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Regional Industrial Specialization in Fishing and Aquaculture (2007-2022)

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Abstract: The fishing and aquaculture industry is one of the most ancient economic activities. Its origins even predate the Neolithic revolution. It can operate in a wide range of areas from the seashore to inland waters such as rivers, lakes, ponds, and dams. The aim of this study is to analyze the development of regional industrial specialization in the fishing and aquaculture industry over the last two decades. In the application part of the study, the location quotient was used as the statistical technique. The data were compiled from the SGK statistical yearbooks at NUTS 3 (provinces) level for the years 2007, 2012, 2017 and 2022. Regional industrial specialization clusters were identified according to the location quotient limit values. The number of provinces in regional industrial specialization clusters, the number of workers employed, and their weights are reported. To visually identify the change in regional industrial agglomeration for four five-year periods, a mapping study based on provinces was carried out on the map of Turkey at NUTS 3 level. The findings show a more than three-fold increase in employment in the fishing and aquaculture industry over two decades. It was observed that employment in this industry was predominantly concentrated in the full regional industrial specialization cluster (LQ≥3). The mapping study also concluded that there has been an increase in the agglomeration of the fishing and aquaculture industry from inland waters to coastal areas over two decades. In summary, a transformation is observed with a significant increase in industrial activities in the sea instead of industrial activities in inland rivers, lakes, ponds, and dams.

Keywords: Fishing and aquaculture, regional industrial specification, Regional cluster, Location quotient, Labor economics, Social politics.

Balıkçılık ve Su Ürünleri Yetiştiriciliğinde Bölgesel Endüstriyel Uzmanlaşma (2007-2022)

Özet: Balıkçılık ve Su Ürünleri Yetiştiriciliğinde endüstrisi en kadim ekonomik faaliyet alanlarından olup kökenleri neolitik devrimin öncesine dayanmaktadır. Deniz kıyısından nehir, göl, gölet, barajların yer aldığı iç sulara kadar geniş bir alanda faaliyet gösterilebilir. Bu çalışmanın amacı, balıkçılık ve su ürünleri yetiştiriciliği endüstrisinde son yirmi yılda yaşanan bölgesel endüstriyel uzmanlaşma gelişimini analiz etmektir. Çalışmanın uygulama kısmında istatistik teknik olarak lokasyon katsayısı kullanılmıştır. Veriler SGK istatistik yıllıklarından 2007, 2012, 2017 ve 2022 yılları için NUTS 3 (iller) düzeyinde derlenmiştir. Lokasyon katsayı sınır değerlerine göre bölgesel endüstriyel uzmanlaşma kümeleri tespit edilmiştir. Bölgesel endüstriyel uzmanlaşma kümelerinde yer alan il sayıları, istihdam edilen işçi sayıları ve ağırlıkları raporlanmıştır. Beşer yıllık dört dönem için bölgesel endüstriyel yığılmanın değişimini görsel olarak da tespit için İBBS 3 düzeyinde Türkiye haritasında illere dayalı haritalama çalışması gerçekleştirildi. Elde edilen bulgular, fishing and aquaculture endüstrisinde yirmi yılda üç katı aşan istihdam artışını göstermiştir. Bu endüstride ağırlıklı olarak tam bölgesel endüstriyel uzmanlaşma kümesinde (LQ≥3) istihdamın yığıldığı gözlendi. Ayrıca haritalama çalışmasında da yirmi yılda fishing and aquaculture endüstrisinde iç sulardan kıyılara doğru yığılmada artış yaşandığı sonucuna ulaşılmıştır. Özetle iç sulardaki nehir, göl, gölet, barajlardaki endüstriyel faaliyetler yerine denizde endüstriyel faaliyetlerde belirgin artışın yaşandığı bir dönüşüm gözlenmektedir.

