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The policy analysis matrix with profit-efficient data: evaluating the profitability of lemon cultivation in Turkey

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ABSTRACT: In this study, the policy analysis matrix (PAM) and data envelopment analysis (DEA) approaches were used to assess lemon producers' productivity in Mersin, Turkey, as well as the international competitiveness of lemon cultivation within the scope of its production plan. According to the findings, most enterprises are inefficient, and the profitability of lemons improved from 2863.5 USD ha^{-1} to 6606.0 USD ha^{-1} with special prices within the framework of profit-maximising production plans. Regarding social prices, an increment from 3500.8 USD ha^{-1} to 8071.5 USD ha^{-1} was proposed to create a more sustainable production plan. To retain competitiveness in the Turkish lemon trade, it has been established that enterprises should transition to a more efficient production structure. For this reason, it has been concluded that inefficiencies in using inputs should be eliminated, and the dissemination of technology and advanced applications will make producers more competitive.
Key words: Lemon, data envelopment analysis, efficient production plans, competitiveness.

A matriz de análise de políticas com dados de eficiência de lucro: avaliando a lucratividade do cultivo de limão na Turquia

RESUMO: Neste estudo, as abordagens da matriz de análise de políticas (PAM) e da análise envoltória de dados (DEA) foram usadas para avaliar a produtividade dos produtores de limão em Mersin, Turquia, bem como a competitividade internacional do cultivo de limão no âmbito de seu plano de produção. De acordo com os resultados, a maioria das empresas é ineficiente e a lucratividade dos limões melhorou de 2863,5 USD ha^{-1} para 6606,0 USD ha^{-1} com preços especiais no âmbito dos planos de produção para maximizar o lucro. Com relação aos preços sociais, foi proposto um incremento de 3.500,8 USD ha^{-1} para 8.071,5 USD ha^{-1} para criar um plano de produção mais sustentável. Para manter a competitividade no comércio de limão turco, foi estabelecido que as empresas devem fazer a transição para uma estrutura de produção mais eficiente. Por isso, concluiu-se que as ineficiências no uso de insumos devem ser eliminadas, e a disseminação de tecnologia e aplicações avançadas tornará os produtores mais competitivos.
Palavras-chave: Lemon, análise envoltória de dados, planos de produção eficientes, competitividade.

INTRODUCTION

Among citrus fruits, lemon shows a different demand in terms of consumption. The most important feature that distinguishes lemon from other citrus fruits is that it can be consumed with other foods. It is a kind of citrus sought and consumed all year round (KADANALI et al., 2010). 20.04 million tons of lemons are produced globally on 1.22 million hectares. However, when statistics on lemon production are evaluated, countries are ignorant of how many lemons and limes they produce. Limes are primarily grown in semitropical and tropical regions where lemons are not grown. Lemons are grown ecologically in warm and humid places in summers and warm in winters (TUZCU, 1999). India, Mexico, and Brazil are located in the semitropical and tropical climate zone, and almost all of their production consists of lime species. Turkey ranks 6th in the world in terms of production area and quantity. In addition, it ranks 5th in the world with 242.7 million USD in lemon exports (FAOSTAT, 2021).

1.2 million tons of lemons are produced on 46 thousand hectares of land in Turkey. The average yield is 25.32 t/ha. Mersin province ranks first in Turkey's lemon production area and quantity, with 44.51% and 52.68%, respectively (TURKSTAT, 2021). Lemon cultivation in the region is one of the most important sources of income. However, as in many products, producers face risks and uncertainties in lemon production. Small-scale enterprises usually carry out lemon production due to land constraints. Due to the inability of the producers to act in an organized manner, it is often not possible to increase

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their competitiveness in marketing. In addition to the problems experienced by lemon enterprises, a pandemic has swept the world. In the Covid 19 pandemic, lemon emerges as an important problem that may negatively affect the success of enterprises. This study, carried out during the Covid-19 pandemic, examined lemon production's profitability and competitiveness with policy analysis matrix (PAM) and data envelopment analysis (DEA) methods.

