ECONOMIC EFFECTIVENESS OF ECOLOGICALLY ACCEPTABLE PRODUCTION OF VEGETABLES IN PROTECTED AREA[1]

Jonel Subić[2], Marko Jeločnik[3]

Abstract

In the conditions of the growth of global population, among basic principles of agriculture, regardless of territorial level observed, the maintenance of food security, i.e. maintenance of sufficient quantity of food, at affordable prices, for each inhabitant, should be emphasized. Pressured with constant growth in the volume of industrial food production, the principle of food safety, i.e. maintenance of health-acceptable supplies of agricultural and food products to all categories of the population, is to some extent neglected. Whether organized in a protected area or in an open field, vegetable production is among the most intensive sectors of agriculture.

At the national level, for many years vegetable production has been characterized with the constant growth in the production volume. Consumer requirements that determine the demand for vegetable, from the aspect of the variety and quality of offered products, are increasingly being profiled as a factor of sustainability of vegetable realization at local markets. Due to this, the producers are faced with the task to, in addition to the quantities, the delivery continuities, and the technological quality of vegetables, focus more on the specific nutrition and health safety of fresh vegetables and their processed products.

Although the concept of vegetable production in line to environmental requirements is not of a recent date, up till today it hasn't been adopted to a greater extent by vegetable producers. Further development and strengthening of the presence

1 Paper is a part of the research at the project no. III-46006, funded by the Ministry of Education, Science and Technological Development of the Republic of Serbia, as well as project no. 680-00-00041/1/2017-02, funded by the Ministry of Agriculture, Forestry and Water Management of the Republic of Serbia.

2 Jonel Subić, Ph.D., Associate Professor, Principal Research Fellow, Institute of Agricultural Economics, Volgina Street no. 15, 11060 Belgrade, Serbia, Phone: +381 11 697 28 58, E-mail: jonel_s@iep.bg.ac.rs

3 Marko Jeločnik, Ph.D., Research Associate, Institute of Agricultural Economics, Volgina Street no. 15, 11060 Belgrade, Serbia, Phone: +381 11 697 28 52, E-mail: marko_j@iep.bg.ac.rs

of ecologically oriented vegetable production in the open field or in a protected area, should provide positive implications for national agriculture by providing sufficient quantities of quality and health safety vegetables, as well as creation of a recognizable image of domestic vegetable producers, from the point of consistent adherence to the principles of good agricultural practice in the regional framework.

According to basic goal of this paper, promotion of a health safe and ecologically acceptable vegetable production in a protected area, which provides economic benefits and the security of products realization for the vegetable producer, the research imposed the need to analyse the economic effects of ecologically acceptable vegetable production in relation to the conventional vegetable production. Accordingly, the necessary data were collected through an in-depth interview with members of selected family agricultural holdings specialized in the production of vegetables. Most of gained data are directly related to 2018, while some represent a reflection of the interpreter's assessment or scientifically verified standards in vegetable production. Starting from the fact that the basic representativeness of producers is provided by their long tradition in vegetable production, as well as their production orientation, selected agricultural holdings were categorized as family agricultural holding A (engaged in ecologically acceptable vegetable production) and family agricultural holding B (engaged in conventional vegetable production).

The results obtained from the analytical calculation based on variable costs show that positive contribution margins have been achieved (in the case of a family agricultural holding A: 27.815,00 RSD/are, or in the case of family agricultural holding B: 28.896,65 RSD/are). As opposed to conventional production, ecologically acceptable vegetable production (tomatoes) achieved better yields (total 1.170 kg/are compared to 1.130 kg/are) and higher sales prices on the market (average of 64,76 RSD/kg compared to average of 45,00 RSD/kg). On the other hand, conventional production is characterized by considerably lower variable costs which led to a better gross financial result, primarily due to the large share of laboratory analyses (52,13%) in the variable costs structure in ecologically acceptable vegetable production.

Key words: *economic effectiveness, ecological sustainability, vegetable production, protected area.*

Introduction

In an effort to intensify the linking between the development and environmental protection, national agriculture accepts the concept of sustainable development that requires the use of land and water resources without disturbing their ecological status.

In line with the concept of sustainable agriculture, the specificities of sustainable production in agriculture could be recognized *in the contribution to sustainable land management in agriculture and the preservation of agro-biodiversity, in accordance with the rules of Good Agricultural Practice (GAP),* (Vasiljević et al., 2010).

In accordance with the GAP Codex[4], efficient management of agricultural holding implies, above all, the application of standards that include[5]:

- Protection of natural resources;
- Environmental management;
- Safety of the workforce;
- Animal health and welfare;
- Food and feed safety;
- Health care.

