COMPARATIVE STUDY ON THE ECONOMIC EFFICIENCY OF HEMP CULTURE IN A CONVENTIONAL AND ECOLOGICAL SYSTEM

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Abstract: *In order to analyze the degree of development of economic systems for the two agriculture types, conventional and ecological, as well as the "survival" capacity and the direction of their development, it is necessary to take into account the correct definition and measurement of the economic efficiency for the culture analyzed. Economic efficiency is most often defined as the close link between the resources allocated to the production process and what follows from the process, which leads to consuming the resources available in a rational way. Thus, economic efficiency can be determined by comparing the effects of an action with the efforts required to produce it. The present study aims to highlighting the two economical agricultural systems for hemp culture by analyzing and comparing the set of technical and economic indicators present in the income and expenditure budget. The revenue and expenditure budget highlights issues such as: the value of production, the costs incurred with this crop, the resulting income and the rate of return. The main objective of the study is to bring to light the agricultural system that is most economically efficient for the culture in the analysis*.

Key words: *economic efficiency, ecological / conventional hemp, profit*

JEL Classification: *Q 12, Q57*

INTRODUCTION

Industrial hemp *(Cannabis sativa L.)* is a herbaceous annual plant of the family Cannabaceae with a class average of 2-3 meters, but it is conceivable to reach up to a height of 5 meters in some exceptional cases [12]. It is cultivated for industrial properties and derived products [8]. It is considered to be one of the plants with a fast growing cycle [6] and is one of the first plants to be transformed and used as fiber about 10 000 years ago [9]. Hemp is probably one of the oldest plants cultivated by man, according to archaeologists was used since the time of the Neolithic in countries like China and the islands that are nearby Japan (islands oki), archaeologists found prints of fiber ceramics which dates back to 5000 BC. [7]. Textile expert Elizabeth Wayland Barber has over time synthesized all historical evidence of this culture and has shown to the general public that this plant was known and used not only in the above mentioned countries but also in all the northern regions of Europe Germany, Switzerland, Austria, Romania, Ukraine) [3]. The widespread use of these plants makes it a plant of the future, making it a multiplicity of commercial products such as paper, textile fibers, biodegradable materials (biodegradable plastics), paints and biofuels [4]. This plant can also be used in the livestock sector, according to a study carried out in 2003, that more than 95% of hemp seeds were sold in the European Union and used in feed and poultry. [5]

At present (2017), according to the study "Hemp as an Agricultural Commodity" by Renee Johmson (agricultural policy specialist), more than 30 countries worldwide cultivate industrial hemp and use it as agricultural commodities on the global market. Thus, for the year 2016, the total area of 44 388 hectares of industrial hemp is recorded, it is worth mentioning that the areas increased by 7.22% compared to 2012 but decreased by -3.45% compared to production in 2016 at the modal level was 71 475 tonnes, 27.5% higher than in 2012 and -9.32% lower than in 2015.

The main hemp producers worldwide for the year 2016 were: Europe, China, South Korea and Russia. The European Union has an active hemp market with production in most member countries but with production centered in France, the Netherlands, Lithuania and Romania.

According to data provided by the Ministry of Agriculture and Rural Development of Romania, in 2016, that country held an area of 904.83 hectares in a conventional system, representing 2.04% of the total area of the world with this crop, with a share in production 4,5% representing 3 200 tonnes. In an ecological system, Romania had an area of only 53.39 hectares for 2016, but 20.6% more than in 2012, representing about 8.61 hectares.

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Before analyzing the economic efficiency of hemp production in a conventional and organic system, it is necessary to briefly describe them.

As defined by the European Council "Organic farming is farming practices which are designed to minimize human impact on the environment, while ensuring a more natural functioning of the agricultural system." [10] While classical or conventional farming is the opposite of what it means to organic farming and is represented by the use of pesticides that have a negative effect on natural balances.

In view of the above-mentioned importance of this culture at global and national level in both industrial and zootechnical fields, I propose to compare the two hemp cultivation systems in order to determine the economic efficiency of this plant in both systems, conventional and environmentally friendly.

