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Examination of the volume and value of fish and fish products imports into Serbia from 2012 to 2021

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ABSTRACT

Serbia is partially supplied with fish from its own aquaculture and fishing, both commercial and recreational, which averaged 6.70 tons for the period from 2012 to 2021. The majority of fish in the market during the same period came from imports (an average of 34,090 tons). Out of the total catch of fish and fish products on the market in Serbia, 92.80% consisted of marine fish and seafood, while only 7.14% consisted of freshwater fish. The volume of imported sea fish and fish products followed this descending order: hake > tuna > seafood > canned fish > fish fillets > herring > sardines > mackerel > other seafood. Among freshwater fish, trout was the most commonly imported, followed by other species of fish and carp. The average total value of fish imports from 2012 to 2021 was €86.030 million, and the average import price of fish was €2.50/kg. With the import of fish and fish products, and fish from domestic production and catches, the fish market in Serbia was supplied with 41,270 tons of fish during the period studied, which means that the annual per capita fish consumption in Serbia was about 7 kilograms.

1. Introduction

The importance of fish in human nutrition is well known (proteins, fats, minerals, vitamins) and that is why this type of food is appreciated by the largest number of consumers (*Phogat et al.,* 2022). Despite the exceptional nutritional value, the consumption of fish is very variable in different parts and countries of the world, which depends on numerous factors (supply, demand, habits, price). According to data from 2023, the catch of fish from natural resources (oceans, seas, rivers, lakes) and fish from aquaculture (freshwater, seas, brackish waters) amounted to 186 million tons (MT), of which 90.6 MT came from catches and 96 MT from aquaculture (*FAO,* 2022). The volume of fish on the world market can be increased by the production of fish from aquaculture, while the catch of fish from natural resources will stagnate due to the protection of the fish stock, especially the catch of the most commonly caught fish species (hake, small blue fish) and the prevention of changes in the water ecosystem. Overfishing of natural resources is protected by limiting the catch of fish in each fishing area. Fishing areas in oceans and seas (with the exception of coastal territorial waters of states) are divided by international agreements to countries that have fishing fleets (*Ivanović et al.*, 2015). The world's largest producer of fish (catch and aquaculture) is China with 67.8 MT (38% of world production), and among the five largest producers are Indonesia (16.7 MT), India (10.9 MT), Vietnam (6.4 MT), and Bangladesh (6.3 MT). 58.8 million people are employed in the primary fishing sector (catch and production in aquaculture), and a total of about 600 million people work in the secondary sector (processing, transport, traffic).

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China, Chile and Norway had the biggest increase in fish production, and Egypt and Nigeria had the biggest decrease in production. From 1961 to 2022, the increase in fish production in aquaculture grew at an average annual rate of 3%. In the same period, the population of people in the world grew at an average annual rate of 1.6%. It is believed that by 2030, fish production in aquaculture will increase by 14% and will amount to 106 MT (*Anon.,* 2022).

In contrast to the world trends of fish production in aquaculture in Serbia, fish production is declining. In 2023, 149 carp ponds, 77 trout ponds, and three for the cultivation of catfish were registered in Serbia. In 2023, around 2,000 workers were employed in primary production. The area under carp ponds was 13,750 hectares in 1997, 8,411 hectares in 2010, and 5,527 hectares in 2022. In 1997, there were 146,933 square meters under trout ponds, in 2018 it was 81,411 square meters, and in 2022 it was 60,135 square meters. In addition to the reduction of the area under ponds, there was also a drop in fish production per unit area, which is particularly pronounced in carp ponds, where fish production per hectare fell below one ton (*Anon.,* 1997; 2010; 2018; 2022). Serbian fisheries share the fate of livestock production in Serbia (reduction in the number of cattle, pigs, poultry, import of frozen meat, import of meat products). In order to meet the needs of fish for the market, Serbia imports fish and fishery products from as many as 65 countries in the world, mostly from Spain, Norway, Thailand, Vietnam and Croatia. The volume of fish exports from Serbia is negligible and refers to the re-export of processed fish (smoked, packaged). With fish from its own production, fish from commercial and recreational fishing, Serbia cannot meet the needs of the market, so fish and fish products are imported. From these two sources (fish from Serbia and fish from imports), the quantity of fish is ensured so that the consumption of fish in Serbia is equal to a third of the average consumption of fish in the world (*Anon.,* 2019*; Baltić et al.,* 2023).

