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**Conference Paper**

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**Provided in Cooperation with:**

The Research Institute for Agriculture Economy and Rural Development (ICEADR), Bucharest

*Suggested Citation:* Șurcă, Daniela-Elena (2018) : Comparative study on the economic efficiency of rice culture in a conventional and organic system, In: Agrarian Economy and Rural Development - Realities and Perspectives for Romania. 9th Edition of the International Symposium, November 2018, Bucharest, The Research Institute for Agricultural Economy and Rural Development (ICEADR), Bucharest, pp. 278-285

This Version is available at:

<https://hdl.handle.net/10419/205120>

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# COMPARATIVE STUDY ON THE ECONOMIC EFFICIENCY OF RICE CULTURE IN A CONVENTIONAL AND ORGANIC SYSTEM

ȘURCĂ DANIELA-ELENA<sup>1</sup>

**Abstract:** *Economic efficiency is defined by the obtaining of useful economic effects, provided that material, human and financial resources are used rationally. Thus, in general terms, economic efficiency can be defined as the connection between the useful effects obtained from a certain economic activity and the efforts made in the respective activity represented by the expenses related to the production process. The main objective of the study is to highlight the economic efficiency of two system conventional and organic for rice crops. In the context of the achievement of the main objective of the paper, it will be analyze the technical and economic indicators referring to: the dynamics of the surfaces, the average outputs, the budget of revenues and expenditures. The revenue and expenditure budget will highlight certain economic issues, such as the value of production, the costs incurred with this crop, the resulting income and the rate of return. In conclusion, this paper seeks to highlight the best agricultural system in terms of economic efficiency, for rice crops, using the comparative method on the set of indicators analyzed.*

**Key words:** *economic efficiency, organic / conventional rice, profit*

**JEL Classification:** *Q12, Q57*

## INTRODUCTION

Rice culture is considered to be one of the most important crops in the world due to the high global consumption, but also because it fits well with the demands of industrialization and processing. After the rice is processed, various oils are used in the cosmetic and pharmaceutical industry, as well as various flours and cakes used in the livestock sector.

According to the FAO Biennial Global Food Markets Report, global rice use has fallen by 1.3% in 2016/2017. [6]

Of the total quantity of cereals consumed globally, rice has a share of 21%, the largest consumer and rice producers being China, India and Indonesia. Thus, rice crops (*Oryza sativa*) around the world have a wider coverage. In the crop year 2016-2017, this crop occupies approximately 161.1 million hectares [12], representing 14% of the world's agricultural land with a production of 483.9 million tonnes, accounting for 19% of the total grain yield of the world.

Although global surface area and rice production is growing, at a national level (Romania), the situation is the opposite, the areas recorded with this crop gradually declining for the last years 2014-2016 / 2017, from 12 719 (year 2014) hectares at 8 360 hectares (year 2017) in conventional system and from 4 466 hectares (year 2014) to 3 164 hectares (year 2016) in the organic system. [13]. Before analyzing the economic efficiency of rice production in both conventional and organic systems, it is necessary to know and describe them.

Organic farming is presented by INFOAM (National Federation of Organic Farming Movements) as "*a production system that supports the health of soils, ecosystems and humans. It is based on ecological systems, biodiversity and life cycles adapted to local conditions instead of using input materials with adverse or negative effects on the environment.*" [5] Organic farming is also defined by Regulation (EC) No. 834/2017 as "*a global system for agricultural management and food production that combines best environmental practices, high biodiversity, natural resource conservation, high animal welfare standards and a production method that respects the preferences of certain consumers for products obtained using natural substances and processes.*" [9]

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In short, organic farming is presented as a system that avoids the use of chemical fertilizers, pesticides and growth regulators, through organic farming systems in pursuit of natural balance. [10]

While conventional or classical agriculture is at the opposite end, and is represented by intensive mechanized agriculture based on maximizing productivity and profitability, it can be said that this type of agriculture is the opposite of organic farming, using inputs that can have a negative effect on the environment and with time it can create natural imbalances.

In view of the above considerations, but also the worldwide demand for this product for both the industrial and the food sectors, I believe that the two system (conventional and organic) should be compared in order to determine their economic efficiency.

## **MATERIALS AND METHODS**

In the first part of the paper there will be a qualitative and quantitative research on the statistical data. For the highest accuracy of the data, we will consult the websites of specialized institutions in this field, such as: National Institute of Statistics, Eurostat, Faostat and FiBL. Thus, it is desired to create an overview of the past and current situation regarding the areas and the yields obtained in the two rice crop systems.