MATERIALS AND METHODS

The paper is structured in two parts, so in the first part of the paper a qualitative and quantitative analysis of statistical data will be carried out. For greater accuracy as data will be analyzed statistical yearbooks released by specialized institutions in the field of statistics: Eurostat, FiBL, FAOSTAT, the National Statistics Institute. Therefore, in the first part of the paper, an overview of current and past state of hemp culture in the two systems is to be carried out, analyzing the surfaces and the total yields obtained.

In the second part of the paper we will use the income and expenditure budget of the hemp crop, it is an instrument containing economic data related to the value of the production, the production expenses and their structure, plus the net income as well as rate of return.

The revenue and expenditure budget will be taken over from the ADER project 13.1.2 "Technical and economic fundamentals of production costs and estimates of the prices for wheat, corn, sunflower, rapeseed, soybean, sugar beet, rice, hemp, hops, tobacco, potatoes for conventional farming and organic farming "[1] phase / stage eight, which has as its general objective the management of costs in conventional and organic agriculture. The specific objectives of the phase have led to the simulation of as many scenarios as possible in determining the profitability threshold, so that the research carried out aims to provide the best information on the economic efficiency indicators for the two agricultural systems.

The objective of the paper is to calculate economic indicators describing the yield and feasibility of hemp crop according to the agricultural system (conventional or organic).

The paper has a synthetic methodological character, highlighting the theories, concepts and models of technical and economic analysis, the presentation of the indicators used in assessing the economic efficiency of the production activity, the profitability threshold, as well as the effect of average output and price on the gross margin. Optimal solutions have a specific character and research has been based on descriptive research (ADER 13.1.2, Phase 4, MADR).

RESULTS AND DISCUSSIONS

In Romania, an area of approximately 904.83 hectares of hemp in a conventional system was grown in 2016, according to statistics, it was more than 10 times in 2012, representing an area of 830 hectares with a 43.4% over the previous year (2011). For the period under review, increases are recorded from one year to the next, except for the year 2015 where there is a decrease in areas of -17.6%.

Table 1. Evolution of hemp surfaces and production

Specifications	**2012**	**2013**	**2014**	**2015**	**2016**	**2012**
Surface area (thousand ha)	74.04	184.27	765.72	630.74	904.83	74.04
Total production (thousand t)	33.06	284.67	678.11	2617.82	3200.09	33.06
Average yield (kg / ha)	446.5	1544.9	885.6	4150.4	3536.7	446.5

Source: FAOSTAT; INS

If we refer to total hemp production, we see in Table 1 that it is gradually increasing from one year to the next, thus the largest production is recorded in 2016 by 22.3% higher than in 2015 and by approximately 10 times higher than the base year 2012.

Thus, according to the two indices, average yields per hectare of hemp cultivation were calculated, it varied in the analyzed period (2012-2016) between 446.5 kg per hectare (year 2012) and 4 150.4 kg per hectare (2015). *It is worth mentioning that these productions are taken into account after the production is dried up, otherwise, as production is still green it weighs more.*

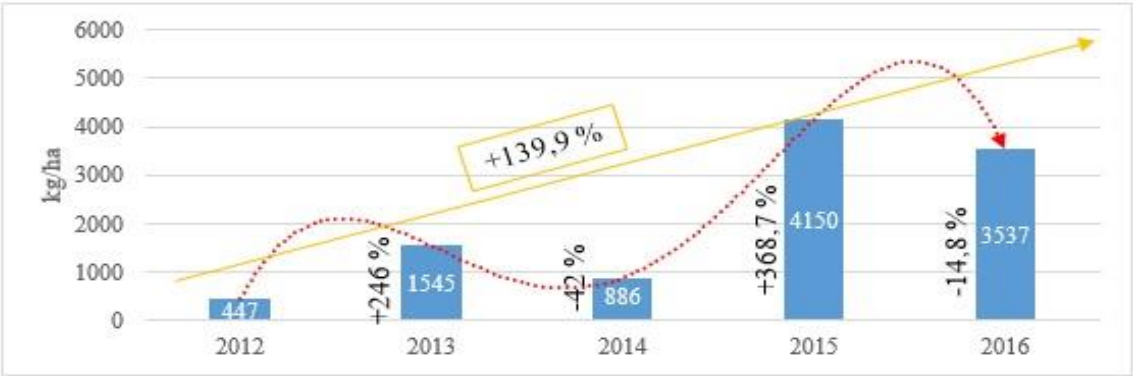

Figure 1. The average yield of dried hemp in conventional system
Source: data processing FAOSTAT, INS

As can be seen in Figure 1, average hemp production increased by 139.9% on average, reaching peak in 2015, while 2016 is ranked second from this point of view, with average yield per hectare being of 3537 kg, with -14.8% less compared to the maximum year 2015.