One of the most significant and largest fish farms in Europe, Ečka (covering 1,700 ha), was in operation for over 120 years and closed in 2023. Today, Serbia is supplied with fish from aquaculture (carp and trout farms), commercial and recreational fishing, and primarily, from the import of marine fish.

The aim of this paper is to examine the volume, import, and value of fish and fish products (marine and freshwater) in Serbia from 2012 to 2021 (ten years).

2. Materials and Methods

Data on the volume and value of fish and fish products in Serbia were obtained from the Statistical Office of the Republic of Serbia, Department for Dissemination and Public Relations (*www.stat.gov.rs*). The volume and value of imports were prepared based on tariff numbers assigned to each type of fish or fish product. Based on these data, the volume of imports and the value of fish were classified into two main groups: marine and freshwater fish. Marine fish were further categorized according to the volume and value of fish and fish products into eight groups (hake, tuna, canned fish, sardines, herring, mackerel, fish fillets, and seafood). Seafood (mollusks, crustaceans, and shellfish) was also included in the marine fish group. Freshwater fish were classified into three groups (carp, trout, and other freshwater fish species).

The average total value (€) of fish imports, classified into three groups (marine fish, seafood, and freshwater fish) is presented. The average values of imports per kilogram (€/kg) for total fish and by groups are also shown.

The results obtained were compared by statistical analysis using GraphPad Prism software, version 9.00 for Windows (GraphPad Software, San Diego, California USA, *www.graphpad.com*). The mean values, and measures of volume and value of fish and fish products imports for the ten-year period were calculated. Trends were computed, and all results are presented tabularly and graphically using Microsoft Excel 2010.

3. Results and Discusion

Globally, the fish market is supplied by catches from open waters (oceans, seas, lakes, rivers) and fish farmed in aquaculture. In 2023, the volume of fish caught in open waters was 90.6 million tons. This level has been maintained for over 30 years because a larger catch would threaten the survival of the most commonly caught species of fish (small pelagic fish, hakes) and would lead to disturbances in the ecosystems of open waters (seas, oceans). Today, 96 million tons of fish are harvested from aquaculture (freshwater, saltwater, and brackish water). Although aquaculture was known more than 2000 years ago, it was not given significant attention until the 1960s. This is the period when there was a rapid increase in the world human population (the population boom), with the number

of inhabitants increasing by one billion every 12 to 14 years, reaching 8 billion in 2023 (*Baltić & Marković*, 2017).

A particularly rapid increase in fish production in aquaculture was recorded from the 1990s. By that time, the nutritional value of fish as food with a well-balanced content of macronutrients such as proteins (high content, good digestibility, essential amino acids) and fats (low content, favorable ratio of n-3/n-6 fatty acids) was already known, especially eicosapentaenoic acid (EPA) and docosahexaenoic acid (DHA). Micronutrients and vitamins also significantly contribute to the nutritional value of fish (A, D, B_{12}, folic acid, and choline), as do important minerals (Ca, Zn, Se, I, Cu, F, Mg, Mn, and Cr) (*Ghaly et al*., 2013; *Khalili & Sampels*, 2018; *Innes & Calder*, 2020; *Boyd et al.*, 2022; *Phogat et al.*, 2022; *Tacon*, 2023). Fish is recommended in human diets because it protects against various non-communicable diseases, especially cardiovascular diseases, preterm born and mentally ill children (*Luo et al*., 2022). The global fish catch in 2023 was 90.6 million tons, and aquaculture production was 96 million tons, meaning that the total fish supplied to the market in 2023 was 186.6 million tons (*Ali et al.*, 2022).

The largest catch and production of fish in 2023 were in China, followed by Indonesia, Vietnam, and the USA. Out of the total catch and production of fish, 166 million tons were intended for human consumption, 15 million tons for animal feed, and 4 million tons were used for other purposes. Out of the total catch and production of fish, 65 million tons were subject to trade (export/import) (*Baltić et al*., 2023).

The average total import (Table 1) of fish and fish products into Serbia from 2012 to 2021 was 34,090±3,421 tons with a coefficient of variation of 10.04%. Among marine fish, the most commonly imported types were various types of hake, tuna, then canned fish (sardines, tuna), small pelagic fish (sardines, herring, mackerel), fillets, and other types of marine fish (scorpionfish, sea bream, sea bass, salmon). The import of seafood such as mollusks, crustaceans, and shellfish was also significant (4,104±1,045 tons). Among freshwater fish, trout was most commonly imported (1,519±351.3 tons), while the import of carp and other types of freshwater fish (bighead carp, grass carp, catfish, pike) was much lower. The import of marine fish (Figure 1) was significantly higher (92.86%) than the import of freshwater fish (7.14%).

