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SUNFLOWER PRODUCTION AND ECO-MARKETING APPLICATION

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Abstract: *The study analyzes production of sunflower primarily because of its great importance as an important oil production raw material. Sunflower production analysis in Serbia and in the world based on five-year studies results. The following parameters were examined: area, grain yield and total production. The study's findings*

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demonstrated a clear upward trend in sunflower acreage in Serbia and globally. The World and the Republic of Serbia planted sunflower on an average of 27.42 mill. ha (219,868 ha) throughout the test period. The average yield of grain was 1.88 t ha^{-1} / 2.97 t ha^{-1}, and the production was 50,850,021 t / 652,238 t. The exceptional soil and agro-ecological conditions in Serbia, along with the indigenous high-yielding genotypes-of which the assortment of the Institute of Field and Vegetable Crops from Novi Sad dominates-make it an ideal place to produce sunflowers. Sustainable development means stable economy, environmentally sustainable sectors and reduce of unemployment using social resources in the labor market.

Keywords: *Sunflower production, grain yield, trade, circular economy.*

INTRODUCTION

The production of renewable biological resources and their transformation into food, feed, bio-based products, and bio-energy through the use of creative and effective technologies made possible by industrial biotechnology are all included in the bio-economy. It gives many solutions but also an opportunities to a rising number of major challenges, including the fight for energy and food security, sustainable resources as well as against negative climate change. Currently, the European bio-economy employs over 22 million people, mostly in small and medium-sized businesses (SMEs) and rural or coastal areas, and is valued at over €2 trillion yearly, https://commission.europa.eu/research-and-innovation_en?pg= policy. Starting from middle of XX century, there are constant growth of economic and eco-marketing activities influence on the environment. It is in relation with growth of populationin but also the wealth increasion in the developed countries. People in Western Europe in particular benefited from the growing wealth and the steadily rising demand for agricultural products from developing nations.

Sunflower seed is usualy used in production of oil and meal. *Helianthus annuus* L., or sunflower, is the fourth most significant oil crop in the world (Huang et al., 2005). Serbia ranks seventh in the world in sunflower production. In recent years, its production was not stable

because the size of the sown areas changed and the climatic conditions were unfavorable.

As a rainfed crop, sunflowers exhibit a highly exploratory root system that demonstrates their resistance to water stress situations (Sadras et al., 1991). Significant ecological changes brought on by climate change result in extreme climate-related events such hurricanes, floods, heat waves, and droughts (IPCC, 2014; Maksimović et al., 2018). Stress factors, both abiotic and biotic, influences plants properties so breeding of stress-resistant crops is what is the most important for breeders future work. Varieties well customized to climate change can positively affect productivity of sunflower. The plant growth and yield depend soil types, genotypes, technological measures, precipitation and temperature optimum etc. (Gray & Brady, 2016). Proper time of seed sowing is important for germination and emergence seedling and positively influenced on the plants vitality. Additionally, it impacts the length of the developmental phases and the growth time (Barros et al., 2004). In Serbia the best yields results were when the planting was end of March / begining of April (2.08 t ha^{-1}) and after that were slightly lower. This means that early sowing of quality seeds is advantage, because it certainly achieved the highest yield, due to their lower variability (Crnobarac et al., 2006; 2012b). The nutrient that has the biggest effect on plant growth and productivity in both agriculture and the natural world is nitrogen. In soil, nitrogen is primarily found as nitrate (NO^{3-}). Reason for that is that ammonium ion (NH_{4+}) rapidly oxidizing to NO_3 since (including one from added fertilizer) - by process of nitrifying done by bacteria. Assimilatory reduction in NO_3 is the mechanism by which nitric nitrogen in plants changes into ammonium nitrogen (Kishorekumar et al., 2020).

