



## National Level Evaluation of Fish Consumption and Analysis of Consumption Trends and Regional Differences in Türkiye

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**Abstract:** This study examines fish consumption habits across Türkiye's seven geographical regions and identifies the factors driving regional differences in consumption. Data were collected through face to face surveys with 387 randomly selected individuals between May and September and analyzed using a Decision Tree algorithm. The findings indicate that regional, socio economic, and demographic variables significantly affect fish consumption behavior. Despite Türkiye being surrounded by seas on three sides and having substantial inland water resources, per capita fish consumption has remained below global and European averages. Although consumption has increased in recent years, annual per capita intake in Türkiye ranges from 7 to 11 kg, compared with approximately 20 kg worldwide and 24 kg in the European Union. Fish is a nutritionally valuable food, providing high quality protein, omega 3 fatty acids, vitamins, and minerals, with well established health benefits. However, low consumption in Türkiye is mainly linked to traditional dietary habits, price fluctuations, limited access to fresh fish, insufficient consumer awareness, and socio economic constraints. Consumption is higher in coastal regions, while inland regions show lower intake due to accessibility and cultural factors. The study highlights the need for region specific awareness initiatives, consumer education, and sustainable aquaculture policies to increase fish consumption in Türkiye.

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## Türkiye'de Balık Tüketiminin Ulusal Düzeyde Değerlendirilmesi ve Tüketim Eğilimleri ile Bölgesel Farklılıkların Analizi



**Öz:** Bu çalışma, Türkiye'nin yedi coğrafi bölgesindeki balık tüketim alışkanlıklarını incelemekte ve tüketimdeki bölgesel farklılıkları yönlendiren faktörleri belirlemektedir. Veriler, Mayıs ve Eylül ayları arasında rastgele seçilen 387 kişiyle yüz yüze yapılan anketler yoluyla toplanmış ve Karar Ağacı algoritması kullanılarak analiz edilmiştir. Bulgular, bölgesel, sosyoekonomik ve demografik değişkenlerin balık tüketim davranışını önemli ölçüde etkilediğini göstermektedir. Türkiye'nin üç tarafı denizlerle çevrili olmasına ve önemli iç su kaynaklarına sahip olmasına rağmen, kişi başına balık tüketimi küresel ve Avrupa ortalamalarının altında kalmıştır. Son yıllarda tüketim artmış olsa da, Türkiye'de yıllık kişi başına tüketim 7 ila 11 kg arasında değişmekte olup, bu rakam dünya genelinde yaklaşık 20 kg ve Avrupa Birliği'nde 24 kg'dır. Balık, yüksek kaliteli protein, omega 3 yağ asitleri, vitaminler ve mineraller sağlayan, besin değeri yüksek ve sağlık açısından faydaları iyi bilinen bir besindir. Bununla birlikte, Türkiye'deki düşük tüketim esas olarak geleneksel beslenme alışkanlıkları, fiyat dalgalanmaları, taze balığa sınırlı erişim, yetersiz tüketici bilinci ve sosyoekonomik kısıtlamalarla bağlantılıdır. Tüketim kıyı bölgelerinde daha yüksekken, iç bölgelerde erişilebilirlik ve kültürel faktörler nedeniyle daha düşük tüketim görülmektedir. Bu çalışma, Türkiye'de balık tüketimini artırmak için bölgeye özgü farkındalık girişimlerine, tüketici eğitimine ve sürdürülebilir su ürünleri yetiştiriciliği politikalarına duyulan ihtiyacı vurgulamaktadır.

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**Anahtar kelimeler:** Balık tüketimi, Türkiye, coğrafi bölge, beslenme alışkanlıkları.

