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FACTOR PRODUCTIVITY OF CHOSEN BULGARIAN AGRICULTURAL PRODUCTIONS

SUMMARY

The study focus on the Total Factor Productivity (TFP) for selected agricultural sectors (fruit growing, viticulture and dairy cattle breeding). The methodology used to determine TFP is according to Regulation (EU) 834/2014 laying down monitoring and evaluation framework for CAP 2014-2020. The Laspeyers index was applied to analyze the development of agricultural production and to explore the influence of different factors on the production output during the CAP implementation. The change was reviewed in comparison to a basis period and TFP was estimated as an index coefficient represented as industry output and the driving inputs (including labour, capital, land, variable production costs and subsidies).

The study reveals a significant change in TFP indexes over the period after Bulgaria's accession to the EU. The results show the TFP indexes decrease for fruits and cow's milk and increase for grapes (due to improved efficiency). There is a drop in production for grapes and cow's milk but a significant increase in production quantities for fruits. Meanwhile, the TFP index for fruit growing is slumping down, which is explicated by tangible enhancement in investment and capital costs during the covered period, which deems to improve the productivity and efficiency in the coming years. There is a need to increase and target the financial support for viticulture and dairy farming in order to hoist up the productivity and production outputs.

Keywords: Factor productivity, Fruit growing, Viticulture, Cow's milk, Input-output, Bulgaria

INTRODUCTION

In the years after Bulgaria's accession to the EU, the problems of Bulgarian agriculture continue to be related to productivity and overall production in the industry (IAE, 2020, Ivanov, 2020). Productivity per unit area or animal remains at levels lower than other European countries, with the exception of cereals and oilseeds (Ivanov *et al*., 2020). The main challenges

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facing Bulgarian agriculture are related with structural and sectorial imbalances, uneven distribution of financial support, polarization and overconcentration in the sector (Beluhova-Uzunova *et al*., 2018). Vegetable production, fruit growing, viticulture and animal husbandry are the sectors that experience the most serious difficulties for the development of their production and economic potential (Yovchevska, 2015). According to Manolova (2021), the more difficult access to financing for fruit growers complicates the widespread diffusion of innovative technological approaches, which is a challenge for the competitiveness of the sector. Another important problem, pointed out in the same study, is the lack of a long-term strategy for the development of fruit growing. Dimitrova and Dimitrov (2017) noted that in 2016, compared to 2007, the production of wine grapes in Bulgaria decreased by 41.6%, and of table grapes by 26.2%. The main reason for this is the drastic reduction in the area of vine plantations, which is influenced by the conditions of the economic environment in the branch - rising production costs, low purchase prices, insufficient financial support, a limited domestic market and weak competitive positions on the international market. Harizanova-Metodieva and Harizanova-Bartos (2019) stated the relatively uncompetitive production as a serious drawback of the Bulgarian dairy sector, which, in the conditions of strong international competition, leads to a decline in cow's milk production in Bulgaria after 2000.

Regardless of the different rates of development and importance of separate sectors for the national agriculture, similar problems are also observed in other European countries. According to Jandrić *et al*. (2015) challenges to the development of the dairy sector in Serbia, specifically in the Pešter region, are related to seasonal fluctuations in milk production, price variations, difficult terrain conditions, extensive gray market and the lack of funding and logistics. The authors stated that variable production costs – costs of materials, fuel and energy costs, costs of production services, and cost of sold goods create the greatest burden on operating income. In Romania (an EU member state), the development of the dairy sector faces a number of challenges, mainly related to the organization of farms in general, processing problems and high European milk quality standards (Chiurciu and Soare, 2019). Micu (2015) defined as an important problem for the development of the Romanian fruit growing sector the excessive fragmentation of the orchards and the small farm size. The author added to it the shortage of labor, as well as the lack of irrigation. Sudarić *et al*. (2020) considered that there are stimulating conditions for the sustainable development of the viticulture and winemaking in Croatia, but noted the high level of competition, relevant level of gray economy, high level of administrative legislation and a relatively small production capacity of manufacturers in comparison with other countries. According to Paschalidis *et al*. (2019) the existing problems in the wine sector in Greece stem mainly from high production costs and the accumulation of large stocks, as well as serious competition from countries outside the EU, especially from Latin America.