Management has several meanings: management, leadership and organization (Bakmaz et al., 2023). Types of management according to activities are classified into two basic categories: human work intended for economic purposes and human work intended for general social needs. There are specialized ones, i.e. branch managements, such as: management in agriculture, management in trade, management in traffic, management in industry and mining, management in culture, etc. It is common for all the mentioned types of branch management and their managers to apply the same rules in planning, organizing, managing and controlling work, and the difference occurs only in their application

(Mihailović, 2005; Novaković et al., 2018; Radović et al., 2019). Management as leadership represents the processes of planning, organizing, motivating and controlling which aim is achieving of work control (preventive, ongoing and subsequent). Because it assumes that the goals are chosen correctly, it is seen as a necessary condition for every organization to have a successful business. Practice has shown that the response to effectiveness is much better with management teamwork, where much greater synergistic benefits are realized. The basic economic principle is to achieve the greatest possible business results with as little investment as possible (Mihailović, 2005). Conecting of best buisness results and marketing discipline is in "Eco-marketing" that, apart from satisfying customers and meeting organizational goals, have influence on minimizing pollution of the ecosystem. Guided by that principle, by comparing results and investments, we can express three partial economic principles: productivity, economy and profitability. By applying management, respecting all aspects of cultivation technology (Glamočlija et al., 2012; 2015; Popović et al., 2013; 2015; 2016; Živanović et al., 2017; Lalić et al., 2018; Šarčević Todosijević et al., 2018), and sowing the most productive sunflower genotypes, profitable production will be achieved. This paper analyzes the economic aspects of sunflower production. Due to rising food consumption it is also noted increases of production, so that can be consider in Serbia as opportunity for producers.

MATERIAL AND METHODS

The parameters of sunflower production during a five-year period (2016-2020) are examined in this research, in Serbia and in the world. Sunflower production data origin is FAO statistical publications (FAO, 2022). Descriptive statistical and mathematical methods were applied to examine the parameters (area, ha; yield, kg ha^{-1}; and production, t ha^{-1}). The results are displayed in graphs and tables.

RESULTS AND DISCUSSION

The findings of the study period 2016-2022 for the total areas, average world production and average grain yield in the world and in Serbia are displayed in table 1. Over the course of five years, the total area in the

world was 27,041,595 hectares. There has been a noticeable increase in the area planted to sunflowers. Figure 1 shows that 2020 saw the highest areas sown (27,874,284 ha), while 2016 saw the smallest (26,342,662 ha).

Table 1. *Global and Serbian averages for sunflower production*

Parameter	Area, ha		Yield, t ha^{-1}		Production, t	
	World	Serbia	World	Serbia	World	EU
Year	Sunflower					
2016	26342632	200299	1.80	3.10	47476776	621.127
2017	26849793	219338	1.81	2.46	48609350	540590
2018	26809106	239148	1.93	3.10	51913748	733706
2019	27332159	219404	2.04	3.32	56020665	729079
2020	27874284	221149	1.80	2.88	50229567	636688
Average	27041595	219868	1.88	2.97	50850021	652238
Std. dev.*	582492	13755	0.11	0.33	3341086	80958
Source: FAO 2022; * Authors calculations; Standard deviation						

During the test period, the global average grain production was 50,850,021 t. The lowest grain production was achieved in 2016 (47,476,776 t), the highest grain production was achieved in 2019 (56,020,665 t), figure 2.

Over the course of five years, the average global grain yield was 1.88 t ha^{-1}. According to figure 3, the lowest grain yields occurred in 2016, 2017, and 2020 (1.80 t ha^{-1}), followed by 2018 (1.93 t ha^{-1}), and 2019 (2.04 t ha^{-1}) as the greatest.

The average grain yield in Serbia in the tested period was 2.97 t ha^{-1}. The years with the lowest levels were 2017 (2.46 t ha^{-1}), 2020 (2.88 t ha^{-1}), and 2019 (3.32 t ha^{-1}), followed by 2016 and 2018 (3.10 t ha^{-1}), as shown in figure 3.

The total area under crops in tested period in Serbia was 219,868 ha. The growth of areas under sunflower with oscillations is evident. Figure 4 shows that the largest areas (239,148 ha) were seeded in 2018 and the smallest areas (200,299 ha) in 2016.

