the leading global producers.

Analyzing the cultivated area by development regions in Romania throughout the analyzed timeframe, it is evident that in the North-East Region the indicator had higher average values (2,614.714 ha), followed by South-Muntenia with 1,747.857 ha and South-West Oltenia with 1,728.143 ha, and the opposite pole with small areas were Bucharest-Ilfov Region with 244.5 ha and Center with 763 ha (Table 1).

In 2023, it is noted that all regions recorded decreases compared to 2010, the largest decrease was recorded in Bucharest-Ilfov Region of -63.3%, and in 2023 compared to 2022 the decrease was -17.6 %, in South-East Region.

Regarding the North-East Region, it was the only one that recorded in 2023 an increase but insignificant of only 0.04% compared to 2022 (Table 2).

In 2018, the Romanian Government implemented the scheme "De minimis aid for the implementation of the garlic production support program" to cover the expenses related to the applied technology, however, no positive effects were identified regarding the cultivated areas, which have been decreasing in recent years.

Table 1. Area cultivated with garlic by development regions in the period 2010-2023 (thousand hectares)

Development regions	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023
NORTH-WEST	1,087	1,135	929	939	931	924	913	918	927	932	921	928	805	783
CENTER Region	757	725	683	758	775	990	899	847	848	848	709	700	572	572
NORTH - EAST	3,119	3,013	2,984	2,738	2,698	2,618	2,464	2,467	2,660	2,502	2,494	2,444	2,202	2,203
SOUTH-EAST Region	1,232	1,171	1,292	1,021	1,007	980	1035	889	903	899	895	870	1,106	911
SOUTH-MUNTENIA	2,313	2,183	1,833	1,792	1,831	1,824	1,580	1,578	1,586	1,582	1,501	1,672	1,608	1,587
BUCHAREST - ILFOV	434	382	323	285	286	285	209	179	178	182	169	184	169	159
SOUTH-WEST OLTENIA	2,367	2,067	1,873	1,665	1,755	1,744	1,693	1,688	1,681	1,679	1,470	1,618	1,460	1,434
WEST	1,494	1,452	1,450	1,418	1,420	1,413	1,418	1,408	1,413	1,406	1,379	1,153	1,064	1,064
TOTAL	12,803	12,128	11,367	10,616	10,703	10,778	10,211	9,974	10,195	10,029	9,539	9,569	8,986	8,713

Source: NIS - TEMPO Online, Accessed on 20.01.2025, [26].

Regarding the statistical analysis of the data for the cultivated area during the period 2010-2023, it is found that the standard deviation from the average had values ranging between 88.6 in Bucharest – Ilfov and 247.0 in South-West Oltenia, and the coefficient of variability was between 9.58% and 15.3% for the majority of regions, which indicates an average variation, and a high variability of 36.2% in Bucharest – Ilfov Region.

Annual growth rate for the area cultivated registered negative values for all development regions, the values being between -1.98% in Center Region and -6.92% in București-Ilfov Region (Table 2).

Regarding the total garlic production, throughout the dynamic series, a downward evolution is observed in all regions.

Thus, during the period 2010-2023, the average total garlic production in Romania recorded values of 67,215 thousand tons in

2010 when the highest production was recorded and in 2023 it decreased to 45,801 thousand tons, when it was recorded the lowest

production, representing a decrease of -31.8% (Table 3).

Table 2. Descriptive statistics regarding area cultivated with garlic in the period 2010-2023

Development regions	2023/2010 (%)	2023/2022 (%)	MIN.	MAX.	Average	Standard deviation	Coefficient of variation (%)	Annual growth rate (%)
NORTH-WEST	-27.9	-2.7	913	1135	933.7	89.5	9.58	-2.32
CENTER	-24.4	0	572	990	763.0	117.4	15.38	-1.98
NORTH -EAST	-29.3	0.04	2,202	3,119	2,614.7	279.3	10.68	-2.45
SOUTH-EAST	-26.0	-17.6	870	1,232	1,015.0	137.6	13.55	-2.13
SOUTH-MUNTENIA	-31.3	-1.3	1,501	2,313	1,747.8	240.7	13.77	-2.65
BUCHAREST – ILFOV	-63.3	-5.9	159	434	244.5	88.6	36.2	-6.92
SOUTH-WEST OLTENIA	-45.6	-1.78	1,434	2,367	1,728.1	247.0	14.29	-3.52
WEST	-28.7	0	1,064	1,494	1,353.7	144.8	10.69	-2.40
TOTAL	-31.6	-3.03	8,713	12,803	10,400.7	168.1	10.88	-2.71

Source: Own calculation.

