The Growth Trends and Forecasting of Turkish Fishery Sector

Türkiye'nin Balıkçılık Sektöründeki Gelişmeler ve Tahminler

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THE GROWTH TRENDS AND FORECASTING OF TURKISH FISHERY SECTOR

ABSTRACT

The aim of this research was to forecast Turkish fishery sector for an outlook of 2024-2028 period and introduce the growth trends in order to evaluate the fishery sector with policy implications. The fishery production, net export, processed product and per capita consumption series of 1981-2023 were used in projections and modelled with double exponential smoothing method. It was forecasted that production would increase by 13.9 % and reach 1,151,226 tons by 2028 with respect to 2023. Accordingly, net export would increase by 42.6 % and reach 237,989 tons by 2028 with respect to 2023. The forecasting results showed that processed product would reach 151,595 tons whereas per capita consumption would be 7.62 kg by 2028. The rise of both production and net export is expected to be resulted from aquaculture. On the other hand, slight change in processed product was caused by decreasing share of catching and rise of export. This study concluded that aquaculture support policy of Türkiye has significant impact and aquaculture would be key element of fishery production and net export in the near future. Therefore, the continuity and improvement of these policies is of vital importance.

Keywords: Fishery sector, Forecasting, Double exponential smoothing, Policy, Türkiye.

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TÜRKİYE'NİN BALIKÇILIK SEKTÖRÜNDEKİ GELİŞMELER VE TAHMİNLER

ÖZ

Bu araştırmanın amacı, Türkiye'de balıkçılık sektörüne ilişkin 2024-2028 dönemi tahmini ve gelişmeler ışığında sektörün değerlendirilmesidir. Balıkçılık sektöründe 1981-2023 dönemine ilişkin üretim, net ihracat, işlenen ürün ve kişi başına tüketim verileri kullanılmış olup, seriler çift üstel düzeltme yöntemi ile modellenmiştir. Araştırma sonuçlarına göre üretimin 2028 yılında 2023 yılına göre % 13.9 artarak 1,151,226 tona ulaşacağı, net ihracatın ise % 42.6 göre artarak 237,989 tona ulaşacağı beklenmektedir. Model tahminleri 2028 yılında işlenen ürün miktarının 151,595 ton ve kişi başı tüketim miktarının 7.62 kg olacağını göstermektedir. Araştırma sonuçlarına göre üretim ve net ihracattaki artışın yetiştiricilik kaynaklı olup, işlenen üründeki değişim ise üretimde avcılığın payının azalması ve ihracatın artmasından kaynaklanmaktadır. Bu araştırma, Türkiye'de yetiştiricilik desteklerinin

önemli etkisinin olduğunu ve yetiştiriciliğin, yakın gelecekte balık üretimi ve net ihracatın temel unsuru olacağını göstermektedir. Bu nedenle, destekleme politikalarının devamlılığı ve geliştirilmesi büyük önem taşımaktadır.

Anahtar Kelimeler: Balıkçılık, Tahmin, Çift üstel düzeltme, Politika, Türkiye

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1. INTRODUCTION

Total fisheries and aquaculture production reached a record level of 214 million tons in 2020, largely due to the growth of aquaculture, particularly in Asia. The international trade of fisheries and aquaculture products generated around USD 151 billion in 2020, down from the record of USD 165 billion in 2018 mainly due to the outbreak of COVID-19. Official statistics indicated that world fishery and aquaculture production reached almost 185 million tons by 2022 and FAO's fisheries and aquaculture outlook for to 2030 projected increase in production, consumption and trade, in spite of slower growth rates. Total production of aquatic animals was expected to reach 202 million tons in 2030, thanks mainly to sustained growth of aquaculture. On the other hand, world capture fisheries were projected to increase by 6 % during the 2020-2030 period, as a result of improved resource management, underfished resources, and reduced discards, waste and losses (FAO, 2022).

