PROFITABILITY OF ORGANIC FARMING OF SPELT IN THE CLIMATE CONDITIONS OF SERBIA

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A R T I C L E   I N F O

Original Article

Received: *21 January 2024*

Accepted: *14 March 2024*

doi:10.59267/ekoPolj240199D

UDC 633.11:631.147(497.11)

Keywords:

spelt, organic farming, profitability, climate change, Serbia.

JEL: *Q12, Q14, Q15*

A B S T R A C T

This research focuses on assessing the general profitability of organically produced spelt. Spelt is an ancient grain that has experienced a resurgence in Serbia in the late seventies of the previous century, due to its exceptional nutritional value and high compatibility with organic farming. Field experiments were conducted in northern Serbia over four years, applying further financial analysis. The main goal of the research is to identify and quantify the costs, benefits, and general profitability of organic production of spelt in the climatic conditions of Serbia. Results indicate that organically produced spelt is economically profitable, primarily due to its significantly higher market price compared to conventionally produced spelt. Given climate change concerns, promoting the cultivation of climate-resilient crops, like spelt, becomes crucial. Organic spelt cultivation could play a significant role in adapting crops to climate change, emphasizing the need for activities that mitigate negative environmental impacts.

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Introduction

Spelt (Triticum spelta) is an ancient species of wheat, originally grown in the Nile Valley back in 4,000 BC. It was known to the Romans and it was also grown for a long time in Germany, the Alpine region, and parts of the Pannonian Plain. As the Pannonian Plain became populated, Hungarian tribes continued to grow spelt (Kiš et al., 2016; Medović et al., 2021). However, spelt was almost disappeared over time and it was kept only in gene banks worldwide. It was rediscovered in the 1970s, due to rise in environmental awareness and increase in consumption of organically produced food (Campbell, 2010).

Today, spelt is gaining an increase in market share as people recognize its multiple worth. The morphological structure of the crop is such that it cannot prevail in soils containing heavy metals, therefore it is ideal for system of organic farming (Yonkova et al., 2016, Biel et al., 2016). Meanwhile, the thick grain membrane (husk) protects spelt from insects, but also pesticides, and other toxic substances (Deng et al., 2005). Spelt grain and flour attract potential consumers by its rich flavor (sweet and nutty), adequate and pleasant texture of derived bakery products, and well-balanced nutritional values (Wójtowicz et al., 2020). Its use is currently widespread, among other things because spelt contains less gluten than some other cereals (Frakolaki et al., 2018). So good nutritional quality recommends the spelt grain in food industry (specifically in bakery, pasta and confectioners' production, or beverage industry), (Chetrariu, Dabija, 2021), or as a animal feed (especially in growing horses), (Fayt et al., 2008), while straw and husks could be used for animal bedding in stables (Riedel et al., 2023).

Spelt grain has ideal combination of protein, carbohydrates, fats, minerals, vitamins, and fiber (Sinkovič et al., 2023). Compared to common wheat, it may have a higher content of protein and fiber, as well certain oligo-minerals and micro elements (e.g. phosphorus), or vitamins (e.g. β-carotene and retinol), (Escarnot et al., 2012; Huertas García et al., 2023).

Spelt fiber is readily soluble in water and this property enhances the resorption of nutrients by the body (Krahl et al., 2010). From the aspect of health, relative to bread wheat, spelt contains much more essential amino acids: leucine, methionine, and phenylalanine (Ranhotra et al., 1995; Rakszegi et al., 2023). Phenylalanine produces dopamine, and noradrenaline and adrenaline. Under certain conditions, deficit of dopamine may lead to Parkinson's disease, while noradrenaline and adrenaline control blood sugar, or their deficit could lead in severe depression (Jankovic et al., 2015). Spelt is rich in tryptophan, which supports the synthesis of serotonin, hormone that affects mood and mental balance (Munoz Insa et al., 2016).

Spelt grain abounds in minerals, microelements, and vitamins, and contains much more vitamin B1, vitamin B2, and niacin than common wheat. Selenium content is also high (Zuk Golaszewska et al., 2022). Consumption of spelt protects the human body from disease and boosts immunity. In some countries, like Germany, spelt is part of therapy for chronic infections such as herpes and AIDS, bone and nervous system ailments

(Parkinson's and Alzheimer's disease, or arthritis), cancer, as it effects the prolonged influence of antibiotics (Wójtowicz et al., 2020).