As a modern concept of agricultural business, a GAP codex requires from the agricultural producers that everyone, in accordance with their possibilities, contributes to the preservation of the environment, soil fertility and potentials in food production, as well as to advancement of quality of agricultural products[6].

In order to improve the existing knowledge of agricultural producers along with other market actors, the promotion of health-safe and ecologically acceptable vegetable production is based, inter alia, on the importance and specificities of ecologically acceptable vegetable production in protected area. On the other hand, the cost-effectiveness of production and the security of products' realization impose the two crucial requisites:

4 The Codex of Good Agricultural Practice in the form of by-law is prescribed by the Minister of the Ministry of Agriculture, Forestry and Water Management, two years after the Law had been passed (Vasiljević et al., 2010).

5 http://istocar.bg.ac.rs/tic_inst/obuka02.html

6 http://cms.optimus.ba/Avanti_ApplicationFiles/122/Documents/kodeks_dobre_polj_prakse.pdf

- An analysis of the economic effects of the application of the concept of ecologically acceptable vegetable production contrary to the conventional vegetable production;
- Recording of all data related to production process within the Crop Record Book.

As a specific goal and result of this research, and in line with the abovementioned, the comparative economic analysis is set, i.e. making of analytical calculations based on variable costs (contribution margin) for the selected line of vegetable production in a protected area, organized in the systems of ecologically acceptable or conventional production. Through the obtained results for the contribution margin, in addition to the previously considered impacts of ecological and social sustainability of production, their economic importance is emphasized if they were applied by certain vegetable producers. In other words, it was attempted to demonstrate the potential economic benefit that could be achieved on family agricultural holdings specialized in the vegetable production (either in the open field, or in a protected area), in addition to the general (complete social community) and individual (consumers) health and ecological impact of the application of this method of vegetable production.

Simplification of the conducted analyzes and securing the significance of the comparability of the obtained results assumed the development of analytical calculations in both applied production systems only for one line of vegetable production (tomato production line) organized at selected agricultural holdings. Also, better comparability of the obtained results is ensured by presenting all incomes and costs within the observed productions per uniform unit of the production area (per are, or one hectare) in the national currency (RSD). The optimality of the adopted production technology was evaluated throughout the presentation of the structure of variable costs, while all results, in order to better transparency, were presented in form of table or graphically.

Methodology

According to the Census of Agriculture - 2012 (SORS, 2013), there are 290.233 *specialized agricultural holdings* in the Republic of Serbia (or 45,96% of the total number of agricultural holdings), out of which:

- 128.901 agricultural holdings (44,41% of the total number of specialized agricultural holdings) are specialized in crop production;

- 55.562 agricultural holdings (19,14% of the total number of specialized agricultural holdings) are specialized in pigs and poultry production;
- 52.905 agricultural holdings (18,23% of the total number of specialized agricultural holdings) are specialized in the breeding of grazing livestock (cattle, sheep or goats);
- 44.058 agricultural holdings (15,18% of the total number of specialized agricultural holdings) are specialized in growing of permanent crops (vine and fruits);
- 8.807 agricultural holdings (3,03% of the total number of specialized agricultural holdings) are specialized in vegetable, flower and other horticulture products production.

Beside the fact that in the category of *specialized agricultural holdings* in the Republic of Serbia, agricultural holdings oriented to vegetable production are at the bottom of the list, their presence within the group of *mixed agricultural holdings* for plant production (56.906 agricultural holdings, or 9,01% of the total number of agricultural holdings) leads to the conclusion that their number is not small, and it's close to 10.000 *agricultural holdings specialized in the vegetable production* (Vasiljević et al., 2018).

Based on the character of this paper, the following research was conducted:
- Analytical calculations based on variable costs for ecologically acceptable vegetable production in protected area (i.e., production of tomato in greenhouse) have been made;
- Analytical calculations based on variable costs for conventional vegetable production in protected area (i.e., production of tomato in greenhouse) have been made.

In both cases, the processed and presented data are directly related to the cycles of vegetable production organized in protected area (i.e., production of tomato in greenhouse).

The characteristic of agricultural production is that in a large extent it is dependent on the environmental factors, which is more visible in plant production than in cattle breeding (Devendra, 2012). Plant production organized in protected areas (greenhouses) is less susceptible to the impact of climate factors (FAO, 2013), but generates specific costs that need to be identified and which size has to be determined (Laate, 2013). One way for determining the production

costs present in all lines or segments of agriculture (including production in greenhouses) is the development of analytical calculations based on variable costs (contribution margin).

In conditions of transition, or frequent changes in business environment, agricultural producers begin to focus on profitable productions that enable the achievement of a positive financial result, i.e. that generate production value higher than the total costs of production (Subić et al., 2010).

