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Efficiency Factors in the Olive Oil Sector in Turkey

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Abstract: Turkey ranks among the top five olive oil-producing countries in the world, and the olive crop plays a crucial role in its economy, economically, environmentally, and socially. One of the primary challenges facing the agricultural sector is its profitability. Therefore, the aim of this study is to analyse the olive sector in terms of economic efficiency, to identify productive and organizational variables directly associated with higher economic efficiency. Data were obtained from 193 organizations in the sector. A dual methodology is employed, comprising Data Envelopment Analysis (DEA) and, subsequently, Qualitative Comparative Analysis (QCA). The findings highlight the relevance of variables such as organization size, irrigation usage, focus on olive oil, or cultivation on sloping terrain as factors associated with a higher level of economic efficiency.

Keywords: olive oil; Turkey; economic efficiency; DEA; fsQCA

1. Introduction

The cultivation of olive groves and the production of olive oil represent one of the main drivers of employment and rural development in major producing countries, positioning olive oil as a flagship product of the renowned Mediterranean Diet. The global olive oil market has witnessed remarkable growth in recent years, driven by increased agricultural acreage dedicated to olive cultivation and improved productivity on the supply side, as well as growing consumption in countries where demand for this product was previously limited [1]. With its versatility, olive oil serves not only as an essential component in the diet but has applications ranging from religious uses to skincare and culinary purposes. This phenomenon translates into a continual increase in prices [2]. Eleanor [3] argues that it is crucial for olive oil-producing companies in various countries to secure certification endorsing global best practices. This certification is essential for meeting international standards and enabling cost-effective production, thereby ensuring ongoing competitiveness.

This work is timely, as it addresses the primary issue currently faced by the agricultural sector both within and outside Europe: profitability. Through the uncommon combination of two reliable and rigorous methods, it identifies variables associated with economic efficiency in the olive sector. As such, it fills an academic gap due to the type of study conducted and the variables considered in the analysis.

Turkey plays a crucial role in both the production and cultivation of olive oil, holding a prominent position in global olive oil production. Furthermore, it serves as a significant exporter to the European Union, a role that has been progressively gaining importance [4]. As per the International Olive Council (IOC), the trajectory of olive oil production has witnessed a remarkable increase, surging from 80,000 tons during the 1991/92 season (constituting 5.5% of world production) to an impressive 380,000 tons for the 2022/23 season. This substantial growth elevates Turkey's olive oil production to nearly 14% of the world's total [1].

Culliney [5] highlights a significant issue worthy of exploration to delve deeper into the subject of value creation and comprehend the marketability of olive oil produced in Turkey. The primary concern is to identify the factors contributing to its lack of recognition

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in the global market. Secondly, the fact that only 40% of Turkey's products reach the international market necessitates an investigation into its value-added chains to assess its competitiveness on a global scale. However, the global under-recognition of Turkey as a major player in olive oil production, as stated by Pilak and Ülger [4], implies a lack of attention from previous scholars. Therefore, examining this gap in the literature aims to contribute to existing knowledge, prompting future studies to accord the necessary attention to Turkey as an essential olive oil producer in the international market.

Within this framework, the objective of this study is to scrutinize olive oil entities in relation to economic efficiency, with the purpose of pinpointing organizational variables directly correlated with heightened efficiency. Understanding the economic efficiency of companies operating in this sector provides crucial insights for enhancing their competitiveness and sustainability. Additionally, given the socioeconomic and environmental impact of olive cultivation and olive oil production in Turkey, evaluating their economic efficiency can help identify key factors for developing more profitable practices. Moreover, improving the economic efficiency of the olive oil sector in Turkey can contribute to the country's economic growth and the well-being of local communities dependent on this industry. To achieve this objective, the study employs Data Envelopment Analysis, taking into account classical and pertinent variables linked to the economic performance of the companies under examination. Furthermore, in a subsequent phase of analysis, the QCA technique is applied to the previously acquired efficiency levels.

In accordance with the stated objectives, this paper is structured as follows: after this introduction, the contextual framework is presented, detailing the study propositions; then, the technical characteristics of the research are indicated in the methodology section; the results are then presented; and finally, the corresponding conclusions are presented.

2. Theoretical Framework

2.1. The Turkey Olive Oil Sector

The value chain theory, developed by Michael Porter, provides a conceptual framework for understanding how companies create value through a series of interconnected activities. It is divided into primary activities, directly related to the production and delivery of the product or service, and support activities, which provide the necessary support to carry out primary activities efficiently. This theory emphasizes the importance of identifying activities that add the most value and of minimizing costs at each stage of the process, enabling companies to make strategic decisions to improve their competitiveness and profitability [6]. The essential stakeholders in the olive oil value chain, particularly in Turkey's cultivation and mill stages, are olive farmers, labour, olive and olive oil cooperatives and unions, olive oil mills, brokers (traders), industrial olive oil producers, and supporting industries and organisations. Olive farmers are critical for olive tree planting, growing, and harvesting, with around 320,000 olive farmer families in Turkey using traditional methods. Labour is essential for harvesting, which is labour-intensive, accounting for at least half of production costs. Olive and olive oil cooperatives and unions play an important role in marketing and supporting farmers through agricultural inputs and financial credits. Olive oil mills are small firms that extract olive oil for a fee or in exchange for olive oil, while brokers collect and sell olive oil to industrial producers. Industrial olive oil producers in Turkey can be classified into major producers, minor producers, and boutique producers, with private industrial production accounting for 80–85% of total olive oil production. Supporting industries and organisations include international olive councils, agricultural chambers, commodity exchanges, exporter unions, and research institutes [7].

