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ECONOMIC COMPETITIVENESS OF AUTOCHTHONOUS (LOCAL) GRAPEVINE VARIETIES FOR THE PRODUCTION OF WHITE WINES⁴

Abstract

Grapevine belongs to the group of essential agro-food products. Moreover, through the presence of autochthonous varieties it could bear the part of cultural and ethnic identity of certain nation or local community. The main goal of the paper is to assess if there is general economic competitiveness for the farm contained in growing autochthonous (local) contrary to widely recognized international grapevine varieties with the purpose of producing white wines. Method used implies calculation of contribution margin, and determination of critical values in grapevine production. Analyzed data set was gained from the producer located in the Tri Morave wine-growing region (PDO), Trstenik wine-growing subregion in central Serbia. Gained results showed that in circumstances of growing demand of white wine better economic competitiveness could be derived from autochthonous (local) than international variety growing. Obtained results could be used in popularization of autochthonous and regional varieties growing at national level.

Key words: grapevine, autochthonous (local) varieties, international varieties, white wine, economic analysis.

JEL Classification: Q12, Q13

ЕКОНОМСКА КОНКУРЕНТНОСТ АУТОХТОНИХ (ЛОКАЛНИХ) СОРТИ ГРОЖЉА ЗА ПРОИЗВОДЊУ БЕЛИХ ВИНА

Апстракт

Грожђе спада у групу основних пољопривредно-прехранбених производа. Штавише, присуством аутохтоних сорти оно може носити део културног и етничког идентитета одређене нације или локалне заједнице. Основни циљ рада је процена постојања генералне економске конкурентности за

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газдинство садржане у гајењу аутохтоних (локалних) сорти грожђа насу-
прот међународно признатих сорти у циљу производње белих вина. У раду је
употребљен методолошки оквир који подразумева израчунавање маржи по-
крића и одређивање критичних вредности у производњи грожђа. Анализира-
ни подаци добијени су од виноградара лоцираног у виноградарском рејону три
мораве (пдо), ближе у трстеничком виногорју у централној србији. Добијени
резултати истраживања су показали да се у условима растуће потражње
за белим винима боља економска конкурентност газдинства може постићи
гајењем аутохтоних (локалних) сорти у односу на интернационалне сорте
грожђа. Претходно се може искористити за популаризацију узгоја ауто-
хтоних и регионалних сорти грожђа на националном нивоу.

Кључне речи: грожђе, аутохтоне (локалне) сорте, интернационалне сор-
те, бело вино, економска анализа.

Introduction

Nowadays, the grapevine growing its usually linked to Eurasian grape (*Vitis vinifera* L.) as it represents globally the most grown, while economically significant fruit crop (Arroyo Garcia et al., 2006). The oldest archaeological proof of grape domestication was found in Egypt and Syria, and refers to 4th millennium B.C. (Jacquat, Martinoli, 1999; This et al., 2006). So, *Vitis vinifera*, or generally accepted grapevine, is originated from the southwestern Asia, or more closely from the region of the Caspian Sea. Thanks to wine that was labelled as holy or gods drink in ancient world, some nations additionally spread the wine varieties worldwide, as like Phoenicians to the territories of ancient Greece and Romans, or to south France, while Romans later push the grapevine varieties all over the Europe (Crowther, 1979; Harutyunyan, Malfeito Ferreira, 2022). Discovering America helps further introduction of vine farming in Mexico and California, or in next step in South America and Australia (Vlahović et al., 2012). Currently, besides the Europe, grapevine is well dispersed across the all continents characterized by the continental or Mediterranean, and even subtropical climate, especially in parts of Asia and North America (Terral et al., 2010). According to growing areas and value of production, grapevine belongs to the group of the major fruit crops worldwide (Riaz et al., 2018; Alston, Sambucci, 2019).