Calculation of the coverage of variable costs (contribution margin) in the production of certain vegetables at the agricultural holding is calculated on the basis of the total realized incomes generated by the production of that crop, reduced for the total generated variable costs of mentioned production. Total sum of generated incomes includes the market value of the primary and by-products, increased by the subsidies for the observed line of production. In vegetable growing, the majority of used inputs have the characteristic of variable costs, e.g., seeds, seedlings, mineral and organic fertilizers, substrates, pesticides and growth bio-stimulators, fuels and lubricants, agricultural mechanization services, engaged labor (in certain cases work of members of the household), certain supplies and accessories, etc. (Subić, Jeločnik, 2016).

Analytical calculation based on variable costs could be expressed by next mathematical formula (Subić, Jeločnik, 2013):

$$PVT = Q - VT, \text{ while } Q = (q \times c) + p$$

Where analytical elements represents:
- PVT - Contribution margin (coverage of variable costs);
- Q - Achieved production value;
- VT - Gained variable costs;
- q - Volume of product per unit of production area;
- c - Price of product per unit of measure;
- p - Subsidies per unit of production area.

Most often, producers have a negligible impact on realized incomes (selling price of product), as they are primarily a result of confrontation of overall supply and demand on the certain market. However, by the adequate control of the production activities and reduction of justified costs, or elimination of needless costs, they can

have a great effect on total production costs and generating of cost price of their products (Subić et al., 2015/1).

By summing the contribution margins of all production lines that are carrying out at the agricultural holding, it could be obtained the total contribution margin that reflects rough valorization of complete business activity success. According to its value reduced for the total fixed costs realized on the agricultural holding, it could be calculated the gained gross financial result. Calculating the contribution margins for individual production lines leads to marking of those production lines that produce more favorable economic results (in case of equalized fixed costs), what represents a good base for decision regarding the future production orientation and further development of the certain agricultural household (Jeločnik et al., 2015). At the same time, it enables identification of certain cost's impacts on achieved production results, whose reduction could initiate advancement of household's business result (Jeločnik et al., 2013; Subić et al., 2015/2).

In plant production, the contribution margin is commonly calculated per unit of production area, previously aligned with the total surfaces under the grown crop. Therefore, the observed method could be also used for comparison of production results of individual culture produced within the different levels of production intensity (Ivanović, Jeločnik, 2016). Besides, method allows quick and simple insight into the business of agricultural holding derived from one production year or one production cycle, as well as calculation of achieved results after the change in scale of production, or change in practiced production lines (Subić et al., 2010).

By calculations based on variable costs it could be estimated the ability of producer to cover all variable costs after sale of the product, as well as to achieve a certain value that will be used for covering of fixed costs and possible gaining of profit (Andrić, 1998). Simplicity of application of mentioned method is quite important for agricultural holdings that are not pressured with required business recording and book-keeping (Vasiljević, Subić, 2010), as it creates a position for making of prompt insight into the financial result they generate. Method represents an excellent tool for supporting the decision-making process during the economic analysis of current state within organized production lines, since it provides an adequate assessment of the sustainability of adopted technical-technological approach and achieved results of production (Jeločnik et al., 2016).

In line to the significant influence of weather conditions (lead to oscillation in yields) and market conditions (changes in prices of primary products and used inputs) on the holdings' business results, it should be also done an analysis of production results in conditions of uncertainty. For this purpose, generally the method for determining the critical values of production is used (values that equalize the contribution margin with zero), that implies critical price, critical yield and critical variable costs. Calculation of mentioned indicators considers the following formulas (Nastić et al., 2014):

Critical price: $KC = (VT - p) / OP$
Critical yield: $KP = (VT - p) / OC$
Critical variable costs: $KVT = (OP \times OC) + p$

Where:
OP - Expected yield;
OC - Expected price;
p - Subsidy;
VT - Variable costs.

As well, in the conditions of uncertainty, a method of sensitivity analysis is used, by which is monitored the rate of change in contribution margin due to decrease in yield or selling price, or due to growth of variable costs of production (Subić, Jeločnik, 2012).

Research results with discussion

In accordance to previously set research goals, the analysis of economic effects of applying the concept of ecologically acceptable production of vegetable in protected area and their comparison with results obtained in conventional production, was preceded by the field research organized during the period January-October 2018. The research has involved production of tomato in protected area (greenhouse), in two different production systems (ecologically acceptable and conventional agro-technical approach).

The research has included collecting the necessary data throughout the in-depth interviews with the members of selected family agricultural holdings predominantly oriented to vegetable production. The most of obtained data are directly linked to the production cycles organized in 2018, while some are assessments of respondents, or scientifically verified standards in vegetable production.

