

## IMPACT OF THE ECONOMIC CRISIS ON THE APPLE PRODUCTION PRICE IN THE REPUBLIC OF NORTH MACEDONIA\*

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### Summary

Apple production has the greatest significance among all types of fruit crops in Macedonia, sharing 56% of the total fruit production. Due to the economic crisis caused by Covid-19 and the war in Ukraine, the prices of agricultural inputs have increased greatly. To that end, the main goal of this paper is to evaluate the impact of the global economic crisis on the apple production price. The production costs calculation is based on calculation of variable and fixed costs of apple production for 2020 and 2021 as reference years and 2022 as the year when the production price change is considered. Data for the normative calculation and production price for 2020 and 2021 are obtained based on the expert knowledge and confirmed with the semi-structured interview with 3 farmers and 2 apple producing companies. Based on this normative calculation and market prices for inputs in 2020, 2021 and 2022 collected from the 10 input suppliers, AMIS and SSO, the apple production price is calculated. The results show that the economic crisis has a large negative economic impact on apple production, as the estimated full production price of apples in 2022 has increased by 37% compared with that of 2020 & 2021.

*Keywords: impact assessment, socio-economic crisis, apple producers, production price, production costs.*

### INTRODUCTION

The economic consequences of the COVID-19 pandemic, the military conflicts in Ukraine and severity of climate change are exposing global food supply chains to high levels of fragility. Russia's military aggression against Ukraine has raised a widespread international concern of a global food crisis similar, or worse, to the one the world faced in 2007-2008. These two countries are key agricultural players which, combined, export nearly 12% of the food calories traded globally, and are major providers of basic agro-commodities, including wheat, maize and sunflower oil (Capril & Pichon, 2022). Russia is also the world's largest exporter of fertilisers. Russia's war against Ukraine has

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demonstrated that the EU's and many other countries depend on Russian coal, oil and gas. Since the invasion started, energy prices have risen dramatically, forcing consumers to pay more for petrol, heating and electricity. This resulted in huge disruptions in the supply of agri-food products, which have relatively begun to recover from the stresses and disruptions of the Covid-19 virus pandemic and limited supplies after 2020. This caused volatility and increased commodity prices, and consequently, an increase of food prices to levels not seen since the 2007-2008 crisis (WB, 2022). The FAO Food Price Index, tracking monthly changes in international commodity prices, indicates an increasingly difficult situation, it averaged 140.7 points in February 2022, its highest point ever (FAO, 2022). In the EU, food prices have increased 5.6% compared to February 2021. Concerning fertiliser, prices were already on the rise before the war, reaching levels unseen since the global financial crisis, mostly due to higher gas prices. The FAO forecasts that the global reference price of fertiliser would undergo an additional 13 per-cent increase in 2022/23, relative to its already elevated baseline level, in response to the more expensive production inputs implied by the higher crude oil price, but also by higher crop prices. This increase would influence production costs for the 2022/23 growing seasons (Capril & Pichon, 2022).

Countries that have weak institutions and/or societies with ingrained inequalities, or high dependency on imports of inputs and food, already face grievances that can be intensified by price and availability of necessities, like food. The socio-economic impact of the disruption of supply chains is particularly related to food security, development of agriculture and the well-being of rural households.

Since apple production in Republic of North Macedonia is the main fruit crop in terms of exports value, production and land areas, and has a large socioeconomic impact in the regions where it is grown, it is of particular importance to determine the impact on the price of apple production in conditions of disrupted value chains.

The areas under fruit plantations in the country in 2020, take about 3.3% of the total arable area or 17.095 ha, sharing 56% of the total fruit production. Apple plantations in 2020 amounted to 5,900 ha, taking up 34.5% of the total area of orchards (17,095 ha). Compared to the previous year, 2019, there was an increase in the total areas under fruit plantations by 311 ha. The most important region for apple production is the lake region (Prespansko-Ohridski), where about 75% of the total amount of apples is produced. The production of apples in 2020 was about 105.940 tons, which is an increase of about 19.3% compared to the year before. The increase in production is mainly the result of increased production per tree (on average 3 kg additional yield compared with 2019). About 25% of the total production of apples is sold on the domestic market, while the remaining 75% are processed or exported. The value of exported apples in 2020 was around 7.7 million EUR and is significantly higher compared with the exported value of 5.4 million EUR in 2019.