Although the spelt farming in Serbia is quit a limited, it has recently been expanding due to the exceptional nutritional value of the grain and its suitability for organic production (in organic system of production, it is grown at less than 200 ha, while the largest areas are in Vojvodina), (Golijan et al., 2019). Previously, spelt had not been included in seed production in Serbia. However, scientific institutions, such as the Institute of Field and Vegetable Crops from Novi Sad, or Maize institute from Zemun polje recognized its significance and proceeded to multiply seeds to promote spelt farming (Jankovic et al., 2015; Lazarević et al., 2022). Limited areas under spelt are usually linked for high costs of husks dehulling from the grain, as the processing lines for that purposes are great investment for the majority of farms, that could lead to the zone of unprofitability (Kolankowska et al., 2023; Sinkovic et al., 2023).

Crop farming in Serbia directly depends on climate conditions, as it is largely rainfed (Daničić et al., 2021). On the other side, temporal and spatial distribution of rainfalls is uneven, especially during the growing season, generating semi-favorable conditions for crop production and high yield uncertainty (Zubović et al., 2018). Apart from erratic rainfall, climate in Serbia involves high summer air temperatures and frequent heat waves, while in general air temperatures exhibit an upward trend. In addition, in Serbia may be expected more frequent occurrence of heavy rainfalls and extreme heat, or drought (Bonacci, 2019; Pecelj et al., 2020). So, mentioned climate conditions have in certain extent negative impact on plant production, while given climate predictions points out that crop productivity will continue to reduce, especially in production of spring crops (Iglesias et al., 2012; Milošević et al., 2015). Given that one of the ways for adapting to the impact of climate change on crop farming is adequate selection of crops and varieties tolerant to high temperatures and drought, there is believe that organic farming in Serbia should be given serious consideration (Jovanovic and Stikic, 2012; Djekic et al., 2021), especially in case of spelt varieties.

Appliance of organic farming allows farmers to benefit from several economic and social advantages over conventional farming. Usual conventional crop production system currently involves highly intensive activities based on high-energy inputs, mainly harmful to the environment. Practicing organic farming offers much shallower environmental footprint due to absence of synthetic agro-chemicals, while its efficiency could vary in line to used management choices (Gomiero et al., 2011). As in case of spelt wheat, the adequate variety represents key factor for efficient organic production, while its current cultivars do not fit assumed production and market requirements of organic agriculture (Konvalina et al., 2009). Oftentimes farmers involve in organic crop production old varieties of cereals, as they are more resistant to diseases, or they require lower fertilization, contrary to expected lower yields. So, the basic criteria for varieties selection is their fitting to local climate (heat waves and drought, frosts, hail or wind, and water-logging), plant yield capacity and stability, well-rooting, level of required macro and micro nutrient, tolerance to diseases, pests and weeds, etc. (Lammerts van Bueren et al., 2011; Rawat et al., 2021).

Differing results in profitable organic farming derived as combination of yield oscillations, cut in input costs, and level of subsidies and price premiums. Like in other grains production, the costs of agro-chemicals (fertilizers, growth stimulators or pesticides) are significantly lower in spelt organic contrary to conventional production (McBride et al., 2015). Additionally, mentioned production is pressed by higher costs of seed, more intensive tilling and land cultivation (higher fuel costs), labor intensive approach (e.g. making the organic fertilizers, performing the intensive weed and pest control, etc.), affecting the overall profitability of organic cereals growing. Providing the sustainable profitability in crop growing is difficult task, both in organic and non-organic farming. Meanwhile, the costs in grain (spelt) organic production are more often higher, while the yields are potentially lower in conventional farming, where the expected higher prices for organic agro-food products could make profitability more challenging (McBride et al., 2015; Simin et al., 2019).

The main purpose of paper is to identify and quantify the general costs, benefits, and profitability of organic spelt farming in climate conditions of Serbia. The emphasis in this research is based on appliance of common economic method and the use of real data. Although the potential limitation is in observed production period, it could serve for perceiving the profitability potential of this line of crop production, as well as derived results could apply to similar geographic and climate areas, or by production technology similar crops.