The PAM approach essentially measures the effects of agricultural price policies implemented by governments on producer incomes. It also measured the effects of policy makers-controlled policies on detecting transfers between consumers and producers and the distribution of government budgets (PEARSON et al., 2003).

Efficiency studies decide whether the inputs are used at the desired stage. In order to ensure more efficient production, minimize costs and increase profits, measures can be taken by determining the cause of inefficiency based on the findings of efficiency analysis.

This study assessed lemon production's profitability and competitiveness in Mersin during the Covid-19 pandemic. Private and social profitability are examined by combining two methods; PAM and DEA.

PAM and efficiency studies have been carried out on many different products. In some studies on citrus fruits; PELLOKILA et al. (2004) examined the citrus production in 3 different regions with the PAM and determined that the production was profitable with private and social prices. GUNEY (2014) examined the net policy implications and the system's orange production competitiveness in the Çukurova Region. The PAM was created for the region using the 2009-2010 production period data obtained by questionary. As for efficiency coefficients, domestic resource cost coefficients, nominal protection coefficients, effective protection coefficients, and private cost coefficients were determined. According to the results, private profitability is negative in orange production and the sustainability of production regarding social profitability. In addition, it was concluded that Turkish orange production is competitive within the framework of productivity coefficients BUDAK et al. (2015). In this study, the effects of production and export incentives in the Turkish citrus sector were examined in terms of global competitiveness. The data were obtained by a questionnaire from 201 exporter companies in the 2014-2015 production period. The PAM revealed Comparative Advantages Index for lemon, orange, tangerine, and grapefruit created Turkey. As a result of the findings, increasing the production incentives lemons by 50% increasing competition, while increasing the export incentives by 10% increase competitiveness. ROMDHON et al. (2018) measured the comparative advantage of growing Siamese oranges with data from 84 producers using the PAM approach. The results showed that the cultivation of siamese orange has a high comparative advantage, with a domestic resource cost ratio (DRC) of less than one. It was stated that this advantage is sustainable through developing workforce skills, modern technology, and the efficient use of local resources.

Studies on agricultural policies and market failures have been carried out with the PAM approach in other agricultural products. These studies were mainly carried out on field crops and partially on vegetable and fruit products. Such as; rice (SOUZA, A.R.L et al., 2017; FATAH et al., 2017; SULE et al., 2019), cotton (GURER et al., 2017; ELSAMIE et al., 2020), wheat (MACIC, 2015), maize (HARYANTO et al., 2018) tomatoes (AKHTAR, 2016). The primary efficiency studies in citrus fruits are made by (MARTINEZ et al. 2004; PICAZO-TADEO et al., 2006; MADAU, 2012).

A limited number of studies have evaluated agricultural systems' private and social profitability by combining the PAM and the data envelopment analysis method. These studies, examined mainly rice, corn and soybean farming (PICAZO-TADEO et al., 2007; REIG-MARTINEZ et al., 2008; AKRAMOV et al., 2012; MANTAU et al., 2018). No literature reported lemon's private and social profitability by combining PAM and DEA methods.

The primary purpose of this study is to evaluate the private and social profitability of the lemon growing system in terms of both observed and profit maximization production plans during the Covid-19 pandemic in Mersin province, where the most critical lemon production and export region of Turkey.

MATERIALS AND METHODS

Primary data obtained from 95 producers by the questionary method in Erdemli, Tarsus, and Silifke districts, which provide 89.72% of lemon production in Mersin, constituted the primary material of the study. Data belongs to the 2020-2021 production period. The sampling criteria were the size of the land reserved for lemon processing, the sampling error margin of 10%, and the confidence level of 90%. The sample size was determined by using the formula below;

$$n = \frac{N * s^2 * t^2}{(N-1) * d^2 + s^2 + t^2}$$

In addition, studies, statistics, and reports on the subject were used.

Table 1 presents a sample description of the data. There is one output and six inputs in the dataset. The quantity of lemons produced is measured in kilograms. Fixed input is the amount of cultivated land in hectares. Labor, fertilizers, agrochemicals, irrigation, maintenance, and harvest are variable inputs. Maintenance and harvest are included in the PAM table under labor.

