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## CONVENTIONAL AND CONTEMPORARY PRACTICES IN MONTENEGRIN OLIVICULTURE: RELYING ON TRADITION HEADING TOWARDS AN INNOVATIVE FUTURE

### SUMMARY

Olive growing and olive oil production has been an ingrained tradition in the coastal areas of Montenegro for more than three millennia. However, various problems such as complex terrain configuration, scattered land, elderly households, urbanization and poor infrastructure led to olive orchards abandonment during the last century. On the other side, climate changes enabled olive growing to shift in more northern areas of Montenegro and that restimulated farmers to revitalize their centennial olive trees, to connect oliviculture with tourism and to implement innovations in this sector. Therefore, our team analyzed the degree of conventional and contemporary practices in Montenegrin olive growing and olive oil production. Local farmers practice olive growing as a secondary activity or as a hobby, very rarely as a primary business (8.33%). Moreover, 88.33% out of interviewed farmers implement rainfed agriculture, relying solely on annual precipitation level. They made more significant progress in olive oil production than in olive growing during the last two decades. One half of the interviewed farmers start harvesting olives in October, when there are less than 25% of olives turning black and 79% of olive producers harvest by hand or use manual and/or electric shakers. Contemporary practices are implemented in post-harvesting techniques and all farmers process their olives 48 hours (the latest) after the harvest, while more than 73% use mechanical process of cold extraction on 2-phase decanters. Finally, 23% of the farmers concluded that olive oil waste management is highly important issue that has to be regulated by law.

**Keywords:** olive, olive oil, tradition, innovation, Montenegro

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## INTRODUCTION

Traditional olive orchards account for a large share of the area under olives in the EU, particularly in marginal areas and therefore, olive growing can be described as a low-intensity production system, associated with old trees, giving small yields and receiving low inputs of labor and materials (Duarte *et al.*, 2008). Olive oil is one of the most globally recognized high-value agricultural product. Europe is the top olive oil producer, with 67% of total production and 4 million hectares cultivated, mostly in Spain, Italy and Greece, at the top three leading producers of olive oil (Rapa and Ciano, 2022). With Portugal, those four countries produce more than 95% of total EU olive oil production of 12.5 million tons annually (Patsios *et al.*, 2021). It is estimated that the following countries will be the leading forces in future production of olive oil, with 29.93%, 9.08%, 9.06%, 9.00%, and 8.90% of the world's production provided by Spain, Greece, Turkey, Morocco, and Italy, respectively. These five countries will account for 65.96% of the world's production level (Kurtoğlu *et al.*, 2024).

Gagour *et al.* (2024) reports that olive oil is widely recognized as a main component in the Mediterranean diet owing to its unique chemical composition and associated health-promoting properties. The health advantages of extra-virgin olive oil are ascribed mainly to the antioxidant ability of the phenolic compounds (Dini *et al.*, 2020). Olive oil storage is a critical post-processing operation that must be optimized to avoid oxidation. Owing to its great commercial value on markets, olive oil is a target to adulteration with other vegetable oils (Gagour *et al.*, 2024).

Olive growing and olive oil production has always been an ingrained tradition in Montenegro. Historical manuscripts on olive production, preservation and protection on the coast of Montenegro, dating back to 11<sup>th</sup> and 13<sup>th</sup> century, testify the importance of olive growing in this region (Perović *et al.*, 2007). The witnesses of the long lasting olive growing tradition in Montenegro are millennial olive trees, such as Old Olive Tree at Mirovica in Bar and Big olive in Ivanovići, near Budva (Lazović *et al.*, 2007). Olive orchards in Montenegro are mainly located on the slopes of mountain massifs of Orjen, Lovćen and Rumija, on hilly terrains (85%), up to the 500 meters above sea level. Suitable ecological conditions prevailing in the coastal zone of Montenegro enabled olive to become the leader among fruit species, covering about 3200 ha (Lazović *et al.*, 2018), with about 436.000 productive trees (Statistical Year Book of Montenegro, 2012). Based on the olive diversity, known for numerous autochthonous varieties (domestic and domesticated) area of Montenegrin coast may be divided in two sub-areas: Bar sub-area (municipalities of Ulcinj, Bar and Budva) and Boka Kotorska sub-area (municipalities of Tivat, Kotor and Herceg Novi) (Miranović K., 2007).