Labour is an essential component in the olive oil value chain, playing a crucial role in various stages, especially in harvesting. Moreover, labour is necessary for cultivation, which is labour-intensive, accounting for nearly half of its costs. Harvesting olives by hand is considered to produce the highest-quality olive oil, increasing its labour costs. The traditional methods of growing olives in Turkey and the European Union result in labour costs accounting for a significant portion of the production costs, with the family workforce making up 43–57% of those costs and paid labour 10–17%. This aspect highlights the significance of labour in the olive oil value chain and the need for adequate resources to ensure a smooth and efficient process [8].

2.2. Development Factors for the Turkey Olive Sector

In the early 1990s, no considerable structural changes happened within the international olive oil markets [9]. Nonetheless, significant changes in supply and demand are slowly disrupting traditional trends. Regarding the supply side, we have witnessed constant production in most of the biggest producers, mainly because of the new orchards and restructuring of the plantations to be more productive.

The cultivation of olives in Turkey is predominantly carried out by small-scale agriculturists employing age-old, ancestral techniques. This system of cultivation has a rich and storied history in Turkey since immemorial times. Currently, the majority of olive orchards in Turkey are small-scale enterprises owned and managed by indigenous farmers. These farmers commonly rely on time-tested methods inherited from their forebears, which have been perfected through centuries of practice, to guarantee the production of top-notch olives.

Turkey has misunderstood modernity as an excuse to eradicate its agriculture and animal husbandry. The process has been greatly accelerated under the present government, which supported the dominant mind-set in this regard, which has already been in place for years. Generally, the cultivation of olives and the production of olive oil have not been prominent aspects of Turkish culture and tradition if we compare it with Syria before the war, for example. This aspect can be attributed to several factors, including the country's geography, climate conditions, and the availability of other crops and resources, which conditions are unlike those of other Mediterranean countries, such as Greece, Italy, and Spain, where olive trees have been grown and harvested for thousands of years [10].

However, in recent years, the Turkish government has recognised the economic and cultural benefits of olive cultivation and has made efforts to promote the industry. This has led to an increase in olive farming and production in the country, but it still does not have the same cultural significance as in other Mediterranean countries with a long history of olive cultivation. Additionally, the lack of a strong tradition of olive cultivation in Turkey has also led to a lack of emphasis on insurance and risk management for olive farmers [11].

Organizational theories, such as scale or scope, emphasize the importance of organizational size in carrying out operational functions more efficiently [12]. Consequently, various authors argue for a positive relationship between efficiency and company size [13]. Moreover, studies in agricultural sectors have identified organizational size as an explanatory factor for higher profitability [14]. Therefore, size assumes special significance in leveraging environmental opportunities based on profitability and efficiency criteria [15]. These assertions prompt us to formulate the following hypothesis:

Hypothesis 1 (H1). *The size of the organization, measured by the number of olive trees, favours the economic efficiency of the organization.*

Nearly 75% of olive groves in Turkey thrive in sloping areas with shallow soil depth and without irrigation facilities [16]. In addition to making production, harvesting and mechanization tasks more difficult, the main risk of steep slope olive groves is erosion [17]. While these alternative methods are feasible, they tend to be more time consuming and costly than their mechanized counterparts. Therefore, these steep, traditional, non-mechanized olive groves are often the least profitable within olive cultivation typologies [18]. This leads us to the following hypothesis:

Hypothesis 2 (H2). *Hillside olive grove reduces the economic efficiency of the organization.*

The olive tree is considered a drought-resistant shrub, since water is a scarce commodity in the main producing regions. However, the number of irrigated crops is increasing due to the increase in productivity that this characteristic entails [19]. In Turkey, irrigation possibilities are scarce, although its application entails a considerable increase in production [16]. Moreover, Fraga et al. [20] established that the improved productivity in olive oil is attributed to enhanced cultural practices and drip irrigation. However, irrigation can also negatively affect yield when performed erroneously. In this line, Arslan et al. [21] point out that in Turkey it has a high water wastage. In general, despite the malpractices, the following hypothesis can be expected:

Hypothesis 3 (H3). *The irrigated olive grove increases the economic efficiency of the organization.*

Beginning with the Aegean Region, 80% of the olives produced are processed into olive oil, and 20% go for table production. In the Marmara region, wedged between the Mediterranean and the Black Sea, the shares are the other way around: 90% of production goes for table olives and 10% for oil. Moreover, this region accounts for 40% of all table olives produced in Turkey, focusing on cured black olives. In South-eastern Anatolia, where 86% of olive production goes for oil and 14% for table olives, olive growing is concentrated in those parts of Gaziantep, Kilis, Şanlıurfa, Kahramanmaraş and Mardin where the climate is Mediterranean. Between both types of products from olive cultivation, olive oil presents greater market opportunities in terms of added value [22]. Although the efficiency relationships between the two types of products have not been studied in depth, the comparison has been transferred to other concepts, in which greater progress can be seen in oil production, although there is still a long way to go [23]. Along these lines, we propose the following hypothesis:

