
INFLUENCE OF INPUT PRICES ON FUTURE APPLE PRODUCTION

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ABSTRACT

This paper analyzes the impact of human labor prices, mineral fertilizers, pesticides and oil on future apple production, based on ten-year data from 10 surveyed apple producers in the Republic of North Macedonia. The results showed that the prices of all inputs (except oil) in the future period (until 2029) will rise, and that the value of production will decrease. This, in turn, will directly affect the reduction of surface volume and apple production.

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Introduction

Agricultural production in North Macedonia is organized on 1,266,008ha during 2017. Of that, 1.3% are orchards, or 14,543 ha, mainly (87.9%) from individual farms. Orchards account for about 3% of the country's total arable land.

According to the data from the State Statistical Office (SSO), the total number of fruit trees in 2010 was 8,315,535 trees, and in 2019 - 9,692,759, which represents an increase of 11.7%. SSO does not provide data for all fruit crops, but only for: cherries, sour cherries, apricots, quinces, pears, apples, plums, peaches, walnuts and almonds. Here, apples dominate with 54%, in 2010 and with 50.5%, in 2019.

The average area under apples in the past ten years (2010-2019) is 5,340 ha. Here, the dominating municipality with almost 65% is Resen. Within the total area in the municipality of Resen (average 3,470 ha), the most planted variety of apples (over 60%) is the variety Ajdared (Municipality of Resen: Investor Guide, 2014). This variety is followed by planting the varieties Golden Delicious, Mutsu and Red Delicious with over 10%, Jonagold and Granny Smith with 3% each, as well as the varieties Fuji, Gala, Rubystar, Hapki, etc., with over 2%.

However, the analyzed data showed that there is a relatively large fluctuation in the research period, both on the surface and the total number of fruits, as well as the total production and average yields of apples.

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The aim of this paper is to determine the impact of future apple production in Macedonia, based on the movement of prices of major inputs,.

Materials and methods

For the realization of the set goal, we used official data from state institutions: State Statistical Office (SSO), Ministry of Agriculture, Forestry and Water Economy (MAFWE), Agency for Financial Support of Agriculture and Rural Development (AFSARD), as well as data from 10 surveyed individual agricultural holdings in the country, mainly (six holdings) from the municipality of Resen. We also used data (prices) from the archives of private companies that have been selling mineral fertilizers and pesticides in this time period.

The research refers to the period from 2010 to 2019 as a ground (base), and the forecast is made until 2029.

We performed the data processing with several mathematical-statistical methods: minimum, maximum, average values, exponential trend, comparative method and other methods, common for such agro-economic research.

Results and Discussions

Movement of the quantity and prices of labor

According to the statements of the surveyed agricultural holdings, an average of 1,500 h of human labor is consumed in the process of apple production. This consumption depends, primarily on the degree of realization of the usual production technology, which in turn ranges in the interval difference of 12.7 hours between the minimum and the maximum.

The research has shown that the price of labor ranges from a minimum of 71.00 MKD/h, in 2010 to a maximum of 113.00 MKD/h in 2019 or there is an interval difference of 42 MKD/h (Table 1).

Table 1. Dynamics of total costs and prices of basic inputs in apple production

Year	Type of cost					Total costs (MKD/ha)
	Labor (MKD/h)	NPK 8:16:24 (MKD/kg)	NPK + Mg 6:14:12:14 (MKD/kg)	Pesticides (MKD/kg)	Oil (MKD/l)	
2010	71,00	70,00	160,00	1.192,00	57,00	156.610,00
2011	75,00	70,00	160,00	1.192,00	66,00	164.068,00
2012	80,00	70,00	160,00	1.192,00	72,00	172.540,00
2013	82,00	70,00	160,00	1.210,00	69,00	175.454,00
2014	85,00	70,00	160,00	1.290,00	65,00	179.525,00
2015	86,00	70,00	160,00	1.290,00	52,00	178.594,00

