Economic analysis of enterprises fishing Pearl Mullet (*Alburnus tarichi* Guldenstaedtii, 1814) in Lake Van

Análisis económico de la pesca de salmonete perla (*Alburnus tarichi* Guldenstaedtii, 1814) en el lago Van

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ABSTRACT

This study aimed to conduct an economic analysis of enterprises involved in Pearl Mullet fishing in Lake Van. The primary data source for this study was information gathered from 72 fishing enterprises actively engaged in Pearl Mullet fishing in Lake Van. Besides the economic analysis of these enterprises, the factors influencing sales income were estimated using multiple linear regression analysis. It was observed that fuel and oil expenses were the highest, followed by labor expenses and net expenses among the cost components within these enterprises. According to the regression analysis, fuel and oil costs, labor costs, net costs, and other costs were statistically significant ($P<0.05$). Consequently, the establishment of a fish market in the study area, the implementation of measures to facilitate the use of SCT–free diesel oil, the construction of suitable boatyards for boat maintenance and repair, and the formation of a robust organization are believed to have a positive impact on the sales revenues and profitability of these enterprises.

Key words: Profitability; cost; regression analysis; fisheries; lake Van

RESUMEN

Este estudio tuvo como objetivo realizar un análisis económico de las empresas involucradas en la pesca del pez salmonete perla en el Lago Van. La fuente principal de datos para este estudio fue la información recopilada de 72 empresas pesqueras que participan activamente en la pesca del pez salmonete perla en el lago Van. Además del análisis económico de estas empresas, estimamos los factores que influyen en los ingresos por ventas mediante un análisis de regresión lineal múltiple. Se observó que los gastos de combustible y lubricantes fueron los más altos, seguidos por los gastos laborales y los gastos de redes de pesca, entre los componentes de costos dentro de estas empresas. Según el análisis de regresión, los costos de combustible y lubricantes, costos laborales, costos netos y otros costos fueron estadísticamente significativos ($P<0,05$). En consecuencia, se cree que el establecimiento de un mercado de pescado en el área de estudio, la implementación de medidas para facilitar el uso de gasóleo libre de SCT, la construcción de astilleros adecuados para el mantenimiento y reparación de embarcaciones y la formación de una organización sólida han tenido un impacto positivo en los ingresos por ventas y la rentabilidad de estas empresas.

Palabras clave: Rentabilidad; costo; análisis de regresión; pesca; lago Van

INTRODUCTION

In the World, the aquaculture sector has become one of the most developed sectors due to the increasing population and the demand for animal products [1, 2]. This sector plays a significant role in promoting human health, nutrition, and employment in various countries. In Turkey, the aquaculture sector has also witnessed rapid and effective development, contributing to human health and nutrition [2, 3].

Turkey, surrounded by seas on three sides, holds a strategic position in aquaculture due to its abundant rivers, dams, lakes, and ponds [4, 5]. Among these water resources, Lake Van stands out as Turkey's largest lake, covering an area of 3712 km², with an average depth of 171 m and a maximum depth of 451 m (FIG. 1). Lake Van is a lake surrounded by the provinces of Van and Bitlis. This lake is renowned as the world's largest alkaline lake – it's a saline soda lake–, offering a pH level of 9.7–9.9 and a salinity of approximately 0.22%. Pearl Mullet (*Alburnus tarichi*) is the only species that can live in Lake Van; it has this unusual water feature, is economically important and is fished [6, 7]. Pearl Mullet is recognized as an endemic species with a declining population trend [8].

In Lake Van, the Pearl Mullet fishing season spans nine months, with a fishing prohibition from April 15th to July 15th, coinciding with the fish's breeding period. During this timeframe, Pearl Mullet migrate to the freshwater rivers that flow into Lake Van. These migrations occur when the water temperature in the rivers reaches 13°C, and when an ion balance between the lake and the river is established. The broodstocks, responsible for egg–laying, return to the lake during this process [6]. This reverse migration, against the river's current, also creates a visually stunning spectacle.

In Turkey, the total quantity of aquaculture products harvested from inland waters in 2022 amounted to 33,256 tonnes, with a Pearl Mullet catch totaling 9,991 tonnes [9]. Based on these statistics, Pearl Mullet fishing accounted for 30% of the total catch from inland waters in Turkey. In this respect, Pearl Mullet fishing is an important source of livelihood for people living in rural areas on the shores of lakes, and it has touristic and ecological importance because of the visual feasting it creates during its migration to fresh water, which is necessary for breeding biology in Pearl Mullet. With these characteristics, Pearl Mullet has serious economic potential in the Lake Van basin.