The level of production and productivity in agriculture are directly dependent on inputs, and the ratios between productivity and income on the one hand and production costs on the other determine the efficiency of the activity performed (Ivanov, 2021). The improvement of efficiency of resource used in vulnerable agricultural industries, such as the production of fruits, grapes and milk is important both for stabilizing the majority of family farms specialized in those sectors and to bring about the raising the value added from Bulgarian agriculture, which is seen as one of the most crucial issue.

The Total Factor Productivity (TFP) is a key economic concept characterizing the efficiency and competitiveness of agriculture, both at the national and at the sectoral levels (Buks, 2011, Čechura *et al*., 2014, Domanska *et al*., 2014). The complex matter of this concept allows its use as a tool for estimating the efficiency and optimization from the resource use and their return. The TFP is an index revealing the change in total output and the change in total inputs - labor, land, capital, specific costs of seeds, tillage, fertilizers and crop protection in crop production and feeding and veterinary expenses in dairy production (Čechura *et al*., 2014, Saikia, 2014, Ivanov, 2019, Kryszak *et al*, 2021). As a measure of the efficient use of factors of production, it makes possible to assess the dynamics of productivity over a period of time. According to Bacovic (2021), which was studied changes in the total factor productivity of the national economy and by different sectors, the application of the sectoral approach gives a more detailed picture of the overall structural changes in the economy. Following the author's logic, the changes in the factor productivity of selected agricultural productions for two comparable periods can outline the ongoing structural changes in agriculture.

The aim of the study was to determine the Total Factor Productivity (TFP) for selected Bulgarian agricultural sectors (fruit growing, viticulture and dairy cow husbandry) upon the period of Bulgaria's membership to the EU and to explore the influence and importance of different input and output elements for TFP evolution.

MATERIAL AND METHODS

The methodology used to carry out the TFP analysis was complied with general framework for monitoring and evaluation of the CAP 2014-2020, adopted by Regulation (EU) No. 834/2014 of the Commission. The contribution of the study is that it was done at the sectoral level and it was tried to differentiate thus to compare the factor productivity among key agricultural industries in Bulgaria.

The TFP indices are an integral part of the economic analysis and are widespread way for input-output research. The advantage of the approach is the relatively easiness in application and the adequate reliability of the results revealing the efficiency and interdependency between input factors and production output. The approach was considered inappropriate as a measure of technological change, as it suffers from conceptual and empirical shortcomings

(OECD, 2001). For agriculture, the data on the costs of different sectors and the input values were taken from the Farm Accountancy Data Network (FADN), whereas the output figures were adopted from Eurostat production statistics.

The main issue in carrying out the input-output analysis is the way by which those indicators will be normalized, weighted and aggregated. There are different approaches, like the main indices used being of Laspeyres, Paasche, Fisher, Tornqvist. Eltetö-Köves-Szulc, leading to a different presentation of the indicator (Latruffe, 2010). Each one of the indices implicitly predisposes a certain type of production function. For example, the Tornqvist index is compatible with a translog production function, while the Laspeyers index assumes a Leontief production function. (Capalbo *et al*., 1990).

For the purposes of the study, the analytical presentation of Laspeyers was chosen as the production factors used are available proxy indicators representing the key five input resources – land, capital, labour, materials and subsidies. As a measure of production efficiency, the TFP index makes it possible to assess the change in the use, efficiency and rationality of production factors in dynamics. The algorithm for estimations was represented as:

$$TFP_0^t\_L = \frac{O_0^t\_L}{I_0^t\_L} = \frac{\left(\frac{q_{1t}}{q_{10}} * w_{10} + \frac{q_{2t}}{q_{20}} * w_{20} + \ldots + \frac{q_{nt}}{q_{n0}} * w_{n0}\right) / (w_{10} + w_{20} + \ldots + w_{n0})}{\left(\frac{i_{1t}}{i_{10}} * x_{10} + \frac{i_{2t}}{i_{20}} * x_{20} + \ldots + \frac{i_{rt}}{i_{r0}} * x_{r0}\right) / (x_{10} + x_{20} + \ldots + x_{r0})},$$

where:

q_{it} – represents the quantity produced;

w_{it} – coefficient representing the share of the respective agricultural production in the total;

i_{1t}-cost elements;

x_{it}– coefficient representing the share of the element of total production costs.