Hypothesis 4 (H4). *The commitment to the sale of olive oil, instead of table olives, favours the economic efficiency of the organization.*

One important aspect for these farmers is the financial support for harvesting, which the government provides through subsidies and support. However, these supports are not based on the quality of the olives but rather on the farming area and the volume of olive oil produced. This point means that farmers who produce a higher yield of olives are not necessarily rewarded more under the current system. However, a higher yield translates into a higher quantity of oil and therefore into profit for the farmer [24]. However, a higher added value is obtained with a product of higher sensory quality, premium, resulting from an early harvest with lower yield [25]. In any case, because of the olive grove situation in Turkey where further modernization is still expected [21], we hypothesize the following:

Hypothesis 5 (H5). *The percentage of olive oil, yield, obtained in the harvest favours the economic efficiency of the organization.*

3. Materials and Method

3.1. Population

The study focused on olive oil-producing farms in Turkey, utilizing a semi-structured survey to collect data from oil mills located in the provinces of Hatay, Izmir, Kahramanmaraş, Gaziantep, and Kilis. Specifically, organizational managers of these farms were targeted for the survey. The total number of valid responses obtained was 193 organizations. To ensure the reliability of the responses, cross-referencing was carried out using information from alternative sources, and trended questions were carefully examined. The gathered information encompasses various aspects, including organizational structure, processes, production, and economic variables. Data collection was carried out during the second quarter of 2023.

3.2. Methods

The initial phase involves conducting an efficiency analysis, followed by examining the optimal scores obtained in the second phase to identify explanatory factors. In the literature, three different models are highlighted for determining productive efficiency among a set of economic units: Data Envelopment Analysis (DEA), Stochastic Frontier Analysis (SFA), and Deterministic Frontier Analysis (DFA). Among these, the DEA technique has been selected for its validity and reliability in achieving the objectives of this research. Additionally, it is the most prevalent and widely used efficiency analysis technique in the literature [26,27]. DEA is a deterministic nonparametric technique, which aims to measure the efficiency of different homogeneous decision-making units (DMUs). Through the linear programming technique, identical inputs and outputs in a given set of units are compared, to yield an efficiency ranking [28]. Entities that obtain a score of 1 are considered fully efficient, and their graphical representation will be the efficiency frontier [29]. This way of proceeding does not limit the scope of DEA to production but is also used to evaluate and compare different organizational performances based on best practices, in terms of productivity, output and performance [30]. The analysis employed various DEA methods, including the classic CCR and BCC methods. The BCC method, in particular, takes into account the variable returns to scale of the evaluated organizations [31]. On the other hand, an output orientation, for maximization of the result, has been chosen. The mathematical approaches in matrix form of the primal problem are as follows:

$$\begin{aligned} &\text{CCR\_O } max_{\varnothing,\lambda,s^+,s^-} \\ &z_0 = \varnothing + \varepsilon\cdot \vec{1}s^+ + \varepsilon\cdot \vec{1}s^- \\ &\text{subject to: } \varnothing Y_0 - Y\lambda + s^+ = 0 \\ &X\lambda + s^- = X_0 \\ &\lambda, s^+, s^- \geq 0 \end{aligned} \qquad \begin{aligned} &\text{BCC\_O } max_{\varnothing,\lambda,s^+,s^-} \\ &z_0 = \varnothing + \varepsilon\cdot \vec{1}s^+ + \varepsilon\cdot \vec{1}s^- \\ &\text{subject to: } \varnothing Y_0 - Y\lambda + s^+ = 0 \\ &X\lambda + s^- = X_0 \\ &\vec{1}\lambda = 1 \\ &\lambda, s^+, s^- \geq 0 \end{aligned}$$

One of the main drawbacks of the DEA method is its high sensitivity to outliers, as it uses extreme values to determine fully efficient DMUs [32]. To address this issue, we have employed the super-efficiency method, which serves to detect and eliminate outliers [33]. We have set a maximum value of 2 for the super-efficiency index as a reference threshold for removing units with highly dispersed values [34]. In our study, one outlier value which exceeded the thresholds previously established to apply DEA correctly was detected and removed; thus, the entire research is applied to 192 organizations. Table 1 shows the statistical averages of the variables before being used in the DEA method.

Table 1. Details of the variables proposed for the DEA method.

Variable	Inputs				Output
Details	**Labour Costs**	**Supply Costs**	**Depreciation Costs**	**Other Costs**	**Production (Kg)**
Mean	0.8781	0.4408	0.1123	0.3773	3000.00
SD	0.0600	0.1987	0.0925	0.0675	31,105.82
Max	1.0761	1.2448	0.8036	0.5781	260,000.00
Min	0.7748	0.0739	0.0407	0.2143	420.00

Note: details of the 193 organizations analysed. Source: own compilation.

In the DEA literature, it is common to encounter a second phase of study that concludes this technique, aiming to determine the contextual variables surrounding the highest efficiency scores [26]. The use of regression models is typically the most common alternative in these second-stage DEA analyses [31]. However, the difficulty of establishing clear causal relationships, due to the complexity of the studied phenomenon, leads us to use Qualitative Comparative Analysis (QCA) as a reliable and valid approach for determining the factors surrounding the highest economic efficiency scores. This second phase of DEA will enable us to address the study's objective and the assertions made in the theoretical framework.

