RESEARCH ARTICLE   **ARAŞTIRMA MAKALESİ**

Comparative analysis of Türkiye's competitiveness with major countries in fisheries exports

Balıkçılık ihracatında majör ülkelerle Türkiye'nin rekabet gücünün karşılaştırmalı analizi

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Abstract: In the study, the export competitiveness of the 10 countries that export the most fisheries products in the world and Türkiye was analyzed using the Normalized Revealed Comparative Advantages (NRCA) method. The 42 fisheries products included in the analysis are subject to a 5-digit classification in the Standard International Trade Classification (SITC) revision 3 category. The analysis results show that the countries with the highest competitiveness in fisheries products among 11 countries are China, Norway, Ecuador, Chile and Sweden. The country with the lowest competitive power is Türkiye. In this context, for Türkiye to increase its competitive power in the fishing sector, it needs to use technology actively in this field, implement environmentally friendly policies to increase the population of fishing products, and take precautions against marine pollution (especially mucilage problems, etc.).

Keywords: Fisheries products, export competitiveness, NRCA analysis, Türkiye

Öz: Çalışmada, dünyada en fazla su ürünleri ihracatı yapan 10 ülkenin ve Türkiye'nin ihracat rekabet gücü, Normalize Edilmiş Açıklanmış Karşılaştırmalı Üstünlükler (NRCA) yöntemi kullanılarak analiz edilmiştir. Analize dahil edilen 42 balıkçılık ürünü, Standart Uluslararası Ticaret Sınıflandırması (SITC) revizyon 3 kategorisindeki 5 basamaklı ürün grubudur. Analiz sonuçları, 11 ülke arasında balıkçılık ürünlerinde rekabet gücünün en yüksek olduğu ülkelerin Çin, Norveç, Ekvador, Şili ve İsveç olduğunu göstermektedir. Rekabet gücünün en düşük olduğu ülke ise Türkiye'dir. Bu bağlamda, Türkiye'nin balıkçılık sektöründeki rekabet gücünü artırabilmesi için teknolojiyi bu alanda aktif olarak kullanması, su ürünleri popülasyonunu artırmaya yönelik çevre dostu politikalar uygulaması ve deniz kirliliğine (özellikle müsilaj sorunları vb.) karşı önlem alması gerekmektedir.

Anahtar kelimeler: Balıkçılık ürünleri, ihracat rekabet gücü, NRCA analizi, Türkiye

INTRODUCTION

In our age, the competition race for countries is more intense and fiercer than ever. The factors that reveal the competitiveness of countries are no longer just their national income and export volumes. Because today, competition has come to the fore on a sectoral basis. In this context, specialization in foreign trade and comparative advantages for sectors are the main factors that determine competitiveness.

Although not as high in added value as electronics, communications, machinery, equipment, etc. sectors, seafood and fisheries exports are extremely important, especially in terms of both sectoral and global competitiveness of some countries. The seafood and fisheries sector is the main source of income and employment in many countries. The specialization and global competitiveness to be achieved in these sectors will also be decisive in terms of the socio-economic development of the countries. The countries with the highest fishing sector exports in the world are China, Norway, Ecuador, Chile and India (Table 1). Although Türkiye has reached a relatively significant export amount in the sector, this data is not at a level that can provide a competitiveness when the aquaculture potential of the country's economy is considered.

Table 1. Top 10 exporting countries in fisheries products and Türkiye (2023, thousand dollars) (COMTRADE, 2025)

Countries	Export	Import
China	19.352.254	19.224.118
Norway	15.499.490	597.601
Ecuador	8.897.827	146.933
Chile	7.730.392	288.923
India	7.021.778	131.175
Sweden	5.795.605	6.487.294
Spain	5.711.654	8.715.722
Canada	5.537.316	2.992.547
Netherlands	5.511.780	3.830.982
Thailand	4.993.962	3.947.249
Türkiye	1.719.963	292.917

Note: Based on the 2-digit 03 coded fisheries category in the SITC Rev. 3 category.

In this perspective, this study analyzes the comparative export competitiveness of the 10 countries with the highest exports of fisheries products in the world and Türkiye. Evaluations were made and policy recommendations were presented according to the findings obtained because of the competitiveness analyzes conducted by considering the sub-product groups of the fisheries sector.

There are many studies related to Normalized Revealed Comparative Advantages (NRCA) analysis in the literature (Demir et al., 2024; Erkan and Bozduman 2022; Aydemir, 2022; Fakhrudin et al., 2019). In addition, there is a very widespread literature on aquaculture. When the literature is examined, it is seen that competitiveness analyses have been made both on a specific product basis and in the context of aquaculture products in general. Some of these analyses are related to export competitiveness and some to domestic competitiveness. Consequently, many different economic, mathematical and statistical methods have been used in the relevant scientific publications to conduct competitiveness analyses.

Galvão et al. (2005), Somasekharan et al. (2013), Carrazco-Escalante et al. (2024), Khan et al. (2023), Ismail et al. (2013) have conducted studies on shrimp competitiveness. Among these studies, Galvão et al. (2005) analyzed the competitiveness of marinated shrimp in his study on the northern region of Brazil using the Pearson chi-square statistic test. According to the results, 41% of shrimp producers face aggressive competition in the market and the environmental impacts of the activity in question were not high. Khan et al. (2023) analyzed the shrimp export competitiveness of Bangladesh, China, India, Indonesia, Thailand, and Vietnam using the symmetric model of Balassa's RCA index (RSCA). They also used the dynamic Autoregressive Distributed Lagged (ARDL) model. The mentioned countries generally had shrimp export competitive advantage. However, China had completely lost its competitiveness especially after 2004.

