

## THE INFLUENCE OF THE YIELD OF THE MAIZE HARVEST ON THE PROFITABILITY OF FARMS

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### **Abstract**

*The profitability of maize cultivation depends on the production yield of this crop. This paper presents the analysis of the yield and profitability of maize cultivation in three crop farms of different sizes in Romania. From the analysis carried out, a number of results are obtained, which lead to the conclusion that in order to reach the profitability threshold, the production in the 60 ha farm would have to be at least 133.26 tons of maize in 2019, at least 85.83 tons of maize in 2020, and at least 165.56 tons of maize in 2021; in the 600 ha farm, the production in 2019 would have to be at least 2.350.23 tons of maize in 2019, 2,198.44 tons of maize in 2020, and 3,172.33 tons of maize in 2021; and in the 3,000 ha farm, the production should have been at least 4,157.75 tons of maize in 2019, 4,424.70 tons of maize in 2020, and 6,284.46 tons of maize in 2021. These productions were made only by the farm of 3,000 ha, which had a constant profitability of the maize crop, exceeding the profitability threshold every year, as follows: in 2019 with 2,216.85 tons of maize, in 2020 with 2,738.60 tons of maize and in 2021 with 3,887.34 tons. On farms of 60 ha and 600 ha, the profitability threshold could not be reached, in most cases, the major causes being of agropedoclimatic and economic nature. The conclusion of the analysis carried out was that, in order to have a constant profitability of the maize crop, it is necessary to counteract the drought by introducing irrigation to this crop, reducing production expenses and increasing the value of subsidies, so that the gross product highlights the profitability of the maize crop.*

**Key words:** maize crop, yield, profitability, subsidies

### **INTRODUCTION**

Maize culture is of great importance throughout the world because this culture represents a major component of animal feed, being at the same time a basic food for the world's population, which is growing. Also, maize is a multifunctional agricultural crop, being used in consumer goods, for industrial products, biofuels, sweetener, but also for the extraction of starch. Maize has a series of particularities that justify its importance among crops: a great ecological plasticity, being cultivated on land and in different climatic conditions; a good resistance to drought and heat; presents a low number of diseases and pests; it supports monocultures, being a good precursor culture for most cultures. This culture makes good use of organic and mineral fertilizers, giving

significant productions in an irrigated system, having a high multiplication coefficient, which leads to high harvests [5]. The full mechanization of this crop is another factor that contributes to its existence in most large crop farms, being able to be sown as a second crop, after early-harvesting plants, which leads to the efficiency of agricultural land use. Worldwide, in 2022 the main maize producing countries are the USA, China, Brazil and the European Union [12]. However, one third of the amount of cereals cultivated in the EU is represented by maize. In 2022, Romania achieved the lowest maize production in recent years (8,037,134 tons), down 45.77% compared to the previous year [7], a large part of which was exported [8]. Production costs, increasing due to the increase in the price of inputs, have led Romanian farmers to reduce cultivated areas

(2,549,281 ha in 2021, with a decrease of 4.63% in 2022 [7].

Currently, the phenomena included in the spectrum of climate changes, such as the prolonged drought, have affected the production of the maize crop. In order to face these challenges, it is necessary to invest in high-performance irrigation systems and to find new innovative technological solutions [6]. Crop rotation is important in this context for improving soil quality [2, 9] and can be successfully applied in farms. By reducing the use of herbicides, we hope to improve the quality of the soil and increase the productivity of crops [1]. The recommendations regarding the technologies applied to crops aim at the use of biological preparations and some resistant hybrids, which will lead to economic efficiency and the preservation of biodiversity in the areas where they are applied [3, 13]. Maize hybrids must be selected so that they have a high productivity even in conditions of reduced availability of water in the soil [4]. Another modern practice aims to practice conservative agriculture to restore the organic substance in the soil and, thus, by improving the quality of the soil that has decreased as a result of the effects of global warming [14]. All these aspects need to be applied in large crop farms, which in the case of maize crop. It is necessary to find technological solutions that counteract these effects [10]. It is essential to support the dermis by granting subsidies, which only in these conditions will be able to survive and maintain profitability [11].

This paper aimed to analyze yield and profitability of maize cultivation in three crop farms of different sizes: 60 ha, 600 ha and 3,000 ha in Romania.