Anahtar Kelimeler: Balıkçılık ve su ürünleri yetiştiriciliği, Bölgesel uzmanlaşma, Bölgesel kümelenme, Lokasyon katsayısı, Çalışma ekonomisi, Sosyal politika

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1. Introduction

Fishing is an ancient activity dating back to before the Neolithic revolution. It is the main activity of the hunting and gathering period. It maintained its importance after the Neolithic revolution. However, it has started to lose its former vitality with the increasing urbanization since the Industrial Revolution. With the transition to the information society, the use of technology in the fishing and aquaculture industry has increased day by day, just as the agricultural sector has internalized technological advances, but this increase has not allowed for a general increase in employment. Today, fishing is carried out with vessels using advanced technology compared to the past. Aquaculture, although not as old as fishing, is an industry with a history of nearly five thousand years, with origins dating back to 2000 BC. Production started in China and continued in the Roman period with fish farming in ponds built on the coast. As the 21st century approached, aquaculture has reached half of the amount supplied by fishing. Especially since the 1980s, the demand for aquaculture products has gradually increased and new strategies and practices in aquaculture have contributed to the rapid development of this very old culture (Başçınar, 2004).

The fishing and aquaculture industry in Turkey has experienced a rapid acceleration, especially in the last two decades. The number of workers employed in the industry has more than tripled in just two decades. In the same period, the overall increase in the number of employed workers was more than doubling. Thus, employment growth in the fishing and aquaculture industry has been much higher than overall employment growth in the country. However, the share of workers employed in this industry in the total number of employed workers does not reach 1/1000. In a country surrounded by seas on three sides, it is expected to have a much higher weight even if it is not the main economic activity. This situation supports the fact that the employment potential in the fishing and aquaculture industry is extremely high.

The existence of high potential despite rapid industrial progress was the first motivation for the study. The second motivation was to raise awareness of the divergence of industrial progress between coastal and inland areas. The third motivation was to identify whether the regional industrial specialization in the fishing and aquaculture industry has progressed in developed metropolitan areas or in medium and small cities. Thus, the aim of the study is to contribute to the literature by analyzing the development of regional industrial specialization in the fishing and aquaculture industry between 2007 and 2022, which is still a weak industrial area despite its rapid acceleration in the last two decades.

2. Materials and Methods

The study used the number of workers employed in the fishing and aquaculture industry by province. Data were collected from SGK statistical yearbooks for four different years (SGK, 2007, 2012, 2017, 2022). The statistical method used in the applications is the coefficient of location technique. The location quotient is a well-established analysis technique. This technique was first devised as a "location quotient" by P. Sargent Florence, and then, it was used for estimating that industrial location in USA by National Resources Planning Board in 1943 (Mattila, & Thompson, 1955). The location quotient technique is commonly used to analyze the level of industrial regional agglomeration based on employment data. However, over time, in addition to analyses based on employment data, analyses based on many different data such as production, income, wealth, migration, race, and crime types have started to be carried out with the location quotient technique. In this study, the classical location quotient technique (LQ) was used to analyze regional industrial specialization based on employment data.

The value of the location quotient is calculated according to the following formulation:

$$LQ_{i,j} = \frac{E_{i,j}/E_{i,n}}{E_j/E_n} \qquad (1)$$

$LQ_{i,j}$ is the coefficient that gives the specialization value in industry $_j$ in province i. $E_{i,j}$ stands for the number of jobs in industry j in province i, $E_{i,n}$ stands for total employment in province i, E_j stands for employment in industry j in the whole country, E_n stands for total employment in the country (Çiftçi & Çiftçi, 2020).

In studies where the location quotient is used, it is an important issue of debate what the boundaries for the level of regional industrial specialization should be. The first study prepared to determine the limits that will determine the level of regional industrial specialization belongs to Miller et al. (1991). In this study, it was stated that the location quotient value should be at least 0.70 for regional industrial specialization to start, even at a low level. There are many studies that argue that the location quotient value should be at least 1.25 for regional industrial specialization to take place, this value should reach 2 for high regional industrial specialization, and the LQ should take at least 3 for full regional industrial specialization. Based on the literature on the

determination of cut-off values in regional industrial specialization, Çiftçi & Çiftçi (2020) identified five clusters. The five different regional industrial specialization clusters are as follows:

LQ<0.70 => Regional industrial specialization has not started.