The social and economic aspects are of equal importance alongside the conservation and development of Pearl Mullet stock. The Mediterranean General Fisheries Commission has emphasized the significance of socioeconomic data for effective fisheries management policies [10]. In the aquaculture sector, enterprises must consistently monitor their annual production costs to optimize benefits while minimizing expenses through the utilization of production factors [11]. Previous research has examined the socioeconomic and technical aspects of Pearl Mullet fishing in Lake Van [12, 7]. This study represents the first comprehensive analysis of the economic aspects, including cost and profitability, of enterprises engaged in Pearl Mullet fishing in Lake Van.

The primary objective of this study was to conduct an in–depth economic analysis, including cost and profitability assessment of the enterprises involved in Pearl Mullet fishing in Lake Van. Additionally, the study aimed to determining the problems related to the sector, to solve these problems and to present recommendations regarding economic policy measures that can be taken in the development of this branch of production.

FIGURE 1. Map of the study area

MATERIAL AND METHODS

The primary dataset for this study comprises information from a total of 72 fishing enterprises. Among these, 11 are located in Bitlis, while 61 are in Van. These enterprises hold Fisheries License Certificates issued by the Provincial Directorates of Agriculture and Forestry in Bitlis and Van and are actively engaged in Pearl Mullet fishing in Lake Van. Data regarding the fishing activities of these enterprises during the 2020–2021 and 2021–2022 seasons were collected using the complete census method [13].

In terms of scale, the grouping of the fishing enterprises included in the scope of the research was within the scope of "small–scale fishing enterprises". In the literature on the definition of small–scale fisheries, a general definition of the subject has not yet been put forward. The Food and Agriculture Organization of the United Nations (FAO) has acknowledged that numerous factors, including vessel structure, size, fishing gear, technology, and seasonality, prevent the establishment of a universal definition for small–scale fishing [14]. Nevertheless, in many studies on this topic, a boat length of 12 m has been used as a reference point for classifying small–scale fisheries [15, 16]. Consequently, in this study, fishing enterprises were categorized into two groups: those with a vessel length of 12 m or less (34 enterprises) and those with a vessel length exceeding 12 m (38 enterprises). This approach was adopted to facilitate comparable analysis results by ensuring a relatively balanced distribution of enterprises between the two groups.

The data collected were analyzed and assessed based on the categories established according to boat lengths. This analysis was conducted using SPSS Statistics Version 25 (IBM Corp. Released 2017, IBM SPSS Statistics for Windows 25.0. Armonk, NY: IBM Corp.) and Microsoft Excel. The data were scrutinized and evaluated with reference to these boat length categories. During the data evaluation process, descriptive statistics, including percentage, mean, and standard deviation values, were employed.

The factors influencing the sales income of enterprises engaged in Pearl Mullet fishing in Lake Van were determined through multiple linear regression analysis. The sales revenue function model was constructed with the entry method. Before applying these models, the assumptions of multiple linear regression, including linearity, normal distribution, zero mean of error terms, constant variance, absence of autocorrelation, and absence of multicollinearity among independent variables, were thoroughly assessed. As all these conditions were satisfied, the models were considered appropriate for analysis.

Within the framework of these approaches, the regression equation for the sales revenue function model was formulated as follows:

$$Y = b_0 + b_1 X_1 + b_2 X_2 + b_3 X_3 + b_4 X_4 + \varepsilon$$

○ Y = Pearl Mullet Sales Revenue (dependent variable),

○ X_1 = Fuel and Oil Costs: Diesel and motor oil expenses for Pearl Mullet fishing in ₺ (Turkish Lira),

○ X_2 = Labor Costs: Expenses for family labor force and foreign labor force in ₺,

○ X_3 = Net Costs: Expenses for nets used in Pearl Mullet fishing in ₺,

○ X_4 = Other Costs: Expenses like provisioning, clothing, loan interest, reel and boat maintenance and repair, co–operative dues, fees, visa renewal, transport, etc. in ₺,

○ ε = Error Term

It is important to note that a strong correlation between independent variables is not desirable. A high correlation between independent variables can indicate the presence of multicollinearity, and when the correlation value is 0.90 or higher, it suggests a serious multicollinearity problem. The correlation between independent variables should not be 0.90 or greater [17, 18]. The Durbin–Watson value was used to evaluate the autocorrelation status, and a value between 1.5 and 2.5 indicated that there was no autocorrelation [19].