In this study, PAM was used to evaluate the effects and competitiveness of agricultural policies in lemon production. The PAM is an analysis method developed by MONKE & PEARSON (1989) and used to evaluate the effects of policies. Using the PAM method, the effect of market prices deteriorating due to interventions in agricultural input and product markets can be revealed. In addition, the effects of interventions on the competitiveness and resource use efficiency of different production systems can be discussed. The PAM allows the measurement of transfers caused by policies (BAHADIR, 2006; ABAY et al., 2017).

In this context, private and social prices define the revenue value, marketable inputs, and domestic resources. To estimate the net effects of agricultural policies on lemon cultivation, the domestic resource ratio, nominal protection coefficient, effective protection coefficient, private cost coefficients, and producer subsidy ratio were determined. These ratios identified significant market distortions, income transfers, comparative advantages, and sector sensitivities (MONKE & PEARSON, 1989; FAO, 1991; REIG-MARTINEZ et al., 2008; AKRAMOV et al., 2012; OZALP et al., 2020). Two types of profitability calculations are made under the PAM method. These are private profits and social profits. Custom refers to observed revenues and costs that reflect current market prices. Private profits thus indicate the competitiveness of the production system, output, and policy at the current input prices of the produced product. In short, it is the current income received by the producers. Special Profits are obtained by subtracting the value of return calculated at market prices (A) from the tradable inputs (B) and national resources (C) calculated from special prices and are indicated by the letter "D" in the PAM table. If private profits are negative (D<0), the operators earn a below-normal return and they must exit the system at least until they reach breakeven (D=0), and a situation where profits increase is achieved. Positive special profits (D>0) are an indicator of abnormal incomes, and this level are reached in the future stages of the system (PEARSON et al., 2003). Table 2 shows a simplified PAM.

• Output Transfers (I) = A-E: Transfers formed by the difference between domestic prices and border prices. It allows the measurement of differences in incomes. (1)

• Input Transfers (J) = B-F: Transfers formed by the difference between domestic prices and border prices. Calculates differences in tradable inputs. (2)

• Factor Transfers (K) = C-G: Transfers consisting of shadow price differences with current prices. It shows the differences in national sources. (3)

• Net Policy Transfers (L) = D-H (Social Profits-Private Profits) or (I-J-K): Indicates the net effect of government interventions (FAO, 1991). (4)

The PAM enables the creation of several ratios that can be used to determine if a farming system

Table 1 - Sample Description.

		----------Quantities----------		
Variables	Description	Units	Mean	Standard deviation
Output	Lemon	Kg ha^{-1}	34.150	12073.1
Fixed input	Cultivated land	Hectares	2.87	4,05
Variable inputs	Labor	USD ha^{-1}	1355.4	81.1
	Fertilizers	USD ha^{-1}	799.0	80.1
	Agro Chemicals	USD ha^{-1}	629.0	69.6
	Irrigation	USD ha^{-1}	104.0	10.0
	Maintenance	USD ha^{-1}	324.0	37.6
	Harvest	USD ha^{-1}	277.0	81.5

Table 2 - Policy Analysis Matrix.

	Input Costs			
	Total Revenue	Tradable Inputs	Domestic Resources	Profit
Private Prices	A	B	C	D
Social Prices	E	F	G	H
Transfers	I	J	K	L

has a comparative advantage in the international market. In this study, the following five formulae were calculated:

The private cost ratio is the DRC measured at special prices and shows the profitability of production at special prices. PCR < 1 means the activity generates positive private returns (GUBA, 2000).

Private Cost Ratio: PCR = (C/A-B) (5)

The Nominal Protection Coefficient (NPC) is obtained by dividing the output value calculated by private prices by the output value calculated by social prices. NPC >1 indicates that the state protects the producers. If the ratio is less than 1, the product's price is lower than the world prices.

