

## AN OVERVIEW OF THE VEGETABLE SECTOR IN ROMANIA

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### Abstract:

*The paper analyses the surplus and production in the period 2010-2021 for total vegetables, field-grown vegetables, vegetables grown in glasshouses and greenhouses, vegetables from home gardens and the main vegetable species: potatoes, tomatoes, aubergines, peppers, dried onions, white cabbage. For these, the main statistical indicators were calculated on the basis of areas and yields, that is, standard deviation, coefficient of variation. Romania's place in the European Union in terms of area and production of the crops analysed was also identified. Thus, Romania is at the top of the ranking for the area cultivated with cabbage (19.45 thousand hectares), it ranks 2nd for the area cultivated with aubergines (4.94 thousand hectares) and peppers (10.37 thousand hectares), and 3rd for the area cultivated with tomatoes (18.13 thousand hectares). In terms of production, Romania ranks 3rd for the production of cabbage (548.3 thousand tonnes) and tomatoes (95.86 thousand tonnes). According to the coefficient of variation, for the production of vegetable crops, the variation of the data series is small and the annual rate is negative, except for vegetables grown in glasshouses (4.66%) and peppers (0.19%). For area, the annual rate is negative, except for vegetables grown in glasshouses (4.64%).*

**Keywords:** *Vegetables, statistical indicators, Romania*

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### Introduction

Among the global issues facing humanity are food security for the population and environmental protection. Efforts are now being made to improve people's mindsets and raise awareness that natural resources are finite (Brumă et al., 2021; Micu et al., 2022). Practice of organic farming systems can be solutions to these problems, and their role will help improve food security through survival. The importance of vegetables in nutrition is recognized by a multitude of studies, but today the consumption of animal protein is much higher than the consumption of plant protein, but globally the consumption of plant-based foods is increasingly promoted in order to change dietary patterns (Lădaru et al., 2020; Dumitru et al., 2021).

Global trade in vegetables makes a significant contribution in terms of added value, but in the chase for profit, the requirements for food security should not be neglected. At the onset of the COVID-19 pandemic, Romania restricted cereal exports to the EU in order to ensure food security (Constantin et al., 2022; Dumitru et al., 2022).

## 1. Literature review

According to Alboiu (2012) The dynamics of the agri-food chain and the process of globalisation have been spreading rapidly in recent years and have caused great changes in the supply chain of countries in transition, including Romania. Unlike producers in industrialised countries, who benefit from adequate infrastructure, efficient institutional systems and agricultural policies to promote and widely adopt good agricultural practices and environmental standards, producers in emerging economies may face serious difficulties in complying with quality standards.

According to Popescu, in his paper "Some considerations regarding the Romanian vegetable sector after accession to the European Union", he presents the situation of agriculture, namely, vegetables were grown in greenhouses on thousands of hectares, while after 2000 they were grown on hundreds of hectares, which indicates that in the cold season the need for vegetables cannot be covered, the only solution being imports.

In the paper „The evolution of the fruit and vegetable sector in Romania, in the current economic crisis" by Cîrstea (2013), Tudor (2022), the fruit and vegetable sector in Romania was analyzed to identify measures that can reduce the negative effects caused by the financial crisis. Using data collected from Faostat and Eurostat, statistical analyses of the data were carried out, which led to some important conclusions such as: the predominance of small farms, the areas cultivated with vegetables are fragmented and decreasing, the lack of management and marketing knowledge. Therefore, it is necessary to implement measures aimed at competitiveness and stabilisation of meadows and reduction of production costs (Bădan et al., 2007).

In the paper "Analysis of Romania's fruit and vegetable sector compared to other EU countries during the period 2007- 2018" the importance of the two sectors at the European level is presented, with an analysis of the production areas, imports, exports, and consumption. For the analysis, some indicators have been used to highlight the high potential of Romania. Although small farms are predominant and the level of technology is low, Romania in 2018 is fifth in terms of the area cultivated with vegetables compared to other EU countries.

According to Necula, the paper entitled „Ways to increase the vegetable production in Romania" highlighted the strategic role of vegetable farming for the national economy, but also for the population's diet. Ways of increasing production were identified, such as the use of appropriate and environmentally friendly methods leading to high yields and higher quality produce.