RESULTS AND DISCUSSION

The proportional distributions of the cost components comprising the expenses in the enterprises involved in Pearl Mullet fishing in Lake Van are displayed in TABLE I. Meanwhile, TABLE II provides the average values of these cost components. Additionally, TABLE III presents the average values of the sales revenues, expenses, and net profit / loss for these enterprises.

Upon reviewing TABLE I, it becomes apparent that fuel and oil expenses ranked as the highest, followed by labor expenses in the second position, and netting expenses in the third position, for both fishing seasons. When considered in terms of groups, fuel and oil costs exhibited a similar pattern in both groups. However, labor costs were lower in the enterprises with a vessel length of 12 m or less compared to the other group.

TABLE I
Proportional Distribution of Expense Items Composing Costs in Enterprises by Groups

Cost Elements	Fishing Season	Enterprises with ≤ 12 m boat length	Enterprises with > 12 m boat length	General
		%	%	%
Fuel and Oil Costs	2020–2021	31.6	30.4	30.9
	2021–2022	39.3	37.0	38.1
Labor Costs	2020–2021	27.8	32.0	30.1
	2021–2022	24.8	30.0	27.6
Ration Costs	2020–2021	5.3	5.7	5.5
	2021–2022	6.1	5.9	6.0
Clothing Costs	2020–2021	1.0	0.9	1.0
	2021–2022	0.9	1.0	0.9
Net Costs	2020–2021	17.9	15.3	16.5
	2021–2022	13.5	12.6	13.0
Loan Interest	2020–2021	4.6	4.1	4.3
	2021–2022	4.5	3.6	4.1
Reel (Purse Seine) Costs	2020–2021	0.4	0.4	0.4
	2021–2022	0.3	0.4	0.3
Other Costs	2020–2021	0.8	1.1	1.0
	2021–2022	0.5	0.7	0.6
Depreciation Costs	2020–2021	4.4	3.8	4.1
	2021–2022	4.0	3.6	3.8
Boat Maintenance and Repair Costs	2020–2021	2.7	3.1	2.9
	2021–2022	2.6	2.0	2.3
General Administration Costs	2020–2021	3.5	3.2	3.3
	2021–2022	3.5	3.2	3.3

There was an 8% rise in the proportional distribution of fuel and oil costs within the cost components compared to the previous season. This increase in fuel and oil expenses can be attributed to the impact of various factors, including the Covid–19 pandemic, the Russia–Ukraine war, and the significant surge in oil prices resulting from unfavorable developments in the Turkish economy. Although there have been fluctuations in all other cost items apart from fuel and oil costs, they have not seen significant changes. Compared with those of the other groups, the labor costs of the enterprises with a boat length of 12 m or less were lower. This difference may be due to the difference in the daily wage amounts between the groups.

The findings of various studies conducted by Reddy [20], Ünal [21], Rad and Delioğlan [22], Luong [23], Taşdan et al. [16], Doğan and Gönülal [24], Cambiè et al. [25], Cesur et al. [26], Guillen and Maynou [27], Sangün et al. [28], Güngör et al. [29], Agbebi et al. [30], Birkan and Öndes [31], Ashley–Dejo and Adelaja [32] consistently indicate that fuel and oil costs constitute the largest portion of the cost elements. Consequently, it is evident that these studies align with the findings of the study.

The studies conducted by Üze [33], Inoni and Oyaide [34], Coşkun [35], Peixer and Maroni Neto [36], Çeliker et al. [37], Doğan [38], and Çeliker et al. [39] have consistently identified labor costs as having the most significant share among the cost elements that comprise the overall cost. These findings are inconsistent with the study. The reason for this difference may be that the prices of fuels and labor vary according to region and year. The variation in costs could also be attributed to the utilization of diesel without SCT (special consumption tax). This factor may have an influence on the overall cost structure and contribute to differences in expenses observed in various studies.

