

# Estimated Cost of Production for Medical Cannabis (*Cannabis sativa* L.) in Greece

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## Abstract

In recent years, cannabis has raised public awareness in many countries worldwide about its medical uses. The European cannabis market reached its peak during 2018 with investments of 500 million €. Greece introduced Law 4523/2018, which regulates the production and processing of medical cannabis. A start-up business plan was drawn up for a medical cannabis operation owned a 1 ha greenhouse to estimate the start-up costs and the costs of cultivating and processing medical cannabis under greenhouse conditions in Greece. The results of the present study revealed that the investment was estimated at 4,960,044 €. Net profit in the first year amounted to 3,584,621.70 €, while the annual net profits from the second to the tenth year amounted to approximately 7.07 billion. The Net Present Value with a value of 45,425,241.24 € is positive and the internal rate of return (IRR) is 94.14%, which means that the investment can be characterized as profitable.

**Keywords:** business plan, economic analysis, greenhouse cultivation, medical-cannabis facility, profitability

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## Introduction

Cannabis (*Cannabis sativa* L.) is a plant species mainly associated with its psychoactive use, which is due to the substance of tetrahydrocannabinol (THC). THC is the main psychoactive compound and the most well-known. As a result, it has several therapeutic properties that make the plant one of the most talked about plant species in the world (Kingham *et al.*, 2017).

In recent years, cannabis has raised public awareness in many countries worldwide about its medical uses. This has subsequently led to a

number of jurisdictions, either by decriminalizing cannabis or legalizing it for medicinal use, with some countries moving towards full legalization. With the growing acceptance of cannabis by the public, it is possible to create an entire cannabis industry to meet consumer demand and preferences, such as demand for cannabis-based medicines (EverBlu Capital, 2017).

The European cannabis market reached its peak during 2018, with investments of 500 million €. This market has so far focused on the distribution of medical cannabis licenses. Across

**Table 1.** Arrangement of medical cannabis integrated production unit owned a 1 ha greenhouse

	Description	Land Area (m <sup>2</sup> )	Cultivation Area (m <sup>2</sup> )
<b>I.</b>	<b>Greenhouse facilities</b>		
I.1	Vegetation zones	5,916	3,549.6
I.2	Flowering zones	8,875	5,325
I.3	Mechanical equipment area	640	-
	Subtotal	15,431	8,874.6
<b>II.</b>	<b>Building premises</b>		
II.1	Mother Plants - Clone area	800	700
II.2	Service area	300	-
II.3	Trimming area	50	-
II.4	Drying area	60	-
II.5	Packaging area	170	-
II.6	Warehouse area	300	-
	Subtotal	1,680	700
<b>III.</b>	<b>Exterior premises</b>		
III.1	Solar disinfection platform	350	-
III.2	Soil substrates storage area	280	-
III.3	Ovens area	60	-
	Subtotal	690	-
<b>VI.</b>	<b>Other auxiliary premises</b>		
VI.1	Offices, restaurants and rooms (e.g. changing rooms)	1,100	-
	Subtotal	1,100	-
	<b>Total area (m<sup>2</sup>)</b>	<b>18,901</b>	<b>9,574.6</b>

Europe, countries are reviewing the application of medical cannabis throughout the region. Countries such as France, the United Kingdom, and Spain are reviewing their current legislation. On the other hand, industry leaders (Germany, Italy and the Netherlands) focus on expanding the existing medical programs (Prohibition Partners, 2019).

In March of 2018, Greece introduced Law 4523/2018, which regulates the production and processing of medical cannabis. This law was applied due to the desire to revitalize the crop industry and to trade in cannabis products. For the granting of approval for installation and authorization, the applicant must submit documents for all stages (from cultivation to processing and production of final medical cannabis products). On the basis of legislation, the cultivation will take place under greenhouse or indoor conditions (Folina *et al.*, 2019). The objectives of this study were to estimate the start-up costs and the costs of cultivating and processing medical cannabis under greenhouse conditions in Greece.

### Materials and Methods

A start-up business plan was drawn up for a medical cannabis operation owned a 1 ha

greenhouse. The arrangement of this integrated production unit expressed in square meters is presented in Table 1.