Fishery sector was supported in the world in the last fifty years and Turkey was also adapted to this trend since 2000. Turkish fishery policy has started to be regulated with European Union under Chapter 13 which consisted Common Fisheries Policy (CFP) and CFP consisted four main policy areas as: i) Conservation and control policy (fisheries management), ii) structural policy, iii) marketing policy and iv) international policy (Anonymous, 2022). In this context, Turkish support policy for fishery sector could be classified into three categories as: i) supports to improve aquaculture and enhance production, ii) supports to ensure a sustainable fisheries sector and to create a balance between the fish catching activities and reproduction of fish stocks and, iii) supports by different governmental organizations via interest rates and tax deductions (Anonymous, 2017). For the first support category, aquaculture supports have started to grant since 2003 and it has had significant impact on development of aquaculture and production. In the period of 2003-2018, aquaculture producers were granted 1.28 billion TL. For the second support category, vessels which ceased catching and decertified were started to be granted by 2012 and 1,264 vessel license were decertified in 2012-2018 period and totally 165 million TL was granted. For the last support category, vessels could use tax-free fuel since 2004 and total amount of these taxes were 1.87 billion TL for the period of 2004-2018 (TAGEM, 2019). Besides, coastal fishing was also supported since 2017 in order to realize sustainable management with recording (Anonymous, 2017).

In this context, fishery sector is essential for Türkiye because of geographical condition as being a peninsula country with 8,333 km coast and having great potential in fishery. In 2022, Türkiye produced almost 0.5 % of total world fish and the share of the country has increased year by year. Nevertheless, fishery sector had serious fluctuations in time. Turkish Statistical Institute (TURKSTAT) stated that Türkiye produced 1,010,346 tons of fishery products in 2023. Of total, the share of catching was 45 %, including 38.3 % sea fish, 3.3 % other sea products and 3.4 % fresh water products whereas the share of aquaculture was 55 % (TURKSTAT, 2024). Fishery production increased by 2.1 times in the last 43 years-period, from 1981 to 2023. Nevertheless, the rise of fishery production was considerably resulted from the aquaculture, which increased by 181 times in the specified period. The tendency of production evolved from catching to aquaculture showed globally correct variation (Anonymous, 2023). Türkiye is also a net exporter country on fishery products thanks to the rise of aquaculture and development of product process technologies. By the way, processed product increased by two times in 1981-2023 period, which contributed to the growth of net export. Although domestic consumption increased by 1.8 times in the last four decades, the rate of population also increased by 1.9 times which caused per capita consumption not to seriously change. These statistics showed some structural inferences about fishery sector in Türkiye and necessitate some statistical projections in order to evaluate the current situation and consider future prospect. Therefore, forecasting of fishery statistics is of vital importance and statistics should be evaluated in terms of these projections and the policies should also be handled to assess this sector.

Much effort of literature has been devoted to forecast production and foreign trade of fishery in Türkiye (Saygi et al., 2011; Candemir and Dağtekin, 2020; Demir and Aksoy, 2021). Nevertheless, in international literature, Mehmood et al. (2020), Yadav et al. (2020), Boruah et al. (2020) and Voumik (2021) introduced country cases to forecast fishery production. Some studies examined more global scene for production and/or foreign trade relations such as world leading fishery countries, Baltic countries, Middle Eastern countries etc. (Bashimov and Aydın, 2018; Saygi et al., 2018; Arisoy et al., 2021). Most of these studies used traditional ARIMA methodology.

Although production and foreign trade were handled to forecast fishery in Türkiye, there are two essential utilization channel of production: domestic consumption and processed product. These components should have also taken into consideration in order to reach wider scene of the sector. Therefore, the aim of this research was to forecast production, processed product, net export and per capita consumption of Turkish fishery sector for the period of 2024-2028 to evaluate the future of the sector via fishery policies and provide decision makers with policy recommendations. By the way, fishery sector could be analyzed via production, international trade, industry and consumption perspective.

2. MATERIAL AND METHODS

2.1. Material

In this research, Turkish fishery sector was examined for the period of 1981-2023 and the data was obtained from TURKSTAT (TURKSTAT, 1992; 1997; 2005; 2013; 2014; 2024). There were four different fishery time series explored: production, net export, processed product and per capita consumption. Table 1 denoted descriptive statistics and computation forms of fishery series in methodology. In the first computation, four components of production and in the second computation, utilization channels of production were examined. In this research, basic fishery series were taken into consideration and analyzed. Therefore, sector could be analyzed with respect to both production and consumption.

Table 1. Descriptive statistics and computation of fishery time series of Türkiye.