Ismail and Abdullah (2013) analyzed the shrimp export competitiveness of Malaysia and some selected ASEAN countries using relative trade advantage indices. Malaysia and Thailand maintained their export competitiveness in fresh shrimp and Indonesia maintained their export competitiveness in canned shrimp exports. Carrazco-Escalante et al. (2024) used a multiple linear regression analysis method. For this purpose, they examined the effect of Information Absorption Capacity and its dimensions on the competitiveness of shrimp producing firms in Mexico. There was a direct relationship between the dimensions of information absorption capacity and competitiveness. Somasekharan et al. (2013) studied the cephalopod competitiveness with shrimp in India using The Constant Market Share model. Cephalopod competitiveness was increasing, and shrimp competitiveness is decreasing.

Martinez et al. (2004) and Dai et al. (2020) examined the competitiveness of tilapia. They drew attention to the advantages of clustering on the subject. Relationships and connections between coexisting companies increase the competitiveness of the relevant product. Dai et al. (2020) analyzed the tilapia export competitiveness of China and Indonesia in the US market with the Constant Market Share (CMS) model. The results showed that Indonesia's competitiveness in the sector was higher than China.

Suryana and Nurmahendra (2021) investigated the competitiveness of ponds aquaculture in West Java Province. They used the Productivity Production per Land and Workforce method and stated that the competitiveness in the sector was high in the province in question. Girard and Daures (2015) analyzed the competitiveness of fisheries and aquaculture products in the EU. They used various cost and profitability analyses and stated that joint studies should be carried out and policy recommendations should be developed to increase the competitiveness of both sectors. Cao and Shen (2023) analyzed the competitiveness and convergence status of China's marine fish and aquaculture. According to the results obtained with the help of the S-convergence model and absolute b-convergence model, the competitiveness difference in marine fish farming in nine cities was decreasing and the sector was experiencing regional development. Engle and Stone (2013) analyzed UBD's aquaculture competitiveness with various cost analyses. The increase in the number and frequency of regulations in the sector led to increases in costs in the sector, affecting its competitiveness.

Destiningsih et al. (2020) analyzed Indonesia's fisheries export competitiveness using Trade Specialization Index (TSI), the RCA and Export Product Dynamics (EPD) methods. The competitiveness was gradually increasing, and it is thought that the fisheries sector will become one of the leading sectors in Indonesia in the future. Ali et al. (2024) analyzed Bangladesh's seafood competitiveness with the help of the RCA, RSCA, REC and UEP. The country had a low market share and had an average competitiveness compared to other Asian countries. Polymeros et al. (2005) analyzed the export competitiveness of Mediterranean countries using the RCA method. The relevant products had different levels of competitive advantage. Erokhin et al. (2021) analyzed the export competitiveness of Fish and Seafood of ASEAN countries with the help of the RCA, RTA, and Lafay index. Fish and seafood global competitiveness was generally positive for countries. However, it varies from country to country.

The objective of this study is to evaluate Türkiye's export performance in the fisheries sector on an international scale and to compare it with the performance of leading countries in the sector. In this context, an examination of Türkiye's fisheries exports was conducted from the perspective of competitiveness using the NRCA analysis. The study's objectives include the identification of the strengths and weaknesses of leading countries in the sector, such as China and Norway, and Türkiye. Additionally, it aims to develop policy recommendations that will increase export competitiveness.

MATERIALS AND METHODS

In the study, the NRCA method was used for the competitiveness analysis of the 10 countries that export the most in the world's fishing sector and Türkiye (according to 2023 export figures). For the export competitiveness analysis of the fisheries sector, the 5-digit Standard International Trade Classification (SITC) revision 3 for 42 fisheries products was used. The codes and names of the products are given in

Appendix 1. The data of the 42 products subject to analysis were obtained from the COMTRADE database of the World Integrated Trade Solution (WITS) website (COMTRADE, 2025). The NRCA is formulated as follows (X: export, i: country, j: relevant sector, w: world) (Wosiek and Visvizi, 2021):

$$NRCA_{ij} = (X_{ij}/X_w) - [(X_i.X_{wJ}) / X_w.X_w]$$

NRCA scores range from -0.25 to +0.25 (Deb and Sengupta, 2016). Negative scores indicate that the country has a competitive disadvantage in the export of the relevant sector. Positive scores indicate that the country has a comparative advantage and competitive advantage in the export of the relevant product. However, competitiveness is a relative concept and its interpretation is important. If the NRCA score of a country X is 0.001 and the NRCA score of country Y is 0.003, the export competitiveness of country Y in the relevant sector is 3 times that of country X (Sukmaya and Saptana, 2021).

RESULTS

This section of the study includes the analysis of the export competitiveness of the top 10 countries exporting fisheries products and Türkiye between 2000-2023. The countries subject to the analysis are China, Norway, Ecuador, Chile, India, Sweden, Spain, Canada, the Netherlands, Thailand and Türkiye. The analysis of the export competitiveness of these countries was carried out using the NRCA method, and arithmetic mean values were used for the analysis results. The highest and lowest values in the series were removed when calculating the averages. The aim here is to minimize the effects of negative and positive shocks that may affect the competitiveness scores for the years. However, only products with competitive advantages were specified in the analysis tables, and products with competitive disadvantages were not included.