## Materials and methods

This research presents data provided by the National Institute of Statistics and Eurostat for the area and production of vegetables, field-grown vegetables, vegetables grown in glasshouses and greenhouses, fresh vegetables from home gardens, potatoes, tomatoes, aubergines, peppers, dried onions, and white cabbage. The main statistical indicators were analyzed on the basis of the data:

- Standard deviation

$$\sigma = \sqrt{\frac{\sum(x_i - \bar{x})^2}{n - 1}}$$

- Coefficient of variation

$$C = \frac{\sigma}{\bar{X}} * 100$$

- Growth rate

$$\bar{R} = (I \times 100) - 100.$$

The aim of the work is to identify where Romania ranks in 2021 for potato, tomato, aubergine, pepper, dried onion, white cabbage areas and yields compared to the other EU countries, and to determine the variation of data series and growth rates for the crops analysed. Future research directions include the analysis of foreign trade in vegetables and Romania's export potential for vegetables.

## 2. Experimental section

The total vegetable area in Romania recorded 262.7 thousand acres in 2010, reaching 197.7 thousand hectares in 2021, showing a decrease of 24% (Table 1).

**Table 1. Area of vegetable crops in Romania, 2010-2021 (thousand hectares)**

Culture	Year											
	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021
Total vegetable	262.7	263.4	258.9	259.0	239.5	239.5	228.1	224.6	226.3	227.7	200.5	197.7
Field-grown vegetables	159.4	161.4	157.6	153.8	136.8	138.9	131.2	128.6	129.9	132.4	106.7	106.5
Vegetables grown in glasshouses and greenhouses	2.5	3.5	3.3	3.4	4.0	4.0	4.2	4.0	4.5	4.4	4.3	4.2
Fresh vegetables from home gardens	92.4	89.7	88.4	93.2	90.0	88.3	86.0	85.6	85.4	84.0	86.9	84.1
Potatoes	241.3	242.6	223.5	203.4	198.5	191.8	182.2	167.4	169.3	170.1	98.5	84.4
Tomatoes	49.8	51.8	49.7	48.4	43.9	44.3	41.0	40.0	40.7	40.8	34.1	34.7
Aubergines	10.3	10.0	9.6	9.4	9.2	9.2	8.8	8.7	9.0	9.0	8.6	9.1
Peppers	21.0	20.0	19.9	19.5	18.2	18.4	18.0	17.7	18.0	18.7	17.2	18.3
Dried onions	33.8	33.1	33.1	32.2	30.3	31.2	30.3	30.0	30.3	30.3	29.2	29.3
White cabbage	47.0	47.0	49.1	54.9	47.8	48.7	46.2	46.2	47.3	47.2	37.6	38.0

Source: INS data

As regards the area of vegetables grown in the field and those grown in solariums, the average area of vegetables grown in the field is 136.9 thousand hectares, which is significantly higher than that grown in solariums, 3849.5 hectares (Table 1). The annual rate for vegetables grown in the field is negative (3.6%) while the annual rate for crops grown in glasshouses is positive (4.64%) (Table 2). The area under potatoes varies between 84.4 thousand hectares (2021) and 242.6 thousand hectares (2011), the average for the period being 181 thousand hectares. According to the coefficient of variation (0.27%), the data series shows a medium variation and the growth rate is negative, -9.11% (Table 2). In the case of tomatoes, the area showed limits between 34115 hectares (2020) and 51754 hectares (2011), with an average of 43262.42 hectares. The coefficient of variation is 0.13%, showing a small variation of the data series, and the annual rate is negative (-3.21%) (Table 2).

The average area under aubergines in Romania in the period 2010-2021 was 9233.75 hectares, varying between 8576 hectares (2020) and 10315 hectares (2010), presenting a negative growth rate (-1.13%). In the case of areas under peppers, they varied between 17188 hectares (2020) and 21005 hectares (2010), with a period average of 18745.5 hectares. The

coefficient of variation is 0.6%, indicating a small variation in the data series, and the annual rate is negative (-1.26%). Dry onions show an average area over the period 2010-2021 of 31097.67 hectares and a negative annual rate (-1.32%). The area of white cabbage ranges from 37626 hectares (2020) to 54907 hectares (2013), with a negative annual rate (-1.93%) (Table 2).