QCA stands out for its qualitative as well as quantitative nature and is oriented towards determining causality conditions in complex situations, such as those found in social sciences studies [35]. This method is centred on set theory, which, based on Boolean algebra, allows for a more complex analysis than what can be obtained through regression techniques by establishing relationships among subsets of variables [36]. QCA has a higher explanatory power and can be used independently to gain profound insights into the relationships of interest [37]. This is because QCA assumes the existence of asymmetry, equifinality, and causal complexity, which mitigates some of the limitations of multiple regression [38]. It is a highly objective technique for deriving predictive conclusions, applying complexity theory to scientific research [39]. For the proper execution of this technique, the recommended phases in the literature are followed [40]: calibration of variables as needed, both for conditions and outcomes; necessity analysis; and sufficiency analysis. Table 2 provides a detailed display of the variables used in fsQCA.

Table 2. Details of the variables used in QCA.

Outcome	Description	Type of Variable
BCC CCR	Scores derived from the proposed economic efficiency methods are utilized, with one variable obtained through the CCR method and the other through BCC.	Continuous *
Antecedents	**Description**	**Type of variable**
Size	H1. Organization size, measured by the number of olive trees.	Continuous *
Hillside	H2. Hillside olive grove.	Dichotomous **
Irrigation	H3. Irrigated olive grove.	Dichotomous **
Olive oil	H4. Quantity of production destined to olive oil production	Continuous *
Yield	H5. The percentage of olive oil.	Continuous *

Notes: * Continuous variables were calibrated using fsQCA 3.1 software, according to the recommended thresholds. Although the literature recommends avoiding automatic calibration, it is the most appropriate when there are no previous references on the variable [40]. ** Dichotomous variables indicate the presence of the condition with a value of 1 and 0 its absence.

In the first phase of the analysis, the existence of necessary conditions was verified. These conditions are identified when they exceed the consistency threshold of 0.9, established in the literature. Similarly, it is important to note that the fsQCA technique is not symmetric, and it is beneficial to study which combinations (or configurations) of factors result in a low level of reported information, also referred to as trivial conditions [41]. Considering the efficiency indices resulting from the BCC method (with variable returns to scale), no necessary conditions were detected. On the other hand, using the efficiency indices resulting from the CCR method (without variable returns to scale), two necessary conditions were detected, namely: size and fat.

4. Results

As an initial step, the mean values of the variables employed to assess economic efficiency via DEA were computed (see Table 3). The results obtained reveal that only a small number of organizations within the Turkish olive oil sector can be deemed efficient, thus forming what is referred to as the efficiency frontier. Organizations are recognized as efficient when they optimize their outcomes, taking into account their available resources. Any enhancement in production would necessitate a proportional rise in their costs. Similarly, the organizations that fall short of efficiency are significantly distant from this frontier, displaying markedly lower average values, both in BCC and, notably, in CCR. These findings underscore a distinct gap between efficient and inefficient organizations, notwithstanding the prior elimination of outlier organizations with extreme values using the super-efficiency method. As a control measure, after removing the outlier, the dataset was re-examined for the presence of units with outliers using the super-efficiency technique. However, no values met the previously established criteria for exclusion.

Table 3. Results of economic efficiency analysis.

Indicators	Values CCR	Values BCC
Number of efficient DMUs	2	12
Percentage of efficient DMUs	1.04	6.25
Average efficiency	9.76	14.53
Standard deviation	0.17	0.25

Source: own data.

The main findings of this analysis are shown in Table 4, which shows the various combinations that lead to greater communication about the traceability of the company's products. Specifically, four solutions were identified and are presented in order from highest to lowest gross coverage. Using the usual terminology in this type of study, black circles (•) denote the presence of a condition, while crossed-out circles (⊗) indicate its absence. A blank indicates that a condition is irrelevant. The distinction between a central and a peripheral condition is denoted by the use of large and small circles, respectively [42]. The following Table 4 includes the set-theory consistency values for each configuration, as well as the overall model solution [40].

Table 4. Analysis of sufficiency results.

	BCC_o = f (Size, Hillside, Irrigation, Fat, Yield)				**CCR_o = f (Size, Hillside, Irrigation, Fat, Yield)**				
Configurations	1	2	3	4	1	2	3	4	5
Size	●	●		●	●	●		●	⊗
Hillside	⊗	⊗	⊗		⊗	⊗	⊗		⨂
Irrigation		•	•	⊗		•	•	⊗	⨂
Olive oil	●		●	●	●		●	●	⊗
Yield		⊗	•	•		⊗	•	•	⨂
Raw coverage	0.8334	0.5453	0.3171	0.1839	0.8794	0.5630	0.3108	0.1884	0.1429
Unique coverage	0.0785	0.0144	0.0176	0.0343	0.0679	0.0163	0.0179	0.0341	0.0035
Consistency	0.8507	0.8821	0.8822	0.8430	0.9442	0.9579	0.9094	0.9085	0.8111
Model coverage			0.8998			Model coverage		0.9515	
Model consistency			0.8313			Model consistency		0.8993	

Source: own compilation.