By region, it is found that in the North-East was produced the largest quantity of garlic, the average being 14,818.8 thousand tons, and the minimum production was registered in 2023 of 11,215 thousand tons and the maximum was reached in 2011 of 17,130 thousand tons. Additionally, during the period under review,

the South-Muntenia Region achieved a notable average production of 10,044.6 thousand tons followed by the South-West Oltenia Region, with 9,850.3 thousand tons. West, North-West, Center, South-East and Bucharest-Ilfov Regions had a smaller contribution, ranging between 1,368.7 and 7,543 thousand tons.

Table 3. Total garlic production by development region in the period 2010-2023 (thousand tons)

Development regions	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023
NORTH-WEST	6,017	6,298	5,410	5,856	5,740	5,784	5,479	5,599	5,645	5,611	5,955	6,355	4,938	4,432
CENTER	3,614	3,798	3,751	4,142	4,035	5,248	4,617	4,520	4,544	4,378	3,956	4,025	3,124	2,895
NORTH -EAST	14,928	17,130	15,551	15,934	16,378	16,253	12,962	13,968	14,755	13,330	16,626	16,348	12,086	11,215
SOUTH-EAST	6,155	6,375	6,324	5,563	5,352	5,380	5,114	4,775	5,133	4,883	5,657	5,570	5,461	4,666
SOUTH-MUNTENIA	13,040	12,293	9,479	10,953	11,122	11,004	8,926	8,938	9,364	9,000	8,724	10,184	9,256	8,342
BUCHAREST – ILFOV	2,517	1,733	1,359	1,948	1,639	1,634	911	822	841	822	1,410	1,488	1,098	940
SOUTH-WEST OLTENIA	13,287	10,705	10,015	9,576	10,503	10,577	9,483	9,495	9,670	9,245	8,836	9,961	8,534	8,018
WEST	7,657	8,270	7,479	8,184	8,004	8,260	6,897	7,556	8,023	7,593	9,978	6,670	5,738	5,293
TOTAL	67,215	66,602	59,368	62,156	62,773	64,140	54,389	55,673	57,975	54,862	61,142	60,601	50,235	45,801

Source: NIS - TEMPO Online, Accessed on 20.01.2025, [26].

The statistical analysis of the production data for the period 2010-2023 indicates an average variability in all regions except Bucharest-Ilfov Region where a variability coefficient of 36.7% is recorded, indicating a high variation.

The annual growth rate recorded negative values regarding the production for all development regions, with values between -1.57 in Center Region and -6.79 in Bucharest-Ilfov Region (Table 4).

Variations in total production can be influenced by numerous factors, such as change in cultivated area, applied technology, pedoclimatic conditions or increasing production costs, technology management, infrastructure or socio-economic conditions.

Table 4. Statistical indicators calculated for total garlic production in the period 2010-2023