Variables	Production (tons)	Net Export (tons)	Processed Product (tons)	Per Capita Consumption (kg)
Mean	616,210.30	17,973.47	109,020.56	7.51
Std. Dev	121,469.66	48,861.79	58,459.58	1.27
Min	364,661.00	-29,697.00	17,842.00	5.34
Max	1,010,346.00	166,940.00	228,709.00	10.80
Median	607,515.00	6,565.00	105,000.00	7.64
Computation	Production=Sea fish+Other sea products+Aquaculture+Freshwater products			
	Production=Domestic consumption+Processed+Loss[1]+Net export (Export-Import)			
	Per capita consumption=Domestic consumption/population (yearly)			

In Türkiye, data of fishery production was compiled by three different components: i) sea products ii) freshwater products iii) aquaculture and the first and second components constituted catching. Sea products included two different sources as: sea fish and other sea products. Sea fish included quantity of sixty-six different types of fish caught whereas other sea products included quantity of twenty-three different type of crustaceas and molluscs caught. Both type of data was compiled by the Monthly Large Scale Fishermen and Seasonal Small Scale Fishermen Catch Survey. Methodologically, fisherman was the statistical unit of these surveys; large scale fishermen was a fisherman who had a vessel equal or more than 10 meters-length whereas small scale fishermen was a fisherman who had a vessel less than 10 meters-length. Large scale fishermen were covered by enumeration method whereas small scale fishermen had been covered by sampling methods

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[1]   Although loss product (not processed and consumed) was taken into consideration in computation, it was not forecasted because loss product has been lower than 1% of total production on average.

since 1980 and all data was obtained via face-to-face surveys in 28 coastal provinces of Türkiye. Freshwater and aquaculture data covered all professional fishermen fishing at freshwater, fishery producers and aquaculture enterprises and they were directly obtained from Ministry of Agriculture and Forestry. Every year, questionnaires were sent to Province Directorates of Ministry of Agriculture and Forestry and these forms were compiled by interviewing with fishery cooperatives, fishery producers and aquaculture enterprises (TURKSTAT, 2014; 2023).

Figure 1 reported total fishery production of Türkiye in the last 43 years and considered some significant points: i) Quantity of production was 471,066 tons in 1981, increased by 2.1 times and reached 1,010,346 tons in 2023. Therefore, it has an increasing trend. ii) There were serious fluctuations in time; sharp decreases and increases were experienced. Official statistics showed that the rise of production was mainly caused by aquaculture and revealed that Turkish fishery production had inverted from catching to aquaculture in the last four decades.
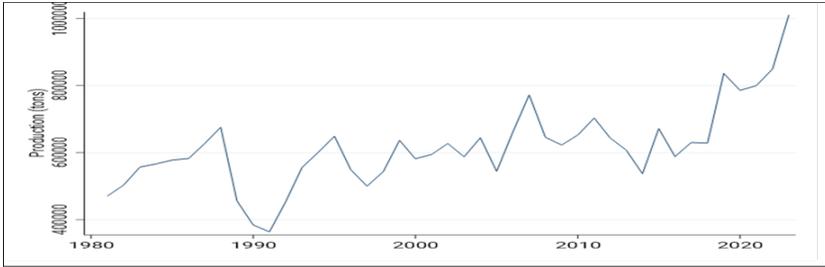
Figure 1. Time series plot of fishery production of Türkiye.

Net export data was computed by difference between export and import fishery series and Figure 2 introduced net export in Türkiye over the period from 1981 to 2023. Export of fishery product did not considerably change until 2000's but in the last two decades there was an upward trend and especially after 2002, the increasing slope had indicated that export would not have constant mean and variance. The quantity of fishery export was 11,523 tons in 1981 and increased to 272,192 tons by 2023. On the other hand, the first import data was measured as 195 tons by 1985 but it raised to 105,252 tons in 2023. Import had an upward trend in the reference period but this trend ended in 2015 and started to decrease until 2020 and then it had fluctuations. By the way, the negative value of net export in 1990's and 2000's changed and net export started to seriously rise until 2023.
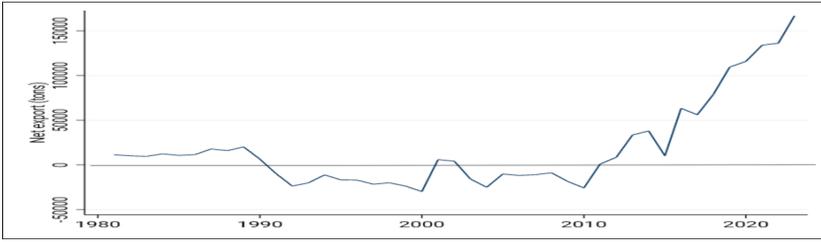
Figure 2. Time series plot of fishery net export of Türkiye.