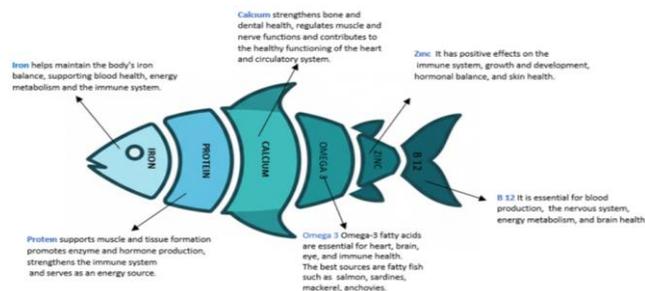
### INTRODUCTION

Türkiye is essentially a peninsula due to being surrounded by seas on three sides and possesses a coastline of approximately 8,333 km, along with rich inland water resources. The country hosts 200 natural lakes, over 300 dam lakes, 750 ponds, and 33 major rivers, offering significant potential for both fishing (capture) and aquaculture activities

(TEPGE, 2024). Furthermore, with a total water surface area of approximately 25 million hectares, an extensive coastline, and a river network reaching 177,714 km, Türkiye has a structure favorable for the sustainable production and supply of fish not only in coastal regions but also in inland areas (Karadaş et al., 2024). The varying temperature and salinity characteristics of its seas support species diversity, thereby increasing the productivity of its aquatic resources.

Aquaculture production in Türkiye is realized through two main methods: capture fisheries and aquaculture. According to 2023 data, 55% of the total production was sourced from aquaculture. Of this aquaculture output, 72% was carried out in marine waters and 28% in inland waters. Dominant species in aquaculture include especially sea bass (*Dicentrarchus labrax*), sea bream (*Sparus aurata*), and rainbow trout (*Oncorhynchus mykiss*). The vast majority of capture production is derived from the seas, with marine capture constituting 93% of the total capture production in 2023. This level of production positions Türkiye among the leading seafood producers in Europe (TEPGE, 2024). In 2025, total seafood production in Türkiye reached 1.02 million tons, exceeding the one million ton threshold for the first time and achieving the highest level recorded to date. Of this production, 420 thousand tons were obtained from marine and inland capture fisheries, while 600 thousand tons were supplied by aquaculture facilities. In 2025, anchovy (*Engraulis encrasicolus*), which constitutes the backbone of capture production, was recorded at 245 thousand tons. According to economic data, the export value of this production reached approximately 2 billion (USB Certification, personal communication, 2026)

Fish and other seafood are rich sources of high quality protein, long chain omega-3 polyunsaturated fatty acids (EPA and DHA), vitamins, and minerals (Figure 1). Regular fish consumption plays a crucial role in the prevention of chronic diseases such as cardiovascular diseases, inflammatory disorders, and hyperlipidemia (Chen et al., 2022). Fish is also abundant in iodine, selenium, and various vitamins, making it critically important in providing essential nutrients, particularly for infants, children, and pregnant women. Fish protein hydrolysates and peptides offer additional health benefits due to their antioxidant and biological activities (Chalamaiah et al., 2012). Current nutritional guidelines recommend consuming fatty fish at least one or two times per week (WHO, 2021).



**Figure 1.** Main nutrients found in fish and their key health benefits for humans (Author's own elaboration).

Individual seafood consumption is influenced by numerous factors, including geographical location, socio demographic characteristics, income level, palatability, habits, and accessibility (Verbeke et al., 2007; Zhang et al., 2021). Per capita seafood consumption in Türkiye remains

low compared to European and global averages, standing at approximately 7 kg annually, versus 24–25 kg in the European Union and around 22 kg globally (TÜİK, 2024). Consumption is higher in coastal regions and lower in inland regions, correlating directly with regional production capacity, price, socio economic conditions, and accessibility. Consumer behavior is shaped by factors such as the product's physical properties, preparation ease, price, and family attitudes; furthermore, eco labeling and information programs increase the tendency to choose sustainable seafood (Murray et al., 2017). The development of aquaculture in Türkiye reflects the global growth trend. Rainbow trout, sea bass, and sea bream dominate total production, and this production structure places Türkiye among Europe's leading aquaculture countries, ranking second overall. The seafood sector in Türkiye has gained significant momentum, especially since the 1980s, with aquaculture production showing an approximately eight fold increase over the last 20 years. About a quarter of the production is directed towards foreign markets, underscoring the strategic economic importance of the sector (GDFA, 2020). However, increasing per capita consumption will only be possible by raising public health awareness and strengthening accessibility. In this context, examining regional consumption habits will contribute to developing strategies that promote seafood consumption and strengthen food safety policies. This study aims to reveal the causes of regional differences by examining the fish consumption habits of individuals residing in Türkiye's seven geographical regions using a survey method. The data obtained are expected to form a scientific basis for designing policies aimed at increasing seafood consumption and strengthening public health programs.