NPC = A / E (6)

This is the ratio of the cost of domestic factors valued at special prices to the value-added estimated at special prices. It will be competitive if the quotient is less than or equal to one.

DRC = (G / E -F) (7)

The Effective Protection Coefficient (EPC) examines the degree of policy transfers. Measured added value compared with social and private prices. EPC less than 1 means that government policies have negative protection on producers.

EPC = (A-B) / (E-F) (8)

The subsidy ratio to producers (SRP) expresses the net policy transfer to producers as a percentage of total social income. The producer subsidy ratio compares how all policies subsidize the specific crop-producing system. A positive SRP suggested a general transfer from society to the producer, whereas a negative value shows a general transfer from the producer to society and taxpayers.

SRP = (D – H / E) (9)

In the input-oriented model approach, target outputs can be achieved with minimum input usage. Therefore, there is a savings-oriented approach to resource use (FARE & GROSSKOPF, 1994; COELLI et al., 2006).

The social price is the price that emerges in the absence of market-breaking behaviors and government involvement. Shadow prices for income and cost items were determined in this situation. In calculating shadow prices, world prices without government intervention were used. FOB prices were used to calculate social gains (PEARSON et al., 2003). In calculating labor social prices, in a study conducted by the World Bank for rural areas in Turkey, a rate of 0.60 was used to calculate social wages (MASHAYEKI, 1980). Calculating the social price of fertilizer, the subsidy per hectare given by the state was added to private prices. The government has no price-distorting effect on the market for agrochemicals.

For this reason, no special price-social price discrimination was made for pesticides, and both prices were considered equal. In determining the social price of capital, T.C. Ziraat Bank's (the bank which funds agricultural credits in Turkey) nominal interest rates (19%) were used, and half of this rate (9.5%) was multiplied by variable costs. Administrative cost item has been accepted as 3% of total production expenses (ACIL, 1974). A 10% social discount rate was used instead of the 5% bare land value interest used to calculate the facility cost for Turkey (EC, 2010). The social cost of the facility cost was calculated by taking into account the difference between the facility cost interest of 5%, calculated with private prices, and 10%, the facility cost interest calculated with social prices. Export refund aids were provided to subsidize periodic price increases, and decreases were added to social prices.

Data Envelopment Analysis (DEA) is a calculation method that maximizes short-run profit for certain input and output prices. CHARLES et al. (1978) developed DEA techniques; REIG-MARTINEZ & TADEO (2004) emphasized their utility in studying farming systems. Essentially, these techniques evaluate peer unit performance by generating a data surface that allows the observed behavior of a decision-making unit to be compared to best-observed practices.

In the study, DEA was used to calculate efficiency plans. Calculating the productive plan that maximizes short-run profit for farm k' necessitates

comparing its actual observed output and input data to those exhibiting best-observed practices, i.e., profit-efficient farms. The following program formalizes the profit-maximising combination of variable inputs and output of farm k':

$$Profit(r,\ p,\ x_f^k) = Max \qquad (ry^{k\prime} \sum_{v=1}^{6} p_v\, x_v^{k\prime}) \tag{10}$$

$$x_v^{k\prime}, y^{k\prime}, z^{k\prime}$$

Subjet to;

$$y^{k\prime} \leq \sum_{k=1}^{95} z^k\ y^k \qquad (i)$$

$$x_f^{k\prime} = \sum_{k=1}^{95} z^k\, x_f^k\ f = 1 \qquad (ii)$$

$$x_v^{k\prime} \geq \sum_{k=1}^{95} z^k\ x_v^k\ v = 1, \ldots.,6 \qquad (iii)$$

$$z^k \geq 0 \qquad k = 1, \ldots\ldots 95 \qquad (iv)$$

$$\sum_{k=1}^{95} z^k = 1 \qquad (v)$$

y^k, x^k_f and x^k_v k are the observations of output and both fixed and variable inputs of farm k, respectively. However, r and p_v are output and variable input prices, and z^k indicates the weight of each farm k in the technological frontier's composition, respectively. Variable returns to scale are determined in the last stage (REIG-MARTINEZ et al., 2008).

