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OUTLOOKS AND PERSPECTIVES OF THE COMMON CARP PRODUCTION

WYNIKI I PERSPEKTYWY PRODUKCJI KARPIA ZWYCZAJNEGO

Key words: common carp, main tendency, production, trade, consumption

Słowa kluczowe: karp zwyczajny, tendencja rozwojowa, produkcja, handel, konsumpcja

JEL codes: Q13, Q17

Abstract. The common carp (*Cyprinus carpio*) is one of the longest-produced sweetwater fish species, the global production of which covers around 3.4% (4.4 million tons in 2015) of the world's fish production and fisheries. Carp is the third most significant fish species of the world's aquaculture production and 97.3% of its global production is originated from aquaculture. Furthermore, carp amounts to 8.3% of the world's aquaculture fish production. Its feed technology is fish meal-independent and is mainly based on cereals. In Europe, the common carp is the most important fish species of aquaculture populated with extensive polyculture. The Czech Republic, Poland, Hungary, Germany and Croatia are among the biggest carp production countries of the European Union. The combined output of the TOP 3 carp production countries of the EU (CZ, PL, HU) amounts to 67.7% of the EU-28 (2015). Trade between EU countries is done primarily in the form of live fish and secondarily as fresh, primary processed carp.

Introduction

Sustainability and sustainable development are becoming increasingly important, as this concept is one of the most significant challenges globally, especially in agriculture. It is also an important challenge to provide the proper quantity of quality foods to the increasingly growing population [Horn 2014]. This challenge is also faced by the livestock sector, since it is one of the main tasks to meet the increasing customer needs for foods of animal origin by "wisely using" the available natural resources. The livestock sector has been growing steadily over the past decades, and the demand for animal products in developing countries by 2030 is likely to increase more than two-fold [FAO 2017a]. In this respect, the role of fisheries and the aquaculture sector is also significant, since fish products can be regarded as a major source of protein; therefore, increasing their production can contribute to the supply of protein to the population. The combined production of fisheries and aquaculture is characterised by a world-wide trend which is mainly due to the year-by-year growth of aquaculture, while the volume of inland and offshore catches is decreasing. The reason for the increase in production is mainly attributable to the development of Asian countries by means of aquaculture, and the decline in sea fishing is due to overfishing and the policy quotas introduced by the European Commission in 2013 [SustainAqua 2009].

Carp production has a major share within global and European aquaculture. Its significance can be interpreted along all three pillars of sustainability, i.e., it has an important economic role, since it produces high protein content food and it provides fish for recreational fisheries and fishing. It is important to pinpoint that carp production mainly takes place in rural areas, thereby contributing to job creation, resulting in the improvement of the subsistence and retention capacity of rural populations. Extensive carp pond farms serve as wetland and provide high biodiversity habitats for several protected birds, as well as amphibian, reptile and mammal species. In addition, carp pond farms positively affect the microclimate of the surrounding areas and have a significantly higher agroecological value than plough lands and grasslands. As a summary, it can be concluded that carp production provides significant ecological services to the society.

The majority of carp pond farms operate as extensive fish pond systems, using special resources which could not be used for the production of other fish species with more special needs. Carp species can be produced even in lower quality waters, which is an especially valuable characteristic in the Asian region. From the aspect of sustainability achieved in carp pond farms, it is essential to perform fish meal-independent and cereal-based fish meat production which provides increasing production of this fish species in the long run. The global per capita carp consumption can be considered low, since it is not consumed in all countries. Fish products are popular mainly in Asia and Europe, where consumption is rather high, since this fish species constitutes an inseparable part of the local gastronomy of various ethnic groups living in this area [MAHAL 2017].

Objectives

In the long run, it can be observed that the amount of marine and inland catches is constantly decreasing, while the demand for fish products is increasing. As a result, the role of aquaculture is becoming increasingly important, especially if it covers fish meal-independent feeding technology. In this paper, an objective was set to survey the current tendencies of carp production, trade and consumption using a trend analysis, as well as the factors which influence the fish meal-independent carp production potential globally and in the European Union. The analysis described in this paper focuses on the economic, social and ecological sustainability of carp production. Based on the examination of international technical literature sources, the following hypothesis was set up: "Based on our conclusions drawn from trend analysis and other identified factors, the current carp production potential is sustainable in the future both on the global scale and in the European Union" (H1).