Table 1. Average fish imports (tons), total and by species, for the ten-year period from 2012 to 2021.

Origin	Total import	$\overline{X}$	Measures of variation				
			Sd	Se	X_{min}	X_{max}	C_v (%)
		34090	**3421**	**1082**	**29490**	**41071**	**10.04**
Marine	Hake	7755	1752	554	5065	11238	22.59
	Tuna	4858	601,1	190,1	4219	5934	12.37
	Canned fish	3485	1320	417,4	1993	5701	37.88
	Sardines	2369	354	111,9	1682	2915	14.95
	Herring	2604	503,6	159,2	1773	3382	19.34
	Mackerel	2367	431,5	136,5	1788	2896	18.23
	Fillets	2755	1044	330,3	1316	4836	37.90
	Other types of marine fish	1361	574,4	181,7	458	2053	43.09
	Seafood	4104	1045	330,4	2908	6545	25.46
Freshwater	Carp	450	348,7	110,3	83	1143	77.50
	Trout	1519	351,3	111,1	940	1830	23.13
	Other types of freshwater fish	463	214,6	67,87	209	912	46.35

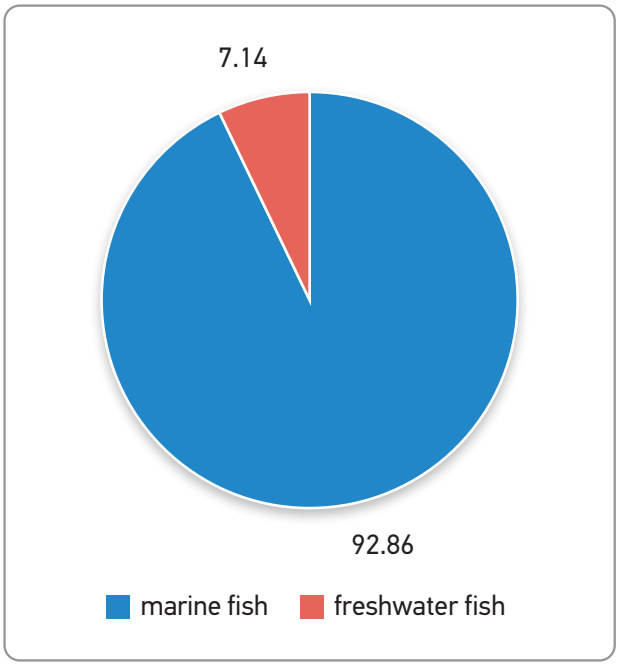

Figure 1. Average share (%) of imports of marine and freshwater fish species for the ten-year period from 2012 to 2021.

Data on the average share of individual marine fish species and fish products, as well as seafood, for the ten-year period from 2012 to 2021 are shown in Figure 2. Approximately a quarter of the import of marine fish and fish products consisted of hake (24.52%), while the least common imports were other types of marine fish (4.21%).

In Serbia, fish is most commonly imported frozen. Freezing (−18 °C to −30 °C) is, in fact, the most common method of preserving fish and making it available for sale. Only small quantities of the highest quality fish species (salmon, sea bass, sea bream, Peter's fish, tuna fillets) are imported chilled on ice (−1 °C) and are intended for specialized restaurants and the most modernly equipped supermarkets (*Zhu et al.*, 2021). These fish also command the highest prices, as do various types of seafood (crabs, shellfish, some types of mollusks), which are imported frozen or on ice. Among fish products, canned small pelagic fish (sardines) and canned large pelagic fish (tuna) are the most commonly imported. Canned fish accounted for 11.02%, or 3,485 tons, of the total fish imports (Figure 2). Cans are thermally processed products (113 °C to 160 °C) in hermetically sealed containers (most often cans) that do not require special storage conditions during distribution and sale, have a long shelf life (over a year), and are well accepted by consumers (*Tsironi et al.*, 2019).

