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Artigo

Competitiveness of the Brazilian extra virgin olive oil productive chain

Abstract – The olive tree is one of the first cultivated plants and is associated with ancient traditions, customs and eating habits of the Mediterranean basin. Recently, the benefits to nutrition and health have encouraged cultivation in several countries. Brazil is the second largest importer of olive oil and olives, with commercial production less than 1% of consumed volumes. Import substitution suffers from the resistance of technological and organizational innovation challenges in the production chain. The objective of this study was to analyze economic aspects of the emerging Brazilian extra virgin olive oil industry, with emphasis on obtaining information on the productive efficiency of olive groves and mills, indicators of comparative advantages and competitiveness coefficients, in addition to generating metrics on the effects of some policies that distort prices paid and received. The results achieved indicated several useful aspects for business management, important for sector governance and allowed the accumulation of information essential to the development of new knowledge and technologies. The prices observed in the chain links showed that Brazilian olive farming is profitable and competitive, even with high levels of taxation and possible market failures. The low yields of olive groves to date have been compensated by the high prices obtained for extra virgin olive oil at retail, well above the international average. In this sense, as volumes and competition increase, more technological and organizational innovations will be needed to increase productivity and promote sustainability.

Keywords: Brazil, costs, efficiency, olive farming, policy analysis matrix (PAM), profitability.

Competitividade da cadeia produtiva do azeite de oliva extravirgem brasileira

Resumo – A oliveira é uma das primeiras plantas cultivadas e está associada a milenares tradições, costumes e hábitos

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alimentares da bacia do Mediterrâneo. Recentemente, os benefícios à nutrição e à saúde têm incentivado o cultivo em diversos países. O Brasil é o segundo maior importador de azeite e azeitonas, com produção comercial inferior a 1% dos volumes consumidos. A substituição de importações sofre com a resistência dos desafios de inovação tecnológica e organizacional na cadeia produtiva. O objetivo deste estudo foi analisar aspectos econômicos da emergente indústria brasileira de azeite de oliva extravirgem, com ênfase na obtenção de informações sobre a eficiência produtiva de olivais e lagares, indicadores de vantagens comparativas e coeficientes de competitividade, além de gerar métricas sobre os efeitos de algumas políticas que distorcem os preços pagos e recebidos. Os resultados alcançados indicaram diversos aspectos úteis para a gestão empresarial, importantes para a governança do setor, e permitiram o acúmulo de informações essenciais ao desenvolvimento de novos conhecimentos e tecnologias. Os preços observados nos elos da cadeia mostraram que a olivicultura brasileira é lucrativa e competitiva, mesmo com altos níveis de tributação e possíveis falhas de mercado. Os baixos níveis de produção nos olivais têm sido compensados pelos elevados preços obtidos no varejo, acima da média internacional. No entanto, à medida que os volumes e a concorrência aumentam, serão necessárias mais inovações para impulsionar a produtividade e medidas que visem à sustentabilidade.

Palavras-chave: Brasil, custos, eficiência, olivicultura, matriz de análise de política (MAP), rentabilidade.

Introduction

The global olive oil value chain in 2023 was estimated at 14.64 billion dollars and there is a prospect of reaching 18.42 billion in 2027 (Faostat, 2024). This is a progressive trajectory and offers substantial revenue potential for stakeholders. The drivers of this market expansion are raising health awareness among consumers, improving notions of the benefits of nutrition and the varied end-user industries such as food and beverages, cosmetics and pharmaceuticals (Belarmino et al., 2022). This maximization is due to the growth in world consumption, which has increased 160% in the last 20 years. Olive production in 2022 reached 21,449,867.5 t on 10,948,521 ha (yield = 1,96 t/ha). The largest producers were Spain (5.8 million t), Italy (2.9), Greece (2.5), Turkey (1.5), Morocco (1) and Tunisia (0.9). World olive oil production in 2021 was 3,348,153.67 t and the largest producers were Spain (1,492,069 t), Italy (338,631 t) and Greece (293,000 t) (Faostat, 2024).

In 2022, Brazil has already imported 110,027.77 tons of olive oil, an expense of US$559,787,000.00 (average price of US$5,087.69/t), while preserved olives (table) were 122,113.64 t and expenditure of US$128,927,000.00 (average price of US$1,055.79/t), according to Faostat (2024). The sum of the values of imports in 2022 represents US$688,714,000 or R$3.79 billion at the exchange of USD1.00 for R$5.50. Per capita consumption in Brazil is also estimated at 0.52 liters/year, while in Spain it is 11.2 liters/inhabitant (IOC, 2024).

Brazil generated 448.5 t in 2022 in 8,000 ha, according to Ibraoliva (2023) and Rio Grande do Sul (2023), which identified and seeks innovations to overcome agronomic, agro-industrial and organizational challenges. The national product has the advantage of greater freshness and better quality conservation through a shorter supply chain, fundamental for the olive oil (Crizel et al., 2020; Belarmino, 2022; Flos Olei, 2023). The production of olive trees in Brazil is geographically similar to other production centers in the world and is part of the group of nations that recently started the production of olives and olive oils and can become an important producer in the medium and long term (Coutinho & Jorge, 2013). One of the factors that corroborates this potential performance is the growth of the domestic market, since the consumption of olive oil increased 143.33% in seven years. Another pertinent aspect refers to the phytogeographic conditions in Brazil for the cultivation of olive groves, justified by the subtropical climate, potentially favorable to the development of the species, mainly in territories of the Pampa biome and higher areas of the South and Southeast Regions, as they influence the organoleptic characteristics of the product (Filoda et al., 2021).

Systemic competitiveness influences the performance of companies and impacts individual or group performance, changing the price conditions for the supply of a certain product or service to the final consumer (Gasparetto, 2003; Zylbersztajn et al., 2015; Batalha, 2021; Belarmino, 2024). Specifically,

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the analysis of an agro-industrial value chain is carried out by analyzing systemic competitiveness and, therefore, cannot be interpreted only as the simple individual sum of the agents that compose it (Batalha & Silva, 2007). Aspects concerning competitiveness have been applied to the most different products and branches of agribusiness (Pahlavani et al., 2017; Lanfranco et al., 2018).

