

## ANALYSIS AND FORECASTING OF PROFIT BY USING SIMULATION MODELS FOR GROWING PEA IN CONVENTIONAL AND ORGANIC PLANT PRODUCTION IN SERBIA

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### Summary

*Bean is the third most important food legume crop of the world after soybean and groundnuts; it provides an important source of dietary proteins, carbohydrates, minerals and fiber essential in human nutrition worldwide. A high, per capita bean consumption of 13 to 40 kg yr<sup>-1</sup> was observed in developing countries. In EU developed countries, market of the organic products is growing in average 10 % per annum, but this growth has not been followed by production growth and this is the chance for Serbian products. Organic bean growing enables the producers a higher profit. Expenses in organic production are higher (2170 EUR/ha) than those in conventional bean production (1825 EUR/ha). However, net profit in the organic production was estimated to 1440 EUR/ha, while the profit in the conventional concept was 315 EUR/ha. Also, profitability rate and the economic efficiency coefficient had higher values when growing bean in organic concept.*

**Key words:** *bean, expenses, net profit, organic production*

**JEL:** *Q16*

### Introduction

Bean (*Phaseolus vulgaris* L.) is an edible legume that belongs to the family *Leguminosae/Fabaceae*, subfamily *Papilionideae* described in the tribe *Phaseoleae*, sub tribe *Phaseolinae*

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in the section *Phaseoli* (Debouck, 1991). Cultivars and landraces of *P. vulgaris* are derived from independent domestication of wild beans in the Andean and Middle American centers (Chacon et al., 2005). Bean is the third most important legume crop in the world after soybean and groundnuts, it provides an important source of dietary proteins, carbohydrates, minerals and fiber essential in human nutrition worldwide. A high per capita consumption of 13 to 40 kg yr<sup>-1</sup> bean was observed in developing countries, especially within low-income families in urban and rural areas (Singh, 1999). Bean remains the primary source of dietary protein in most of the developing countries where it is regarded as poor man's meat. In addition to its central nutritional and dietary role, bean is gaining importance as a source of household income for small scale farmers, who sell through intermediaries to urban dwellers and exporters (Kusolwa, 2007). Recent studies highlighted nutritional values and health benefits of dry bean diets (Thompson et al., 2008; Mitchell et al., 2009).

Bean (*Phaseolus vulgaris*) is grown in Serbia on more than 20.000 acres, as a pure crop, with average perennial yield about 1.3 t/ha (FAO 2012). During last five years, certified organic surface has grown rapidly and it was very hard to gain the information regarding the income from these surfaces, since Serbia does not keep official records data on organic production (Stefanović et al., 2010). Certified organic production is increased and the data systematically collects Ministry of Agriculture and Environmental Protection, through accredited companies to control and certification ([http://www.dnrl.minpolj.gov.rs/o\\_nama/organska.html](http://www.dnrl.minpolj.gov.rs/o_nama/organska.html)).

The increasing demand for healthy food and the need for environmental and economic sustainability of agricultural production promoted the organic farming worldwide. The economic feasibility is a key factor for technology adoption and sustainable production (Wander et al., 2007). In order to obtain higher prices on the market, the significant point could be the certificated organic production. Organic production implies ecological management of production, improvement of biodiversity, circulation of matter in the nature, microbiological activity in land and environment protection (Zdravković et al., 2012). Conventional production demands the use of chemical preparations, which directly distort the existing soil structure. It also impacts the fertility of soil, food quality and leads to complete distortion of the environment (Petrović, 2014). In developed EU countries, the organic market is growing averagely 10 % per year, where this increase is not accompanied by the production growth and we believe that this is the chance for Serbian products (Berenji et al., 2013).

Profit forecast is very important for any company. Monte Carlo methods are stochastic techniques – meaning they are based on the use of random numbers and probability statistics to investigate problems. Monte Carlo simulation shows stochastic processes where time is not crucial, but simulates some sources of uncertainty that impact the value of gain so it can be a method of repeated tries (Zekić et al., 2014). This method gives the unique balance among estimations and calculations, so it is very suitable for estimation of economic results in agriculture (Wayne, 2004, Korn et al., 2010). Monte Carlo simulation forecasts the gain depending on changes of input variables (price, yield etc). The basic use of this method was simulation based on mathematic model that simulates real effect of input change (Zekić et al., 2014).

The aim of this research was to analyze two concepts of bean production (conventional and organic) by applying the method of productivity, profitability and its comparison.

### Material and method

In order to research the productivity and profitability of growing bean in conventional and organic way a trial was set up at the experimental field of Institute for Vegetable Crops, Smederevska Palanka. The Institute has 2.2 ha of certified soil for vegetable growing in organic concept. Organic bean was grown on this certified organic field and the conventional production was performed in the nearby uncertified plot. The size of the trial field in both concepts was one acre. During the vegetation season, standard technology of bean growing was applied for both concepts.

Prices of dry bean produced in conventional way were taken from wholesale market (STIPS, 2013). Prices of dry bean produced in organic concept were estimated by interviewing producers/sellers of organic bean from Belgrade and Novi Sad.