Processed product was a component of consumption and showed the quantity of fishery product used by fishery industry for fishery meal and oil factories. Figure 3 explored processed product in 1981-2023 and indicated that processed product was measured as 109,396 tons in 1981, seriously fluctuated in time and reached 228,607 tons in 2023.
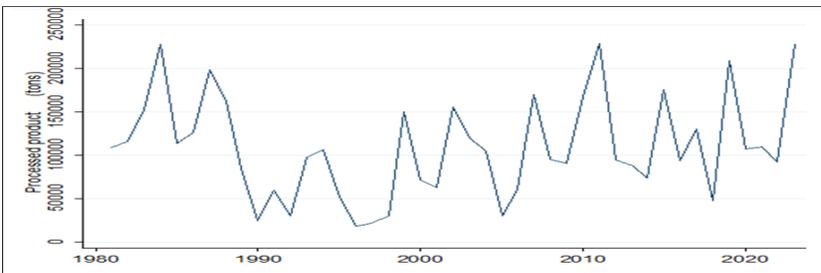

Figure 3. Time series plot of fishery processed product of Türkiye.

Last time series of fishery was per capita consumption and computed with domestic consumption and yearly population. Figure 4 showed per capita consumption of fishery in Türkiye in 1981-2023 period and indicated that per capita consumption did not considerably change in the last four decades in spite of serious fluctuations.
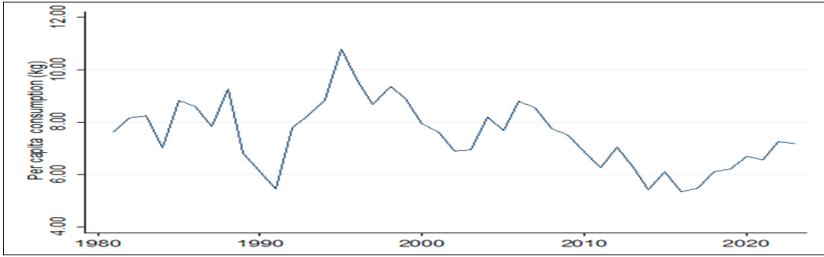
Figure 4. Time series plot of fishery per capita consumption of Türkiye.

2.2. Method

In this study, before modelling fishery time series, both correlogram graphs, Autocorrelation (ACF) and partial autocorrelation (PACF), were examined. ACF and PACF could provide a statistical summary at a particular lag (Ediger and Akar, 2007) and although ACF and PACF graphs could also provide information to decide whether the series were stationary or not, and AR and MA order of models, stationarity was not exactly decided. Therefore, Augmented Dickey-Fuller (ADF) test was examined.

ADF is a unit root test which has been used to confirm stationarity of time series. ADF test could be formulated as follows when $\{x_t\}$ is a time series indexed by time .

$$\Delta x_i = \mu + \gamma t + \alpha_1 x_{t-1} + \sum_{j=2}^{k} \alpha_j \Delta x_{t-j+1} + u_t \qquad\qquad t = 1,2, \dots., T \qquad (1)$$

Here, Δ is the difference of operator and is a white noise innovation. The null hypothesis of a unit root is represented by α_1=0. The ADF test examines the negativity of α_1 based on its regression t-ratio (Cheung and Lai, 1998).

In time series forecasting, different methods can be used and exponential smoothing method is one of these methods. In this study, double exponential smoothing was used to forecast fishery time series because it is a statistical method that extends the simple exponential smoothing to take into account both level and trend components in time series data, providing better forecasting accuracy (Boukerche et al., 2020).