0.70≤LQ<1.25 => There is low regional industrial specialization.

1.25≤LQ<2 => Regional industrial specialization has started

2≤LQ<3 => There is high regional industrial specialization.

3≤LQ => There is full regional industrial specialization.

3. Results

LQ values were between 0 and 30.58 in 2007. While the average was 1.57, the median value among 81 provinces was 0.32. LQ2007 showed a significant decrease compared to the values in the following years compared to the maximum. LQ2012 decreased to 22.42, LQ2017 decreased to 20.81 and LQ2022 decreased to 20.55. The value of 0, indicating no industrial activity, remained the minimum value in all four years. LQ mean values were close to each other, ranging from 1.47 to 1.64. The median value also varied slightly between 0.32 and 0.53. As for the standard deviation and variance values, which are important indicators of the severity of regional concentration the highest level was observed in 2007. In the following years, there was a decline. Therefore, the severity of deviation from the mean among provinces decreased after 2007 and the severity of regional concentration decreased (Table 1).

Table 1. Descriptive Statistics

LQn	N	Minimum	Maximum	Mean	Median	Std. Deviation	Variance
LQ_{2007}	81	0	30.58	1.57	0.32	3.88	15.08
LQ_{2012}	81	0	22.42	1.64	0.53	3.24	10.50
LQ_{2017}	81	0	20.81	1.47	0.32	3.01	9.05
LQ_{2022}	81	0	20.55	1.60	0.40	3.24	10.51
Valid N (listwise) 81							

Provinces formed specialization clusters in five groups according to their LQ values. The number of provinces defined in the full industrial specialization (LQ≥3) cluster was 12 in 2007, 13 in 2012, 11 in 2017 and 14 in 2022. The number of provinces defined in the high industrial specialization (3>LQ≥2) cluster was 3 in 2007, 3 in 2012, 5 in 2017 and 2 in 2022. The number of provinces defined in the industrial specialization (2>LQ≥1.25) cluster was 6 in 2007, 11 in 2012, 9 in 2017 and 4 in 2022. There were 11 provinces in 2007, 8 provinces in 2012, 7 provinces in 2017, and 8 provinces in 2022 defined in the cluster of industrial specialization onset (1.25>LQ≥0.7). The number of provinces defined in the cluster of no industrial specialization (0>LQ≥0.70) was 49 in 2007, 46 in 2012, 49 in 2017 and 53 in 2022 (Table 2).

Table 2. Number of provinces by LQ grouping

2007	2012	2017	2022	2007
LQ≥3	12	13	11	14
3>LQ≥2	3	3	5	2
2>LQ≥1.25	6	11	9	4
1.25>LQ≥0.70	11	8	7	8
LQ<0.70	49	46	49	53
Total	81	81	81	81

The number of people employed in industrial specialization clusters increased in line with the overall increase in employment. The number of employees in provinces defined in the full industrial specialization (LQ≥3) cluster was 3.216 in 2007, 5.134 in 2012, 4.917 in 2017 and 9.089 in 2022. The most significant increase in the number of people employed in provinces in this cluster was observed between 2017 and 2022. The number of people employed in provinces defined in the high industrial specialization (3>LQ≥2) cluster was 114 in 2007, 472 in 2012, 1.782 in 2017 and 432 in 2022. While the increase in the number of employed in the provinces in this cluster was around four times between 2007-2012 and 2012-2017, there was a sharp decline between 2017-2022. Thus, the number of employed in 2022 is below the level in 2012. The number of people employed in provinces defined in the industrial specialization (2>LQ≥1.25) cluster was 251 in 2007, 1626 in 2012, 750 in 2017 and 2.154 in 2022. The volume of employment in this cluster has been volatile over the years. While it exceeded 6 times between 2007-2012, there was a significant decline between 2012-2017. Between 2017-2022, there was a near 3-fold increase. The number of employment in provinces defined in the cluster of the beginning of industrial specialization (1.25>LQ≥0.7) was 1.062 in 2007, 782 in 2012, 543 in 2017 and 1.009 in 2022. Thus, while the number of employed people in the provinces in this cluster decreased by approximately ½ between 2007-2017, it increased by approximately 2-fold to 1,009 between 2017-2022. Thus, the employment loss between 2007-2017 was recovered between 2027-2022. The number of people employed in provinces defined in the cluster without industrial specialization (LQ<0.7) was 4.995 in 2007, 8.846 in 2012, 9.062 in 2017 and 15.583 in 2022. Thus, the number of people employed in provinces defined as clusters without industrial specialization increased steadily over the four periods, with employment growth exceeding three times between 2007 and 2022. This employment growth stability could not be achieved in the other four specialization clusters (Table 3).