Materials and methods

This section mainly includes several details about the study area, used spelt variety, performed organic farming practices, available climate parameters and soil type, and the used methodological approach.

Study area and used variety

The research is focused on organic spelt production. The study area is in the north of Serbia - the Province of Vojvodina, specifically location is in Ada municipality (Figure 1.). The study period covers four years (2010/11-2013/14.). Location has been chosen based on assumption that Vojvodina is a Serbia's leader in field crop farming, attracting the majority of spelt organic production, so it could be adequate represent of available climate conditions, performed practices and profitability linked to spelt production. To assess the economic feasibility of organic spelt production in real-time, evaluation parameters were also projected in 2023. based on the occurred inflation rate.

Organic farming is performed at the fields (on several plots) of the agricultural company Bio Farma doo, that is generally specialized in crop, mainly grains production. The available soil is highly fertile (carbonate chernozem type, on a loess plateau). The observed climate parameters involve amount of overall precipitation (rainfalls), mean daily or monthly air temperature, and potential evapotranspiration (ETo).

Figure 1. Location of study area and photos of the organic production and harvesting of spelt in a fields of Bio Farma doo in Ada during the study period

Source: photos: Nandor Terek; map: http://commons.wikimedia.org/wiki/File:Municipialities_of_Serbia_Map-sr.svg#/media/File:Municipialities_of_Serbia_Map-sr.svg

The data for daily precipitation during the study period (2010/11-2013/14.) were collected from a rain-gauge station installed in the Halas Jožef field in Ada. The other meteorological data and ETo, were taken from the Republic Hydrometeorological Service of Serbia (RHSS) for the weather station at Palić, as a representative for the study area. ETo was calculated according to Penman-Monteith method (Allen et al., 1998). The studied crop was spelt, specifically Nirvana cultivar, as its suitable for growing in system of organic agriculture, as well as its highly tolerant to low winter temperatures (NSS, 2023).

Organic farming

The transition to organic crop management at Bio Farma doo was initiated in 2005-2006., while actual organic farming has begun (upon certification) in the spring of 2008. Spelt was grown during the study period at 10 ha plot, pursuant to the Serbian Organic Farming Law (Official Gazette of Republic of Serbia no. 30/10 and 17/19). The crop preceding spelt in the first and fourth year (2010/2011. and 2013/14.) was maize, while in the second and third year (2011/12. and 2012/13.) was soybean. The spelt, Nirvana cultivar, was sown in the late October, while it was harvested in mid-July of following year. Firstly, land tilling is made with tractor Belarus 820 in two passes. Prior to sowing, the soil was disked by New Holland tractor and large disc harrow, while field preparation for sowing was done by the New Holland tractor and seedbed conditioner (4 m wide). The used crop density was 500-550 germinating grains per m^2. The crop was harvested by a New Holland harvester equipped with a straw shredder. Organic fertilizer was applied using a Torpedo tractor and depositor, while biostimulators was applied by Torpedo tractor and adequate atomizer. Irrigation system was not implemented. In the first year the crop was not fertilized, while in the second year Guanito (6N - 15P2O5 - 3 K2O) pelleted fertilizer was used (250 kg/ha), or in the third and fourth year Italpolino (12N-5P2O5-15K2O) pelleted fertilizer (250 kg/ha) was applied prior to plots preparation for sowing. In spring, as side-dressing was used Italpolino (3N - 3P2O5 - 3 K2O, in norm of 150 kg/ha) or Dix fertilizers (10N, in norm 250 kg/ha). In the third year of observed period biostimulators Humus (1.5 l/ha) and Green Shield (2.1 l/ha) were also applied.