In TABLE II it can be seen that during the 2020–2021 season, the expenses were ranked as follows: Fuel and oil costs came in first at ₺50,733.06 (€5,684.3). Labor costs ranked second at ₺49,411.11 (€5,536.2). Net costs were in the third position at ₺27,026.39 (€3,028.1). In the 2021–2022 season, the expense ranking was as follows: Fuel and oil costs remained in the top position with ₺98,574.44 (€11,044.6). Labor costs came second at ₺71,441.67 (€8,004.56). Net costs ranked third with ₺33,638.89 (€3,796.9). When comparing the two groups, it is notable that labor costs were lower in enterprises with a vessel length of 12 m or less compared to the other group.

In a study conducted on fisheries in the Marmara Sea, it was determined that the average fuel cost was the highest at €8,540, and the average labor cost was the second highest at €7,976 [29]. The outcomes from this study are consistent with the results mentioned. However, it is worth noting that the average values of labor and fuel costs in the studies conducted by Aksoy and Koç [40], Güngör et al.

TABLE II
Mean Values of the Cost Elements of the Enterprises at the Group Level (₺)

Cost Elements	Fishing Season	Enterprises with ≤ 12 m boat length	Enterprises with > 12 m boat length	General
Fuel and Oil Costs	2020–2021	49,327.94	51,990.26	50,733.06
	2021–2022	98,502.35	98,638.95	98,574.44
Labor Costs	2020–2021	43,350.00	54,834.21	49,411.11
	2021–2022	62,026.47	79,865.79	71,441.67
Ration Costs	2020–2021	8,327.94	9,684.21	9,043.75
	2021–2022	15,408.82	15,600.00	15,509.72
Clothing Costs	2020–2021	1,611.62	1,583.68	1,596.88
	2021–2022	2,215.29	2,628.68	2,433.47
Net Costs	2020–2021	27,885.29	26,257.89	27,026.39
	2021–2022	33,773.53	33,518.42	33,638.89
Loan Interest	2020–2021	7,147.06	7,105.26	7,125.00
	2021–2022	11,227.94	9,717.11	10,430.56
Reel (Purse Seine) Costs	2020–2021	700.00	627.89	661.94
	2021–2022	808.82	953.95	885.42
Other Costs	2020–2021	1,207.35	1,780.79	1,510.00
	2021–2022	1,368.62	1,822.37	1,608.10
Depreciation Costs	2020–2021	6,833.33	6,496.49	6,655.56
	2021–2022	10,127.45	9,464.91	9,777.78
Boat Maintenance and Repair Costs	2020–2021	4,242.65	5,361.84	4,833.33
	2021–2022	6,441.18	5,585.53	5,989.58
General Administration Costs	2020–2021	5,440.07	5,512.82	5,478.47
	2021–2022	8,653.55	8,542.83	8,595.12

₺: Turkish Lira

[41] do not align with the findings of the present study, indicating some disparity in cost patterns across these different researches. The reason for this inconsistency may be that the prices of the cost elements that make up the fishing costs vary according to year and region. It is also thought that the use of SCT–free diesel oil is effective because of the difference in fuel costs.

For the 2020–2021 fishing season (TABLE III), the average sales revenue amounted to ₺251,354.17 (€28,163), while the average cost was ₺162,915.76 (€18,254), resulting in an average net profit of ₺88,438.41 (€9,909). In the 2021–2022 fishing season, the corresponding figures

TABLE III
Mean Sales Revenue, Costs, and Net Profit/Loss Values of Enterprises

Enterprises	Sales Revenue (₺)		Cost (₺)		Net Profit / Loss (₺)	
	2020–2021	2021–2022	2020–2021	2021–2022	2020–2021	2021–2022
Enterprises with ≤ 12 m boat length	240,661.76	414,411.76	154,867.37	249,127.56	85,794.39	165,284.20
Enterprises with > 12 m boat length	260,921.05	430,657.89	170,116.94	264,888.53	90,804.11	165,769.36
General	251,354.17	422,986.11	162,915.76	257,445.85	88,438.41	165,540.26

₺: Turkish Lira

were as follows: Average sales revenue: ₺422,986.11 (€47,393), Average cost: ₺257,445.85 (€28,845), Average net profit: ₺165,540.26 (€18,548).

When comparing the two fishing seasons covered in the study, it is evident that there was an increase in the average values of sales revenue, cost, and net profit. This increase amounted to approximately 2 times for average sales revenue and average net profit, while it was approximately 1.5 times for average cost, between the two period of years studied. The primary factor contributing to the rise in average cost is believed to be the increase in fuel prices. On the other hand, the increase in average sales revenue and average net profit is attributed to higher sales prices for Pearl Mullet and an increased catch volume compared to the previous season. While the sales price was high, the increase in catch volume increased sales revenue and net profit. Furthermore, these three parameters exhibited an increase in values as the length of the vessels increased.