Table 3. Employment according to LQ classification

2007	2012	2017	2022	2007
LQ≥3	3.216	5.136	4.917	9.089
3>LQ≥2	114	472	1.782	432
2>LQ≥1.25	251	1.626	750	2.154
1.25>LQ≥0.70	1.062	782	543	1009
LQ<0.70	352	830	1.070	2.899
Total	4.995	8.846	9.062	15.583

Table 4 shows the percentage distribution of workers employed in the fishing and aquaculture industry by level of industrial specialization. The weight of those in provinces defined in the full specialization (LQ≥3) cluster peaked at 64.38% in 2007, declined to 58.06% in 2012, continued to decline at 54.26% in 2017, and

increased to 58.33% in 2022. The weight of workers employed in provinces defined in the cluster of high industrial specialization (3>LQ≥2) has fluctuated considerably over the two decades, reaching 2.28% in 2007; 5.34% in 2012; 19.66% in 2017; and 2.77% in 2022. This points to an extremely unstable distribution of employment. The weight of employed workers in provinces defined within the cluster of industrial specialization (2>LQ≥1.25) also fluctuated. The employment weight was 5.03% in 2007; 18.38% in 2012; 8.28% in 2017; and 13.82% in 2022. The weight of employed workers in provinces defined in the cluster of industrial specialization onset (1.25>LQ≥0.7) peaked in 2007 with 21.66%. After the peak, it declined to 8.84% in 2012 and 5.99% in 2017. It then rose from the 2017 trough to 6.48% in 2022. There has been a steady increase in the weight of employed workers in provinces defined in the cluster with no industrial specialization (LQ<0.7). The employment weight was 7.05% in 2007; 9.38% in 2012; 11.81% in 2017; and 18.60% in 2022.

Table 4. Employment distribution by LQ classification, %

2007	2012	2017	2022	2007
LQ≥3	64.38	58.06	54.26	58.33
3>LQ≥2	2.28	5.34	19.66	2.77
2>LQ≥1.25	5.03	18.38	8.28	13.82
1.25>LQ≥0.70	21.26	8.84	5.99	6.48
LQ<0.70	7.05	9.38	11.81	18.60
Total	100.00	100.00	100.00	100.00