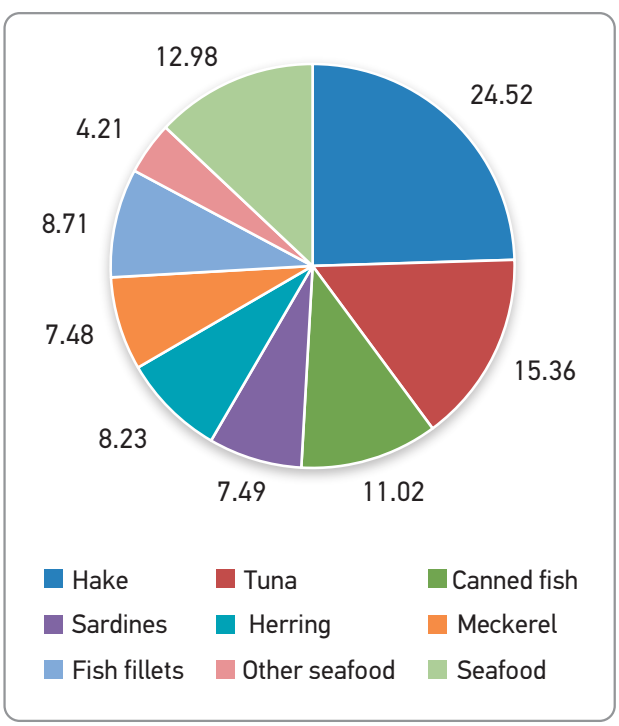

Figure 2. Average share (%) of imports of individual marine fish species and fish products, as well as seafood, for the ten-year period from 2012 to 2021.

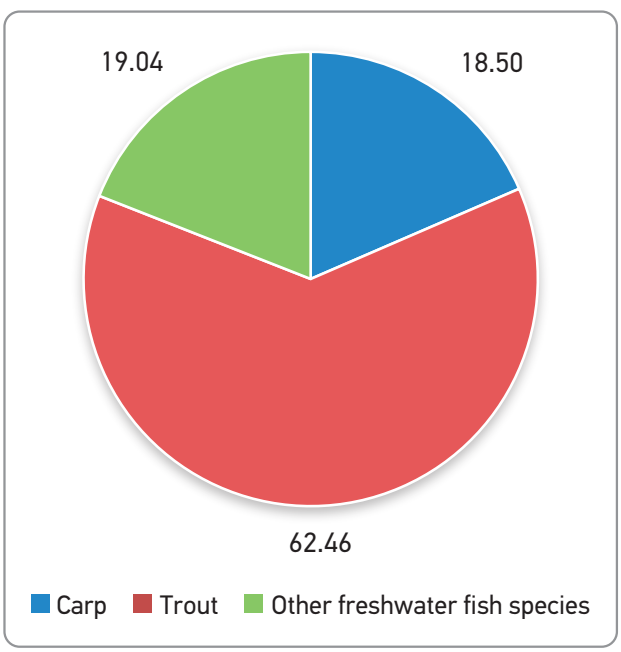

Figure 3. Average share (%) of imports of individual freshwater fish species for the ten-year period from 2012 to 2021.

Freshwater fish are most commonly imported live from neighboring countries (Bosnia and Herzegovina, Croatia, and North Macedonia). Less than a quarter of freshwater fish imports consisted

of carp (18.50%) and other freshwater fish species (19.04%), with a significantly larger import of trout (62.46%) (Figure 3).

Figure 4 shows the trend of the average total fish imports, and total imports of marine fish, seafood, and freshwater fish (000 tons) for the ten-year period from 2012 to 2021. The trends of total imports (y = 0.9296x + 28.978), and imports of marine fish (y = 0.6302x + 24.06) and seafood (y = 0.2624x + 2.661) were increasing, which was particularly pronounced in 2020 and 2021, while the trend of freshwater fish imports was stagnant (y = 0.0289x + 2.2731).

The value of fish and fish product imports is shown in Table 2. The average import value in the observed period was €86.030±22.100 million, with a coefficient of variation of 25.69%. The average import value of marine fish was €74.883±18.884 million, seafood €4.957±1.545 million, and freshwater fish €6.189±2.024 million.

The trend of the value of fish and fish product imports (million €) for the ten-year period from 2012 to 2021 is shown in Figure 5. The total value of fish and fish product imports increased from 2012 to 2021, as demonstrated by the trend equation y = 6.4523x + 50.542. A similar trend was observed for the import of marine fish and fish products, where the trend equation was y = 5.4658x + 44.822. The trends of seafood imports (y = 0.4322x + 2.5793) and freshwater fish imports (y = 0.5549x + 3.1369) were aligned, as shown by the trend equations.