Double exponential smoothing model should be used when the time series data has a trend without seasonality and the model is presented in equation 2 and 3:

$$S_t^{(1)} = \alpha y_t + (1-\alpha)S_{t-1}^{(1)}$$

(2)

$$S_t^{(2)} = \alpha y_t + (1-\alpha)S_{t-1}^{(2)}$$

(3)

Double exponential smoothing model is considerably used for variable parameters of linear trend series prediction. Variable parameters of linear trend forecasting model expressed as;

$$Y_{t+T} = a_t + b_t T$$

(4)

where $S_t^{(1)}$ is a single exponential smoothing value and $S_t^{(2)}$ is a double exponential smoothing value, is smoothing parameter and is the predicted number of instalments starting period t (Li, 2013).

3. RESULTS AND DISCUSSION

ACF and PACF graphs indicated that delays of production, net export and per capita consumption exactly exceed the confidence limit and therefore they were not stationary at level whereas processed product was stationary (Figure 5). Therefore, ADF test was applied to decide whether the series have unit root or not. ADF test results revealed that all fishery sector series were non-stationary at 5 % significance level except for processed product. Nevertheless, the series of production, net export and per capita consumption were stationary at first-difference (Table 2) and absolute value for the first difference of all series was higher than the absolute value of the critical values at 5 % significance level. Therefore, the null of a unit root in the first-differenced of the series could be rejected. Order of integration for the series were I (1).
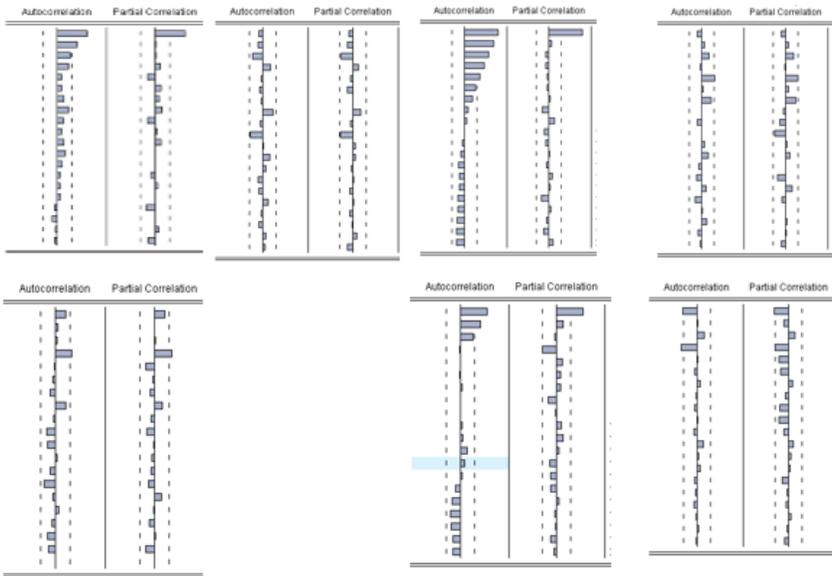
Figure 5. ACF and PACF graphs of series at level and 1st difference in (a) Production (b) Net Export (c) Processed Product (d) Per Capita Consumption.

Table 2. The results of ADF unit root test.

Model	Level		1st difference	
	t-statistic	Prob*	t-statistic	Prob*
Production	-1.25	0.64	-6.63	0.00
Net Export	1.41	0.99	-6.72	0.00
Processed Product	-4.69	0.00	-	-
Per Capita Consumption	-3.29	0.02	-8.83	0.00

*5% significance level

In order to decide which alternative is better among the models developed with exponential smoothing methods, goodness of fit criteria was taken into consideration. The parameters of the double exponential method used in this study are given in Table 3. As a result of the evaluation, it was determined that the findings obtained from the forecasting methods used have acceptable error percentages and the forecasts have accuracy margins. Since the goodness-of-fit criteria are lower in the future period forecast, the double exponential smoothing method is preferred.

Table 3. Model selection criteria.

		Production	Net Export	Processed Product	Per Capita Consumption
Alpha		0.3180	0.3700	0.1200	0.2780
Sum of Squared Residuals (SSR)		3.20E+11	9.09E+09	1.51E+11	40.88432
Root Mean Squared Error (RMSE)		86227.74	14539.58	59243.47	0.975089
End of period Levels	Mean	942309.0	161802.2	141919.8	7.039565
	Trend	41783.45	15237.46	1935.055	0.116566

The forecasted values from 2024 to 2028 were given in Table 4 and Figure 6. The model results showed that fishery production would increase by 13.9 % and reach 1,151,226 tons in 2028 with respect to 2023. This rise is expected to be resulted from aquaculture and there are some reasons of this change within the context of policy implications. First of all, aquaculture has been supported since 2003 and the share of aquaculture in total production has perpetually increased. Fishery production by catching would increase to a limited extent and showed that policies and management on sustainable fishery sector would be substantially realized. Candemir and Dağtekin (2020) also proved that the difference between catching and aquaculture would be decreased on behalf of aquaculture.