## MATERIALS AND METHODS

The present paper highlights the yield of the maize crop and its influence on profitability, the analysis was carried out on three large crop farms of different sizes from the Ialomita area, South Muntenia Region, Romania. This area benefits from a temperate-continental climate, with a relatively high annual and

diurnal temperature range, with very hot summers, periodically dry, cold winters, frequently marked by strong blizzards, with a low average annual rainfall (450 mm annually) and with the following types of winds encountered: The Criva, which brings blizzards in winter and droughts in summer, the Austrul, which causes long periods of drought and the Băltarețul which is present in spring. In this county, the existing soil types are: in the range of Mărculești commune, the dominant soil is calcareous Cernoziom, Cernisoluri class, in the radius of Mihail Kogălniceanu commune, the dominant soils are represented by Cernoziomuri, Cernisols and Alluviums class, Protisoluri class and in the radius of Șândărei commune, the dominant soil is calcareous Cernoziom, Cernisols class [9]. A series of technical-economic indicators were analysed and they targeted the areas cultivated with maize by the three large crop farms; the average and total productions as well as the value of the production, the subsidies received, the gross product made in the maize crop, but also the total expenses, gross and net income, the production cost and the price of maize in the period 2019-2021. The present indicators were determined and analysed based on the maize crop budget and the annual financial statements of the three farms. The analysis followed the variation of the indicators presented both in absolute values and in relative values. The results of the research were presented in tabular form, but also graphically, in order to highlight them.

## RESULTS AND DISCUSSIONS

Maize culture, which constitutes the basis of the analysis of this work, is analyzed from an economic-financial point of view within three large crop farms, located in a favorable region from the point of view of climatic conditions, in Romania. In order to highlight the profitability indicators of this crop, the data provided by the three farms under study were used, both based on the budgets of the maize crop and from the annual financial statements. The different size of the farms (approximately

60 ha, 600 ha and 3,000 ha) led to specific results.

Within the 60 ha farm, the evolution of the main technical-economic indicators for maize cultivation is presented in Table 1, noting an

oscillation of the area cultivated with maize during the analysis period, as follows: a decrease of 3.13% in 2020 compared to of 2019 and an increase of 32.26% in 2021 compared to 2020.

Table 1. *Crop farm of 60 ha: the budget of the maize crop*

Specification	MU	Year			Variation				
		2019	2020	2021	2020/2019		2021/2020		
					Absolute -ha-	Relative -%-	Absolute -ha-	Relative -%-	
Surface cultivated with maize	ha	16	15.5	20.5	-0.5	96.88	+5	132.26	
Production of maize	Average	Kg/ha	6	2	7.5	-4	33.33	+5.5	375.00
	Total	tone	96	31	153.75	-65	32.29	+122.75	495.97
Production value	Average	lei	3.72	1.46	6.3	-2.26	39.25	+4.84	431.51
	Total	lei	59.52	22.63	129.15	-36.89	38.02	+106.52	570.70
Subsidies	lei	47,810.88	19,166.99	61,179.38	-28,643.89	40.09	+42,012.39	319.19	
Total expenses	Per ha	lei/ha	6,708.18	2,696.58	9,284.36	-4,011.6	40.20	+6,587.78	344.30
	Per area	lei	107,330.88	41,796.99	190,329.38	-65,533.89	38.94	+148,532.39	455.37
	Per ha	lei/ha	5,164.04	4,042.59	6,784.03	-1,121.45	78.28	+2,741.44	167.81
	Per area	lei	82,624.64	62,660.15	139,072.62	-19,964.49	75.84	+76,412.47	221.95
Production cost	lei/kg	0.86	2.02	0.9	+1.16	234.88	-1.12	44.55	
Capitalization price	lei/kg	0.62	0.73	0.84	+0.11	117.74	+0.11	115.07	
Gross income	Per ha	lei/ha	1,544.14	-1,346.01	2,500.33	-2,890.15	-87.17	+3,846.34	-185.76
	Per area	lei	24,706.24	-20,863.20	51,256.77	-45,569.44	-84.45	+72,119.97	-245.68
Net income	Per ha	lei/ha	1,488.11	-1,371.47	2,432.82	-2,859.58	-92.16	+3,804.29	-177.39
	Per area	lei	23,809.76	-21,257.79	49,872.81	-45,067.55	-89.28	+71,130.6	-234.61

Source: Own data processing.