Grape is the crop with strong historical, cultural and spiritual connotation within the overall progress of human society (Hannickel, 2013). It's usually divided on table and wine, or red and white, or international and autochthonous grapevine varieties, etc. (Venkitasamy et al., 2019). Globally is described and in use are 6 to 10 thousand grape varieties (Zombardo et al., 2022), while in all growing areas international and local varieties are used in same time, offering fresh or dried grape, or wine and wine products (Kupe et al., 2021).

In Serbia, currently are grown 224 grapevine varieties, both for the commercial production of grapes and wine. Within mentioned group, 31 wine varieties could be considered as local, actually as autochthonous and regional varieties (Jakšić et al., 2024). Grapes are widely used in human nutrition, food and alcoholic beverage industry (mostly for wine production), medicine and cosmetology, etc. (Teixeira et al., 2014).

Nutritional power of grapes is considered in high content carbohydrates, fiber, or various minerals and vitamins, especially K and Mn, or B, C, and K vitamins (Sousa et al., 2014; Zhu et al., 2017). Besides, there are present several bioactive compounds, such as flavonoids, tannins, phenolic acids, anthocyanins, resveratrol, etc., that secure the desirable health status to grapes (Fontana et al., 2013; Dwibedi et al., 2022). So, in line to health benefits, grape has significant impact to human health status. It is good antioxidant and immunity protector (primarily protection against cancer, certain microbes, or viruses). It shows strong anti-inflammatory activities, it is good in preventing cardiovascular, or neuro degenerations, it maintains bones density well, etc. (Yang, Xiao, 2013; Georgiev et al., 2014; Blanton, 2018).

In 2022., there were over the 6.73 million ha under the grapevine worldwide. It has to be mentioned, that overall surfaces have showed small oscillations in last few years. Within the structure of overall areas, Europe dominates with almost 51%, while Asia has significant share too, around 28% (FAO, 2024). According to available areas, among the top five grape growing countries are China, France, USA, SAR, and Italy, while the top five grown grapevine varieties are Cabernet Sauvignon, Merlot, Tempranillo, Airen, Chardonnay, and Syrah (Khan et al., 2020). Some estimation shows that generally exists moderate but positive correlation that links grape and wine production, as in certain countries have been grown grapes, while they have not reported wine production (Stancu, 2015).

Serbia has available favorable climate and other natural conditions for grape growing. Unfortunately, it lags behind the other territorial units with identical conditions (Denda, Denda, 2016). Serbia has on disposal around 20.000 ha (+/- 10%) under the vineyards in last few years (FAO, 2024). Certain level of annual oscillations derives from the replacement of old by new vineyards. Almost 77% of active vineyards are located in Central Serbia. Wine varieties dominate over the table grape varieties (app. 79% : 21%). Over the 13% of agricultural households disposes with vineyards (Trišić et al., 2019). So, larger part of grown grapes is processed into the wine (Dašić et al., 2022). The most of grape producers (over the 60%) are part of the group that have on disposal small size vineyards (0.1-0.5 ha). Current trend in grape growing is turned to rise of number of small farms, or small wine producers, that are more and more introducing the wines of higher quality labeled by geographical indications (Prodanović et al., 2020). Grape growing is usually linked to wine-growing areas. Serbia has on disposal various terroir conditions, dividing the entire wine-growing area (Wine-growing Serbia) in three large wine-growing units, 22 wine-growing regions, and 77 wine-growing sub-regions (Jakšić et al., 2015). As the largest wine-growing region at national level is marked the Tri Morave wine-growing region (Protected Designation of Origin/PDO Tri Morave) in Central Serbia, that spreads along the Zapadna, Južna and Velika Morava rivers. The mentioned region implies the favorable climate and other natural conditions required for vine growing and production of high-quality wines with geographic indications (Tomić et al., 2017; Jakšić et al., 2020).

In previous couple decades, in Serbia has been started with the intensive renewal of old vineyards, implementing the well-recognized or some new commercially more productive grapevine varieties, modern technological solutions and mechanization, striving to achieve sustainability of national wine sector that will be internationally visible (Prodanović et al., 2021). Mentioned transition period transforms big state-

owned vine holdings into the small private, mostly family vine holdings and wineries (Simonović et al., 2019). In line to that, nowadays, in Serbia there are organizing over the 30 manifestations focused on grape or wine (Jević et al., 2016).