## MATERIAL AND METHOD

**Material:** The primary dataset for this research was collected from a sample determined to be representative of all seven geographical regions of Türkiye. A total of 387 individuals were selected using a random sampling method from various age groups, genders, occupational groups, educational levels, and income classes. Face to face surveys were conducted with these participants between May and September of 2025. The sociodemographic characteristics of the participants were grouped in accordance with the structure of the Decision Tree model and are summarized in Table 1.

The survey instrument was designed to comprehensively reveal individuals' fish consumption habits. It included questions addressing the most frequently consumed and preferred fish species, annual and seasonal consumption quantities, the key factors influencing fish consumption (e.g., taste, price, habit, health), fish purchasing behavior, and preparation and cooking methods.

Additionally, the questionnaire contained items focused on identifying factors that restrict consumption and determining regional differences. In addition to the primary data, the scope of the research was broadened by utilizing official records from relevant public institutions and organizations, along with domestic and international scientific publications, journals, reports, and various literature sources, to establish a more robust analytical foundation.

**Method:**

**Analysis Phase:** In this research, an artificial intelligence based decision modeling method was employed, and the Decision Tree algorithm, frequently favored in data mining applications, was applied during the analysis process. Decision trees are a powerful analytical tool due to their ability to work with missing data, their high processing speed with large datasets, and their success in representing non linear relationships between variables. The algorithm clearly demonstrates the effects of independent variables on the dependent variable, contributing to the identification of influential factors, and the visualizable nature of the tree structure enhances the interpretability of the results. The accuracy of the classification results obtained through the Decision Tree analysis was calculated using the criteria presented in Table 2. To increase the predictive accuracy of the model, the parent and child node ratio was set at 2:1, and 10% cross validation was applied to ensure the model's generalizability. During the model construction process,

different algorithms (EXHAUSTIVE CHAID, C&RT, and CHAID) were compared. Based on the evaluation, the CHAID algorithm was structured as the final model because it yielded the most successful results in terms of both discriminatory power of the variables and classification accuracy.

The accuracy of the classification results of the data obtained by decision tree analysis was calculated using the criteria presented in Table 3 (Sackett, 1973).

$$\text{Test Validity} = ((\text{TP}+\text{TN}) / (\text{TP}+\text{TN}+\text{FP}+\text{FN})) * 100$$

Represents a classic confusion matrix structure for evaluating the performance of a classification model. In the matrix, a (True Positive, TP) represents observations classified as true positive, b (False Negative, FN) represents observations classified as false negative despite being true positive, c (False Positive, FP) represents observations classified as false positive despite being true negative, and d (True Negative, TN) represents observations correctly classified as true negative. Row and column sums reveal the distribution of true positive and negative samples, as well as the positive and negative predictions of the test. This structure is a fundamental tool for quantitatively evaluating the performance of the model (Fawcett 2006; Piryonesi and El-Dirab, 2020; Ting 2011).

**Table 1.** Descriptive statistics of the sample demographic and regional distribution (Developed by the authors).

Category	Frequency (n)	Percentage (%)
<b>Region (Main Grouping)</b>		
Marmara, Black Sea, Southeast	208	53.7
Aegean, Eastern Anatolia, Mediterranean, Central Anatolia	177	45.7
<b>Total</b>	385*	100.0
<b>Education Level</b>		
Postgraduate/University	182	47.3
Secondary School/Primary School/High School	26	6.8
<b>Total (from Node 1)</b>	208	54.0
<b>Age Group</b>		
≤ 30	49	12.7
> 30	128	33.2
<b>Total (from Node 2)</b>	177	46.0
<b>Income Level</b>		
≤10,000 TL	127	33.0
> 10,000 TL	55	14.3
<b>Total (from Node 3)</b>	182	47.3
<b>Gender</b>		
Female	42	10.9
Male	86	22.3
<b>Total (from Node 6)</b>	128	33.2

