PROFIT IN THE GREENHOUSE: CASE STUDY OF CONVENTIONAL, HYDROPONIC AND ORGANIC TOMATO GROWING SYSTEMS

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Abstract:

This study investigates the production costs and revenues of the enterprises engaged in greenhouse tomato cultivation, in the region of Moldova, Romania and examines the differences based on the growing system: conventional, hydroponic and organic. It also tries to generate useful data for antrepreneurs who are interested in investing in growing greenhouse tomatoes.

The currentresearch was carried out in three different locations. The conventional and organic growing systems took into analysis are located in Vaslui County (Duda-Epureni and Bogdăniţa), while the hydroponic tomatoes are grown in Iaşi County (Bivolari). The data used in this research were collected using questionnaires and belong to the 2014 – 2016 production period. All the economic and financial indicators included in the study are reported in the same unit of measurement, square meter, for there to be a common basis of comparison among the growing systems. Using the conventional technology, the farmer obtained a revenue of 41.16 lei per square meter of classic tomatoes in the first year of study and of 35.45 lei in the second year. The classic hydroponic tomatoes brought the farmer an income of 94.40 lei in 2014 – 2014 and of 125.72 lei and the cherry organic tomatoes have provided a revenue of 117.68 lei and 53.28 lei respectively.

Key-words: *greenhouse, tomato, profitability, growing system, technology*

INTRODUCTION

In Romania tomatoes are grown mainly in open field, but there is a quite large production sector in protected environment – greenhouses. According to Eurostat, in 2008, tomatoes were

allocated about 30,000 hectares, with a production volume of 536,000 tons. This is 40% less than the peak in 2004. In 2015, tomatoes were grown in Romania on the area of 24,300 ha. Record production was of 464.8 thousand tons, at an average selling price of 60.74 euro / 100 kg (Eurostat).

In the early 2000s there has been an intense process of restructuring theagricultural activities so that the production volume of tomatoes grown in private homegardens was significantly reduced, while the production volume by professional farmers increased. The share of industrial processing tomatoes is of 20 to 30%.

The retail market in Romania continues to grow rapidly, and the purchasing method is changing rapidly and substantially, so that 40% of fruit and vegetables are now purchased in supermarkets rather than traditional street markets.

Because of product perishability (fewer opportunities for a long-distance transport) and of the possibility to organize profitable production in greenhouses, the international trade of tomato is obviously regional.

This research examines the production costs and revenues, along with profits of conventional, hydroponic and organic greenhouse tomato farms in Moldavia region and it also tries to draw some idea of the comparative profitability of the three techonologies used.

The conventional greenhouse used in this analysis is made of woodframe covered with inflated double polyethylene (PE) film with a total are of 300 sqm. The hydroponic greenhouses are made of galvanized steel frame covered with polycarbonate and consist of a total area of 30,000 sqm. The organic greenhouse is built similarly to the conventional one, differing the frame which is of aluminium; during the first year of study, the organic tomatoes were grown on 2,700 sqm while the following year the area was of 2,000 sqm.

MATERIAL AND METHOD

The main material of this paper consisted of data collected in face-to-face interviews through questionnaires from the farmers engaged in tomato greenhouse production activities in Moldavia region (Iasi and Vaslui counties). Farmers were asked to share expenses and labor hours for different tasks on a standardized form. In the late fall of 2015 and 2016, the author visited each farm, reviewed the statements and estimated any missing data through recall. The

secondary data were obtained from certain organizations, such as Eurostat. Besides, the findings of relevant national and international studies were also employed.

All the economic and financial indicators included in the study are reported in the same unit of measurement, square meter (sqm), for there to be a common basis of comparison among the growing systems. The farmers of all three cultivation systems have opted for a single production cycle of tomatoes.