Development regions	2023/2010 (%)	2023/2022 (%)	MIN.	MAX.	Average	Standard deviation	Coefficient of variation (%)	Annual growth rate (%)
NORTH-WEST	-26.3	-10.2	4,432	6,355	5,651.3	503.4	8.9	-2.16
CENTER	-19.9	-7.3	2,895	4,617	4,046.2	612.7	15.1	-1.57
NORTH - EAST	-24.8	-7.2	11,215	17,130	14,818.8	1,841.2	12.4	-2.02
SOUTH-EAST	-24.2	-14.5	4,666	6,375	5,457.7	541.0	9.9	-1.96
SOUTH-MUNTENIA	-36.0	-9.8	8,342	13,040	10,044.6	1,429.6	14.2	-3.14
BUCHAREST – ILFOV	-62.6	-14.3	822	2,517	1,368.7	503.0	36.7	-6.79
SOUTH-WEST OLTENIA	-39.6	-6.0	8,018	13,287	9,850.3	1,252.3	12.7	-3.54
WEST	-30.8	-7.6	5,293	9,978	7,543	1,155.1	15.3	-2.60
TOTAL	-31.8	-8.8	45,801	67,215	58,780.8	1,155.1	1.96	-2.70

Source: Own calculation.

Regarding the average production per hectare, there are oscillations from one year to another, the average values being between 5.22 t/ha in 2012 and 6.41 t/ha in 2020 (Table 5). The average production/ha in 2023 compared to 2010 registered a difference of 0.13%, being higher in the North-East Region by 6.36% and lower in the South-Muntenia Region -6.76% (Table 6).

Table 5. Average production/ha of garlic by development region during 2010-2023 (tons/ha)

Development regions	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023
NORTH-WEST	5.54	5.55	5.82	6.24	6.17	6.26	6.00	6.10	6.09	6.02	6.47	6.85	6.13	5.66
CENTER	4.77	5.24	5.49	5.46	5.21	5.30	5.14	5.34	5.36	5.16	5.58	5.75	5.46	5.06
NORTH -EAST	4.79	5.69	5.21	5.82	6.07	6.21	5.26	5.66	5.55	5.33	6.67	6.69	5.49	5.09
SOUTH-EAST	5.00	5.44	4.89	5.45	5.31	5.49	4.94	5.37	5.68	5.43	6.32	6.40	4.94	5.12
SOUTH-MUNTENIA	5.64	5.63	5.17	6.11	6.07	6.03	5.65	5.66	5.90	5.69	5.81	6.09	5.76	5.26
BUCHAREST – ILFOV	5.80	4.54	4.21	6.84	5.73	5.73	4.36	4.59	4.72	4.52	8.34	8.09	6.50	5.91
SOUTH-WEST OLTENIA	5.61	5.18	5.35	5.75	5.98	6.06	5.60	5.63	5.75	5.51	6.01	6.16	5.85	5.59
WEST	5.13	5.70	5.16	5.77	5.64	5.85	4.86	5.37	5.68	5.40	7.24	5.78	5.39	4.97
TOTAL	5.25	5.49	5.22	5.85	5.86	5.95	5.33	5.58	5.69	5.47	6.41	6.33	5.59	5.26

Source: NIS - TEMPO Online, Accessed on 20.01.2025, [26].

Garlic production/hectare in 2023 compared to 2022 was smaller in all regions except for South-East Region where an increase of 3.73% was recorded. Regarding the analysis of the calculated statistical indicators, values between 0.24 and 1.35 were recorded for standard deviation and for the coefficient of variation, values between 0.24% and 1.35%, indicating low variability. Regarding the annual growth rate, positive increases were observed in the North-West (0.16), Center (0.42), North-East (0.44), South-East (0.18) and Bucharest-Ilfov (0.14) while negative values were recorded in regions such as South-Muntenia (-0.50) and South-West Oltenia (-0.03) and West (-0.21) (Table 6). The demand for garlic is continuously increasing, the domestic market is expanding.

The choice of cultivars adapted to the growing conditions can contribute to significantly

improving production and increasing the long-term market competitiveness of this species.