The average productions also fluctuated during the analysed period, noting a decrease in 2020 compared to 2019, by 66.67% and an increase in 2021 by 275% compared to 2020 and by 25% compared to 2019. And the total production follows the same trend, a decrease of 67.71% in 2020 compared to 2019 and an increase of 395.97% in 2021 compared to 2020 was evident (Figure 1).

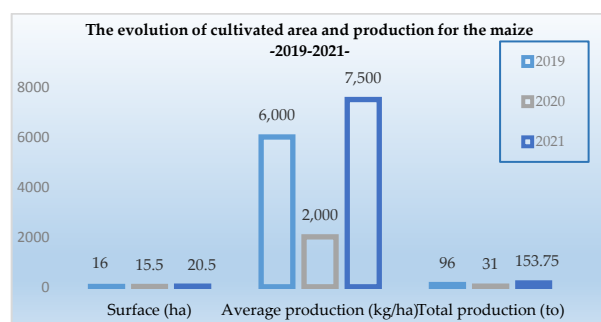


Fig. 1. *Farm of 60 ha: areas and production in maize crop*

Source: Own results.

The gross product achieved per hectare cultivated with maize, in 2020, had the most unfavorable economic situation with a value located 59.80% lower than in 2019 and 70.96%

lower compared to the value recorded in 2022 (Figure 2).

Production expenses per hectare also fluctuated during the analysis period, with a decrease of 21.72% in 2020 compared to 2019 and an increase of 67.81% in 2021 compared to 2020 (Figure 2).

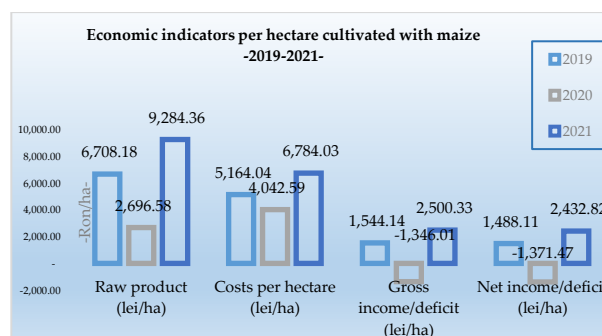


Fig. 2. *Crop farm of 60 ha: income and productions expenses per hectare cultivated with maize*

Source: Own results.

The total expenditure on the maize crop decreased in 2020 compared to 2019 by 24.16% and increased by 21.95% in 2021 compared to 2020 (Figure 3).

Considering that in 2020 the productions were small, the 60 ha farm registered a deficit in

the maize crop, a deficit that could not be compensated even by the subsidies received.

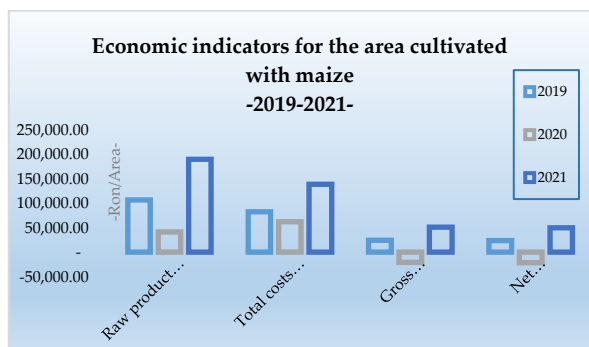


Fig. 3. *Crop farm of 60 ha*: income and productions expenses per area cultivated with maize  
 Source: Own results.

The best year for the maize crop in terms of income was 2021, the year in which the net income exceeded by 25% the one achieved in 2019. Regarding the cost of production, there was an increase in the year 2020 compared to the years 2019 and 2021, against the background of small and poor quality productions, respectively 2.02 lei (2020) compared to 0.86 lei in 2019 and 0.9 lei in 2021, favorable agricultural years in which the farm also obtained high productions (Figure 4).