**Table 2.** Criteria commonly used in the evaluation of tests (Developed by the authors).

Test Result (Predicted)	Positive (+)	Negative (-)	Total
Test (+) (Predicted Positive)	a (TP)	c (FP)	a+c
Test (-) (Predicted Negative)	b (FN)	d (TN)	b+d
<b>Total (Actual Condition)</b>	a+b	c+d	a+b+c+d

TP: True Positive, FP: False Positive, FN: False Negative, TN: True Negative

**Table 3.** Classification Results (Developed by the authors).

Observed (Rows) / Predicted (Columns)	More Information	Affordable Price	Correct Percentage (Accuracy)
<b>More Information</b>	294 <sup>1</sup>	4 <sup>2</sup>	98.7% <sup>3</sup>
<b>Affordable Price</b>	71 <sup>4</sup>	16 <sup>5</sup>	18.4% <sup>6</sup>
<b>Overall Percentage</b>	94.8% <sup>7</sup>	5.2% <sup>8</sup>	80.5% <sup>9</sup>

**FINDINGS**

Upon examining Figure 2, the dependent variable of the analysis is "fish consumption motivation," which is categorized into two groups: "More information" (red) and "Affordable price" (yellow). The research thus investigated whether the primary motivation driving individuals' fish consumption is information or price. According to the root node of the tree, 77.4% of the participants generally associated their fish consumption with "more information," while 22.6% deemed "affordable price" as the primary factor. The initial split was based on the Region of Residence, which was the strongest factor differentiating fish consumption motivation ( $p < 0.001$ ).

Motivation among individuals residing in the Marmara, Black Sea, and Southeastern Anatolia Regions was primarily information based, whereas the influence of price was slightly more pronounced in the Aegean, Eastern Anatolia, Mediterranean, and Central Anatolia Regions.

For those living in the Marmara, Black Sea, and Southeast regions, the second most significant variable was Education Level ( $p = 0.002$ ). While the majority of university graduates (79.3%) explained their fish consumption motivation as seeking "more information," this ratio decreased among those with lower educational attainment. Within this group, Income Level ( $p = 0.013$ ) was also influential, with individuals in the higher income bracket (above 4000 TL) showing a greater information-based motivation. In the Aegean, Eastern Anatolia, Mediterranean, and Central Anatolia Regions, the second split was based on the Age variable ( $p = 0.040$ ). Motivation related to an affordable price was higher among individuals under the age of 30, while the influence of information increased among those over 30. Furthermore, the Gender variable ( $p = 0.025$ ) was also effective in this group, with females exhibiting a higher information-oriented motivation compared to males.

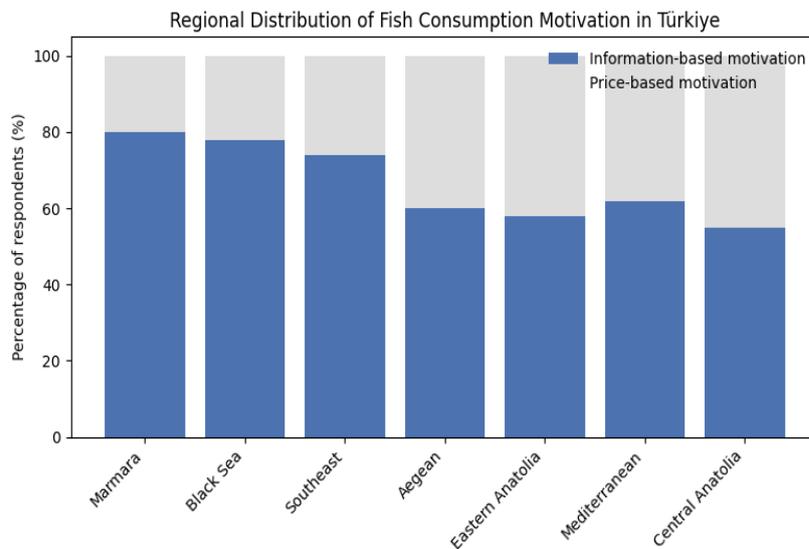


Fig 2. Regional differences in fish consumption motivation are illustrated.

