

THE ECONOMIC PROFITABILITY OF PEPPER CULTIVATED IN SOLAR SYSTEM IN CONVENTIONAL AND ORGANIC AGRICULTURE – CASE STUDY IN ROMANIA

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Abstract

The paper presents the analysis of the profitability threshold of bell pepper cultivation in the solar system in conventional farming and organic farming with proposed for the crop year 2022/2023. Thus, by using a system of indicators (specific indicators, result indicators and profitability indicators, production costs, capitalization prices and the degree of profitability per product unit can be estimated. Economic profitability is evaluated in terms of the use of production framework technologies in the production process and the rational use of raw materials, human and financial resources with the aim of obtaining low-cost and high-quality products. Agribusiness actions will always be based on crop profitability. The findings of the undertaken study can favourably influence farmers, giving them the opportunity to adjust their existing farm resources and capacities to achieve higher yields.

Key words: profitability threshold, bell pepper culture in solar, conventional system, ecological system

INTRODUCTION

Belonging to the Solanaceae family, pepper (*Capsicum annuum* L.) is considered a popular vegetable being one of the most widespread crops grown in greenhouses around the world [5]. Originally from Central and South America, the pepper is considered to be one of the oldest cultivated plants. Brought to Europe in 1493, it spread very quickly in Italy, France (16th century) and the Balkan Peninsula (17th century). In our country, first appeared the hot pepper from the western area, then the bell pepper and the donut from the southern part (18th-19th centuries) [8].

In our country, pepper is among the main cultivated vegetable crops, being an annual plant with a long production cycle. According to the Official Catalog of Cultivated Plant Varieties in Romania for the year 2023, more than 80 varieties of pepper (*Capsicum annuum* L, - Pepper) are registered, the most recommended and appreciated being those varieties or hybrids that ensure constant production over the entire period of vegetation, have an increased resistance to diseases and the fruits have a thick and uniform pulp [10].

Pepper fruits have multiple uses: fresh or cooked food, raw material in the canning industry, the food industry (food dyes) or the pharmaceutical industry (due to the capsaicin content) [6]. Peppers have a vitamin C content between 150-300 mg/100 g, this being influenced by the degree of maturity, the size or color of the fruits, but also by the cultivation conditions used (field, protected spaces) [3, 12].

Soil properties and nutrients have a high impact on bell pepper growth and yield quality [1].

Also, some authors comparatively studied sweet pepper cropping in plastic tunnels and open field, emphasizing the beneficial effect of crop protection in protected areas [11].

Under a proper fertilization and irrigation management, organic production of peppers is equivalent to that produced in conventional system [13, 4].

Investments in protected areas are largely used and their feasibility and advantages are justified by the fast income return [14].

The specialization and development of agricultural activities while lowering production costs characterize traditional agricultural systems. Ecological agricultural system can be represented by the min-max

function, this means maximizing production while minimizing the negative side effects of agricultural activities [2].

According to the Eurostat database, in protected areas, peppers were grown on an area of 170 hectares in 2010, with a maximum of 550 hectares in the years 2018–2019. After having an upward trend from 2010 to 2019, the evolution of the pepper-cultivated area in protected spaces saw a little reduction by 1.85%, registering by the end of 2020 at just 540 hectares. For the next 3 years (2020–2022) the cultivated area remained constant, at 540 hectares, this being an increase of 217.6% compared to the cultivated area in 2010 (Fig.1).

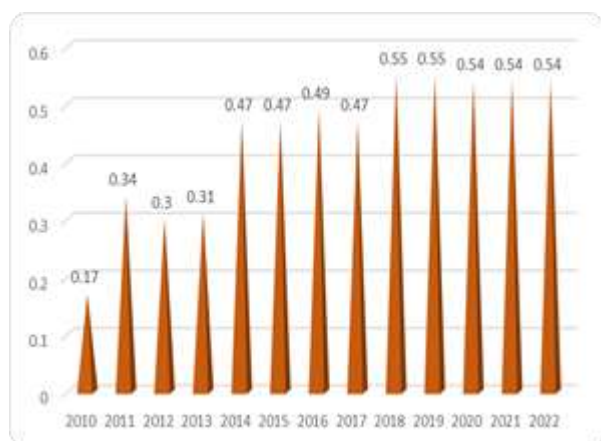


Fig. 1. The evolution of the area cultivated with peppers in protected areas in Romania in the period 2010-2022 (1,000 ha)

Source: Own design based on the data from [7].