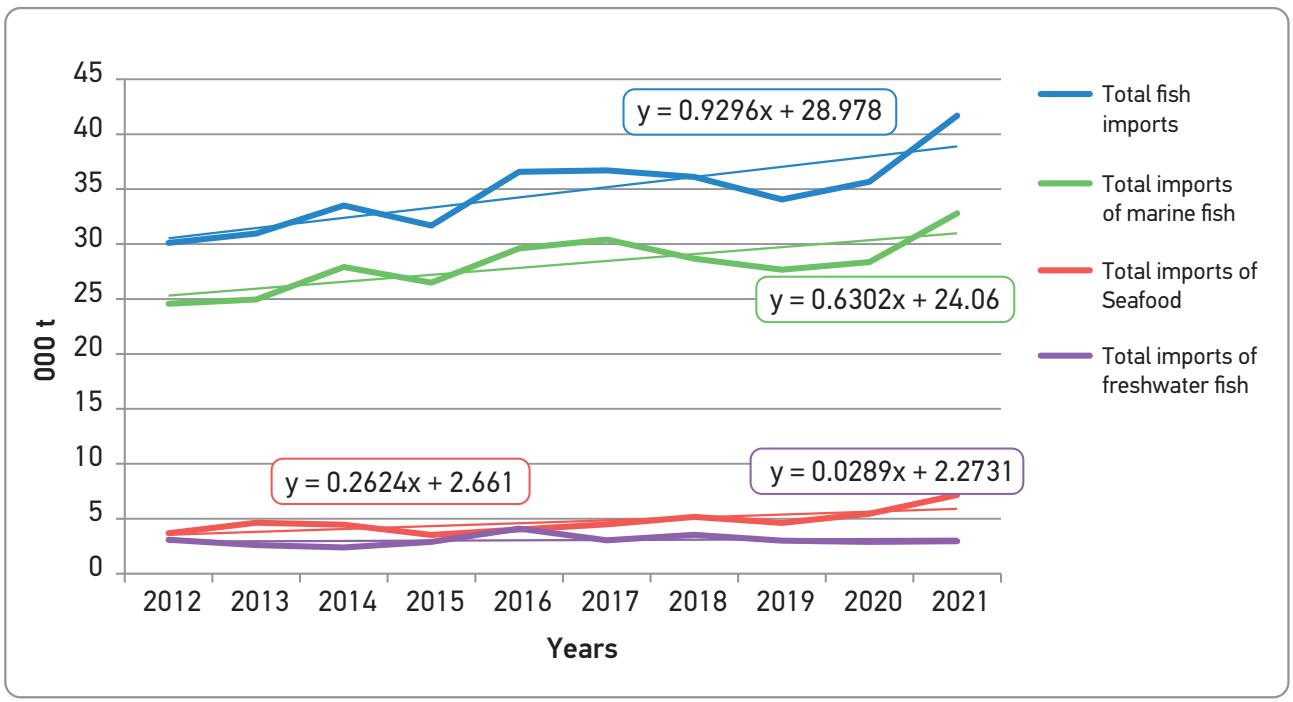

Figure 4. The trend of fish imports (000 tons) for the ten-year period from 2012 to 2021.

Table 2. Average values (000 €) of fish imports, total and by species, for the ten-year period from 2012 to 2021.

Import value (€)	$\overline{X}$	Measures of variation				
		Sd	Se	X_{min}	X_{max}	C_v (%)
Total	86030	22100	6989	63665	138515	25,69
Marine	74883	18884	5972	55916	120401	25,22
Seafood	4957	1545	488,6	3345	8463	31,17
Freshwater	6189	2024	640,1	3655	9651	32,71