Table 2 examines China's competitiveness in fisheries products. China has a competitive advantage in 32 of its 42 fisheries products. The products with the highest competitive advantage among the 32 products are frozen fish excluding liver and not classified elsewhere (coded 03428), dried octopus and squid (coded 03637), prepared and preserved fish (coded 03715), prepared and preserved crustaceans (coded 03721) and prepared and preserved molluscs (coded 03722).

Table 3 examines Norway's competitiveness in fisheries products. Norway has a competitive advantage in 31 of its 42 fisheries products. The products with the highest competitive advantage among the 31 products are fresh salmon/trout (coded 03412), frozen salmon and trout (coded 03421), frozen mackerel (coded 03426), fish fillet (coded 03451) and dried cod (coded 03511).

Table 4 examines the competitiveness of Ecuador in fisheries products. Ecuador has a competitive advantage in 22 of its 42 fisheries products. The products with the highest competitive advantage among the 22 products are frozen shrimp (coded 03611), prepared and preserved tuna (coded 03713), prepared and preserved fish not classified elsewhere (coded 03716).

Table 5 examines Chile's competitiveness in fisheries products. Chile has a competitive advantage in 24 of its 42 fisheries products. The products with the highest competitive advantage among the 24 products are fresh salmon/trout (coded 03412), frozen salmon and trout (coded 03421), fish fillet (coded 03451) and fish meat excluding fillet (coded 03455).

Table 6 examines India's competitiveness in fisheries products. India has competitive advantage in 21 out of 42 fisheries products. The products with the highest competitive advantage among the 21 products are frozen fish excluding liver (code 03428) and not elsewhere classified, frozen shrimp (code 03611), fresh octopus and squid (code 03633) and prepared and preserved crustaceans (code 03721).

Table 2. China's NRCA analysis results

P. Code	P. Name	NRCA	P. Code	P. Name	NRCA
03411	Fish, live	0.0000713	03611	Shrimps/prawns, frozen	0.0000575
03418	Fish, n.e.s fresh/chld	0.0000178	03619	Crustaceans n.e.s frozen	0.0000198
03419	Fish liver/roe, frsh/chld	0.0000025	03631	Oysters	0.0000011
03422	Fish, flat, frozen	0.0000086	03633	Octopus/squid, frsh/chld	0.0000110
03423	Tuna/skipjack/bonito, frz	0.0000228	03635	Shell fish n.e.s frsh/chld	0.0000277
03424	Herring/sardine/spratfrz	0.0000116	03637	Octopus/squid, frz/drd	0.0001254
03425	Cod, frozen, excliver/roe	0.0000005	03639	Shell fish n.e.s frz/drd/saltd	0.0000358
03426	Mackerel, frozen, exc roe	0.0000296	03711	Salmon, prepd/preserved	0.0000029
03428	Fish n.e.s frz exc liver/roe	0.0001575	03712	Herring etc prepd/presvd	0.0000085
03429	Fish liver/roe, frozen	0.0000041	03713	Tuna etc prepd/preserved	0.0000382
03455	Fish meat exc fillet, frz	0.0000292	03714	Mackerel prepd/preserved	0.0000212
03511	Cod, dried	0.0000034	03715	Fish nes prepd/preserved	0.0002578
03512	Fish fillets, dried/saltd	0.0000181	03716	Fish prepard, presvd n.e.s	0.0000592
03513	Fish (exc cod)dried/salted	0.0000129	03717	Caviar/substitutes	0.0000144
03521	Cod, salted, not drd/smkd	0.0000009	03721	Crustaceans, prepd/presvd	0.0002423
03529	Fish n.e.s salted, wet	0.0000013	03722	Molluscs, prepared/presvd	0.0002227

Source: It was calculated with data from the COMTRADE database.
Note: n.e.s = not elsewhere classified, frz = frozen, chld = chilled, frsh = fresh, exc = exclude, drd = dried, saltd = salted, smkd = smoked, presvd = preserved, prepd= prepared, etc= et cetera

Table 3. Norway's NRCA analysis results

P. Code	P. Name	NRCA	P. Code	P. Name	NRCA
03411	Fish, live	0.0000005	03451	Fish fillets/meat, frsh/chld	0.0001112
03412	Salmon/trout, fresh	0.0006855	03455	Fish meat excfillet, frz	0.0000203
03413	Fish, flat, fresh/chilled	0.0000046	03511	Cod, dried	0.0000592
03415	Herring/sardine/sprat	0.0000039	03512	Fish fillets, dried/saltd	0.0000062
03416	Cod, fresh/chilled	0.0000232	03513	Fish (exc cod)dried/salted	0.0000356
03417	Mackerel, fresh/chilled	0.0000016	03521	Cod, salted, not drd/smkd	0.0000211
03418	Fish, n.e.s fresh/chld	0.0000179	03522	Anchovies, salted, not dry	0.0000000
03419	Fish liver/roe, frsh/chld	0.0000002	03529	Fish n.e.s salted, wet	0.0000026
03421	Salmon/trout, frozen	0.0000469	03619	Crustaceans n.e.s frozen	0.0000021
03422	Fish, flat, frozen	0.0000089	03635	Shell fish nes, frsh/chld	0.0000002
03424	Herring/sardine/sprat, frz	0.0000351	03711	Salmon, prepd/preserved	0.0000007
03425	Cod, frozen, exc liver/roe	0.0000246	03712	Herring etc prepd/presvd	0.0000045
03426	Mackerel, frozen, exc roe	0.0000702	03716	Fish prepard, presvd n.e.s	0.0000012
03427	Hake, frozen, exc liver /roe	0.0000000	03717	Caviar/substitutes	0.0000002
03428	Fish n.e.s frzn exc liver/roe	0.0000350	03721	Crustaceans, prepd/presvd	0.0000061
03429	Fish liver/roe, frozen	0.0000028			