In the second part, the income and expenditure budget of the crop is used, the tool is used to assess the value of the production (both main and secondary) and the structure of the production expenses, to which are added the net income and the rate of profitability. This budget was taken over from the ADER project 13.1.2 "Technical and economic costing of production costs and estimates of the prices for wheat, maize, sunflower, rape, soybean, sugar beet, rice, hemp, hop , Tobacco, Potato for Conventional Agriculture and Organic Farming "[1] managed by the Research Institute for the Economy of Agriculture and Rural Development, the project runs between 2015-2018, takes place in stages and the results of the stages are presented to the public on the official website of the institute. The budgetary data presented in this article were processed from the above-mentioned ADER project from the number eighth phase (Analyzing the economic efficiency of plant production for conventional and organic agriculture) the main objective being the comparative analysis of the economic efficiency of the vegetal production for conventional agriculture and organic farming. The specific objectives of the phase have led to as many simulations of possible scenarios as possible in determining the profitability threshold, so the research carried out aims to provide the best information regarding the economic efficiency indicators for the two agricultural systems. [11]

The paper has a methodological, synthetic character, emphasizing the theories, concepts and models of technical and economic analysis, the presentation of the indicators used in the appreciation of the economic efficiency of the production activity (indicators reflecting the economic effort - the consumption of working time, production indicators, indicators reflecting the economic effect - average production, total incomes, average price on the farm, indicators reflecting the actual economic efficiency - labor productivity, production cost, gross profit, profit rate, production costs per 1000 lei income material expenses per 1000 lei of income, etc.), the profitability threshold as well as the effect of the average production and the price of capitalization on the gross margin. [3]. Optimal solutions have a specific character. Through studies and analyzes we are pursuing the ways of increasing the economic efficiency and determining this efficient. The research was based on descriptive research (web report of ADER 13.1.2, Phase 8, MADR) [11].

## **RESULTS AND DISCUSSIONS**

In Romania, approximately 9 435 hectares of conventional rice were grown in 2016, less by -14.74% compared to the previous year, but there are also increases in the area for 2013 compared to the previous year 2.43% and in 2014 compared to 2013 by 9.84% and 12.52% as compared to 2012. (Table 1)

Table 1. Evolution of rice surfaces and yields

Specifications	2012	2013	2014	2015	2016	2012
Surface area (thousand ha)	11 304	11 579	12 719	11 067	9 435	11 304
Total production (thousand t)	50 862	54 646	45 159	49 773	43 635	50 862
Average yield (kg / ha)	4 499	4 719	3 505	4 497	4 624	4 499

Source: INS

If we refer to total rice production, we can see from Table 1 that it decreases for the year 2014 compared to 2013 by -17.36%, respectively 9 487 tonnes. The same situation is also noted in 2016 as compared to the previous year, when the total production drops by -12,33% that means with 6 138 tonnes.

Thus, on the basis of these two indicators the production averages per hectare were calculated, it varied between 4 719 kg / ha (year 2013) and 3 505 kg / ha for the analyzed period (2012-2016).



Figure 1. The average yield of rice in the conventional system

Source: INS data processing

As can be seen in Figure 1, the average yield of rice increased on average by +2.57%, reaching the maximum in 2013, while in 2016 the average yield was 4 624 kg/ha, with -2,01% less compared to the maximum year, ranking the second place.

According to the same figure it is observed that average production per hectare is changing from one year to the next, the largest decrease being in 2014 compared to 2013 by -25.7%, while the highest increase is in 2015 compared to the previous year being + 28.3%.

In terms of organic farming data were taken from the European site Eurostat organic farming section and FiBL Statistical, for 2012-2016 period. It can be seen in table no. 2 that the areas for this ecological crop have reached a maximum of 4 466 hectares in 2014, representing an increase of 160.8% compared to year 2012 (+2 754 hectares) and +70,6% compared to year 2013 (+1 848 hectares). Surfaces begin to decline over 2014 by -30.9% in 2015 and by -29.15% in 2016. The year at the opposite end, with the smallest area, is 2012 with an area of organic rice of only 1 712 hectares.