Table 6. Descriptive statistics for garlic production /hectar in 2010-2023

Development regions	2023/2010 (%)	2023/2022 (%)	MIN.	MAX.	Average	Standard deviation	Coefficient of variation (%)	Annual growth rate (%)
NORTH-WEST	2.26	-7.73	5.54	6.85	6.06	0.35	0.35	0.16
CENTER	6.01	-7.33	4.77	5.75	5.31	0.24	0.24	0.42
NORTH-EAST	6.36	-7.25	4.79	6.69	5.68	0.57	0.57	0.44
SOUTH-EAST	2.52	3.73	4.89	6.40	5.41	0.47	0.47	0.18
SOUTH-MUNTENIA	-6.76	-8.68	5.17	6.11	5.75	0.29	0.29	-0.50
BUCHAREST – ILFOV	1.94	-9.01	4.21	8.34	5.71	1.35	1.35	0.14
SOUTH-WEST OLTENIA	-0.39	-4.34	5.18	6.16	5.72	0.28	0.28	-0.03
WEST	-2.94	-7.76	4.86	5.85	5.57	0.57	0.57	-0.21
TOTAL	0.13	-5.97	5.22	6.41	5.66	0.38	0.38	0.01

Source: Own calculation.

Garlic cultivars are quite diverse and have good adaptability to the environmental conditions in traditional areas [15]. For satisfactory garlic productivity, a permanent evaluation of the planting date is also needed, depending on the climatic changes in the growing area [9].

Garlic, being an essential minor agricultural product can have a significant impact on the livelihoods of industry stakeholders and consumers due to its price volatility [23]. Regarding the average price of garlic in Romania, in the analyzed period it was 12.67 lei/kg in 2010, reaching the value of 18.8 lei/kg in 2023. Figure 1 illustrates the trend of annual average garlic production prices in Romania, having an upward trajectory reflected by an increase of 48.38%.

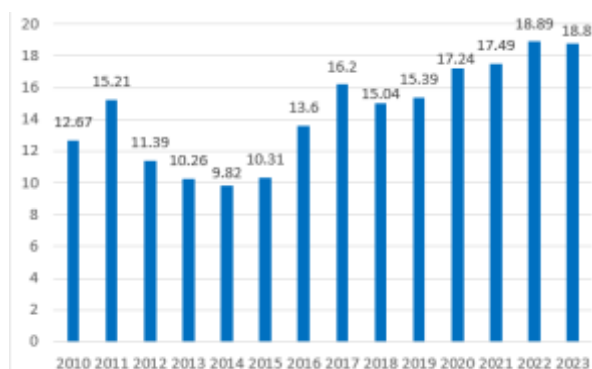


Fig. 1. Evolution of average annual prices for garlic production in Romania, 2010-2023 (lei/kg).

Source: Own design based on the data from [26].

International trade can affect all national economies, their dependence on the world market manifesting itself differently, depending on the country, both in terms of exports and imports [16]. From the data presented in Table 7, it is observed that from the total garlic quantity of 1,274,014 kg, the largest imported quantity of garlic in 2010 was from Netherlands (402,302 kg) which in the total structure of imports amounts to more than a third of total imports, followed closely by the Czech Republic with the volume being significantly lower in comparison to the Netherlands, of only 99,209 kg. Total imports in 2010 amounted 2,200,299 \$, representing a quantity of 1,274,014 kg.

In 2023, imported quantities increased significantly, reaching 6,307,323 kg and totaled a value of 13,165,376 \$. The main importing country was also the Netherlands, followed by Germany.

Table 7. Garlic import in Romania

Country	Trade Value(US\$)	Quantity (Kg)
2010		
World	2,200,299	1,274,014
Netherlands	1,366,308	402,302
Czechia	386,853	99,209
2023		
World	13,165,376	6,307,323
Netherlands	8,192,319	3,613,302
Germany	1,575,660	425,997

Source: <https://comtradeplus.un.org>, [26].

Massive imports of garlic for Romania have negatively influenced its valorization from domestic production. According to [1], the existence of inadequate conditions regarding conditioning and storage have caused difficulties in garlic trade, favoring imports. Some authors have stated that in order to increase productivity it is necessary to expand the crop by investing in modern farms and applying new cultivation technologies [12]. The trade balance was determined as a difference between the value of exports and imports. Romania registered a deficit in its trade balance for vegetables in the period 2010-2020, and the main species were tomatoes, cucumbers, potatoes, beans and garlic [22]. Regarding the trade balance with garlic from 2010 to 2023, it can be noted that there is deficit, imports to Romania being higher than exports, resulting in a deficit of -947,729 US\$ in 2010 up to -12,862,547 US\$ in 2023. According to the trendline, the trade balance decreased on average by approximately 334,435 US\$ per year (Figure 3).