Source: It was calculated with data from the COMTRADE database.
Note: n.e.s = not elsewhere classified, frz = frozen, chld = chilled, frsh = fresh, exc = exclude, drd = dried, saltd = salted, smkd = smoked, presvd = preserved, prepd= prepared, etc= et cetera

Table 4. Ecuador's NRCA analysis results

P. Code	P. Name	NRCA	P. Code	P. Name	NRCA
03411	Fish, live	0.0000001	03455	Fish meat excfillet, frz	0.0000036
03413	Fish, flat, fresh/chilled	0.0000001	03513	Fish (exc cod)dried/salted	0.0000002
03414	Tuna/bonito	0.0000023	03611	Shrimps/prawns, frozen	0.0001262
03418	Fish, n.e.s fresh/chld	0.0000062	03639	Shell fish n.e.s frz/drd/saltd	0.0000001
03422	Fish, flat, frozen	0.0000004	03712	Herring etc prepd/presvd	0.0000073
03423	Tuna/skipjack/bonito, frz	0.0000032	03713	Tuna etc prepd/preserved	0.0001072
03424	Herring/sardine/sprat, frz	0.0000001	03714	Mackerel prepd/preserved	0.0000006
03426	Mackerel, frozen, exc roe	0.0000009	03715	Fish n.e.s prepd/preserved	0.0000018
03427	Hake, frozen, exc liver/roe	0.0000004	03716	Fish prepard, presvd n.e.s	0.0000189
03428	Fish n.e.s, frz exc liver/roe	0.0000050	03717	Caviar/substitutes	0.0000011
03451	Fish fillets/meat, frsh/chld	0.0000050	03721	Crustaceans, prepd/presvd	0.0000025

Source: It was calculated with data from the COMTRADE database.
Note: n.e.s = not elsewhere classified, frz = frozen, chld = chilled, frsh = fresh, exc = exclude, drd = dried, saltd = salted, smkd = smoked, presvd = preserved, prepd= prepared, etc= et cetera

Table 5. Chile's NRCA analysis results

P. Code	P. Name	NRCA	P. Code	P. Name	NRCA
03412	Salmon/trout, fresh	0.0000616	03529	Fish n.e.s salted, wet	0.0000005
03413	Fish, flat, fresh/chilled	0.0000001	03619	Crustaceans n.e.s frozen	0.0000029
03418	Fish, n.e.s fresh/chld	0.0000055	03631	Oysters	0.0000002
03421	Salmon/trout, frozen	0.0001647	03635	Shell fish n.e.s, frsh/chld	0.0000013
03427	Hake, frozen, exc liver/roe	0.0000050	03637	Octopus/squid, frz/dry	0.0000025
03428	Fish n.e.s, frz exc liver/roe	0.0000244	03639	Shell fish n.e.s, frz/drd/saltd	0.0000129
03429	Fish liver/roe, frozen	0.0000004	03711	Salmon, prepd/preserved	0.0000033
03451	Fish fillets/meat, frsh/chld	0.0001307	03714	Mackerel prepd/preserved	0.0000002
03455	Fish meat exc fillet, frz	0.0000460	03715	Fish n.e.s prepd/preserved	0.0000082
03512	Fish fillets, dried/saltd	0.0000003	03716	Fish prepd, presvd n.e.s	0.0000010
03513	Fish (exc cod)dried/salted	0.0000001	03721	Crustaceans, prepd/presvd	0.0000051
03522	Anchovies, salted, not dry	0.0000001	03722	Molluscs, prepared/presvd	0.0000336

Source: It was calculated with data from the COMTRADE database.
Note: n.e.s = not elsewhere classified, frz = frozen, chld = chilled, frsh = fresh, exc = exclude, drd = dried, saltd = salted, smkd = smoked, presvd = preserved, prepd= prepared, etc= et cetera

Table 6. India's NRCA analysis results

P. Code	P. Name	NRCA	P. Code	P. Name	NRCA
03412	Salmon/trout, fresh	0.0000001	03513	Fish (exc cod)dried/salted	0.0000019
03414	Tuna/bonito	0.0000002	03529	Fish n.e.s salted, wet	0.0000006
03417	Mackerel, fresh/chilled	0.0000001	03611	Shrimps/prawns, frozen	0.0002191
03418	Fish, n.e.s fresh/chld	0.0000035	03619	Crustaceans n.e.s frozen	0.0000050
03421	Salmon/trout, frozen	0.0000004	03633	Octopus/squid, frsh/chld	0.0000146
03422	Fish, flat, frozen	0.0000013	03637	Octopus/squid, frz/dry	0.0000281
03423	Tuna/skipjack/bonito, frz	0.0000050	03639	Shell fish n.e.s frz/drd/saltd	0.0000012
03424	Herring/sardine/sprat, frz	0.0000001	03716	Fish prepd, presvd n.e.s	0.0000056
03426	Mackerel, frozen, excroe	0.0000045	03721	Crustaceans, prepd/presvd	0.0000332
03428	Fish n.e.s frz exc liver/roe	0.0000598	03722	Molluscs, prepared/presvd	0.0000006
03455	Fish meat exc fillet, frz	0.0000160			

Source: It was calculated with data from the COMTRADE database.
Note: n.e.s = not elsewhere classified, frz = frozen, chld = chilled, frsh = fresh, exc = exclude, drd = dried, saltd = salted, smkd = smoked, presvd = preserved, prepd= prepared, etc= et cetera

Table 7 examines Sweden's competitiveness in fisheries products. Sweden has a competitive advantage in 24 of its 42 fisheries products. The products with the highest competitive advantage among the 24 products are fresh salmon/trout (coded 03412), fish fillet (coded 03451) and dried cod (coded 03511).

