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PRODUCTION AND ECONOMIC INDICATORS OF CORN SILAGE PRODUCTION

PROIZVODNO-EKONOMSKI POKAZATELJI PROIZVODNJE KUKURUZNE SILAŽE

Vedad FALAN, Alen MUJČINOVIĆ, Emir BEĆIROVIĆ
University of Sarajevo, Faculty of Agriculture and Food Science,Sarajevo, Zmaja od Bosne 8, Bosnia and Herzegovina
a.mujcinovic@ppf.unsa.ba

ABSTRACT

The highest quality silage is produced from corn (corn silage), which is also the most common livestock feed. The lack of corn silage in livestock production can be compensated only by concentrated feed, which is usually more expensive, but this is a well-applied practice in B&H. Therefore, the main aim of this paper was to determine the economic viability of corn silage production in B&H for the period 2014-2019. Primary data for this research were collected based on a semi-structured interview with representatives of the farm "Farma Spreča" Kalesija with a total harvested area of 500 ha. Results indicate that with total harvested area increases 61.29 %, yield increases only 6.26 %, while efficiency decreased by 6.38 % implying problems related to productivity. Based on that, corn silage production in B&H shows positive financial performances, but low yield even with a strong increase in harvested areas indicates the need for further technological and technical improvement.

Keywords: *corn silage, livestock production, economic analysis, cost management*

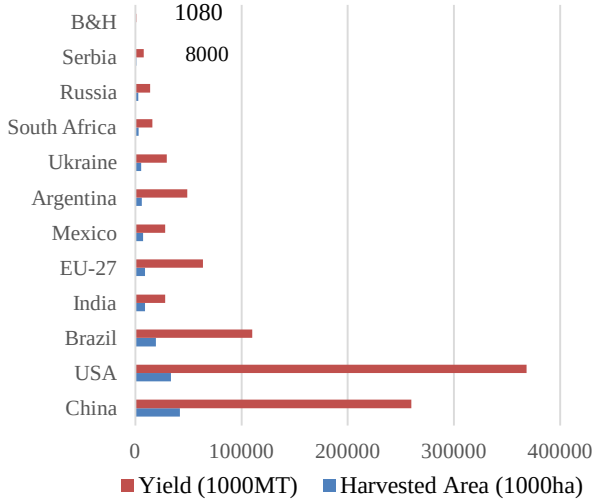
REZIME

Najkvalitetnija silaža dobiva se od kukuruza (kukuruzna silaža) koja je najzastupljenije kabasto hranjivo u stočarstvu, a posebno u ishrani goveda. Nedostatak kukuruzne silaže u ishrani goveda može se nadomjestiti samo koncentrovanim hranivima, koja su znatno skuplja, međutim ovo je veoma česta praksa primjenjena u animalnoj proizvodnji u BiH. Radi navedenog, cilj ovog rada je utvrditi ekonomsku isplativost proizvodnje kukuruzne silaže na području BiH. Primarni podaci za ovo istraživanje su prikupljeni na osnovu polustruktuiranog intervjua sa predstavnicima poljoprivrednog gazdinstva "Farma Spreča" Kalesija, koja proizvodi silažni kukuruz na površini od 500 ha. Na osnovu prikupljenih podataka sastavljene su obračunske analitičke kalkulacije za proizvodnju kukuruzne silaže. Na osnovu kalkulacija su utvrđeni obimi i troškovi proizvodnje za ukupnu površinu i površinu po ha. Procjena vrijednosti proizvodnje je utvrđena na osnovu tržišne cijene kukuruzne silaže, te su na kraju utvrđeni pokazatelji finansijskog rezultata i ekonomičnosti za period 2014-2019 godina. U posmatranom periodu došlo je do povećanja površina na kojima se uzgaja kukuruzna silaža od čak 61,29 %, međutim ostvareni obim proizvodnje kukuruzne silaže nije pratio rast površina, te je ostvaren blagi rast od 6,26 %. Posmatrani pokazatelj ekonomičnosti bilježi blagi pad od 6,38 % što ukazuje na potencijalne probleme vezane za produktivnost. Na osnovu navedenog, može se reći da proizvodnja silažnog kukuruza u BiH bilježi pozitivne finansijske performanse, ali da nizak obim proizvodnje i pored snažnog rasta zasijanih površina ukazuje na potrebu za tehničko-tehnološkim unapređenjem, a sa ciljem unapređenja ukupnih performansi poslovanja ali i sektora u cjelini.