The budget data were collected over the course of two distinct growing seasons, 2015 and 2016, on each farm. Using the basic framework of Kay R. D. and Edwards W. M. (1999), costs were divided into direct operating (variable) costs and indirect (fixed) costs.Variable costs were organized into inputs and labor needed to perform each task associated with growing, harvesting and packing the produce. For each techonology or growing system, this included costs of inputs and labor for tillage, fertility, seeding, transplanting, pest and disease control, irrigation, harvest and packing. Fixed costs covered buildings, machinery,equipment (amortized by expected years of service), utilities, taxes and all other associated expenses.

RESULTS AND DISCUTIONS

The budget of an enterprise can be used to estimate its profitability by including sales revenue and net returns. Net returns are expressed as gross margin and net income. Gross margin is expressed as revenue minus variable cost and net income represents the revenue minus all costs and taxes. Enterprise budgets do not address whether the enterprise can produce a sufficient flow of funds to meet the cash obligations of the enterprise (Hood K. et al., 2007).

Cash flow analysis is used to determine whether the cash generated from operations (cash inflow) will be adequate to meet the cash outlays required to operate the enterprise (cash outflow) over a given period of time. Unpaid family labor is charged to the enterprise as an expense because it represents the loss of opportunity for the family member to work elsewhere and earn income (Grigore A. A. et al., 2008).

Both enterprise and cash flow budgets for greenhouse tomato production for each growing system are presented in the following tables and discussed and analyzed in this paper.

Expenses are defined as the amount of money consumed in order to organize and conduct an economic activity to meet its needs of productive or unproductive consumption. On the other hand, cost is the value of the consumption factors that bring revenue (Ștefan G., 2014).

Cost is generally defined as all sacrifices incurred in order to gain an advantage or benefit, or a certain amount of money spent in exchange of a commodity. Cost is also described as the total amount of the expenditures made on production factors utilized in the manufacturing of specific goods or services (Başbuğ T. and Gül M., 2016).

The profitability ratio is used to assess a business's ability to generate earnings compared to its expenses and other relevant costs incurred during a specific period of time. Having a higher value relative to a competitor's ratio or relative to the same ratio from a previous period indicates that the company is doing well.

Gross profit is the value obtained after deducting the incurred variable expenses associated with production operations from the gross production value.

At the end of 2014 – 2015 agricultural year, the highest income per sqm was obtained in the organic farm, with 117.68 lei (Table 3), followed by the hydroponic farm with 94,40 lei (Table 2), while the conventional farm registered 41.16 lei (Table 1). The next year, the value of hydroponic tomatoes with 125.72 lei/sqm surpassed both the organic and conventional tomatoes. Although the cherry organic tomatoes were transplanted late in august and the plants froze in november, the gross income of 53.28 lei/sqm was higher than the one of classic conventional tomatoes.

The variable costs were highest for producing the classic hydroponic tomatoes, the biggest share consisting of planting material. The conventional tomatoes required less operating costs, of 14.57 lei/sqm, while the organic tomatoes needed only 0.87 lei/sqm. The values were about the same at the end of year 2016.

Table 1

The budget of conventional greenhouse growing system of tomatoes

INDICATORS	2014 – 2015		2015 – 2016	
	Value (lei)	Value per square meter (lei/sqm)	Value (lei)	Value per square meter (lei/sqm)
A. GROSS PRODUCTION VALUE	12,350	41.16	10,635	35.45
B. (+) SUBSIDIES	–	–	–	–
C. (=) GROSS INCOME	5,380.13	17.93	3,835.34	12.78
D. (–) TOTAL COST	6,969.87	23.23	6,799.66	22.66
I. VARIABLE COST	4,371.77	14.57	4,201.56	14
1. Cost of inputs	992.40	3.30	965.31	3.21