Table 8 examines Spain's competitiveness in fisheries products. Spain has a competitive advantage in 40 out of 42

fisheries products. In other words, it has a competitive power in almost all its 5-digit fisheries products.

The products with the highest competitive advantage among the 40 products are tuna and bonito (coded 03414), fish not classified elsewhere (coded 03418), frozen fish except liver and not classified elsewhere (coded 03428), frozen shrimp (coded 03611), dried octopus and squid (coded 03637) and prepared and preserved tuna (coded 03713).

Table 7. Sweden's NRCA analysis results

P. Code	P. Name	NRCA	P. Code	P. Name	NRCA
03411	Fish, live	0.0000001	03455	Fish meat exc fillet, frz	0.0000002
03412	Salmon/trout, fresh	0.0003120	03511	Cod, dried	0.0000242
03413	Fish, flat, fresh/chilled	0.0000006	03512	Fish fillets, dried/saltd	0.0000021
03415	Herring/sardine/sprat	0.0000047	03521	Cod, salted, not drd/smkd	0.0000121
03416	Cod, fresh/chilled	0.0000088	03529	Fish n.e.s salted, wet	0.0000001
03417	Mackerel, fresh/chilled	0.0000004	03711	Salmon, prepd/preserved	0.0000016
03418	Fish, n.e.s fresh/chld	0.0000046	03712	Herring etc prepd/presvd	0.0000036
03419	Fish liver/roe, frsh/chld	0.0000001	03714	Mackerel prepd/preserved	0.0000020
03421	Salmon/trout, frozen	0.0000001	03715	Fish n.e.s prepd/preserved	0.0000014
03424	Herring/sardine/sprat, frz	0.0000024	03716	Fish prepd, presvd n.e.s	0.0000022
03425	Cod, frozen, exc liver/roe	0.0000021	03717	Caviar/substitutes	0.0000022
03451	Fish fillets/meat, frsh/chld	0.0000332	03721	Crustaceans, prepd/presvd	0.0000011

Source: It was calculated with data from the COMTRADE database.
Note: n.e.s = not elsewhere classified, frz = frozen, chld = chilled, frsh = fresh, exc = exclude, drd = dried, saltd = salted, smkd = smoked, presvd = preserved, prepd= prepared, etc= et cetera

Table 8. Spain's NRCA analysis results

P. Code	P. Name	NRCA	P. Code	P. Name	NRCA
03411	Fish, live	0.0000081	03511	Cod, dried	0.0000027
03412	Salmon/trout, fresh	0.0000001	03512	Fish fillets, dried/saltd	0.0000020
03413	Fish, flat, fresh/chilled	0.0000083	03513	Fish (exc cod)dried/salted	0.0000013
03414	Tuna/bonito	0.0000150	03521	Cod, salted, not drd/smkd	0.0000021
03415	Herring/sardine/sprat	0.0000028	03522	Anchovies, salted, not dry	0.0000021
03416	Cod, fresh/chilled	0.0000002	03529	Fish n.e.s salted, wet	0.0000002
03417	Mackerel, fresh/chilled	0.0000024	03611	Shrimps/prawns, frozen	0.0000222
03418	Fish, n.e.s fresh/chld	0.0000421	03619	Crustaceans n.e.s frozen	0.0000038
03419	Fish liver/roe, frsh/chld	0.0000002	03631	Oysters	0.0000001
03421	Salmon/trout, frozen	0.0000005	03633	Octopus/squid, frsh/chld	0.0000061
03422	Fish, flat, frozen	0.0000090	03635	Shell fish n.e.s, frsh/chld	0.0000081
03423	Tuna/skipjack/bonito, frz	0.0000416	03637	Octopus/squid, frz/dry	0.0000500
03424	Herring/sardine/sprat, frz	0.0000044	03639	Shell fish n.e.s, frz/drd/saltd	0.0000073
03425	Cod, frozen, exc liver/roe	0.0000027	03712	Herring etc prepd/presvd	0.0000014
03426	Mackerel, frozen, exc roe	0.0000054	03713	Tuna etc prepd/preserved	0.0000720
03427	Hake, frozen, exc liver/roe	0.0000170	03714	Mackerel prepd/preserved	0.0000015
03428	Fish n.e.s, frz exc liver/roe	0.0000339	03715	Fish n.e.s prepd/preserved	0.0000076
03429	Fish liver/roe, frozen	0.0000003	03716	Fish prepd, presvd n.e.s	0.0000200
03451	Fish fillets/meat, frsh/chld	0.0000092	03717	Caviar/substitutes	0.0000005
03455	Fish meat exc fillet, frz	0.0000099	03722	Molluscs, prepared/presvd	0.0000197

Source: It was calculated with data from the COMTRADE database.
Note: n.e.s = not elsewhere classified, frz = frozen, chld = chilled, frsh = fresh, exc = exclude, drd = dried, saltd = salted, smkd = smoked, presvd = preserved, prepd= prepared, etc= et cetera

Table 9 examines Canada's competitiveness in fisheries products. Canada has a competitive advantage in 27 of its 42 fisheries products. The products with the highest competitive advantage among the 27 products are fresh salmon/trout (coded 03412), frozen crustaceans not classified elsewhere (coded 03619), frozen fish excluding liver not classified elsewhere (coded 03428) and prepared and preserved crustaceans (coded 03721).