Literature review

According to the latest data from FAO [2017a], the global amount of fish and fishery products (fish, crustaceans, molluscs, excluding aquatic plants) increased by some 96.1% in the last 30 years, amounting to 169.2 million tonnes in 2015, including (both offshore and inland) fisheries, as well as (extensible and intensive) aquaculture production. During the examined period, aquaculture is considered to be one of the fastest growing production sectors of food of animal origin on a global scale due to the increase in the sector's production. This sector is mainly significant on the Asian continent, mostly in China and Vietnam.

According to the FAO [2017b] forecast, this growth will continue in the long term, with a yearly increase of 1-2% in terms of total production and 4-5% in aquaculture output. On a global scale, the amount of fish production (covering only the quantity of fish produced / caught), including aquaculture and fisheries, was 129.9 million tonnes in 2015, which represents 76.8% of total aquaculture production and its value is constantly increasing (fig. 1). The European Union (EU-28) contributes 3.2% to total production, making it the 5th largest fisheries and aquaculture producer worldwide. In 2015, the TOP-5 countries of the EU-28 with the highest output provided 61.4% of total EU-28 production, ranging from Spain, Denmark, the United

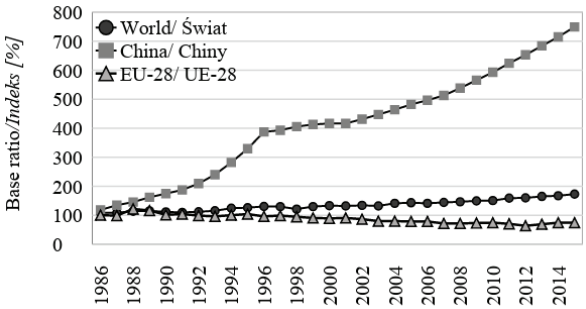

Figure 1. Global fish production (capture & aquaculture) (base: 1985=100%)
Rysunek 1. Globalna produkcja ryb (połów + akwakultura) (indeks, 1985=100%)
Source/*Źródło*: [FAO 2017a]

Kingdom, France and the Netherlands. The yearly production of Poland is around 242.4 thousand tonnes, thereby contributing 4.4% to the EU production, while the contribution of Hungry is around 0.5% with its yearly production of 27.2 thousand tons [PCP 2016].

As a result of the increase in aquaculture, the so-called "fishmeal trap" is becoming increasingly prominent, i.e. aquaculture includes species (crustaceans, predatory fish, etc.) whose breeding requires sea-derived fishmeal, which is becoming increasingly difficult to acquire [Buyucapar, Kamalak 2007]. The production of fishmeal of such origin cannot be considered guaranteed in the long run, as it fundamentally depends on the amount of forage fish to be fished in natural waters, which is limited due to the depletion of such populations. As a result, this issue is one of the greatest challenges of the aquaculture sector, since, in addition to satisfying the constantly increasing demand, it is questionable how to maintain the production of fish species whose feeding is performed using fishmeal. Alternatively, fish production using cereal-based feed may become more prominent; therefore, the demand for carp may increase [Chamberlain 2011].

By way of using international trade as a basis, the products of the fisheries and aquaculture sector have always significantly contributed to international trade, since they became one of the segments with the highest turnover in the whole food industry sector during recent years. Between 1985 and 2015, the global exported and imported quantities of fish and fisheries products more than doubled. The trade of all fish and fisheries products, which includes the international trade of aquatic animals and plants, more specifically the trade of live fish for human consumption, increased nearly tenfold between 1985 and 2015 [FAO 2017a]. The EU-28 is the biggest importer of the world, its international trade reached 54 billion EUR in 2015. Furthermore, specific sales prices are also rather high. In addition, Japan and the USA also imports a significant quantity of fish and fisheries products [Eurostat 2017].

Nowadays, it can be observed that the increase of the global supply of fish and fisheries products exceeds the growth of the world's population [Gilland 2002]. The volume of consumption is uneven between different countries and even between each region of a given country. The reason for this difference is either availability, price, income, as well as social, economic and cultural factors, such as gastronomic traditions, eating habits, flavours and the used marketing communication. The specific consumption data show especially high values in coastal, fluvial and inland areas [AKI 2017]. The per capita consumption of fish and fisheries products (in live weight), which includes all fish and fisheries products, excluding aquatic plants, increased from 14 to 19.7 kg per person per year in global terms during the last 30 years. However, it is predicted that this value may even reach 20 kg per person per year in a few years. During this period, the greatest increase (+32%) was observed in Asia, but the EU value also reached 25.1 kg per person per year in the EU (2015). The greatest consumer countries in the EU include Portugal, Spain and France. Poland's average yearly fish consumption (in live weight) was 13.6 kg per person per year, which is nearly 50% lower than the level of fish consumption in the European Union. Hungary has the lowest per capita fish product consumption value (nearly 5 kg per person per year) among the Member States of the EU [EUMOFA 2017].