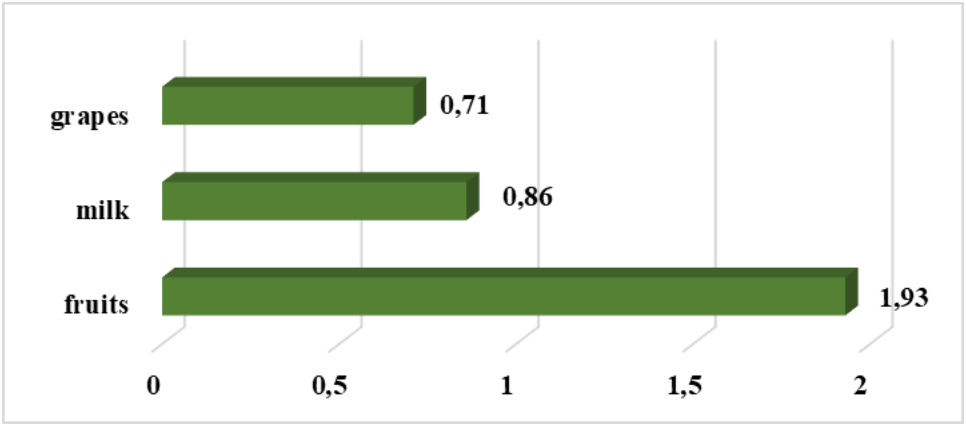
According to Ivanov (2019), the TFP is expected to display the common effects from comprised factors including the new technologies, efficiency changes, economy of scale, management capacity and organizational shifts, which may stand behind the TFP results. When calculating for one sector, the output indicator represented by production output was put in the equation numerator and it was yielded as ratio between production out in the new period to counterpart past time.

The basic period was 2008-2010, while the new, comparative period was the weighted average for 2016-2018. Thus, the development for the period during the Bulgaria's accession to the EU was analyzed.

RESULTS AND DISCUSSION

The Figure 1 shows the index of change in production output. A significant increase compared to the basic period was observed only in fruits, where the amount of production was almost doubled (the value of the production output index is 1.93). The reasons for this were attributed to the expansion of the area with orchards in the country, observed in recent years, and the increase in average yields.

Contrarily to the positive trend in fruit-growing, the drastic reduction of vineyards area, which was not compensated by the slow growth in average yields, led to a significant decline in grape production - from 285 thousand tons on average for the period 2008-2010 to 201.3 thousand tons averaged for the compared three years - 2016 to 2018 (-29.4%).



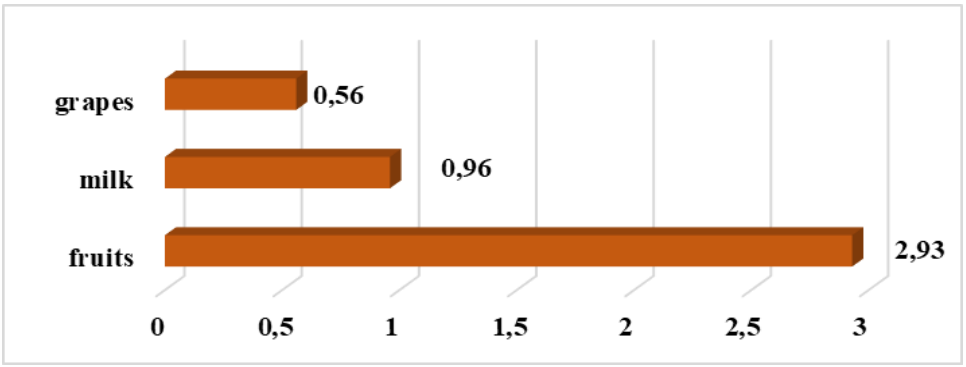
Sources: FADN, own calculations

Figure 1. Output index by sectors

The amount of cow's milk produced was also declining, albeit at a slower pace than in viticulture. The production decreased from 1081.2 thousand liters during the basic period to 933.8 thousand liters on average for 2016-2018 (-13.6%). The negative change in production was mainly due to the decrease in the number of dairy cows after Bulgaria entered into the EU, caused by unprofitable activities leading to bankruptcy and exit of sector from the small farm (Stoychev, 2021). Additionally, the increased requirements for the quality of milk, as well as the difficult access to subsidies contributed to this.

