

ADDING VALUE TO WINTER WHEAT CROP BY ORGANIC SEED PRODUCTION – SOCIO-ECONOMIC CASE STUDY

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Abstract

Chemical fertilizers costs intensified worldwide from 2019 to 2022 due to the gas price crisis. Also the climate change affects crops susceptibility and response to applied synthetic inputs in conventional agriculture. Farmers are returning to agroecological measures and shifting to organic agriculture. In both agricultural systems seed producing is adding value to the final product. This study case aims to analyze the production cost and income on winter wheat (Glosa variety – used by over 60% of Romanian farmers), for certified seed in organic agriculture system. The used data are from applied technology in experimental and seed production fields of National Agricultural Research and Development Institute Fundulea, Calarasi county, Romania. The production costs are influenced by manual operations and fuel price. Seed production in organic agriculture, even if generated an income of 476.05 €/ha, for this study case in 2022, is not economical viable without organic farming subsidies in all situations.

Key words: *organic, seed production, wheat, Romania, costs, income*

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Introduction

CoVid-19 Crisis (Nicolae *et al.*, 2021) and the conflict in Ukraine (Schnitkey *et al.*, 2022) is threatening the energy costs and the market of two main basic agricultural inputs that are necessary for agricultural production: diesel and fertilizers. Last years showed that energy plays an undisputed place for the breakdown of costs. Energy crisis experienced since the conflict between Russia Ukraine started increased the food system vulnerability and shifted some of the old paradigms. This added to the volatility of natural gas prices going all the way back to the pandemic start, which has an impact on the fertilizer market since natural gas is a key component in fertilizer manufacturing (Mottaleb, Kruseman and Snapp, 2022).

Nevertheless, in Europe there are different farm types and socio-economic contexts. For most of Central and Eastern European countries like Czech Republic, Hungary, Slovakia, Poland, Bulgaria, Estonia, Latvia, Lithuania, Romania, Serbia, Slovenia the business environment is more susceptible, with a lower level of security (Andrei *et al.*, 2021). In the strategies for green energy, it is also important the secondary production of agricultural crops, that could be used as biomass, although it is needed also the industrial development to use multiple sources of energy (Ciornei *et al.*, 2022). To be able to adapt to societal needs and keep up with the rapid rate of development and population growth, agriculture has experienced countless mutations over time. Traditional agriculture dominated a long span of time, from the beginning of civilization until the Industrial Revolution. It was defined by the involvement of many people and the use of basic tools; low yields and a minimum level of competence were required for the production methods (Popescu, 2017).

With the industrial revolution, industrial agriculture was developed. On this occasion, the metropolitan areas that are required to fill the employment gaps left by the mechanization of production processes in the agriculture sector are in the spotlight. The transition is being made to big farms that can use this type of system. The gene pool and biodiversity of cultivars had been seriously reduced, by extending only a few top variety or hybrid with performant yield, although for different plant diseases there it is needed heterogeneity (Cristina, Turcu and Ciuca, 2015).

After side-effects of intensive agricultural systems promoted by green revolution, agroecological principles and organic agriculture are brought into focus (Pingali, 2012). This is associated with movements for the

protection of the environment and supports the need to approach this branch through the prism of activities that contribute to the protection and support of biodiversity.

As highlighted above industrial agriculture and organic agriculture are in contrast but there is also a similarity namely both require a large consumption of inputs and agricultural works on the soil, which demands high investments.

Material and Methods

The data of this study case was collected from technology journal of winter wheat organic produced at the Center for Research of Organic Agriculture and from Development Department of National Agricultural Research and Development Institute from 3 agricultural years: 2018-2019, 2019-2020 and 2020-2021. Both production systems on organic and conventional are on the same soil type: cambic chernozem in non-irrigated conditions. Also it was used the same winter wheat variety: Glosa, that in conventional agriculture on fertilized and non-fertilized, grain protein content, Zeleny sedimentation and rheological parameters qualifies it's as a product for baking quality wheat (Marinciu *et al.*, 2019). The sowing period of each year was in the optimal period (1-20 October) for winter wheat for South-East Romania continental temperate area. The previous crops were field grain legumes: soybean/field peas. The typical crop rotation used was: Soybean – Wheat – Maize – Sunflower. For conventional agriculture the quantity per surface of active compounds of used fertilizers were 75 N kg/ha + 50 kg P₂O₅/ha (N₇₀P₅₀).