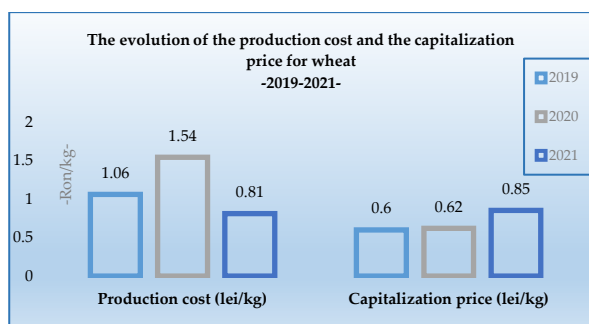


Fig. 4. *Crop farm of 60 ha*: production cost and selling price of maize  
 Source: Own results.

The capitalization price for maize in the years 2019, 2020 and 2021 were lower than the expenses incurred, which indicates that the farm capitalized the production of maize below the realized production cost, by 0.24 lei lower (2019), by 1, 29 lei (2020) and 0.06 lei (2021) (Figure 4).

It is necessary to emphasize that for this crop, in the respective years, this spending deficit was partially covered by the operating

subsidies received, in 2020 losses were recorded for this crop.

Under these conditions, on the 60 ha farm, it was found that the financial results were unfavorable for the maize crop, in the entire analyzed period, the yield deficit recorded was 37.26 tons (2019), 54.83 tons (2020) and 11.81 tons (2021) (Table 2 and Figure 5).

Table 2. *Crop farm of 60 ha*: the yield and profitability of the maize crop

Specification	U.m.	2019	2020	2021
The production yield necessary to cover expenses	tons	133.26	85.83	165.56
The production surplus/deficit after covering production expenses		-37.26	-54.83	-11.81

Source: Own data processing.

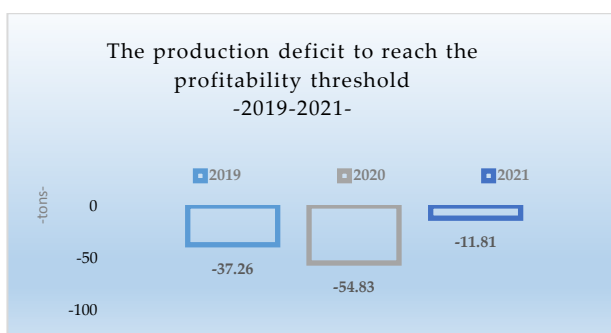


Fig. 5. *Crop farm of 60 ha*: production deficit for the maize crop  
 Source: Own results.

Within the 600 ha farm, the main technical-economic indicators for maize cultivation are detailed in Table 3. At this farm, the areas cultivated with maize varied in the period 2019-2021, as follows: in 2020 compared to 2019, by 16.28% higher, and in 2021 compared to 2020 by 7.20% lower.

Maize crop production fluctuated during the analysed period, noting the reduction of both average production/ha (by 42.95%) and total production (by 33.47%) in 2020 compared to 2019 (Table 3).

The year 2020 was decisive and led the farmer to introduce irrigation to this crop, and the results were not slow to appear. In the 2020-2021 agricultural year, the average production of the maize crop was a record, 14,309 kg/ha, respectively 306.04% higher than in the previous year, and the total

production was 204.43% higher than in 2020 (Figure 6).  
 The gross product achieved for each hectare cultivated with maize has increased annually:

in 2020, the gross product was 47.15% higher compared to the gross product recorded in 2019 and in 2021 compared to the previous year by 85.33% higher (Figure 7).