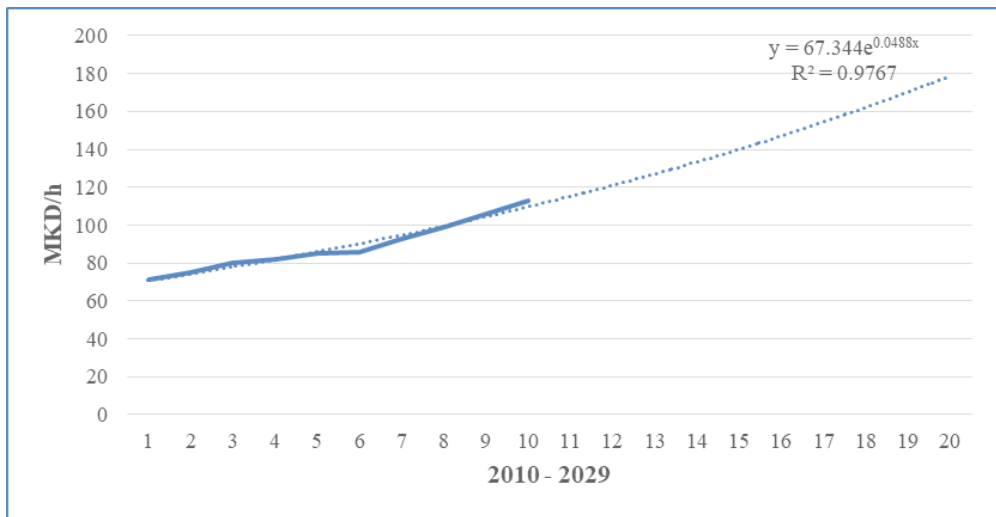
Year	Type of cost					Total costs (MKD/ha)
	Labor (MKD/h)	NPK 8:16:24 (MKD/kg)	NPK + Mg 6:14:12:14 (MKD/kg)	Pesticides (MKD/kg)	Oil (MKD/l)	
2016	93,00	65,00	170,00	1.290,00	48,00	166.521,00
2017	99,00	65,00	180,00	1.299,00	53,00	176.658,00
2018	106,00	65,00	180,00	1.299,00	63,00	189.093,00
2019	113,00	65,00	180,00	1.325,00	62,00	199.194,00
Average	89,00	68,00	167,00	1.257,90	60,70	175.826,00

Source: Author calculations based on data from the State Statistical Office of RNM, private agricultural pharmacies, energy regulatory commission of RNM.

As it can be seen from the data shown in Table 1, the cost of human labor is constantly increasing. Such an increase in the average price of human labor will cause a continuous increase in the future, until 2029 (Figure 1). Here, the increase is 38% of the average price.

The increase in the price of the human labor is a result of the fact that the number and quality of the labor force in Macedonia is continuously decreasing in the current period. This is primarily due to migration from rural to urban areas, but also due to emigration abroad.

Figure 1. Labor price trend



Source: Our calculations based on data from the State Statistical Office of RNM.

Movement of the quantity and prices of mineral fertilizers

The mineral complex granular fertilizer, composed of nitrogen, phosphorus and potassium in the proportions of 8:16:24, is used in an average amount of 350 kg/ha for apples.

Figure 2. NPK (8:16:24) price trend

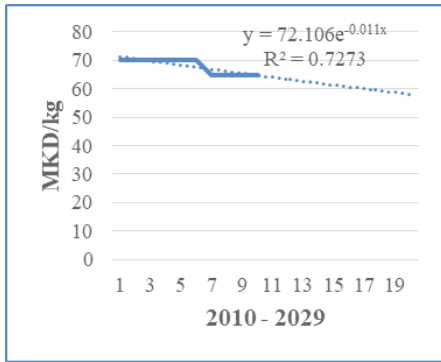
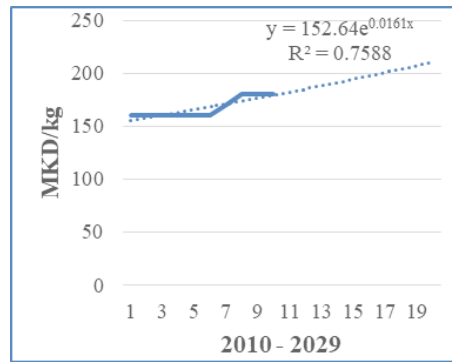