Regarding the total production of peppers grown in protected areas (Fig. 2), for the analyzed period, it had an oscillating trend, varying from 3,540 tons in 2010 and a maximum of 19,030 tons in 2018, the productions being influenced by the cultivated areas but and the varieties used. Thus, compared to 2018, when a production maximum was recorded, in 2022 the production level decreased by 28.37%, reaching 13,630 tons.

The main reasons that led to the decrease in pepper production in protected areas are the rather high technological costs (energy and water for irrigation).

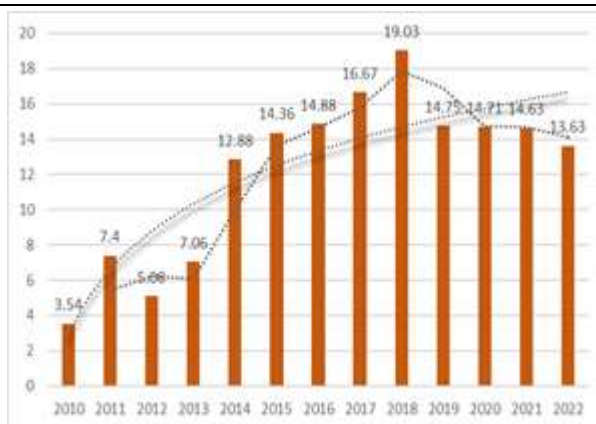


Fig. 2. The evolution of pepper production in protected areas in Romania in the period 2010-2022 (1,000 tons)
 Source: Own design based on the data from [7].

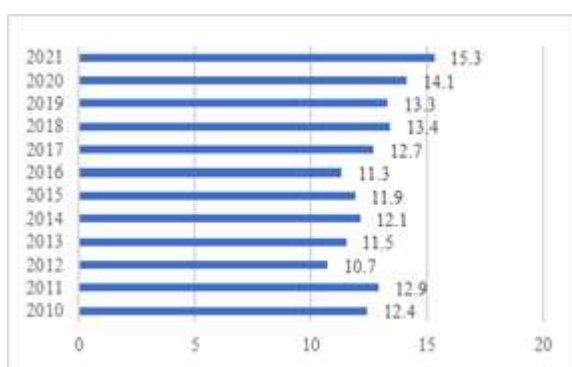


Fig. 3. Average annual consumption of peppers in Romania during 2010-2021 (kg/inhabitant)
 Source: Own design based on the data from [9].

According to data from the National Institute of Statistics, between 2010 and 2021, Romania's average annual pepper consumption varied (Fig. 3). Thus, in 2010 the average annual consumption of peppers was 12.4 kg/inhabitant, reaching in 2021 a consumption of 15.3 kg/inhabitant, representing an increase of approximately 23.3%. In 2012, the lowest pepper consumption of 10.7 kg/inhabitant was recorded.

The objective of this study is to determine the economic profitability of solar peppers grown by conventional and organic methods in 2022/2023.

MATERIALS AND METHODS

Using the techno-economic analysis method, the profitability of pepper cultivation in conventional and organic farming systems was analyzed.

From a methodological point of view, the aim is to develop income and expenditure budgets at the level of the culture under study, differentiated according to the applied technologies, the level of allocation of the production factors, but also the yields per surface unit corresponding to the economic conditions for the two systems of culture, conventional and ecological.

The income and expenditure budget for pepper cultivation in solar includes elements of economic evaluation with final techno-economic indicators: costs, benefits, profitability and capitalization price estimates. In this research, the production framework technologies for pepper culture in conventional and organic farming systems were adapted to the existing resources and conditions in Romania in the vegetable basin in the area of Buzău county and proposals were made for the year 2022/2023.

RESULTS AND DISCUSSIONS

Analysis of the income and expenditure budget for the bell pepper culture in solar grown in conventional farming system

The estimated average production of 35,000 kg/ha of bell pepper on land cultivated with traditional farming methods corresponds to a production value of 323,250.5 lei/ha. Adding 18,992.1 lei/ha of subsidies, the total production value is 342,242.6 lei/ha (Table 1). Variable costs account for 74% of total agricultural technology expenditure, which is 82% of total raw material and input consumption. Fixed costs account for 26% of total costs and 82% of consumption by permanent workers. If the total expenses are deducted from the production value, this results in taxable income of 53,875.1 lei/ha, final net income of 48,487.6 lei/ha and an income rate of 20%. The cost of production is calculated by dividing the total agricultural technology costs by the estimated average production and provides a general indication of the level of economic efficiency that can be achieved by growing bell pepper in solar using conventional farming methods.