Table 10 examines the competitiveness of the Netherlands in fisheries products. The Netherlands has a competitive advantage in 27 of its 42 fisheries products. The products with the highest competitive advantage among the 27 products are fresh and chilled flatfish (code 03413), frozen fish excluding

liver (code 03428) and not elsewhere classified, fish fillet (code 03451), fish not elsewhere classified (code 03635) and crustaceans (code 03721), prepared and preserved crustaceans (code 03721).

Table 11 examines Thailand's competitiveness in fisheries products. Thailand has competitive advantages in 25 of its 42 fisheries products. The products with the highest competitive advantage among the 25 products are frozen shrimp (coded 03611), dried octopus and squid (coded 03637), prepared and preserved tuna (coded 03713), prepared and preserved crustaceans (coded 03721).

Table 12 examines Türkiye's competitiveness in fisheries

products. Türkiye has a competitive advantage in 14 of its 42 fisheries products. The products with the highest competitive advantage among the 14 products are fish not classified elsewhere (coded 03418) and fish fillet (coded 03451).

Table 9. Canada's NRCA analysis results

P. Code	P. Name	NRCA	P. Code	P. Name	NRCA
03411	Fish, live	0.0000012	03512	Fish fillets, dried/saltd	0.0000028
03412	Salmon/trout, fresh	0.0000687	03513	Fish (exc cod) dried/salted	0.0000010
03413	Fish, flat, fresh/chilled	0.0000111	03521	Cod, salted, not drd/smkd	0.0000009
03418	Fish, n.e.s fresh/chld	0.0000056	03529	Fish n.e.s salted, wet	0.0000024
03419	Fish liver/roe, frsh/chld	0.0000001	03611	Shrimps/prawns, frozen	0.0000179
03421	Salmon/trout, frozen	0.0000023	03619	Crustaceans n.e.s frozen	0.0001045
03422	Fish, flat, frozen	0.0000073	03631	Oysters	0.0000030
03424	Herring/sardine/sprat, frz	0.0000002	03635	Shell fish n.e.s, frsh/chld	0.0000222
03426	Mackerel, frozen, exc roe	0.0000003	03639	Shell fish n.e.s, frz/drd/saltd	0.0000120
03427	Hake,frozen,exc liver/roe	0.0000060	03711	Salmon, prepd/preserved	0.0000046
03428	Fish n.e.s, frz exc liver/roe	0.0000042	03712	Herring etc prepd/presvd	0.0000042
03429	Fish liver/roe, frozen	0.0000032	03715	Fish n.e.s prepd/preserved	0.0000008
03451	Fish fillets/meat, frsh/chld	0.0000197	03721	Crustaceans, prepd/presvd	0.0000418
03511	Cod, dried	0.0000004			

Source: It was calculated with data from the COMTRADE database.
Note: n.e.s = not elsewhere classified, frz = frozen, chld = chilled, frsh = fresh, exc = exclude, drd = dried, saltd = salted, smkd = smoked, presvd = preserved, prepd= prepared, etc= et cetera

Table 10. Netherlands' NRCA analysis results

P. Code	P. Name	NRCA	P. Code	P. Name	NRCA
03411	Fish, live	0.0000029	03611	Shrimps/prawns, frozen	0.0000086
03413	Fish, flat, fresh/chilled	0.0000234	03619	Crustaceans n.e.s frozen	0.0000015
03415	Herring/sardine/sprat	0.0000001	03631	Oysters	0.0000021
03416	Cod, fresh/chilled	0.0000014	03635	Shell fish n.e.s frsh/chld	0.0000265
03417	Mackerel, fresh/chilled	0.0000005	03639	Shell fish n.e.s frz/drd/saltd	0.0000009
03418	Fish, n.e.s fresh/chld	0.0000200	03711	Salmon, prepd/preserved	0.0000009
03422	Fish, flat, frozen	0.0000098	03712	Herring etc prepd/presvd	0.0000020
03424	Herring/sardine/sprat, frz	0.0000226	03713	Tuna etc prepd/preserved	0.0000163
03425	Cod, frozen, exc liver/roe	0.0000055	03714	Mackerel prepd/preserved	0.0000003
03426	Mackerel, frozen, exc roe	0.0000194	03715	Fish n.e.s prepd/preserved	0.0000114
03428	Fish n.e.s, frz exc liver/roe	0.0000335	03716	Fish prepd, presvd n.e.s	0.0000006
03451	Fish fillets/meat, frsh/chld	0.0000448	03721	Crustaceans, prepd/presvd	0.0000397
03455	Fish meat exc fillet, frz	0.0000017	03722	Molluscs, prepared/presvd	0.0000068
03529	Fish n.e.s salted, wet	0.0000013			

Source: It was calculated with data from the COMTRADE database.
Note: n.e.s = not elsewhere classified, frz = frozen, chld = chilled, frsh = fresh, exc = exclude, drd = dried, saltd = salted, smkd = smoked, presvd = preserved, prepd= prepared, etc= et cetera