The LQ values of 81 provinces were colored according to their LQ ranges in four different maps prepared for the years 2007, 2012, 2017 and 2022. The first map shows the situation in 2007. The provinces with full industrial specialization in coastal regions were Sinop in the Western Black Sea Region; Ordu, Trabzon, Rize and Artvin in the Eastern Black Sea Region; Aydın and Muğla in the Aegean Region; and Yalova in Marmara Region. Bilecik, Yozgat, Gümüşhane and Elazığ stood out in the inland regions. The second map shows the situation in 2012. The provinces with full industrial specialization in coastal regions were Sinop in the Western Black Sea Region; Ordu, Trabzon and Rize in the Eastern Black Sea Region; and Aydın and Muğla in the Aegean Region. Among the coastal provinces, industrial specialization declined in Yalova and Artvin. In the inland regions, Gümüşhane and Elazığ maintained their positions, while Bilecik and Yozgat experienced a decline in industrial specialization. Burdur, Kayseri and Tunceli joined the inland provinces. The third map shows provinces by industrial specialization in 2017. Among the provinces with full industrial specialization in coastal regions, Samsun was added to Sinop in the Western Black Sea Region. In the Eastern Black Sea Region, Trabzon and Rize remained in place, while Ordu left and Artvin was added. In the Aegean Region, Aydın and Muğla retained their positions. There are no provinces bordering the Sea of Marmara with a fully specialized industrial sector. In inland regions, Gümüşhane, Elazığ and Burdur remain, while Kayseri and Tunceli exit the full industrial specialization cluster and K. Maraş is added. The fourth and final map included the mapping of 81 provinces by industrial specialization in 2022. Among the provinces with full industrial specialization in coastal regions, Sinop and Samsun in the Western Black Sea Region retained their positions. In the Eastern Black Sea Region, Ordu and Giresun were added to Trabzon, Rize, and Artvin. Thus, full specialization in the fishing and aquaculture industry was achieved along the entire Black Sea coast from Sinop to Artvin. In the Aegean Region, Balıkesir was added to Aydın and Muğla. The provinces bordering the Marmara Sea with full industrial specialization were Yalova and Balıkesir, which also border the Aegean Sea. In the inland regions, Gümüşhane and Elazığ remained in place, while Burdur and K. Maraş left and Tunceli was added (Figure 1).