Table 3. *Crop farm of 600 ha: the budget of the maize crop*

Specification	MU	Year			Variation				
		2019	2020	2021	2020/2019		2021/2020		
					Absolute -ha-	Relative -%-	Absolute -ha-	Relative -%-	
Surface cultivated with maize	ha	215	250	232	+35	116.28	-18	92.80	
Production of maize	Average	Kg/ha	6,177	3,524	14,309	-2,653	57.05	+10,785	406.04
	Total	tone	1,328	881	3,319.68	-447	66.34	+2,438.68	376.81
Production value	Average	lei	3,706.20	6,043.66	12,148.34	+2,337.46	163.07	+6,104.68	201.01
	Total	lei	796,833	1,510,915	2,818,415.11	+714,082	189.62	+1,307,500.11	186.54
Subsidies	lei	273,373.49	320,219.36	330,835.05	+46,845.87	117.14	+1,0615.69	103.32	
Total expenses	Per ha	lei/ha	4,977.70	7,324.54	13,574.35	+2,346.84	147.15	+6,249.81	185.33
	Per area	lei	1,070,206.49	1,831,134.36	3,149,250.17	+760,927.87	171.10	+1,318,115.81	171.98
	Per ha	lei/ha	6,558.79	5,452.14	11,622.77	-1,106.65	83.13	+6,170.63	213.18
	Per area	lei	1,410,140.41	1,363,034.95	2,696,483.79	-47,105.46	96.66	+1,333,448.84	197.83
Production cost	lei/kg	1.06	1.54	1.00	0.48	145.28	-0.54	64.94	
Capitalization price	lei/kg	0.6	0.62	0.85	0.02	103.33	+0.23	137.10	
Gross income	Per ha	lei/ha	-1,581.09	1,872.40	1,951.58	+3,453.49	-118.42	+79.18	104.23
	Per area	lei	-339,933.92	468,099.41	452,766.38	+808,033.33	-137.70	-15,333.03	96.72
Net income	Per ha	lei/ha	4,360.13	4,958.02	6,185.88	+597.89	113.71	+1227.86	124.77
	Per area	lei	-1,618.92	1,844.20	1,658.01	+3,463.12	-113.92	-186.19	89.90

Source: Own data processing.

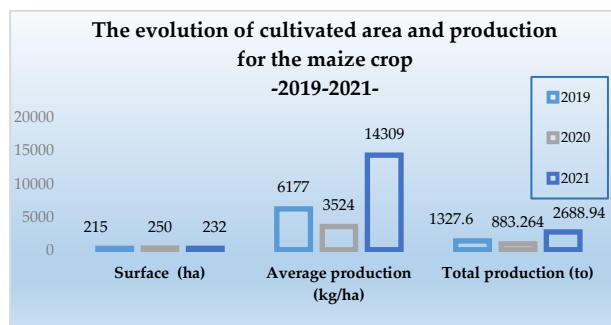


Fig. 6. *Crop farm of 600 ha: areas and productions in maize crop*  
 Source: Own results.

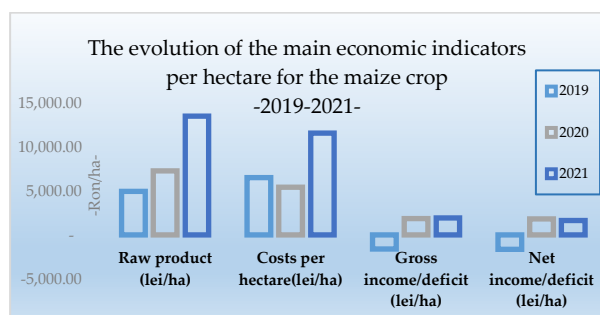


Fig. 7. *Crop farm of 600 ha: income and expenses per hectare cultivated with maize*  
 Source: Own results.

The expenditure per hectare for the maize crop registered a decrease in 2020 compared to 2019 by 16.87% and an increase

in 2021 compared to the previous year, by 13.18%. Total production expenses had the same trend, which registered a slight decrease in 2020 compared to 2019, by 3.35% and an increase of 97.82% in 2021 compared to 2020 (Figure 8).

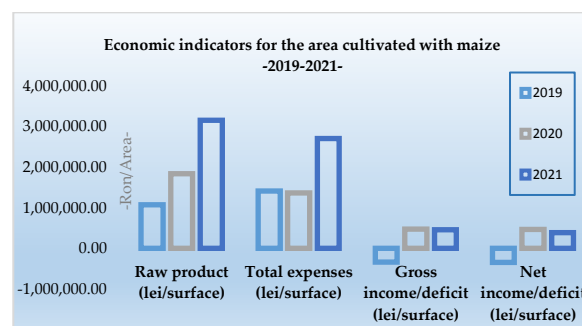


Fig. 8. *Crop farm of 600 ha: income and expenses on the area cultivated with maize*

Regarding the incomes made by this farm from the maize crop, in the period 2019-2021, with the exception of 2019 in which a deficit was highlighted for this crop, a deficit that could not be compensated by the subsidies received, in the years 2020 and 2021 they recorded surpluses. But the reduction of the cultivated area did not attract the reduction of production expenses, because the increase in

the prices of inputs led to the increase of expenses in the year 2021 (Figure 7).