The results show the different combinations that lead to higher efficiency, considering the returns to scale (BCC) and without the scale effect (CCR). Table 4 includes the set-theory consistency values for each configuration, as well as the global solution of each model. As can be seen, the global solution in both models is above the recommended threshold of 0.8 [40]. The global model resulting from this analysis reflects a total coverage of 0.8807 and 0.9204, for BCC and CCR, respectively. Thus, in approximately 90% of the analysed olive companies, the higher economic efficiency is associated with different sets of causal configurations.

The core conditions of the first model obtained (BCC) are two: size of the olive grove and dedication to olive oil production. On the other hand, the core conditions of the second model (CCR) are identical, although the following is incorporated: ~irrigation ~hillside*~yield. This configuration has less explanatory power, and after checking these cases, we observe that they are associated with crops oriented to the sale of table olives.

In the BCC model, which is based on pure efficiency by eliminating the scale effect among the organizations analysed, we observe that the first causal configuration exhibits a gross coverage of 0.8334. In simpler terms, it is established that the combination of size, olive oil and the absence of a steeply sloping olive grove yield explains 83.34% of the cases associated with greater economic efficiency. Consistency reveals that 85.07% of the cases exhibit this noteworthy result. The second configuration indicates that 54.53% of the cases linked to greater economic efficiency are attributed to size, non-high slope, and irrigated olive groves with low yields, with a consistency of 88.21%. These cases are oriented to the sale of table olives or premium first-harvest oils.

Focusing on the CCR model, which does not account for the scale effect of organizations, we observe that the results are very similar to those obtained in the previous model, with modifications in the last causal configurations. In general terms, the size of the olive grove is associated with greater economic efficiency, as a key variable together with the orientation to olive oil production. In combination with the previous variables, irrigation is positively associated. Yield has a lower impact on economic efficiency, being not relevant at all when production is focused on the sale of table olives and not olive oil. In a small number of cases and when the scale effect is not considered, different non-irrigated, small size, low slope and table-olive-oriented crops also achieve high economic efficiency.

5. Discussion

This study assesses the economic efficiency of olive oil producer entities to identify the specific production and organizational variables directly linked to increased economic efficiency. Through DEA, the efficiency of olive oil-producing organizations has been calculated, considering the classic models of this technique, which show pure and scale efficiency (CCR and BCC models). Once these indicators were calculated, they were used as outcomes to apply QCA, allowing us to determine which sets of variables are associated with higher efficiency scores.

The economic efficiency of olive entities has been similarly analysed in other countries. Fernández et al. [43] in the Tunisian olive sector and Bernal et al. [44] in the Spanish olive sector analyse economic efficiency, showing higher efficiency averages compared to our results. Although the results should not be directly compared, as the contexts are different, they do allow us to infer that there is a clear performance gap among Tunisian olive organizations. There is ample room for improvement for the majority of the analysed Tunisian olive mills, aiming to achieve performance levels similar to those with better practices. In the Tunisian sector itself, Ozden and Rafaela [45], employing a different model, arrive at similar conclusions, attributing the differences to organizational variables associated with ownership structure.

Our findings indicate that the organization's size and emphasis on olive oil as the main product, rather than table olives, are factors leading to efficiency. The olive oil production process itself, involving a larger quantity of olives, can result in economies of scale and lower unit costs [15], as well as capitalize on higher added value [22]. Moreover, olive oil can be more easily exported to international markets, expanding sales opportunities and potential profits. In this regard, exports have been identified as an explanatory factor for organizational efficiency within this sector [43]. Contrary to the previous factors, slope cultivation reduces the profitability of the olive grove. This latter characteristic is very common in olive cultivation in Turkey [16]. There is no doubt that slope cultivation requires more labour and resources for management and harvesting, thus increasing production costs. Similarly, these conditions hinder mechanization, making them less profitable [15]. Additionally, Lima et al. [17] point out how the slope can increase the risk of soil erosion and nutrient loss, negatively impacting crop yield and quality.

Our results also indicate that organizations with a lesser focus on olive oil production and greater dedication to table olives are efficient. In this scenario, yield is less relevant, but irrigation plays a significant role. Once again, size has a positive impact, while slope has a notably negative effect, as mentioned earlier. One of the main reasons for this is that table olives are typically cultivated with varieties requiring more consistent and abundant irrigation to ensure their desired size, texture, and flavour. In olive oil production, irrigation is shown to enhance efficiency [19]. However, there are also isolated cases, albeit fewer in number, where irrigation is associated with lower efficiency. This aligns with findings by Arslan et al. [21], who suggest that improper irrigation management, leading to water wastage, can also hinder organizational efficiency. In line with Türkekul et al. [46], mechanization and irrigation are two essential variables for profitability and competitiveness in the Turkish olive sector, provided they are managed correctly.

Regarding oil yield in olive oil production, it should be noted that it is closely linked to economic efficiency [24]. A higher yield signifies a greater amount of oil produced per unit of processed olives, thereby reducing production costs and enhancing the sector's profitability [47]. However, lower yield can sometimes result in greater efficiency when it generates higher value in the product. We are referring to first-harvest oils, collected at the beginning of the season. These oils are characterized by their outstanding organoleptic and health properties, which can provide the organization with a competitive advantage due to the quality of its product [25].

In summary, academic literature has assessed the aforementioned factors separately, but not in the manner undertaken in this research, which thus addresses a gap in the literature. Such factors must be considered for proper management leading to the organization's economic efficiency. With the aforementioned considerations, our findings lead us to accept the hypotheses proposed in the theoretical framework.