Economic evaluation parameters

The profitability assessment of applied organic management in spelt production involves financial analysis in line to commonly used analytical calculations based on variable costs (contribution margin), (Kresovic et al., 2014; Đuričin et al., 2018; Jeločnik et al., 2021). Contribution margin represents the overall economic benefit derived from certain production line (Kendall et al., 2007). It shows the difference between overall income and overall expenses (mainly variable costs) gained in observed production, in this case spelt organic growing. Basically, fixed costs and taxes was not included in calculation. Income represents the expression of achieved yields and current market prices of certain crop, while the total income is increased for assigned incentives for organic crop production (Subić et al., 2021). Starting from 2013. the Ministry of Agriculture, Forestry and Water-management has been started to subsidies the organic crop producers per hectare, determining the level of incentives for each production year (previously sum of subsidies in organic crop production was equal to sum given for conventional crop production). Up today incentives have showed upward trend. Made expenses (overall variable costs) covers the value of used inputs (in line to prices at local market in certain year). They include the costs of using machinery, labor, fuel, seed and agro-chemicals (fertilizers, pesticides and biostimulators). The costs for used mechanization were calculated according to pricelists of the Cooperative Union of Vojvodina for observed years. All mentioned were used to calculate income and variable costs (contribution margin) for the organic production of spelt. Norm of used inputs were obtained from the producers' internal documentation.

Further, future values of costs and incomes were projected to examine the economic feasibility of organic spelt production in real-time (Table 3.). They represent the all values at a specific moment, in this case in 2023., increased for a given inflation rate. Estimation of production cost and prices for 2023. was performed using the formula that considers the future value of money, while the inflation rate is used instead of interest rate (Ruiz Menjivar et al., 2015):

$$RtV = BV*(1+IR)^t \tag{1}$$

Where:

RtV = real-time values,

BV = basic values for the observed period,

IR = inflation rate, and

t = number of periods (years) until the moment in the future (selected year).

For basic values, average cost and price values were used, while for the inflation rate, the annual inflation rate in the Republic of Serbia for the year 2023. was used, amounting to 7.6% (CEKOS IN, 2023). The number of periods (years) until the determined future moment was set at 9 years, representing the number of periods from 2014., for which there is real data, to 2023, the year for which the values are projected. The projection of income and cost values in real-time is based on price projections, while the yield is based on the average value achieved during the period 2011-2014. Future yield values are not projected since the research indicates the achievable production quantity under existing agroecological conditions. Incentives for 2023. are determined by the Ministry.

Results with Discussion

Climate conditions

The average annual air temperature for the past 50 years (1960/61-2010/11.) in the study area (weather station at Palić) is 10.8 C, while the average annual precipitation is 565 mm (Table 1.). Like for winter wheat, the growing season of spelt is from October to June, and it is characterized by average air temperature (1960/61-2010/11.) of 8.0 C and average precipitation of 405 mm. To better illustrate the trends of main climate parameters (air temperature and precipitation), in Table 1. are shown the average values for the first 30 years (1960/61-1990/91.), the following 20 years (1991/92-2010/11.), and each observed year in study period (study years represents hydrological years or vegetation period linked to organic spelt production, from October to November).

Table 1. Main climate parameters of northern Serbia (Palić weather station) for certain years and growing season (October-June)

Period	T (in C)		P (in mm)		ETo (in mm)		ETo - P (in mm)	
	Hydr. year	Oct-Jun	Hydr. Year	Oct-Jun	Hydr. Year	Oct-Jun	Hydr. year	Oct-Jun
1960/61-1990/91.	10.5	7.6	539	395	854	497	315	103
1991/92-2010/11.	11.4	8.5	605	420	914	534	309	114
2010/11.	12.3	8.9	508	382	827	488	319	106
2011/12.	12.8	9	342	295	825	470	483	176
2012/13.	12.3	9	729	574	941	522	212	-52
2013/14.	12.8	8.3	758	444	850	514	92	69
2010/11-2013/14.	12.6	8.8	584	424	861	499	277	75

Mean air temperature (in C)												
Period	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
1960/61-1990/91.	11	5.2	0.7	-1.6	1.1	5.6	11.1	16.3	19.4	21	20.2	16.5
2010/11.	9.3	9	0.4	0.4	0.4	6.7	13.9	17.8	22.2	22.5	24.1	21.2
2011/12.	11.2	3.2	3.8	1.6	-4	8.5	14	18.6	24.3	26.4	25.9	20.6
2012/13.	12.7	8.4	0	1.8	3.8	5.6	14.1	18.2	16.5	25.3	24.7	16.5
2013/14.	14.4	8.6	2	3.1	5.1	9.9	13.3	16.0	20.4	22.3	21.0	17.4
2010/11-2013/14.	11.9	7.3	1.5	1.7	1.3	7.7	13.8	17.7	20.9	24.1	23.9	18.9
Precipitation (in mm)												
Period	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
1960/61-1990/91.	28	46	46	36	31	34	43	55	74	57	54	36