Table 2. Situation of organic rice areas and production

Specifications	2012	2013	2014	2015	2016	2012
Surface area (thousand ha)	1 712	2 618	4 466	3 085	3 164	1 712
Total production (thousand t)	5 314	6 158	12 521	15 473	9 743	5 314
Average yield (kg / ha)	3 103	2 352	2 804	5 016	3 079	3 103

Source: Eurostat; FiBL

If we refer to the total production of organic rice we see a very high increase in 2015, reaching a maximum of 15 473 tons, this being higher by + 23.6% compared to the previous year, followed by it will decrease in 2016 with -37.03% representing a number of 5 730 hectares. It is worth mentioning that for the period 2012-2016 the total production increases by +26.43%.



Figure 2. The average yield of rice in organic system  
Source: data processing Eurostat; FiBL

As can be seen in figure 2, the average yield of rice increased on average by + 8.82%, reaching the maximum in 2015, while in 2016 the average yield was 3 079 kg / ha, with - 38.6% less than the full year, ranking third, after 2012 with an average production of 3,103 kg / ha.

According to the same figure, average production per hectare is changing from one year to the next, the highest increase being recorded in 2015 compared to 2014 by + 78.9%.

Thus, in order to establish the economic efficiency of rice crops in the two types of agricultural systems, I will submit to the analysis, the income and expenditure budget for rice crops in both organic and conventional systems. It is worth mentioning that the indicators to be presented have been calculated for a hectare cultivated with rice in a medium-sized plain area for 2015-2016.

Table 3. Income and Expense Budget of Conventional and Organic Rice Cultures

INDICATORS	U.M	Culture System	
		Conventional	Organic
Average production	kg/ha	3500	3000
A. VALUE OF PRODUCTION	lei	3740	9000
A1. Of which the main production	lei	3500	9000
B (+) SUBVENTIES	lei	3654.1	3654.1
C (=) GROSS PRODUCT	lei	7394.1	12654.1
D (-) TOTAL EXPENSES	lei	5227.1	9443.4
D1. Of which for the main production	lei	4987.1	9443.4
I. VARIABLE CHARGES	lei	4923.0	8512.3
1. Expenditure on raw materials and materials	lei	2502.4	5577.5
- Seed and planting material	lei	487.5	462.5
- Chemical / organic fertilizers	lei	1466.5	4508.1
- Pesticides / Organic pesticides	lei	548.0	606.9
- Other materials	lei	0.36	0.0
2. Expenditure on mechanized works	lei	1516.4	1823.1
3. Spending on irrigation	lei	725	725.0
4. Supply costs	lei	75.1	167.3
5. Temporary labor costs *	lei	x	X
6. Insurance	lei	104.1	219.4
II. FIXED EXPENSES	lei	304.1	931.1
- Expenditure on permanent labor	lei	71.4	483.2
- General and management expenses	lei	83.3	175.5
- Loan interest	lei	106.4	165.2
- Lease	lei	x	x
- Entertainment for buildings and utilities	lei	43	107.2
E. (=) IMPORTANT INCOME	lei	-1487.1	-443.4
(-) Taxes and fees	lei	-237.9	-70.9
(-) Rental	lei	x	x
F. (=) NET INCOME + subsidies	lei	2250.8	3281.6
G. TAX INCOME TAX (%)	%	-29.8	-4.7
H. NET INCOME RATE + Subsidies (%)	%	45.1	34.8

COST OF PRODUCTION	lei/to	1425	3147.8
PREVIOUS PRICE MARKET PRICE	lei/to	1000	3000

Source: ADER Project 13.1.2

As can be seen from the rice crop budget (Table 3), average rice production in a conventional system was set at 3 500 kilograms, while in an organic system at 3 000 kilograms per hectare, with -14.28% lower. Analyzing the value of total production, it can be noticed that the differences are significant from 3 740 lei in the conventional system to 9 000 in the ecological system, which is higher by 5 260 lei (140%).

Although the production gap is not very high from one system to another, production value differs significantly, the reason for this difference is given by the price of production capitalization; according to Table 3 (income and expenditure budget) organic production of rice has a higher market price compared to the conventional one, which is three times higher.