Regard to organic farming data have been taken from the Eurostat European Statistical Site and FiBL, the organic farming area for the years included in the study, from 2012 to 2016. As shown in Table 2, areas for this organic crop have reached and a maximum of 54.1 hectares in 2014, with 20.7% more than the surface in the year 2012 and with 4.4% more compare to the year 2013, recording a minimum of 44.8 hectares in the year 2012.

Table 2. Situation of organic hemp- surfaces and production

Specifications	2012	2013	2014	2015	2016
Ecological Surface (hectares)	44,8	51,8	54,1	52,8	53,3
Organic production (tonnes)	47,2	47,13	88,46	83,04	81,74
Average organic production. (Kg / ha)	1054	910	1635	1573	1534

Source: FAOSTAT; INS

If we refer to total dry hemp production in an ecological system, we can see from table no. 2 that they record a maximum of 88.46 tons in 2014, 87.7% more than in the previous year, which is expected to decrease by -6.13% in 2015. In 2016, the total production of dried hemp for fiber is 81.74 tonnes with -1.57% less than in 2015 but 73.2% higher than the base year of 2012.

Figure 2. Average production of organic hemp dried hemp
Source: data processing Eurostat; FiBL

According to figure 2, average hemp production increased by an average of 14.9%, reaching a peak in 2014, similar to total production, while in 2016 they fell by 2.49% as compared to 2015, 6.21% compared to 2014, but they are higher compared to 2012 by 45.6%.

Average production for this crop change from year to year, the most significant change being in 2014 compared to the previous year, when average production increases by 79.7%.

In order to get closer to the study we need to be able to determine the economic efficiency of hemp crop in the two agricultural systems, so we will analyze the income and expenditure budget of this crop for the two types of systems farm. Indicators presented in the Income and Expenditure budget were calculations on a hectare area, in a medium-sized plains area for 2015-2016, on the still green production of this crop.

Table 3. Income and Expense budget of conventional and organic hemp cultures

INDICATORS	U.M	Culture System	
		Conventional	Organic
Average production	kg/ha	45000	35000
A. VALUE OF PRODUCTION	lei	5107.5	5141.5
A1. Of which the main production	lei	5107.5	5141.5
B (+) SUBVENTIES	lei	2142.1	2142.1
C (=) GROSS PRODUCT	lei	6516.0	7283.6
D (-) TOTAL EXPENSES	lei	5820.9	4418.0
D1. Of which for the main production	lei	5820.9	4418.0
I. VARIABLE CHARGES	lei	5536.5	4195.3
1.Expenditure on raw materials and materials	lei	4049.2	2812.5
- Seed and planting material	lei	1440.0	1440.0
-Chemical / organic fertilizers	lei	1388.4	1019.2
- Pesticides / Organic pesticides	lei	1220.6	353.3
- Other materials	lei	0.1	0.0
2. Expenditure on mechanized works	lei	1230.4	1195.7
3. Spending on irrigation	lei	x	x
4. Supply costs	lei	121.5	84.4
5. Temporary labor costs *	lei	x	x
6. Insurance	lei	135.5	102.7
II. FIXED EXPENSES	lei	284.3	222.7
- Expenditure on permanent labor	lei	17.1	17.1
- General and management expenses	lei	108.4	82.2
- Loan interest	lei	115.9	80.5
- Lease	lei	x	x
-Entertainment for buildings and utilities	lei	43.0	43.0
E. (=) IMPORTANT INCOME	lei	-713.4	723.5
(-) Taxes and fees	lei	-114.1	115.8
(-) Rental	lei	x	x
F. (=) NET INCOME + subsidies	lei	1542.8	607.7
G. TAX INCOME TAX (%)	%	-12.3	16.4
H. NET INCOME RATE + Subsidies (%)	%	26.5	62.2
COST OF PRODUCTION	lei/to	129.4	126.2
PREVIOUS PRICE MARKET PRICE	lei/to	113.5	146.9

Source: ADER Project 13.1.2

As can be seen from the hemp crop budget (Table 3), average yield of green hemp was set at 45,000 kg in the conventional system and at 35,000 kilograms in the organic system by 22,2% lower. Analyzing the value of total production, it can be seen that the differences are relatively small, from 5107.5 in the conventional system to 5141.5 in the ecological system, representing a difference of 0.67% (-34 lei).