The change in the indices of inputs reveals different tendencies by sectors (Fig. 2). Resource intensity increased significantly in fruit growing, while in dairy cow husbandry and viticulture it declined. Such a development was due to the increase of production in fruit growing and from the strategy for optimization of the used resources in the production of grapes and cow's milk. The shrink of the activity in viticulture and dairy cow husbandry and the predominant farm goal to reduce the production costs, as safeguard behavior of producers against

the low purchase prices, determine the lower values of the input index in both sectors.



Sources: FADN, own calculations
Figure 2. Input`s index by sectors

Table 1 shows the change in the elements of input`s index for the three sectors observed. While intermediate consumption of fruit crops farms increased synchronously with the growth of production, in the cattle farms saw a decrease, which was more significant than the decrease in production and probably reflected a certain increase in herd productivity.

Table 1. Change in the elements of input`s index*

Sectors	**Elements of input`s index**				
	Intermediate consumption	Labour (AWU)	Capital	Utilized agricultural area (UAA)	Subsidies
Fruit growing	1.8	1.3	1.9	1.3	5.6
Viticulture	0.43	0.35	0.46	0.55	1.2
Dairy cow husbandry	0.77	0.41	1.5	0.65	1.4

Sources: FADN, Brussels; Own calculation
*Recalculated at sector level

The largest reduction in costs (for fertilizers, plant protection and other specific costs) was observed in viticulture (index of change of intermediate consumption for the both compared periods was 0.43). The reason for this was the price pressure on producers, as the purchase prices of wine grapes for the period 2008-2018 remained in the range of 500 - 650 BGN/t without VAT, according to the National Statistical Institute. Rising prices of inputs are pushing producers to reduce the amount of inputs in production in an effort to maintain the economic viability of their farms.

The provision of skilled labor is problematic not only for different sectors of agricultural production, but also for the entire agriculture. The results of a

questionnaire study, conducted by Bashev and Koteva (2022), show that a significant part of farms in the country have serious problems in effectively providing the necessary labor force. Popescu *et al*. (2021) indicated that Bulgaria is among the countries that remain below the EU average for agricultural output per AWU in 2020. The authors concluded that the efficiency of the use of labor force varies across EU member states depending on its efforts to increase net gross value and decrease labor input.

In the conditions of labor shortage, the reduction of labor input (AWU) is logical, as its replacement with automation and mechanization of production processes is increasingly sought. As can be seen from the data shown in Table 1, the most serious was the decrease in labor input in viticulture - the index of change was 0.35. The increasingly difficult provision of skilled workers and the growth of wages in agriculture is limiting the use of labor resources in the production of grapes. This has a negative impact on the production process in viticulture, both in the short and long term, due to non-compliance with the specific agricultural techniques of growing vines and hence obtaining unsatisfactory economic results. The labor resources used in dairy farming were also declining, while there was growth in fruit growing.