In a study on fisheries in the Aegean Sea, the average annual gross profit of enterprises was reported as €8,757 [31], which is notably like to the value observed in the 2020–2021 season of the current study. However, when examining average net profit, average income, and average cost in studies conducted by Dağtekin [42], Üze [33], Çeliker et al. [37], Çeliker et al. [39], Coşkun [35], Taşdan et al. [16], Cesur et al. [26], Doğan [38], Dartay et al. [43], Güngör et al. [29], and Güngör et al. [41], they appear to be inconsistent with the findings of this study. These differences could be attributed to various factors, including regional variations, methodological distinctions, and time–specific circumstances. This inconsistency may be due to differences in the economic value of the fish caught, the amount of fish caught and the associated costs according to the year, the differences in the fishing areas, and the differences in the fishing technology and methods used.

The outcomes of the financial profitability and economic ratios of the enterprises can be found in TABLE IV.

TABLE IV
Mean Values of the Financial Ratio and Economic Ratio of the Enterprises (Mean±SD)

Enterprises	Financial Rationality		Rate of Economization	
	2020–2021	2021–2022	2020–2021	2021–2022
Enterprises with ≤ 12 m boat length	32.56±8.67	42.16±11.96	2.19±0.67	1.87±0.30
Enterprises with > 12 m boat length	34.50±9.37	41.53±8.50	2.03±0.51	1.84±0.26
General	33.59±9.04	41.83±10.21	2.10±0.59	1.86±0.27

Based on the data presented in TABLE IV, regarding financial profitability, during the 2020–2021 fishing season, it was greater in the enterprises with a boat length exceeding 12 m compared to the other group. However, in the 2021–2022 fishing season, the values were relatively similar between the two groups. In terms of economic ratios, it was observed that the values in both groups were quite comparable in both fishing seasons.

The average financial profitability, which represents the profitability of equity capital, indicated that enterprises with a boat length exceeding 12 m performed more successfully than those with a boat length of 12 m or less, with a 2% difference in the 2020–2021 fishing season. However, in the following fishing season, it was determined that both groups of enterprises achieved a similar level of success. Based on the data from the Central Bank of the Republic of Turkey (CBRT), the average interest rate on time deposits was 16.42% in the 2020–2021 fishing season and 22.92% in the 2021–2022 fishing season [44]. It was observed that the financial profitability rates in this study exceeded the time deposit interest rates during these periods. Therefore, it can be concluded that Pearl Mullet fishing in Lake Van was a profitable economic activity during these periods. When considering the alternative cost of capital, it is also possible to assert that an income exceeding the alternative cost was obtained.

The average financial profitability value of 40.4% reported by Rad and Delioğlan [22] in their study on the economic situation of Taşucu trawlers is consistent with the findings of the present study. Additionally, in a study conducted by Çeliker et al. [39] on fishermen in the Aegean Sea, the average financial profitability was determined to be 32.43%. These figures are in line with the financial profitability values observed in this study, suggesting some degree of similarity in the economic performance of the enterprises across these different studies. While these values are like to the values in this study for the 2020–2021 season, they were found to be incompatible with the values for the 2021–2022 season. In various studies conducted by different researchers, varying levels of average financial profitability were observed among fishermen in different regions: Çeliker et al. [37] found an average financial profitability of 9.61% among fishermen in the Black Sea region. Coşkun [35] reported an average financial profitability of 17.9% in Sinop province. Üze [33] determined an average financial profitability of 5.99% in Kastamonu. These results illustrate the diversity in economic performance and profitability among fishermen in different geographical areas and contexts. These values were not consistent with the study. This incompatibility may arise from differences in fishing areas, economic values of hunted species, net profits, equity capital of enterprises, and fishing seasons.

Within the scope of the research, economic ratios above 1 serve as indicators of profitable operation for enterprises engaged in Pearl Mullet fishing in Lake Van. The results of the regression analysis are presented in TABLE V.