Under the influence of the total expenses incurred on the maize crop as well as the productions achieved, the production cost showed the efficiency of the activity carried out by the farm on this crop. An increase in the cost of production was noted in 2020 compared to 2019 against the background of small productions, respectively 1.54 lei/kg compared to 1.06 lei/kg (2019) and 0.81 lei/kg (2021), agricultural years in which yields were high (Figure 9).

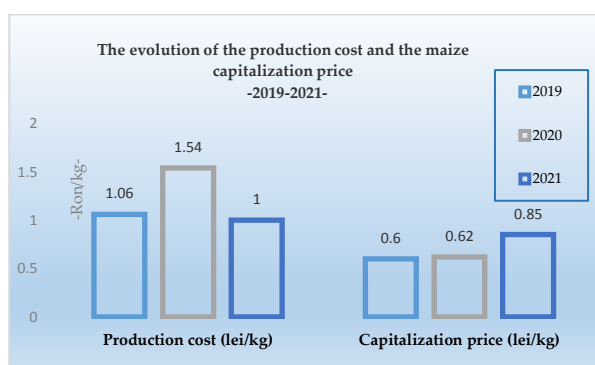


Fig. 9. *Crop farm of 600 ha*: production cost and sale price of maize  
Source: Own results.

Under these conditions, on the 600 ha farm, the maize crop was profitable only in 2021 of the analysed period, the year in which the production value (147.34 tons) was the one that brought added value to this crop.

Table 4. *Crop farm of 600 ha*: the yield and profitability of the maize crop

Specification	U.m.	2019	2020	2021
The production yield necessary to cover expenses	tons	2,350.23	2,198.44	3,172.33
The production surplus/deficit after covering production expenses		-1,022.23	-1,317.44	+147.34

Source: Own data processing .

In the years 2019 and 2020, unprofitable years for the maize crop, the production deficit to cover expenses and reach the profitability threshold was 1,022.23 tons (2019) and 1,317.44 tons (2020) (Table 4 and Figure 10).

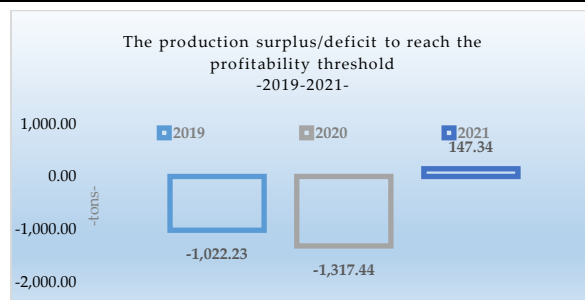


Fig. 10 *Crop farm of 600 ha*: the production deficit in the maize crop  
Source: Own results.

Within the large crop farm of 3,000 ha, the evolution of the main technical-economic indicators for maize cultivation are presented in Table 5. The total area cultivated with maize owned in 2019 was of 486.61 ha, in 2020 was of 564 ha and in 2021 was of 759.09 ha (Figure 11).

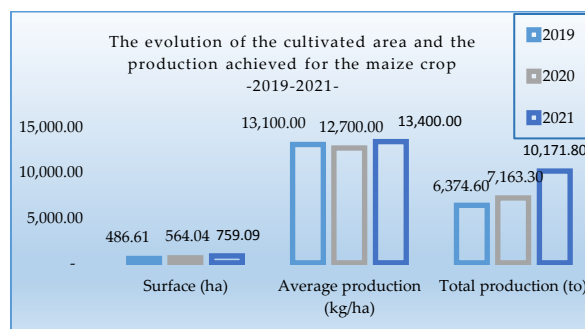


Fig. 11. *Crop farm of 3,000 ha*: areas and productions in maize crop  
Source: Own results.

The gross product achieved per hectare cultivated with maize in 2019 was lower than in 2020 (by 7.76%) and 2021 (by 48.39%). Production expenses per hectare registered an upward trend during the analysis period, 1.26% higher in 2020 compared to 2019 and 44.94% higher in 2021 compared to 2020 (Figure 12).

