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**Conference Paper**

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**Provided in Cooperation with:**

The Research Institute for Agriculture Economy and Rural Development (ICEADR), Bucharest

*Suggested Citation:* Necula, Diana Maria; Berevoianu, Rozi Liliana (2018) : Breakeven point analysis at cucumber crop in the conventional and ecological agricultural system, In: Agrarian Economy and Rural Development - Realities and Perspectives for Romania. 9th Edition of the International Symposium, November 2018, Bucharest, The Research Institute for Agricultural Economy and Rural Development (ICEADR), Bucharest, pp. 110-116

This Version is available at:

<https://hdl.handle.net/10419/205092>

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# BREAKEVEN POINT ANALYSIS AT CUCUMBER CROP IN THE CONVENTIONAL AND ECOLOGICAL AGRICULTURAL SYSTEM

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**Summary:** *Cucumber is found amongst vegetables grown for 3000 years and is of particular importance because of its nutritional value with a very low caloric intake. Cultivation of cucumbers is one of the most widespread in our country and can be consumed in both crudest and preserved state. In the present paper, based on some technical and economic indicators, an estimation of the economic efficiency for the cultivation of cucumbers cultivated in protected areas for conventional and ecological agriculture was made. Economic efficiency has been estimated in terms of applying modern technology to the production process and the rational use of material, human, financial resources to provide superior products at a low cost. Actions taken on agricultural holdings are permanently guided by the economic efficiency of crops.*

**Key words:** *economic efficiency, profitability, cucumber culture, conventional system, ecological system*

**JEL Classification:** *O12, Q14, Q57*

## INTRODUCTION

An important part of agriculture in our country is represented by vegetable growing. The beneficial effect of eating vegetables on the human body is demonstrated in countless studies over time. It represents important source of food and, as well as an important source of income for producers. To meet consumption needs, vegetables are grown both in the field and in protected areas (greenhouses, solariums, etc.) ensuring the need for vegetables on the market for a longer period. The vegetable market has grown considerably due to the increased demand for vegetables throughout the year and the consumer's orientation towards domestic products.

An important share among crops of vegetables grown in our country, holds the cucumber crop. According to EUROSTAT statistics, the areas cultivated with cucumbers grown in protected areas increased, ensuring the growing consumption of cucumbers in the off season. Cucumber consumption has increased in recent years due to its low-calorie intake of just 20 kcal per 100g.

It is necessary to support and increase the production of vegetables to ensure the nutritional needs of the population. This goal can be achieved by developing the vegetable sector grown in protected areas where large yields can be achieved on small areas. To achieve this goal, agricultural research needs to support producers by providing them with the most efficient technological and economic solution.

## MATERIAL AND METHOD

The production technology encompasses all agrophytotechnical, agrochemical and phytosanitary measures and works applied to a culture that materializes in the technological value. On the basis of the technological estimate, the revenue and expenditure budgets are drawn up and operational plans of the agricultural holdings are drawn up.

The structure of the budget per culture refers to the detailed presentation of all the components, as follows:

- Production value - is calculated taking into account average yields per hectare and estimated domestic market prices for the main production as well as the value of secondary production;
- Subsidies - represents the state's financial support in the harvest year for the producers in the vegetal sector;

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- Gross product - is calculated by adding subsidies from the budget to the grant amount;
- Intermediate consumption - is the sum of the value of inputs and services that contribute to the production of agricultural products, including seed and planting material, fertilizers and amendments, pesticides and other materials, mechanical works, irrigation, supply costs, labor costs, and management, interest on loans, insurance, amortization for buildings and utilities.
- Taxable income - is calculated by subtracting the principal production value of intermediate consumption for the main production;
- Net income - is obtained by deducting from the taxable income the related tax value;
- Net income + subsidies - is calculated by summing the subsidies granted by the state budget to the net income.
- Rate of taxable income - is expressed as a percentage and is calculated by reporting the taxable income at intermediate consumption for the main production;
- Rate of Net income + subsidies - is expressed as a percentage and is calculated by dividing net income + subsidies on intermediate consumption for main production;
- Cost of production - is obtained by reporting the expenditure for the main product to the main crop production;
- The foreseeable domestic market price is the price at which the capitalization production will be made in the harvest year considered.
- *The yield threshold* is expressed by the average production limit (Kg / ha), from which the profitability of the crop begins, is determined by the following formula :

$$PR (kg / ha) = Ch (lei / ha) / Pv (lei / kg)$$

In which: PR - profitability threshold Kg / ha ; Ch - main production expenses lei / ha ; Pv - sale price RON / Kg

- *The rentability rate* is expressed as a percentage (%) and is determined by comparing the total benefit to the overall expenditure of the culture for the main product, or by reporting the benefit per tonne to the cost of production per tonne multiplied by 100 by the formula:

$$Rr = (B (lei / tonne) / Cost (lei / tonne)) \times 100$$

In the paper we used indicators such as the average rate and the annual growth rate, having the formula:

$$r_{2012-2016} = \sqrt[4]{\prod (p1/p0)} - 1$$

where: r 2012 - 2016 = annual rate;  $\prod p1 / p0 =$

chain-linked growth indicators.