One of the crucial tasks in olive growing development is comprehensive characterization of the local olive assortment on morphological and molecular level, as well as recognition and segregation of the clones from the main olive varieties (Lazović *et al.*, 2014). According to Lazović *et al.* (2000), olive

growing in Montenegro is mostly on extensive (70%) or marginal bases (28%), while the intensive agro-technics apply in only 2% of olive orchards. Average age of olive trees is from 150 to 200 years. Trees are from 7 to 10 meters high, going up even to 15 meters, which indicates non-suitability for intensive agricultural practices, such as efficient pruning, pest control and harvesting. Lazović *et al.* (2014) reported that plan protection highly influences olive growing, olive production and olive oil quality; however, is conditioned by the terrain structure, traditional olive groves and small properties. Knežević *et al.* (2017) reported that the areas suitable for olive cultivation in Montenegro are expected to shift northwards, and to the higher altitudes, due to global warming that would anticipate the flowering period of olives.

To improve the consumption of domestic olive oil, there is a need for more affordable prices and better marketing, as well as additional education on the importance of consumption and its health benefits and nutritional value (Jovanović and Joksimović, 2020). Ali *et al.* (2024) recommend to address the challenges and needs within the olive sector, which include awareness and training among farmers, infrastructure improvement, adequate storage and packaging facilities, standardized quality testing, and competitive pricing, through training programs, conducting surveys for data collection, increasing awareness of the health benefits of olive oil and establishing loan schemes and private-sector investments. Furthermore, encouraging the local production of olive oil extraction machinery and upgrading technology can help reduce reliance on imports (Ali *et al.*, 2024).

Considering the fact that Montenegro is pre-accession candidate to European Union, significant funds are available for projects implementation in domain of agriculture. Unfortunately, available grants are still not sufficiently utilized, which entails the necessity for connecting the possibilities with the stakeholders in terms of capacity building on local and national level (Markoč M., 2020).

## MATERIAL AND METHODS

In this study, different segments of oliviculture have been compared among sixty farmers located in the southern Montenegro in order to assess the degree of conventional and contemporary practices in olive growing and olive oil production.

Onsite interview method was used in order to collect the data. The comprehensive survey sheet considered eight pillars of oliviculture: General information on farmers (I); General information on agricultural holdings (II); General information on olive orchards (III); Cultivation and maintenance of olive orchards (IV); Olive processing and olive oil production (V); Institutional and professional support (VI); Future investments in olive orchards (VII); Needs of olive growers' for further growth and development (VIII). This well-structured survey sheet was more than useful for the detailed analysis of both conventional and contemporary practices in Montenegrin olive growing.

The interviews with farmers have been performed onsite from January to December 2023, at territory of Bar municipality. Statistical tables and area charts were used in order to present and discuss the obtained results. Finally, desk research method and comparison method were used in order to display the data in this paper.

## RESULTS AND DISCUSSION

Farmers on the territory of Montenegrin coast engage in olive growing as a secondary activity or as a hobby, very rarely as a primary business. Therefore, only 5 out of 60 respondents (or 8.33%) stated that olive production is their main occupation. For as many as 63% of respondents, income from olive growing contributes less than 10% of the total household budget, and which indicates the worrying fact that residents seldom perform this activity in professional manner (Figure 1). Furthermore, this research has shown that the lack of young labor is one of the most expressed problems of Montenegrin agriculture (35% of interviewed farmers are retired and above 60 years old).

In order to ensure strategic development of Montenegrin oliviculture, it is important to implement innovative technologies with the support of relevant public and private institutions. However, in order to receive governmental support, it is necessary for farmer to register their agricultural household with the relevant ministry. Anyway, this survey showed that 30% of the farmers has not been registered yet, while there are only 6.67% of registered legal entities in domain of olive production.

