

Comparative Technical and Economic Analysis of Organic and Conventional Soybean Production in Greece

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Abstract

Soybean is considered to be an alternative crop and its cultivation could offer an innovative and high-quality product. A case study was implemented on an existing farm to examine the prospects of soybean production in Greece and to evaluate the economic outcomes of the crop cultivation under organic and conventional cropping system. The economic analysis showed that the cost of conventional soybean production was 0.37 €/kg, while the cost of organic soybeans was 0.50 €/kg. The organic and conventional soybean selling prices were 0.6 and 0.4 €/kg, respectively. In addition, the financial performance of the farm improved after the introduction of organic soybean crop, where the net profit increased by 26.3% compared to the initial profit of the farm, while the increase in the conventional was less at 10%. Soybean is a relatively new crop in Greece with high net profit, especially under organic cultivation mainly due to lower inflow of external imports.

Keywords: business plan, economic analysis, organic farming, soybean

Introduction

Organic farming relies on ecologically based practices including cultural and biological pest management (McBride and Greene, 2008). The increasing demand for the environmental, economic and social results of the chemical based conventional agriculture have led many producers to adopt to organic farming during the last two decades. In addition, organic farming constitutes an opportunity for the cultivation of new crops that will bring sufficient revenues to the producers.

Soybean is considered to be an alternative crop, and its cultivation under organic cropping system could offer an innovative and high-quality product. It is a species of the legume family

native to East Asia, widely grown for its edible seeds which are used for both protein meal and vegetable oil. Soybean is grown on an estimated 6% of the world's arable land and over the last 40 years, it has experienced the highest percentage of yearly increases in production area compared to any other major crop (Hartman *et al.*, 2011). Soybean production was around 351.3 million tonnes in 2016/17, of which 92 per cent came from United States of America, Brazil, Argentina, China, India, and Paraguay. At the same time, the European Union produced 2.49 million metric tons (MMT). Six countries produced 91.6 per cent of the EU's soybean: Italy (1.08 MMT), France (0.36 MMT), Romania (0.26 MMT), Croatia (0.24 MMT),

Table 1. SWOT analysis for organic soybean cultivation in Greece

Strengths	Weaknesses
<ul style="list-style-type: none"> • High demand for organic soybean • High production capability • Reduced competition • High prices 	<ul style="list-style-type: none"> • Lack of Greek seed production • Free import of EU seeds • Lack of know-how
Opportunities	Threats
<ul style="list-style-type: none"> • Opportunities for growth and progress • Higher profits 	<ul style="list-style-type: none"> • Mainly loss of production due to natural disasters

Hungary (0.18 MMT) and Austria (0.15 MMT) (EC, 2017).

The first attempt to cultivate soybean in Greece was made in 1930 without any result. A new interest was emerged in 1987, when the European Union applied a subsidy measure to increase soybeans production within the Union and reduce imports. There was an upward trend of cultivated land until 1989 (an area of 7,600 ha) and then a gradual decrease. In 2012, the soybean cultivation area was estimated at 286 ha (FAO, 2018). According to the Food and Agriculture Organization of the United Nations, in 2016, 1198 ha of soybeans were grown, yielding 3727.22 tonnes (FAO, 2018).

The aims of the present study were to examine the prospects of soybean production in Greece and to evaluate the economic outcomes of the cultivation of this crop under organic and conventional cropping system.

Materials and Methods

A case study was implemented on an existing farm in Aliartos area situated in Prefecture of Viotia, Central Greece. Specifically, for the comparative analysis of organic and conventional soybean production, two business plans were developed, one for each cropping system. The total area of the studied farm was 44 ha and originally grown wheat (35 ha) and cotton (9 ha). The soybean crop was introduced in an area of 10 ha. The business plan for each type of farming (organic and conventional) included 27 ha of wheat, 7 ha of cotton and 10 ha of soybean. According to the rules of transitioning to organic production, the business plan in the case of organic soybean cultivation was a 5-year. In addition, before business planning, a SWOT (strengths, weaknesses, opportunities and threats) analysis (Tab. 1) was performed to identify and analyze the internal and external factors that

can have an impact on viability of organic soybean cultivation in Greece.