Thus, considering the innovative potential of such cultivation, the olive oil value chain in Rio Grande do Sul is in development. In this innovative market in Brazilian agribusiness, there is the Policy Analysis Matrix (PAM) as a tool for the analysis of competitiveness in agricultural value chains. Using the PAM, it is possible to identify whether the activity is being encouraged or not by the state government, allowing to verify the impact of direct policies on the production of a certain product. In addition, it allows us to identify the impacts that the activity has on society, as well as verify the effects that government interference and market distortions cause to private profitability (Monke & Pearson, 1989; FAO, 2007; Oliveira et al., 2012).

Given the above, the research carried out aimed to analyze competitiveness and economic efficiency of the value chain of extra virgin olive oil in the State of Rio Grande do Sul in the light of the policy analysis matrix (PAM). To this end, the designations and definitions of olive oils from the International Olive Council (IOC, 2023) were adopted, where extra virgin olive oil (EVOO) "has a free acidity, expressed as oleic acid, of not more than 0.8 grams per 100 grams, and the other characteristics of which correspond to those fixed for this category in the IOC standard". Therefore, it is the purest and most nutrient-rich oil and the healthiest of all conventional vegetable oils (Almeida, 2022).

Literature review

Panorama of olive cultivation

The olive tree (*Olea europea* L) is one of humanity's oldest crops. In Brazil, production is recent and is more specialized in Rio Grande do Sul, where the average annual supply is approximately four times higher than that found in Spain, the largest center for ancient world production (Rio Grande do Sul, 2023). Although it is not possible to define its origin precisely, much of the literature points out that the domestication of the plant began in the Paleolithic and Neolithic period, probably in Mesopotamia (Vieira Neto et al., 2008). Concomitantly, extra virgin olive oil corresponds to oil from olives, fruit of the olive tree, obtained exclusively through mechanical or physical means (Clodoveo et al., 2014). It is noteworthy that the upstream stage of the value chain for extra virgin olive oil includes inputs suppliers, also known as "before the gate". The production of olives refers to the stage "inside the gate", with the downstream stages corresponding to the environment "after the gate". In addition, a number of factors interfere in this productive arrangement, as well as all its flows (Silva, 2013).

Since the 1950s, the area planted with olive trees in the world has grown exponentially, occupying approximately 11 million hectares in 47 countries, located on five continents (Faostat, 2024). However, it appears that the majority are the areas between latitudes 30 ° and 45 ° in the Southern Hemispheres (harvest from April to July) and North (harvest from October to April) (Coutinho & Jorge, 2013). However, 98% of the world's olives are harvested in the Mediterranean region (Faostat, 2024).

In particular, the region of Andalusia is responsible for 70% of this production (Sanz Cañada et al., 2010). Therefore, despite being a rare food in the world, this characteristic is not perceived because the main producers are also the largest consumers of extra virgin olive oil (Luchetti, 2002). In other words, approximately 95% of world production and 89% of consumption are concentrated in the Mediterranean region (Türkekul et al., 2007).

According to the International Oil Council (IOC, 2024), the only intergovernmental organization in the world that compiles information about the production and consumption of olive oil and olives, there are approximately 12,000 olive oil factories in the world and the product is consumed in more than 160 countries. In Brazil, due to climatic aspects, olive growing has been practiced in the South and Southeast regions, even though these are not considered the best for planting cultivars with commercial value (Wrege et al., 2015).

Thus, although there is no official survey on the area cultivated with olive trees in the country, it is estimated that there are 6 thousand hectares planted, with an expected expansion corresponding to 10 thousand hectares by the end of the decade (Saueressig, 2018; Rio Grande do Sul, 2023). Specifically, in Rio Grande do Sul, studies developed by Embrapa Clima Temperado showed positive results with regard to agro climatic factors for production. Thus, the best regions for planting are located in the West and in the Middle South, far from the mountain and coastal regions, where the relative humidity of the air (Coutinho & Jorge, 2013).

In 1947, the State Government published Law No. 59, which included the creation of the Commission for the Study and Promotion of Olive Growing and Industrialization, and proposed tax incentives and the distribution of prizes to producers. Subsequently, in 1948, the Olive Service was created under the Secretariat of Agriculture (Rio Grande do Sul, 2023). Furthermore, the new phase of olive growing in the region intensified in 2005, when a group of producers set up orchards with the assistance of the Secretariat of Agriculture, in Caçapava do Sul (João et al., 2017).

In the same year, Embrapa Clima Temperado approved a research project for the introduction of olive cultivars in Rio Grande do Sul and Santa Catarina, installing observation units. Therefore, from 2010, orchards began to demonstrate positive results, boosting the offer of government incentives and the implementation of new plantings (Rio Grande do Sul, 2019). In 2012 the 1st Official Opening of Olive harvesting was promoted and the Sectorial Chamber of Olive Cultivation was created. According to the Rio Grande do Sul Olive Oil Registry, the area planted in the State corresponded to approximately 3,464.6 hectares in 2017, covering 56 municipalities, with 145 producers engaged in the activity (João et al., 2017).

In 2017, the main varieties grown were *Arbequina, Arbosana, Koroneike, Frantoio* and *Picual*, according to the Secretariat of Agriculture, Livestock and Rural Development of RS (Rio Grande do Sul, 2019). The municipalities with the largest planted area in the state are Canguçu, Encruzilhada do Sul and Pinheiro Machado, with 572.2 ha, 568.5 ha and 383.7 ha of planted area, respectively (Sauressig, 2018).

With regard to the processing of olives, in 2017 eight extraction units were in operation in RS, one in the municipality of Formigueiro, one in Pinheiro Machado, two in Caçapava do Sul, one in Candiota, one in Canguçu, one in the municipality of Cachoeira do Sul and one in Santana do Livramento. Regarding the olive oil brands, in this same year, there were twenty brands produced in the State, given the possibility of the same unit benefiting fruits from other producers. Thus, in 2017, olive oil production in RS corresponded to approximately 57,873 liters (João et al., 2017).