Period	T (in C)			P (in mm)			ETo (in mm)			ETo - P (in mm)		
	Hydr. year		Oct-Jun	Hydr. Year		Oct-Jun	Hydr. Year		Oct-Jun	Hydr. year		Oct-Jun
2010/11.	54	49	65	35	25	58	3	65	28	82	15	29
2011/12.	36	0	44	33	35	10	59	57	23	29	4	14
2012/13.	77	41	71	49	67	86	50	82	52	24	62	70
2013/14.	70	0	3	32	22	51	25	193	50	103	97	114
2010/11-2013/14.	59	23	46	37	37	51	34	99	38	60	44	57

Source: RHSS, 2023.

Note: Air temperatures (T), annual and seasonal (Oct-Jun), overall precipitation (P), and potential evapotranspiration (ETo)

Air temperature over the past 50 years exhibits an upward trend (Table 1.). In the previous four years, the average annual temperatures have risen by as much as 2.1 C, while during the growing season of spelt (October-June) by 1.2 C, relative to the period 1960/61-1990/91. Average annual temperatures in observed period (2010/11-2013/14.) varied from 12.3 C to 12.8 C. The warmest hydrological years were 2011/12. and 2013/14., with an average annual temperature of 12.8 C. The warmest growing seasons (October-June), with an average temperature of 9.0 C, were recorded in 2011/12. and 2012/13. (Table 1.).

Annual overall precipitation in observed period varied from 342 mm to 758 mm, where the first two observed years were drier than normal (1960/61-1990/91.), while the last two observed years were above the normal (Table 1.). The least precipitation (342 mm) was recorded in hydrological year 2011/12., when is registered for 37% less rainfall than normal. The rainiest year was 2013/14. with 758 mm, or for 41% more rainfall than normal. The driest growing season (October-June) was in 2011/12., with only 295 mm of rainfall, or for 25% less than normal. The optimal spelt yield may be obtained in regions with overall rainfalls in range 650-750 mm, with rainfall distribution in line to crop requirements for water in individual growing stages (Vojnov et al., 2020).

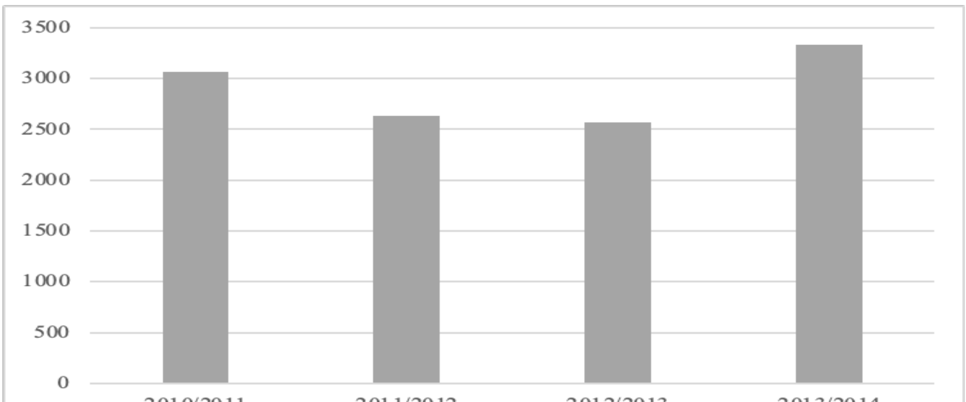
The sum of annual potential evapotranspiration (ETo) in observed hydrological years was in average 861 mm, while in the spelt growing season (October-June) was 499 mm. These values were close to the 30-year average (1960/61-1990/91.), (Table 1.). In the study years (2010/11-2013/14.), the annual ETo was higher than the annual precipitation. Water deficit for the studied crop was from 92 mm (in 2013/14.) to 483 mm (in 2011/12.). Determined water deficit (overall and by separate parts of growing season) is in line to certain findings for Serbia and wheat growing (Jeločnik et al., 2019), while mentioned impose the implementation of irrigation in cereal production. In general, high yield variability is the main feature of rainfed crop production in Serbia (Matović et al., 2013), while level of temperature and crops' drought tolerance is among the major criteria in selection the species, varieties, or hybrids, in organic and conventional farming.