Economic indicators of profitability of bean production were calculated by applying analytic calculation. Total expenses, total income, gain, the costs per unit, breakeven point (kg/a), the rate of profitability and cost-effectiveness ratio (%) were calculated.

Forecast of net profit for conventional and organic system of growing dry bean has been done by applying method Monte Carlo simulation model in Microsoft Excel program (Wayne, 2004).

Net Profit = Sales Volume x (Selling Price - Unit cost) - Fixed costs.

### Results and discussion

Cost of agricultural production depends on the price and refund of the expenses incurred during production (Clark et al., 1999). In order to evaluate the risk of investing in crop production, managers must make an assessment of the cost of basic inputs in production and to determinate the necessary yield for its coverage. More detailed information regarding the production costs enable the producers the estimation of the budget (Fonash, 2009). The highest expenses were in organic bean growing concept 2170 EUR/ha, while in conventional growing it was 1825 EUR/ha (Table 1). The knowledge of specific costs and its participation in total production structure is important for business management, when the economic analysis of production points to dominant expenses which have the highest impact on the price of the finished product (Kanisek et al., 2008).

**Table 1:** Costs of conventional and certified organic dry bean production per area unit (EUR / ha)

Costs:	dry bean (EUR/ha)	
	conventional	organic
mineral fertilizer	250	0
application of mineral fertilizer	30	0

Costs:	dry bean (EUR/ha)	
	conventional	organic
basic soil tillage	100	100
additional soil tillage	40	40
pre-sowing soil preparation	30	30
seeds	570	750
sowing	30	30
herbicides	35	0
foliar fertilizers	40	30
pesticides	30	0
allowed pesticides	75	75
spraying	125	75
cultivation	90	90
human labour	230	500
certification	0	250
harvest	150	150
Total:	1825	2170

Source: Pavlović, 2016

Structure of the total expenses in our research proves that the highest expenses in both ways of production are seeds and labour work for removing the weeds from the crops (Table 1). These expenses are much higher when growing beans in organic production (Table 1). Identical results were reported by Clark et al., 1999. These costs take 19.75% in organic and 11.08% in conventional production from total expenses.

Bean yield in organic and conventional production was similar. In our research it was 950 kg/ha in organic and 1070 kg/ha in conventional. In most organic productions, the yield was significantly lower, up to 34% (De Ponti et al., 2012, Seufert et al., 2012). This is not the case with beans, which has very high yield comparing to other vegetable crops grown in the organic concept. Clark et al., 1999, also found higher yield of bean in the organic production than other agricultural cultures. The difference in yield was not significant. Heilig and Kelly 2012 found that the yield and the differences of yield for organic and conventional crop production were the result of different genotype. Yield differences among different genotypes in the same cropping system can vary up to 25%. The profit in the organic bean production directly depends from the selling prices. The selling price of the bean produced in the organic concept was 35% higher than conventional due to limited offer of products without residuals (Sellen et al., 1994). Organic farming can be a viable option even if the producer prices are the same as those of conventional food (Wander et al., 2007). If the price of the product is reduced by the premium that most countries provide for producers as a stimulant for the organic production, then the profitability of growing organic crops is further increased. The price of dry bean grain, produced in the organic concept in Serbia is 3.8 EUR/kg (Table 2).

**Table 2:** Achieved dry bean yields per unit area (kg / ha), the price per unit (EUR / kg), the value of production (EUR / ha).

Indicators:	dry bean	
	conventional	organic
yield (kg / ha)	1070	950
Price (EUR/kg)	2,00	3,80
Production value (EUR)	2.140,00	3.610,00

Source: Pavlović, 2016

Relatively low cost price of production and high selling price make organic production highly profitable (Clark et al., 1999). Sellen et al., 1994 set a trial in London and found that the total costs of organic bean production were 3480 EUR/ha. Total value of expenses in Serbia for the same production was lower and amounts 2170 EUR/ha. On the other hand, the total costs made in conventional production were lower (1825 EUR/ha). Business goal was to decrease the expenses and increase the total income and operate more economically in that way (Pavlović et al., 2014). The total income in the organic bean production concept, in our research, was 3610 EUR/ha (Table 2). The lower income was achieved in conventional production and was 2140 EUR/ha. Border of profitability were 571.05 kg/ha (organic production) and 912.5 kg/ha (Table 3). By analysing both concepts of production, income was higher than outcome, which proves that both researched concepts were economical. Similar results were found by Sellen et al., 1994, Clark et al., 1999, Salami et al., 2009, Garcia et al., 2012, Sibiko et al., 2013.