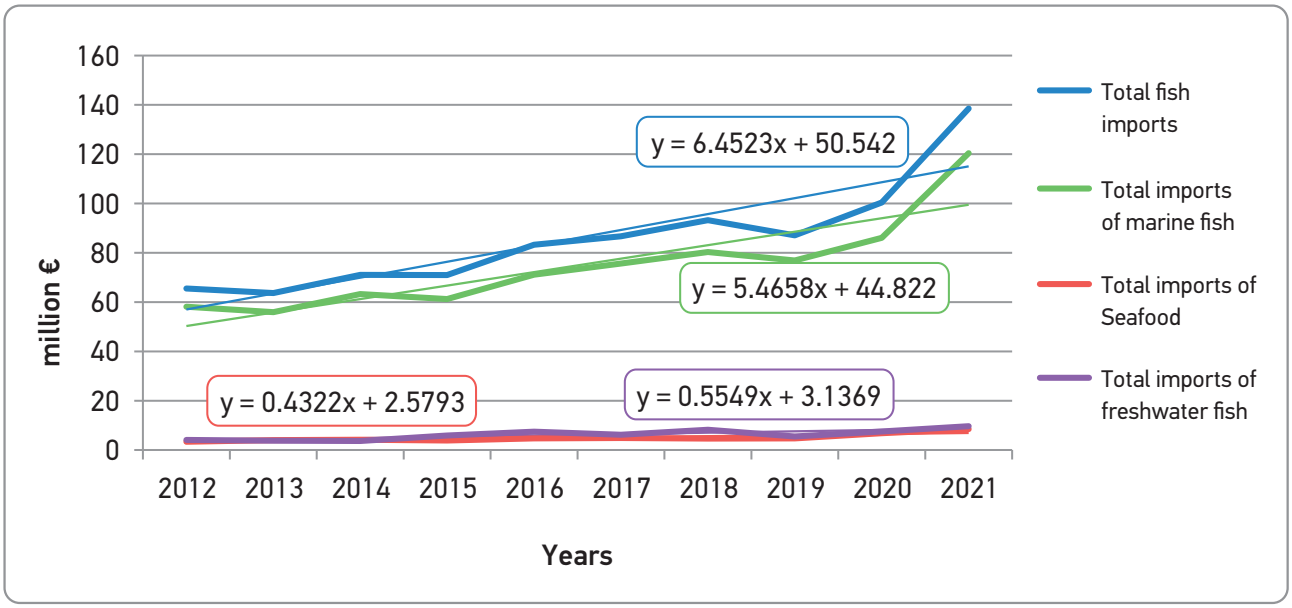

Figure 5. The trend in the value of fish and fish product imports (million €) for the ten-year period from 2012 to 2021.

The average import value of fish and fish product imports, expressed in €/kg for the examined period, was €2.49±0.39/kg, for marine fish €2.44±0.39/kg, for seafood €3.55±0.66/kg, and for freshwater fish €2.56±0.36/kg (Figure 6).

The trend in the value of fish and fish product imports (€/kg) for the examined period is shown in Figure 7. The largest increase in import value per kg was recorded for seafood imports (y =X0.2047x + 2.4293).

The total value of fish and fish product imports, as well as the value of marine fish, seafood, and freshwater fish imports, increased during the examined period, as defined by the equations (y = 0.1152x + 1.8593, y = 0.1144x + 1.8107, y = 0,2047x + 2,4293, and y = 0.079x + 2.1293, respectively).

Serbia is a fish-importing country, especially of marine fish. As evident from the data collected since 2012, the import of fish to Serbia has been constantly