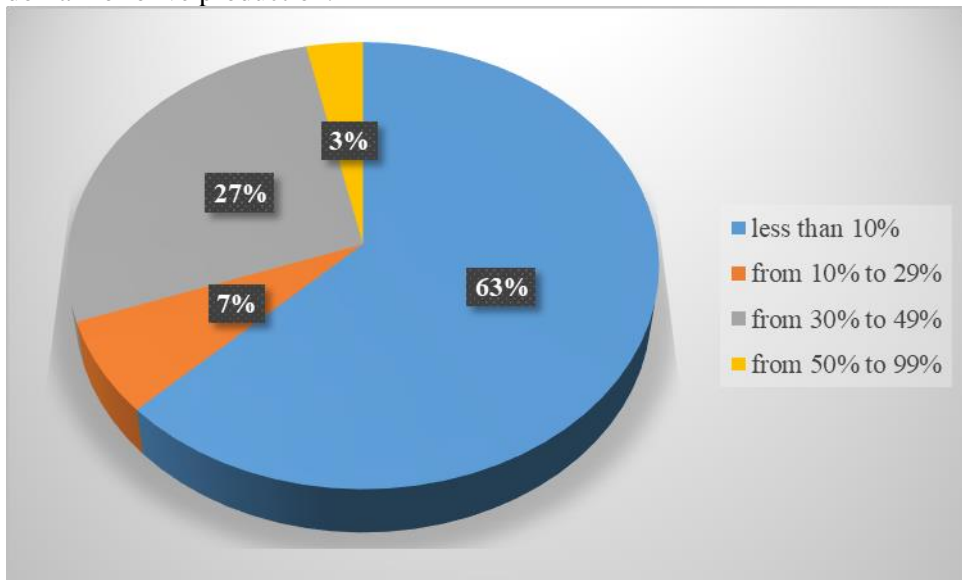


Figure 1: Contribution of olive growing and olive oil production at the total income of agricultural household

Lazović *et al.* (2017) stated that variety *Žutica* predominates in Montenegrin olive growing area with 65% (about 98% in Bar sub-area), followed by *Crnica* (14.8%), *Sitnica* (5.5%), *Lumbardeška* (6.6%) and *Šarulja* (4.5%), while the other varieties are present in about 2% within Montenegrin olive growing area. This research confirmed previously obtained results since 86.67% farmers grow *Žutica*, while the most common introduced olive varieties in Bar municipality are *Arbequina*, *Leccino*, *Frantoio*, *Picholine*, *Maurino*, *Coratina*, *Arbosana*, *Ascolana Tenera*. Montenegrin farmers grow olives predominantly in monoculture (71.67 %).

However, it is a devastating fact that 88.33% out of interviewed farmers implement rainfed agriculture, relying solely on precipitation level during the year. This is particularly worrying since in Montenegro there is an expressed climatic phenomenon of resource paradox – the least amount of precipitation occurs in the period when the plants have the highest water needs that leads to drought and has negative impact on the quantity and quality of the yield (Markoč M., 2020). Furthermore, merely 20% of farmers apply cultivation methods regularly, such as tillage, fertilization, pruning and pest and disease protection. This lead to the conclusion that olive growing in Montenegro is still closer to extensive than intensive, which is caused by presence of autochthonous assortment prone to alternate bearing; complex relief and terrain configuration, as well as insufficiently developed infrastructure (27%).

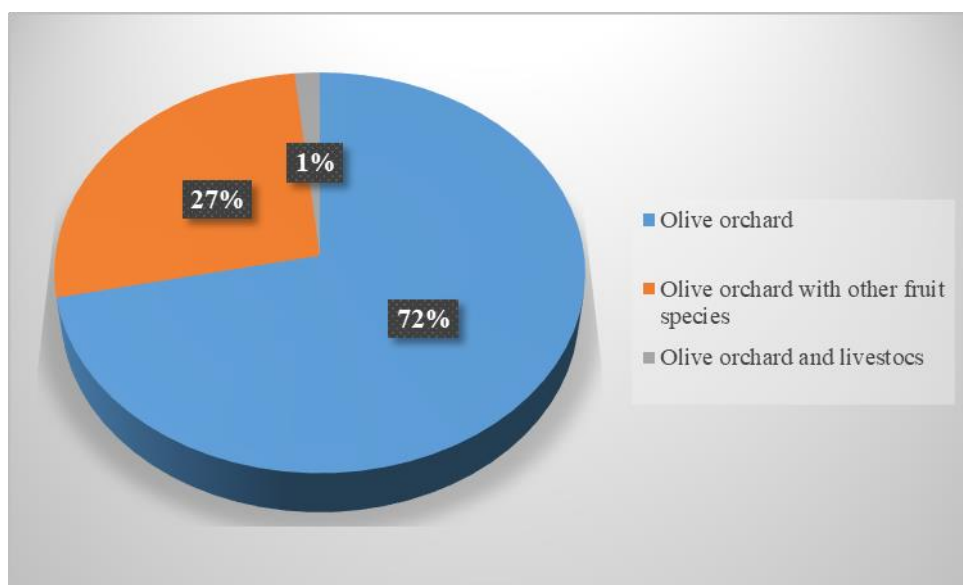


Figure 2: Monoculture system of olive growing in analyzed area

Regarding the results of soil and leaf analysis in olive orchards in southern Montenegro, it is generally recommended to decrease fertilization with potassium, but in some orchards to increase the nitrogen. Since the content of

iron, and in the most cases of magnesium, was below optimal, the foliar fertilizers should be applied. In saline and calcareous soils, the application of organic fertilizers could improve nutrient uptake, transport and availability to the plant (Topalović *et al.*, 2020).