Certain differences in mechanization costs are primarily reflection of the possession of partially different mechanization at the holdings (from the aspect of manufacturer and their general characteristics), as well as the influence of their age and technical condition on the energy consumption. Since the labour costs involve only the engagement of external labourer (the engagement of family members at the holding is just considered, but not included by the calculation), differences in the value of performed operations between the observed agricultural holdings are primarily caused by the number of family members, as well as level of training or working approach of externally engaged labourers.
In line to key element of agricultural holdings selection (implementation of certain production system in vegetable production), all holdings are grouped into the two categories. The first category represents the family agricultural holding (holding A) characterized by ecologically acceptable vegetable production in protected area, while the second category represents the family agricultural holding (holding B) characterized by conventional production of vegetable in the protected area.

Focusing to the family agricultural holding A, developed analytical calculation of contribution margin shows the production results gained in ecologically acceptable system of tomato production in protected area (Table 1-2. and Graph 1.).

Table 1. *Starting facts*

Greenhouse surface:	5 ares	**Agricultural holding:**	A
Production line:	Tomato - hybrid Viva	**District:**	Belgrade city
Type of production:	Vegetable production	**Statistical region:**	Serbia - North (Belgrade)
Unit of measure of production capacity:	1 are	**Production year:**	2018
Technological approach:	Production in greenhouse	**Exchange rate: 1 EUR**	118,24 RSD

Source: *Field research – required data-set for development of contribution margin calculation in vegetable production (Jeločnik et al., 2018).*

Analytical calculation based on variable costs applied to ecologically accepted tomato production in greenhouse refers to next results (Table 2.):

- It was realized a positive contribution margin (27.815,00 RSD/are) that should be large enough for covering of all fixed costs and profit gaining;
- Average selling price amounts 64,76 RSD/kg, and it was obtained according to formula: Total production value (RSD/are) / Total quantity of produced tomato (kg/are) = 75.775,00 / 1.170,00);

- Achieved incomes are for almost 1,6 times higher than generated variable costs.

Table 2. *Contribution margin*

Element	Quantity	UM	Price per UM (in RSD)	Total RSD/are	Total RSD/ha
1 – Incomes					
Tomato	1.170,00	kg	-	-	-
I class (85%)	995,00	kg	70,00[1]	69.650,00	6.965.000,00
II class (15%)	175,00	kg	35,00[1]	6.125,00	612.500,00
Insurance premium				-	-
Subsidies				-	-
Value of production (total 1)				**75.775,00**	**7.577.500,00**
2 – Variable costs					
Seed	260,00	seed	13,75	3.575,00	357.500,00
Seedlings	260,00	stalk	26,00	6.760,00	676.000,00
Manure	-	kg	-	-	-
Mineral fertilizers and bio-stimulators				2.106,00	210.600,00
Pesticides				-	-
Binder	0,80	hank	145,00	116,00	11.600,00
Mulch foil (stripes)	120,00	m	10,50	1.260,00	126.000,00
Laboratory analyses	1	set	25.000,00	25.000,00	25.000,00
Packaging (crates)	130,00	pcs	10,00	1.300,00	130.000,00
Drip irrigation tapes	120,00	m	4,30	516,00	51.600,00
Green market fee	-	day	-	-	-
Costs of mechanization				2.732,00	273.200,00
Costs of irrigation				1.440,00	144.000,00
Costs of insurance				-	-
Other costs				675,00	67.500,00
Engaged external labour				2.480,00	248.000,00
Variable costs (total 2)				**47.960,00**	**2.321.000,00**
3 – Contribution margin (1-2)				**27.815,00**	**5.256.500,00**

Source: *Field research – required data-set for development of contribution margin calculation in vegetable production (Jeločnik et al., 2018).*

Considering the structure of variable costs, ecologically acceptable tomato production in greenhouse is generally characterized with:

- Application of organic and mineral fertilizers, as well as bio-stimulators for plants growth during the phase of primary land cultivation (tilling) and supplemental plant feeding within the season of vegetation;
- Absence or ultimate rigidity in application of pesticides in production process;
- Plant breeding in greenhouse of contemporary construction, with possibility