The costs of fuel and materials are given on different agricultural years as their acquisition costs. The number of working hours vary from specific field conditions. On calculation it was considered the number of maximum working hours estimated. The labor costs have been considered at 5€/hour on simply operations and at 7 €/hour on mechanized operations.

Subsidies for wheat are according to measure 11.2 for Sustaining Organic Agriculture Program by Agency for Payments and Interventions in Agriculture (APIA, 2014).

For this study case, indirect costs are at 20% from working hours costs.

The price for organic and conventional bread quality wheat also is considered at the real market selling price, even if the value on international market was different (Gimbășanu and Tudor, 2019).

Results and discussions

This study case, could suffer radical changes regarding costs if it will be applied to different farms and technologies. First of all, "chernozem" soils are the most suitable for cereals. Soil type is an important variable, that will determine the further steps for soil tillage mechanization works and the quantity of applied fertilizers.

Materials (quantity) used, their costs, as well as labor expenses and labor hours, were considered to give an overview of the agricultural operation costs for winter wheat.

The first table displays the processes used in both types of agriculture, while the following ones shows the particular processes used in conventional agriculture (second table), organic farming (third table), and the last table displays the specific operations for seed production.

Table 1: Agriculture operations with their working hours and costs

Winter Wheat					
Agricultural operations	Machinery and Materials used	Quantity used (kg/l)/(ha/ t)	Materials costs	Working hours (h)	Working hours costs
Disk harrow	Tractor+Disk harrow 3.8/Diesel	8.5	15.3	0.9	6.3
Total cultivation	Tractor+ Cultivator/Diesel	29	52.2	2	14
S-tine cultivator	Tractor+S-tine cultivator/Diesel	5.3	9.54	0.6	4.2
Seeding	Tractor+Seeder/Diesel	5.3	9.54	1	7
	Wheat Seed - Base Category	210	63		
Harvesting	Combine harvester	20	36		
	Wheat - C1 - brute quantity	3700			
Straw return + weeds chopping	Tractor+Straw return/Diesel	5	9	0.8	5.6

Source: National Agriculture Research and Development Institute, Fundulea, Călărași

Table 2: Conventional agriculture operations with their working hours and costs

Agricultural operations	Machinery and Materials used	Quantity used (kg/l)/(ha/ t)	Materials costs	Working hours (h)	Working hours costs
Chemical fertilizer	Tractor+Fertilizer machine/Diesel	4	7.2	0.5	3.5
	Fertilizer N16P16	300	300		
Chemical fertilizer	Tractor+Fertilizer machine/Diesel	4	7.2	0.5	3.5
	Fertilizer Urea	50	100		
Chemical fertilizer	Tractor+Spray machine/Diesel	4	7.2	1	7
	Herbicide	2	50		

Source: National Agriculture Research and Development Institute, Fundulea, Călărași

The chemical fertilizer doze it was not chosen for this case at the maximum yield potential of the variety. Due to the various factors. First of all, the fields are non-irrigated, in an area, where the average precipitation quantity does not overcome 275 mm/m², from October to April, the most important vegetation period for wheat (Petcu *et al.*, 2022).

Except of seed treatment, there is no treatment with chemical fungicide or insecticide at the target yield of 6000 kg/ha. But this varies with annual conditions. A sustainable principle is to not include the treatments in the crop production technology. The treatments to diseases or pests are applied just in case of emergency. In this particular study the seed treatment cost for conventional agriculture is neglected.

The chemical weeding by herbicides treatments differs by the product needed, that is relative to weed spectrum in different areas. It is recommended to perform periodically assessment of weed species, and to keep records of the field history from the previous years, in order to chose the suitable products, for Monocotyledon or Dicotyledon species.

To increase the sustainability also organic fertilizers or more friendly plant protection products could be used.