Table 11. Thailand's NRCA analysis results

P. Code	P. Name	NRCA	P. Code	P. Name	NRCA
03411	Fish, live	0.0000036	03633	Octopus/squid, frsh/chld	0.0000006
03414	Tuna/bonito	0.0000013	03635	Shell fish n.e.s frsh/chld	0.0000008
03417	Mackerel, fresh/chilled	0.0000002	03637	Octopus/squid, frz/dry	0.0000439
03418	Fish, n.e.s fresh/chld	0.0000030	03639	Shell fish n.e.s frz/drd/saltd	0.0000053
03423	Tuna/skipjack/bonito, frz	0.0000034	03711	Salmon, prepd/preserved	0.0000147
03428	Fish n.e.s frz exc liver/roe	0.0000127	03712	Herring etc prepd/presvd	0.0000200
03451	Fish fillets/meat, frsh/chld	0.0000004	03713	Tuna etc prepd/preserved	0.0002904
03455	Fish meat exc fillet, frz	0.0000216	03714	Mackerel prepd/preserved	0.0000097
03513	Fish (exc cod)dried/salted	0.0000077	03715	Fish n.e.s prepd/preserved	0.0000068
03522	Anchovies, salted, not dry	0.0000001	03716	Fish prepd, presvd n.e.s	0.0000339
03529	Fish n.e.s salted, wet	0.0000004	03721	Crustaceans, prepd/presvd	0.0001776
03611	Shrimps/prawns, frozen	0.0001333	03722	Molluscs, prepared/presvd	0.0000125
03619	Crustaceans n.e.s frozen	0.0000024			

Source: It was calculated with data from the COMTRADE database.
Note: n.e.s = not elsewhere classified, frz = frozen, chld = chilled, frsh = fresh, exc = exclude, drd = dried, saltd = salted, smkd = smoked, presvd = preserved, prepd= prepared, etc= et cetera

Table 12. Türkiye's NRCA analysis results

P. Code	P. Name	NRCA	P. Code	P. Name	NRCA
03411	Fish, live	0.0000002	03633	Octopus/squid, frsh/chld	0.0000001
03412	Salmon/trout, fresh	0.0000011	03635	Shell fish n.e.s frsh/chld	0.0000003
03414	Tuna/bonito	0.0000073	03639	Shell fish n.e.s frz/drd/saltd	0.0000014
03418	Fish, n.e.s fresh/chld	0.0000350	03715	Fish n.e.s prepd/preserved	0.0000001
03421	Fish, n.e.s fresh/chld	0.0000074	03716	Fish prepd, presvd n.e.s	0.0000028
03428	Fish fillets/meat, frsh/chld	0.0000031	03721	Crustaceans, prepd/presvd	0.0000007
03451	Fish meat exc fillet, frz	0.0000087	03722	Molluscs, prepared/presvd	0.0000012

Source: It was calculated with data from the COMTRADE database.
Note: n.e.s = not elsewhere classified, frz = frozen, chld = chilled, frsh = fresh, exc = exclude, drd = dried, saltd = salted, smkd = smoked, presvd = preserved, prepd= prepared, etc= et cetera

DISCUSSION

In the study, the 10 countries that export the most fisheries products in the world (based on the year 2023) and Türkiye's export competitiveness were analyzed using the NRCA method. The analysis was based on 5 digit 42 products in the SITC Rev. 3 category. The findings are included in the empirical results section of the study. The findings generally show that China, Norway, Ecuador, Chile and Sweden have a significant advantage in the competitiveness of fisheries products exports compared to other countries. In particular, the richness of natural resources and geographical location of these countries play an important role in both the production and export of many fisheries products. In addition, the branding of some fisheries products (such as Norwegian salmon) by countries with high competitiveness greatly increases the production and export of fisheries products.

Many studies analyzed the competitiveness of marine or lake aquatic products in general, rather than specific products. Examples include Khanal and Deb (2022), Yıldırım et al. (2022), Huu (2018), Tri and Thanh (2022), Alsaleh et al. (2024), Klasra and Fidan (2005), Destiningsih et al. (2020), Ali et al. (2024), Polymeros et al. (2005), Erokhin et al. (2021).

Khanal and Deb (2022) analyzed India's export competitiveness of fish and crustaceans, mollusks, and other aquatic invertebrates using Balassa and Vollrath indices. India gained competitive advantage in the export of frozen fish, shellfish, and mollusks. However, it had a competitive disadvantage in the export of live fish, fresh and chilled fish, fish fillets, and other fish meat, and dried/salted/pickled and smoked fish. Yıldırım et al. (2022) analyzed the competitiveness of the aquaculture industry in Türkiye with the help of the data envelopment method and the Malmquist efficiency index. Türkiye's export competitiveness in the sector was weak. However, it had a relative advantage over the EU countries. Huu (2018) measured Vietnam's seafood competitiveness by interviewing seafood export enterprises and using factor analysis. Both export and competitiveness in the sector were increasing. More creativity and entrepreneurship were needed to increase global competitiveness.

Tri and Thanh (2022) analyzed the seafood competitiveness of Mekong Delta, Vietnam, through interviews with 200 people in 200 sectors. The competitiveness of Mekong Delta food exporters was weak, and policies should be implemented to improve competitiveness in the sector. Alsaleh et al. (2024) analyzed the competitiveness of the fishing industry of 27 EU countries using Panel Cointegration. The results show that the EU14 developed countries had a higher level of competitiveness than the EU13 underdeveloped countries, which significantly benefits sustainability in the sector. Klasra and Fidan (2005) analyzed the competitiveness of fisheries in 13 selected countries with the CMS model. Denmark, Netherlands and Türkiye were relatively low competitive countries and their market shares in exports were decreasing.