Although there is a fairly large difference between the two productions, their value does not differ greatly, the reason why the values of the two productions do not differ significantly is given by the price, which are relatively close.

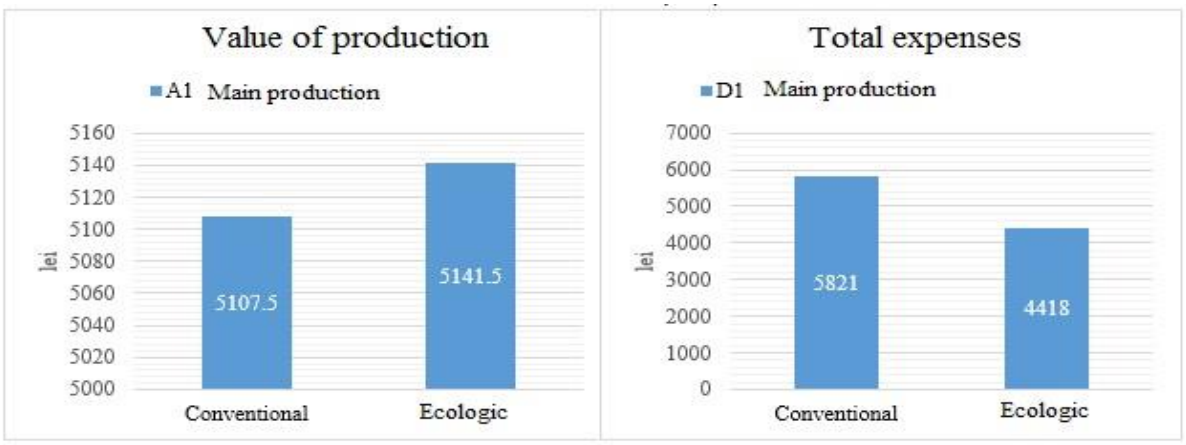

Figure 3. Structure of production value and expenditure
Source: own processing based on Income and Expense Budget data ADER Project 13.1.2

Concerning hemp crop expenditure for the two agricultural systems, it is noted that in the case of organic hemp crops, total expenditure is lower than that found in the conventional system. In other words, the economic effort is lower by -24.1% compared to conventional production expenditure.

This is due to the fact that certain expenses with raw materials and materials found in this system are lower than those found in the conventional system, the same is true for general and management expenses. The total costs amount to 4481 lei, in an ecological system and are used in the main production, with no secondary production, as is the case with the conventional system.

On the other hand, the conventional production is done with an effort amounting to 5821 lei, of which 95.11% represents the variable expenses presented in the income and expenditure budget of crops (Table 3), while the remaining 4.89% represents the expenses fixed, namely 284.3 lei.

Analyzing all these costs compared to the value of the production, it can be observed that for hemp grown in ecological system, the expenditures reach a fairly high level of profitability, so for this production there was a taxable income of 723.5 lei; while the value of the amount of taxable income in the conventional system is negative -713.4 applying the tax index means that no profit is achieved if no subsidies are granted.

With the addition of subsidies granted to this culture in an ecological and conventional system, we can see that the net income + subsidies is positive for both systems, so for the conventional system we get a value of 1542,8 lei, and in ecological system we get the value of 607,7 lei .

Profitability rates establish economic efficiency, so for conventional hemp crops, we notice that the taxable income is -12.3%, while in the organic system this is 16.4%, which shows that the income is higher than expenses, resulting profit.

Going forward and analyzing the cost per unit of product, in our case per ton, we can see (Table 3) that it does not differ significantly from one system to another, the difference being very low of only 3.2 lei /tonne, respectively to 129.4 lei / ton in a conventional system at 126.2 lei / ton in ecological system.