6. Conclusions

The conclusions that can be drawn from the results described above are clear. The proposed variables are clear indicators for improving the organizational practices of Turkish production entities and, consequently, their efficiency. Thus, the size of the entity (determined by the number of olive trees) and its focus on olive oil production are clear indicators of higher efficiency. Irrigation and low-slope olive groves also contribute to this efficiency, as well as to the yield obtained in olive oil production.

To improve the value chain of Turkey's olive oil production, the research recommends introducing organised companies that would facilitate production, processing, and marketing. Companies can acquire the latest technologies to boost productivity and shorten processing time. Additionally, companies owning or coordinating the farms can win better bargains in the international market. This strategy will assist in transforming Turkey from a price taker to a price maker in the global market of olive oil. Next, access to financial services for the farmers should be increased to facilitate the farm activities of irrigation, pruning, and harvesting. Based on the findings, funding only reached the mills but did not dissipate to the farmers. This led to low-quality fruits, which interfered with the quality of the oil extracted. Moreover, the study recommends the implementation of serious regulations for the pricing and cost of olive oil products in Turkey. The step is significant in helping the country control the production process and costs and eventually determine the right prices for the local and international markets. The hoarding problem has made Turkey's olive oil attractive only domestically.

It is crucial to underscore the primary limitations of this study. Firstly, our research is focused solely on companies within the olive oil sector. However, it is worth noting that this sector holds significant importance both domestically and globally. We believe that the insights gathered from this research can be extrapolated to other sectors within the agri-food industry. Secondly, the scope of our study is confined to a single country, Turkey. While Turkey holds a privileged position in olive oil production, conducting a comparative analysis with other producing countries could offer invaluable insights. Moreover, the Turkish olive oil sector grapples with various challenges, including issues related to profitability, efficiency, and international market competitiveness. A comprehensive understanding of these aspects is crucial for identifying avenues for improvement, fostering sustainability, and driving the country's economic development forward.

This study unfolds a spectrum of avenues for future research endeavours. These encompass a more profound exploration of organizational structure as a catalyst for market targeting through virtual social networks and other information and communication technologies. Additionally, there is a need to ascertain whether the elucidated explanatory model resonates with other agri-food sectors and to investigate the potential enhancement of efficiency results for companies scrutinized in this study through modifications to the identified key factors.

7. Policy Implications

To enhance the efficiency and competitiveness of the Turkish olive sector, it is imperative to undertake comprehensive strategies addressing various aspects of agricultural production and management. One key aspect involves focusing on value addition throughout the supply chain and strategically targeting international markets for olive oil exports, aiming to establish Turkey as a prominent player alongside Spain and Greece. Achieving this goal requires a multifaceted approach that encompasses modernization of agricultural practices, adoption of cutting-edge technologies, and promotion of mechanization to bolster productivity while simultaneously reducing operational costs. Additionally, there should be a concerted effort to diversify olive-derived products, invest in research and development initiatives aimed at elevating production quality and efficiency, and provide farmers with adequate training and education opportunities. These efforts must be underpinned by clear and supportive policies and regulations that prioritize transparency and environmental sustainability across the entire olive sector value chain.

This study helps establish a series of policy implications of particular concern to enhance the economic efficiency of olive farms. The results indicate that policies focused on irrigation are crucial for enhancing the competitiveness of these entities. It is imperative to promote the modernization of irrigation systems and encourage sustainable practices that optimize water use, thereby ensuring an increase in efficiency and productivity in this sector. Furthermore, the need for policies aimed at addressing variability in topography and farm size has been identified. It is essential to implement measures that facilitate the adoption of cultivation techniques adapted to the terrain characteristics and provide support to small-scale producers to improve their access to resources and technology. This would not only increase efficiency in olive and oil production but also promote equity within the sector.

Finally, these policies are essential for promoting economic growth in Turkey's olive sector. Improving efficiency can enhance the competitiveness of the economy as a whole, thereby potentially fostering positive impacts on economic growth and national development. Increased efficiency and productivity also lead to higher income and economic stability for farmers. Consequently, these policies hold the potential to positively transform farmers' livelihoods, contributing significantly to the enhancement of satisfaction and prosperity within the olive farming sector.

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References

1. International Olive Oil Council (IOC). Publications Olivae. Available online: https://observatory.internationaloliveoil.org/apps (accessed on 20 December 2023).
2. George, E.; Marshall, S.; Mayr, H.; Trakman, G.; Tatucu-Babet, O.; Lassemillante, A.; Bramley, A.; Reddy, A.; Forsyth, A. The effect of high-polyphenol extra virgin olive oil on cardiovascular risk factors: A systematic review and meta-analysis. *Crit. Rev. Food Sci. Nutr.* **2018**, *59*, 2772–2795. [CrossRef] [PubMed]