Uzmanoğlu and Arslan (2020), Demir and Aksoy (2021), Suryana and Nurmahendra (2021), Girard and Daures (2015), Cao and Shen (2023), Engle and Stone (2013) also analyzed the competitiveness of aquaculture. Uzmanoğlu and Arslan (2020) analyzed the competitiveness of the marine fish culture industry in Türkiye with factor analysis. Sales price, speed and financial power stood out as the most important components of competition. Demir and Aksoy (2021) analyzed the export competitiveness of Türkiye, China, Indonesia, India, Peru, and Russia using the RCA and Vollrath Relative Export Advantage Index (RXA). Indonesia and India, in particular stand out as countries with higher competitiveness in the sector.

The results of the study are consistent with many studies in the literature. In particular, the findings of Yıldırım et al. (2022), Uzmanoğlu and Arslan (2020), Demir and Aksoy (2021) and Klasra and Fidan (2005) also indicate low competitiveness in Türkiye's fisheries sector.

NRCA results, not all countries have a competitive advantage. This shows that the market is in fact competitive in the relevant products. In addition, countries that stand out in the rankings among themselves can be said to have a relative competitive advantage, such as China, and a relative competitive disadvantage for countries such as Türkiye.

CONCLUSION

Some of the countries in the analysis have more competitiveness in more products, while some have less competitiveness in fewer products. Among these 11 countries, China has a competitive advantage in 32 products, Norway in 31, Ecuador in 22, Chile and Sweden in 24, India in 21, Spain in 40, Canada and the Netherlands in 27, Thailand in 25, and Türkiye in 14. In this case, it is possible to say that Spain has competitive power in almost all the products analyzed. Spain stands out positively from other countries. However, when the exports and imports of the analyzed countries in 2023 in fisheries products are examined (Table 1), it is seen that Spain has much more imports than exports. The fact that Spain's imports in the fisheries sector are more than its exports and that it has competitiveness in 40 of the 42 products indicates that the production in the country is only for export. This situation shows that there may be some deficiencies or imbalances in the domestic market. Thus, examining only the exports of a country quantitatively may be insufficient in terms of understanding the existence of competitiveness. Because, according to Table 1, Türkiye's exports in fisheries products are much higher than its imports in the same sector, but it has competitiveness in only 14 out of 42 products. This situation causes Türkiye to be negatively differentiated from the countries in question and puts it in the position of the country with the least competitive advantage compared to other countries.

For countries to increase their global competitiveness in the field of fishing, they need to implement certain policies that consider climate change. As a result of climate change, there may be a decrease in product quality in the fishing sector, and the quality of fresh fish or seafood may be negatively affected due to temperature changes and pollution. This situation may

negatively affect the production and export of countries in this sector. In addition, disruptions in supply chains in the fishing sector due to climate change make it difficult to catch some fish species, which may lead to a decrease in the competitiveness of countries in international markets.

In this context, countries reducing these impacts with sustainable methods and innovative solutions will positively affect export competitiveness. For example, the use of AI technologies in a framework that prioritizes sustainable development can help make fishing activities more efficient and monitor fish populations and production. In addition, countries need to increase cooperation between countries and protect the fishing sector to combat climate change at the international level. Therefore, governments can encourage more efficient use of resources related to the fishing sector and the spread of environmentally friendly methods by developing international agreements and cooperation policies.

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AUTHORSHIP CONTRIBUTIONS

Elif Tuğçe Bozduman organized and analyzed the data and interpreted the results of the analysis. Birol Erkan, on the other hand, prepared the introduction, literature and methodology sections. The final version of the study was reviewed and approved by all authors.

CONFLICT OF INTEREST

There is no conflict of interest.

ETHICS APPROVAL

There is no need for any ethical approval for this study.

DECLARATION OF USING AI

The idea of the article title (revision requested) was generated by the ChatGPT-5 AI program and adapted to the content of the study by the authors.

DATA AVAILABILITY

Authors can be contacted about the data sets.

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Appendix 1: SITC Rev. 3, 5-digit fisheries products

Product Code	Product Name
03411	Fish, live
03412	Salmon/trout, fresh
03413	Fish, flat, fresh/chilled
03414	Tuna/bonito
03415	Herring/sardine/sprat
03416	Cod, fresh/chilled
03417	Mackerel, fresh/chilled
03418	Fish, n.e.s fresh/chld
03419	Fish liver/roe, frsh/chld
03421	Salmon/trout, frozen
03422	Fish, flat, frozen
03423	Tuna/skipjack/bonito, frz
03424	Herring/sardine/sprat, fz
03425	Cod, frozen, exc liver/roe
03426	Mackerel, frozen, exc roe
03427	Hake, frozen, exc liver/roe
03428	Fish n.e.s, frzn exc liver/roe
03429	Fish liver/roe, frozen
03451	Fish fillets/meat, frsh/chld
03455	Fish meat exc fillet, frz
03511	Cod, dried
03512	Fish fillets, dried/saltd
03513	Fish (exc cod)dried/salted
03521	Cod, salted, not drd/smkd
03522	Anchovies, salted, not dry
03529	Fish n.e.s salted, wet
03611	Shrimps/prawns, frozen
03619	Crustaceans n.e.s frozen
03631	Oysters
03633	Octopus/squid, frsh/chld
03635	Shell fish n.e.s frsh/chld
03637	Octopus/squid, frz/dry
03639	Shell fish n.e.s, frz/drd/salted
03711	Salmon, prepd/preserved
03712	Herring etc prepd/presvd
03713	Tuna etc prepd/preserved
03714	Mackerel prepd/preserved
03715	Fish n.e.s prepd/preserved
03716	Fish prepard, presvd n.e.s
03717	Caviar/substitutes
03721	Crustaceans, prepd/presvd
03722	Molluscs, prepared/presvd

Source: (COMTRADE, 2025)