In order to better determine the feasibility and economic efficiency of this culture presented in two systems, were calculated the following indicators.

Table 4. Indicators on the economic efficiency of hemp culture in a conventional and ecological system

INDICATORS	U.M	Culture System	
		Conventional	Organic
Gross margin	lei	-429	946,2
Expenses for 1000 lei production pp.	lei	1139,7	859,3
Consumption of working time	man-hours / ha	13,2	13,2
Labor productivity (value)	lei / hour-man	385,9	389,7
Work productivity (physical)	Kg / h-man	0,3	0,4
Profit or loss (gross)	lei / ha	-713,37	723,5
Profit threshold (physical)	kg	48780	28560

Source: ADER Project 13.1.2; Ana Ursu, et. al (2017)

The gross margin in table 4 was determined by calculating the difference between the value of the main production and the variable costs of the hemp culture for both systems, conventional and ecological (environmentally friendly). As can be seen from the above table (table no. 4), the gross margin of conventional hemp crop is negative, justifying that variable costs with this conventional crop culture exceed the value of the main production by about 8.39% . However, at the other pole there is the gross margin for the same crop but in ecological system, where it can be seen as positive, with a value of 946,2 lei, being higher than that of hemp culture obtained in a traditional system. One of the main reasons why the gross margin is positive in an organic system compared to a conventional system is that some variable costs are lower, such as material expenses.

The second indicator presented in table 4 "expenses per 1000 lei of main production" determines the level of distribution of the factors of production, in order to obtain the finished product, in this case dried fiber for hemp. So, for a simple observation, the effect of this indicator on the economic efficiency of this culture will be plotted.

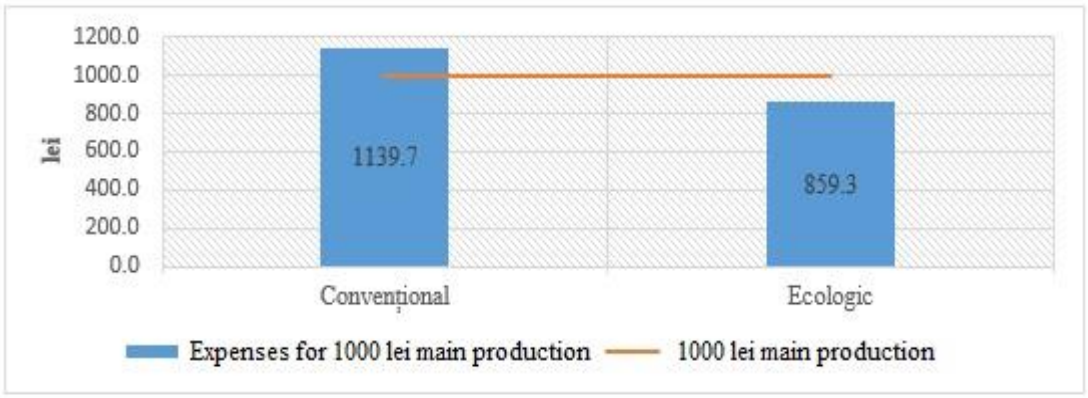

Figure 4. Costs per 1000 lei of main production
Source: own data processing ADER Project 13.1.2

As can be seen in figure 4, there are differences between the two agricultural systems used in the hemp crop. Thus, the expenses per 1000 lei of the main production exceed the value of 1000 lei, thus exceeding the conventional profitability threshold, for a production of 1000 lei were spent 1139.7 lei with a difference of 280.4 lei compared to hemp in an ecological system, where to produce hemp in the amount of 1000 lei is spent 859,3 lei which falls within the profitability threshold. The above mentioned shows that the chosen agricultural system may have an impact on the profitability of the hemp crop.