Ključne riječi: *kukuruzna silaža, animalna proizvodnja, ekonomska analiza, upravljanje troškovima*

INTRODUCTION

Farmers/growers, along with other actors, are exposed to new challenges brought upon by globalization, market volatility, complexity, and scrutiny (Stiring et al., 2013). Besides, climate change has a strong impact on agriculture causing a wide range of problems, ranging from feed shortage/yield to the quality of products/inputs that consequently have a strong effect on production and overall farm management (Sahoo, 2018). Because of that, farmers tend to seek solutions to minimize the aforementioned risks, and one way to achieve that is with the production of their inputs such as feed for livestock production. The most popular livestock feed worldwide is corn silage. Silage is usually defined as a specific technological process of processing and preserving certain fodder plants using lactic acid bacteria, which retains the natural properties and nutritional value of plants. Worldwide, production of corn increased by 24.58 %, in the USA 15.45 % (USDA, 2021), while on contrary in the EU corn production decreased by 7.6 % (EUROSTAT, 2021) for the observed period 2011-2020. Major corn producers worldwide are the USA, followed by China, Brazil, and EU-27 countries (Figure 1). This particular crop is popular (and gaining on popularity) because of its wide range of benefits such as low harvesting cost, minimum production risks, high yields, high energy intake for livestock, increase lactation length, stocking rate digestibility, palatability, storage ability, etc. (Allen et al., 2003; Schroede, 2004; Ferraretto et al., 2018).



Legend: MT – metric ton (1MT = 1000kg)
Fig. 1. World corn production (www.indexmundi.com)

Its efficient use of energies helps to achieve increased production and productivity in general, contributing to the overall competitiveness of agricultural farms and sustainability in rural areas (Ozkan et al., 2004; Ozkan et al., 2007; Komleh et al., 2011). Because of that, it's up to the individual farms' ability to convert effectively inputs into outputs and respond optimally to economic signals (Yu and Huang, 2020). The importance of achieving such output is widely recognised by the 2030 Agenda for Sustainable Development (2030 Agenda) that seeks to double the incomes of smallholder farmers through Sustainable Development Goal (SDG) 2.3 (Thomas, 2020). This particular crop becomes interesting for both producers and researchers in our region (Terzić et al., 2014; Radosavljević et al., 2015; Milašinović-Šeremešić et al., 2017; Zrakić et al., 2017; Veljković et al., 2018; Domaćinović and Solić, 2020; Terzić et al., 2020), aiming for improvement in production technologies, new silage maize hybrids, quality of biomass and yields, and a stronger market position. Therefore, the main aim of this paper is to determine production and economic indicators of corn silage in Bosnia and Herzegovina to promote this well-established practice for feed management in livestock production.

MATERIAL AND METHOD

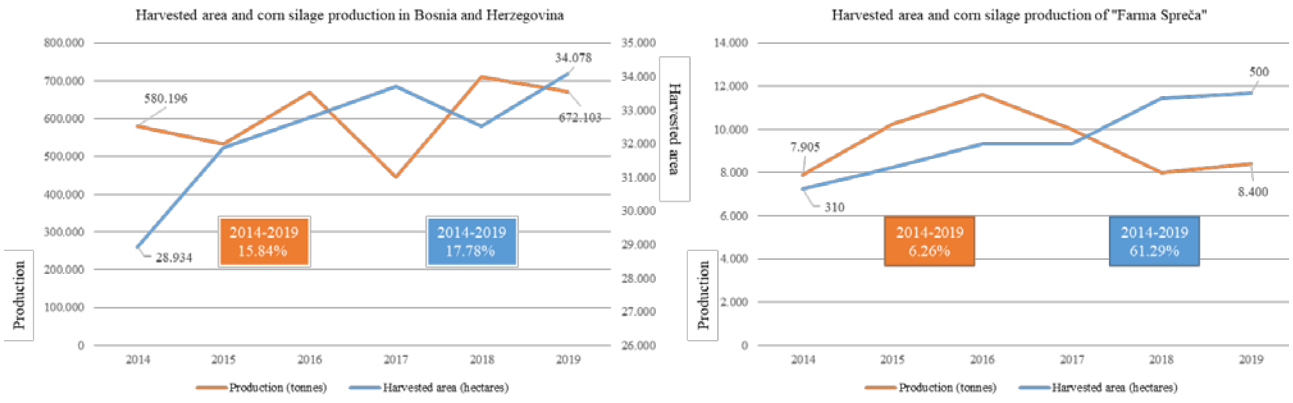
Primary data for this study were collected through semi-structured interviews with farm representatives. Farm „Farma Spreča" d.o.o. Kalesija is the biggest producer of cow milk and corn silage in Bosnia and Herzegovina. This modern farm currently has more than 1700 cows with total milk production of 5.84 million. The farm owns 9.1 ha of own land and leases 800 ha. Besides, the farm has a modern biogas plant facility, an orchard, and also produces various other forage crops such as alfalfa, grass-clover mixtures, triticale, barley and wheat. Secondary data were collected through official statistical agencies of national and international organizations, and other reports, journals, etc. Based on collected data for the observed period 2014-2019 analytical calculations were created and production-economic indicators were assessed. The main indicators include total and average yield per ha, total production costs and cost per ha, cost of production (per kg), gross revenue and revenue per ha, profit and profit per ha, and economic efficiency. Also, all costs are divided into two categories, primarily on variable and fixed costs, and secondarily based on different subgroups that allow identification and detail analysis.