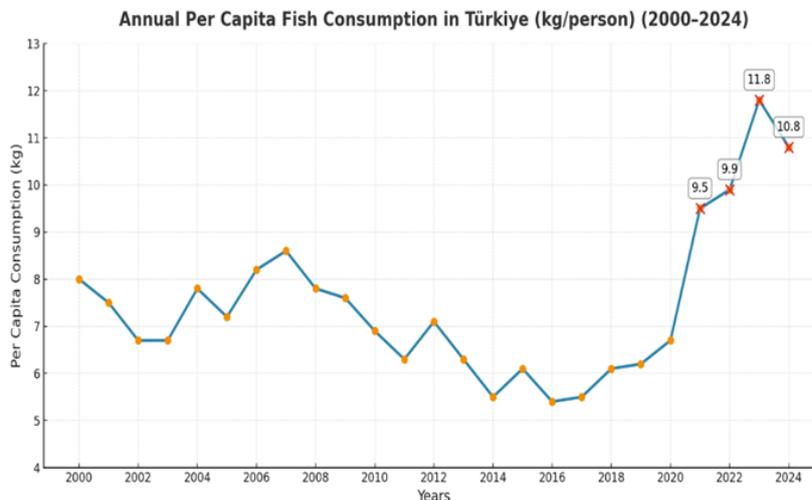


Fig 3. Annual per capita fish consumption in Türkiye (TÜİK 2000-2024).

Overall, the analysis demonstrates that regional, socio economic, and demographic variables significantly influence fish consumption motivation. Information-based motivation is particularly strong among individuals with higher education and income levels residing in the Marmara and Black Sea regions, whereas price sensitivity is more pronounced among younger, lower income individuals and those living in regions such as the Aegean and Central Anatolia. In addition, the trend of annual per capita fish consumption in Türkiye over time is illustrated

in Figure 3, highlighting that despite recent increases, consumption levels remain below global and European averages. These findings suggest that policies aimed at increasing fish consumption should differentiate both information campaigns and pricing strategies according to target groups (Figure 4). The overall correct classification rate of the model is 80.5%, indicating a highly successful result, with the model demonstrating a strong ability to predict individuals motivated by “more information” with an accuracy of 98.7%.