Montenegrin producers made more significant progress in secondary production (olive oil production) than in primary production (olive growing) during the last two decades. Therefore, 50% of interviewed farmers start harvesting olives in October (when there are less than 25% of olives turning black) and end harvesting in November (when there are around 50% of olive turning black), while 79% of olive producers harvest by hand or use manual and/or electric shakers (Figure 3 and Figure 4). Finally, contemporary practices are implemented in post-harvesting techniques as well, and all farmers process their olives in 48 hours (the latest) after the harvest.

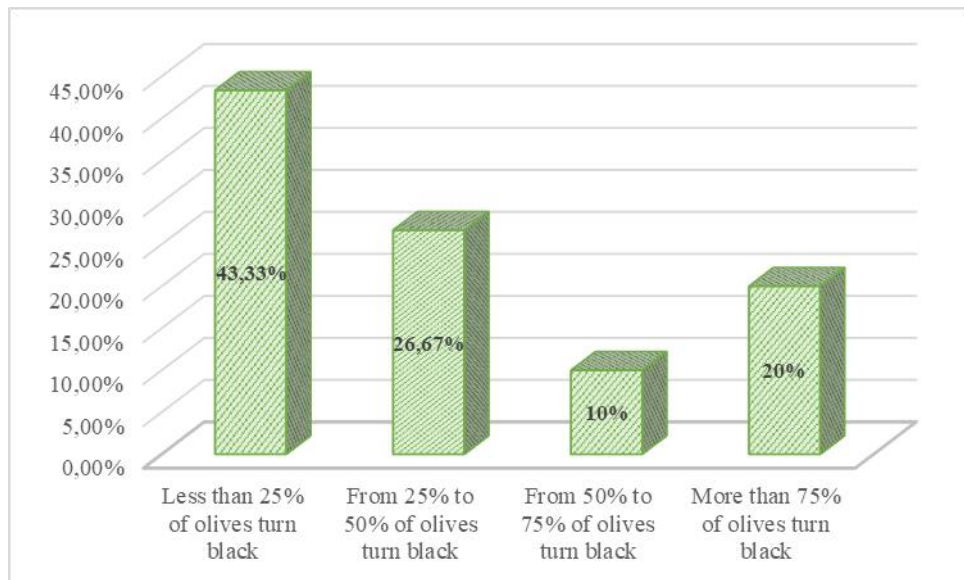


Figure 3: Determination of the beginning of the harvest according to the fruit ripening stage in analyzed olive growing area

The most popular method of olive oil production is mechanical process of cold extraction on 2-phase decanters and is practiced by 73.33% surveyed farmers (Figure 5).

Furthermore, 48.33% producers store their olive oil in tanks made of stainless steel; however, 43.33% farmers still use plastic canisters for these purposes, suggesting improper storage and preservation techniques (Table 1). Except extra-virgin and virgin olive oil, Montenegrin farmers produce table olives, olive paste, olive oil with aromatic plants (such as addition of St. John's Wort) and souvenirs made of olive wood. One of the concerns that was raised during this research regards olive oil sale, since 38.33% out of interviewed farmers practice doorstep selling, within their agricultural holding (Table 2).