Figure 1. *Total world area under sunflower crop, 2016-2020*

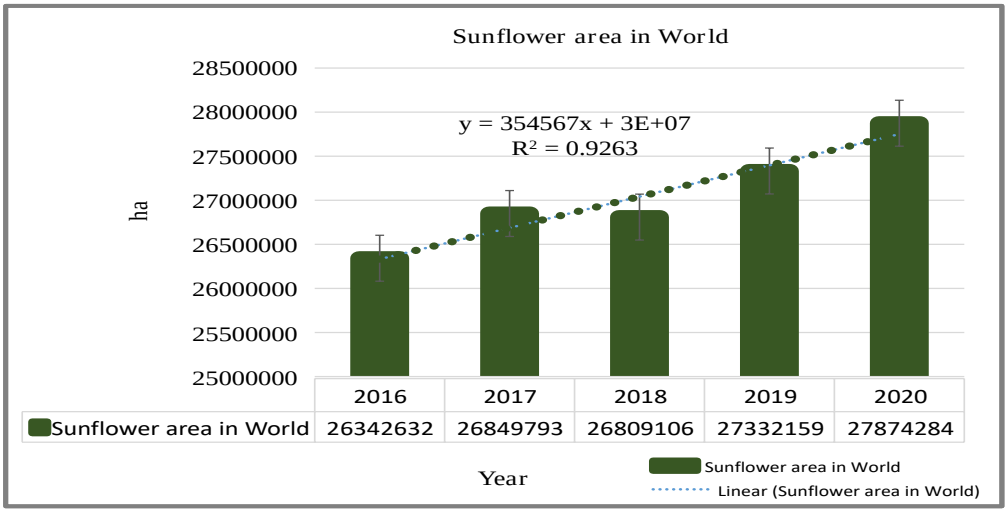


Figure 2. *Total world sunflower production, t, 2016-2020*

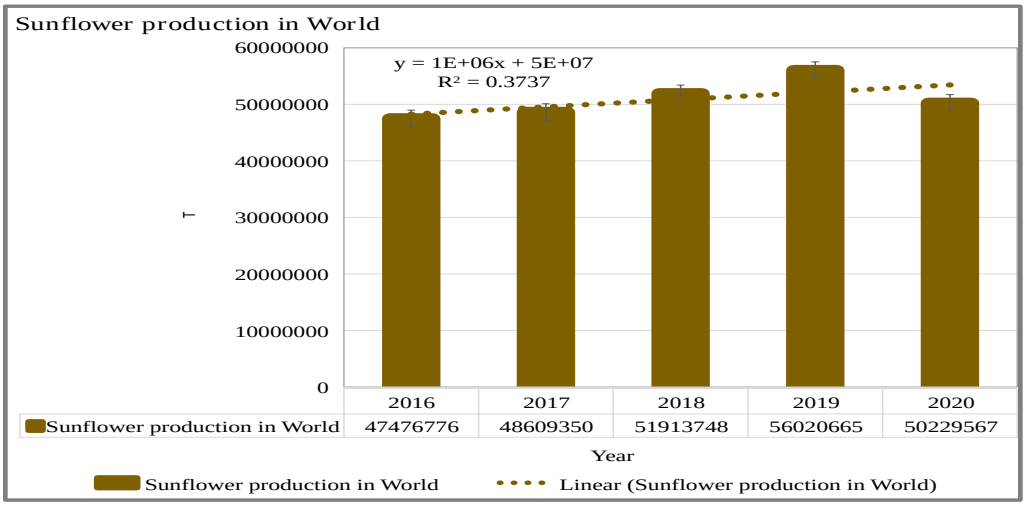


Figure 3. *Total sunflower grain yield in the world and Serbia, t ha^{-1}, 2016-2020*