The analysis of economic results was based on the tables and calculations of annual depreciation and annual expenditure, respectively, provided by Hellenic Statistical Authority (ELSTAT, 2018). The average soybean yield was estimated at 4,980 and 5,830 kg ha⁻¹ for organic and conventional production, respectively. The following equations were used for the calculation of the economic results:

$$\text{Gross Annuity} = \text{Total Sales Value} + \text{Total Subsidies} \quad (1)$$

$$\text{Net Profit} = \text{Gross Annuity} - \text{Production Costs} \quad (2)$$

$$\text{Gross Profits} = \text{Gross Annuity} - \text{Total Variable Costs} \quad (3)$$

$$\text{Agricultural Farmer's Income} = \text{Gross Annuity} - \text{Total Apparent Costs} \quad (4)$$

$$\text{Net Annuity} = \text{Net Profit} + \text{Interest} + \text{Rent} \quad (5)$$

$$\text{Capital Efficiency (\%)} = \text{Net Annuity} / \text{Average Invested Capital} \quad (6)$$

For the comparison between the economic results of the different cultivation systems, the data of the fourth year of organic soybean cultivation (the first year of certified organic production) were used, because the first year of the production was considered conventional, the second and third were transitional, while the fifth year presented the similar results as the fourth year.

Results and Discussion

The technical and economic analysis showed that, with lower yields and higher per hectare costs, the total production cost of organic soybean was 96.83 € ha⁻¹ (0.08 € kg⁻¹) higher than the cost of conventional soybeans (Tab. 2), as there were costs associated with the certification of organic

Table 2. Annual production costs of organic and conventional soybean production.

Production Items	Organic (€/ha)	Conventional (€/ha)
A. Land		
i. Land rent	437.50	437.50
B. Labor		
i. Unpaid (Farmer's family) labor	484.72	391.28
ii. Paid labor	119.72	50.00
iii. Insurance contributions to Unified Social Security Fund (EFKA)	45.00	45.00
iv. Interests	25.66	18.75
C. Capital		
i. Fixed Capital		
a) Amortization	223.50	229.28
b) Fixed capital interests	146.81	191.79
c) Maintenance	48.94	63.93
d) Insurance premiums	13.54	16.28
e) Maintenance & Insurance premiums interests	2.66	3.41
ii. Circulating Capital		
Consumables (Seeds, Fertilizers, Fuels etc.)	235.00	200.00
b) Contributions to Greek Agricultural Insurance Organization (ELGA)	4.50	4.50
c) Third party services	360.00	360.00
d) Other costs	300.00	300.00
e) Circulating capital interest	39.95	38.46
Total Production Costs	(€/ha) 2,487.50	2,390.67
	(€/kg) 0.50	0.41

production, the consumables such as the greater use of field machinery, as well as the paid and unpaid labor (McBride and Greene, 2008). The labor costs for organic production total 675.1 € per hectare, compared to 505.03 € for conventional soybean production.

Regarding the selling price, the organic soybeans were 50% more expensive than conventional (0.6 and 0.4 € kg⁻¹ for organic and conventional, respectively). It is worth taking into consideration that, according to the EU's Common Agricultural Policy, higher subsidies are given for organic farming.

The net profit in the studied farm, was 11,360 and 1,913 € for the organic and conventional soybean production, respectively (Tab. 3). By comparison, the financial performance of the farm improved after the introduction of organic soybean crop, and this is apparent from the net profit, which was increased by 26.3% compared to the initial

profit of the farm (16,894 €; data not shown), while the increase in the conventional was less at 10%. Moreover, the net profit of organic soybean production accounted for 53.2% of the total net profit of the farm (Tab. 3). It is worth noting that according to the literature, the average soybean yield in the organic system is approximately 18% lower than to conventional (Zhang et al., 2015).

The SWOT analysis carried out on organic soybean indicated that the strongest points of cultivation are the high demand for organic soybean, the high production capability, the reduced competition and the high prices. On the other hand, the biggest weaknesses are the lack of Greek seed production, the free import of EU seed and the lack of know-how (Tab. 1).

In Greece, soybean is mainly used as animal feed and secondly is consumed by humans as food. The needs of livestock animals, mainly poultry and pigs, are about 500,000-550,000 metric

Table 3. Annual economic outcomes of soybean cultivation (10 ha) and studied farm (27 ha wheat, 7 ha cotton and 10 ha soybean) under organic and conventional cropping systems

Economic outcomes	Organic		Conventional	
	Soybean (€)	Farm (€)	Soybean (€)	Farm (€)
Gross annuity	36,640	83,888	25,820	80,888
Net profit	11,360	21,336	1,913	18,590
Gross profits	25,643	50,526	15,885	48,247
Agricultural farmer's income	18,518	36,721	8,350	35,443
Net annuity	17,886	36,122	8,812	34,445
Capital efficiency (%)	14	194	7	195

tonnes per year of soybean meal. Only 20% of the soybean meal is consumed by the cattle and sheep. According to Hellenic Statistical Authority, soybean is the third most important agricultural import product, mainly due to the high needs in livestock sector (ELSTAT, 2018). Therefore, soybean is a relatively new crop in Greece with a high net profit, especially under organic cultivation, where the inflow of external imports is lower.

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