The orchards production is occupation of around 35,549 rural households, mostly apple growers, out of which only 82 are business entities.

## MATERIALS AND METHODS

The production costs calculation is based on calculation of variable and fixed costs of apple production for 2020 and 2021 as reference years and 2022 as the year when the production price change is considered. Data for the normative calculation and production price for 2020 and 2021 are obtained based on the expert knowledge and confirmed with the semi-structured interview with 3 farmers and 2 apple producing companies. Based on this normative calculation and market prices for inputs in 2020, 2021 and 2022 collected from the 10 input suppliers, Agriculture Market Information System (AMIS) of the Ministry of Agriculture, Forestry and Water Economy (MAFWE) and the State Statistical Office (SSO), the apple production price is calculated.

As an economic indicator, cost of production (CoP) is the average cost of production for producing one unit of apple (kg product). At the same time CoP is presenting the minimum selling price of 1 kg apple (break-even price) as a break-even point in order to manage production without losses covering all costs of production. The apple CoP are calculated based on standard (normative) production on 1 hectare apple plantation and methodology used in different relevant literature (for example, see Ciaian *et al.*, 2013; Kay *et al.*, 2014; FAO, 2016), also customarily applied in the local context (Milanov and Martinovska, 2002; Martinovska *et al.*, 2009).

$$\text{CoP} = \text{TC} / \text{Y}$$

CoP - Cost of production (in EUR/kg)<sup>2</sup>

TC - Total cost (in EUR)

Y - Yield (produced apple in kg)

The CoP of apple production are calculated based on the total cost of production, calculated as used quantities for inputs and other resources for apple production, formed upon pre-defined normative costs of apple production, multiplied by their real market values in 2020/2021 and 2022.<sup>3</sup> In addition, the fixed costs (depreciation) of apple plantation are included in the total costs.

Apple yields normatively are fixed on average yearly expected yields of 30,000 kg apples per hectare.

The total costs represent the sum of variable and fixed costs of apple production.

$$\text{TC} = \text{VC} + \text{FC}$$

VC - Variable cost (in EUR)

FC - Fixed cost (in EUR)

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<sup>2</sup> All values are presented in EUR. The average exchange rate for 2020/2021 is calculated as average yearly exchange rates in 2020 and 2021 (61.651 MKD/EUR) and average daily exchange rates in 2022 from 1 January to 15 June 2022 (61.677 MKD/EUR).

<sup>3</sup> The difference in market prices in 2020 and 2021 is minor. Modest increase in the value of the fertilizers can be noticed, which does not have huge impact on costs of production and unit price.

The variable yearly costs are the sum of the direct costs used for materials (fertilizer, pesticides) and resources consumed, irrigation and machinery costs for soil cultivation and additionally the labour used for apple production.

The value of fixed costs of apple production is calculated based on the costs of depreciation of the assets for apple production. The depreciation and value of fixed costs are calculated based on the value of apple plant establishment (cost of investment).

$$D = VA \times DR$$

D – Annual depreciation (in EUR)

VA – Value of the asset (Investment in apple plantation establishment in EUR)

DR – Depreciation rate (in %,  $DR = 1 \div \text{Years of assets utilization}$ )

The value of machinery, equipment and other assets used for apple producing are calculated as services provided and included in the variable cost.

According the methodology for investment in perennial crops, the value of apple plantation establishment as an investment asset is calculated as the sum of costs for plantation establishment, including the costs for regular yearly maintenance/production (in case of apples - 4 years), reduced by the gain income in this period. The period of investment and yearly maintenance costs are calculated until the yearly maintenance costs are higher than the yearly gained income from the archived yields.

## RESULTS AND DISCUSSION

The comparative analyses of the production costs provide solid ground to describe the economic impact on apple production. In regards to the investment costs between the reference years 2020 and 2021 with 2022, presented in the Tables from 1 to 4, show that the investment costs for establishing an apple orchard have increased greatly.