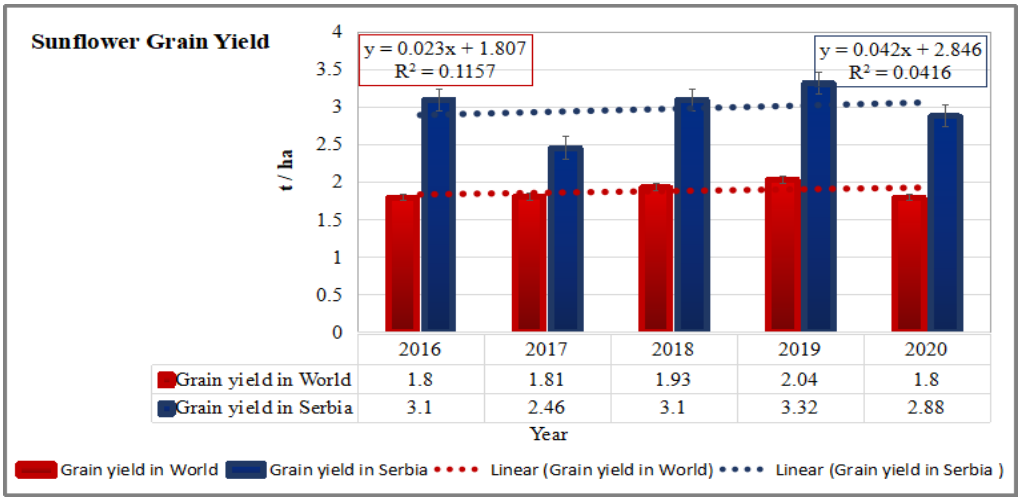


Figure 4. *Total area under sunflower in Serbia, ha, 2016-2020*

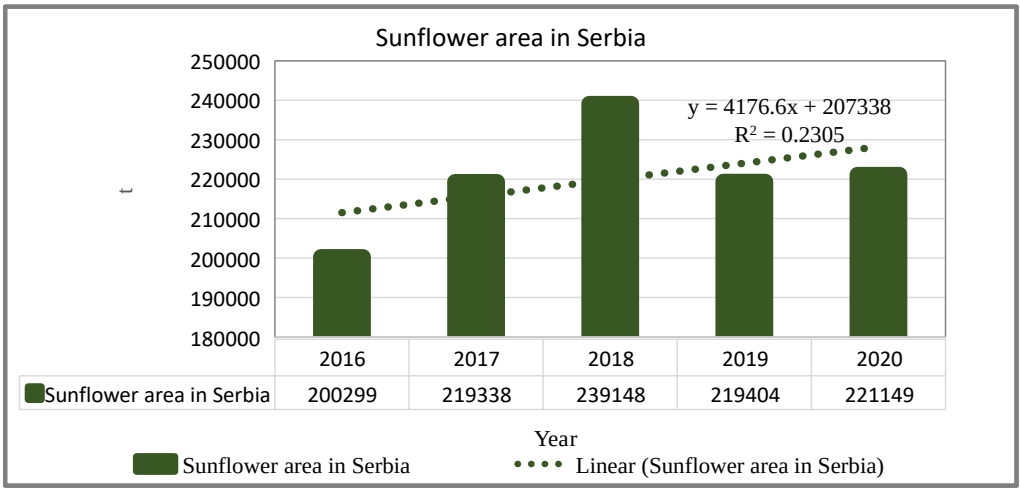
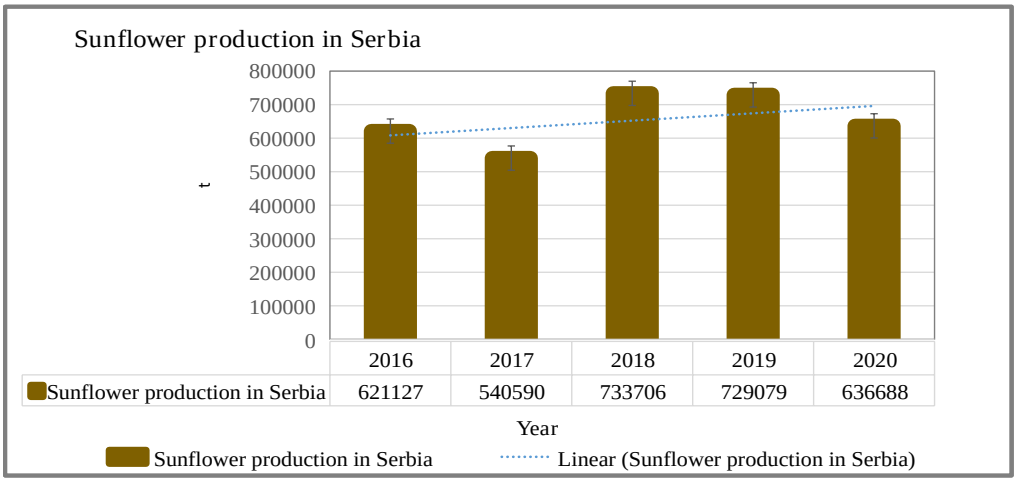