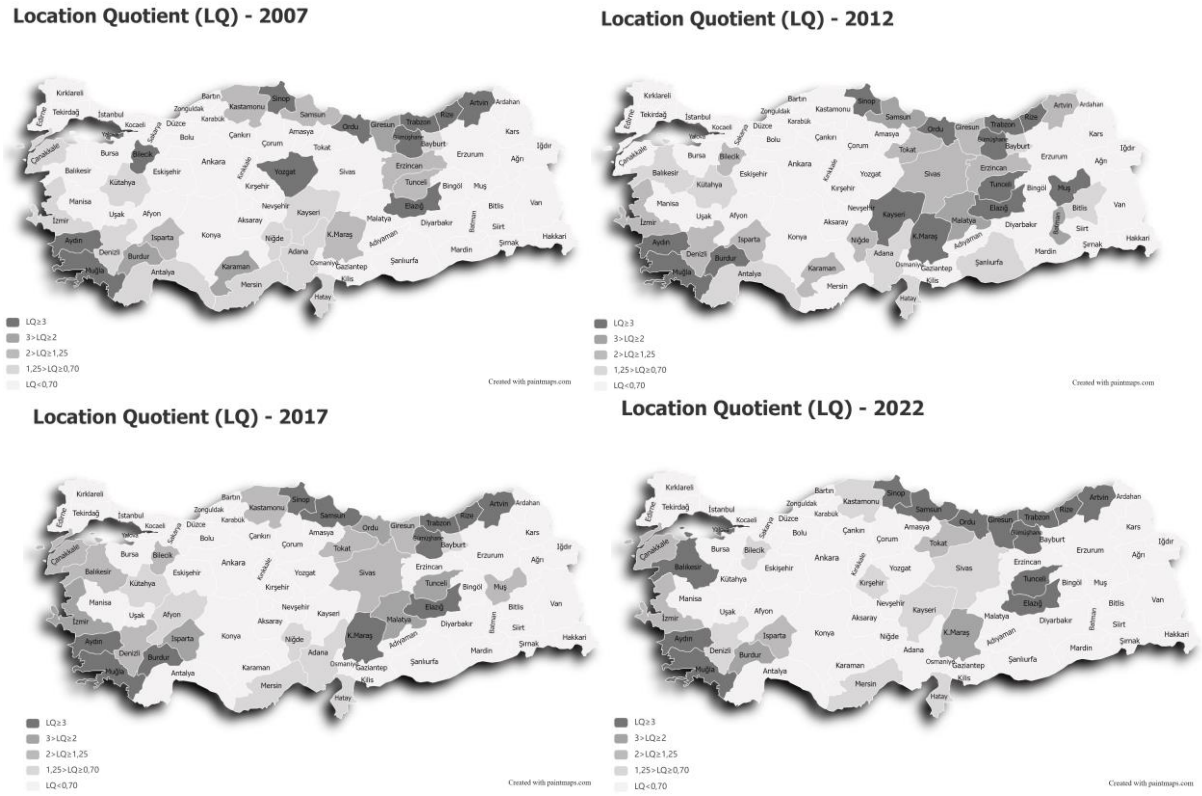

Figure 1. Appearance of Provinces on the Map of Turkey by Industrial Specialization Levels (2007, 2012, 2017, 2022)

4. Discussion

Generally, regional industrial specialization in the fishing industry is most prominent in island states. However, in developed countries, even if they are island states, this is weakened by the fact that other industries are highly developed and regional concentration to achieve industrial specialization is limited. For example, two studies focusing on the analysis of sectoral regional specialization in Ireland in 2007 found that the fishing sector reached a location quotient value of 1.44, indicating a level of industrial specialization and clustering in the BWM region (Morrisey, 2014, 2016). In the Southeast region, the LQ declined to 0.10 (Morriey, & O'Donoghue, 2013). Average Location Quotient in the Great Lakes Basin Region in Canada for 2016 was as low as 0.38 in fishing and fish production (Graziano, et al 2019). These levels are well below the level of regional industrial specialization for many provinces in Turkey.

Fishing was found to be the most concentrated industry with an LQ of 3.25 in the clustering of regional industrial specialization among the 54 regions in the EU 12 (Mack & Jacobson, 1996), even though it consists of developed countries with the exceptions of Portugal and Greece. The findings support that the fishing industry is very important for the EU. Indeed, for the EU country Latvia, regional industrial specialization was satisfactory for the sector. Industry with the highest cluster potential in Riga, Pieriga and Kurzeme regions of Latvia's six regions are processing and preserving of fish, crustaceans, and molluscs (Garanti, & Zvirbule-Berzina, 2014). For another EU country, Poland, Czapliński (2014) found that regional concentration in the fish processing industry increased between 1999 and 2011. This was attributed to the increase in investment in the fish processing industry because of Poland's accession to the EU in 2004. Turkey, which is not a member of the EU but is in close cooperation with it, also experienced an increase in regional concentration between 2007 and 2022, especially in coastal areas such as the Northern Black Sea coast, while employment tripled, which is in line with the results of Turkey and Poland. Although this result is obtained in the fish processing industry in Poland, the existence of an industrial overlap between the two countries is supported as it is ultimately a fishing-based industry.

It was argued that the fishing industry in Greece, a political, social and economic competitor with Turkey in many political, social and economic areas, is weakly realized in the North and South Aegean and is not strong in the economies of the region. To justify this, it was calculated that the LQ value of the industry was

around 1 and ranked 37th out of 60 sectors (Loizou et al, 2010). However, more recent studies have found results that support the development of the sector. For example, Komminos et al (2020) found that regional industrial specialization in the fishing sector (both Marine fishing and Freshwater fishing) was high in all seven regions for 2016, with LQ ranging from 2.35 to 7.28. These LQ values are quite satisfactory even for the LQ values in Turkey. It also supports that regional industrial specialization in Greece tends to be concentrated in the fishing sector on a regional basis, as in Turkey.

In emerging markets, including Turkey, there has been an upward trend in regional industrial specialization in recent years, as in Turkey. In a study for China, the largest emerging market, Li (2015) showed that the fishing industry in coastal areas is very strong, with an LQ as high as 6.64. He also pointed out that while the number of fishermen is declining in many developed countries such as Japan, Norway and the United Kingdom, while in China the industry is an employment generator like in Turkey. While the number of fishermen in China increased to 14 million, the number of fishermen in Turkey tripled to more than 15.000 between 2007 and 2022, up from 5.000 in 2007-2022. Liu et al (2022) calculated LQ for fisheries ranged between 0.02 and 3.20 in a total of 232 8-year observations in 29 provinces in China between 2013 and 2020. Although this range is high, it is much higher for Turkey than for China in all four years 2007, 2012, 2017, 2022 (Table 1).