The data used were as follows : Eurostat , <https://ec.europa.eu/eurostat/data/database> and data from the literature.

## RESULTS AND DISCUSSIONS

### 1. Grown surfaces, outputs and sales prices for cultivated cucumbers in field and in protected areas

Romania in 2017, according to official data from EUROSTAT, is in the top of the countries with the largest areas cultivated with cucumbers in field and protected areas in the EU. In 2017, Turkey cultivated the largest cucumber areas of 36,000 ha, Spain cultivated 7,480 ha and Romania 5,440 ha. Romania cultivated cucumbers in field on surfaces with 84.9% lower than Turkey, 28.3% lower than Spain but 9 times larger than Netherlands. However, there is a much lower production in Romania than in these countries. Thus, we get an average production per hectare of 17.07 t / ha, while Turkey gets 50t / ha, Spain approx. 84t / ha, and the Netherlands 667

t/ha. And in the case of cucumbers grown in protected areas, the Netherlands obtains the highest production per hectare of about 689 t/ha, Denmark and Belgium about 400 t/ha, while Romania, even if it is in the top of those who cultivate the most large cucumber areas in the EU get an average production of 50 t/ha.

Table no. 1 The analysis of cucumber surfaces and production in field during 2012-2017

Category	MU	2012	2013	2014	2015	2016	2017	Average rhythm (%)	Annual growth rate (%)
Surface	1,000 ha	6.69	6.32	6.44	5.73	5.70	5.44	88.58	-4.05
	%	100	94.47	96.26	85.65	85.20	81.32		
Production	1,000 t	102.54	103.76	115.31	102.47	88.75	92.91	98.15	-1.95
	%	100	101.19	112.45	99.93	86.55	90.61		

Source: EUROSTAT, <https://ec.europa.eu/eurostat/data/database> , accessed 08.10.2018

As it can be seen from the data presented in Table 1, in Romania the area cultivated with cucumbers in field is decreasing, being in 2017 with 18.7% lower compared to the reference year 2012, with an annual growth rate of - 4.05%. In the analyzed period 2012-2017, the production has the same decreasing trend as the areas cultivated with cucumbers, being approx. 10% lower in 2017 compared to 2012, falling at an annual rate of -1.95%, but are higher by 4.7% compared to the previous year.

Table no. 2 The analysis of areas and total productions of cucumbers cultivated in protected areas during 2012-2017

Category	MU	2012	2013	2014	2015	2016	2017	Average rhythm (%)	Annual growth rate (%)
Surface	1,000 ha	1.09	1.12	1.24	1.23	1.22	1.16	109.54	1.25
	%	100	102.75	113.76	112.84	111.93	106.42		
Production	1,000 t	35.95	33.69	44.62	56.97	52.98	57.51	136.73	9.85
	%	100	93.71	124.12	158.47	147.37	159.97		

Source: EUROSTAT, <https://ec.europa.eu/eurostat/data/database> , accessed 08.10.2018

From the data presented in table no. 2 it is observed that the area cultivated with cucumbers in protected areas in 2017 increased by 6.42% compared to the first year of the period, with an annual growth rate of 1.25%, but compared to previous years it decreased about 5%.

The productions increased considerably compared with the first year of the period with a faster growth rate of 9.85%. If in 2013 the production had a downward trend (by 6.3%) compared to the previous year, starting with 2014 it increased by 59.97% higher than in 2012.

Table no. 3 The analysis of the sales price of cucumbers grown in field and protected areas in the period 2012-2017, expressed in euro / 100kg

Price euro /100kg	2012	2013	2014	2015	2016	2017	Average Rhythm%	Annual growth rate %
Cucumber in the field	49.34	48.88	48.83	46.12	55.90	52.09	102.08	1.09
	100.00	99.07	98.97	93.47	113.30	105.57		
Cucumber in protected areas	62.12	53.63	48.38	52.64	45.65	80.55	90.42	5.33
	100.00	86.33	77.88	84.74	73.49	129.67		

Source: EUROSTAT, <https://ec.europa.eu/eurostat/data/database> , accessed 08.10.2018

The selling price of cucumbers cultivated in field falls as evidenced by data analysis in Table 3 in the first part of the period under review, reaching in 2015 with aprox. 7% lower than in 2012. In the following year it increases by 21% compared to the previous year and by 13%, compared to 2012.