According to the Vineyard register, five the most represented wine varieties, per area, in Serbia are Merlot, Cabernet Sauvignon, Chardonnay, Riesling and Sauvignon blanc. Further, five the most represented newly created domestic wine varieties are: Župljanka, Morava, Probus, Sila and Župski Bojadiser, while the five most represented autochthonous and regional wine varieties (local varieties) are: Grašac (although some authors classify it as a widespread regional variety), Frankovka (regional variety), Prokupac, Tamjanika Bela (group of genotypes/sub-varieties - according to some authors, a regional variety) and Smederevka. The five most widely represented table grapevine varieties in Serbia are: Muskat Hamburg, Moldova, Muskat Italia, Victoria and Cardinal (Jakšić, 2019; Jakšić et al., 2024).

Generally, in this moment Serbia is missing sufficient level of vineyard areas, and consequently, Serbia is missing adequate quantities of domestic grapes, wine and wine products, and spirit drinks produced by domestic grapes to provide overall self-sufficiency (Petrović et al., 2024). Besides, out the season table varieties are imported towards the strengthening the offer of fresh grapes in retail. In recent time, intensification in tourism development and establishment of several quite attractive wine routs in Serbia cause the increase in “silent” export of domestic wine sector.

The main goal of the paper is to perceive the economic benefits for the vine growers in Serbia coming from larger implementation of certain autochthonous (local) contrary to international grapevine varieties. So, the main hypothesis of the research is set as: Growing the autochthonous (local) grapevine variety has greater potential of profitability than the international grapevine variety.

Methodology

Like in some previous research linked to lines of crop's production and processing, used method was based on analytical calculations underlying variable costs (determining the contribution margin), as well as on assessing the critical values of production (Subić et al., 2015; Subić, Jeločnik, 2019; Jeločnik et al., 2019; Nastić et al., 2020). In this way there could be analyzed economic potential of certain grape varieties successfully grown at the national level, and later support the adequate producers' decision related to introduction of the variety that gives better profitability into the vineyard.

Data set required for economic analysis was gained from the Tri Morave wine-growing region, specifically Trstenik wine-growing subregion (widely recognized wine-growing area), while they refer to growing season 2022/23. Analysis assumes the identical, or at least quite a similar production conditions available at the observed farm, i.e. the use of the same fixed assets (land, mechanization, equipment, etc.) and inputs (pesticides, fertilizers, external labor, etc.), in norms that fit the best the specificity of grown variety (except in case when the grown variety requires some special treatment).

Presentation of all derived results is done through the adequate tables, while all results are expressed in EUR. All costs and incomes are assumed for the one hectare of vineyard in full yielding. Development of analysis implies consultation with available

scientific and professional literature focused on vine growing, as well as experts in grape production.

Potential research limitations are recognized in development of analytical calculations just towards the data derived from one growing season and one locality. Also, derived results could differ in line to used technological approach in production, state of mechanization and equipment, as well as level of used mechanization in growing activities, main producers' goal (balance between the quantity and quality of gained yields), etc.

Results and Discussion

Globally and locally, growing wine varieties are dominating over the table varieties. Towards to mentioned fact, as well as providing the better economic comparability, there are chosen two wine varieties of white wine variety, one international (Chardonnay) and one autochthonous (local), (Tamjanika Bela), mostly grown in Serbian vineyards. It's assumed that applied growing technology and gained yields in both used varieties guarantee later production of high-quality wine. However, it should be borne in mind that the Tamjanika Bela variety is actually a Muscat variety whose wines are increasingly favored by domestic wine consumers.

More closely, Tamjanika Bela represents old local variety with specific muscat taste and aroma after it reaches the full maturity (in October). There are some believes that variety originated from France as a sub-variety of Muscat. It has great vegetative strength, developing semi-massive compact grape cluster. Grape is yellowish or greenish with some rusty color shade. It belongs to semi-yielding variety that prefers warmer regions. Variety is considered as the oldest Serbian autochthonous variety, grown even in the time of Nemanjić dynasty. Tamjanika Bela is usually grown in central, and eastern Serbia (Beslic et al., 2012; Tarailo, Vuksanovic, 2018).