**Table 2. Main technical indicators for the area of vegetable crops in Romania, 2010-2021**

Statistical Indicators	Minimum	Maximum	Average	Standard deviation	Coefficient of variation %	Growth rate %
Total vegetable	84.402	242.636	167.24	49.32	0.29	-2.55
Field-grown vegetables	106.491	161.355	136.93	18.65	0.14	-3.6
Vegetables grown in glasshouses and greenhouses	2.545	4.461	3.85	0.56	0.15	4.64
Fresh vegetables from home gardens	84.032	93.181	87.83	3.04	0.03	-0.85
Potatoes	84.402	242.636	181.10	49.32	0.27	-9.11
Tomatoes	34.115	51.754	43.26	5.77	0.13	-3.21
Aubergines	8.576	10.315	9.23	0.52	0.06	-1.13
Peppers	17.188	21.005	18.75	1.12	0.06	-1.26
Dried onions	29.201	33.842	31.10	1.58	0.05	-1.32
White cabbage	37.626	54.907	46.43	4.65	0.10	-1.93

Source: own calculations based on INS data

The total production of vegetables shows fluctuations in the period 2010-2021, thus in 2021 Romania produced 3495.1 thousand tons of vegetables, down by 9.5% compared to the quantity produced in 2010 (3863.6 thousand tons). Regarding the vegetables grown in the field and in the garden, it can be seen that the production of vegetables grown in the field is much higher than the production of vegetables grown in greenhouses and In the garden; in 2021, the production of vegetables grown in the field was 2194 thousand tonnes, while the production of vegetables grown in the garden was 149.5 thousand tonnes (Table 3).

**Table 3. Production of vegetable crops in Romania, 2010-2021 (thousand tonnes)**

Culture	Year											
	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021
Total vegetable	3,863.6	4,176.3	3,535.3	3,961.0	3,802.5	3,673.5	3,358.4	3,638.4	3,797.4	3,529.6	3,483.0	3,495.1
Field-grown vegetables	2,388.8	2,753.1	2,374.0	2,594.4	2,479.1	2,336.9	2,110.1	2,317.5	2,438.2	2,239.4	2,170.8	2,194.0
Vegetables grown in glasshouses and greenhouses	90.5	124.6	98.2	112.2	152.6	170.3	186.0	175.7	197.1	162.7	153.8	149.5
Fresh vegetables from home gardens	1,384.4	1,298.6	1,063.2	1,254.4	1,170.7	1,166.3	1,062.3	1,145.2	1,162.2	1,127.5	1,158.4	1,151.7
Potatoes	3,283.9	4,076.6	2,465.2	3,289.7	3,519.3	2,699.7	2,689.7	3,116.9	3,022.8	2,626.8	1,601.2	1,397.8
Tomatoes	768.5	911.0	683.3	749.1	706.2	701.8	627.2	679.8	742.9	689.4	745.7	753.4
Aubergines	144.4	160.0	126.0	123.3	127.6	128.4	116.2	127.8	137.8	129.0	138.2	143.5
Peppers	243.5	253.5	207.1	227.7	228.6	226.3	201.9	226.5	229.7	223.3	230.8	248.7
Dried onions	369.1	394.3	345.3	391.8	387.0	360.8	325.1	352.2	350.2	340.6	373.0	357.2
White cabbage	981.2	1,025.3	987.9	1,156.4	1,123.1	1,078.0	992.4	1,026.6	1,065.5	985.8	915.2	920.0

Source: INS data

The total vegetable production showed annual variations between 3358389 tonnes (2016) and 4176298 tonnes (2011), with an average of 3408790.46 tonnes. The coefficient of variation was 0.07%, which indicates a small variation in the data, and the annual rhythm showed negative values (-0.91%). The crops grown in the field, showed an average production of 2366345.75 tons and a negative annual rhythm (-0.77). In the case of vegetable production grown in solariums, the average for the period was 147776.25 and the annual rhythm showed positive values (4.66%) (Table 4).

**Table 4. Main Technical Indicators for Vegetable Crop Production in Romania, 2010-2021**

Statistical Indicators	Minimum	Maximum	Average	Standard deviation	Coefficient of variation %	Growth rate %
Total vegetable	3,358.389	4,176.298	3,408.7905	235,008.31	0.07	-0.91
Field-grown vegetables	2,110.074	2,753.054	2,366.3458	184,140.01	0.08	-0.77
Vegetables grown in glasshouses and greenhouses	90.534	197.064	147.77625	34,386.35	0.23	4.66
Fresh vegetables from home gardens	1,062.294	1,384.389	1,178.7418	92,773.55	0.08	-1.66
Potatoes	1,397.835	4,076.57	2,815.7988	75,8918	0.27	-7.47
Tomatoes	627.177	910.978	729.85617	69,964.92	0.1	-0.18
Aubergines	116.225	160.01	133.51942	11,813.96	0.09	-0.06
Peppers	201.881	253.505	228.957	14,977.95	0.07	0.19
Dried onions	325.074	394.305	362.21467	21,506.15	0.06	-0.3
White cabbage	915.246	1,156.436	1,021.4598	73,963.11	0.07	-0.58