The research assumption is that efficient agronomic practices are based on optimal land use, crop selection, to maximize returns and yields and that the main reasons for the yield gap are (Adamopoulos and Restuccia, 2018; Thomas, 2020): wrong choice/inadequate agrotechnical practice; low technology application; poor resource allocation.

RESULTS AND DISCUSSION

Corn and fodder plant production, in general, has always been a significant agricultural branch in Bosnia and Herzegovina due to its favorable geo-climatic position and the presence of livestock production. Based on the available data, the tendency of increase is evident for the production of fodder plants in Bosnia and Herzegovina (17 %), while the highest growth is recorded in the production of corn for grain (55 %), followed by alfalfa (25 %), corn for silage (16 %), and clover and clover mixtures (10 %) during the observed period 2011-2019 (BHAS, 2021). Corn silage production is currently carried out on 35.000 hectares, with a total production of 781.000 tons (BHAS; 2021), or an average yield of 22 t/ha, which is significantly lower than the yield in some countries. Within the region, in Serbia in 2017 the average yield was 20 t/ha) (Nastić et al., 2018), while in Croatia in 2019 the average 35 t/ha) (Central Bureau of Statistics of the Republic of Croatia, 2021).

From Figure 2, it can be noticed that in the period 2014-2019, the total harvested area with corn in Bosnia and Herzegovina tend to increase (18.78 %), and the total production follows the growth of sown area (15.84 %). On the observed farm, in the same period, there was also a significant increase in harvested areas (61.29 %), but the total production of corn increased only by 6.26 %. Instead of the expected increase in total production, which should be accompanied by an increase in total harvested areas, in this period, there is a decline in productivity of silage corn average production, especially in 2017 and 2018. There are several possible reasons for this, and some have been identified by respondents. They pointed out that there was a dry period in those years which negatively reflected the total yield. However, still, the producers did not highlight any specific reason for the decline in productivity in 2018 and 2019. It should not be forgotten that corn silage is a crop that has a strong effect on soil erosion, which is maintained on soil productivity if appropriate conservation practices are not applied (Allan et al., 2003). Lack of application of cover crops, ie crop rotation, can lead to loss of organic matter, and also if the harvest is done when the soil is moist, soil compaction can occur due to the use of heavy machinery, which also disrupts soil structure and directly affects productivity (Allan et al., 2003).