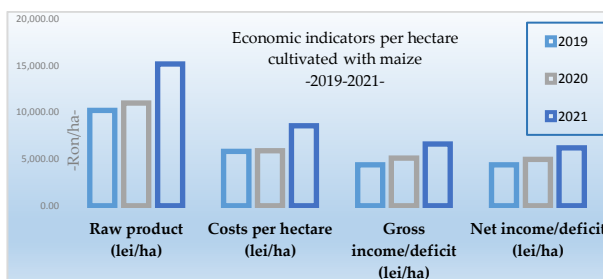


Fig. 12. *Crop farm of 3,000 ha*: income and expenses per hectare cultivated with maize  
Own data processing .

The total expenditure on the maize crop evolved upwards, 17.38% higher in 2020 compared to 2019 and 95.06% higher in 2021 compared to 2020 (Figure 13).

Table 5. *Crop farm of 3,000 ha: the budget of the maize crop*

Specification		MU	Year			Variation			
			2020/2019		2021/2020				
			2019	2020	2021	Absolute -ha-	Relative -%-	Absolute -ha-	Relative -%-
Surface cultivated with maize		ha	486.61	564.04	759.09	+77.43	115.91	+195.05	134.58
Production of maize	Average	Kg/ha	13,100	12,700	13,400	-400.00	96.95	+700	105.51
	Total	tone	6,374.6	7,163.3	10,171.8	+788.70	112.37	+3,008.5	142.00
Production value	Average	lei	8,908	9,525	13,802	+617.00	106.93	+4,277	144.90
	Total	lei	4,334,721.88	5,372,481	10,476,960.2	1,037,759.12	123.94	+5,104,479.2	195.01
Subsidies		lei	622,602.89	819,808.5	998,474.95	+197,205.61	131.67	+178,666.45	121.79
Total expenses	Per ha	lei/ha	10,187.47	10,978.46	15,117.36	+790.99	107.76	+4,138.9	137.70
	Per area	lei	4,957,324.77	6,192,289	11,475,435.1	1,234,964.23	124.91	+5,283,146.1	185.32
	Per ha	lei/ha	5,810.13	5,883.49	8,527.31	+73.36	101.26	+2,643.82	144.94
	Per area	lei	2,827,267.36	3,318,524	6,472,995.75	+491,256.64	117.38	+3,154,471.75	195.06
Production cost		lei/kg	0.44	0.46	0.64	+0.02	104.55	+0.18	139.13
Capitalization price		lei/kg	0.68	0.75	1.03	+0.07	110.29	+0.28	137.33
Gross income	Per ha	lei/ha	4,377.34	5,094.97	6,590.05	+717.63	116.39	+1,495.08	129.34
	Per area	lei	2,130,057.42	2,873,766	5,002,439.38	+743,708.58	134.91	+2,128,673.38	174.07
Net income	Per ha	lei/ha	4,360.13	4,958.02	6,185.88	+597.89	113.71	+1,227.86	124.77
	Per area	lei	2,121,682.86	2,796,520	4,695,637.98	+674,837.14	131.81	+1,899,117.98	167.91

Source: Own data processing.

The production cost of maize was 0.46 lei in 2020 compared to 0.44 lei in 2019 and 0.64 lei in 2021, agricultural years in which the farm obtained quantitatively significant productions.

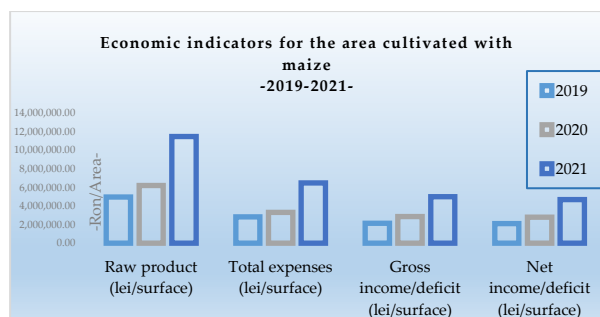


Fig. 13. *Crop farm of 3,000 ha: income and expenses on the area cultivated with maize*

Source: Own results.

Regarding the price of maize, it exceeds the production cost as follows: in 2019 by 0.24 lei, in 2020 by 0.29 lei and in 2021 by 0.39 lei (Figure 14). The production cost of maize was 0.46 lei in 2020 compared to 0.44 lei in 2019 and 0.64 lei in 2021, agricultural years in which the farm obtained quantitatively significant productions. Regarding the price of maize, it exceeds the production cost as follows: in 2019 by 0.24 lei, in 2020 by 0.29 lei and in 2021 by 0.39 lei (Figure 14).