- Seed	458.10	1.52	458.10	1.52
- Fertilizers	220	0.73	250	0.83
- Pesticides	314.30	1.04	257.21	0.85
2. Cost of mechanical labour	22.65	0.07	23.35	0.07
3. Cost of irrigation	294.22	1.31	250.40	0.83
4. Cost of temporar labour	1,012.50	3.37	950	3.16
5. Other costs	2,050	6.83	2,012.5	6.70
II. FIXED COST	2,598.10	8.66	2,598.10	8.66
1. Cost of permanent labour	–	–	–	–
- Social insurance etc.	–	–	–	–
2. Loan interest	–	–	–	–
3. Rent	–	–	–	–
4. Other costs	–	–	–	–
5. Amortization for buildings and utilities	2,598.10	8.66	2,598.10	8.66
E. (=) TAXABLE INCOME	5,380.13	17.93	3,835.34	12.78
(–) Taxes	860.82	2.86	613.65	2.04
(–) Rent	–	–	–	–
F. (=) NET INCOME + subsidies	4,519.31	15.04	3,221.69	10.73
G. Cost of production	0.87	–	1.69	–
H. Profitability ratio	77.19%	–	56.40%	–
I. Gross profit	1,008.36	–	-366.22	–

Source: Own calculation.

Taking into consideration the fact that 16 permanent employees work full time growing the hydroponic tomatoes, plus the expenses with amortization of the 3 hectares of greenhouse, the highest fixed costs were made with also the hydroponic tomatoes, with 42.72 lei/sqm. In the organic growing system, besides the permanent labour and amortization, an additional fee was added in the first year of study for certifying the products as organic tomatoes. The lowest indirect costs were recorded with the conventional tomatoes, of just 8.66 lei/sqm.

Table 2

The budget of hydroponic greenhouse growing system of tomatoes

INDICATORS	2014 – 2015		2015 – 2016	
	Value (lei)	Value per square meter (lei/sqm)	Value (lei)	Value per square meter (lei/sqm)
A. GROSS PRODUCTION VALUE	2,832,000	94.40	3,771,600	125.72
B. (+) SUBSIDIES	–	–	–	–

C. (=) GROSS INCOME	2,832,000	94.40	3,771,600	125.72
D. (–) TOTAL COST	1,906,384.04	63.54	1,933,147.34	64.43
I. VARIABLE COST	624,692.04	20.82	651,455.34	21.71
1. Cost of inputs	479,323.14	15.97	505,714.84	16.85
- Plant material	336,157.50	11.20	226,225	7.54
- Fertilizers	137,700	4.59	275,400	9.18
- Pesticides	5,465.64	0.18	4,089.84	0.13
2. Cost of mechanical labour	–	–	–	–
3. Cost of irrigation	18,780	0.62	18,780	0.62
4. Cost of temporar labour	–	–	–	–
5. Other costs	126,588.90	4.21	126,960.50	
II. FIXED COST	1,281,692	42.72	1,281,692	42.72
1. Cost of permanent labour	606,056	20.20	606,056	20.20
- Social insurance etc.	125,920	4.19	125,920	4.19
2. Loan interest	–	–	–	–
3. Rent	–	–	–	–
4. Other costs	137,784	4.59	137,784	4.59
5. Amortization for buildings and utilities	537,852	17.92	537,852	17.92
E. (=) TAXABLE INCOME	925,615.96	30.85	1,838,452.66	61.28
(–) Taxes	148,098.56	4.93	294,152.43	9.80
(–) Rent	–	–	–	–
F. (=) NET INCOME + subsidies	777,517.40	25.91	1,544,300.23	51.47
G. Cost of production	1.67	–	1.46	–
H. Profitability ratio	48.55%	–	95.10%	–
I. Gross profit	300,923.92	–	1,186,997.32	–

Source: Own calculation.

After paying all the taxes, the farmer who opted for organic tomatoes obtained a net income of 67.52 lei/sqm in 2015. At less than half, the hydroponic tomatoes brought a net revenue of 25.91 lei/sqm and the conventional ones of 15.04 lei/sqm. The following year, since the yield in hydroponic system grew from 1,140,000 kg to 1,350,000 kg, the higest net incomealso grew to 51.47 lei/sqm and exceeded the value of the other two growing systems.

