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COMPARATIVE ANALYSIS OF THE ECONOMIC EFFICIENCY OF EGGPLANT CULTIVATION IN GREENHOUSES: ORGANIC AND CONVENTIONAL AGRICULTURE SYSTEM – FORECASTS 2024/2025

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Summary: *Cultivation of vegetables in sheltered areas has become a common practice, due both to the possibilities of extending the vegetable growing season into the off-season and to the control of extreme climatic conditions (e.g. low temperatures and excessive rains) that can cause substantial damage. Because of these challenges, farmers are looking to implement new farming methods that not only support productivity, but also protect the environment. Eggplant stands out among vegetable crops due to the demand found on the market but also due to its high nutritional value. In the context of global concerns about sustainability and health, the organic farming system is gaining ground in front of the conventional system. This article proposes to carry out a comparative analysis of the economic performance of eggplant cultivation in greenhouses in the two farming systems, organic and conventional, with the aim of providing forecasts for the agricultural year 2024-2025. The production costs involved in the technological process, the capitalization prices and the degree of profitability per product unit will be analyzed. The results of the study will provide valuable information that can support greenhouses eggplant growers to improve existing farm-level strategies to meet both economic and environmental needs.*

Keywords: *economic efficiency, break-even point, eggplant culture, conventional system, ecological system.*

JEL Classification: Q12,Q14,Q57

INTRODUCTION

In the context of global warming and the growing need for organic food, agriculture has an essential role both in ensuring food security and in protecting the environment. Growing eggplant in greenhouses is a viable choice for vegetable growers due to the fact that this vegetable can cope with different environmental conditions with the possibility of obtaining high yields.

The evaluation and comparison of the economic efficiency of eggplant cultivation in greenhouses in conventional and ecological systems is important from several aspects. Initially, consumption of organic agricultural products has increased over the past 10 years, reflecting a shift in consumer choice for nutritious and sustainably produced food options. Based on a study conducted by Meticulous Research and mentioned by Frozen Food Europe, the global organic food market is expected to expand substantially. Therefore, until 2031, the sector is expected to experience an annual growth of approximately 10.1% in the coming years (Frozen Food Europe, 2024). This trend is not only influencing marketing and distribution strategies, but is driving farmers to adopt cultivation methods that meet this need.

Subsequently, both nationally and internationally, policies have begun to be implemented to support the shift to more sustainable farming methods. Recently, financial incentives for organic farming have become more common, which shows the commitment of the authorities to support agricultural practices that protect the environment. The EU Agricultural Policy (CAP) includes special provisions for organic farming, providing subsidies

and assistance for the conversion of conventional land to organic land. In this sense, the European Commission proposes that by 2030, 25% of agricultural land in the European Union will be dedicated to ecological practices, a significant increase compared to the 10.5% estimated for 2022. However, the Court of European Accounts has signaled that the EU strategy does not include clear and measurable objectives, recommending its improvement, as the funds of more than 12 billion euros allocated for the period 2014-2022 have not succeeded achieve the anticipated effect on environmental and economic objectives(European Court of Auditors, Report, 2024).

Cultivating eggplants in protected spaces brings multiple benefits, including the possibility of more efficient management of environmental conditions, control of irrigation systems and ensuring optimal ventilation. Consequently, heat and light regulation are vital for growing eggplants in greenhouses. According to Nelson (2003), the use of advanced greenhouse management technologies helps maintain an optimal temperature, which protects plants from heat stress and supports a more efficient photosynthesis process. Research has shown that a controlled environment can increase both yield and quality of vegetables. Irrigation also plays an essential role in growing vegetables in greenhouses, and modern irrigation systems can provide much more precise water management according to the needs of the plants. In another study, Jones et Tardieu (1998) showed that the use of controlled irrigation systems in protected spaces helps to save water and to use it more efficiently, a crucial aspect for growing vegetables in variable environmental conditions. In addition, ventilation in protected spaces plays an equally important role, guaranteeing sufficient air circulation to prevent the accumulation of moisture, which can lead to the spread of fungal diseases. Boulard (2006) highlighted how crucial ventilation is for maintaining a stable microclimate in greenhouses, an essential aspect for increasing the yield of eggplant culture.