Table 3: Organic agriculture operations with their working hours and costs

Agricultural operations	Machinery and Materials used	Quantity used (kg/l)/(ha/ t)	Materials costs	Working hours (h)	Working hours costs
Tine-flex weeding	Tractor+Tine flex weeder/Diesel	3	5.4	0.2	1.4
Tine-flex weeding	Tractor+Tine flex weeder/Diesel	3	5.4	0.2	1.4
Weeding (Manual)				72	360
Organic foliar fertilizer	Tractor+Spray machine/Diesel	4	7.2	0.5	3.5
	Organic fertilizer	2	50		
	Water	200	34		

Source: Source: National Agriculture Research and Development Institute, Fundulea, Călărași

Wheat is a crop that could be manageable without manual working hours. In practice, in autumn and early spring, there are performed mechanical weeding operations with a tine-flex weeding tool. In different organic farms, manual weeding is performed with stand up weeder tools. There are on the market other simple mechanical tools, or very expensive, that request high digitalization of the farms. Large organic farms in Romania, already adopted a digital profile and for small farms, the investment is not profitable.

In our particular case, it was not used solid organic fertilizer, compost or other type of fertilizer accepted by organic agriculture norms. The use of organic agriculture manure is conditioned by the fact that, it should to origin from an organic certified animal growing farm.

In Romania the animal husbandry sector is at a low level. Organic livestock in 2021 dropped at 14.807 dairy cows, 13.837 of live sheep and 171.391 live poultry (EUROSTAT, 2021). At this level, the output of it is not well correlated with organic country's surface.

In low input organic agriculture system, if no organic fertilizer are applied the protein content will decrease to a level that will no longer meet the demands for bred wheat quality.

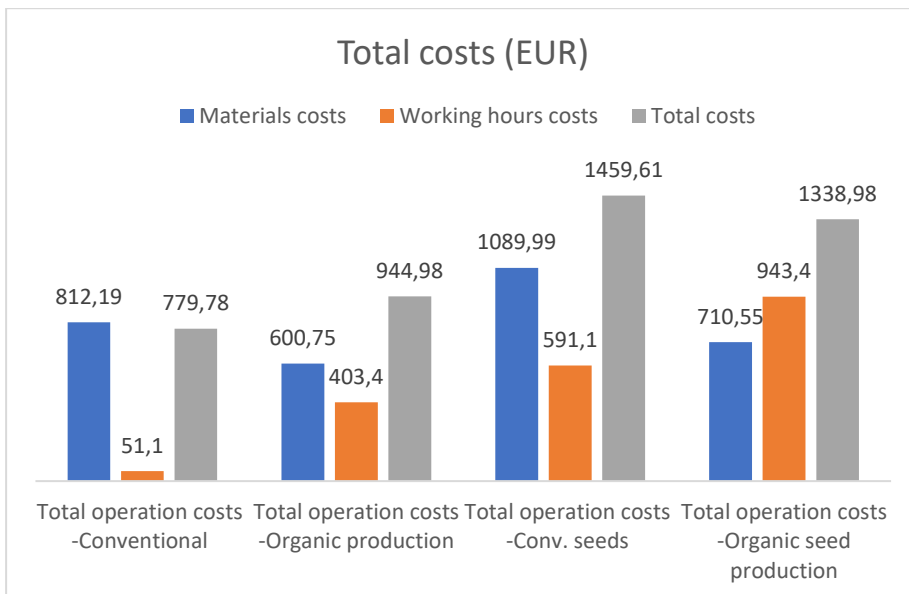
Seeds operations

Agricultural operations	Machinery and Materials used	Quantity used (kg/l)/(ha/ t)	Materials costs	Working hours (h)	Working hours costs
Seed conditioning	Seed conditioner/ KW	50	90	16	96
Seed bagging and labeling	Seed bags. labels	5	9	4	24
Seed certification					20
Roguing (Manual)				80	400

Source: National Agriculture Research and Development Institute, Fundulea, Călărași

Compared with vegetables or other field crops, autumn wheat is not a difficult plant specie for seed production. The crop technology is merely the same with wheat crop production for bread quality. The seed production and especially organic seed production raise a set of challenges for the farmers. First of all, they need to be certified by state (Petcu, 2020). Also, there are other resources that a farmer needs to buy or to use it in frame of a cooperative. This key resources for a simple farmer to became a seed producer are: a facility for conditioning and storing seeds. Seed conditioning equipment. The demands and quality requested for seed production, often requires more plant protection products. In organic agriculture, fungicides and pesticides approved are not very efficient. But with a good management this task is not a bottleneck for the process. The main actor that is missing in Romania are functional cooperatives, in which a seed producer should have his plan for the next following two years with the clear demand for the future requested quantity. Therefore, Romanian farmer that is producing seed for marketing it, is missing the most important block from the business: a sure customer.