Table 3

The budget of organic greenhouse growing system of tomatoes

INDICATORS	2014 – 2015		2015 – 2016	
	Value (lei)	Value per square meter (lei/sqm)	Value (lei)	Value per square meter (lei/sqm)
A. GROSS	317,760	117.68	106,560	53.28

PRODUCTION VALUE				
B. (+) SUBSIDIES	–	–	–	–
C. (=) GROSS INCOME	317,760	117.68	106,560	53.28
D. (–) TOTAL COST	100,704.97	37.29	87,407.90	43.70
I. VARIABLE COST	2,368.15	0.87	1,770.38	0.88
1. Cost of inputs	827.74	0.30	352.24	0.17
- Seed	275.50	0.10	100	0.05
- Fertilizers	452.24	0.16	152.24	0.07
- Biopesticides	100	0.03	100	0.05
2. Cost of mechanical labour	58.89	0.02	45.30	0.02
3. Cost of irrigation	951.52	0.35	838.84	0.41
4. Cost of temporar labour	530	0.19	534	0.26
5. Other costs	–	–	–	–
II. FIXED COSTS	98,336.82	36.42	85,637.52	42.81
1. Cost of permanent labour	30,900	11.44	37,548	18.77
- Social insurance etc.	5,901		7,083	3.54
2. Loan interest	–	–	–	–
3. Rent	–	–	–	–
4. Other costs	13,446.30	2.18	–	–
5. Amortization for buildings and utilities	48,089.52	17.81	48,089.52	17.81
E. (=) TAXABLE INCOME	217,055.03	80.39	19,152.10	9.57
(–) Taxes	34,728.80	12.86	3,064.33	1.53
(–) Rent	–	–	–	–
F. (=) NET INCOME + subsidies	182,326.23	67.52	16,087.77	8.04
G. Cost of production	3.16	–	9.71	–
H. Profitability ratio	215.53%	–	21.91%	–
I. Gross profit	214,686.88	–	17,381.72	–

Source: Own calculation.

The cost of production during 2014 – 2015 registered in the organic system was of 3.16 lei/kg, 1.67 lei/kg in the hydroponic system and 0.87 lei/kg in the conventional system. The production cost was also the highest in the organic system during 2015 – 2016 due to the fact that the farmer was not able to harvest all the potential yield; on the other hand, the level of production cost got lower to 1.46 lei/kg in the hydroponic system since the yield was higher compared to the previous year.

During the first year of analysis, the organic farm registered the highest profitability ratio with 215.53% since the cherry organic tomatoes have a premium price of 12 lei/kg, compared to

2.5 – 3.5 lei/kg of conventional or hydroponic tomatoes. The next year, the profitability was much lower, because of the farmer set the crop late.

The gross profit registred wide variations from year to year in each growing system. In the conventional system, the gross profit was of 1,008.36 lei, but the next year it was of -366.22 lei because of lower yield. A similar result variation was noticed in the organic system, the gross profit going from 214,688.88 lei to 17,381.72 lei. On the contrary, the hydroponic system encountered a lower gross profit in the first year and a high one of 1,186,997.32 lei the next year.

CONCLUSIONS

Based on the findings achieved in this study, where the cost and profitability of greenhouse cultivation were examined, we conclude that larger farms yield better results in terms of economic indicators.

The overall profitability ratio of the enterprises covered in the study more than satisfactory, and this high profitability leads to the expansion of greenhouse agriculture in the region.

While this discussion uses tomato as a crop example, the principles discussed are applicable to other crops such as pepper, cucumber and eggplant. This particular example was chosen to illustrate several important aspects of greenhouse production and marketing that affect profitability such as market price, yield and labor. The practice of greenhouse cultivation in the region is of vital importance, as it promotes effective use of regional sources, increases the income of people in the region and creates employment, thus reducing migration from rural areas.

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