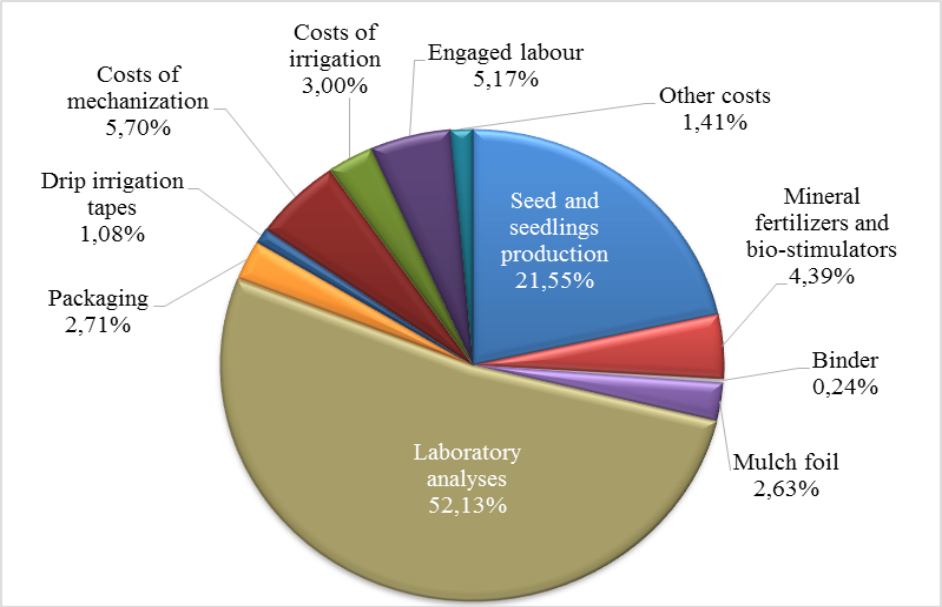
of opening of lateral sides in order to ventilate the production area. Its covered with double foil that is:

- UV rays resistant (there is no need for sun shade cover);
- With good level of heat isolation;
- Prevents moisture condensation and rejects the insects;

- Laboratory analysis set (with total value of 75.000,00 RSD) includes analysis of water, soil and produced fruit of vegetable. As during the production year, agricultural holding apply crop rotation that involves three crops, soil analysis is carried out every two years (before entering of the first and after the harvesting of the last crop), as well as water analysis. Fruit analysis is done for each crop after its harvesting. According to that, the total annual costs of laboratory analysis per grown crop amounts 25.000,00 RSD, or:
  - For fruit analysis 15.000,00 RSD;
  - For soil analysis 5.000,00 RSD;
  - For analysis of water for irrigation 5.000,00 RSD;
- Packaging (wooden crates that are, in order to preserve fruit characteristics, loading with maximally 9 kg of tomato);
- Use of drip irrigation tapes during the one production cycle.
- Family agricultural holding A has on disposal 5 labour active members. In line to fact that a quarter of totally required labour for the execution of all mentioned activities (at complete production area of 5 ares) is spent on the engagement of external labour, the labor costs are presented with the share of 25% of their total sum.

Within the structure of variable costs, the costs of laboratory analysis are dominating (52,87%). Relatively high share have the costs of tomato seed and seedlings production (21,86%), (Graph 1.).

Graph 1. Structure of variable costs – ecologically acceptable production



According to data obtained from the calculation of contribution margin, it could be made an assessment of production results under the conditions of uncertainty. In other words, it could be determined the critical values of ecologically acceptable growing of tomato in protected area (such are critical price, critical yield and critical variable costs), (Tabela 3.).

Table 3. Critical values of production

Description	RSD(kg)/are
Expected yield (OP)	1.170,00
Expected price (OC)	64,76
Subsidy (p)	0,00
Variable costs (VT)	47.960,00
Critical price: KC = (VT - p) / OP	**40,99**
Critical yield: KP = (VT - p) / OC	**740,53**
Critical variable costs: KVT = (OP x OC) + p	**75.775,00**

Note: *In line with fact that holding has been dividing the tomato into classes, expected price (OC) is an average price of sold kilogram of tomato.*

By determination of critical values of mentioned production, it could be shown the level of price, yield and variable costs at which the contribution margin equals to zero.

According to results of analytical calculation based on variable costs, it could be also done the sensitivity analysis of ecologically acceptable production of tomato in greenhouse. In other words, it is possible to show the degree of sensitivity (i.e. the level of change) of the contribution margin due to decrease in yields or selling price, or due to growth of variable costs of production (Tables 4-5.).

Table 4. Change in contribution margin caused by change (fall) in tomato yield or selling price

Fall of tomato yield or price (%)	Value of contribution margin (RSD/are)
5,00	24.025,19
10,00	20.236,49
15,00	16.447,80
20,00	12.659,10
25,00	8.870,41
30,00	5.081,72
35,00	1.293,02
40,00	- 2.495,67

Table 5. Change in contribution margin caused by growth of variable costs of production

Growth of variable costs (%)	Value of contribution margin (RSD/are)
5,00	26.719,00
10,00	24.383,00
15,00	22.047,00
20,00	19.711,00
25,00	17.375,00
30,00	15.039,00
35,00	12.703,00
40,00	10.367,00
45,00	8.031,00
50,00	5.695,00
55,00	3.359,00
60,00	1.023,00
65,00	- 1.313,00

The contribution margin in tomato production in protected area is more sensitive to the fall in value of production than to the growth of production costs. Margin equals to zero with the fall of value of production for 36,71% (each further decline in yield or products' price will induce a negative contribution margin), or with the rise of variable costs for 62,18% (each further growth of variable costs of production will generate a negative contribution margin).