Given that average annual and seasonal climate parameters are insufficient for assessment of rainfed farming, which also requires temperature and rainfall distribution in shorter intervals over the growing season, in Table 1. is also shown the mean monthly air temperatures and precipitation. In the study period, the coldest was in February (in average 0.1 C), while the warmest was in July (in average 24.4 C). The largest rainfalls were recorded in May (in average 99 mm), while the lowest were in November, where without rain were in two observed years (2011 and 2013.). There were also recorded occurrence of moderate spring frosts that haven't affects the gained yields.

Organic spelt wheat grain yields

In Figure 2. are shown the obtained yields of organic spelt within the study period. In average, the yield of organic spelt (Nirvana cultivar) over the observed period was 2.9 t/ha. The entire year 2011/2012., as well as growing season (October-June) in mentioned year was extremely dry, affected by the lowest annual (342 mm) or seasonal precipitation (295 mm) and the highest annual average temperature (12.8 C). Occurred extreme drought in observed area, results in unusually high-water deficit (ETo-P) of 176 mm (Table 1.). In such circumstances, gained yields were lower compared to previous year, when the overall precipitation within the growing season was 382 mm, with average temperature of 8.9 C. So, the yield reduction in 2011/2012. compared to 2010/2011. was 14.3%. Mentioned was not only the result of hot and dry summer in 2012. (June – precipitation 23 mm, mean temperature 24.3 C), but also the extremely dry conditions during the period when the soil cultivation and sowing was performed (September and October of 2011. had rainfalls of 21 mm, or 11 mm), (Table 1.). In such weather conditions, without implemented irrigation, sprouting and initial stages of plant growth was hindered, while there comes to acceleration in ripening. So, having in mind that almost every fifth year in Serbia is characterized by very dry weather (Gocic, Amiri, 2023), negative weather impacts on gained crop yields could be, among all, exceeded by irrigation.

Figure 2. Yields of organic spelt (in kg, period 2010-2014)



Source: Bio Farma, 2023.

Economic assessment of organic spelt production

The economic assessment of the profitability (contribution margin) of organic spelt farming encompasses analytical calculations based on variable costs. The gross profit was calculated as the difference between total incomes (including subsidies) and variable costs derived from organic spelt growing, where the variable costs involve costs of mechanization use, fuel, seed, and agro-chemicals (sum of costs of pesticides, growth stimulators, fertilizers, etc.), (Table 2.).

Table 2. The economic assessment of the profitability of organic spelt farming

Period	2011.	2012.	2013.	2014.	Average
Mechanization (EUR/ha)	163	153	165	180	165
Fuel (EUR/ha)	72	72	74	101	80
Seed (EUR/ha)	116	124	142	139	130
Agro-chemicals (EUR/ha)	80	255	267	361	241
Total variable costs (EUR/ha)	**431**	**604**	**648**	**781**	**616**
Yield (t/ha)	3.07	2.63	2.57	3.33	2.90
Price (EUR/kg)	0.54	0.50	0.61	0.53	0.55
Income (EUR/ha)	**1,658**	**1,315**	**1,568**	**1,765**	**1,581**
Subsidies (EUR/ha)	162	123	110	139	134
Total income (EUR/ha)	**1,820**	**1,438**	**1,678**	**1,904**	**1,714**
Contribution margin (EUR/ha)	**1,389**	**834**	**1,030**	**1,123**	**1,098**

Source: According to authors' calculation.

In economic theory, to labor may be given two opposite views. In line to organization of activities at the agricultural holding, labor costs can be seen as fixed or variable. Usually, as variable costs are assumed if they involve external labor (Subić et al., 2022).

In average, over the study period the sum of variable costs was 616 EUR/ha. Analysis shows that the costs of used agrochemicals have the highest share within the overall variable costs (about 39%), while they have gradually increase, and in average amounts 241 EUR/ha (Table 2.). In addition, costs of mechanization (in average 165 EUR/ha) have also significant share in the structure of overall variable costs (about 27%). Increase in costs of organic agro-chemicals was due to rise in their price at international level (they are mostly imported products). Seed and fuel costs in average for observed period were 130 EUR/ha and 80 EUR/ha, while they have share of 21% and 13%, respectively.