Table 1. The income and expenditure budget for bell pepper culture in greenhouses, conventional system – estimated average production 35,000 kg/ha, calculations per hectare, proposed for 2022/2023

Indicator	UM	Value	
		lei	Euro*
A. Production value, of which:	lei	323,250.5	65,505
B (+). grants	lei	18,992.1	3,849
C (=) Gross product	lei	342,242.6	69,353
D (-) Total expenses	lei	269,375.4	54,587
I. Variable expenses	lei	198,749.0	40,275
II. Fixed expenses	lei	70,626.4	14,312
E (=) Taxable income	lei	53,875.1	10,917
E.1(-) Taxes and fees	lei	5,387.5	1,092
F (=) Net income + subsidies	lei	67,479.7	13,674
F.1 (=) Net income	lei	48,487.6	9,826
G. Rate of taxable income	%	20.0	20.0
H. Net income rate + subsidies	%	25.1	25.1
H.1 Net income rate	%	18.0	18.0
Production cost	lei/to	7,696.4	1,560
Predictable domestic market price	lei/to	9,235.7	1,872

*euro = 4.93477 lei

Source: processing own calculations.

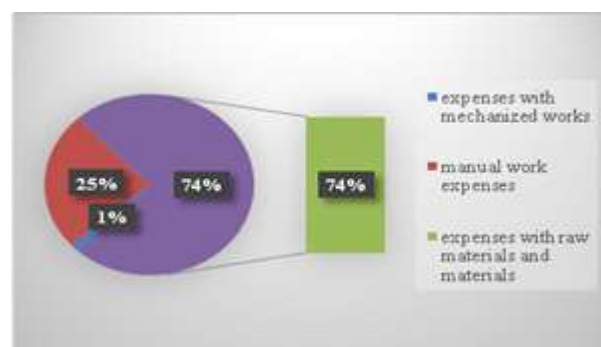


Fig. 4. The distribution of total agrotechnical expenses for bell pepper culture in solar in conventional farming system

Source: design based on own calculations.

Most of the production costs are concentrated on the work with raw materials and materials, so that, for the proposed for the bell pepper harvest in solar in the conventional farming system for the year 2022/2023, they represent 74% of the total production costs, followed by the costs of manual works with 25% and mechanized works with only 1% of the total costs (Fig. 4).

Analysis of the income and expenditure budget for bell pepper cultivation in solar grown in organic farming system

The estimated average production of 28,000 kg/ha of bell pepper cultivation in organically

grown plantations is equivalent to a production value of 337,873.1 lei/ha, which when added to the subsidy of 18,992.1 lei/ha results a total realized production of 356,865.2 lei/ha (Table 2).

Table 2. Income and expenditure budget for bell pepper culture in greenhouses, ecological system – estimated average production 28,000 kg/ha, calculations per hectare, proposed for 2022/2023

indicator	UM	Value	
		lei	Euro*
A. Production value, of which:	lei	337,873.1	68,468
B (+). grants	lei	18,992.1	3,849
C (=) Gross product	lei	356,865.2	72,316
D (-) Total expenses	lei	259,902.4	52,668
I. Variable expenses	lei	194,860.5	39,487
II. Fixed expenses	lei	65,041.8	13,180
E (=) Taxable income	lei	77,970.7	15,800
E.1(-) Taxes and fees	lei	7,797.1	1,580
F (=) Net income + subsidies	lei	89,165.7	18,069
F.1 (=) Net income	lei	70,173.6	14,220
G. Rate of taxable income	%	30.0	30.0
H. Net income rate + subsidies	%	34.3	34.3
H.1 Net income rate	%	27.0	27.0
Production cost	lei/to	9,282.2	1,881
Predictable domestic market price	lei/to	12,066.9	2,445

*euro = 4.93477 lei

Source: processing own calculations.

Variable costs account for 75% of the total agricultural technology costs and 83% of the consumption of raw materials and inputs. Fixed costs account for 25% of total costs and 81% of permanent labor consumption. When total expenses are deducted from the production value, the taxable income is 77,970.7 lei/ha, resulting in a final net income of 70,173.6 lei/ha and an income rate of 30%. Production costs were calculated by dividing total agricultural technology costs by estimated average production as a general indicator of the level of economic efficiency that can be achieved by organic bell pepper cultivation in solar.

Most of the production costs are concentrated on the work with raw materials and materials, so that, for the proposed for the bell pepper harvest in solar in the organic farming system for the year 2022/2023, they represent 76% of the total production costs, followed by the costs of manual works with 23% and

mechanized works with only 1% of the total costs (Fig. 5).