Observing the family agricultural holding B, the analytical calculation based on variable costs relates to the production results gained in conventional system of tomato production in protected area (Table 6-7. and Graph 2.).

Table 6. *Starting facts*

Greenhouse surface:	1,28 ares	**Agricultural holding:**	B
Production line:	Tomato – hybrid Viva	**District:**	Braničevo District
Type of production:	Vegetable production	**Statistical region:**	Serbia - South (Southern and Eastern Serbia)
Unit of measure of production capacity:	1 are	**Production year:**	2018
Technological approach:	Production in greenhouse	**Exchange rate: 1 EUR**	118,24 RSD

Source: *Field research – required data-set for development of contribution margin calculation in vegetable production (Jeločnik et al., 2018).*

Analytical calculation based on variable costs applied to conventional tomato production in greenhouse refers to next results (Tabela 7.):

- It was realized a positive contribution margin (28.896,65 RSD/are) that should be enough for covering of all fixed costs and profit gaining;
- Achieved selling price amounts 45,00 RSD/kg;
- Achieved incomes are for more than 2,3 times higher than generated variable costs of production.

Observing the structure of variable costs, conventional tomato production in greenhouse is generally characterized with:

- Use of pesticides;
- Absence of any kind of laboratory analysis;
- Production in greenhouse of classic construction, without possibility for opening of lateral sides for ventilation, covered by single-layer foil:
  - Resistless to UV rays (there is need for sun shade cover);
  - With bad level of heat isolation;
  - That condense the moisture and does not reject the insects;
- Use of plastic packaging;
- Use of drip irrigation tapes during the few production cycles.

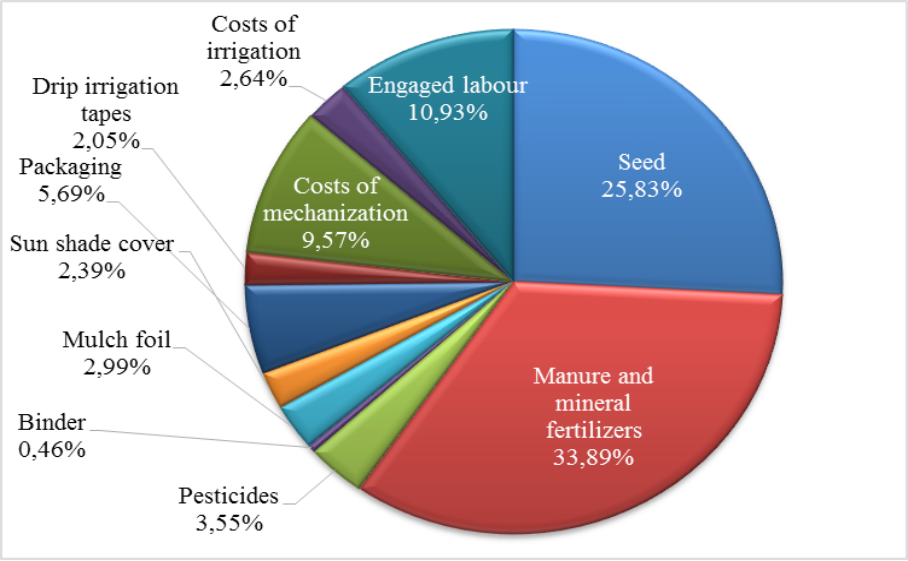
Table 7. *Contribution margin*

Element	Quantity	UM	Price per UM (in RSD)	Total RSD/ are	Total RSD/ha
1 – Incomes					
Tomato	1.130,00	kg	45	50.850,00	5.085.000,00
Insurance premium				-	-
Subsidies				-	-
Value of production (total 1)				**50.850,00**	**5.085.000,00**
2 – Variable costs					
Seed	315,00	seed	18,00	5.670,00	567.000,00
Seedlings	-	stalk	-	-	-
Manure	500	kg	1,00	500,00	50.000,00
Mineral fertilizers				6.940,20	694.020,00
Pesticides				780,40	78.040,00
Binder	0,70	hank	145,00	101,50	10.150,00
Mulch foil (stripes)	62,50	m	10,50	656,25	65.625,00
Sun shade cover	1	set	525,00	525,00	52.500,00
Packaging (crates)	125,00	pcs	10,00	1.250,00	125.000,00
Drip irrigation tapes	100,00	m	4,50	450,00	45.000,00
Green market fee	-	day	-	-	-
Costs of mechanization				2.100,00	210.000,00
Costs of irrigation				580,00	58.000,00
Costs of insurance				-	-
Engaged external labour				2.400,00	240.000,00
Variable costs (total 2)				**21.953,35**	**2.195.335,00**
3 – Contribution margin (1-2)				**28.896,65**	**2.889.665,00**

Source: *Field research – required data-set for development of contribution margin calculation in vegetable production (Jeločnik et al., 2018).*

In the structure of variable costs, the highest share have the costs of manure and mineral fertilizers (33,89%), followed by the costs of seeds and seedlings production (25,83%), (Graph 2.).