In addition, the FAO report (2021) points out that organic farming brings considerable environmental benefits, such as protecting soils and reducing water pollution. However, these advantages involve higher production costs and lower returns in the short term compared to the system of conventional agriculture. Another FAO report from 2023 points out that the transition to more sustainable agriculture, including organic farming, is supported by international policies that promote the use of innovative technologies and efficient farming methods. These initiatives not only meet environmental standards but also contribute to improving food security in the long term. Gomiero et al. (2011) draw attention to the fact that current agricultural practices have a negative impact on the environment. However, there are alternatives that emphasize resource efficiency and soil conservation, thus ensuring long-term sustainability. These alternatives require important socio-economic and value changes to meet future requirements related to food security and protection of natural resources.

According to the research carried out by Foteinis et al. (2021), the comparative study on eggplant cultivation in conventional and organic farming systems and the environmental impact, carried out in the Mediterranean climatic conditions of northern Greece, highlights the significant differences in terms of environmental performance between the two cultivation methods. The organic farming system has a 24.15% lower total ecological footprint per unit area, while the conventional system is 28.10% more efficient. The main environmental challenges for both systems are irrigation and chemical fertilizer application, which underlines the need to implement strict nutrient application guidelines.

The study by Balode et al. (2024) highlighted the challenge that the European Union has in reducing emissions from agriculture. They suggest that organic farming could be an effective solution to achieving climate goals. Even though this type of farming has lower yields and higher production costs, the advantages include reduced operational costs and higher prices for products sold, which may suggest an increase in income for farmers.

This work aims to carry out a comparative analysis of the economic efficiency of eggplant cultivation in greenhouses, investigating the differences between the organic and conventional farming systems, with forecasts for the year 2024/2025.

MATERIAL AND METHOD

The working methodology focuses on the analysis of the income and expenditure budgets for eggplant cultivation in greenhouses, differentiated according to the technologies used, the way production factors are allocated and the yields obtained per surface unit. This approach offers the possibility to compare the two farming systems - conventional and ecological -, highlighting the economic results specific to each system. The production technologies for eggplant cultivation in greenhouses in conventional and organic farming systems have been adapted according to the existing resources and conditions in the vegetable basin in the Buzău area. The estimates were made for the period 2024/2025. The income and expenditure budgets include all the elements necessary for the economic evaluation of the eggplant cultivation in greenhouses in conventional and ecological systems, including the final technical-economic indicators, such as costs, profitability and price estimates. These indicators are essential in evaluating the economic efficiency of each individual system.

RESULTS AND DISCUSSIONS

I. Analysis of the budget of income and expenses for the cultivation of eggplant in greenhouses in the conventional farming system, estimate 2024/2025

For eggplant cultivation in conventional greenhouses systems, the average production is estimated at 45 tons/ha, which determines a gross production value of 253,236.9 lei (51,169 euros). The estimated price for the domestic market is estimated at 5.63 lei/kg (approximately 1.14 euro/kg). This indicator reflects the gross income obtained from the sale of production, an essential component in the evaluation of profitability (Table 1).

The subsidies represent 4.6% of the production value, having a direct impact on the profitability of the eggplant culture in the conventional greenhouses system. The subsidies planned for 2024/2025 are worth 11,740.6 lei (2,372 euros). Estimates show that, without these subsidies, the net income is 35,818.7 lei/ha (7,238 euros). With subsidies included, the income increases to 47,193.8 lei/ha (9,536 euros/ha).

Total production costs are estimated at 211,030.8 lei/ha (42,641 euros/ha). Of these, variable expenses constitute approximately 61% of total expenses, while fixed expenses represent approximately 39% of the total. This ratio indicates that most costs are directly related to production and may vary depending on production volume.