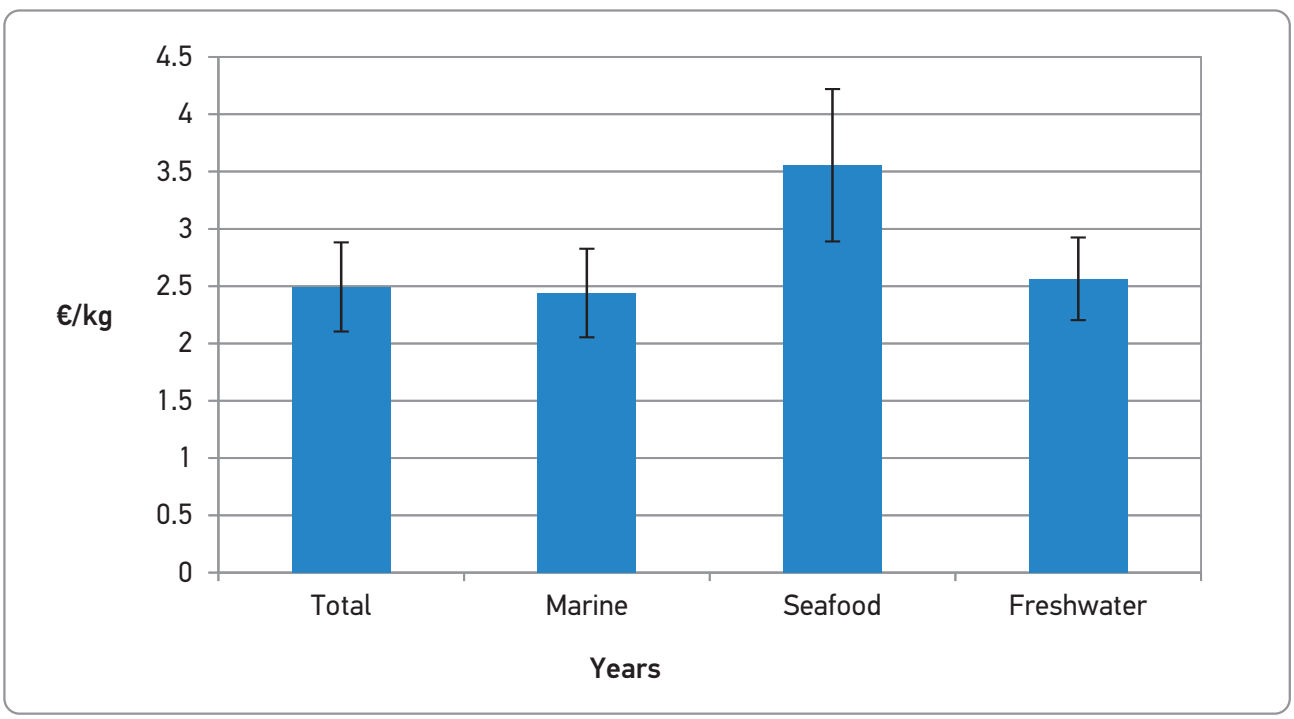

Figure 6. Average import values (€/kg) of fish and fish products for the ten-year period from 2012 to 2021.

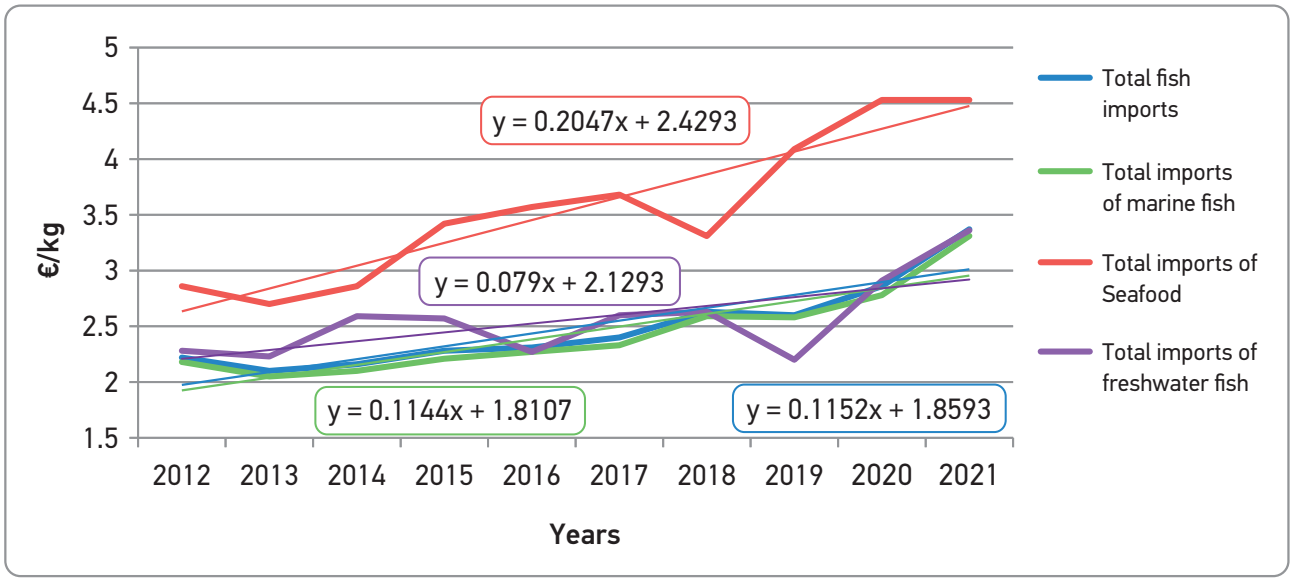

Figure 7. The trend in the value of fish and fish product imports (€/kg) for the ten-year period from 2012 to 2021.