The approach was to identify the various stages from infrastructure setup to the manufacturing of medicinal cannabis oil. The analysis was broken up into costs for business start-up, and then for cultivation and processing. For estimation of the total cost of cultivating and manufacturing medicinal cannabis, the present study was based on publicly available literature and research on medicinal cannabis industries in other countries (Caulkins, 2010; Hawken, 2013; Deloitte, 2016). Where data on the cultivation and manufacture of medicinal cannabis was not available, other crop types that exhibit a similar cost structure or cultivation technique to cannabis were used as proxies, such as cherry tomatoes (Laate, 2013). The construction cost was estimated at 41.4 € m<sup>-2</sup>. The equipment cost required for the medical cannabis cultivation (irrigation systems, drainage systems, fans, lighting, and heating systems) was set at 107.5 € m<sup>-2</sup>. The land price was 8809.5 € per ha. The security cost amounted to 17 € m<sup>-2</sup>. The cost of labor was estimated at 618 € per kg of dry inflorescences or 445 € m<sup>-2</sup>. The shipping cost was set at 0.25 € per kg of dry inflorescences.

**Table 2.** SWOT analysis for greenhouse medical cannabis production in Greece

Strengths	Weaknesses
<ul style="list-style-type: none"> <li>• Ideal environment and climate conditions</li> <li>• Possibility of creating mother plants/seeds with high genetic standards               <ul style="list-style-type: none"> <li>• Direct access to the European market</li> <li>• Lower average production from other countries</li> </ul> </li> <li>• Comparative advantage at a technical level – creating strategic alliances               <ul style="list-style-type: none"> <li>• Direct access to public authorities</li> </ul> </li> <li>• Updated information about developments in the institutional framework</li> </ul>	<ul style="list-style-type: none"> <li>• Legislative gaps and a strict institutional framework for providing authorizations/ operations</li> <li>• Institutional risk of the license framework for extension and modernization               <ul style="list-style-type: none"> <li>• Participation of different and interested institutions/ ministries/ services.</li> </ul> </li> <li>• Lack of comparative domestic productivity/ profitability               <ul style="list-style-type: none"> <li>• No common procedures in cultivation and production in comparison to other plant species</li> </ul> </li> <li>• Lack of experience from the public authorities</li> <li>• Lacks in production from large markets on the legal framework.</li> </ul>
Opportunities	Threats
<ul style="list-style-type: none"> <li>• High and growing demand from the European and international markets</li> <li>• Easy corporate investments with rapid decrease of invested capital</li> <li>• Export capacity under the institutional framework</li> </ul>	<ul style="list-style-type: none"> <li>• The unable policy and financial situation in Greece               <ul style="list-style-type: none"> <li>• The issue of limited number of licenses</li> </ul> </li> <li>• The possible “negative” reaction of pharmaceutical companies               <ul style="list-style-type: none"> <li>• Possibility of direct/ indirect income of competitive foreign companies</li> </ul> </li> <li>• Creation of “cartel” conditions because of the oligopolistic structures of industry</li> </ul>

Regarding the consumables cost, it was estimated at 434 € m<sup>-2</sup>. About 80% of this cost, it is related to nutrients and the remaining 20% to pesticides. Costs of licenses, taxes and certification costs were estimated at 61.4 € m<sup>-2</sup> or 85.2 € per kg of dry inflorescences (Deloitte, 2016).

The calculation of production capacity is based on greenhouse facilities. A three-week period is required to obtain a plant clone derived from the same plant (Miriello, 2017). In the present study, the total number of 1,401 mother plants was divided into three subsets of 467 mother plants each. The weekly production of each mother plant is between 6 and 10 cuttings (estimated at about 7.58 cuttings) (Miriello, 2017). The first harvest of the first year was taken place on the 21st week (Miriello, 2017).

The profitability ratios in the current research were calculated using the following formulas (Wachira *et al.*, 2014; Honoré *et al.*, 2019):

$$\text{Gross Profit Margin (\%)} = [(\text{NS} - \text{PC}) / \text{NS}] \times 100 \quad (1)$$

$$\text{EBITA Margin (\%)} =$$

$$= [(\text{NS} - \text{PC} - \text{AC} - \text{SC} - \text{RDC}) / \text{NS}] \times 100 \quad (2)$$

$$\text{EBT Margin (\%)} = [(\text{EBITA} - \text{I} - \text{A}) / \text{NS}] \times 100 \quad (3)$$

$$\text{Net Profit Margin (\%)} = [(\text{EBT} - \text{T}) / \text{NS}] \times 100 \quad (4)$$

where:

EBITA = Earnings Before Interest, Taxes, and Amortization; EBT = Earnings before taxes and amortization; NS = Net Sales; PC = Production Costs; AC = Administrative Costs; SC = Sale Costs; RDC = Research and Development Costs; I = Interests of loans and working capital; A = Amortization and T = income Tax.