Figure 3. NPK+ Mg (6:14:12:14) Price trend



Source: Our calculations based on data from the private agricultural pharmacies

The research has shown that the prices have been relatively stable (Figure 2), with 70.00 MKD/kg in the first 6 years (2010-2015) and then the prices decreased to 65.00 MKD/kg: Predictions are that the decrease will continue in the period that follows.

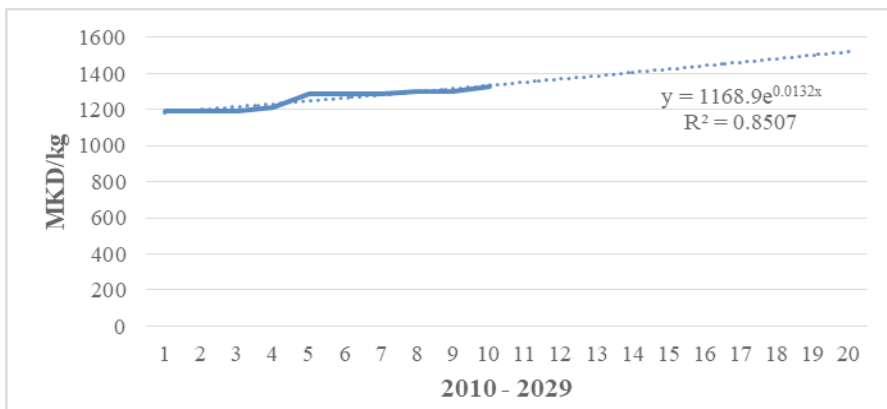
In the technological process of apple production, the farmers use the so-called crystalline fertilizer NPK + Mg (6: 14: 12: 14), in an average amount of 30 kg/ha. It is easily soluble in water, and efficiency is increased if used with the drip system.

The prices of the crystalline fertilizers, compared to the granulated one, were continuously increasing (Figure. 3). The average price was 167.00 MKD/kg. The trend shows that the increase will continue in the future, when it will reach 187.00 MKD/kg.

Movement of the quantity and prices of pesticides

At an average pesticide consumption of 3.0 kg/ha, the average price was MKD 1,257.90 MKD/kg. The increase of prices will continue in the next period (Figure 4).

Figure 4 – Pesticide price trend



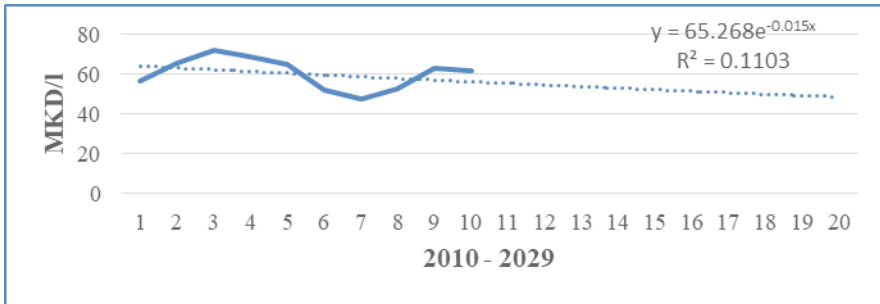
Source: Our calculations based on data from the private agricultural pharmacies

The average annual increase will be 0.85 MKD/kg, and at the end of the period (2029), the average price will reach 1,334.00 MKD/kg.

Movement of the quantity and prices of oil

Oil, in addition to human energy, is the main energy source for performing mechanized work processes in apple production. Here, the average annual consumption is 162 l/ha MKD/l MKD/l.