Policy analysis matrix

The policy analysis matrix (PAM) corresponds to a method proposed by Monke & Pearson (1989) that is based on the concept of economic profit, obtained through the subtraction between revenues and costs, both private and social. In this way, it allows analyzing the competitive performance of the value chains through productivity and profitability. The information needed to execute the model consists of production costs – tradable inputs, which correspond to the inputs used in production, and domestic factors (non-tradable), which comprise the factors of production – revenue and profit.

The PAM is "a product of two accounting identities, one defining profitability based on the difference between revenues and costs and the other measuring the effects of divergences (distortion of policies and market failures)" (Rastegaripour et al., 2011). In this way, the difference between observed and expected parameters is verified, that is, they could exist if the divergences were removed.

The matrix data also include values at international level (private prices), which serve as a basis for prices in force in the market (social prices). Thus, one can verify the efficiency in the allocation of resources from the factors of production (Belarmino, 2024). Furthermore, the economic analysis of profitability and competitiveness contributes to the competition rates of products from agro-industrial systems and collaborates with the management of the enterprises that make up the value chain, as it provides inputs for decision making (Belarmino, 2012, 2024; Belarmino et al., 2022). Thus, there is the relevance of the information provided by the matrix to be made available to public policy makers (Pearson et al., 2004).

In Brazil, researchers from the Brazilian Agricultural Research Corporation (Embrapa) in partnership with employees of Fundação Getúlio Vargas (FGV), carried out a study based on the

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model proposed by Monke & Pearson (1989). The method was revised and adapted, constituting a tool that details the model's indicators and its procedures for application in different Brazilian value chains. The authors also aimed, in this study, to interpret the indicators, becoming a kind of test for the application of the model (Oliveira et al., 2012).

However, as the PAM aims to evaluate mainly the agricultural sector, with a fundamental focus on the evaluation of public policies, we note its application in developing countries, which are susceptible to market failures and price distortions caused by macroeconomic factors (Monke & Pearson, 1989). Nevertheless, studies that use the PAM as a methodological basis were carried out in different countries and in different agro-industrial chains focusing on technological transformations (Adesina & Coulibaly, 1998), also extending to the production of olives (Cappelletti et al., 2017). There are also studies on the distribution of gains along the agro-industrial value chains (Anania et al., 2008) and their consequent profitability (De Gennaro et al., 2012).

Under the focus on production costs, García-González & Aparicio (2010), Camposeo & Vivaldi (2011), De Gennaro et al. (2012), Clodoveo et al. (2014) and Roselli et al. (2018) emphasize the influence of olive production factors, as well as their representativeness under the entire olive oil value chain. Nevertheless, investigations about the complexity of the production process of extra virgin olive oil emerge in comparison with other vegetable oils (Laddomada et al., 2013).

The PAM can also be used to account for environmental effects and transaction costs (Vyssides et al., 2004), assisting in the construction of technological trajectories that suit both society and individuals (Kydd et al., 1996). In addition, this tool makes it possible to compare costs and benefits of agricultural policies in different cultures (Pakravan & Kalashami, 2011) and different productive systems (Pahlavani et al., 2017), as well as analyzing aspects related to free trade policies (Nurfadillah et al., 2018) and price policies (Alves et al., 2017; Lanfranco et al., 2018).

Moreover, the PAM is also used to compare management techniques (Soares et al., 2011), efficiency of irrigation methods (Touré et al., 2013) and different technological levels, for example (Ugochukwu & Ezedinma, 2011). Likewise, there are studies that use PAM to compare the competitiveness of value chains between other countries (Souza et al., 2017) and with olive oil in Turkey (Durmus & Dokuzlu, 2019), Tunisia (Naimi & Oueslati, 2016) and Albania (Mane-Kapaj et al., 2010). It was also the method used to evaluate the effects of certain government programs to promote and encourage agricultural production (Alves et al., 2017; Belarmino et al., 2022).

In view of the above, it can be seen that the method used in the research carried out is widely disseminated in the national and international scientific circles, indicating its consolidation. Furthermore, the matrix is applied in several production systems, so that analyzing the competitiveness of the olive oil value chain through the PAM can contribute to the verification of the contribution (favorable or not) of the institutional environment to the promotion of that hybrid governance structure.

Methodological procedures

Analytical instrument

The PAM was used as an analytical tool, since this method provides inputs for the analysis of the competitiveness and economic efficiency of a given production system. This tool demonstrates profitability through the difference between revenues and costs within the analyzed system. In this way, the effects of divergences between private prices (real prices worked) and social prices (prices without State interference), which refer to equity, parity and efficiency, can be known. Therefore, it becomes possible to verify if this chain is being benefited by public policies or if it is being taxed (Monke & Pearson, 1989).

To this end, it includes data on production costs, transportation and revenues and presents three lines of values: the first corresponds to private prices, expressed by the letters A, B, C and D; the second constitutes the values at social prices represented by the letters E, F, G and H, and the third line represents the effects of divergences between private prices and social prices, with the letters corresponding to such values being expressed by I, J, K and L. Table 1 presents the structure of the policy analysis matrix.

Table 1. Accounting and analytical structure of the PAM.

	Revenue	Costs		Profits
		Tradable inputs	Domestic factors	
Private prices	A	B	C	D
Social prices	E	F	G	H
Divergences	I	J	K	L

Source: Monke & Pearson (1989).

According to Monke & Pearson (1989) profit is calculated using the formula $D = A–B–C$ and the result, when positive, indicates that the chain is being competitive at private prices. In turn, social profit (H) is obtained from the subtraction between this set of elements: $H = E–F–G$. The letter I corresponds to the transfer of revenues given by $I = A–E$, which expresses how much they differ between private and social costs. In the same way, there is the transfer of inputs ($J = B–F$), the transfer of factors ($K = C–G$) and the net transfers ($L = D–H$) or ($L = I–J–K$).

In addition to the structure shown in Table 2, the PAM provides indicators related to competitiveness, comparative advantage and subsidies. Such indicators are calculated from operations between the amounts paid and received, obtained in the data collection of the analyzed object. One of the positive factors of the PAM as an analysis tool is the ability to make data verification simple. The differences found between social prices and private prices correspond to policy transfers that affect the price of production (Kydd et al., 1996; Oliveira et al., 2012).