**Table 3:** Indicators of economy of production of conventional and organic dry bean production

Indicators:	dry bean	
	conventional	organic
Total cost (EUR/ha)	1.825,00	2.170,00
Value of production (EUR/ha)	2.140,00	3.610,00
Cost price (EUR/kg)	2,00	3,80
gain(EUR/ ha)	315,00	1.440,00
border of profitability (kg / ha)	912.50	571,05
business rate of profitability (gain on 100EUR)	14.72	39,25
coefficient of cost-effectiveness (e)	1,17	1,66

Source: Pavlović, 2016

Calculated rate of profitability was 39.89 EUR (organic concept), in the conventional production it was 14.72 EUR (Table 3). The economical coefficient in our research was 1.66 % for organic and 1.17 % for conventional bean production. The obtained values indicate the existence of business success in both analyzed concepts, except that it is slightly higher in organic production. The calculated parameters show that both the concept of production has a business success. It was significantly higher in organic bean production (Table 3). Similar results in their research had Garcia et al., 2012. Profit forecast according to Monte Carlo method has been done according to projected market prices of conventional and organic

bean production. Height of projected prices was estimated according to market oscillation in past years (STIPS, 2013) and the financial effects for these two production ways were observed. Designed in three ways sales, the expected price of 1070kg of dry bean produced conventionally would be 2.40 EUR/kg. The expected price in organic growing for 950kg would be 4.5 EUR /kg. The uncertain variable is unit cost. Unit costs could be from 1.7 EUR up to 3.5 EUR in conventional growing and from 2.28 EUR up to 5.00 EUR in organic, and the most probable costs would be 2.15 EUR and 3.60 EUR. Net profit based on average sales volume, average selling price, and average unit cost. Calculated on this model, net profit was 93.41 EUR in conventional and 348.16 EUR in organic bean growing concept (Table 4).

**Table 4.** Financial forecast to conventional and organic dry bean production by Monte Carlo model

Conventional production			Organic production		
Sales Scenarios	Volume	Price	Sales Scenarios	Volume	Price
Hot market	200.00	2.00EUR	Hot market	180.00	3.80EUR
Ok Market	570.00	2.20EUR	Ok Market	450.00	4.20EUR
Slow Market	300.00	3.80EUR	Slow Market	320.00	5.60EUR
Sales and Cost Data		Average	Sales and Cost Data		Average
Sales Scenario		356.67	Sales Scenario		316.67
Sales Volume		2.67	Sales Volume		4.50
Selling Price		2.40EUR	Selling Price		3.43EUR
Unit Cost		2.15EUR	Unit Cost		3.60EUR
Cost Scenarios		Unit Cost	Cost Scenarios		Unit Cost
Minimum Cost		1.70EUR	Minimum Cost		2.28EUR
Most Likely Cost		2.00EUR	Most Likely Cost		3.00EUR
Maximum Cost		3.50EUR	Maximum Cost		5.00EUR
Fixed Costs		1.70EUR	Fixed Costs		2.28EUR
<b>Profit Forecast (Net Profit)</b>		<b>93.41EUR</b>	<b>Profit Forecast (Net Profit)</b>		<b>348.16EUR</b>

Source: Pavlović, 2016

### Conclusion

The analysis of conventional concept of bean production generated higher income than outcome which points to the economy of both concepts of production. Those farmers, who have large areas of cultivated land and have no possibility of engaging workers, may produce beans by conventional breeding concept. The calculated economic parameters indicate that the concept of production profitable. On the other hand due to the higher cost of certified organic beans on the market and the possibility realizing higher profit more interesting is the production of beans at an organic concept. Calculated cost-effectiveness ratio for organic production was 1.66%, while for the conventional concept it was somewhat lower (1.17%). The value of this relative indicator of success, directly points to the bean production concept that should be applied by producers. The results show that producers should choose the cultivation of beans in accordance with the principles of organic crop production. Then, according to the results obtained indicate that the choice of the concept of organic production does not significantly affect the reduction in yield of beans. In this way, the beans are classified

in the group of those plant species should take more area on cultivated land on which to cultivate organic certified beans.

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## ANALIZA I PREDVIĐANJE PROFITA U KONVENCIONALNOJ I ORGANSKOJ BILJNOJ PROIZVODNJI PASULJA U SRBIJI

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### Rezime

*Gajenje pasulja u skladu sa organskim principima omogućava proizvođačima veći profit u odnosu na konvencionalni sistem gajenja. Ispitivana i komparirana je proizvodnja pasulja u konvencionalnom i organskom sistemu gajenja metodama bazičnih ekonomskih parametara a za metodu prognoze korišćena je Monte Carlo simulacija na osnovu projektovanih prosečnih tržišnih cena po jedinici proizvoda. Troškovi u organskoj proizvodnji su veći (2170 EUR /ha) od troškova u konvencionalnoj proizvodnji pasulja (1745 EUR /ha). Međutim, ostvarena dobit u konceptu organske proizvodnje je iznosila 1402 EUR /ha, dok kod konvencionalnog koncepta je 955 EUR /ha. Takođe, stopa rentabilnosti poslovanja kao i koeficijent ekonomičnosti su imali veće izračunate vrednosti u gajenju pasulja po konceptu organske biljne proizvodnje. Simulacijom rasta cena na tržištu korišćenjem Monte Carlo simulacionog modela u konvencionalnoj proizvodnji figurira neto profit od 93.4 EUR /ha, dok je u organskoj veći i iznosi 348.16 EUR /ha.*

**Ključne reči:** pasulj, troškovi, neto profit, organska proizvodnja

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