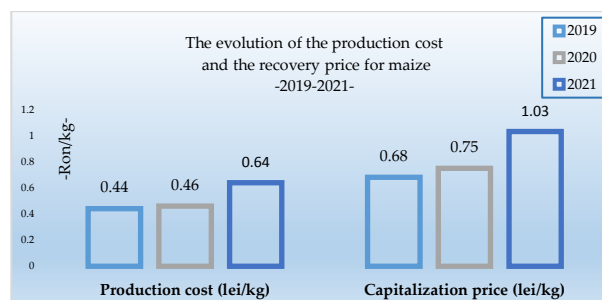


Fig. 14. *Crop farm of 3,000 ha: production cost and sale price of maize*

Source: Own results.

In order to reach the profitability threshold for the maize crop, a minimum total production of 4,157.75 tons (2019), 4,424.70 tons (2020) and 6,284.46 tons (2021) was required within the 3,000 ha farm.

Table 6. *Crop farm of 3,000 ha: farm yield and profitability of the maize crop*

Specification	U.m.	2019	2020	2021
The production maize yield necessary to cover expenses	tons	2,350.23	2,198.44	3,172.33
The production maize surplus/deficit after covering production expenses		-1,022.23	-1,317.44	+147.34

Source: Own data processing.

Under these conditions, the 3000 ha farm registered a profitability of the maize crop throughout the analysis period, the product surplus that led to the recording of positive results for the maize crop in 2019 (2,216.85 tons), in 2020 (2,738.60 tons) and in 2021 (3,887.34 tons) (Table 6 and Figure 15).

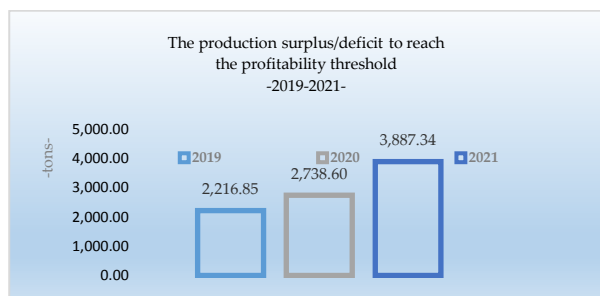


Fig.15. Crop farm of 3,000 ha: production surplus in the maize crop

Source: Own results.

## CONCLUSIONS

The analysis of the yield of the maize crop and its influence on profitability, led to different conclusions for the three large crop farms in Romania and of different dimensions. In general, the price of the inputs needed to harvest maize in optimal conditions increased the production expenses, which had a negative impact on the profitability of this crop. The production achieved in the maize crop was small in the case of the 60 ha and 600 ha farms, negatively impacting the economic efficiency of maize and surplus in the case of the 3000 ha farm. A major control on the part of farmers is required to counteract the influence of climate change in order to maintain quantitatively and qualitatively the production of the maize crop within optimal limits. Thus, maize culture produced the following effects in the studied farms:

- *Within the crop farm of 60 ha*, the results showed that a deficit of production yield was found in the maize crop in the entire analyzed period, as follows: in 2019 with 37.26 tons, in 2020 with 54.83 tons and 2021 with 11.81 tons; the conclusion being that maize culture was unprofitable.

- *Within the crop farm of 600 ha*, the results showed that in the maize crop, the production yield deficit was: in 2019 (1,022.23 tons) and

in 2020 (1,317.44 tons). In the year 2021, the maize crop recorded a production surplus of 147.34 tons, being the only year in the analyzed period in which the maize crop was profitable.

- *Within the crop farm of 3,000 ha*, the results showed that the production yield surplus for the maize crop was: in 2019 of 2,216.85 tons, in 2020 it was 2,738.60 tons, and in 2021 of 3,887.34 tons, ensuring the profitability of this crop over the entire analysis period.

## ACKNOWLEDGEMENTS

This research was funded by USAMV Bucharest, Maize Producers Association of Romania (APPR) and National Federation PRO AGRO, grant number 1062/15.06.2022 "The Technical-economic Impact of the Eco-scheme for Arable Land on Plant-based crops farms of Different Sizes".

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