Yasin et al. (2014) have been reported higher profitability of organic crop management than conventional. In performed research, the profitability (i.e. contribution margin) of organic spelt farming derived from the higher overall income, due to relatively stable yields and price, and increase in subsidies in observed period. The average yield was 2.9 t/ha, while the average price was 0.55 EUR/kg (Table 2.). From the aspect of dynamics, rise in organic spelt wheat's yield (up to natural capacity of used variety), price and national support have led to consistent rise in overall incomes, while the total income increased faster than the total variable costs, resulting in better farm profitability (contribution margin) of organic spelt growing. This way was made the general preconditions for more intensive enlargement of this line of production at national level.

Meanwhile, the economic feasibility of organic spelt production (Table 3.) has been confirmed in real-time. The projected values of costs and prices, with unchanged yields, result in a profit margin 72% higher in 2023. compared to the average profit margin for the period 2011-2014. From a dynamic perspective, with unchanged yields, total income exceeds total costs. The significant increase in total income is largely due to a significant increase in national incentive for organic crop production in 2023. compared to its value in observed period 2011-2014.

Table 3. Estimated assessment of the profitability of organic spelt farming (in 2023.)

Period	Average (2011-2014.)	2023.
Mechanization (EUR/ha)	165	319
Fuel (EUR/ha)	80	155
Seed (EUR/ha)	130	251
Agro-chemicals (EUR/ha)	241	466
Total variable cost (EUR/ha)	616	1.191
Yield (t/ha)	2,9	2,9
Price (EUR/kg)	0,55	1,1
Income (EUR/ha)	1.581	3.084
Subsidies (EUR/ha)	134	538
Total income (EUR/ha)	1.714	3622
Contribution margin (EUR/ha)	**1.098**	**1.893**

Source: Authors' calculations based on available data

Derived profitability of spelt organic production is usually the result of obtained market price, where compared to common (bread) wheat its market price could be up to three times higher. Despite the more expressed energy efficiency, or health and environmental impact in organic agriculture (including the spelt production), (Smith et al., 2015; Takač et al., 2022) the negative side organic production arises from lower yields (Gabriel et al., 2013) that is commonly compensated by higher food-product's prices (Singh and Grover, 2011; Cristache et al., 2018).

The research is in line with general knowledge, emphasizing how pricing, yields stability, national support, or cost control determine the profitability in conventional or organic farming. It has noted that Vojnov et al. (2020) obtained similar yields in spelt organic production in several locations in the north of Serbia. Since the yields in rainfed organic grains production usually lag behind up to 20-30% compared to yields gained in conventional production (Mäder et al., 2002), the gap in derived profitability cannot be explained by yields, its mainly caused by better prices (demand pressure) and stronger national support. For example, the conventionally grown spelt yield in Italy, under rainfed conditions, peaks 3.1 t/ha (hulled grain yield was 2.8 t/ha), (Troccoli and Codianni, 2005), while in Poland it reaches around 2.6 t/ha (Sulewska et al., 2008). In research study, the reached average yield is in line to yields usually gained in organic spelt wheat, around 3 t/ha (Moudrý et al., 2011). On the other side, in some experimental conditions gained yields, depending to intensity of certain production condition, have been varied from around 4 t/ha (Dorval et al., 2015; Wang et al., 2021) to over the 7 t/ha (Pospisil et al., 2012).

Some research results (Novković et al., 2020), show that in northern Serbia conventional spelt growing has better profitability contrary to common wheat, although it reaches 50% smaller yields, as its price is up to 5 times higher, while production costs are for up to 40% lower. So, knowing that spelt is well-adapted to producing in several environmental conditions, in optimal conditions due to climate, soil, used agrotechnical measures, organization of production, etc. under some circumstances it could gain similar yields to common wheat (Jablonskytė Raščė et al., 2013). Like in grains production, there could come to certain gaps in produced volume of other crops (vegetables, pulses, fodder crops, oilseeds, or tuber crops, and fruits) grown in organic or conventional system of production (depend on observed crop and region) they could differ in extreme situation in range from 70 to over 80% (De Ponti et al., 2012).