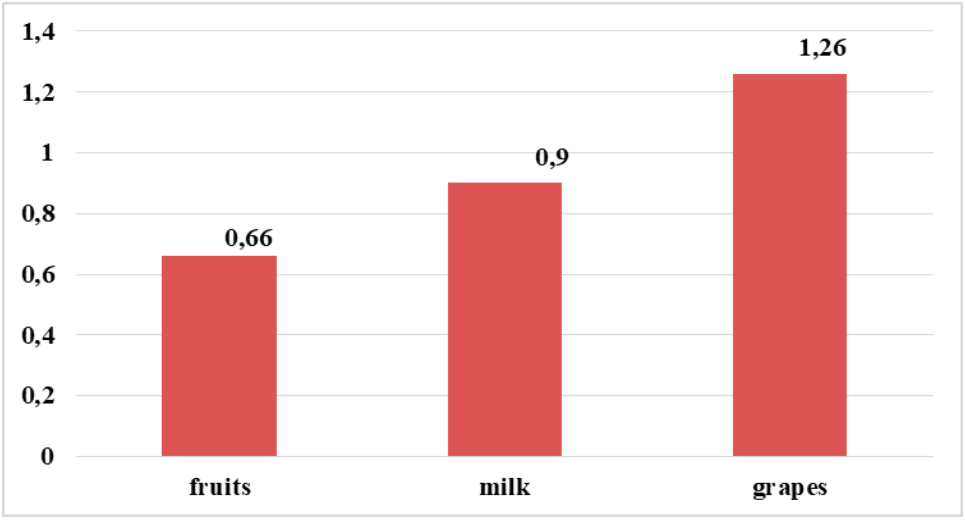
The shrinking scale of production activity in viticulture was the reason for the negative change in the capital used. The decrease was to a lesser extent than that of the labor resources, but it was indicative of the reduced level of technical security, which limited the possibilities for future increase of the efficiency of the production activity. Conversely, in the production of fruits and milk there was an increased use of capital on average for the three years 2016-2018 compared to the base period, which showed a desire to improve the technological level in the farms.

The index of change of agricultural area (UAA), as the main production factor in viticulture, clearly shows the significant contraction of production in the sector during the two periods compared. The area of harvested vineyards decreased by almost half - from 61,8 thousand hectares on average for the period 2008-2010 to 34 thousand hectares on average for 2016-2018 (-45%). In the opposite direction was the development of fruit growing, where there was an increase in area of orchards by 34%, which indicates the presence of entrepreneurial interest in the sector. The decrease in the land resources used in dairy cattle breeding was due to the decreasing number of dairy cows.

The data on financial support show that it was increasing in all sectors considered. This was mainly due to the general framework for amending the subsidies provided under the first pillar of the CAP. In cattle breeding, coupled payments increased significantly at the same time as decoupled direct payments. The index of change of subsidies had similar values in grapes and milk production, respectively 1.2 and 1.4. Significantly higher was the index value in fruit growing – 5.6, which is associated with the expansion of areas, respectively the positive development of activities in some fruit species, such as cherries, pears, raspberries, walnuts, apricots, plums and junipers and others fruits (Popov,

2021). In addition to directly supporting the income of agricultural producers, subsidies are also a factor that influences the price changes of some of the factors of production, such as the rent of agricultural land (Ivanov, 2021). According to Alexandri *et al*. (2020) subsidies do not contribute to productivity in the case of Romanian farms, with the exception of medium-sized dairy farms. A similar conclusion was reached by Martinho *et al*. (2022), according to which policy instruments under the 2013 CAP justify the use of more inputs (or at least at higher costs) for the same level of output, which negatively affects total factor productivity.

The results obtained are illustrated in Fig. 3 and it shows that an increase in factor productivity in the period 2008-2018 is observed only in the production of grapes.



Sources: Own calculations

Figure 3. Total factor productivity index by sectors

Given the previous analysis, the positive result is surprising and probably due to increased yields, but with a sharp reduction in inputs caused by the need for risk management and cost control. Grape production was shrinking, but at a slower pace than resource reduction. The high value of the TFP index – 1.26, indicates the efficient use of resources, which occurs mainly in agribusiness entities with a closed production cycle – growing vines, grape processing, wine production and sale. However, this direction of factor productivity development may be difficult to continue for a long period. The specifics of growing vineyards as permanent crops with a long period of operational life implies significant resource intensity, especially in terms of capital and specific production costs (for fertilizers, plant protection, etc.), as well as the need for skilled labor. Only in this way can be ensured stable economic results for years to come. Viticulture farms often are bound to the low-cost strategy, which leads

to an immediate increase in the resource efficiency, but if the production volume continues to decrease at a faster rate than the decrease in the physical volume of resources it is possible to expect a lower value of the index. Petrov and Borisov (2021) also noted the efforts of wine-growing enterprises to reduce production costs, which allows them to compete on price in the highly competitive conditions of the wine market in Bulgaria. This need arises from the relatively low incomes of consumers, for whom price is an important factor. At the same time, according to the authors, the reduction of production costs has a negative impact on the quality of production. Specifically for the wine market, branding based on the high quality of production allows flexibility in pricing, which is an important condition for overcoming competitive pressure and improving the market positions of wine producers (Nacka *et al*., 2019). It is explained to some extent by Dimitrov (2017), who points out that "as in the case of many other goods nowadays, it is easier to produce wine than to sell it" and the obstacles to sell wine grapes and wine at palatable price may undermine the viticulture output.