increasing. One of the reasons is the decreased fish production in Serbia, particularly lower carp fish production. The causes of the decline in carp production are primarily related to the drastic reduction in the area of carp ponds. From 2011–2013, there were over 8,500 ha of carp ponds, which decreased to less than 6,500 ha by 2019–2021. Additionally, the low yield of carp per ha, which was less than one ton per ha from 2012–2021, has significantly contributed to the reduction in carp production. This is far less than the potential, which is three to five tons in semi-intensive farming and up to 10 tons in intensive farming conditions (*Marković*, 2010; *Ivanović et al.*, 2015; *Baltić et al.*, 2023). The average catch of carp fish in Serbia from 2012 to 2021 was 5,491 tons, and of trout, 1,206 tons, totaling 6,697 tons. With commercial and recreational fishing (carp, bighead carp, bream, goldfish), the local fish supply on the market was increased by 1,183 tons. In the statistical yearbooks of Serbia, commercial and recreational fishing covers only the four most commonly caught species. With fish imports (an average of 34,090 tons), the fish market in Serbia was supplied with 41,270 tons of fish and fish products, meaning that fish consumption in Serbia (six million inhabitants) was around 7 kg per inhabitant annually (*Baltić et al.*, 2023; *www.stat.gov.rs*).

If the average price of imported freshwater fish is €2.65/kg, then the value of fish production in aquaculture in Serbia and from catches would be €18.687 million, which would increase the value of fish on our market to €104.666 million. Among the total value of fish on the market, fish from aquaculture and catches in Serbia accounted for only 18.85% in the study period. This is a consequence of the low value of fish production in Serbia and its small share in the total volume and value of fish on the Serbian market. The situation of fisheries in Serbia is related to the unfavorable state of agricultural production, especially in the primary animal production sector. Agricultural production, including fisheries in Serbia, does not have sufficient state support (subsidies, taxes relief), and without it, regardless of land (water) resources (14,000 ha under carp ponds and 100,000 ha of infertile land that could be used for fish production in Vojvodina), animal feed production, and the possibility of improving fish farming technology, an increase in fish production in aquaculture in Serbia cannot be expected (*Baltić et al.*, 2023; *Baltić et al.*, 2023).

Fish consumption worldwide has been growing annually by 3% since 1961, while the population growth rate was 1.6%, which has led to an increase in fish consumption. The average annual fish consumption worldwide was 9.9 kg in 1961, reaching 20.5 kg in 2019. It is believed that annual fish consumption worldwide will be 21.4 kg per inhabitant by 2030, and aquaculture fish production will increase to 106 million tons. One of the reasons for greater fish consumption is to meet the nutritional needs of the growing number of people worldwide, but also is due to the increasing significance and awareness of the nutritional value of fish in human diets. Iceland has the highest fish consumption in the world (91 kg per inhabitant annually), while Afghanistan has the lowest (0.24 kg per inhabitant annually) (*Baltić et al.*, 2023).

Due to the decreasing volume of fish production in aquaculture and fish catches in open waters in Serbia since 2012, the volume of fish imports has increased. The largest volume of fish imports pertains to the import of marine fish, seafood, and fish products (canned fish). With the increase in the volume of imports and the rising price of fish on the global market, the value of fish imports has been continuously increasing. Thanks primarily to fish imports, the consumption of fish in Serbia per inhabitant per year over the last ten years has been about seven kilograms, which is a third of the average fish consumption per inhabitant worldwide. Serbia has the potential to significantly increase fish production in aquaculture, especially carp fish in the region of Vojvodina.

Ispitivanje obima i vrednosti ribe i proizvoda od ribe u Srbiji od 2012. do 2021. godine

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INFORMACIJE O RADU

Ključne reči:
Ulov
Akvakultura
Tržište Srbije
Potrošnja

APSTRAKT

Srbija se delimično snabdeva ribom iz sopstvene akvakulture i ribolova, komercijalnog i rekreativnog, što u proseku iznosi 6,70 tona za period od 2012. do 2021. godine. Najveći deo ribe na tržištu u istom periodu je iz uvoza (u proseku 34.090 tona). Od ukupnog ulova ribe i ribljih proizvoda, 92,80% čine morska riba i morski plodovi, dok svega 7,14% čini slatkovodna riba. Obim uvezene morske ribe i ribljih proizvoda ima opadajući redosled: oslić > tunjevina > morski plodovi > konzerve od ribe > riblji fileti > haringa > sardine > skuša > ostali morski plodovi. Od slatkovodne ribe najviše se uvozi pastrmka, a zatim ostale vrste riba i šaran. Prosečna ukupna vrednost uvoza ribe od 2012. do 2021. godine iznosila je 86.030 miliona evra, a prosečna uvozna cena ribe 2,5 evra/kg. Pored uvoza ribe i ribljih proizvoda, kao i ribe iz domaće proizvodnje i ulova, tržište ribe u Srbiji snabdeveno je sa 41.270 tona ribe, što znači da je godišnja potrošnja ribe po stanovniku u Srbiji oko 7 kilograma.

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