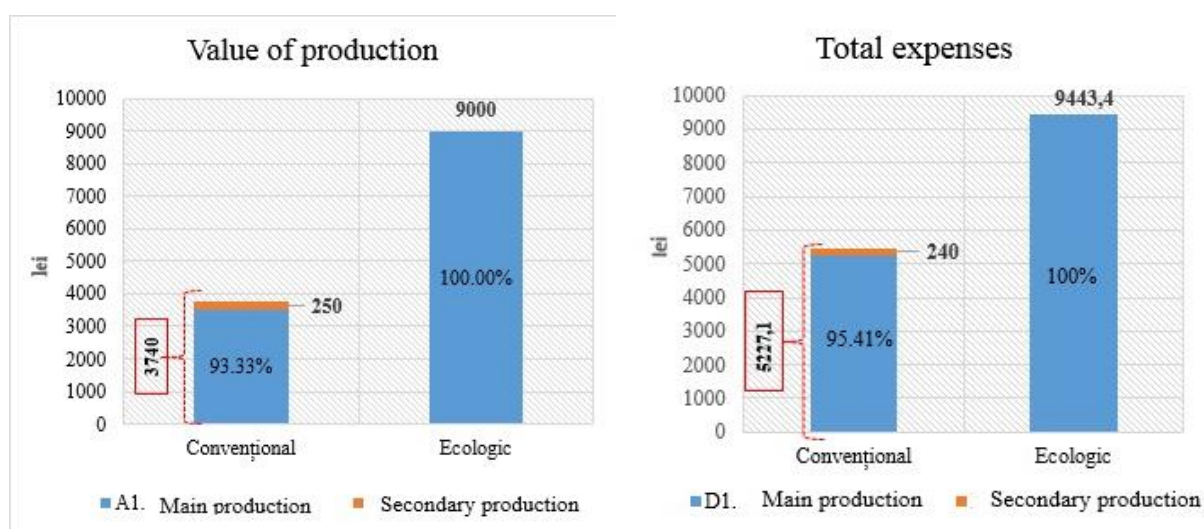


Figure 3. Structure of production value and expenditure  
Source: own processing based on BVC data ADER Project 13.1.2

Concerning the rice crop costs for the two agricultural systems, it is noted that in the case of organic rice crops, the total expenditure is higher than the one found in the conventional system, due to the raw material and material expenses and the permanent workforce. The total expenses amount to 9,443.4 lei and are used in the production of seeds, with no secondary production, this effort is higher with + 122.9% compared to the conventional production costs.

On the other hand, conventional production is made with an effort amounting to 5,227.1 lei, of which 95.41% (4987.1 lei), for the main production, the balance of 240 is the value of the expenditures with the secondary production.

Analyzing the structure of expenditures it can be noticed that for conventional rice crops to obtain 3,500 kilograms production, a value of 5,227.1 lei is spent, out of which 94.18% (4 923 lei) variable expenses while 5.82% (304.1 lei) are fixed costs. In the case of organic production, 90.14% of the total expenditure incurred with this crop for the production of 3 000 kilograms per hectare represents the variable costs (8512.3 lei) while the fixed expenses represent 9.86% (931.1 lei).

Analyzing these in comparison with the value of the production, it can be observed that for the rice cultivated in a conventional system, the expenses reach the minimum profitability, thus for this production there was a taxable income of -1487,1 lei; and even if the ecological production value is higher, the taxable income is still negative -443.4 lei. At these income levels, the tax rate was applied, which means that there is no profit if there is no subsidy.

With the addition of the subsidies granted to this culture in a conventional and ecological system, we note that the net income + subsidies is positive, so in a conventional system we get a value of 2,250.8 lei, while in ecological system we get a value of 3,281.6 sign that there are larger subsidies here.



Rates of return help to establish economic efficiency, so for conventional rice crops, we notice that the taxable income rate was -29.8% and in the ecological system -4.7%, thus demonstrating that the incomes achieved with this culture in the two systems are lower than the costs incurred. After the addition of the subsidies, the rates of return become positive, so in a conventional system it is 45.1% while in the organic system it is 34.8%, which shows that the incomes are higher than the expenses that make profit.

Analyzing the cost per unit of product, in this case per ton, we can see that it differs significantly from one system to another, from 1,425 lei / ton in a conventional system to 3,147.8 lei / ton in ecological system, the difference being 1,722.8 lei, but as shown in Table 3, the price of recovery is higher in the case of organic rice.

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

Table 4. Indicators on the economic efficiency of rice culture in a conventional and organic system

INDICATORS	U.M	Culture System	
		Conventional	Organic
Gross margin	lei	-1423	488
Expenses for 1000 lei production pp.	lei	1424,9	1049,3
Consumption of working time	man-hours / ha	22.9	78.5
Labor productivity (value)	lei / hour-man	152.9	114,6
Work productivity (physical)	Kg / h-man	0,152	0,038
Profit or loss (gross)	lei / ha	-1487.1	-443.4
Profit threshold (physical)	kg	4920	2840

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

The first indicator analyzed in Table 4, is gross margin, and was determined by calculating the difference between the value of the main production and the variable costs of the rice crop, both in the conventional and organic systems. As can be seen from the above table (no. 4), the gross margin of conventional rice crops is negative and quite large, which justifies the fact that the variable costs of this crop in this system exceed the value of the main production. On the opposite side, the gross margin of the same culture is in an ecological system, where it is observed that it is positive with a value of 488 lei, being higher than that of the rice obtained in the classic system. One of the main reasons why the gross margin in the ecological system is positive over the gross margin in a conventional system is due to the fact that the raw materials and materials are less expensive.