Competitiveness indicators, represented by the Profitability Ratio (PC) and Private Cost Ratio (PCR), for a competitive value chain, need to have a PC value greater than one, since they represent benefits for producers. On the other hand, in order to be competitive in the chain analyzed in this study, the CPR must be less than one unit, as it indicates that domestic factors are receiving a higher than normal return, resulting in gains for the country.

Table 2. Competitiveness and comparative advantage indicators and PAM interpretation.

Coefficient of Performance	Formula	Interpretation	Importance
1. Profit Sharing in Revenue (PPR)			
Private	(D/A)*100	Share of profit in revenue	Rate of return
Social	(H/E)*100	How much of the revenue is profit	Continuity of the chain
2. Share of Added Value in Revenue (PAVR)			
Private	[(A–B)/A]*100	Percentage of value addition	Value created in the chain
Social	[(E–F)/E]*100	Value added	Capacity for innovation
3. Share of Domestic Factors in Added Value (PDFAV)			
Private	[C/(A–B)]*100	Domestic factors' remuneration	Tendency is to reduce
Social	[G/(E–F)]*100	Efficiency gain/loss	Aggregation performance
4. Total Factor Productivity (FTP)			
Private	A/(B + C)	Overall revenue result minus costs	Chain performance measure
Social	E/(F + G)	Growth of productive efficiency	Ability of the chain to grow
5. Nominal Product Protection Coefficient (NPCP)	A/E	Calculates the taxation of chicken meat	Assesses the economic distortions to be corrected
6. Nominal Entry Protection Coefficient (NPCI)	B/F	Evaluates the taxation incident on the inputs used in the chain	Higher taxation reduces the competitiveness of the chain
7. Effective Protection Coefficient (EPC)	(A–B)/(E–F)	General measure of taxation that burdens gains in the chain	The weight of public policies in reducing profits
8. Vulnerability of Policy Chains (VCP)	[(H–D)/H]*100	Measures the increase in profitability by removing taxation	Greater technification generates less vulnerability
9. Profitability Coefficient (PC)	D/H	Estimates the value of all policies in the profitability of the chain	Interventional terms shuttle income from the chain
10. Chain Taxation Level (CTL)	(L/E)*(-1)*100	Total amount of taxation levied on chain transactions	Excessive taxation reduces the supply chain competitiveness

Source: Monke & Pearson (1989), FAO (2007) and Oliveira et al. (2012).

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With regard to protection indicators, in order to be considered a "protected" value chain, that is, regulated by policies with protectionist characteristics; it must present values greater than one unit, both for EPC and NPC. The Effective Protection Coefficient greater than one points out that the chain receives a benefit on the prices of products and inputs needed for production. The Nominal Protection Coefficient greater than one shows that there is a transfer of income from society to the producer.

Regarding the indicator called Cost of Domestic Resources (DRC), a value of less than one means that the production chain analyzed has a comparative advantage, because the domestic factors present values higher than the opportunity cost. Regarding the Subsidy Ratio Producer (SRP) indicator, when it has a value greater than one, the value chain is benefiting from policies, that is, the returns are higher due to the action of the State.

Data collect

According to Oliveira et al. (2012), representative enterprises should be selected to collect data for the PAM, that is, those considered benchmarks in the sector, whose activities, technical, economic and management structures are close to the levels of excellence. With the help of researchers at Embrapa Clima Temperado, it was possible to identify representative enterprises, since they had knowledge about the productive structure of the extra virgin olive oil agroindustry in the State of Rio Grande do Sul. In this manner, two representative enterprises were selected, representing the structure of the value chain of extra virgin olive oil at the state level. However, in order to safeguard the information provided by the organizations, their identities remained confidential. Thus, they are identified as Representative Enterprise A and Representative Enterprise B, whose characterization is restricted to the minimum necessary to understand the research carried out.

Representative Enterprise A has approximately 30 hectares of planted area and is located about 500 km away from the capital of Rio Grande do Sul. The orchard is ten years old and the profitability in the production of olives corresponds to two tons per hectare. With regard to the production capacity of olive oil, the agribusiness can process up to 180 kg of fruit per hour. In turn, Representative Enterprise B, distant about 350 km from Porto Alegre, has an orchard of 230 hectares, however, only 90 hectares are in production, whose olive trees are between eight and ten years old. Its productivity also fluctuates around two tons per hectare, having a productive structure with a processing capacity of 1,500 kg of fruit per hour.

It is evident that, in both enterprises, the irrigation system is used, and orchards are considered traditional, with less than 180 olive trees per hectare (Rio Grande do Sul, 2023). It should be noted that all costs and revenues obtained were calculated per hectare and/or ton of products. In this way, the data are equivalent, regardless of the size of the production structure of each enterprise.

Both representative enterprises have vertical integration structures, that is, they are responsible for most of the stages throughout the production process of extra virgin olive oil. This characteristic is in accordance with the reality of the olive oil producing agroindustry in Rio Grande do Sul. Thus, it was possible to obtain the information needed to build the oil PAM in the four stages addressed by the matrix, namely: production, transportation of production to agribusiness, agribusiness and transportation from agribusiness to the port or wholesale market.

The data necessary for the construction of the PAM were collected in two moments. First in July 2018, through on-site visits to agro-industries, preliminary data on costs, production and revenues were obtained. To complement the information, in November of the same year, visits to agroindustry enterprises were again made. Data collection was supported by researchers from Embrapa Clima Temperado-Pelotas (RS). In addition, electronic contacts and emails were also sent to clarify doubts about the inputs used in the production process.

Construction of the PAM of extra virgin olive oil

For the construction of the PAM, a Microsoft Office Excel 2010 spreadsheet was used, whose data were inserted in a matrix formed by a sequence of interconnected spreadsheets. For each private stage and each social stage there is a specific spreadsheet, where costs and revenues are entered. All costs incurred at each stage in the chain are accounted for, whether they are factors of production or inputs and revenues, all at private and social prices. After selecting the data, two matrices were built, one for each enterprise.

Subsequently, the average of the two matrices was calculated in order to obtain results that could be generalized in a way that is reliable to the reality of the value chain of extra virgin olive oil in the State of Rio Grande do Sul.