RESULTS AND DISCUSSION

The primary approach of PAM estimates production costs and income per hectare in terms of private and social prices so that private and social profits can be reported. Due to economic costs and any policy, the current market prices are called special prices. Profits were determined over special prices by calculating the gross domestic product values per hectare. Input elements for calculating costs using special prices are divided into tradable inputs and domestic resources (Table 3).

The social price is the price that happens when there are no market distortions or government interventions. The shadow prices of income and cost elements were estimated in this context. While calculating shadow prices, world prices without government intervention were used. FOB prices were used to calculate the social gains (PEARSON et al., 2003). Table 4 shows the cost budget with social prices. The income and cost estimates based on private and social prices were transferred to PAM to evaluate various policy effects on lemon production. The PAM, which consists of farm data and determined assumptions, shows input and output values regarding social and private prices. Furthermore, the PAM was

Table 3 - Cost budget in terms of private prices for lemon production.

Items	USD ha^{-1}
1. Tradable Inputs	1428.9
1.1. Fertilizer	799.3
1.2 Agrochemical	629.6
2. Domestic Resources	5611.1
2.1. Labor Force	1355.4
Fertilization	199.5
Irrigation	238.9
Disinfection	157.7
Maintenance	482.4
Harvest	276.9
2.2. Interest of Capital (Variable Costs x 0,095)	473.9
2.3. Water expenses	100.4
2.4. Administrative Costs (Production Costs. x 0,03)	149.6
2.5. Rental of Machinery	310.6
2.6. Rental of Land	2389.5
2.7. Facility Cost	238.9
2.8. Taxes	594.2
3. Total Production Expenses	7040.0
4. Total Revenue (34150 tonnes x 0,29 USD/kg)	9903.5
5. Net Profit	2863.5

Table 4 - Cost budget in terms of social prices for lemon production.

Items	USD ha^{-1}
1. Tradable Inputs	1433.7
1.1. Fertilizer	804.1
1.2 Agrochemical	629.6
2. Domestic Resources	5016.0
2.1. Labor Force	813.2
Fertilisation	119.7
Irrigation	143.3
Disinfection	94.6
Maintenance	289.4
Harvest	166.1
2.2. Interest of Capital (Variable Costs x 0,095)	423.5
2.3. Water expenses	100.4
2.4. Administrative Costs (Production Costs. x 0,03)	133.7
2.5. Rental of Machinery	310.6
2.6. Rental of Land	2389.5
2.7. Facility Cost	250.9
2.8. Taxes	594.2
3. Total Production Expenses	6449.7
4. Total Revenue (34150 tonnes x ,0,31 USD/kg)	10586.5
5. Net Profit	4136.8

used to calculate transfer costs for lemon production. The effects of lemon production's government input and output transfer in Mersin province were calculated as 637.3 USD per hectare (Table 5). As a result, the cost of the government's agricultural policy was imposed on the community.

Using the PAM data, coefficients for efficiency were calculated and examined. The nominal coefficient of protection (NPC) is a technical coefficient that occurs when farm prices are below world prices, and government subsidies are not very high (FAO, 1991; ESMAEİLİ, 2008; REIG-MARTINEZ et al., 2008; BUDAK et al., 2015), and is calculated as 0.96 for lemon production. The Effective Protection Coefficient (EPC) calculated as 0.95 shows that lemon producers are indirectly taxed. The domestic resource cost ratio (DRC) was determined as 0.54. It demonstrates that Turkey has a competitive advantage in lemon cultivation and that this agricultural activity is a sustainable social advantage. The Private Cost Ratio (PCR) shows how profitable the production is at special prices. The PCR

Table 5 - Policy analyses matrix for lemon production in Mersin Province (USD ha^{-1}).