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

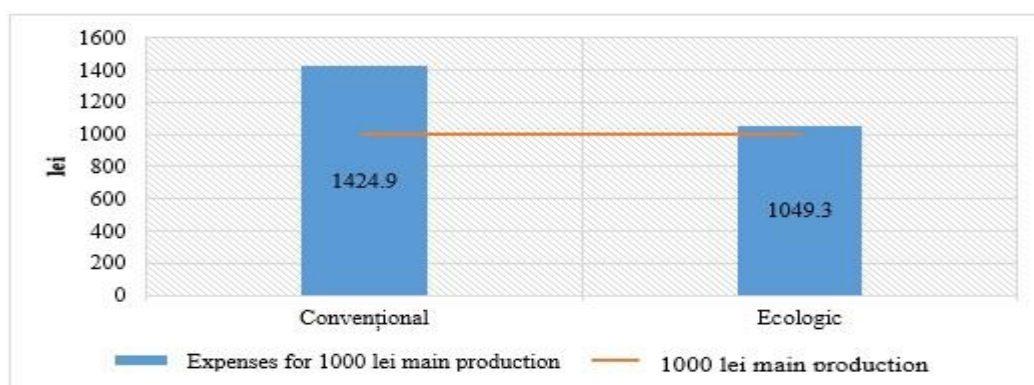


Figure 4. Costs per 1000 lei of main production  
Source: own data processing ADER Project 13.1.2

As can also be seen in figure 4, irrespective of the system used for rice crops, the expenses per 1000 lei of the main production exceed the value of 1000 lei, thus exceeding the profitability, but not at the same level. In the case of classic / conventional rice, for a production of 1000 lei, 1424.9 lei was spent with a difference of 375.6 lei compared to the ecological system where to produce ecological rice worth 1000 lei is spent 1049.3 lei. The above mentioned shows that irrespective of the chosen system, rice crops are not profitable without subsidies.

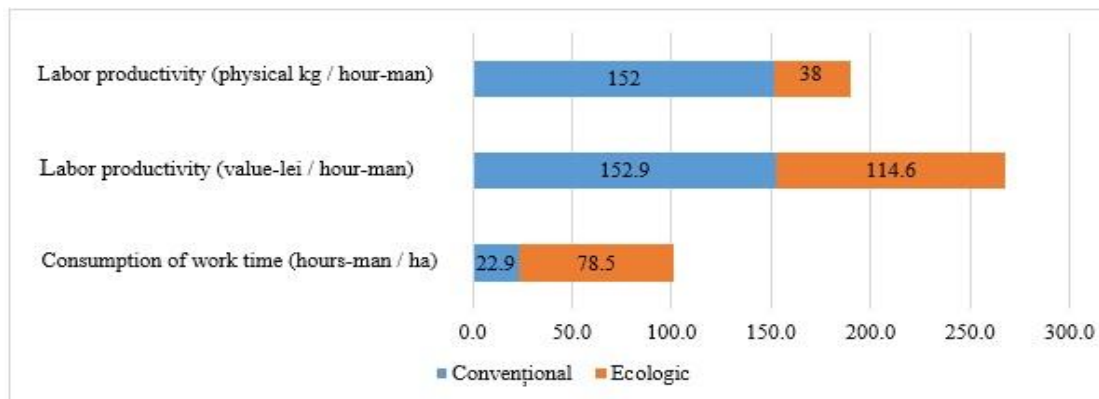


Figure 5. Consumption of working time and labor productivity  
Source: own data processing ADER Project 13.1.

Figure 5 shows the difference in working time consumption, so for conventional rice crops, this consumption was 22.9 hours per person, while the consumption of work per hectare of rice in the ecological system it was more than about 3 times, respectively 78.5 hours-man.

Thus, depending on the output obtained and its value, the two labor productivity can be explained. The productivity of work physically expressed is higher in the conventional system (152 kg / hour-man) than in the ecological system (38 kg / hour-man) 4 times. In the case of labor productivity in terms of value, one can observe a situation similar to the above mentioned, so that for the rice crop in a conventional system the labor productivity is 152.9 lei / hour-man, and in ecological system is 114, 6 lei / man-hour, this being lower by about 25.05%.