Table 1. Investment costs in the first year of establishment of 1 ha apple plantation, average values for the reference years 2020/2021 and 2022 (in EUR).

Costs	Unit	Quantity	2020/2021		2022		Change (%)
			Unit price	Total	Unit price	Total	
Planting material	seedlings	1,000	1.95	1,946	2.11	2,108	8
Deep ploughing (80-100 cm)	number	1	567.71	568	616.11	616	9
Soil cultivation before planting (25-30 cm)	number	1	51.91	52	72.96	73	41
Levelling planting site	number	1	51.91	52	72.96	73	41
Marking of planting distance	days	2	24.33	49	32.43	65	33
Opening holes	ha	1	60.83	61	81.07	81	33
Planting	days	2	24.33	49	32.43	65	33
Cultivation	number	4	32.44	130	56.75	227	75
Mulching	number	4	32.44	130	56.75	227	75
Fertilizer application	number	2	32.44	65	32.43	65	0
Plant protection	number	10	32.44	324	40.53	405	25
Manipulations during the year	number	3	32.44	97	40.53	122	25

Pruning after planting	days	1	24.33	24	32.43	.32	33
Three row cultivation	days	1	24.33	24	32.43	32	33
Irrigation	days	1	24.33	24	32.43	32	33
Pruning	days	1	24.33	24	32.43	32	33
<b>Total costs 1 year</b>				<b>3,620</b>		<b>4,256</b>	<b>18</b>

Table 2. Investment costs in the second year for 1 ha apple plantation establishment 2020/2021 and 2022 (in EUR)

Costs 2 year	Unit	Quantity	2020/2021		2022		Change (%)
			Unit price	Total	Unit price	Total	
Fertilization	total	1	567.71	568	891.74	892	57
Mulching	number	4	56.77	227	72.96	292	29
Plant protection	number	15	89.21	1,338	100.52	1,508	13
Herbicides	number	2	81.10	162	154.03	308	90
Irrigation	ha	5	24.33	122	32.43	162	33
Pruning	days	2	24.33	49	32.43	65	33
Harvest	days	6	24.33	146	32.43	195	33
Transport and manipulation	kg	5,000	0.02	81	0.03	162	100
Mechanization operators	days	20	56.77	1,135	72.96	1,459	29
Other	total	1	97.32	97	97.28	97	0
<b>Total costs 2 year</b>				<b>3,925</b>		<b>5,140</b>	<b>31</b>

Table 3. Investment costs in the third year for 1 ha apple plantation establishment 2020/2021 and 2022 (in EUR)

Costs 3 year	Unit	Quantity	2020/2021		2022		Change (%)
			Unit price	Total	Unit price	Total	
Fertilization	total	1	567.71	568	891.74	892	57
Mulching	number	4	56.77	227	72.96	292	29
Plant protection	number	15	89.21	1,338	100.52	1,508	13
Herbicides	number	2	81.10	162	154.03	308	90
Irrigation	ha	5	24.33	122	32.43	162	33
Pruning	days	4	24.33	97	32.43	130	33
Harvest	days	10	24.33	243	32.43	324	33
Transport and manipulation	kg	8,000	0.02	130	0.03	259	100
Mechanization operators	days	20	56.77	1,135	72.96	1,459	29
Other	total	1	97.32	97	97.28	97	0
<b>Total costs 3 year</b>				<b>4,120</b>		<b>5,432</b>	<b>32</b>

Table 4. Investment costs in the fourth year for 1 ha apple plantation establishment 2020/2021 and 2022 (in EUR)

Costs 4 year	Unit	Quantity	2020/2021		2022		Change (%)
			Unit price	Total	Unit price	Total	
Fertilization	Total	1	567.71	568	891.74	892	57
Mulching	number	4	56.77	227	72.96	292	29
Plant protection	number	15	89.21	1,338	100.52	1,508	13
Herbicides	number	2	81.10	162	154.03	308	90
Irrigation	Ha	5	24.33	122	32.43	162	33
Pruning	Days	4	24.33	97	32.43	130	33