Figure 1. Total costs



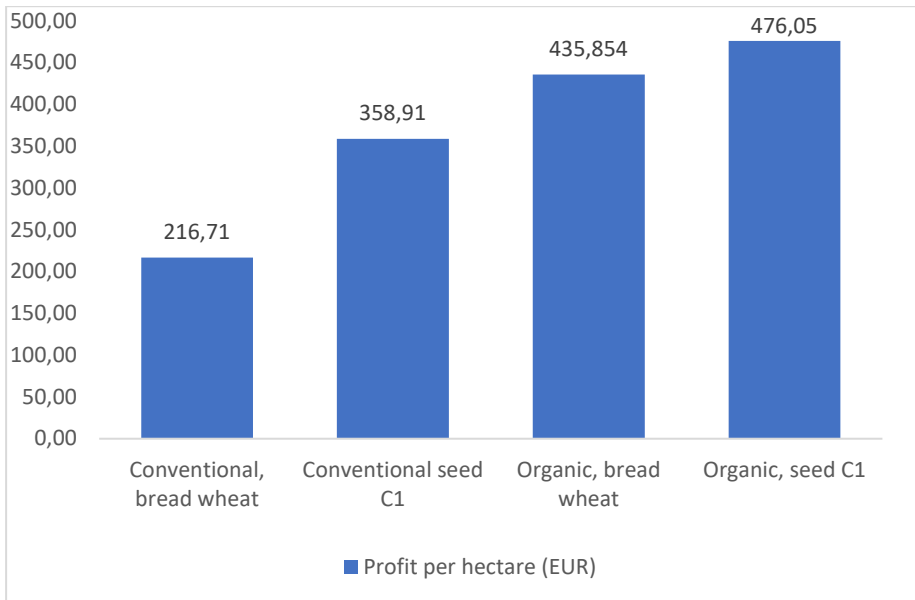
Source: National Agriculture Research and Development Institute, Fundulea, Călărași

When considering the conventional and organic farming it was observed that material costs are similar (Figure 1). While working hours for conventional agriculture are 7.3, the organic agriculture requires more effort (78.2 hours) making the costs for organic farming eight times higher. The main factor for this is the manual operation (weeding) required for organic agriculture.

For seeds, it was noted that material costs for conventional type are double comparing to organic seeds production. While the working hours can be considered similar, the total working hour costs are higher for organic type due to manual operations. The average labor costs per hour is 5 EUR for conventional seeds production and 9.6 for organic seed production.

The economic value per hectare without calculating the subsidies for good agricultural practice or organic farming has a linear growth starting with Conventional bread wheat (216,71€/ha), Conventional seed C1 (358,91€/ha), Organic bread wheat (435,85€/ha), Organic seed C1 (476,05€/ha).

Figure 2. Profit per hectare without any farming subsidies



Source: National Agriculture Research and Development Institute, Fundulea, Călărași

Conclusions

Seed producing is an option to add value to their final product for conventional and organic farmers. In this study case, the seed production, for conventional agriculture added a value of 120,20€/ha and for organic agriculture 40,20€/ha.

The highest added value was by organic agriculture, compared with conventional bread wheat, the profit difference was at 219,15€/ha.

On different soil, whether and farm and market conditions, the data could change and also the depicted order of profit per hectare from conventional bread wheat to organic certified seeds.

The production process of organic bread wheat and organic seed production is a challenge to farmers in Romania, due to key resources: workforce in the rural area, equipment and functional cooperatives to plan and sell the final products.

Acknowledgments:

This research is funded by ERA-NET Cofund Program. European and International Collaboration Subprogramme 3.2 Horizon 2020, project: "Diversification of organic crop production for increasing resilience" – DIVERSILIANCE under the contract 250/2021 with UEFISCDI, Romanian Ministry of Research.

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