Finally, a SWOT analysis (strengths, weaknesses, opportunities and threats analysis; Tab. 2) was performed to identify the internal and external factors that can have an effect on viability of greenhouse medical cannabis production in Greece.

## Results and Discussions

The total investment budget was estimated at 4,960,044 € and distributed among building installation and infrastructures, mechanical-technical equipment, other equipment, and intensive costs in the ratio of 42.28 : 51.56 : 3.08 : 3.09, respectively. A bank loan of 3,968,035.20 €, accounting for 80% of total investment budget, was needed to complete the project. The long-term loan was estimated to last ten years with the first instalment paid off in the first year of the business. The instalment was determined as a half-year and amounted to 198,401.76 € (+3.6% interests).

**Table 3.** Ten-year financial results of 1-hectare medical cannabis operation in Greece (expressed in €)

	1 <sup>st</sup> Year	2 <sup>nd</sup> Year	3 <sup>rd</sup> Year	4 <sup>th</sup> Year	5 <sup>th</sup> Year	6 <sup>th</sup> Year	7 <sup>th</sup> Year	8 <sup>th</sup> Year	9 <sup>th</sup> Year	10 <sup>th</sup> Year
Net Sales	9,515,520.00	15,462,720.00	15,462,720.00	15,462,720.00	15,462,720.00	15,462,720.00	15,462,720.00	15,462,720.00	15,462,720.00	15,462,720.00
(-) Production costs	3,061,981.49	3,571,493.02	3,577,576.61	3,598,675.21	3,589,743.81	3,595,827.40	3,616,926.00	3,607,994.60	3,614,078.19	3,635,176.79
Gross Profit	6,453,538.51	11,891,226.98	11,885,143.39	11,864,044.79	11,872,976.19	11,866,892.60	11,845,794.00	11,854,725.40	11,848,641.81	11,827,543.21
(-) Administrative costs	285,465.60	463,881.60	463,881.60	463,881.60	463,881.60	463,881.60	463,881.60	463,881.60	463,881.60	463,881.60
(-) Sale costs	475,776.00	773,136.00	773,136.00	773,136.00	773,136.00	773,136.00	773,136.00	773,136.00	773,136.00	773,136.00
(-) Research and Development costs	95,155.20	154,627.20	154,627.20	154,627.20	154,627.20	154,627.20	154,627.20	154,627.20	154,627.20	154,627.20
Earnings Before Interest, Taxes, and Amortization - EBITA	5,597,141.71	10,499,582.18	10,493,498.59	10,472,399.99	10,481,331.39	10,475,247.80	10,454,149.20	10,463,080.60	10,456,997.01	10,435,898.41
(-) Long-term loan interest	139,278.04	124,993.11	110,708.18	96,423.26	82,138.33	67,853.40	53,568.48	39,283.55	24,998.62	10,713.70
(-) Working capital interest	38,908.21	55,044.94	55,082.45	55,166.23	55,166.23	55,203.73	55,287.51	55,287.51	55,325.01	55,408.79
Earnings before taxes and amortization	5,418,955.46	10,319,544.13	10,327,707.96	10,320,810.51	10,344,026.84	10,352,190.67	10,345,293.22	10,368,509.55	10,376,673.37	10,369,775.92
(-) Amortization	370,192.50	370,192.50	370,192.50	370,192.50	370,192.50	370,192.50	370,192.50	370,192.50	370,192.50	370,192.50
Earnings Before Tax - EBT	5,048,762.96	9,949,351.63	9,957,515.46	9,950,618.01	9,973,834.34	9,981,998.17	9,975,100.72	9,998,317.05	10,006,480.87	9,999,583.42
(-) Income tax (29%)	1,464,141.26	2,885,311.97	2,887,679.48	2,885,679.22	2,892,411.96	2,894,779.47	2,892,779.21	2,899,511.94	2,901,879.45	2,899,879.19
Net Profit	3,584,621.70	7,064,039.66	7,069,835.98	7,064,938.79	7,081,422.38	7,087,218.70	7,082,321.51	7,098,805.10	7,104,601.42	7,099,704.23