Harvest	Days	19	24.33	462	32.43	616	33
Transport and manipulation	Kg	15,000	0.02	243	0.03	486	100
Mechanization operators	Days	20	56.77	1,135	72.96	1,459	29
Other	Total	1	97.32	97	97.28	97	0
<b>Total costs 4 year</b>						<b>4,452</b>	<b>5,950</b>
						<b>34</b>	

The total costs for establishing an apple plantation have increased for 18% in the first year (Table 1), 31% in the second (Table 2), 32% in the third (Table 3) and 34% in the fourth year of investment (Table 4). The main increase in investment costs can be seen in the increase in the cost of transportation and manipulation of apple with 100% and use of herbicides 90%. Other investment costs increased on average around 33%.

The value of 1ha apple plantation establishment in 2022 has increased by 42% compared with the 2020/2021 period. The total value of apple plantation establishment as the asset and value as basis for calculation of depreciation in 2022 is 15,691 EUR/ha, compared with 11,022 EUR/ha in 2020/2021 (Table 5).

Table 5. Value of 1 ha apple plantation establishment for the reference years 2020/2021 and 2022 (in EUR)

Costs 1 year	2020/2021	2022	Change (%)
Total costs 1 year	3,620	4,256	18
Total costs 2 year	3,925	5,140	31
Total costs 3 year	4,120	5,432	32
Total costs 4 year	4,452	5,950	34
<b>Total costs for apple plantation establishment</b> <b>(<math>\Sigma</math> investment costs 1, 2, 3 and 4 year) in EUR</b>	<b>16,117</b>	<b>20,778</b>	<b>29</b>
<b>Total income (<math>\Sigma</math> income 2, 3 and 4 year) in EUR</b>	<b>5,096</b>	<b>5,094</b>	<b>0</b>
<b>Total value of apple plantation as asset value for depreciation</b> <b>(Total costs apple plantation establishment – Total income)</b>	<b>11,022</b>	<b>15,691</b>	<b>42</b>

The increase in apple plantation establishment means additional 311 EUR fixed costs as an annual depreciation of the apple plantation or rise of annual depreciation cost from 735 EUR in 2022/2021 up to 1,046 EUR in 2022.

The average annual costs - the annual variable costs of apple production have increased for 37% from 5,182 EUR in 2020/2021 up to 7,085 EUR in 2022 or apple producers this year have to pay an additional 1,903 EUR per hectare (Table 6).

Table 6. Average annual cost of apple production for the reference years 2020/2021 and 2022 (in EUR)

Cost of Production	Unit	Quantity	Unit price 2020/2021	Total 2020/2021	Unit price 2022	Total 2022	Change (%)
Fertilization	total	1	568	568	892	892	57
Mulching	number	4	57	227	73	292	29
Plant protection	number	15	89	1,338	101	1,508	13
Herbicides	number	2	81	162	154	308	90
Irrigation	ha	5	24	122	32	162	33

Pruning	days	5	24	122	32	162	33
Harvest	days	38	24	925	32	1,232	33
Transport and manipulation	kg	30,000	0.02	487	0.03	973	100
Mechanization operators	days	20	57	1,135	73	1,459	29
Other	total	1	97	97	97	97	0
<b>Total variable costs</b>				<b>5,182</b>		<b>7,085</b>	<b>37</b>
<b>Yearly depreciation (fixed costs)</b>				<b>735</b>		<b>1,046</b>	<b>42</b>
<b>Total costs in normal year</b>				<b>5,917</b>		<b>8,131</b>	<b>37</b>

The increase of variable costs is primarily due to the increase in fuel and labour costs, which result in an increase of transport and manipulation (100%) and impact the increase of mechanisation processes. In addition, the increase of protection materials, especially herbicides (90%), fertilization (57%) and other materials and operations (in average for 33%), contribute to increased variable costs of apple production (Table 6). These increases of apple production costs, resulted in an increase of apple production price calculated on the basis of variable costs from 0.17 EUR/kg in 2020/2021 to 0.24 EUR/kg in 2022 or additional 0.07 EUR per kilogram apples (Table 7).