Presentation and discussion of results

Production costs of olives and extra virgin olive oil

Table 3 shows the costs incurred for the production of one ton of olives in each of the enterprises analyzed. It is noteworthy that in fixed costs, considering the Selic Rate in force in 2018 to calculate the opportunity cost, a capital return rate of 6.5% per year was determined to measure the capital recovery factor, considering depreciation, the idle rate and the share of assets in one hectare of commercial olive trees.

Table 3. Production costs of olives observed in enterprises A and B in RS, 2017/18 harvest by the PAM method.

Olive production (Stage 1)	Enterprise A (R$/t of olives)	Enterprise B (R$/t of olives)
Fixed costs	**761.51**	**656.61**
Machines and equipment	204.81	51.14
Other manual equipment	10.90	1.71
Civil Works	25.79	51.26
Land cost and olive grove implantation	520.00	552.50
Labor costs	**2,052.77**	**1,970.73**
Permanent work	395.77	919.18
Temporary job	1,180.00	585.55
Administration	477.00	466.00
Intermediate inputs	**1,013.06**	**974.05**
Solid fertilizers	298.23	313.00
Insecticides/ fungicides/herbicides	34.17	41.90
Diesel oil	291.65	228.65
Electricity	375.00	375.00
Other inputs	14.00	15.50
Total production cost	**3,827.35**	**3,601.39**

Regarding the production costs of Stage 1, it is observed that for each ton of product produced, the enterprises had a cost of R$ 3,827.35 and R$ 3,601.39 in A and B, respectively. Although the cost between them is close, there are differences when analyzing specific items, such as machinery/equipment and constructions. For example, in enterprise B, such items have a higher percentage of annual use, which minimizes their fixed costs denoting greater efficiency of allocation of production goods compared to enterprise A. Technological intensification can therefore promote gains in production scale.

According to Fernández-Escobar et al. (2014), to improve the economic and environmental sustainability of an olive plantation, in addition to maximizing productivity and minimizing inputs and production costs, agricultural practices have been improved (Cinelli et al., 2014). Therefore, the cultivation systems and olive extraction techniques have undergone transformations over the decades, causing economic, environmental and social impacts (Cappelletti et al., 2017).

In this sense, the use of suitable fertilizers also stands out, since when it is deficient it can cause damage to plants and decrease production, while its excessive use tends to increase the environmental impact on bodies of water (Vyssides et al., 2004). In view of this, it was identified that the costs referring to fertilizers, insecticides, herbicides and fungicides represent 29.4% and 32.1% of the input costs in enterprise A and B, respectively. It appears that in both enterprises there is care with agricultural practices aiming to maximize productivity, either by the correct investment in domestic factors or by the intensification of intermediate inputs.

This measure or administrative strategy may represent an example of a positive impact of innovation in agribusiness value chains, in the exact measure that they assume a higher volume of spending in relation to expenditures on domestic factors. In other words, it also represents a measure of productivity of these non-tradable factors (especially labor) in the domestic market, because the lower the accounting weight in the total cost, the greater the use of these annual inputs in the generation of the agricultural product under study.

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Therefore, this is a measure of economic efficiency in both cases analyzed.

Regarding the costs incurred with labor, it is identified that they have the largest share among the effective expenses of this productive stage. Such amounts correspond to R$ 2,052.77 at enterprise A, and R$ 1,970.73 at B, equivalent to 53.6%, and 54.7% of total costs, respectively. In this sense, the results corroborate the findings by Clodoveo et al. (2014), who show that the costs of harvesting olives can exceed 50% of production costs. This expenditure on labor in the harvest, pruning and thinning is a frequent reality in fruit production in general.

In addition, García-González & Aparicio (2010) and Camposeo & Vivaldi (2011) assert that four groups of factors influence the composition of olive oil expenses and income in the first productive stage, namely: (i) genetic, which refers to the variety or cultivar of the plant; (ii) environmental, which includes aspects of climate and soil; (iii) agronomic, which relates to the planting, irrigation and fertilization systems, and; (iv) cultivation, which includes the management of the plant. Therefore, such costs justify the quality of the olives in the first stage and, consequently, that of the olive in the third stage.

Thus, in this research, significant costs were identified that refer to labor in harvesting and pruning, in addition to technical advice. Therefore, Fernández-Escobar et al. (2014) point out that depending on the intensity of the olive groves, a higher employment rate may be present. However, in this study, especially in the first stage, the labor used is characterized by seasonality. Furthermore, the enterprises analyzed differ as to the characteristics of the workforce. This distinction is due to the technological level, and consequently, the use of machines and equipment. While in enterprise B there are higher expenses with qualified labor, in enterprise A the predominant work is performed by unskilled labor. Such costs mainly refer to pruning and harvesting activities, which in enterprise B are minimized by the use of equipment.

On the other hand, in enterprise B, permanent work is more usual, given the greater need for qualified labor in relation to unskilled labor. With regard to tradable inputs, it was found that, in both enterprises, the costs are similar. Thus, they have a stake of R$ 1,013.06 in A, and R$ 974.05 in B, representing 26.4% and 27.0% of the total costs of this stage, respectively.

A study carried out by the International Olive Council in 2015 identified the costs of olive production in almost 50 countries that had significant production. The research analyzed different productive systems (traditional, intensive and super intensive) with or without the presence of irrigation. The results obtained conclude that the costs per kilogram of olives in the traditional irrigated system add up to an average of € 2.55/kg of olives, which would correspond to R$ 9.38, considering the average variation suffered by this currency that year (IOC, 2015).

The results obtained demonstrated, based on the average of the enterprises analyzed, a cost of $ 3.71 per kg of olives produced in Rio Grande do Sul. In view of this, the value chain of extra virgin olive oil presents competitive results in the first stage, since the costs are lower than those observed in previous studies (IOC, 2015). It is noteworthy that in Europe, where studies pointed to higher production costs than in Brazil, the production structure is different (Cappelletti et al., 2017). In addition, the market context to which the chain is inserted differs in several aspects.