Figure 5. Oil price trend



Source: Our calculations based on data from the energy regulatory commission of RNM

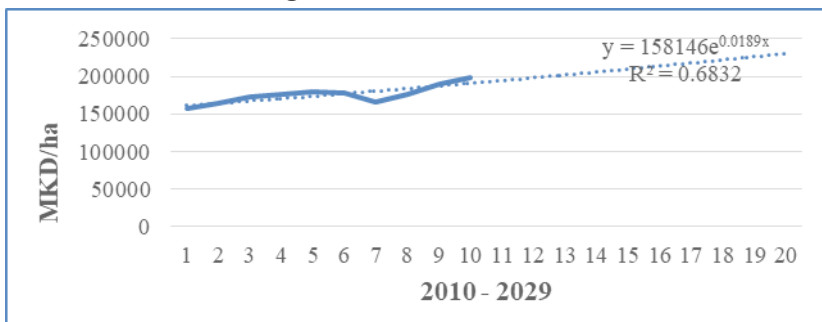
It is generally known that oil is a so-called stock market product. Therefore, the price depends on the movement of oil supply on global stock exchanges. For that reason, in our country, the price of oil in the past ten years has been moving in the interval difference of 14.00 MKD/l, i.e. from a minimum of 48.00 MKD/l. in 2016 to 72.00 MKD/l. in 2012 (Tab. 1).

In general, the price of oil will decrease in the next period, so that in 2029 it will be 60.90 MKD/l (Figure 5).

Movement of total costs in apple production

The research has shown that the total cost of apple production is increasing year by year (Figure 6). The cost ranged in the interval of 42,584 MKD/ha.

Figure 6. Trend of total costs



Source: Our calculations based on data from the State Statistical Office of RNM

The upward trend will continue until the end of 2029, when the total production costs would amount to 199,201.00 MKD/ha. This increase will also negatively affect the profitability of apple production.

Movement of value and income in apple production

It is known that the value of production is a function of the amount of produced quantity of apples and the purchase, ie market prices. Here, we take the purchase prices that are relevant for this purpose, because they are determined on the base of the total value and the total quantity of purchased apples, separately for human consumption and processing. Market prices, on the other hand, are determined regardless of the quality of apples.

The statistical data (Table 2) showed that the average of achieved yields in our country was 21,414 kg/ha in the past ten years. Of that, 86% class I II, ie. apples for human consumption and 14% apples for processing, ie class III.

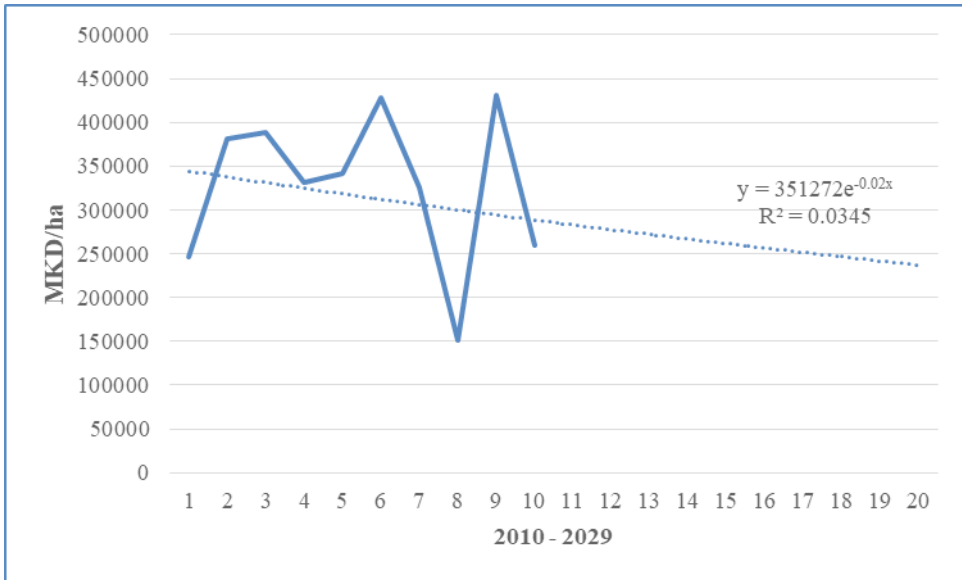
However, the value of production in the past period ranged from 150,718.00 MKD/ha in 2017 to 430,922.00 MKD/ha in 2018, i.e. in a relatively wide range of 280,204.00 MKD/ha.