	Total Revenue	---------Tradable Inputs--------			----------Domestic Resources----------								Total Exp.		Profit
		Fertilizer	Agro Chemicals	∑	Labor	Interest of capital	Water expenses	Administ. Costs	Rental Machinery	Rental of Land	Facility Cost	Taxes	∑		
Private Prices	A	----------B----------					----------C----------						---------B+C-------		D
	9903.5	799.3	629.6	1428.9	1355.4	473.9	100.4	149.6	310.6	2389.5	238.9	594.2	6851.1	7040.0	2863.5
Social Prices	E	----------F----------					----------G----------						---------F+G-------		H
	10586.5	804.1	629.6	1433.7	813.2	423.5	100.4	133.7	310.6	2389.5	250.9	594.2	5652.0	7085.7	3500.8
Transfers	I	----------J----------					----------K----------						--------J+K--------		L
	-683.0	-4.8	0,00	-4.8	542.2	50.4	0,00	15.9	0,00	0,00	-12.0	0,00	1199.1	-45.7	-637.3

for lemon production is calculated as 0.54, which gives the cost and added value of domestic factors at private prices. Due to PCR < 1, lemon production has a competitive structure. BUDAK et al. (2015) calculated NPC, EPC, and DRC for lemon as 0.79, 0.76, and 0.54, respectively. Compared to the results obtained in this study conducted in the same region before the Covid-19 pandemic, domestic lemon production costs increased, and competitiveness decreased somewhat in the 2020/21 production period. The positive value of the SRP indicates the overall transfer from the community to the producer, while the resulting negative value of the SRP (-0.037) indicates the overall transfer from the producer to the community and taxpayers.

The average technical efficiency value with variable returns to scale was 66.2% in the examined enterprises. It is possible to realize the same production if the amount of input used by the enterprises is reduced by 33.8% on average. So, it is clear that reducing the inputs used in production will provide businesses with time, labor, and financial savings. In addition, the scale efficiency score in enterprises was calculated as 81% (Table 6). Efficiency scores under CRS and VRS obtained in the study were calculated as 0.530 and 0.662. Compared with the results obtained in a study conducted in Turkey before the Covid-19 pandemic, efficiency scores for 2015 and 2016 were calculated as 1.00 under the assumption of output-oriented CRS and VRS (MENTEN, 2018).

The observed average formed under the profit-maximising lemon production plan is given in table 7. The profit-maximising production plan revealed 9.1% less on labor, 8.4% on fertilization, 12.1% on spraying, 5.0% on irrigation, 12.9% on maintenance, and 7.2% on harvest to an observed average lemon producer. The plan shows that it produces about 35% more output. In addition to the ineffectiveness of the practices in the lemon growing system, yield differences in lemon varieties also affect the amount of output. The results of the DEA analysis for the lemon show that achieving profit efficiency involves significantly reducing the use of maintenance, agrochemicals, labor and fertilizers.

Using DEA to calculate profit-maximising production plans allows us to establish virtual representative producers of lemons labelled as efficient. This farm earns more income than the typically observed farm because yields per hectare increase by over 35%. Profits are higher for efficient farmers. Because they manage their inputs more efficiently, they have lower per-unit production costs and higher profits than the average observed farmer in the sample. The primary savings come from a 12.9% decrease in labor expenses for mostly labor-intensive maintenance operations. The share of foreign labor is higher than family labor in lemon production in the region. Some practices in lemon cultivation require skilled labor. In this case, the inadequacy of the family workforce in these transactions leads businesses to use foreign workforce. In profit-maximising efficient farms, revenue increases and reduced costs result in lemon farmers' much stronger financial situation.

The private and social profitability of lemon farming calculated under profit-efficient productive plans that maximize profits is shown in table 8. Traditional PAM analysis shows that the observed average and profit-efficient farms are profitable with private and social prices.

It is seen that the profitability of lemons increased from 2863.5 USD ha^{-1} to 6606.0 USD

Table 6 - Efficiency Scores.

Efficiency Scores	CRS	VRS	SE
1,00	2	15	3
0,90-0,99	4	7	25
0,80-0,89	2	6	18
0,70-0,79	8	8	30
0,60-0,69	14	11	17
0,51-0,59	19	24	1
<=0,50	46	24	1
----------Summary Statistics----------			
Mean	0.530	0.662	0.810
Minimum	0.100	0.100	0.467
Maximum	1.000	1.000	1.000

Table 7 - Observed average and production plans for lemon.