Chardonnay represents green-skinned grapevine variety, dominantly used in white wine production. Although is currently grown worldwide, it is supposed that variety was initially introduced in Burgundy (east part of France). In line to good adaptability to various production conditions, variety could be easily cultivated. Meanwhile, it shows certain difficulties towards the pests and diseases (Carvalho et al., 2013; Singh, Srivastava, 2018). There are some estimations (CVO, 2024) that currently in Serbia is 640 ha under the Chardonnay variety in commercial production (8.5% of overall surfaces of commercial vineyards), contrary to 305 ha under Tamjanika Bela (4.05%).

Following the rise in demand for grapevine varieties used in high quality wines production at local market, grape producer is considering to enlarge his vineyard (from 3 ha to 4 ha). Basically, grape grower could be in same time the small wine producer. Owned winery has potential to further process gained yields, as well as to bottle and store the additional wine quantity until the moment of wine selling. In line to adequate respond to market requests he has to decide what grapevine variety will fit the best previously established business strategy, of course adjusted to his experience and available technological base and knowledge (both varieties have been already involved into the production structure of the farm). Besides all, one of the steps in solving business dilemma, i.e. expanding the vineyard with widely recognized international variety, or

with some autochthonous (local) but well-known and now popular variety, requires economic analysis in order to perceive the current profitability potential of observed solutions (Tables 1. and 2.).

Calculation of expected wine varieties production (Chardonnay and Tamjanika Bela) assumed that the same variety will be grown on the full hectare. Overall yield of gained grape will be in function of wine production, while its value will be assessed according to current purchase price (in moment of harvesting) for a given variety at the local market. The producer uses all types of public support given to plant production, specifically viticulture.

It is assumed that all required inputs are purchased at the local market or through suppliers. In order to simplify and later make it more comparable, incurred costs of mechanization are expressed by the use of pricelist of services of mechanization issued by Cooperative Union of Vojvodina (CUV) for the 2024 (CUV, 2024). Labor costs include engagement of farm members and external workers. Value of working day is expressed in gross price, reflecting the current price of labor at the level of local community for similar jobs. Since the main focus of the farm is production of quality wines, to all activities (especially vine pruning and grape harvesting) are carefully approached in accordance with the method of appliance and compliance with agrotechnical deadlines. So, the imperative of producer is not the quantity but the quality of the grown grapes.

Wherever is possible, the production elements are expressed naturally. Although the irrigation has not been used so often in grape growing of wine varieties, observed farm applied this measure. As the farm is equipped by its own dwell, irrigation costs include just the value of spent energy (there are used low pressure electro-pumps linked to drip irrigation system). The negative impact of climate change on the gained yields and quality of grapes is mitigated by insuring vineyards to the extent of about 10% of the planned value of grape production. Land between the rows are maintained as fallow land, including the annual soil cultivation. The performed calculations are in line to vineyard in full yielding.

Some research focused on impact of climate change to grape growing have been noted that there are already certain adaptation strategies that enable producers to decrease derived negative economic effects (unfortunately they usually require larger short-term costs). Besides, current level of climate changes initiate moving of growing areas closer to the both Poles (Ashenfelter, Storchmann, 2016).

There are no significant differences in technological approach, performed operations and norms of used inputs (they are aligned with the requirements of the grown varieties), as well as at expected yields of observed wine varieties. Based on fact that production year 2022/23 meteorologically was not so favorable to viticulture (unusually colder start of summer, and further unstable weather in later spring and summer months, with often change of heatwaves and heavy rains (RHMO, 2023)), deriving the decrease in expected yields and intensive use of pesticides. In the Trstenik wine-growing sub-region, however, the vineyards used for the analysis in this paper were obtained with high, i.e. average yields and high grape quality. However, it should be emphasized that the Tamjanika Bela variety is genetically a higher yielding variety than Chardonnay, but with a later grape ripening time, it is therefore more exposed to a possible stronger infestation by grape botrytis. The mentioned facts certainly affect the costs, but also the profit.