Table 2. Dynamics of total production income

Year	Yield, (kg/ha)			Purchase Price, (MKD/kg)		Value, (MKD/ha)			Subsidies (MKD/ha)	Total Income 9+10 (MKD/ha)
	Total	Class I, II	Class III	Class I, II	Class III	Class I, II	Class III	Total		
1	2	3	4	5	6	7	8	9	10	11
2010	23240	19986	3254	11,79	3,35	235674	10897	246571	43700	290271
2011	24070	20700	3370	17,45	5,74	361263	19351	380614	25000	405614
2012	24070	20700	3370	17,82	5,96	368944	20085	389029	25000	414029
2013	21580	18559	3021	16,52	8,34	306674	25190	331864	28000	359864
2014	20750	17845	2905	18,13	6,07	323476	17645	341122	33000	374122
2015	29880	25697	4183	15,19	8,89	390344	37184	427528	33000	460528
2016	21580	18559	3021	17,24	1,98	320045	5985	326030	33000	359030
2017	8300	7138	1162	20,42	4,26	145764	4954	150718	33000	183718
2018	24900	21414	3486	19,48	3,94	417175	13747	430922	39600	470522
2019	15770	13562	2208	18,63	3,04	252714	6715	259429	50000	309429
Average	21414	18416	2998	17,27	5,16	312207	16175	328383	34330	362713

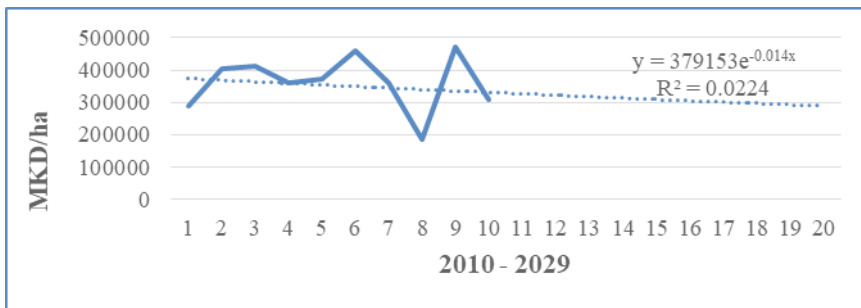
Source: Our calculations based on data from the State Statistical Office of RNM

The large fluctuations in value from year to year, mainly in a negative direction, will have negative effect in the future as well, i.e. the value of production will decrease (Figure 7).

Figure 7. Trend of the total value of production

Source: Our calculations based on data from the State Statistical Office of RNM

Therefore, in order to increase the income of the family farms that produce apples, the state subsidizes that production. Nevertheless, the total revenues from apple production in the future will move downwards (Chart 8).

Figure 8. Trend of total production income

Source: Our calculations based on data from the State Statistical Office of RNM

Conclusions

Based on the results of the study, the following conclusions can be drawn:

1. The price of labor is continuously increasing due to the fact that the number and quality of labor in North Macedonia is continuously decreasing in the current period. This is primarily due to migration from rural to urban areas, but also due to emigration abroad.

2. The prices of some mineral fertilizers (especially crystalline) and pesticides are increasing. This is due to the fact that the application of crystalline fertilizers is significantly facilitated by irrigation systems. The prices of pesticides are increasing, because they are imported and the importer has exclusivity, i.e. there are no competitors in the country.
3. The total costs increased as a result of the increase in certain types of costs. This situation will continue until the end of 2029. This increase will also negatively affect the profitability of apple production.
4. Large fluctuations in value from year to year, mainly in a negative direction will also have a negative impact in the future, i.e. the value of production will decrease.

Conflict of interests

The authors declare no conflict of interest.

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