The analysis of the revenues for the eggplant culture in the conventional greenhouses system shows that the total value of the production is 253,236.9 lei/ha, and by adding the

subsidies of 11,740.6 lei/ha it results a gross product of 264,977.5 lei/ha. The taxable income is 42,206.2 lei/ha, representing 15.93% of the gross product, and the net income plus subsidies reaches 47,193.8 lei/ha, (17.81% of the gross product). The rate of taxable income is 20% and the rate of net income + subsidies is 22.4%.

For the 2024/2025 period, the production cost for the eggplant culture in a conventional greenhouses system is 4,689.6 lei/ha, equivalent to 948 euros/ha. The predictable domestic market price is 5,627.5 lei/ha (1,137 euros/ha), which shows that the estimated revenues exceed production costs.

Table 1. Budget of revenues and expenses for eggplant cultivation in greenhouses, conventional system – estimated average production 45,000 kg/ha, calculations per hectare, estimate 2024/2025

Indicators	Value	
	lei	Euro**
A. Value of production, of which:	253,236.9	51,169
B (+). Grants*	11,740.6	2,372
C (=) Gross product	264,977.5	53,542
D (-) Total expenses	211,030.8	42,641
I. Variable expenses	129,282.1	26,123
II. Fixed expenses	81,748.7	16,518
E (=) Taxable income	42,206.2	8,528
E.1(-) Taxes and fees	6,753.0	1,365
F (=) Net income + subsidies	47,193.8	9,536
F.1 (=) Net income	35,453.2	7,164
G. Rate of taxable income	20.0	20.0
H. Rate of net income + subsidies	22.4	22.4
H.1 Net income rate	16.8	16.8
Production cost	4,689.6	948
Domestic market price predictable	5,627.5	1,137

Note:

*Planned grants:

The APIA subsidy planned for 2024 through the National Strategic Plan of Romania (264.32 euros/ha) = BISS: Basic support for income for the purpose of sustainability (97.85 euros/ha), CRISS: Complementary redistributive support for income for the purpose of sustainability (51.42 euros/ha), PD-04: Environmentally beneficial practices applicable to arable land (56.28 euros/ha), Payment for young people farmers (47 euros/ha), ANT-1: Transitional national aid (11.7734 euros/ha);

The planned APIA subsidy for the coupled support for income – Vegetables grown in greenhouses/greenhouses year 2024 = 2,108 euros/ha;

**Euro exchange value: 4,949 lei

Source: processing own calculations

II. Analysis of the budget of income and expenses for the cultivation of eggplant in the greenhouses system in the organic farming system

For the eggplant culture in the ecological greenhouses system, the average production is estimated at 35 tons/ha, which determines a gross production value of 238,791 lei (48,250 euros). The estimated price for the domestic market is 6.83 lei/kg (approximately

1.37 euros/kg). This indicator reflects the gross income obtained from the sale of production, an essential component in the evaluation of profitability (Table 2).

The subsidies represent 5.8% of the production value, having a direct impact on the profitability of the eggplant culture in the ecological greenhouses system. The subsidies planned for 2024/2025 are worth 13,873.6 lei (2,803 euros). Estimates show that, without these subsidies, the net income is 35,453.2 lei/ha (7,164 euros). With the subsidies included, the income increases to 49,692.3 lei/ha (10,041 euros/ha).

Total production costs are estimated at 198,992.6 lei/ha (40,209 euros/ha). Of these, variable expenses constitute approximately 66% of total expenses, while fixed expenses represent approximately 34% of the total. This ratio indicates that most costs are directly related to production and may vary depending on production volume.

The analysis of the revenues for the eggplant culture in the ecological greenhouses system shows that the total value of the production is 238,791.1 lei/ha, and by adding the subsidies of 13,873.6 lei/ha, a gross product of 252,664.7 lei/ha results. The taxable income is 39,798.5 lei/ha, representing 15.75% of the gross product, and the net income plus subsidies reaches 49,692.3 lei/ha, (19.66% of the gross product). The rate of taxable income is 20% and the rate of net income + subsidies is 25%.