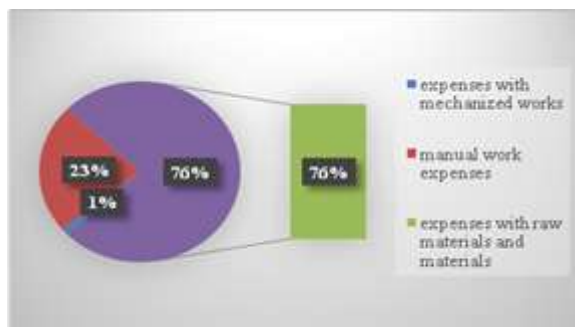


Fig. 5. The distribution of total agrotechnical expenses for the cultivation of bell peppers in solar in the organic farming system

Source: design based on own calculations.

Analysis of the total economic indicators for bell pepper cultivation under conventional and organic farming methods reveals the following:

- bell pepper is produced 20% less in the organic system than in the conventional system, but its production value is 5% higher than in the conventional system.
- the production value from the two systems exceeds the costs incurred by 20% in the conventional system and 30% in the conventional system.
- variable costs account for 74% of total technology costs in conventional systems and 75% in ecological systems, with the difference represented by fixed costs. Raw materials and supplies are 1.3% higher in the conventional system compared to the ecological system.
- the indicator referred to in the assessment of the economic efficiency of costs per unit of product is the unit production obtained, which is 7.7 lei/kg in conventional systems and 9.3 lei/kg in organic systems.
- the average collection price is 9.2 lei/kg for conventional systems and 30.6% higher for eco systems.
- the rate of return obtained was 20% in the conventional system and 30% in the organic system. Thus, solar bell pepper cultivation can be considered profitable in the conventional system with an average production of 19,900 kg/ha and a value of 183,371.5 lei, while in the ecological system this threshold is 12,700

kg/ha in physical units and 153,664 lei in value.

Table 3. Summary economic indicators for the culture of bell pepper in solariums, conventional and ecological system – proposed for 2022/2023

Economic indicators of synthesis	Conventional	Ecological	Deviations	
			UM	%
Average production per ha (to/ha)	35	28	-7.0	80
Production value per ha (lei/ha)	323,251	337,873	14,622	105
Production expenses per ha (lei/ha)	269,475	259,902	-9,573	96
Variable expenses (lei)	198,749	194,861	-3,888	98
Raw materials and materials (lei)	163,304	161,198	-2,106	99
Permanent labor costs (lei)	58,005	52,807	-5,198	91
Fixed expenses (lei)	70,626	65,042	-5,584	92
Unit production cost (lei/kg)	7.7	9.3	1.6	121
Capitalization price (lei/ton)	9,236	12,067	2,831	131
Labor productivity in physical expression (man-hours/ton)	80.4	91.4	11.0	114
Profit or loss per production unit (lei/ha)	53,875	77,971	24,096	145
Profit or loss per product unit (lei/ton)	1,539	2,785	1,246	181
Rate of return (%)	20	30	10	150
The profitability threshold in value units (lei)	183,372	153,664	-29,708	84
The profitability threshold in physical units (to)	19.9	12.7	-7.2	64
Exploitation risk rate (%)	56.7	45.5	-11.2	80
Security Index (Is)	0.4	0.5	0.1	125

Source: processing own calculations.

- The exploitation risk ratio is an indicator that estimates the risk of not realizing the expected production. In the case of bell pepper cultivation in solar, this indicator is 56.7% for conventional systems and 45.5% for ecological systems.
- the safety index represents the margin of security available to achieve the expected production and increases in the same direction as the value of the safety index. This indicator is 0.4 for conventional systems and 0.5 for ecosystem systems.

CONCLUSIONS

Bell peppers have a valuable position among vegetables due to their high nutritional value and medicinal properties. In Romania, the cultivation of bell pepper in solariums is a traditional occupation with agronomic and commercial advantages for the production obtained, due to the period in which it can appear on the market, the first decade of June, when it can be capitalized at a higher price.

Given that the unit production cost of producing 1 kg of bell peppers in solar in conventional farming system is 7.7 lei and 9.3 lei for bell peppers in solar in the organic system, then the profitability of this cultivation is noted for a profit prism of 1.5 lei/kg profit for cultivation in the conventional system and 2.7 lei for cultivation in the ecological system.

In addition, the break-even point represents the level of production, expressed physically or in terms of value, from which the value of the production achieved completely covers the costs incurred, that is, the level from which the culture starts to make a profit. Thus, profitability for bell pepper in solar in the conventional system corresponds to an average production of 19.9 to/ha or 183,371.5 lei, while in the ecological system this threshold is 36.1% lower in physical units and 16.2% lower in monetary units.

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