The model results concluded that net export would increase by 42.6 % and reach 237,989 tons by 2028 with respect to 2023. The change of export was considerably explained with the rise of fishery production especially aquaculture. Candemir and Dağtekin (2020) also forecasted essential rise in aquaculture and explained the rise of export with aquaculture whereas Anonymous (2017) explained this rise with improvement of processing technologies beside aquaculture. Demir and Aksoy (2021) stated that Türkiye is not an important actor in world aquaculture production but it has made significant progress, especially in fresh and chilled fish production. Arisoy *et al.* (2021) introduced that slowness in the growth rate of production of fisheries and few number of suppliers is threatening global exportation of fisheries but Turkey could gain exportation advantage by conducting a better analysis of their existing potential. In this context, existing fishery policies should continue to be applied in order to enhance net export by means of aquaculture.

The research results showed that processed product would sharply decrease (33.7 %) in 2024 with respect to previous year and forecasted 143,854 tons. Nevertheless, it would increase in five years' period and reach 151,595 tons by 2028. This change was mainly resulted from serious fluctuations of processed product in the last four decades due to the changes in catching which was substantially affected by climate change and violation of fishing bann. FAO declared that almost all of the aquaculture products are sold as whole fresh fish (FAO, 2025). Therefore, the tendency of fishery production depending on aquaculture would adversely influence processed product in the long run.

Per capita consumption was the most stable element of fishery because in the last four decades' population and domestic consumption of fishery were change at almost same rate and therefore, there was no remarkable change in per capita consumption. Forecasts showed that per capita consumption would increase by 6 % and reach 7.62 kg in 2028 with respect to 2023 and it would be almost 7 kg in 5 years' period. Although Candemir and Dağtekin (2020) forecasted that per capita consumption would decrease in 2018-2023 period, the actual statistics did not prove the research results. Government has shown a clear intention to increase the per capita fish consumption by increasing the production in the aquaculture sector which seems to be the only option for achieving this increase, rather than limiting options available to increase fishery production (FAO, 2025). Nevertheless, per capita consumption is not only related with quantity of production but also economic and cultural reasons in Türkiye.

Table 4. Forecasted values for 2024-2028.

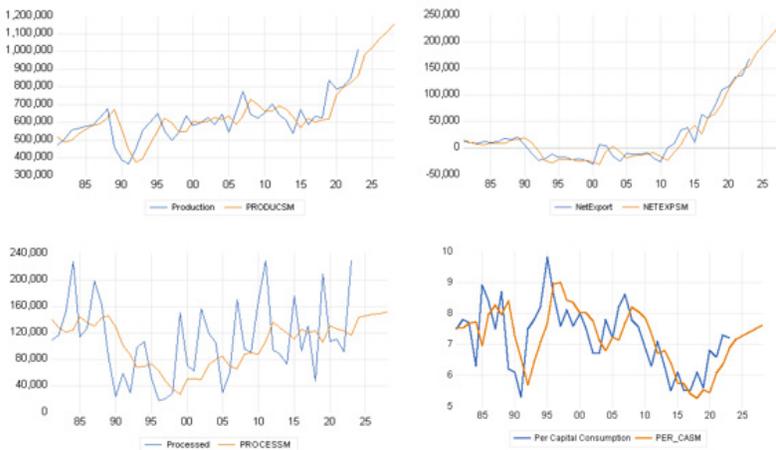| Forecast Year	Production	Net Export	Processed Product	Per Capita Consumption
2024	984,092.4	177,039.6	143,854.8	7.15
2025	1,025,875.9	192,277.1	145,789.9	7.27
2026	1,067,659.3	207,514.5	147,724.9	7.38
2027	1,109,442.8	222,752.0	149,660.0	7.50
2028	1,151,226.2	237,989.4	151,595.0	7.62

Figure 6. Forecasts for (a) Production (b) Net export (c) Processed product (d) Per capita consumption.