Figure 5. *Total sunflower production in Serbia, 2016-2020*



The average sunflower grain production in Serbia was 652,238 t. The lowest grain production was achieved in 2017 (540,590 t) while the highest was in 2018 (733,706 t) and 2019 (729,079 t), figure 5.

It is evident that climate changes highly influences the variation in the sunflower yield and thus production. The most favourable year for yields both in the world and in Serbia was 2019, while the most unfavourable year was 2018 (Ikanović et al. 2018; 2020) in their research state that the influences of environmental factors on the sunflower genotypes productivity was evident. To achieve a profitable and economically justified production, it is recommended to choose the genotype and apply the correct and timely cultivation technology in the management (Ikanović et al., 2018).

Sustainable development and environmental protection are lately increasingly present in scientific research in Serbia. By taking steps to support the Serbian green technology industry, the Strategy for Responsible Development lays out one of the country's development trajectories, which is centered on sustainable development. There are significant policy challenges at the global and European levels to adopt effective cooperative steps to prevent the effects of threats that produce harmful climatic changes on our planet (Popović et al., 2022a; 2022b; 2023). The relationships between sustainability and marketing could be

categorized as follows: 1. Increasing the environmental friendliness of marketing activities; 2. Creating marketing plans and systems for ecological produce; 3. Adapting to the needs of eco-aware consumer groups by modifying product offerings, production and processing methods, and creative PR campaigns; 4. Encouraging consumers, whether or whether they care about the environment, to buy food that is produced or processed in an environmentally friendly manner; 5. Using environmental concerns as a distinctive selling point for certain items; 6. Changing manufacturing behavior through marketing strategies.

Sunflowers growing started from the middle 20th century. It is the most important oil plant from which quality oil is obtained for human consumption and technical use. It has modest requirements in terms of soil and fertilization and is very resistant to drought (Ikanović et al., 2018; 2020), requests lower investments and achieves stable and relatively high returns. By use of domestic hybrids (that are on same level as world hybrids) and timely and by the correct implementation of all agro-technical measures from the recommended production technology, Serbia is in third place in terms of yields in the world. The basic course of the Department for at the Institute of Field and Vegetable Crop in Novi Sad breeding program of oil crops is the creation of oil crops hybrids with a high yield of seed and oil, resistant to dominant diseases and drought. In addition, hybrids are created for special purposes: with different oil quality, edible, for feeding poultry and birds, tolerant to certain groups of herbicides (Imidazolinones and Tribenuron methyl) and decorative. Domestic sunflower hybrids in Serbia are NS-H-111, Bačvanin, Banaćanin, Velja, Sremac, Šumadinac, Baća, Kazanova, Duško, Branko, Oliva, Novosađanin" and others with high grain yied, with a grain yield of over 3.5 t ha^{-1}.

According to the AMMI1 biplot, the most stable hybrids for seed yield and yield oils in the studied localities were Duško, Sremac, and Baća. For oil content, the most stable hybrids were Baća, Bacvanin, and NS-H-111, while the highest oil content was recorded in Serbia at 22.31% (Radić et al., 2009; Crnobarac et al., 2012a; 2012b; Balalić et al., 2012; Ikanović et al., 2018). According to Mrđa (2015), the analysis of variance results for the five tested hybrids: Sremac, Oliva, Cepko, NS-H-111, and Sumo 2 OR showed that the main factors-year, locality, seed fraction, and seedling type—as well as their interactions with one another, significantly contributed to the majority of the traits that were examined. Year and

location had a significant impact on the qualities under investigation. The seed fraction had a substantial impact on seed germination, emergence, yield, dry matter accumulation, and oil production. Oil yield, oil content, enzymatic activity, and seed yield were all significantly impacted by the type of seedling.