Thus, it is understood that Brazil is producing a product with quality and that the domestic market, in addition to being vast, is also keen on spices and gourmet products. On the other hand, in Europe, there is a traditional market, whose source of fat in the Europeans' diet is almost exclusively derived from olive oil, which contributes to increased competition in the productive sector (IOC, 2024). With regard to domestic factors, there are also differences in structures between countries, and thus, such comparisons are characterized as inferences. Regarding the production stage of extra virgin olive oil, the costs incurred in the extraction and product filling processes at the two enterprises were identified, the results of which are shown in Table 4.

At the stage of product industrialization, enterprise B has a cost of R$ 15,943.80 more per ton of oil produced than enterprise A. In addition, in all cost categories, enterprise A has lower expense rates than enterprise B. In fixed costs, this difference may be related to the size of the structure of the extractive agro-industry, as in enterprise B the capacity was designed for a greater extraction,

Table 4. Extra virgin olive oil production costs observed in enterprises A and B in RS, 2017/18 harvest, using the PAM method.

Production of oil (stage 3)	Enterprise A (R$/t of oil)	Enterprise B (R$/t of oil)
Fixed costs	**296.60**	**480.45**
Processing machines and equipment	75.27	204.19
Other office equipment and supplies	71.03	18.36
Civil works	145.23	198.13
Vehicles	5.07	59.77
Labor costs	**16,494.99**	**30,010.57**
Permanent work	3,555.00	19,894.17
Temporary job	573.33	1,312.17
Administration	12,366.66	8,804.23
Intermediate inputs	**48,590.71**	**50,835.08**
Packaging and labels	12,201.28	9,815.59
Cleaning and expedient products	28.22	931.22
Diesel oil	26.90	80.70
Electricity	800.00	3,238.09
Internet and telephone	169.31	507.94
Feedstock	32,040.00	32,040.00
Advertising/ commissions/advice	3,325.00	4,221.54
Total production cost	**65,382.30**	**81,326.10**

which leads to a significant index of idleness. In addition, this agribusiness has a laboratory for the analysis of olive oil, as well as a water and effluent treatment plant, which, although it demonstrates fruitful environmental concerns, incurs addition of fixed costs.

Thus, high production costs make extra virgin olive oil more dependent on quality than on price, that is, its competitiveness agenda (Clodoveo et al., 2014). Thus, compared to other vegetable oils, extra virgin olive oil requires more effort and investment for its production, given its agricultural and technological aspects, the complexity of which results in a quality product (Clodoveo, 2013; Jiménez et al., 2013). Therefore, researchers have an energy expenditure in order to improve their organoleptic characteristics (Bakhouche et al., 2012) and quality, such as polyphenols and volatile compounds (Clodoveo et al., 2014).

In Spain, the prices paid to the olive producer were excessively low in the last harvests, making even the payment of production costs more difficult (IOC, 2013). An unbalanced distribution of market power between the stages of the olive oil value chain and its effects on the formation and transmission of prices led to this situation. In this value chain, the initial cultivation and crushing activities are fragmented, in such a way that market power is centered on the bottling industry and retail, which in turn become increasingly more concentrated and multinational (Clodoveo et al., 2014).

This structural arrangement and governance of the value chain leads to formation and price transmission unfavorable to the producer, which leads to the low price paid for the product (De Gennaro et al., 2012). Another reason that can explain this phenomenon refers to the asymmetry of information, considering the abundance and relevance of the attributes of credibility (Akerlof, 1970). Therefore, there is a need to establish labeling standards so that producers are able to adapt to the demands and new expectations of consumers (Clodoveo et al., 2014). Consequently, there will possibly be the promotion of political and social economy objectives, as well as the maximization of exports (Menapace et al., 2011).

In this sense, the two main olive oil companies in Italy, Unaprol and Codiretti, have asked the International Olive Council to create a new category of extra virgin olive oil. Among the characteristics of this new product is a lower acidity level of extra virgin olive oil, from 0.8% to 0.5%, which would improve the quality of the oil and minimize the possibility of fraud (IOC, 2019).

Under this approach, in the United States, current standards do not apply to the sale of extra virgin olive oils, which allow a variety of products to be sold in this category. Therefore, it is possible to adulterate and mislabel these products, which in turn tends to harm the competitiveness of high quality producers (USITC, 2013). In the value chain under analysis, the beneficiation stage has the highest costs, as well as the highest profits. Consequently, this stage can acquire greater market power, and, consequently, greater negotiation power with previous stages, including production. However, as the Rio Grande do Sul value chain for extra virgin olive oil is characterized by the fact that the industries that benefit are generally also producers, this risk is minimized.

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In addition, in this third stage, labor costs also differ, judging by the different structures between the enterprises. Therefore, the professionals who work in enterprise B have higher qualifications and, consequently, higher salaries, especially with regard to treatment plants and laboratories. As far as intermediate inputs are concerned, they have the highest production stage costs, being responsible for R$ 48,590.71 and R$ 50,835.08 per ton of oil in A and B, corresponding to 74.3% and 62.5% total costs, respectively.

The PAM of the value chain of extra virgin olive oil

With the objective of presenting the reality of the value chain of extra virgin olive oil in the state, a spreadsheet was built from the averages of the results obtained in the two selected Representative Enterprises. In this way, the PAM constituted of the averages represents the value chain of extra virgin olive oil in RS. Therefore, Table 5 presents the results of the policy analysis matrix for that value chain.

As evidenced, the private profit obtained from ($D = A – B – C$) corresponds to R$ 88,036.91 per ton of extra virgin olive oil. This indicator includes values considered at private prices, that is, prices worked in the local market. With regard to social prices, in the second line of the table, the results generated through the equation ($H = E – F – G$) reveal profits of R$ 101,071.56 per ton of oil at social prices. Thus, it is identified that the State's intervention through policies is interfering in the chain's profits, causing the producer to stop earning R$ 13,034.65 per ton of oil sold. It is a fact that value chains are expected to be beneficial to the government and society, contributing in the form of taxes and social charges. However, the balance between public policies that encourage an expanding chain and its contribution must be assessed by public entities.