4. CONCLUSION

This research aimed at forecasting Turkish fishery sector and revealed that fishery production, net export, processed product and per capita consumption would increase in future five-years period. However, forecasted values showed 13.9 % increase in production, 42.6 % increase in net export, 33.7 % decrease in processed product and 5.9 % increase in per capita consumption by 2028 with respect to 2023.

In Türkiye, government supported and encouraged aquaculture production in order to enhance and improve total fishery production, protect fish stocks and decrease production costs since 2003. Therefore, fishery sector was considerably formed by these support policies and the impact of these policies seemed to continue in the near future. This study concluded some remarkable results and projections on Turkish fishery sector within the context of fishery policies. First of all, forecasts showed that aquaculture would continue to rise in the future and be a key element of both fishery production and net export thanks to the support policies as well as technological improvement in production and processing. This tendency of rise is also compatible with the movement of world fishery production. The forecasts showed serious decrease in processed product and this result could be substantially explained by catching (sea fish) part of fishery production and input costs have significant impact on this part Input costs especially feed have pressure on producers and decrease the impact of supports. Therefore, energy support polices such as private consumption tax free fuel should be continued to apply in order to diminish the burden on producers.

This research showed that every component of fishery sector is depends on each other and fishery policies should take this dependency into consideration and improve holistic approach in policy implication. These projections tried to provide a five-year outlook for fishery sector and evaluate the policy implications. However, fishery sector has major global problems such as decreasing fish stocks and overfishing, pollution and climate change and these factors would have adverse impact on projections.

Conflict of Interest

The authors declare that there is no conflict of interest.

Ethics

This study does not require ethics committee approval.

Author Contribution Rates (It will be given with the abbreviation of Name and Surname according to the number of authors order)

Design of Study: NAE (%50), BKT (%50)

Data Acquisition: NAE (%60), BKT (%40)

Data Analysis: NAE (%50), BKT (%50)

Writing up: NAE (%60), BKT (%40)

Submission and Revision: NAE (%70), BKT (%30)

REFERENCES

Arısoy, H., Bayramoğlu, Z., Ağızan K., Ağızan, S., 2021. Global growth trend in fisheries and current situation in Turkey. Ege Journal of Fisheries and Aquatic Sciences, 38(4): 499-505. https://doi.org/ 10.12714/egejfas.38.4.11.

Anonymous, 2017. Kalkınma Bakanlığı, Onbirinci Kalkınma Planı 2019-2023, Su Ürünleri Çalışma Grubu Raporu. file:///C:/Users/10488075384/Downloads/Su%20%C3%9Cr%C3%BCnleri%20Grubu%20Taslak% 20Raporu.pdf.

Anonymous, 2022. Ministry of Foreign Affairs, Directorate for EU Affairs, Chapter 13: Fisheries. https://www.ab.gov. tr/78_en.html.

Anonymous, 2023. Ministry of Agriculture and Forestry, Agricultural Economic and Policy Development Institute, Fishery Products Report, No:373, Ankara. https://arastirma.tarimorman.gov.tr/tepge/Belgeler/PDF %20 %C3%9Cr%C3%BCn%20Raporlar%C4%B1/2023%20%C3%9Cr%C3%BCn%20Raporlar%C4%B1/Su%20 %C3%9Cr%C3%BCnleri%20%C3%9Cr%C3%BCn%20Raporu%202023-373%20TEPGE. pdf

Bashimov, G., Aydın, A., 2018. Competitiveness of Fisheries Sector: A Case Study of Baltic Countries. Turkish Journal of Agricultural and Natural Sciences, 5(1): 48-55.

Boruah, B. B., Roy, P., Dutta, A., & Hazarika, B. B., 2020. Forecasting Marine and Total Fish Production in India Using ARIMA Models. Indian Journal of Economics and Business, 19(2): 161-174.

Boukerche, A., Tao, Y., Sun, P., 2020. Artificial intelligence-based vehicular traffic flow prediction methods for supporting intelligent transportation systems. Computer networks, 182, 107484. https://doi.org/10.1016/ j.comnet.2020.107484.