In 2017 the sale price of cucumbers cultivated in field reaches 52.09 euro/100kg, representing an increase of 5.57% compared to the first year.

The price of cucumbers cultivated in protected areas until 2016 decreased compared to the reference year, but in 2017 it grew by 76% compared to the previous year and 30% more than in 2012.

## 2. Incomes and Expenses Budget

Agricultural research has to come to support the vegetable producers, so that under ADER 1311, developed by ICEADR, production technologies for the main vegetable crops, including cucumbers cultivated in protected areas under conventional farming systems and ecological, with the support of SCDL-Buzău.

On the basis of the technological estimates, the "Incomes and Expenses Budgets" have been compiled with "Total Expenses" consisting of "Fixed Expenses" and "Variable Expenses".

The share of Variable Expenses in Total Expenses is 62.69% in the conventional system and 67.41% in the ecological system, and the Fixed Expenses have a share of 37.31% in the conventional system and 32.59% in the ecological system.

Table no. 4 The comparative analysis of variable costs for cucumber crop cultivated in the solarium in conventional and organic agriculture system

No.	Indicators	Conventional System Estimated production = 100 tonnes / ha		Ecological system Estimated production = 75 tonnes / ha		Deviations	
		lei	%	lei	%	lei	%
1	Variable Expenditures	89,523.1	100	97,310.1	100	7,787.0	109
2	- Expenditure on raw materials and materials	71,243.3	79.58	78,609.8	80.78	7,366.5	110
3	- Expenditure on mechanized works	3,136.6	3.50	2,397.0	2.46	-739.6	76
4	- Expenditure on irrigation	2,343.9	2.62	2,740.5	2.82	396.6	117
5	- Heat expenses (2 months)	3,000.0	3.35	3,000.0	3.08	0.0	100
6	- Supply costs	7,124.3	7.96	7,861.0	8.08	736.7	110
7	- Insurance	2,675.0	2.99	2,701.9	2.78	26.9	101

Own calculations

From the comparative analysis of variable expenses presented in Table 4, it follows that:

- the variable costs in the ecological system are 9% higher than those in the conventional system;
- in both systems of culture the largest share, about 80% of the variable expenses are the expenses with raw materials and materials (it is observed that in the ecological system they are 10% higher than the conventional system);
- Most of the costs incurred in the organic farming system are higher than the conventional system, except for mechanized works that are lower by 24%.

Table no. 5 Comparative analysis of the raw material costs for the cultivation of cucumbers in solarium in conventional and organic agriculture system

No.	Indicators	Conventional System Estimated production = 100 tonnes / ha		Ecological system Estimated production = 75 tonnes / ha		Deviations	
		lei	%	lei	%	lei	%
1	Expenditure on raw materials and materials	71,243.3	100	78,609.8	100	7,366.5	110
2	- seed and planting material	8,190.0	11.50	50,400.0	64.11	42,210.0	615

3	- organic / natural fertilizers	9,000.0	12.63	10,000.0	12.72	1,000.0	111
4	- chemical / foliar fertilizers	6,765.0	9.50	1020.0	1.30	-5,745.0	15
5	Substances for combating diseases and pests	44,455.8	62.40	14,034.8	17.85	-30,421.0	32
6	- other materials	2,832.5	3.98	3155.0	4.01	322.5	111

Own calculations

The most important category of expenditures within the variables are the expenditures on raw materials and materials that have the highest weight.

In the conventional system, the largest share of raw material and material expenditures has 62.4% spending on pest and disease control substances. In the case of the ecological system where it is not allowed to apply chemical treatments, the expenditures on planting material are 64.11%, which is much more expensive than the conventional one.

Comparing the same categories of expenditure in the two crop systems, there are significant differences, so that in the ecological system the expenditures are higher for those with seed and planting material about 6 times the conventional ones, and for the fertilizer expenses and pest and disease control agents are much lower by 85% and 68%, respectively.

Table no. 6 Comparative analysis of fixed expenditures for the cultivation of cucumbers in the conventional and organic farming system

No.	Indicators	Conventional System Estimated production = 100 tonnes / ha		Ecological system Estimated production = 75 tonnes / ha		Deviations	
		lei	%	lei	%	lei	%
1	FIXED EXPENDITURES	53,270.5	100	47,050.3	100	-6,220.2	88
2	- Expenditure on permanent labor	46,900.1	88.04	40,484.4	86.04	-6,415.7	86
3	- General and management costs	3,343.7	6.28	3,377.3	7.18	33.6	101
4	- Loan interest	1,236.2	2.32	1,242.3	2.64	6.1	100
5	- Amortization for buildings and utilities	1,790.5	3.36	1,946.2	4.14	155.7	109

Own calculations

Comparing fixed expenditures between the two cultivation systems is found that in the ecological system, the expenditures are lower by 12% compared to the one in the conventional systems.