Variable	Units	Average	Profit-maximising	Variations (%)
Output	Kg/ha^{-1}	34150	52620	35.11
Inputs				
Labor	USD ha^{-1}	1355.0	1242.0	-9.1
Fertilizers	USD ha^{-1}	799.0	737.0	-8.4
Agro-Chemical	USD ha^{-1}	629.0	561.0	-12.1
Irrigation	USD ha^{-1}	104.0	99.0	-5.0
Maintenance	USD ha^{-1}	324.0	287.0	-12.9
Harvest/logistic	USD ha^{-1}	277.0	257.0	-7.2

ha^{-1} with private prices under profit-maximising production plans. In terms of social prices, it is increased from 3500.8 USD ha^{-1} to 8071.5 USD ha^{-1}, revealing a more profitable production plan. Private and social prices and profits increased at similar rates of 130.69% and 130.56%, respectively. In comparison, with the decrease in tradable inputs by 10.03% with private and social prices, the decrease in agrochemicals was realized as 12.10%. Domestic resources cost decreased by 19.88% with private prices and 12.56% with social prices. Total expenses decreased by 3.77% with private prices and 12.05% with social prices.

CONCLUSION

The lemons produced in the region have a significant domestic and foreign trade advantage. It is crucial to determine the impact of policy tools to increase producer welfare and make businesses more effective in a product with a significant advantage. The study targeted to determine the profitability and competitiveness of lemon cultivation. Therefore, profitability and competitiveness are revealed by combining a policy analysis matrix and efficiency analyses based on data envelopment analysis. The results showed that lemon cultivation is profitable in both observed and profit-maximising production plans. The findings obtained are valid for both alternative profit functions. Traditional PAM results showed that the lemon cultivation system is viable under the observed production plan. However, PAM results under profit-efficient productive plans indicate that current profitability can be further increased in private and social prices. According to the findings, profit-seeking farmers create considerably more production per hectare.

Despite the profitability of lemon production, there are inefficiencies in using inputs compared to a profit-maximising farm. Since it has a production system based on the workforce's intensive use, its inefficiency can be explained by labor productivity. The prominent position of the region in the world lemon foreign trade and the demand for the products in foreign markets increase profitability in both cases.

Technology and advanced applications should become widespread to maintain profitability in the region where the small-scale enterprise

Table 8 - PAM under profit-efficient productive plans.

	Total Revenue	--------Tradable Inputs-------			----------Domestic Resources----------								Total Exp.	Profit
		Fertilizer	Agro Chemicals	∑	Labor	Interest of capital	Water expenses	Administrative Costs	Rental Machinery	Rental of Land	Facility Cost	Taxes	∑	
Private Prices	A	----------B----------			----------C----------								--------B+C------	D
	13380.6	732.1	553.4	1285.5	1232.0	473.9	100.4	149.6	310.6	2389.5	238.9	594.2	5489.1	6774.6	6606.0
Social Prices	E	----------F----------			----------G----------								--------F+G------	H
	14303.4	736.5	553.4	1289.9	739.2	423.5	100.4	133.7	310.6	2389.5	250.9	594.2	4942.0	6231.9	8071.5
Transfers	I	----------J----------			----------K----------								--------J+K-------	L
	-922.8	-4.4	0,00	-4.4	492.8	50.4	0,00	15.9	0,00	0,00	-12.0	0,00	547.1	542.7	-1465.5

structure is dominant. At the same time, enterprises need to become more efficient and productive for the region, Turkey's most crucial lemon export centre, to increase its competitiveness in world markets.

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DECLARATION OF CONFLICT OF INTEREST

The authors declare no conflict of interest. The founding sponsors had no role in the study's design, in the collection, analyses, or interpretation of data, in the writing of the manuscript, and in the decision to publish the results.

AUTHORS' CONTRIBUTIONS

Author critically revised the manuscript and approved of the final version.

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