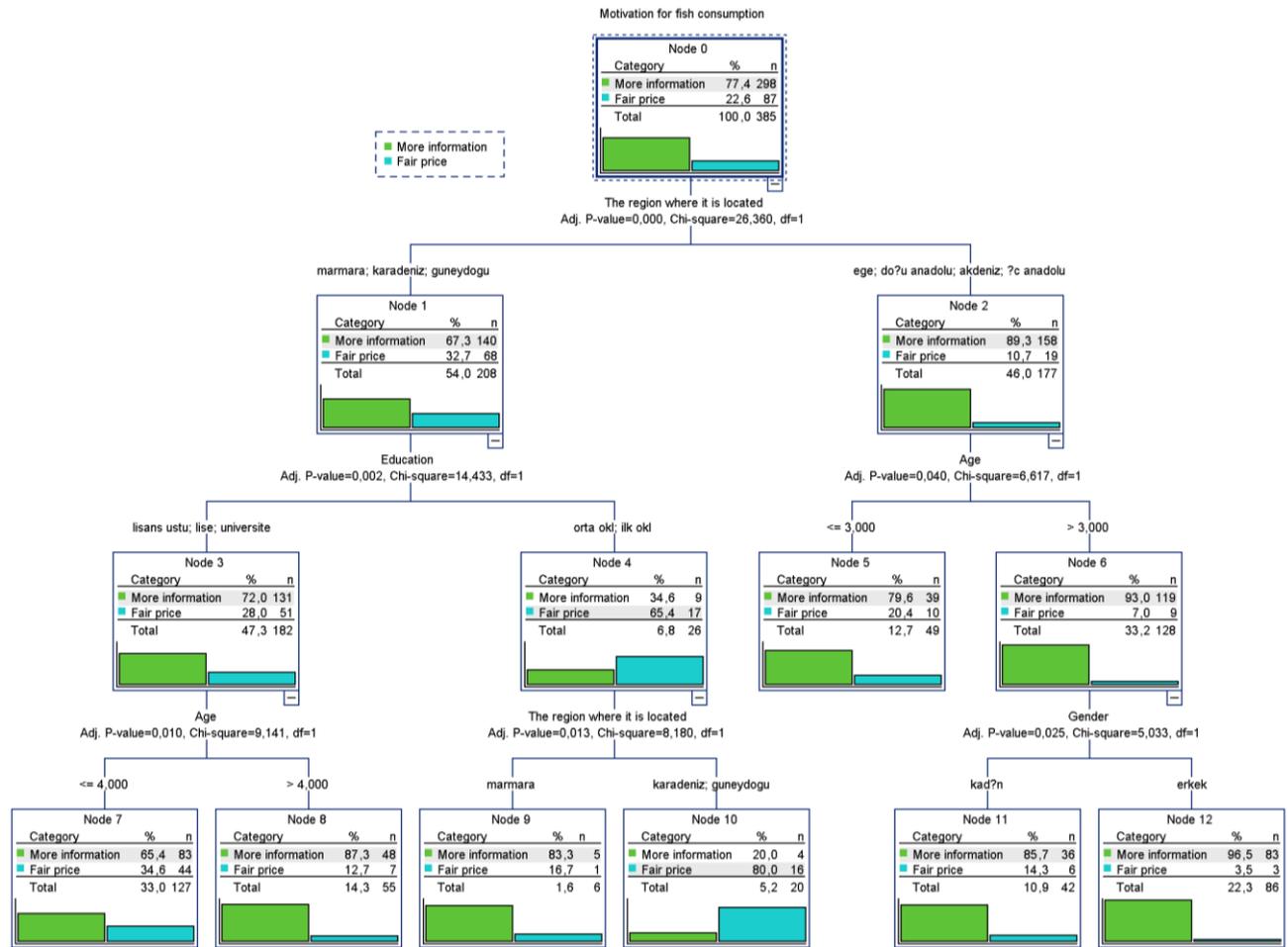


Fig 4. Decision tree of demographic variables affecting fish consumption motivation.

## DISCUSSION

As illustrated in figure 5, per capita fish consumption in Türkiye remains substantially lower than global and European benchmarks. Since the 1980s, Türkiye has experienced a remarkable expansion in aquaculture research and production, driven by institutional growth, increased scientific capacity, and technological development. Studies focusing on key cultured species such as rainbow trout, sea bass, sea bream, and carp have substantially enriched the national knowledge base and contributed to the rapid growth of the aquaculture sector (Bostock et al., 2011). However, the present findings indicate that this production oriented

development has not been accompanied by a proportional increase in domestic fish consumption, revealing a persistent disconnect between supply capacity and consumer demand.

The results of this study confirm that fish consumption behavior in Türkiye is shaped by a complex interaction of geographical, socio economic, and demographic factors rather than a single determinant. In line with previous studies (Verbeke et al., 2007; Zhang et al., 2021; Che et al., 2022), regional differences emerged as the most influential factor affecting consumption motivation. Coastal regions, particularly Marmara and the Black Sea, exhibited higher levels of information driven

motivation, which may be attributed to stronger seafood culture, better access to fresh fish, and greater exposure to information regarding nutritional and health benefits. In contrast, inland regions such as Central and Eastern Anatolia displayed stronger price sensitivity, reflecting both accessibility constraints and economic considerations. Education level and income were found to be key modifiers of consumption motivation. Individuals with higher education and income levels tended to base their consumption decisions on information and health awareness, supporting earlier findings that nutrition knowledge and socio economic status are positively associated with seafood consumption (Darmon & Drewnowski, 2008; Pinho et al., 2018). This pattern suggests that information-based interventions may be more effective among socio economically advantaged groups, whereas price-oriented strategies are necessary to address barriers among lower income populations.