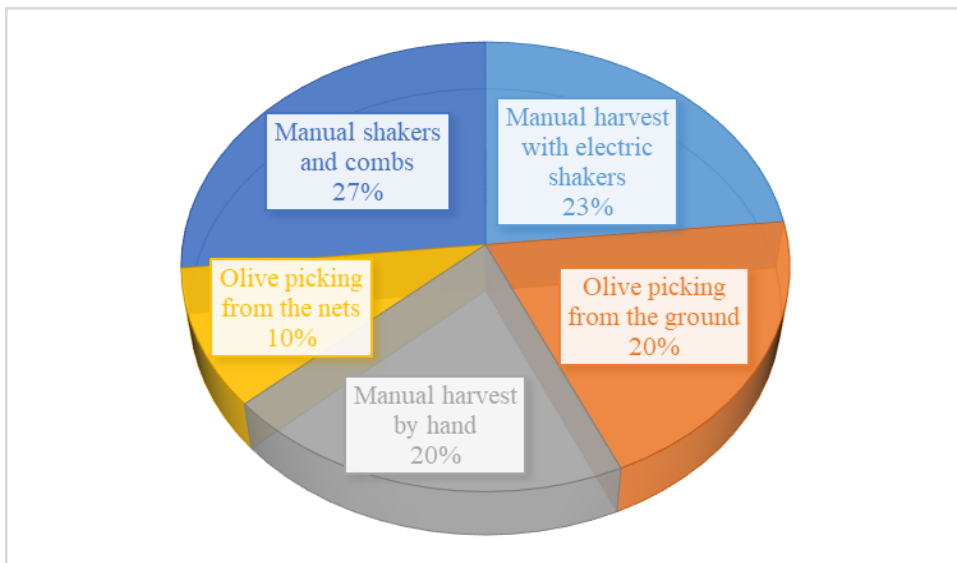


Figure 4: Harvesting techniques in analyzed olive growing area

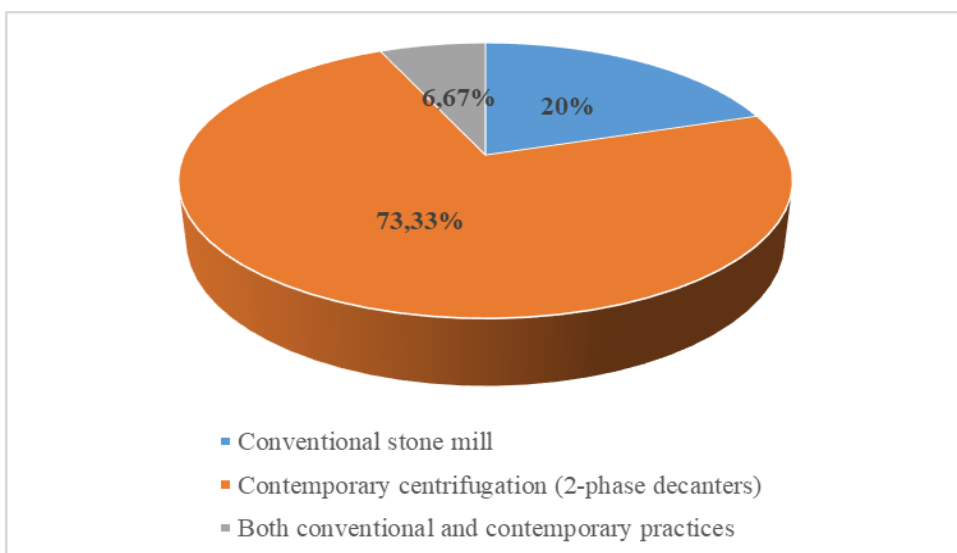


Figure 5: Conventional and contemporary technologies of olive oil production in analyzed olive growing area

Table 1: Olive oil storage and bottling practices

Olive oil storage tanks		Olive oil bottling	
Plastic containers	43.34 %	Plastic bottles	18.33 %
Glass containers	8.33 %	Glass bottles with etiquette	28.33 %
Stainless steel container	48.34 %	Glass bottles without etiquette	43.34 %

Table 2: Olive oil sale channels

<b>Olive oil sale</b>	
Directly on agricultural holding / In olive orchard	38.33 %
Marketplaces and fairs	36.67 %
Supermarkets and HORECA sector	6.67 %
Domestic usage (no sale)	16.33 %

Regarding farmers' satisfaction with advisory services, municipal and ministry support and activities of local growers' associations, this research provided us with interesting results (Table 3). Firstly, 28 out of 60 respondents (47%) is satisfied with advisory services that are on disposal; however, 24 out of 60 respondents (40%) considered that support of ministry and municipality is under average or not satisfactory at all. Non-governmental local growers' associations are bearers of olive growing improvement in Montenegro and 73.3% of farmers are satisfied or very satisfied with their level of activity and contribution to oliviculture development in coastal Montenegro. Also, 38 out of 60 interviewed farmers are members of local growers' association. 30% of interviewed farmers plan to expand their land areas under olive trees, mostly cultivating foreign olive varieties.