*Source: own calculations based on INS data*

The lowest potato production in Romania was obtained in 2021 (1397835 tons) and the highest production in 2011 (4076570 tons), presenting an annual average of 2815798.83 tons and a negative annual rate (-7.47%). The average tomato production in the period 2010-2021 was 729856.17 tonnes and the annual rate was negative (-0.18%). The production of aubergines in Romania showed annual variations between 116225 tonnes (2016) and 160010 tonnes (2011) and an annual average of 133519.42 tonnes. The coefficient of variation was 0.09%, which indicates a low variation of the data series, and the annual rate presented negative values, -0.06%. The average production of dried onions in the period under analysis was 362214.67 tons, the value of the coefficient of variation presented a value of 0.06% and the annual rhythm was negative (-0.3%). The average production of white cabbage was 1021459.75 tons, with limits between 915246 tons (2020) and 1156436 tons (2013). The value of the coefficient of variation of 0.07% and the annual rhythm represented negative values (0.58%) (Table 4).

In the European Union, in terms of the area cultivated with fresh vegetables, Romania ranks 6th with an area of 113.15 thousand hectares, being ahead of countries such as Italy (413.86

thousand hectares), Spain (396.57 thousand hectares), Poland (172.9 thousand hectares). It is worth mentioning that Romania ranks first in the EU with 19.45 thousand hectares cultivated with cabbage, beating countries such as Poland (14.6 thousand hectares), Germany (8.68 thousand hectares), Serbia (7.48 thousand hectares).



**Figure 1. Romania's position in terms of area under vegetables in the European Union in 2021**

*Source: Own representation based on Eurostat data*

In 2021, Romania ranked 6th in terms of area under fresh vegetables, totalling 113.11 thousand hectares. In terms of area under cabbage, Romania ranks first with an area of 19.45 thousand hectares, followed by countries such as Poland (14.6 thousand hectares), Germany (8.68 thousand hectares), Serbia (7.48 thousand hectares).

In the case of eggplant and pepper cultivation, Romania ranked second in Europe with an area of 4.94 thousand hectares, that is, 10.37 thousand hectares in 2021. The tomato area in Romania was 18.13 thousand hectares in 2021, ranking third in the European Union in terms of tomato area. For the onion-cultured area, Romania ranked 6th with an area of 16.33 thousand hectares, and for the potato-cultured area, Romania ranked 7th (85.53 thousand hectares) (Figure 1).



**Figure 2. Romania's position for vegetable production at EU level in 2021**

*Source: Own representation based on Eurostat data*

Romania produced 548.3 thousand tonnes of cabbage in 2021, ranking 3rd in terms of production at EU level. In addition, in the case of aubergine production, Romania ranked the same with 95.86 thousand tonnes of aubergines. For the production of peppers and onions, Romania ranked 7th with 154 thousand tonnes of peppers and 2185.5 tonnes of onions. The eighth place was achieved in the production of potatoes (1.4 million tonnes) and tomatoes (500,000 tonnes) (Figure 2).

### Conclusions

Romania ranks first in terms of cabbage area, second in terms of area under aubergines and pepper area, third in terms of area under tomatoes, sixth in terms of onions and seventh in terms of potatoes in 2021 at EU level. In terms of production, Romania ranks third in terms of aubergine and cabbages, seventh in terms of peppers and onions, and eighth in terms of tomatoes and potatoes.) Analysing the main technical indicators for the area of vegetable crops, the average area of vegetables cultivated in the field and in solariums is 136.9 thousand hectares, which is significantly higher than the average area of vegetables cultivated in solariums, 3849.5 hectares. The annual rate for vegetables grown in the field is negative (3.6%) while the annual rate for crops grown in solariums is positive (4.64%). For the vegetable crops analysed, i.e. potatoes, tomatoes, aubergines, peppers, dried onions and white cabbage, the coefficient of variation shows values below 10%, which indicates a low variation in the data series, except for the potato, which shows a medium variation. In the

case of vegetable crop production, the variation of the data series is low and the annual rate shows negative values, except for vegetables grown in glasshouses (4.66%) and peppers (0.19%).

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