When the Republic of South Africa is examined as another developing country, there was an increase in regional specialization in the fisheries sector in Cape Town between 2002 and 2017, exceeding the full specialization limit of 3 since 2007, while in Nelson Mandela city, this limit reached full specialization in 2017 with a leap compared to five years ago (Niyimbanira et al, 2020). Coleman et al (2019) found that in the regional specialization classification by sectors in New Zealand in 2013, fisheries were included in the full regional industrial specialization cluster as the LQ value was 3.06. However, this level is also much higher for Turkey than for the Republic of South Africa in all four years 2007, 2012, 2017, 2022 (Table 1).

In small settlements, the spatial concentration of fishing can be quite high. In 1978, regional specialization in fishing in Bay County, Florida was quite high with an LQ value of 3.69 (Fernald et al, 1979). In other resent study, LQ values for fishing, hunting and trapping reached up to 491 in Kodiak Island Borough, Alaska (Pominova et al, 2022). The LQ values calculated for Turkey also support this situation. Because the regional specialization in the fishing sector reaches its peak in the provinces of the Central and Northern Black Sea Region, where the population and employment volume are weak.

5. Conclusion

The fishing and aquaculture industry is a high-growth industry with employment growth that has more than tripled in the last two decades. However, it is an industry with a weight that does not even reach 1/1000 of the total employment volume. Therefore, it is clear that this ancient industry has a very high development potential ahead of it. Rapid technological developments in today's information society seem to have strengthened this industry rather than weakening it. The increase in sectoral employment is a clear proof of this situation.

The statistical exercise carried out within the scope of the study supports the existence of a structural change in the fisheries and seafood production industry. Accordingly, in the twenty-year period between 2007 and 2022, the provinces where regional industrial full specialization has occurred have shifted significantly. It is concluded that the land-based industrial activities that were carried out in the interior of the country in rivers, lakes, ponds and dams twenty years ago are now weakening and being replaced by coastal areas. In addition to the fact that marine fisheries cover most of the Black Sea from Sinop to Artvin, regional industrial specialization has also been achieved, especially in the Aegean Region, where aquaculture is widespread. There is also regional industrial full specialization in Marmara, which is an inland sea with the addition of Balıkesir and Yalova. However, full specialization based on inland waters is present in only three provinces. Therefore, it is clearly seen that there is a rapid development process shaped around coastal fisheries.

Another important result is that regional industrial specialization is observed in provinces with low and medium populations. In large cities, where high-tech service and industrial sectors have developed, the fishing and aquaculture industry is not the business sector where regional industrial specialization can be achieved. This is why it has the potential to be a growth pole, especially for low and medium-population coastal provinces. The existence of intense interest and support for this sector in the EU, with which Turkey has close relations, can be considered as an encouraging situation for Turkey. After all, EU countries are also Turkey's largest international trade partner. In addition, Turkey has access to various loans and grants from the EU. EU membership has been the driving force behind Poland's sectoral development. Although Turkey is not a member of the EU, it is a candidate country. This status can be utilized to make an additional contribution to the development of this industry, which has already achieved high growth momentum and has many more potential growth areas ahead of it.

In summary, although an ancient economic activity, the fishing and aquaculture industry has become a

highly developed business sector for developing countries in recent years. The EU, with which we have close relations, also supports the development of this sector. In addition, coastal fishing is becoming increasingly important on a global scale. Especially in the economies of low and medium-populated provinces, this sector is becoming more and more important and supportive of local development. Supporting an industry with such significant growth and potential for future development that has not yet reached saturation point can lead to highly successful outcomes.

7. Compliance with Ethical Standard

a) Author Contributions
Single author.

b) Conflict of Interests
The authors declared that they have no conflict of interest.

c) Statement on the Welfare of Animals
Not relevant

d) Statement of Human Rights
There are no human subjects in this study.

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