Revenues from olive oil production are satisfactory, as they cover expenses incurred in the production process and earn profits. Regarding the price paid for extra virgin olive oil, Jiménez et al. (2013) point out that in countries where the product is traditional, that is, produced and marketed, there is a price limit which the consumer is willing to pay for the quality and benefits of the product, even if it represents a higher disbursement compared to other vegetable oils. The difference evidenced between private and social costs corresponds to the effects of divergences that are expressed in the third line of Table 5. It seems that domestic factors are responsible for most of these divergences, corresponding to R$ 11,872.48 per ton of the product. The revenues obtained at social prices would be higher than those resulting from private prices by R$ 37.13 per ton, revealing that the revenues would achieve better results in a scenario without State intervention.

It was also found that the costs of tradable inputs at social prices would also be lower, with a difference of R$ 1,125.04 per ton of commercialized olive oil. Concomitantly, Souza & Révillion (2013) evaluated the profitability and the direct and indirect effects of taxes on rice production in Brazil, comparing it with the other Mercosur countries. The findings obtained showed that rice production in Argentina and Uruguay showed positive private and social profitability. They also found that in Brazil the total average tax burden represented about 15% of the cost of rice production, having an unfavorable impact on the competitive performance of this chain in relation to the countries studied. According to the findings obtained in this study, the extra virgin olive oil chain also has similar rates.

Table 5. Private and social profitability of the value chain of extra virgin olive oil in Rio Grande do Sul, in reais (R$) per ton of extra virgin olive oil.

	Revenues	Costs		Profit
		Tradable inputs	Domestic factors	
Private prices	A 165,171.86	B 50,712.37	C 26,382.58	D 88,036.91
Social prices	E 165,208.99	F 49,627.33	G 14,510.11	H 101,071.56
Divergencies	I (37.13)	J 1,125.04	K 11,872.48	L (13,034.65)

In order to demonstrate the results of each stage, Table 6 presents the extended PAM of the value chain of extra virgin olive oil in Rio Grande do Sul. In this way, it is possible to see how the chain costs are distributed at both private and social prices.

As evidenced, the value chain of extra virgin olive oil in Rio Grande do Sul shows a positive private result in its four stages, however these profits could be greater if there was no State intervention. The differences found amount to R$ 13,034.65 per ton of extra virgin olive oil produced and sold. In this way, the chain stops receiving this amount because it is exposed to the action of the State, operating under its aegis. It is also evident that this divergence corresponds to the value transferred from the chain to society, through taxes and distortions. The largest share of this transfer is in the third stage, whose value corresponds to R$ 12,058.59 per ton of oil, with domestic factors responsible for 92.5% of this transfer.

It can be seen that labor costs in the third stage are those that have the highest tax burden (social charges) in the value chain, which can be justified because it is a stage that requires qualified professionals. However, in the first stage this value is reduced due to the fact that a large part of the labor in the production of olives is temporary and informal. Still in the first stage, it appears that producers are no longer receiving R$ 920.66 per ton of olive produced, the result of a taxation through the State in the proportion of 22.8% and 77.1% for intermediate inputs and factors of production, respectively. Although the costs with qualified labor are lower in this stage, most of the transfer from the chain to society takes place through taxes on labor.

PAM indicators of the value chain of extra virgin olive oil in RS

In addition to the results already demonstrated, the PAM also provides indicators that describe the competitiveness, protection, comparative advantage and subsidy rate to the producer in the analyzed chain, whose values are presented in Table 7.

The PAM indicators show that the value chain is competitive, since the Profitability Coefficient, which indicates the difference between private and social prices was 0.87. This finding demonstrates that even if the chain has competitive rates, private profit is being reduced by 13% due to the penalties and lack of protection from the State. Still in terms of competitiveness, the Private Cost Ratio index was 0.23, indicating that the value chain has a rate of return that exceeds production costs, even considering depreciation and opportunity

Table 6. Extended PAM of the value chain of extra virgin olive oil in Rio Grande do Sul.

Chain stages	Costs (R$/t)			
	Revenues	Tradable inputs	Domestic Factors	Results
Stage 1- Production of Olives	4,000.00	993.56	2,720.81	285.63
Stage 2- Transport I	5.00	2.60	1.16	1.24
Stage 3- Agribusiness	161,083.60	49,712.90	23,641.29	87,729.41
Stage 4- Transport II	83.26	43.31	19.32	20.62
Private Prices	**165,171.86**	**50,752.37**	**26,382.58**	**88,036.91**
Stage 1- Production of Olives	4,000.00	783.64	2,010.07	1,206.29
Stage 2- Transport I	14.00	2.54	0.78	10.68
Stage 3- Agribusiness	161,083.60	48,809.32	12,486.27	99,788.00
Stage 4- Transport II	111.39	31.82	12.98	66.58
Social Prices	**165,208.99**	**49,627.33**	**14,510.11**	**101,071.56**
Stage 1- Production of Olives	0.00	210.00	710.74	(920.66)
Stage 2- Transport I	(9.00)	(0.06)	0.38	(9.44)
Stage 3- Agribusiness	0.00	903.60	11,155.02	(12,058.59)
Stage 4- Transport II	(28.13)	11.50	6.34	(45.96)
Divergencies	**(37.13)**	**1,125.04**	**11,872.48**	**(13,034.65)**

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Table 7. PAM indicators for the extra virgin olive oil value chain in RS.

Indicators		Formula*	Index
Competitiveness	Profitability Coefficient (PC)	PC = (D/H)	0.87
	Private Cost Ratio (PCR)	PCR = [C/(A–B)]	0.23
Protection	Nominal Protection Coefficient (NPC)	NPC = (A/E)	0.99
	Effective Protection Coefficient (EPC)	EPC= [(A–B)/(E–F)]	0.99
Comparative advantage	Domestic Resource Cost (DRC)	DRC = [G/(E–F)]	0.13
Subsidy	Subsidy Ratio Producer (SRP)	SRP = (L/E)	(0.08)

cost. Thus, the PCR expressed greater economic efficiency in the chain, since domestic factors are being properly used by the system.