Within these expenditures, in both systems of culture, the share of the permanent workforce, namely 88% in the conventional system and 86% in the ecological system, accounts for the largest share, with the difference between the two systems being of 14%.

### 3. Economic synthesis indicators

Table no. 7 Comparative analysis of economic indicators for cucumber culture in protected spaces in the conventional and ecological agriculture system - estimates 2018/2019

Nr. crt.	Economic indicators of synthesis	UM	Conventional system	Ecological system	deviations	
					UM	%
1	Average production per ha	to / ha	100	75	-25	75
2	Production value per ha	lei / ha	171,352.30	180,450.50	9,098.2	105.31
3	Subsidies	lei	542.8	2,525.40	1,982.6	465.25
4	Gross product	lei	171,895.10	182,975.90	11,080.8	106.45
5	Production costs per hectare	lei / ha	142,793.60	144,360.40	1,566.8	101.10
6	Unit cost of production	lei / to	1,427.90	1924.80	496.9	134.80

7	Cost of capitalization	lei / to	1,713.50	2406.00	692.5	140.41
8	Productivity of work in physical expression	man-hours / ton	29.3	33.6	4.3	114.68
9	Profit or loss per unit of production	lei / ha	28,558.70	36,090.10	7,531.4	126.37
10	Profit or loss per unit of product	lei / to	285.6	481.2	195.6	168.49
11	Rate of return	%	20	25	5	125.00
12	Profit threshold in units of value	lei	111,549.60	102,119.40	-9,430.2	91.55
13	The threshold of profitability in physical units	to	65.1	42.4	-22.7	65.13
14	Rate of exploitation risk	%	65.1	56.6	-8.5	86.94
15	Security Index ( Is )		0.3	0.4	0.1	133.33

Own calculations

The above table data presents an analysis of economic synthesis indicators for the crop of cucumbers cultivated in the solarium for both systems: conventional and ecological. From this analysis it follows that:

- The ecological production is 25% lower than in the conventional system, but the value of organic production exceeds with 5.31% compared to the conventional system due to the higher unit price of the product in the case of culture in an ecological system, with 40.41%.
- The synthetic reference indicator for expressing the economic efficiency of expenditure by product, the production cost is 1,427.90 lei / ton in a conventional system, and in the organic system it is 34.8% higher.
- With regard to labor productivity, it is noted that for one tonne of conventional product, 29.3 hours per person are consumed, of which 0.8 hours / t for mechanical works and 28.5 hours / t for manual works, in while a tonne of product required in the organic system a total of 33.6 hours-person, of which 0.8 hours / t for mechanical works and 32.7 hours / t for manual works.
- The rate of profitability was 20% in the conventional system and 25% in organic systems, producing cucumber culture in the solarium system has proved economically efficient.
- In case of cucumbers cultivated in conventional systems, the profitability threshold in physical units is 65.1 t /ha, having a value equivalent of 111.549,6 lei / ha, and in a green system the physical threshold is 42.4 t / ha with the corresponding value threshold of 102,119.4 lei/ ha.
- The rate of exploitation risk consists of a synthetic indicator that evaluates the risk in the case of non-realization of the estimated production. In cucumber culture in the solar, this indicator is 65.1% in the conventional system and 56.6% respectively in the ecological system.
- The security index refers to the existing security margin by building the culture, increasing it in the same way as the value of the security index. For cucumber crops, this index is 0.3 and 0.4 for the two crop systems respectively.

## CONCLUSIONS

- The cucumber culture holds an important share among vegetable crops grown in our country, being a vegetable that can be eaten throughout the year, both in the raw and preserved state.
- Romania in 2017, according to official EUROSTAT data, even if it is in the top of those who cultivate the largest areas of cucumbers in the EU, obtained an average production of 50 t/ ha while production in the Netherlands was about 689 t/ha , in Denmark and Belgium about 400 t / ha.
- In Romania, the area cultivated with cucumbers in protected areas in 2017 increased by 6.42% compared to the first year of the period, and the obtained productions increased considerably compared to the same year by about 60%.

-In 2017 the sales price of cucumbers grown in protected areas by 2016 decreased compared to the reference year, but in 2017 it grew by 76% compared to the previous year and by 30% compared to 2012.

- In order to support the vegetable producers, technological records of cucumbers were produced in the solarium system in a conventional and ecological farming system, on the basis of which the economic indicators were computed. Their analysis shows that the situation of cucumber culture in the sun is favorable and, as a decisive argument, the real value of the turnover exceeds the profitability threshold expressed in units of value by 53.6% and 76.7%, respectively.

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