As per the information in TABLE V, the adjusted R^2 value was calculated to be 0.909. This value signifies that approximately 90.9% of the variation in the dependent variable within the model is accounted for by the independent variables, while the remaining 9.1% can be attributed to variables not incorporated into the model. Additionally, the Durbin–Watson value for this model was recorded as 1.912. Since this value falls within the range of 1.5–2.5, it suggests that there is no autocorrelation present in the model. When P values were examined, fuel and oil costs, labor costs, net costs and other costs were found to be significantly different at the $P<0.05$ level. According to the production function model for all enterprises, the estimated equation for Y= Total Pearl Mullet Sales Revenue is as follows:

$$Y = 20937.565 + 2.231X_1 + 1.021X_2 + 1.019X_3 + 1.240X_4 + \varepsilon$$

According to regression analysis, the relationship between the dependent variable, total Pearl Mullet sales revenue (Y), and the independent variables in the estimated model equation was found to be in the predicted direction. In a study on fisheries in Zonguldak province, regression analysis was conducted, with gross revenue as the dependent variable and diesel fuel costs, engine power, and the number of days spent at sea as independent variables. It was determined that there was a significant relationship between gross

TABLE V
Results of Regression Analysis According to the Production Function Model of Pearl Mullet Sales Revenue in Enterprises

Variables	Non–Standardized		Standardized	t Value	Sig. (P)	Collinearity Statistics	
	B	Beta (β)	Beta (β)			Tolerance	VIF
Fixed	20937.565	9545,246		2.194	0.030		
Fuel and Oil Costs	2.231	0.145	0.586	15.407	0.000	0.437	2.286
Labor Costs	1.021	0.116	0.262	8.839	0.000	0.719	1.392
Net Costs	1.019	0.315	0.099	3.236	0.002	0.683	1.463
Other Costs	1.240	0.251	0.189	4.942	0.000	0.433	2.308

R^2	Adjusted R^2	Durbin–Watson
0.912	0.909	1.912

revenue and diesel fuel costs at the $P<0.05$ level. This finding aligns with the observation of a significant relationship between gross revenue (income from fish sales) and fuel costs [40].

Several issues were identified during the study that had an adverse impact on the profitability of the enterprises. These problems include: a) Owners' inability to influence price determination, as they commence the season in debt to brokers. b) Insufficiencies in both quantity and quality regarding organization. c) Inability of the enterprises to take advantage of SCT–free diesel oil support. d) Absence of suitable dry docks for boat maintenance, repairs, and modifications.

At the start of the season, the fish prices remain low because enterprise owners cannot influence price determination due to their indebtedness to brokers. This negatively impacts enterprise profitability. Establishing a local fish market and promoting collaborative efforts among fishermen are considered effective strategies to enable enterprise owners to have more influence over prices.

It was observed that enterprise owners involved in Pearl Mullet fishing do not benefit from the use of SCT–free fuel, a benefit also provided by the Ministry of Transport and Infrastructure for fishing vessels. During the field research revealed that they face challenges in utilizing this support due to bureaucratic complexities and high associated costs. This situation results in increased enterprise expenses and reduced profitability. It is believed that streamlined procedures, implemented by competent authorities to facilitate fishing vessels' access to SCT–free diesel oil, will have a positive impact on enterprise profitability.

Due to the lack of suitable dry docks for the maintenance and repair of boats, the maintenance and repair costs increase when construction machinery is used to tow boats to land. It is believed that the construction of suitable towing places by competent authorities will have a positive impact on enterprise profitability.

CONCLUSION AND IMPLICATIONS

Based on the results of financial profitability and economic ratios, it has been ascertained that Pearl Mullet fishing in Lake Van is a financially viable activity. In this regard, it is believed that Pearl Mullet fishing plays a crucial role in generating employment opportunities in the rural areas surrounding the lake and curbing the migration of young populations from rural to urban areas. Apart from these significant contributions, it is also considered of utmost importance to prioritize the conservation of the declining population of Pearl Mullet to ensure the sustainability of this fishing activity.

It has been ascertained that the fishing enterprises examined had similar values in different variables (such as cost elements, sales revenue) depending on their vessel sizes. This situation offers production posibility through fishing for both enterprises with a vessel length of 12 m or less, and businesses with a vessel length exceeding 12 m.

The establishment of a fish market in the study region, the simplification of procedures for SCT–free diesel oil usage, the construction of appropriate boat docks for maintenance and repair, and the establishment of a robust organization are believed to have a positive impact on sales revenues and enterprise profitability.

Conflict of interest statement

The authors declare that they have no conflict of interest

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