Candemir, S., Dağtekin, M., 2020. Estimation of Turkey Aquaculture Production and Proficiency Index. Acta Aquatica Turcica, 16(3): 409-415. https://doi.org/10.22392/ actaquatr. 700858.

Cheung, Y. W., Lai, K. S., 1998. Power of the augmented dickey-fuller test with information-based lag selection. Journal of Statistical Computation and Simulation, 60(1): 57-65.https://doi.org/10.1080/ 00949659808811871.

Demir, N., Aksoy, A., 2021. Competitive power of Turkey's aquaculture sector and comparison with other leading countries. Marine Science and Technology Bulletin, 10(3): 258-268. https://doi.org/10.33714/masteb.937890.

Ediger, V.Ş., Akar, S., 2007. ARIMA forecasting of primary energy demand by fuel in Turkey. Energy Policy, 35(3): 1701-1708. https://doi.org/10.1016/j.enpol.2006.05.009.

FAO, 2022. The State of World Fisheries and Aquaculture 2022. Towards Blue Transformation. Rome, FAO. https:// doi.org/10.4060/cc0461en.

FAO, 2025. Türkiye. Text by Deniz, H. In: Fisheries and Aquaculture. https://www.fao.org/fishery/en/ countrysector/naso_turkey.

Li, X., 2013. Comparison and analysis between Holt exponential smoothing and Brown exponential smoothing used for freight turnover forecasts, in: Proc. 2013 3rd Int. Conf. Intell. Syst. Des. Eng. Appl. ISDEA 2013, pp. 453–456. doi:10.1109/ISDEA.2012.112.

Mehmood, Q., M.H. Sial, S. Sharif, A. Hussain, M. Riaz, N. Shaheen., 2020. Forecasting the fisheries production in Pakistan for the year 2017-2026, using Box-Jenkin's methodology. Pakistan Journal of Agricultural Research, 33(1): 140-145. http://dx.doi.org/10.17582/journal.pjar/2020/33.1.140.145.

Saygi, H., Kop, A., Bayhan, B., 2011. The forecast of the future production amounts of some fish species being cultivated in Turkey. Kafkas Universitesi Veteriner Fakultesi Dergisi, 17(1): 13-20. https://doi.org/ 10.9775/ kvfd.2010.2279.

Saygı, H., Kop, A., Tekoğul, H., Altan, Ö., 2018. Aquaculture Production of Middle Eastern Countries. Turkish Journal of Agriculture-Food Science and Technology, 6(10): 1422-1430. https://doi.org/10.24925/ turjaf.v6i10.1422-1430.2058.

TAGEM, 2019. Tarım ve Orman Bakanlığı, Tarımsal Araştırmalar ve Politikalar Genel Müdürlüğü, Su Ürünleri Sektör Politika Belgesi 2019-2023, Ankara.

TURKSTAT, 1992. Fishery Statistics 1990, Turkish Statistical Institute, Publication no: 1517, pg 54.

TURKSTAT, 1997. Fishery Statistics 1995, Turkish Statistical Institute, Publication no: 1995, pg 58.

TURKSTAT, 2005. Fishery Statistics 2003, Turkish Statistical Institute, Publication no: 2937, pg 82.

TURKSTAT, 2013. Statistical Indicators 1923-2021, Turkish Statistical Institute, Fishery Statistics, Publication no: 4131, pg 698.

TURKSTAT, 2014. Fishery Statistics 2013, Turkish Statistical Institute, Publication no: 4349, pg 75.

TURKSTAT, 2024. Turkish Statistical Institute, Agriculture, Statistical Tables, Fishery Statistics. https://data.tuik.gov.tr/Kategori/GetKategori?p=Agriculture-111.

TURKSTAT, 2023. Turkish Statistical Institute, Fishery Statistics, Metadata. https://data.tuik.gov.tr/Kategori/GetKategori?p=tarim-111&dil=1.

Voumik, L. C., 2021. Forecasting and Modelling Fish Production in Bangladesh Using ARIMA Model. Iconic Research and Engineering Journals, 5(4): 114-119.

Yadav, A. K., Das, K. K., Das, P., Raman, R. K., Kumar, J., Das, B. K., 2020. Growth trends and forecasting of fish production in Assam, India using ARIMA model. Journal of Applied and Natural Science, 12(3): 415-421. https://doi.org/10.31018/jans.v12i3.2353.