For the 2024/2025 period, the production cost for the eggplant culture in the ecological greenhouses system is 5,685.5 lei/ha, equivalent to 1,149 euros/ha. The predictable domestic market price is 6,822.6 lei/ha, equivalent to 1,379 euros/ha, which shows that the estimated revenues exceed production costs.

Table 2. Budget of revenues and expenses for eggplant cultivation in greenhouses, ecological system - estimated average production 35,000 kg/ha, calculations per hectare, estimate 2024/2025

Indicators	Value	
	lei	Euro**
A. Value of production, of which:	238,791.1	48,250
B (+). Grants*	13,873.6	2,803
C (=) Gross product	252,664.7	51,054
D (-) Total expenses	198,992.6	40,209
I. Variable expenses	130,542.7	26,378
II. Fixed expenses	68,449.8	13,831
E (=) Taxable income	39,798.5	8,042
E.1(-) Taxes and fees	3,979.9	804
F (=) Net income + subsidies	49,692.3	10,041
F.1 (=) Net income	35,818.7	7,238
G. Rate of taxable income	20.0	20.0
H. Rate of net income + subsidies	25.0	25.0
H.1 Net income rate	18.0	18.0
Production cost	5,685.5	1,149
Domestic market price predictable	6,822.6	1,379

Note:

*Planned grants:

The APIA subsidy planned for 2024 through the National Strategic Plan of Romania (264.32 euros/ha) = BISS: Basic support for income for the purpose of sustainability (97.85 euros/ha), CRISS: Complementary redistributive support for income for the purpose of sustainability (51.42 euros/ha), PD-04: Environmentally beneficial practices applicable to arable land (56.28 euros/ha), Payment for young people farmers (47 euros/ha), ANT-1: Transitional national aid (11.7734 euros/ha);

The planned APIA subsidy for the Coupled Income Support - Vegetables grown in greenhouses/greenhouses year 2024 = 2,108 euros/ha

Organic agriculture subsidy – maintenance of DR-06 certification = 431 euros/ha

**Euro exchange value: 4,949 lei

Source:processing own calculations

III. Analysis of the economic indicators of synthesis for the cultivation of eggplant in the greenhouses system in conventional and ecological aquiculture system

The evaluation of the economic indicators for the cultivation of eggplant in greenhouses, by conventional and ecological methods, highlights the following conclusions (Table 3):

- The average production per hectare is 45 tons in the conventional system and 35 tons in the organic system, representing a 22% reduction for organic farming.
- The production value per hectare is higher in the conventional system, reaching 253,237 lei compared to 238,791 lei in the organic system, which indicates a difference of approximately 6%.
- Total production expenses are higher in the conventional system (211,031 lei/ha) compared to the organic system (198,993 lei/ha), resulting in a 6% decrease in expenses for the organic system.
- The variable costs are lower in the conventional system (129,282 lei) compared to the ecological one (130,543 lei), with a difference of approximately 1%. The expenses for raw materials and consumables are 95,367 lei for conventional and 99,141 lei for organic, marking an increase of 4% in the case of organic culture.
- The unit production cost is 4.69 lei/kg for the conventional system and 5.69 lei/kg for the organic system, indicating a 21% increase in organic farming.
- The recovery price for eggplant is higher in organic farming, reaching 6,823 lei/ton, compared to 5,628 lei/ton in the conventional system, which represents a difference of 21%.