**Table 4.** Ten-year profitability ratios of 1-hectare medical cannabis operation in Greece

Margin (%)	1 <sup>st</sup> Year	2 <sup>nd</sup> Year	3 <sup>rd</sup> Year	4 <sup>th</sup> Year	5 <sup>th</sup> Year	6 <sup>th</sup> Year	7 <sup>th</sup> Year	8 <sup>th</sup> Year	9 <sup>th</sup> Year	10 <sup>th</sup> Year
Gross Profit Margin	67.82	76.90	76.86	76.73	76.78	76.75	76.61	76.67	76.63	76.49
Earnings Before Interest, Taxes, Amortization - EBITA Margin	58.82	67.90	67.86	67.73	67.78	67.75	67.61	67.67	67.63	67.49
Earnings Before Tax - EBT Margin	53.06	64.40	64.40	64.35	64.50	64.56	64.51	64.66	64.71	64.67
Net Profit Margin	37.67	45.72	45.72	45.69	45.80	45.83	45.80	45.91	45.95	45.91

Site preparation was estimated to last six months. During the first year, the final product of dry inflorescence was estimated at 3.171,84 kg, while, from the second year until the tenth year, it was estimated at 5.154,24 kg (Miriello, 2017). Taking into account that the price of final product of dry inflorescence was 3.00 € per kg (Freeman *et al.*, 2018), the net sales amounted to 9,515,520.00 € in the first year, and to 15,462,720.00 € in the next years (Tab. 3).

The smooth operation of the new business required necessary additional working capital arise from the need for available resources and market conditions. Working capital was fully covered by a short-term bank loan. Annual working capital requirements were estimated at 518,776.17 € in the first year and ranged between 733,932.59 and 738,549.82 € during the next years.

The administrative, sales, research and development costs were calculated as the 3, 5, and 1% of the net sales (Deloitte, 2016) (Tab. 3). Annual amortization was estimated at 370,192.50 €. The total income for the first year that the business starts operating was 9,515,520 €. From the second year, the incomes totaled 15,462,720 €. Net profit in the first year amounted to 3,584,621.70 €, while the annual net profits from the second to tenth year amounted to approximately 7.07 billion. The net profit margins ranged from 37.67% (first year) to 45.91% (tenth year) (Tab. 4).

The SWOT analysis revealed that the strongest points of medical cannabis production are the ideal environment and climate conditions in Greece, the possibility of creating mother plants/seeds with high genetic standards, the direct access to the European market and the lower average production from other countries (Folina *et al.*, 2019). On the other hand, the weaknesses are the

legislative gaps and a strict institutional framework for providing authorizations/operations, the institutional risk of the license framework for extension and modernization, the participation of different and interested institutions/ ministries/ services as well as the lack of comparative domestic productivity/profitability (EMCDDA, 2018) (Tab. 2). The high and growing demand from the European and international markets, as well as the fact that the medical cannabis operations are easy corporate investments with a rapid decrease of invested capital, can overpass all the weaknesses and threats that arose in medical cannabis production (Hawken, 2013; Folina *et al.*, 2019).

Cannabis market is a fast-growing and emerging market on a European and global scale, governed by a dynamically evolving environment. The worldwide market for cannabis food is about 200 million € showing steady upward trends in recent years (EverBlu Capital, 2017). About 250 million EU citizens and 500 million worldwide even have legal access to cannabis for medical use. According to forecasts, if all European countries legalize cannabis use, the market is estimated to be around € 56.2 billion, of which € 35.7 billion relates to medical cannabis (Prohibition Partners, 2019).

The results of the present study revealed that the 1-hectare medical cannabis operation in Greece is an investment of 4,960,044 €, which requires a working capital of approximately 520,000 € in the first year, and from the second to the tenth it needs from 730,000 to 740,000 €, as well as it is a business with high depreciation. The Net Present Value with a value of 45,425,241.24 € is positive and the internal rate of return (IRR) is 94.14% with a discount rate of 4.5%, which

means that the investment can be characterized as profitable. However, it has to be noted that due to the desktop nature of the current analysis and the limited capacity to undertake consultations to fill in information gaps, some of the assumptions and costs are stronger than others. In order to provide further insight into the medical cannabis industry, particularly in the context of establishing an industry in Greece and differences that may arise in relation to overseas experience, additional analysis would help to inform assumptions that are both significant in driving overall costs and low in confidence in existing estimates.

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