3. Eleanor, B. Producing Traditions: International Standards and Development in Jordanian Olive Oil. Master's Thesis, University of Kentucky, Lexington, KY, USA, 2018.
4. Pilak, C.; Ülger, S. Determination of the Factors Affecting Turkish Olive Producer's Adoption of Good Agricultural Practices in Marmara Region of Turkey. *Kahramanmaraş Sütçü İmam Üniversitesi Tarım ve Doğa Dergisi* **2021**, *24*, 515–521. [CrossRef]
5. Culliney, K. Turkey to Kick Start US Olive Oil Campaign: We Need to Go in With Quality Oils. FoodNavigator USA. 2018. Available online: https://www.foodnavigator-usa.com/Article/2018/11/14/Turkey-to-kickstart-US-olive-oil-campaign-We-need-to-go-in-with-quality-oils (accessed on 25 February 2024).
6. Porter, M.E. The value chain and competitive advantage. In *Understanding Business Processes*; Routledge: London, UK, 2021; pp. 50–66.
7. Ministry of Customs and Trade. Crop Production Statistics. Available online: https://www.trade.gov.tr/statistics (accessed on 20 December 2023).
8. European Commission. Producing 69% of the World's Production, EU is the Largest Producer of Olive Oil. Agriculture and Rural Development. Available online: https://agriculture.ec.europa.eu/news/producing-69-worlds-production-eu-largest-producer-olive-oil-2020-02-04_en#:~:text=and%20Rural%20Development-,Producing%2069%25%20of%20the%20world's%20production,%20the%20EU%20is%20the,largest%20producer%20of%20olive%20oil&text=The%20EU%20has%20in%20place,organising%20and%20performing%20these%20checks (accessed on 20 December 2023).
9. Issaoui, M.; Delgado, A.M. Olive oil properties from technological aspects to dietary and health claims. In *Fruit Oils: Chemistry and Functionality*; Ramadan, M.F., Ed.; Springer: Berlin/Heidelberg, Germany, 2019; pp. 85–129.
10. Kiliç, T.; Turhan, Ş. Competitiveness of Turkey in organic olive and olive oil sector. *ISPEC Int. J. Soc. Sci. Humanit.* **2020**, *4*, 167–182.
11. Demirtaş, B.; Liman, K. The reflection of the support policies applied in olive and olive oil to the producers. In *Economics and Administrative Sciences Modern Analysis and Researches*; Livre de Lyon: Lyon, France, 2023; p. 137.
12. Schneider, G.P. *Comercio Electrónico*; Thomson: Mexico City, Mexico, 2004.
13. Voulgaris, F.; Lemonakis, C. Productivity and efficiency in the agri-food production industry: The case of fisheries in Greece. *Procedia Technol.* **2013**, *8*, 503–507. [CrossRef]
14. Castillo, J.S.; García, M.D.C. Análisis de los factores explicativos de la rentabilidad de las empresas vinícolas de Castilla-La Mancha. *Rev. De La Fac. De Cienc. Agrar. De La Univ. Nac. De Cuyo* **2013**, *45*, 141–154.
15. Zhao, X.; Wang, P.; Pal, R. The effects of agro-food supply chain integration on product quality and financial performance: Evidence from Chinese agro-food processing business. *Int. J. Prod. Econ.* **2021**, *231*, 107832. [CrossRef]
16. Ozturk, M.; Altay, V.; Gönenç, T.M.; Unal, B.T.; Efe, R.; Akçiçek, E.; Bukhari, A. An overview of olive cultivation in Turkey: Botanical features, eco-physiology and phytochemical aspects. *Agronomy* **2021**, *11*, 295. [CrossRef]
17. Lima, F.; Blanco-Sepúlveda, R.; Calle, M.; Andújar, D. Reconstruction of historical soil surfaces and estimation of soil erosion rates with mound measurements and UAV photogrammetry in Mediterranean olive groves. *Geoderma* **2023**, *440*, 116708. [CrossRef]
18. Carmona-Torres, C.; Parra-López, C.; Sayadi, S.; Reina-Usuga, L. Abandonment factors and alternatives in sloping olive growing: The case of Andalusia, Spain. *Land Use Policy* **2023**, *132*, 106836. [CrossRef]
19. Calvo-Polanco, M.; Sánchez-Castro, I.; Cantos, M.; García, J.L.; Azcón, R.; Ruiz-Lozano, J.M.; Beuzon, C.R.; Aroca, R. Effects of different arbuscular mycorrhizal fungal backgrounds and soils on olive plants growth and water relation properties under well-watered and drought conditions. *Plant Cell Environ.* **2016**, *39*, 2498–2514. [CrossRef]
20. Fraga, H.; Moriondo, M.; Leolini, L.; Santos, J.A. Mediterranean olive orchards under climate change: A review of future impacts and adaptation strategies. *Agronomy* **2021**, *11*, 56. [CrossRef]
21. Arslan, F.; Córcoles Tendero, J.I.; Rodríguez Díaz, J.A.; Zema, D.A. Comparison of irrigation management in water user associations of Italy, Spain and Turkey using benchmarking techniques. *Water Resour. Manag.* **2023**, *37*, 55–74. [CrossRef]
22. Balkan, B.A.; Meral, S. Olive oil industry dynamics: The case of Turkey. In Proceedings of the 35th International Conference of the System Dynamics Society and 60th Anniversary of System Dynamics Celebration, Cambridge, MA, USA, 16–20 July 2017; pp. 1–26.
23. Tok, N.; Çobanoğlu, F.; Tunalıoğlu, R. The Link Between Geographic Indication, Sustainability, and Multifunctionality: The Case of Table Olive Groves in Western Turkey. *Erwerbs-Obstbau* **2023**, *65*, 851–859. [CrossRef]
24. Mehdi, R.; Naqvi, S.R.; Khan, A.A.; Mirani, A.A. Optimization of olive oil extraction from olive pomace using solvent extraction and response surface methodology analysis of oil yield. *Fuel* **2023**, *348*, 128633. [CrossRef]
25. Hilton, A. Quality and Genuineness in the World of Sicilian Olive Oil. *Gastron. J. Food Cult.* **2023**, *23*, 38–50. [CrossRef]
26. Kuosmanen, T.; Johnson, A.; Saastamoinen, A. Stochastic nonparametric approach to efficiency analysis: A unified framework. In *Data Envelopment Analysis*; Springer: Boston, MA, USA, 2015; pp. 191–244.
27. Liu, J.S.; Lu, L.Y.Y.; Lu, W.M. Research fronts in data envelopment analysis. *Omega* **2015**, *58*, 33–45. [CrossRef]
28. Zhu, J. DEA Based Benchmarking Models. In *Data Envelopment Analysis*; Springer: Boston, MA, USA, 2015; pp. 291–308.
29. Samoilenko, S. Overview on Data Envelopment Analysis. In *Advances in Research Methods for Information Systems Research*; Springer: Boston, MA, USA, 2014; pp. 139–150.
30. Cook, W.D.; Tone, K.; Zhu, J. Data envelopment analysis: Prior to choosing a model. *Omega* **2014**, *44*, 1–4. [CrossRef]
31. Charnes, A.; Cooper, W.W.; Lewin, A.Y.; Seiford, L.M. (Eds.) *Data Envelopment Analysis: Theory, Methodology, and Applications*; Springer Science & Business Media: Berlin/Heidelberg, Germany, 2013.
32. Banker, R.D.; Chang, H. The super-efficiency procedure for outlier identification, not for ranking efficient units. *Eur. J. Oper. Res.* **2006**, *175*, 1311–1320. [CrossRef]