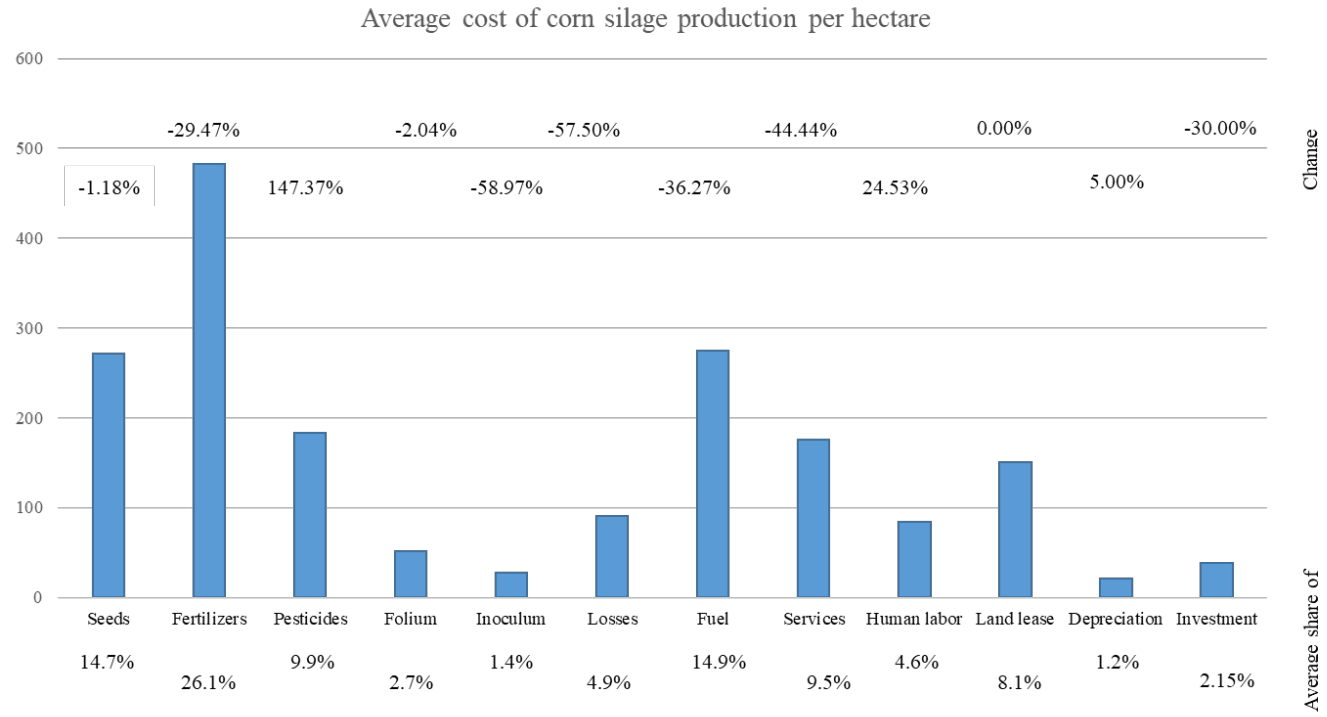


Source: BHAS, 2021; own calculations

Fig. 2. Total harvested area and corn silage production in Bosnia and Herzegovina (left) and farm „Farma Spreča" (right)

The highest total and average yield were achieved in 2016, with 11.613 tons, and 29 t/ha. The lowest total production volume was achieved in 2014, 7.905 tons, and the average in 2018, 16 t/ha. Production costs tend to increase in the first three years and decrease in the next three. Total costs in 2019 are 32.7 % higher than in 2014 and 17.7 % lower per hectare, which indicates higher capacity utilization. The highest total costs per ha were in 2016, 592.489 EUR and 1.481 EUR/ha, the lowest total in 2014, 257.386 EUR, and per ha in 2019, 683 EUR/ha. The average price of silage is 0.06 EUR/kg, the lowest was 0.06 EUR/kg, and the highest, 0.07 EUR/kg. The cost price in 2019 is 17 % higher than in 2014. In the production of corn silage on agricultural farms in the district of Mačva (Serbia), the average yield in the three-year research period (2015-2017) amounted to 35 t/ha (2015), 45 t/ha (2016), and 35 t/ha (2017), and the average variable production costs 607 EUR/ha, 609 EUR/ha and 514 EUR/ha. The average market price per kg of silage was 0.04 EUR/ka (Nastić et. al., 2018). The average share of variable costs in total costs is 88.7 %. The largest share in the total costs has the costs of mineral fertilizers, 26.1 %, followed by fuels for mechanization, 14.9 %, and corn seeds, 14.7 %, while the smallest share has the costs of depreciation, 1.2 % (as presented in Figure 3).

From figure 3 it is evident a significant decrease in the use of fertilizers (-29.47 %), which could have a negative impact on yields. At the same time, there was a strong increase in the use of pesticides (147.37 %), which indicates problems with diseases and pests. Among other significant cost categories, a decrease in the costs of fuel (-36.27 %) and services (-44.44 %) can be noticed, which can be related to more efficient use of machinery.