Table 3. Economic indicators of synthesis for eggplant cultivation in greenhouses, conventional and ecological system – 2024/2025 estimate

Economic indicators of synthesis	Conventional	Ecological	deviations	
			UM	%
Average production per ha (to/ha)	45	35	-10	78
Production value per ha (lei/ha)	253,237	238,791	-14445.8	94
Production expenses per ha (lei/ha)	211,031	198,993	-12038.2	94
Variable expenses (lei)	129,282	130,543	1260.6	101
Raw materials and materials (lei)	95,367	99,141	3774.3	104
Permanent labor costs (lei)	72,340	59,420	-12920.2	82
Fixed expenses (lei)	81,749	68,450	-13298.9	84
Unit production cost (lei/kg)	4.69	5.69	1.0	121

Economic indicators of synthesis	Conventional	Ecological	deviations	
			UM	%
Capitalization price (lei/ton)	5,628	6,823	1195.1	121
Labor productivity in physical expression (man-hours/ton)	45.2	64.0	18.8	142
Profit or loss per production unit (lei/ha)	42,206	39,799	-2407.7	94
Profit or loss per product unit (lei/ton)	938	1,137	199.2	121
Rate of return (%)	20	20	0	100
The profitability threshold in value units (lei)	167,011	150,997	-16013.4	90
The profitability threshold in physical units (to)	29.7	22.1	-7.6	74
Exploitation risk rate (%)	66.0	63.2	-2.8	96
Security Index (Is)	0.3	0.4	0.1	133

Source: processing own calculations

- The profit per product unit is higher in the organic system (1,137 lei/ton) compared to the conventional one (938 lei/ton), suggesting a profit of 21% for the organic system.

- The break-even point is lower in the ecological system both in value units (150,997 lei) and in physical units (22.1 tons), which indicates a 10% and 26% lower break-even point respectively

- The operating risk ratio is an indicator that estimates the financial stability and ability of an agricultural holding to cope with market fluctuations and unforeseen expenses. For the conventional system, the operating risk rate is 66%, which means that 66% of the revenues obtained are needed to cover fixed and variable expenses. This indicates moderate vulnerability to market changes and variations in production costs. For the ecological system, the exploitation risk rate is 63.2%, suggesting a slight improvement in financial stability compared to conventional methods. In this case, 63.2% of the earned income is needed to cover expenses, which indicates a better ability to withstand market fluctuations and unforeseen costs.

- The safety index is a financial indicator used to assess economic stability and the ability of a business to withstand external fluctuations, such as changes in prices, costs or unpredictable income. For the conventional cropping system, the safety index is 0.3 which indicates a lower level of financial stability compared to the organic system. For the ecological system the safety index is 0.4, which shows a greater capacity to manage risks and vulnerabilities, reflecting a 33% higher financial stability

CONCLUSIONS

The comparative analysis of the economic efficiency of the cultivation of eggplant in greenhouses within the two farming systems – conventional and organic – emphasizes the importance of farmers' adaptation to market needs and environmental challenges. In the context of a growing demand for organic food products and policies increasingly favorable to organic farming, farmers need to adjust their strategies and invest in innovative technologies. These initiatives not only support sustainability and environmental protection, but also contribute to increasing competitiveness in an increasingly demanding market.

Production costs are important in assessing the viability of each type of farming system. Consequently, the total production expenses in conventional agriculture involve higher

costs (211,030.8 lei/ha) compared to organic agriculture (198,933 lei/ha), which represents a difference of 6%. Variable expenses represent an important share of the total costs, constituting 61% in the conventional system and 66% in the ecological one.

Another important factor in ensuring the economic viability of both farming systems is subsidies. The analysis showed how much they influence the net income and profitability of farmers, having a significant impact on the activities of the vegetable sector.

Although production and production value are higher in the conventional system, the organic system stands out with higher net income and profitability due to higher selling prices and subsidies allocated. Thus, the net income including subsidies in the ecological system is 5.29% higher compared to that in the conventional system. In terms of profitability, the ecological system turns out to be more economically advantageous, with a percentage of 25% compared to 22.4% in the conventional system.

Finally, the estimated analysis of the synthetic economic indicators for eggplant culture in greenhouses, both conventional and ecological systems, underlines the role of subsidies in improving the profitability and sustainability of the vegetable sector. The study shows that, through adequate financial support, high costs can be balanced and the promotion of ecological practices becomes much more accessible to farmers.

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