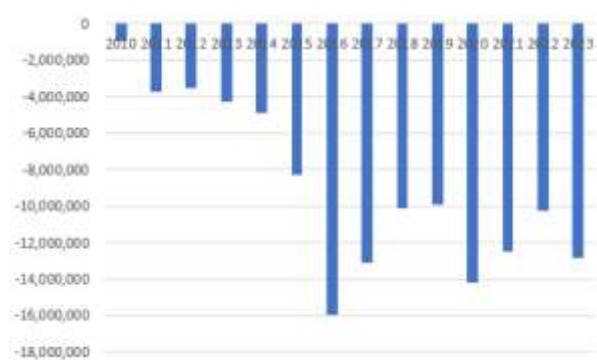


Fig. 3. Evolution of the trade balance in value with garlic in Romania, between 2010-2023 (US\$)

Source: Own design based on the data from [26].

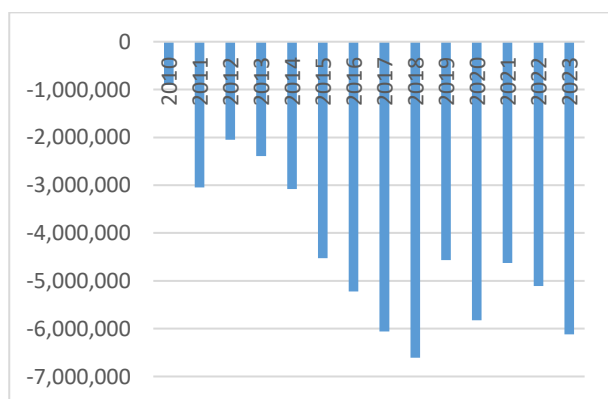


Fig. 4. Evolution of the quantitative trade balance with garlic in Romania, between 2010-2023 (Kg)

Source: Own design based on the data from [26].

According to the analysis of the quantitative trade balance, it is found that it is negative throughout the studied period. The trade deficit may also be due to the high selling price per unit of volume. Thus, the deficit increased from -906.691 kg in 2010 to -6,119,919 kg in 2023. The highest value was registered 2018, of -6,610,835 kg (Figure 4). An approach to correct the trade balance could involve enhancing yields per hectare, which may address the issues related to vegetable supply [22].

CONCLUSIONS

Throughout the analyzed period, 2010-2023, the following insights can be observed:

- The trend of garlic cultivation surfaces at national level registered a decline, with an average area of 12,803 ha in 2010 and only 8,713 ha in 2023, decreasing by approximately -31.6 %;
- The cultivated area in the development regions of Romania during the period under study was the largest in the North-East region and followed by South-Muntenia region;
- The total average garlic production in Romania recorded values between 67,215 thousand tons in 2010 when the highest production was recorded and 45,801 thousand tons in 2023, when the lowest production was recorded, which represents a decrease of -31.8%. Regarding the development regions, North-East and South-Muntenia registered greater average total yield per hectare;
- National garlic yield reached 6.41 t/ha in 2020, and at the level of development regions it was higher in the North-East and South;
- The production of garlic is also low due to the decrease of the surfaces during the period under study.
- The much negative growth rate was reflected in production instability;
- The greater instability recorded in production may also be due to the use of garlic varieties by farmers, with lower yields, inadequate cultivation practices and price volatility on the market;
- Production variability is the main component influencing price fluctuations, demand, import and export. Regarding the average price of

garlic in Romania, it indicates an upward trend, the average annual growth rate being 32.6%;
- The trade balance, both quantitative and value was in deficit throughout the analyzed period. In order to promote garlic production as a stimulating agricultural activity, it is necessary to improve cultivation technology, use genotypes with good adaptability to pedo-climatic conditions and provide further financial support, through national legislation, to farmers for obtaining higher profits.

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