In recent years, the areas have been increasing, and therefore the production of sunflowers. Because sunflowers are good at absorbing undesirable stress conditions, the emergence of increasingly drier vegetative seasons with lower precipitation and greater temperatures supports the need to expand the area planted to sunflowers (García-López et al., 2014). More intense expansion of areas and sunflower grain output can be attributed to agroecological circumstances, hybrid selection, crop rotation expansion, high grain yields, and processing capacities (Pavićević, 1979; 1990a; 1990b; Živanović et al., 2017; Terzić et al., 2019; Rakić et al., 2023).

Eco-marketing is a need for products, with a goal that products are placed on discerning market (Bakmaz et al., 2023). It is marketing of ecological food products and service. Standard information of the sunflower product composition and quality is amended with instructions for use and the information about eco-products.

Breeder seed should be produced in sufficient quantities to be used at the appropriate time utilizing the sales proceeds. Governments must assist public research organizations and provide finance management systems that facilitate an easier accountability procedure (Opie et al., 2022). Producers of sunflowers seed have to deside which market segments are their target and developed market plan (strategy of marketing 4Ps; product, price, place, and promotion) and analyze what can be done for improving customer satisfaction and strengthen its competitive market position. Many criteria such as market size, market profitability, market accessibility and seed firm capabilities should be a part of their strategy decision. Pricing strategies may be cost, competition and demand based. Producers of hybrides may sign contracts with other countries companies. There are very similar distribution channels for sales seeds to farmers - informing of the customer about their product (qualities, features, proper use, and benefits) and to persuade customers to buy their product.

CONCLUSION

Management as leadership represents the processes of planning, organizing, motivating and controlling which aim is achieving of work control (preventive, ongoing and subsequent). The three pillars of economics are economy, profitability, and productivity. Efficiency is the most important for any organization, since it presumes the right goal schoosing. Profitable sunflower production is achieved through appropriate management, planting the most productive varieties, and adhering to suitable cultivation technology. There has been a noticeable increase in the area planted to sunflowers. The total area for the five-year period was 27,041,595 ha. The largest areas were sown in 2020 (27,874,284 ha), and the least in 2016 (26,342,662 ha). Average grain yield for the period 2016-2020 was 1.88 t ha^{-1}. 2016–2017 and 2020 had the lowest grain yields (1.80 t ha^{-1}), followed by 2018 (1.93 t ha^{-1}), and 2019 (2.04 t ha^{-1}) had the greatest. A profitable and economically justified production could be achieved by choosing the most productive and stable sunflower genotypes and the application of varietal cultivation technology, as appropriate field management procedures.

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Conflict of interests

No conflicts of interest are disclosed by the writers.

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PROIZVODNJA SUNCOKRETA I PRIMENA EKO-MARKETINGA

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Sažetak: *Studija analizira proizvodnju suncokreta, prvenstveno zbog njegovog velikog značaja kao važne sirovine za proizvodnju ulja. Analizirana je proizvodnja suncokreta u Srbiji i svetu na osnovu rezultata petogodišnjih studija. Ispitivani su parametri: površina, prinos zrna i ukupna proizvodnja. Nalazi studije pokazali su trend evidentnog rasta površina pod suncokretom kako u Srbiji tako i u svetu. Prosečna površina pod suncokretom u svetu i Republici Srbiji u ispitivanom periodu iznosila je 27,42 mil. ha /219.868 ha, prosečan prinos je bio 1,88 t* ha^{-1} */ 2,97 t* ha^{-1} *i proizvodnja 50.850.021 t / 652.238 t. Srbija ima odlične uslove za proizvodnju suncokreta, zahvaljujući izvanrednim zemljišnim i agroekološkim uslovima i domaćim visokoprinosnim genotipovima među kojima dominira asortiman Instituta za ratarstvo i povrtarstvo. Održivi razvoj podrazumeva stabilnu ekonomiju, ekološki održive sektore i smanjenje nezaposlenosti korišćenjem društvenih resursa na tržištu rada.*

Ključne reči: *proizvodnja suncokreta, IFVCNS, promet, prinos zrna, cirkularna ekonomija.*