Table 3: Level of farmers' satisfaction with institutional support

<b><i>Local and national advisory services</i></b>	
unsatisfactory	16.67 %
average	36.67 %
satisfactory	46.66 %
<b><i>NGOs – Local growers' associations</i></b>	
unsatisfactory	1.67 %
average	25.00 %
satisfactory	13.34 %
very satisfactory	60.00 %
<b><i>Municipality of Bar and Ministry of Agriculture, Forestry and Water management</i></b>	
unsatisfactory	11.67 %
average	28.33 %
satisfactory	1.67 %
very satisfactory	35.00 %

This research examined farmers' needs for further work and progress in olive production as well (Table 4). Therefore, in domain of olive orchard raising, 31 out of 60 respondents or 51.67% need to acquire higher knowledge regarding proper selection of olive assortment and pollinators. In domain of olive orchard cultivation, 25 out of 60 respondents (41.67%) do not have innovative skills in proper pest and disease protection. Also, 25% of farmer needs more training in regenerative pruning of centennial and millennial olive trees. Nevertheless, in domain of olive oil production, 22 producers (36.67%) asked for more intensive



education in order to understand better the technological process of olive processing and olive oil production. Also, 28.33% of farmers emphasized that are willing to attend specialized courses on organoleptic assessment of virgin olive oils. Regarding post-production techniques, farmers expressed the importance of proper olive oil storage throughout the year. One third of the farmers invest in marketing of their olive oil and other olive products, while 23.33% of the farmers stated that olive oil waste management is highly important issue that has to be regulated by law, since Montenegro is pre-candidate country for accession to the European Union.

Table 4: Needs of olive growers' for further growth and development

<b><i>Raising olive orchard</i></b>	
Analysis of soil characteristics in olive orchard	21.67 %
Business plan development for olive cultivation	21.66 %
Proper selection of olive assortment and pollinators	51.67 %
Proper sampling for soil and leaf agrochemical analysis	5 %
<b><i>Maintaining olive orchard</i></b>	
Application of organic fertilizers and manure	6.67 %
Irrigation of olive orchard	6.67 %
Soil tillage and management practices in olive orchard	1.67 %
Organic olive growing	18.33 %
Regenerative pruning of ancient olive trees	25.00 %
Integral pest and disease protection of olive trees	41.67 %
<b><i>Olive oil production</i></b>	
Olive oil packaging	6.67 %
Conventional and contemporary processing techniques	16.67 %
Study visits of olive oil factories abroad	11.67 %
Specialized courses for olive oil quality assessment	28.33 %
Olive oil production technology	36.67 %
<b><i>Mechanization in olive growing</i></b>	
Atomizers and sprinklers in olive growing	18.33 %
Pruning residues crushers	25.00 %
Electric shakers	28.33 %
Motor saws and cutters	28.33 %
<b><i>Equipment and supplies</i></b>	
Olive nets for harvesting	28.33 %
Olive crates from harvesting to milling	40.00 %
Olive oil storage tanks	31.67 %
<b><i>Post-production techniques</i></b>	
Marketing of olive and olive oil	33.33 %
Olive oil branding and registering trademark	23.33 %
Olive waste valorization	43.34 %

## CONCLUSIONS

This research gave an overview of conventional and contemporary agricultural practices in olive growing and olive production of Montenegro. Therefore, olive growing in Montenegro is still closer to extensive than intensive, which is caused by presence of autochthonous assortment prone to alternate bearing; complex relief and terrain configuration, as well as insufficiently developed infrastructure. On the other hand, local farmers significantly improved their skills and knowledge regarding high quality olive oil production.

Also, this research examined farmers' needs for further work and progress in olive production as well. There is an expressed need to acquire higher knowledge regarding proper selection of olive assortment and pollinators and more training in regenerative pruning of centennial and millennial olive trees. Furthermore, farmers asked for more intensive education in order to understand better the technological process of olive processing and olive oil production and emphasized that are willing to attend specialized courses on organoleptic assessment of virgin olive oils.

Given the convenient Mediterranean climate conditions, suitable soils for olive growing, availability of land for further olive expansion, touristic attractiveness that enables placement of olive products, Montenegrin olive growing has yet to be used at its full capacity. Some of the improvements that should be carried out as soon as possible are the establishment of olive growers cadaster, increment of the production of olive seedlings, successful estimation of seasonal pests and diseases attack, expansion of olive growing area, as well as further regeneration of ancient olive trees.

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