Besides, there could be implemented certain production mechanisms in organic crop management that will provide further yields stability if occurs the lack of applied irrigation towards the exposed level of water deficit in some crop development stages within the growing seasons. As were previously mentioned yield oscillations is common issue in rainfed crop production, where the crops tolerance to high temperature and drought is mainly desired. Besides, activities that are increasing the drought tolerance of grown crop involve maintaining the higher level of soil water-holding capacity (Wells et al., 2000), or higher level of soil organic carbon (SOC), (Iizumi and Wagai, 2019). Then, some experimental measurements have shown much more available water in soil by practicing organic than conventional pulses growing. In same manner, crop resilience to drought in organic crop management is more affected by presence of mycorrhiza (Ortiz et al., 2015).

Conclusions with recommendations

Policymakers, together with national association of organic producers can have a much more expressed impact on spreading the areas under the organic spelt. It could be done through various support mechanisms (especially to farmers that are in transition period), such are introduction of new and rising the level of practiced direct payments and indirect subsidies (e.g., grants for organic certification, low-interest loans for used inputs, certain forms of tax breaks, etc.). Furthermore, it should be allocated more funds for research (to scientific institutions) and knowledge transfer or training programs for farmers (primarily to extension services), that are mainly linked to organic spelt farming techniques, pest and disease, or soil improvement management. Policy makers should support initiation of collaboration between research institutions, farmers, and private enterprises, due to development and implementation of innovative technology and organic growing practices (specifically for spelt). Additionally, there has to be established close connection between policy makers and national association of organic producers, and other stakeholders, as are retailers, food processors, restaurants, etc. in order to rise the demand for organic spelt (due to rise in awareness to consumers related to benefits of organic spelt) and further to provide stable farmers' incomes and market stability. Then has to be well-maintained and in some parts adjusted existing system of (re)certification towards the spelt growing.

Although is mainly the producers' decision, towards the expected profit and existing market demand, policy makers could have to adopt current land use policies in a way to prioritize organic farming practices and reallocate some suitable land areas to organic spelt growing. Mentioned could involve protecting available agricultural land from urban encroachment, or promoting the conversion of conventional to organic farms. Policy makers should also develop and support policies that address the issues and challenges of current climate change trends in agriculture, where one segment may be through organic spelt growing practices. At the end, by previously mentioned they could affect promotion of sustainable agriculture, enhancing food security, environmental conservation, as well as fostering health life at local population. Unfortunately, there is still not in operation the marketing information system for organic products and inputs at national level, whose establishment will surely facilitate dynamics of current production and consumption of organic agro-food products (Kovačević, 2021).

Considering observed farm and performed economic assessment, it could be assumed profitable (based on contribution margin) spelt organic production in Serbia (in rainfed conditions), as the total incomes are over the total variable costs. Considering the granted state subsidies, actual profitability could be even higher. Applied calculation method could be used in other production lines, or production systems, as well as different geographic regions, or alternative growing periods, etc. It is expected in Serbia that current state support together with rise in farms' and consumers' awareness towards the general economic and health benefits will encourage large-scale organic farming in upcoming period. This would be extremely important not only for Serbia, but the entire West Balkans where the agriculture is among the most important economic activities that affects national GDPs, while by mentioned trend will be activated the additional creation of value added in agriculture.

Given the current climate changes and upward trends in average temperatures, heatwave and drought frequency and intensity, generally higher drought tolerance of organic crops and wider implementation of irrigation could also support the increase of areas under the system of organic management. Future research could involve a comparative analysis of gained climate and economic results with those obtained in upcoming four years period (e.g. 2024-2027), or at other location, with assumption of ceteris paribus. Further, future comparative analysis could include deeper examination of climate conditions, achieved yields, etc., trying to discover whether the previous elements determining the profitability in spelt production have been changed in the meantime.

Acknowledgements

Research study was supported by the Ministry of Science, Technological Development and Innovation of Republic of Serbia (Grants no. 451-03-66/2024-03/200005, 451-03-66/2024-03/200010, and 451-03-65/2024-03/200116). Authors wish to express their gratitude to the company Bio Farma doo Belgrade for making available their production data relevant to performed research. Special thanks go to Ms. Jelena Gedošev and Mr. Nandor Terek for their generous assistance, critical review, and suggestions that have contributed to the final version of paper.

Conflict of interests

The authors declare no conflict of interest.

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