Source: own calculations

Fig. 3. The average cost of corn silage production (per hectare)

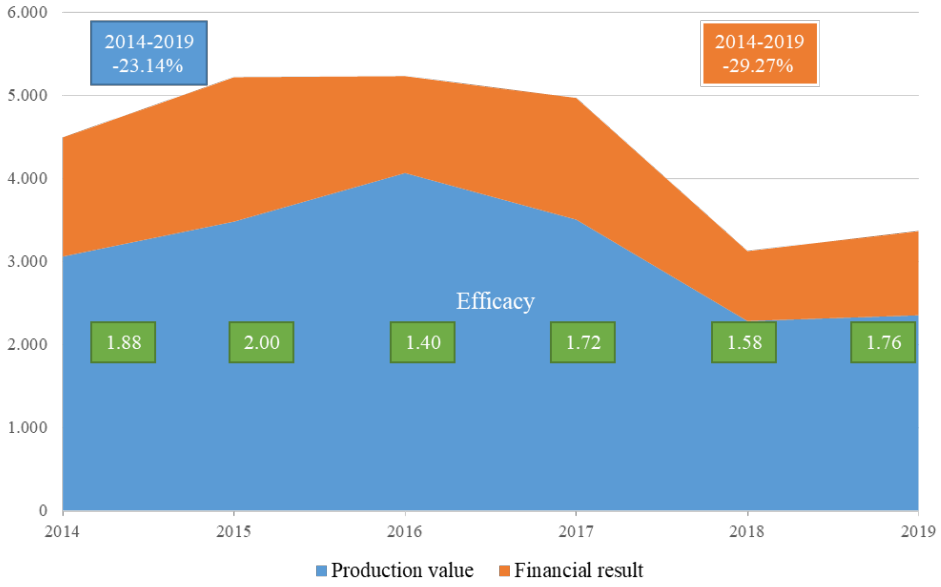


Fig. 4. Production and economic indicators of corn silage production per hectare (2014-2019)

Human labor has of course increased (24.53 %) which is related to the increase in harvested areas.

Finally, Figure 4 shows production value and financial result per unit area, and the efficacy for the observed period 2014-2019. It should be noted that the corn silage production values were determined based on average market prices, which in the first two years amounted to 0.06 EUR/kg, and in the next four 0.07 EUR/ha.

Production value has varied over the years depending on the variation in yields. The total value of production in 2019 is 24 % higher than in 2014 and 23.1 % lower per hectare. The highest total value of production and average production was realized in 2016, 830.935 EUR/kg and 2.077 EUR/kg, the lowest total in 2014, 484.812 EUR/kg, and average in 2018, 1.166 EUR/kg. The financial result was positive in all observed years. The total financial result in 2019 is 14.1 % higher than in 2014 and 29.3 % lower per hectare. The highest total and financial results per ha were achieved in 2015, 313.520 EUR and 888 EUR/kg, and the lowest in 2018, 210.961 EUR and 430 EUR/kg. The efficacy of production on average was 1.72, the highest was in 2015, 2.00, and the lowest was in 2016, 1.40. Efficiency in 2019 is 6.4 % lower compared to 2014.

CONCLUSION

Silage corn is the most important feed in livestock production. In the production of corn silage in Bosnia and Herzegovina in the last 10 years, there has been an increase in harvested areas (39.7 %), total production (78 %), and yield per ha (27.4 %), but the level of production that would meet domestic needs has not yet been reached. Producers of corn silage are mostly larger agricultural farms focused on cattle production. Total harvested areas under silage corn in the ten years (2011-2020) increased (except 2018), and in parallel with the growth of areas and total production of corn silage and yields per hectare with some variation during the observed period. Within the microeconomic part of the research, the most significant production and economic indicators of corn silage production at the Spreča Farm for six years of production (2014-2019) were determined. There was a trend of increasing the harvested area with silage corn and varying the total volume of production. According to the respondents, the variation (and decrease) of the production volume is the result of bad weather conditions (ie drought in certain years), however, it should be noted that the choice of drought-resistant hybrids plays a very important role in ensuring high and stable yield. The highest yield per ha was achieved in 2016 (29 t/ha), and the lowest in 2018 (16 t/ha) and averaged 23 t/ha, which is more than the average in the country. Total production costs per hectare increased in the first three years and decreased in the next three, and the cost structure was dominated by the costs of mineral fertilizers (26.1 %), and the lowest by depreciation costs (1.2 %). It should be noted that there has been an increase in the cost of pesticides, and a decrease in the cost of fertilizers, which indicates problems with diseases, pests, weeds, which is probably a reason for yields decrease. In all observed years, the financial result was positive, while the efficacy on average was 1.72, the highest was in 2015 (2.00), and the lowest in 2016 (1.40), so these elements clearly show that the corn silage production provides stability to agricultural producers. What should be pointed out is that the application of adequate agro-technical measures, especially since it is a crop associated with soil erosion, reduction of organic matter in the soil, or generally reducing soil productivity is something that should be approached with special care. In addition, the choice of hybrids that are more resistant to diseases, pests, drought, that have higher biomass quality, can significantly improve the overall business of agricultural producers.

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