The increase of total costs of apple production (increased by 37% in 2022 with increase from 5,917 EUR/ha in 2020/2021 up to 8,131 EUR/ha in 2022 or additional 2,214 EUR per hectare) results in increases of the full apple production price (CoP at total costs) calculated based on total costs from 0.20 EUR/kg in 2020/2021 to 0.27 EUR/kg in 2022 or additional 0.07 EUR per kilogram apples and 37% increase (Table 7).

Table 7. Cost of apple production 2020/2021 and 2022 (in EUR)

Cost of Production normal year		Quantity	Unit price	Total	Unit price	Total	Change (%)
Yields apple	kg	30,000					
<b>CoP (at variable costs)</b>	<b>EUR/kg</b>			<b>0.17</b>		<b>0.24</b>	<b>37</b>
<b>CoP (at fixed costs)</b>	<b>EUR/kg</b>			<b>0.02</b>		<b>0.03</b>	<b>42</b>
<b>CoP (at total costs)</b>	<b>EUR/kg</b>			<b>0.20</b>		<b>0.27</b>	<b>37</b>

## CONCLUSION

The combined impact of the Covid-19 pandemic and the war in Ukraine has created a number of disruptions to the country's apple production, markets and supply chains that have been ongoing for the past several years. The main impact refers to the price of apple production, due to an increase in investments and input costs, mainly due to increase of transportation and manipulation costs, herbicides by 90% and fertilizers by 57%. The estimated production costs of apples show that the negative impact of the economic crisis results in an increase in the total cost of apple production by 37% i.e. apple producers have to invest 0.07 EUR for production of 1kg apples more in 2022 compared to 2020/2021.

Under the influence of the crises, the actual wholesale prices of apple in Macedonia have risen from 0.38 EUR/kg in 2020/2021 up to 0.49 EUR/kg in 2022 or additional 0.11 EUR/kg.

Even though the wholesale prices increase is higher than the increase of production cost prices, this situation suggests that we should rethink and adopt more sustainable management and production practises on agricultural farms in relation to the new conditions. The Government and apple producers should introduce more efficient and effective measures and production systems for reducing production costs and increasing the efficiency of production, such as implementing new and modern technology, innovation and digitalization and strengthening of cooperative work and cooperatives.

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## **UTICAJ EKONOMSKE KRIZE NA PROIZVODNU CIJENU JABUKE U REPUBLICI SJEVERNOJ MAKEDONIJI**

### **Rezime**

Proizvodnja jabuka ima najveći značaj među svim vrstama voćarskih kultura u Makedoniji, sa 56% ukupne proizvodnje voća. Zbog ekonomske krize izazvane Covid-19 i rata u Ukrajini, cijene poljoprivrednih inputa su značajno porasle. U tom cilju, osnovni cilj ovog rada je da se procijeni uticaj svjetske ekonomske krize na proizvodnu

cijenu jabuke. Obračun troškova proizvodnje zasniva se na kalkulaciji varijabilnih i fiksnih troškova proizvodnje jabuke za 2020. i 2021. kao referentne godine i 2022. kao godinu kada se uzima u obzir promjena proizvodne cijene. Podaci za normativni obračun i proizvodnu cijenu za 2020 i 2021 godinu su dobijeni na osnovu ekspertsku procenu, potvrđeni putem polu-strukturiranim intervjuom sa 3 poljoprivrednika i 2 kompanije za proizvodnju jabuka. Na osnovu ovog normativnog obračuna i tržišnih cijena inputa u 2020, 2021 i 2022 godini prikupljenih od 10 dobavljača inputa, AMIS i SSO, izračunava se proizvodna cijena jabuke. Rezultati pokazuju da ekonomska kriza ima veliki negativan ekonomski uticaj na proizvodnju jabuka, jer je procijenjena puna proizvodna cijena jabuka u 2022. godini porasla za 37% u odnosu na onu iz 2020. i 2021. godine.

*Ključne riječi: procjena uticaja, socio-ekonomska kriza, proizvođači jabuka, proizvodna cijena, troškovi proizvodnje.*