It is assumed that the additional production of grapes at the farm, but not the purchase of grapes or wine in bulk at the market, would have a better effect on the quality level of the raw material later used in wine production. The determination towards the observed varieties is the fact that Chardonnay is a wine variety that always has a satisfactory demand on the local and regional market, while Tamjanika Bela represents the autochthonous (local) variety that have made a significant increase in demand in recent period, which could ultimately achieve a slightly higher price in conditions of shortage in supply.

There has to be underlined again that produced grape will be later processed at the farm into the wine, while it will be valued at the wholesale (fair-trade) price that could be gained at local market. All inputs required in grape growing are purchased locally. All occurred costs in grape growing will be assessed towards the previous technological experience of the producer. Available mechanization and external labor could be utilized in production at expanded vineyard. Producers' business moto is focused to quality than to quantity of produced grapes.

Table 1. Contribution margin in grape growing (in EUR/ha, growing season 2022/2023, variety Chardonnay)

Element	UM	Quantity (per ha)	Price per UM (EUR)	Total (EUR/ha)
I – Value of production				
Grape	kg	10,000	0.85	8,500
Subsidy (annual area-based coupled payment)	set	1	150	150
Total				8,650
II – Costs of production				
Mineral fertilizers				350
Pesticides				1,385
Costs of irrigation (energy)	kwh	600	0.1	60
Binder	kg	6	10	60
Mechanization				850
Crates (wooden - 2 layers, 10 kg)	pcs	250	1	250
Insurance (10%)				850
Labor				1,945
Other costs				100
Total				5,850
Contribution margin (I-II)				2,800

Source: according to authors' calculation

According to results in previous tables (Table 1. and 2.), higher incomes (for over the 40%) in Tamjanika Bela growing derives from higher yields and better selling price at local market. Contrary to that at the cost side, in Chardonnay growing are made for 15% lower costs in observed year. Within the structure of overall variable costs in both productions dominate the costs of labor and applied pesticides. In both varieties

are achieving the positive contribution margins, in extent that secures later satisfying level of profitability. Mineral fertilizers include the NPK and KAN appliance. Used pesticides involves herbicides, insecticides and mainly the fungicides. High labor costs are something as a standard in a grape growing, although in recent time producers much more implement mechanical pruning or grape harvesting, while simultaneously facing the issue of larger costs of lost yields due to mechanical harming of grape kernel (Kurtural et al., 2019; Jobbágy et al., 2021).

Costs of mechanization services covers the following activities: spring and autumn deep ploughing, shallow soil cultivation, pesticides application, basic and additional fertilization, summer pruning, transport of used inputs and harvested grapes, etc. On the other side, costs of labor involve next activities: winter and summer (corrective) pruning, collecting and taking out of cut vine branches, repair of poles and strings straining, binding the branches and young shoots, correction of spring and autumn tilling, shallow land cultivation within the rows, pesticides preparation and appliance (corrective), handling the used inputs in and out the vehicles, grape harvesting, maintaining the farm roads, etc.

Table 2. Contribution margin in grape growing (in EUR/ha, growing season 2022/2023, variety Tamjanika Bela)

Element	UM	Quantity (per ha)	Price per UM (EUR)	Total (EUR/ha)
I – Value of production				
Grape	kg	12,000	1	12,000
Subsidy (annual area-based coupled payment)	set	1	150	150
Total				12,150
II – Costs of production				
Mineral fertilizers				385
Pesticides				1,525
Costs of irrigation (energy)	kwh	600	0.1	60
Binder	kg	6	10	60
Mechanization				935
Crates (wooden - 2 layers, 10 kg)	pcs	300	1	300
Insurance (10%)				1,200
Labor				2,140
Other costs				150
Total				6,755
Contribution margin (I-II)				5,395

Source: according to authors' calculation

Higher yielding, but also slightly later time of grape ripening, as a result of which there is a possibility of grape botrytis attack of variety Tamjanika Bela assumes certain costs more expressed contrary to those gained at Chardonnay. Generally, according to economic aspect, gained contribution margins strongly favorize the business decision turned to growing the Tamjanika Bela.