Graph 2. Structure of variable costs – conventional production



Relaying to data obtained from the calculation of contribution margin, it was done the estimation of production results under the conditions of uncertainty (determination of critical values in conventional tomato production in greenhouse), (Tabela 8.).

Table 8. Critical values of production

Description	RSD(kg)/are
Expected yield (OP)	1.130,00
Expected price (OC)	45,00
Subsidy (p)	0,00
Variable costs (VT)	21.953,35
Critical price: KC = (VT - p) / OP	**19,43**
Critical yield: KP = (VT - p) / OC	**487,85**
Critical variable costs: KVT = (OP x OC) + p	**50.850,00**

By presentation of critical values in conventional production of tomato are shown the exact price, yield and sum of variable costs that lead to equalization of contribution margin with zero.

Based on results gained from the analytical calculation, it could be also done the sensitivity analysis of conventional production of tomato in protected area (i.e. it could be shown the strength of impact of yield, selling price, or variable costs change to change of contribution margin (Tables 9-10.).

Table 9. Change in contribution margin caused by change (fall) in tomato yield or selling price

Fall of tomato yield or price (%)	Value of contribution margin (RSD/are)
10	23.811,65
20	18.726,65
30	13.641,65
40	8.556,65
50	3.471,65
60	-1.613,35

Table 10. Change in contribution margin caused by growth of variable costs of production

Growth of variable costs (%)	Value of contribution margin (RSD/are)
20,00	24.505,98
40,00	20.115,31
60,00	15.724,64
80,00	11.333,97
100,00	6.943,30
120,00	2.552,63
135,00	-740,37

As in case of first agricultural holding, the contribution margin is more sensitive to the fall in value of production than to the growth of production costs. It equals to zero with the decline in value of production for 56,83% (while any further decrease in achieved yields or products' price will generate a negative contribution margin), or with the rise of variable costs for 131,63% (while any further increase in variable costs of production will induce a negative contribution margin).

Conclusions

Focusing on the tomato production in the greenhouse (at the level of family agricultural holdings A and B), developed comparative analysis of the contribution margin points to the following conclusions:

- At both observed agricultural holdings specialized in the production of vegetables in protected areas (greenhouse), whether it is ecologically accepted production, or conventional production, a positive contribution margins have been achieved (in the first case, in the amount of 27.815,00 RSD/are, while in the second case, in the amount of 28,896.65 RSD/are). Besides, gained contribution margins leave enough space for covering of fixed costs of production, as well as for profit generation.

- Achieved incomes are higher than realized variable costs (in the first case, for around 1,6 times, while in the second case, for around 2,3 times).
- At both observed agricultural holdings, obtained critical values of production (values when the contribution margin equals to zero) leave enough space for business risk mitigation and prevention of uncertainty.
- Contribution margin in tomato production in protected area is more sensitive to the decline in value of production than to the growth of production costs. In the first case, the contribution margin values zero, with a fall of the value of production for 36,71%, or after a rise of variable costs for 62,18%. In the second case, the contribution margin equals the zero, if production value falls for 56,83%, or if variable costs of production increase for 131,63%.

Also, it should be underlined that in the structure of variable costs, in the case of ecologically acceptable production of tomato (agricultural holding A), the significant amount of costs refer to laboratory analyses (analyses of soil fertility, water used for irrigation and harvested fruits), around 25.000,00 RSD/are (i.e. 52,13%). Consequently, if these costs are included in the structure of variable costs generated in conventional tomato production (agricultural holding B), achieved contribution margin would be decreased for the same value, and become much lower than the contribution margin obtained in the ecologically acceptable production.

Literature

1. Andrić, J. (1998): Troškovi i kalkulacije u poljoprivrednoj proizvodnji, Third edition, Savremena administracija, Beograd, Srbija.

2. Devendra, C. (2012): Rainfed areas and animal agriculture in Asia: The wanting agenda for transforming productivity growth and rural poverty, Asian-Australasian Journal of Animal Sciences, vol. 25, no. 1, pp. 122-142.

3. FAO (2013): Good Agricultural Practices for greenhouse vegetable crops: Principles for Mediterranean climate areas, Food and Agriculture Organization of the United Nations, FAO, Rome, Italy.