33. Banker, R.D.; Gifford, J.L. *A Relative Efficiency Model for the Evaluation of Public Health Nurse Productivity*; Mellon y University Mimeo, Carnegie: Pittsburgh, PA, USA, 1988.
34. Martínez, M.; Pérez, W.S. Efficiency analysis of information technology and online social networks management: An integrated DEA-model assessment. *Inf. Manag.* **2014**, *51*, 712–725. [CrossRef]
35. Rihoux, B.; Ragin, C.C. *Configurational Comparative Methods: Qualitative Comparative Analysis (QCA) and Related Techniques*; Sage Publications: Thousand Oaks, CA, USA, 2008.
36. Ragin, C.C. *The Comparative Method: Moving Beyond Qualitative and Quantitative Strategies*; University of California Press: Berkeley, CA, USA, 2014.
37. Gligor, D.; Bozkurt, S. FsQCA versus regression: The context of customer engagement. *J. Retail. Consum. Serv.* **2020**, *52*, 101929. [CrossRef]
38. Ragin, C.C. Set relations in social research: Evaluating their consistency and coverage. *Political Anal.* **2006**, *14*, 291–310. [CrossRef]
39. Kumar, S.; Sahoo, S.; Lim, W.M.; Kraus, S.; Bamel, U. Fuzzy-set qualitative comparative analysis (fsQCA) in business and management research: A contemporary overview. *Technol. Forecast. Soc. Chang.* **2022**, *178*, 121599. [CrossRef]
40. Pappas, I.O.; Woodside, A.G. Fuzzy-set Qualitative Comparative Analysis (fsQCA): Guidelines for research practice in Information Systems and marketing. *Int. J. Inf. Manag.* **2021**, *58*, 102310. [CrossRef]
41. Schneider, C.Q.; Wagemann, C. *Set-Theoretic Methods for the Social Sciences: A Guide to Qualitative Comparative Analysis*; Cambridge University Press: Cambridge, UK, 2012.
42. Fiss, P.C. Building better causal theories: A fuzzy set approach to typologies in organization research. *Acad. Manag. J.* **2011**, *54*, 393–420. [CrossRef]
43. Fernández-Uclés, D.; Elfkih, S.; Mozas-Moral, A.; Bernal-Jurado, E.; Medina-Viruel, M.J.; Abdallah, S.B. Economic efficiency in the tunisian olive oil sector. *Agriculture* **2020**, *10*, 391. [CrossRef]
44. Bernal Jurado, E.; Mozas Moral, A.; Medina Viruel, M.J.; Fernández Uclés, D. Evaluation of corporate websites and their influence on the performance of olive oil companies. *Sustainability* **2018**, *10*, 1274. [CrossRef]
45. Ozden, A.; Rafaela, D.P. Is the olive oil an efficient sector? A meta frontier analysis considering the ownership structure. *New Medit: Mediterr. J. Econ. Agric. Environ.* **2016**, *15*, 2.
46. Türkekul, B.; Günden, C.; Abay, C.; Miran, B. The competitiveness of Turkish olive oil on the world market. *J. Food Agric. Environ.* **2010**, *8*, 68–73.
47. Çolak, A.M.; Çulha, H. The Importance and Position of Manisa Province in Olive Growing of Turkey. *J. Agric. Vet. Sci.* **2020**, *13*, 27–35.

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