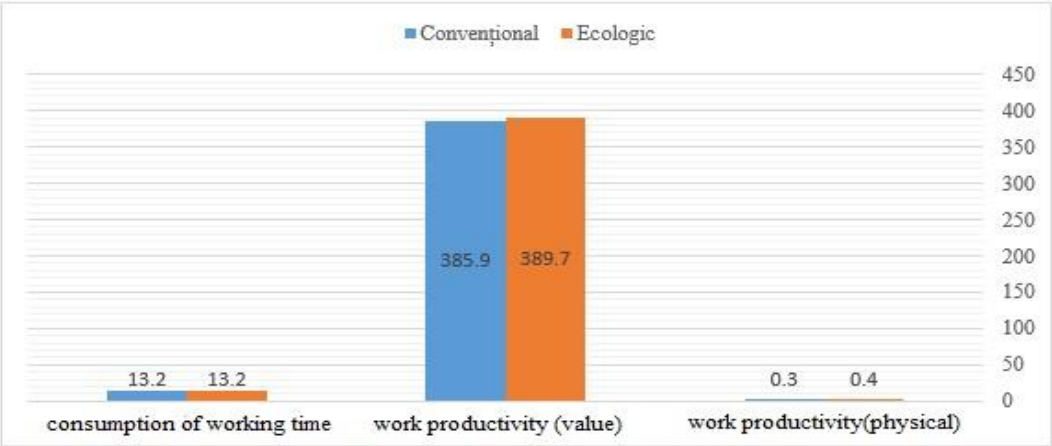

Figure 5. Consumption of working time and labor productivity
Source: own data processing ADER Project 13.1.2

In figure 5, one can observe not only the difference from one agricultural system to another that is relatively small, but also the differences between the indicators analyzed. Thus, according to figure no.5, labor consumption for hemp cultivation was 13.2 hours for both agricultural systems for a hectare area.

Depending on the output obtained and its value, it can explain the two labor productivity. Therefore, the productivity of the physically expressed work is higher in the ecological system with 0.1 kg / h in the ecological system, a small difference from one system to another, a sign that the agricultural system used (conventional or organic) does not greatly influence, in this culture, the productivity of work physically expressed.

In the case of labor productivity from a value point of view, there can be noticed a difference of 3.8 lei / hour-man, so in an ecological system for hemp culture the labor productivity expressed in terms of value is marginal by 0.98% conventional system.

Figure 6. The physical profitability threshold
Source: own data processing ADER Project 13.1.2

In figure 6, it can be seen that the profitability threshold for each hemp farming system. Thus, in order to grow hemp in a conventional system with a minimum profitability, a production level of 48.78 tonnes / ha has to be attained, which shows in this case that the production of 45 tonnes / ha is not profitable. In the organic system, due to the higher domestic market price for this product, the profitability threshold in the physical unit is lower at a level of 28.56 tons per hectare. Thus, the level of cost-effective production in the organic system has been exceeded in the present case by approximately 22.6%, which shows that organic hemp production is profitable with a production of 35 tons / ha, yielding a profit physically 6.44 tons / ha.

CONCLUSIONS

The first part of this paper presents a brief description of the hemp culture as well as the main growers of this plant continuing with the surfaces cultivated with this culture, both in conventional and ecological systems, highlighting the evolution of surfaces, total and average productions, observing that they were on average increasing for each system (139.9% conventional, 14.94% ecological).

Regarding economic efficiency, it can be argued that only an agricultural system for hemp cultivation for the analyzed productions (35000 kg / ha in the organic system and 45000 kg / ha in conventional system respectively) brings a profit to the farmer, namely hemp cultivation in an ecological system. From the revenue and expenditure budget it can be seen that the amount of taxable income is negative for the conventional agricultural system.

Due to the higher recovery price for organic hemp, it can be seen that for a lower production by 22.2% compared to the conventional one, production value is 0.66% higher. In terms of total expenditure, given the same production gap, the level of organic production is lower by about 24.1% compared to conventional production.

By addressing all aspects listed above for the purpose of determining economic efficiency, the subject of this paper, we can say that this culture is cost-effective in an ecological system (with or without subsidies) and less cost-effective in a conventional system (if not granted subsidies this crop records losses in a conventional system). Thus, the rates of return without subsidies differ from one system to another, in the case of traditional agriculture, hemp cultivation obtained a negative rate of -12.3% while in the ecological system a rate of 16.4 %; subsidy rate rates are 26.5% conventional and 62.2% organic, ecologically used can be an advantageous income-enhancing solution for the Romanian farmer.

In conclusion, I believe we have pointed out that the economic risk culture and the farmer who chooses this plant must take into account all the cost economics of both organic and conventional. The production level must be taken into account as it determines the physical profitability threshold that can make the difference between gain and loss.

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