The increase of inputs in fruit growing was higher than that of production, which led to a decrease in factor productivity. According to Ivanov (2021), the main reasons for fluctuations in the quantities produced are largely due to the climatic conditions of the year. This raises the question of improving risk management mechanisms, both in farms (production insurance) and at the sectoral level (prevention of hail, frost, droughts, etc.). The participation of fruit growers in producer organizations can also support efforts in this direction. Dzhuvinov and Gandev (2015) considered that in Bulgaria the producers' organizations are insufficient, both by groups of fruit species and at the regional and national level, and they fail to protect the interests of their members. For comparison, in Poland, which is among the largest fruit producers in the EU, at September 28, 2018 there were 273 recognized fruit and vegetable producer organizations, associating 6.7 thousand members (Łakomiak and Zhichkin, 2020). According to Manolova (2021) to build highly competitive and efficient fruit growing sector in Bulgaria, producers, experts and institutions must join their efforts in the future.

The contraction of production was the main reason for the decline in factor productivity in dairy farming, but there were also regulatory factors, such as the introduction of European quality standards for raw milk, leading to a change in the specialization of some farms in the direction of beef production. According to Ivanov (2022), the low basic levels of productivity in the Bulgarian dairy sector compared to the leading countries in the EU, theoretically set prerequisites for improving its market competitiveness in the future period through appropriate interventions. The author indicated the critical situation of the middle class farms, which need for more investment and capitalization. Žáková Kroupova *et al*. (2020) cited research findings, according to which productivity growth in the dairy sector is mainly driven by technological change. Such an effect was observed in the Czech Republic, Estonia, Belgium, Hungary, Italy,

Sweden, Finland and Ireland. Following the example of European countries, it can be concluded that modernization and innovation are of key importance for increasing production, respectively factor productivity in the Bulgarian dairy sector.

The established values of the index of the total factor productivity are close to those, obtained by Ivanov (2019). The author pointed out that for the nine years of the period 2007-2017 an increase in productivity in the production of wine grapes was achieved – TFP index is 1.11 (+ 11%), while the productivity in cow's milk decreased (0.95). According to the cited study, Bulgarian agriculture follows a trend of optimizing inputs and production results, while in developed European countries the orientation is to maximize the result through high levels of resource intensity. In general, the factor productivity of agriculture in our country increased during the period 2007-2017, but continued to lag behind the average productivity in the EU (Ivanov, 2021). The implementation of innovations and better technological solutions can ensure the necessary growth rates of production and hence of productivity.

CONCLUSIONS

The results show that the TFP index decreases in fruits and cow's milk, but increases for viticulture. The increase in viticulture is due to a more significant reduction in inputs regardless the output is also down in the present years compared to the beginning of Bulgarian membership in EU. Generally, it testifies for an increase in production efficiency. However, such development in viticulture is thought to be difficultly maintained in the next years because the lack of space for replacing labor with capital.

The significant investment required to create new plantations of fruit trees and the lag in time to reach the full productivity in fruit crops are likely the cause for the downing value of TFP. Besides, the huge of the received subsides in the fruit growing farms by 5.6 times in the compared periods, which are liquid financial resource are considered as other reason for aggravated TFP index for fruit-growing sector. It is expected that in the coming years the value of the index in fruit production will increase with attaining full productivity of meantime founded plantations.

The importance of subsidies as an element of total factor productivity increased in the period 2008-2018. Despite the growth of financial support, the output is increase only in fruit growing. There is need to increase and focus financial support for viticulture and specialized dairy farms in order to maintain the current production volumes in the country.

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