Age related differences further emphasize the heterogeneity of consumer behavior. Younger individuals were more likely to prioritize affordability, whereas older participants demonstrated greater responsiveness to information, particularly regarding health benefits. This finding aligns with previous research indicating that awareness of cardiovascular and metabolic benefits of fish consumption increases with age and health consciousness (Mendivil, 2021). Given the well documented protective role of omega-3 fatty acids against cardiovascular diseases (Li et al., 2022), targeted communication strategies emphasizing preventive health outcomes may be particularly effective for middle aged and older populations. Despite recent increases, per capita fish consumption in Türkiye remains below global and European averages (Figure 3). (FAO, 2022; TÜİK, 2024).

This persistent gap underscores the influence of deeply rooted dietary habits favoring red and white meat consumption, as well as price volatility and limited consumer trust in seafood supply chains (GDFA, 2020; USDA FAS, 2024). The findings of the present study reinforce the argument that increasing consumption cannot be achieved solely through expanding production but requires parallel efforts aimed at strengthening consumer awareness, improving market accessibility, and stabilizing prices. From a methodological perspective, the high classification accuracy of the CHAID decision tree model (80.5%) demonstrates the robustness of artificial intelligence based analytical approaches in identifying consumption drivers at the national scale. Compared to traditional statistical methods, decision tree analysis offers enhanced interpretability and the ability to capture non linear relationships among variables, making it particularly suitable for complex food consumption studies. Similar approaches have increasingly been applied in consumer behavior research, highlighting their potential to inform evidence based policy development.

Overall, the results indicate that policy measures aimed at increasing fish consumption in Türkiye should adopt a differentiated and region specific framework. Information campaigns emphasizing nutritional value and health benefits should be prioritized in regions and groups already responsive to knowledge based motivation, while economic support mechanisms, pricing policies, and distribution improvements are essential for price sensitive populations. Such integrated strategies are critical not only for improving public health outcomes but also for ensuring the long term sustainability and economic resilience of Türkiye's aquaculture sector.

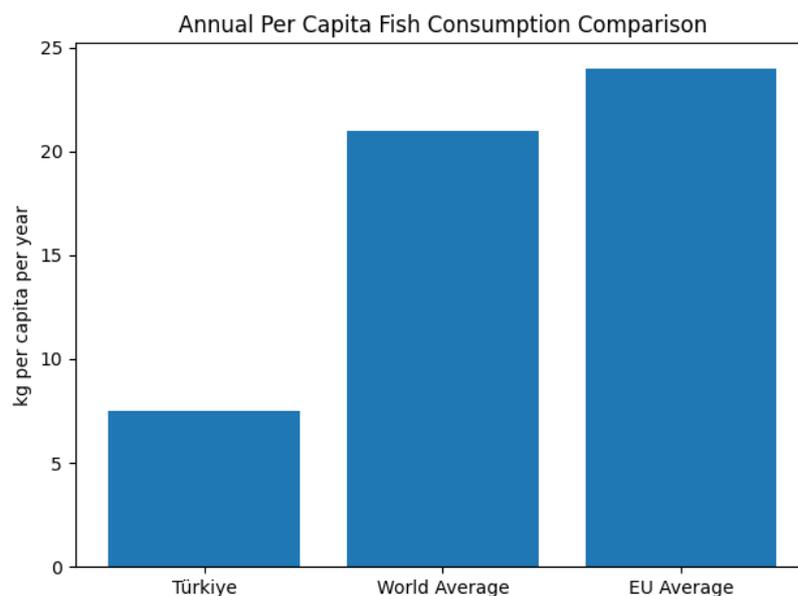
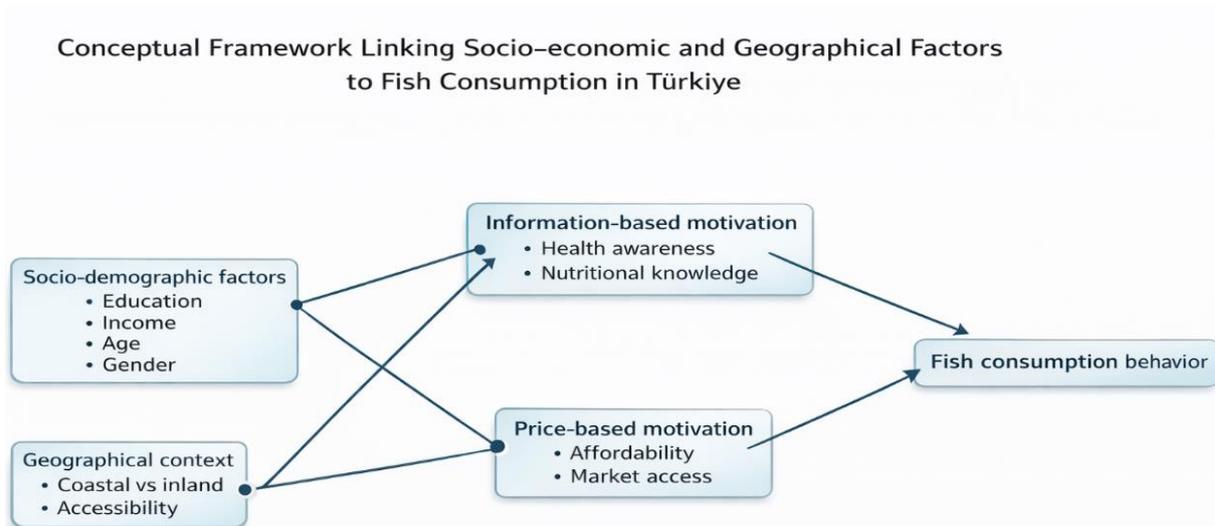