4. Ivanović, L., Jeločnik, M. (2016): Uputstvo i model za izračunavanje marže pokrića na poljoprivrednim gazdinstvima. In: Unapređenje finansijskih znanja i evidencija na poljoprivrednim gazdinstvima u Republici Srbiji, Eds.: Subić, J., Janković, S., Vasiljević, Z., Lukić, M., IEP, Beograd, Srbija, pp. 145-160.

5. Jeločnik, M., Bekić, B., Subić, J. (2013): Marža pokrića u mobilnom pčelarenju na teritoriji grada Pančeva. Ekonomika, vol. 59, no. 2, pp. 73-82.

6. Jeločnik, M., Nastić, L., Subić, J. (2015): Analiza pokrića varijabilnih troškova u proizvodnji šećerne repe. Zbornik naučnih radova Instituta PKB Agroekonomik, vol. 21, no. 1-2, pp. 201-208.

7. Jeločnik, M., Nastić, L., Subić, J. (2018): Field research – required data-set for development of contribution margine calculation in vegetable production. Institute of Agricultural Economics, Belgrade, Serbia.

8. Jeločnik, M., Subić, J., Zubović, J., Zdravković, A. (2016): Ekonomski aspekti primene obnovljivih izvora energije u procesu navodnjavanja u proizvodnji povrća. Ecologica, vol. 23, no. 83, pp. 473-479.

9. Laate, E. A. (2013): The economics of production and marketing of greenhouse crops in Alberta, Alberta Agriculture and Rural Development, Edmonton, Canada.

10. Nastić, L., Jeločnik, M., Subić, J. (2014): Analiza proizvodnje kale i krastavca u plasteniku. Ekonomika, vol. 60, no. 4, pp. 209-217.

11. SORS (2013): Agricultural census 2012., Agriculture in Republic of Serbia, book 1, Statistical Office of the Republis of Serbia, Belgrade.

12. Subić, J. (2010): Specifičnosti procesa investiranja u poljoprivredi, Institut za ekonomiku poljoprivrede, Beograd, Srbija.

13. Subić, J., Ivanović, L., Jeločnik, M. (2010): Uticaj podsticaja na pokriće varijabilnih troškova u proizvodnji ratarskih useva, Zbornik naučnih radova Instituta PKB Agroekonomik, vol. 16, no. 1-2, pp. 251-264.

14. Subić, J., Jeločnik, M. (2012): Economic-financial aspects of production on livestock farms in Serbia: Case study of pigs fattening. In: Solutions and interventions for the technological transfer and the innovation of the agro-food sector in south east regions – TECH.FOOD project, Eds.: Cvijanović, D., Jeločnik, M., Bekić, B., Institute of Agricultural Economics, Belgrade, pp. 77- 93.

15. Subić, J., Jeločnik, M. (2013): Economic and environmental aspects of controlled vegetable production within the region of Danube basin. In: Sustainable Technologies, Policies and Constraints in the Green Economy, volume of the Advances in environmental engineering and green technologies (AEEGT) book series, Eds.: Andrei, J. V., Turek, A., Subić, J., Dusmanescu, D., IGI Global, Hershey, USA, pp. 39-62.

16. Subić, J., Jeločnik, M. (2016): Economic effects of new technologies application in vegetable production. In: Emerging technologies and the development of agriculture, Eds.: Subić, J., Tomić, D., Lovre, K., Ševarlić, M., SAAE, IAE, Belgrade, Faculty of Economics, University of Subotica, Serbia, pp. 15-35.

17. Subić, J., Jeločnik, M., Zubović, J. (2015/1): Primena navodnjavanja kao agrotehničke mere – analiza marže pokrića u proizvodnji kukuruza, Ecologica, vol. 22, no. 78, pp. 245- 251.

18. Subić, J., Nastić, L., Jeločnik, M. (2015/2): Analiza bruto marže u proizvodnji trešnje. Zbornik naučnih radova Instituta PKB Agroekonomik, vol. 21, no. 5, pp. 61-69.

19. Vasiljević, Z., Subić, J. (2010): Importance of the costs calculation at the family farms in Serbia. In: Agriculture in late transition: Experience of Serbia, Eds.: Tomić, D., Ševarlić, M., SAAE, Belgrade, Serbia, pp. 123-138.

20. Vasiljević, Z., Subić, J., Kovačević, V. (2018): Mogućnosti korišćenja obnovljivih izvora energija na poljoprivrednim gazdinstvima u Srbiji. Ekonomski vidici, vol. 23, no. 3-4, pp. 191-208.

21. http://cms.optimus.ba/Avanti_ApplicationFiles/122/Documents/kodeks_dobre_polj_prakse.pdf

22. http://istocar.bg.ac.rs/tic_inst/obuka02.html

23. http://popispoljoprivrede.stat.rs/