In next table (Table 3.) are defined the critical values of production, i.e. the values that equalize the gained contribution margin with zero (Subić et al., 2017), linked to growing of both varieties. According to gained results, there are standing out the production line of Chardonnay as economically more sensitive to possible production risks.

Table 3. Critical values of Chardonnay and Tamjanika Bela grape growing

Description	Grapevine variety	
	Chardonnay (in EUR/ha, EUR/kg)	Tamjanika Bela (in EUR/ha, EUR/kg)
Expected yield (EY)	10,000	12,000
Expected price (EP)	0.85	1.00
Subsidy (s)	150	150
Variable costs (VC)	5,850	6,755
Critical price: $CP = (VC - s) / EY$	0.57	0.55
Critical yield: $CY = (VC - s) / EP$	5,674	6,605
Critical variable costs: $CVC = (EY \times EP) + s$	8,650	12,150

Source: according to authors' calculation

According to economic analysis, growing both grapevine varieties show good potential in profit gaining (contribution margins are positive, while their values represent fine assurance that producer will reach sufficient level of net income, enough even for accumulation and further investments). Better results are obtained at Tamjanika Bela, that could be a first producers' choice in upcoming planting vineyard enlargement. Of course, one of good decisions could be also splitting the newly implemented vineyard surface into the equable parts (or in certain portion) that will involve both varieties. It has to be mentioned that gained research results (positive contribution margin) are generally in line to some previous researches in Serbia and worldwide, providing the evidence that grape growing could be profitable (Filipovic et al., 2017; Milić et al., 2016; Koctürk, Engindeniz, 2009; Pappalardo et al., 2013).

Generally, the main benefits for producer after stepping up the vineyard enlargement are that he could affect the level of grape quality, to avoid certain market instabilities, and at the end through the wine making he could secure better overall profitability for the farm. However, it should be noted that Muscat wine made from grapes of the Tamjanika Bela variety is currently quite popular, so that grapes of this variety have a slightly higher price.

Conclusion

Serbia has good natural conditions and production potentials for further development of viticulture and winemaking sector. In current structure of grapevine varieties available in vineyards at national level, besides international one, there are present several autochthonous and regional varieties. Paper tried to discuss is there

any economic effect that will trigger producers' decision to planting international or autochthonous (local) grapevine variety with the purpose of producing white wines, in situation when he has already entered process of vineyard enlargement.

In line to obtained data for the production year 2022/23 and Tri Morave wine-growing region (PDO), Trstenik wine-growing subregion, derived research results show that from annual running of one hectare under the predefined wine varieties producer could expect achieving of positive contribution margin (specifically 8,650 EUR/ha by growing the Chardonnay, or 12,150 EUR/ha by growing Tamjanika Bela). According to the level of gained contribution margin and level of production risks (level of calculated critical values), final decision could slightly favorize growing of autochthonous (local) wine variety at the observed locality. In line to previously mentioned, derived results fully agree the initially set research hypothesis.

Performed research could support promotion of growing autochthonous and regional grapevine varieties at national level. Meanwhile, there are certain research limitation that could initiate wrong decision. Before all, any decision based just on one production year in agriculture could be linked to uncertainty (occurrence of specific weather and market conditions). So, in some further research, there could be used average production results derived from three-year period and from same farm or grape producers in other wine-growing area. It is also proposed that priority be given to studies on different grapevine varieties (group of red wine varieties, comparison with table varieties, etc.) in order to support producers and the institutions responsible for implementing agricultural policy measures. Besides, gained results could serve as a good base for next research steps that will advance producers' final decision, as it has to be dispersed to economic analysis of creation value added in wine making with observed varieties, as well as to investment analysis of planed planting vineyard enlargement.

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