Fig 5. A comparison of per capita fish consumption in Türkiye with global and European benchmarks is presented (GDFA 2020-2024).



**Fig 6.** Based on the findings of the present study, a conceptual framework summarizing the pathways through which regional and socio economic factors influence fish consumption behavior in Türkiye is presented (Author's own elaboration).

## CONCLUSION

Based on the findings of this study a conceptual framework summarizing the pathways through which regional and socio-economic factors influence fish consumption behavior in Türkiye is presented in Figure 6. This comprehensive study has utilized an artificial intelligence based Decision Tree (CHAID) algorithm to deeply investigate the fish consumption motivations and habits of individuals across Türkiye's seven geographical regions, revealing the regional, socioeconomic, and demographic factors underpinning the country's low per capita consumption level. It was confirmed that despite Türkiye's rich aquatic resources, the annual per capita fish consumption (approximately 7 kg) significantly lags behind the global (approximately 20) and European Union (approximately 22 kg) averages. The analysis demonstrated that the primary motivation for increasing fish consumption for the vast majority of participants was "more information" (77.4%), followed by "affordable price" (22.6%).

The strongest factor differentiating consumption motivation was the Geographical Region of Residence. Information Driven Motivation was predominantly observed in highly educated (Undergraduate/Graduate) and high income individuals residing in the Marmara, Black Sea, and Southeastern Anatolia regions. This finding suggests that these groups are more aware of the health benefits of fish (high quality protein, omega 3 fatty acids, etc.). Conversely, Price sensitivity was more distinctly pronounced among younger individuals (under 30) and low income individuals living in the Aegean, Eastern Anatolia, Mediterranean, and Central Anatolia regions. This confirms that price remains a significant economic barrier for lower income groups.

The derived model showed a highly successful overall classification rate of 80.5%. The results reveal that steps taken to increase fish consumption in Türkiye must be differentiated to target specific regional and demographic characteristics by focusing on public health awareness campaigns and economic support policies designed to stabilize consumer prices. Bringing Türkiye's consumption level closer to international averages is critical for both improving public health and realizing the economic potential of the aquaculture sector. Fish consumption habits in Türkiye were analyzed using nationally representative survey data. Significant regional differences in fish consumption were identified across Türkiye's seven geographical regions. Socio economic and demographic variables were found to be key determinants of fish consumption behavior. Decision Tree analysis effectively revealed the main factors influencing consumption preferences.

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**Conflict of interest:** The authors declare that they have no conflict of interest.

**Congress/Symposium information:** This study has not been presented at any congress or symposium.

**Thesis information:** This study is not derived from any thesis.

**Project information:** This research did not receive any specific grant from funding agencies.

**Ethical approval:** Ethical approval was not required for this study.

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