As for the comparative advantage indicator, it is observed that the Cost of Domestic Resources denoted the efficiency in the use of domestic resources. The DRC was 0.13, confirming that resources are being allocated satisfactorily in this activity, that is, only R$ 0.13 of domestic resources is used for each R$ 1.00 generated by exports or saved by substitution imports. Regarding the producer subsidy indicator, the research findings reveal that in addition to not having protection, the chain is being penalized through taxes. The SRP was -0.08, which means that the producer is being penalized by 8%.

It is evident that, although encouraged in the early years, olive oil production today lacks other interventions. Thus, in view of the chain's contribution to society (social versus private results), it can be inferred that the State could support this segment, creating mechanisms to strengthen production, making the country less dependent on product imports, or self-sufficient. In addition, because it is a systemic arrangement, agents are directly or indirectly influenced by economic, institutional and cultural factors, which in turn interfere with the system's competitiveness (Coutinho & Ferraz, 2002). It was found that, although the environment in which olive oil is being introduced is not the traditional one, that is, historically, the Brazilian consumer is not widely familiar with the product and, in general, only in the last few years, has included the product in its consumption habits (Ertel, 2015), the return of the activities of this productive chain is favorable in the domestic market, as can be observed in this study.

This can be verified by the indexes of transferring resources from this productive arrangement to society, where the contribution is evidenced through the transfer of values corresponding to taxation and efficiency in the use of domestic resources in the country. In this context, it also indicates the bias increasing legitimacy of extra virgin olive oil in the Brazilian institutional environment, since this element involves economic, political and sociological orientations (Chanlat, 1989).

The use of domestic factors may justify the fact that olive production costs in RS are lower than those observed internationally. This difference can be up to three times smaller when comparing the production costs shown in worldwide studies carried out by IOC (2015), depending on the country, technological level and cultivars produced. Thus, similar to what occurs in other agro-industrial productive chains in Brazil, such as rice, for example, factors such as productivity development, technologies and exchange rates interfere in the profitability of their production (Souza & Révillion, 2013), and, consequently, in the competitive performance of the system. Therefore, promoting investment in technologies, research / development and training of labor tends to maximize productivity and benefit the socioeconomic performance of production arrangements.

Consequently, in addition to the possibility of becoming self-sufficient in the production of extra virgin olive oil, one of the alternatives for the recognition of the Rio Grande do Sul product on a global level corresponds to the enterprise of high quality standards. This could be an initial step to make the product's origin as a competitive differential, similar to the Origin Denominations or Geographical Denominations. This strategy is interesting, above all, considering the recurring controversies about fraud and non-conformities in different brands of olive oil. This reality also includes imported products, which from October 2016 to February 2017 accounted for the import of 650 thousand liters of unrefined oil, known as "*lampante*" or lamp oil (Brasil, 2017).

Finally, it seems that the value chain of extra virgin olive oil in Rio Grande do Sul is competitive, makes efficient use of domestic resources and is promoting positive economic returns to society. In this way, producers are failing to receive greater profits due to distorting policies. Although the production of olive oil and olives is not a traditional crop in the state and the country, it appears that such activity has the potential to consolidate in the medium and long term. It is also noteworthy that, according to the results obtained so far in RS, due to the maximization of the number of producers and extraction industries, Brazil may move towards a lesser dependence on international oils, or even become self-sufficient in a few decades.

Final considerations

In order to identify the levels of competitiveness and efficiency in the value chain of extra virgin olive oil in RS, the Policy Analysis Matrix-PAM was used in two representative enterprises. The obtained data showed that the Brazilian productive chain is competitive and efficient, it was also verified that the profits obtained at private prices are being reduced by the action of the State, since the profits at social prices are higher. Regarding the production costs of olives and extra virgin olive oil, it was found that both enterprises have similar costs and that their financial returns are satisfactory.

In the costs of producing olives, labor contributes the largest share of total expenses. Thus, although there is a predominance of temporary workers, who do not incur charges and taxes, they represent significant values. In this study, considering all costs and expenses inherent to the primary stage, it was identified that, on average, olive producers have a cost of R$ 3,714.37 per ton produced, with variation according to the productive structure and technological intensification of the olive groves.

It was also possible to identify that the production of olives in the State of RS has a lower cost when compared to other countries, as evidenced in a study by the International Olive Council. In this way, the efficiency and competitiveness of this value chain that has transferred resources to society is shown. With regard to the stage of industrialization of olive oil, it accounts for the highest costs in the chain, as well as holds the highest revenues.

Thus, the contribution of the third stage corresponds to 92.51% of the entire chain transfer. It can also be seen that costs and revenues may vary according to the production and management efficiency of the enterprises. It is evident that the highest costs of this stage are related to intermediate inputs, and of these, the largest financial participation occurs in the costs of raw materials and packaging. The average cost for the production and sale of a ton of extra virgin olive oil in Rio Grande do Sul corresponds to R$ 73,399, considering transportation costs.

As a contribution, the results of the research carried out can assist in managerial aspects of the chain agents, as well as negotiations between the stages that compose it, that is, they tend to contribute to improve the governance of this productive structure. Therefore, the findings obtained can be useful to encourage or direct the formulation of management strategies, as well as guide the decision-making processes of the sector's enterprises and their stakeholders. Thus, this study can also be used as an instrument for lobbying the governments (state and federal). The findings presented here can serve as a support in future discussions between the State and those interested in the development of the chain, including IBRAOLIVA itself, which aims to strengthen olive-growing activities. Furthermore, public policies can be developed that will contribute to the consolidation of activity in the country.

The research carried out also presented limitations with regard to the application of the PAM, given that the failure to assess the internationalization of the ton of extra virgin olive oil to compare it to the national price may have influenced the results obtained in the protection indexes. In this way, only the recipes at private prices in stages 1 and 2 were used. It is suggested that, in future studies, the price of internationalization of the extra virgin olive oil product be determined with the same quality as that produced in the country, in order to allow comparisons.

For further studies it is also recommended to compare the competitiveness of the value chain of different types of olive oil (virgin, extra virgin and refined) in RS and others States or in Mercosul members, in order to identify whether there is a significant difference in production costs and other indicators provided by the PAM. In addition, the comparison of the productive chain in the state of Rio Grande do Sul with that of the main producing regions in Portugal, Spain and Italy (major world producers) can assist in the identification of specific strategies that can be incorporated into the reality of the State.

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