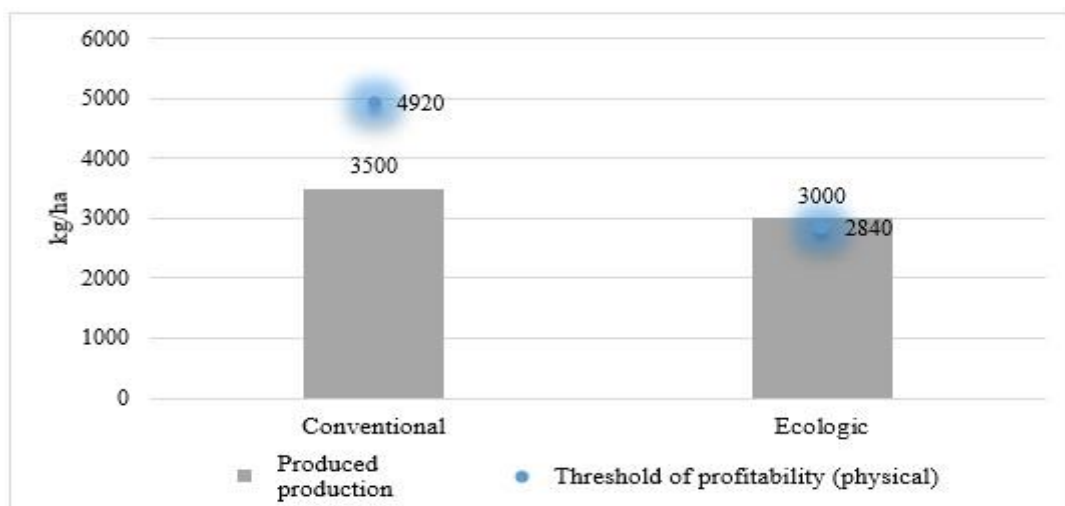


Figure 6. The physical profitability threshold  
Source: own data processing ADER Project 13.1.2

In figure 6, you can see the profitability threshold for each rice growing system. Thus, in order to grow conventional rice with a minimum profitability, a production level of 4920 kilograms per hectare must be attained, which demonstrates in this case that conventional rice production is not profitable for production 3500 kg / ha; in the ecological system, due to the higher pricing price, a lower profitability threshold (physical units) was set, ie 2840 kilograms per hectare. Therefore, this level of cost-effective production in the organic system was slightly exceeded by the calculated



production, which in the present case demonstrates that the production of organic rice is profitable with a production of 3000 kg / ha, thus obtaining a profit physically 160 kg / ha.

## CONCLUSIONS

The first part of this paper presents the areas cultivated with rice, both in conventional and organic systems, showing the evolution of surfaces, of total and average production, observing that they (average outputs) were on average increasing for each system (2,57 Conventional, 8.82% organic).

As regards economic efficiency, it can be argued that only an agricultural system of rice cultivation for the analyzed productions (3500 kg / ha in the conventional system and 3000 kg / ha in the ecological system) brings a profit to the farmer, namely growing rice in an ecological system. From the revenue and expenditure budget, it can be seen that the amount of taxable income (that determines the profit or loss) is negative.

Due to the better pricing price for organic rice, it can be seen that for a smaller production of 14.2% compared to the conventional one, production value is 157.14% higher. In terms of total expenditure, given the same production gap, the level of organic production costs is higher than the yield differential, total organic rice expenditure is 80% higher than conventional production.

Using all aspects addressed in order to determine economic efficiency, we can say that both systems bring profit as long as subsidies are given to this culture, without subsidies the rates of profitability are negative, so losses are recorded. Rates of return on subsidies differ from one system to another, in the case of classical agriculture, rice crops obtained a rate of 45.1% while in the organic system a rate of 34.8% was obtained, which we leads to the idea that this culture, practiced in a conventional system, is an optimal solution for increasing the income of the Romanian farmer.

In conclusion, in order to attract the attention of Romanian farmers, I believe that it must be emphasized that this crop presents certain economic risks and that all the cost elements of rice crops must be taken into account, both in a conventional and ecological system. It should also be mentioned that farmers willing to cultivate this plant must have a level of production as this determines the physical profitability threshold, so an imbalance of 160 kg / ha in an ecological system can make the difference between gain and loss.

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