As a summary, it can be concluded that fish production increased globally, but it decreased on the EU-28 scale. In the EU-28 countries, both aquaculture production and the amount of marine catches decreased, while the amount of global marine catches stagnates or slightly decreases and global aquaculture production is dynamically increasing. Production is mostly concentrate around Asia and a further dominance of this region is expected. Based on the current forecasts, total fish production may exceed 150 million tons by 2025, due to China's further increasing role in production. Also, it has to be emphasised that China has a significant role in the production of carp species. As regards trade and consumption, the role of fish products is becoming increasingly important, since the fish product segment is one of the main contributors to the trade of food products.

Research material and methodology

In accordance with the objective of this study, data obtained with secondary data collection was used to demonstrate and describe the production, trade and consumption of fish and fisheries products. This data was obtained from Hungarian and international papers, statistical databases and specialised sectorial materials. In order to survey the global market and European Union (EU-28) situation of fisheries and aquaculture products, the database and reports of FAO (Food and Agricultural Organization of the United Nations), Eurostat (Statistical Office of the European Communities) and Comtrade (International Trade Statistics Database) were taken as a basis. The Hungarian conditions were observed using the databases of AKI (Research Institute of Agricultural Economics), while the Polish situation was surveyed on the basis of the LDB (Local Data Bank). These data were considered with regard to the interval between 1985-2015 and we used the latest data available for the entire year in all cases. In the case of the European Union, data were corrected to all 28 Member States on all occasions. In addition to presenting the situation of the entire sector, the data collection mainly focuses on the production, consumption and trade relations of carp products between 1985 and 2015, as well as the future.

Data processing was performed using descriptive statistics and time series analysis. Microsoft Excel was used to provide forecasts based on past data and a trend function was extrapolated to determine production for a 10-year-long period. The function was created by filtering the necessary data from the largest currently available database (FAO FishStat). Base ratios were used to describe the relative proportion of change (base: data from 1985).

Research results

Production in the carp sector

Global carp production was constantly growing in the examined years (by +496.3% between 1985 and 2015). In 1985, 91.4% of the total production originated from aquaculture, while this proportion was 97.3% in 2015, reaching 4.4 million tonnes. The main carp production countries are located in Asia, such as China and Indonesia, the combined production of which amounted to 86.2% of the total production in 2015 (tab. 1).

Table 1. Carp production between 1985 and 2015
Tabela 1. Produkcja karpia w okresie od 1985 do 2015 roku

Description/ *Wyszczególnienie*	Produkcja karpia [tys.t]/*Carp production [thous. t]*							Change/ *Zmiana [%]*
	1985	1990	1995	2000	2005	2010	2015	
World total/ *Świat razem*	745.7	1 205.0	1 909.7	2 481.7	2 735.3	3 504.5	4 447.0	496.3
– fisheries/*rybołówstwo*	64.4	70.7	82.4	71.3	69.0	83.9	118.9	84.6
– aquaculture/*akwakultura*	681.3	1 134.3	1 827.4	2 410.4	2 666.3	3 420.6	4 328.1	535.3
China total/*Chiny razem*	238.9	523.3	1 398.9	1 804.7	2 135.8	2 538.5	3 357.9	1 305.6
– fisheries/*rybołówstwo*	-	-	-	-	-	-	-	-
– aquaculture/*akwakultura*	238.9	523.3	1 398.9	1 804.7	2 135.8	2 538.5	3 357.9	1 305.6
EU-28 total/*UE-28 razem*	80.9	98.3	85.8	83.2	81.4	76.8	83.8	3.5
– fisheries/*rybołówstwo*	1.4	12.2	8.1	9.0	9.4	8.8	12.6	801.7
– aquaculture/*akwakultura*	79.5	86.1	77.7	74.2	71.9	68.0	71.2	-10.5
Hungary/*Węgry*	10.1	23.1	10.2	11.9	13.2	13.2	18.0	78.3
– fisheries/*rybołówstwo*	-	9.9	2.9	3.2	3.5	3.2	7.3	-
– aquaculture/*akwakultura*	10.1	13.2	7.4	8.7	9.7	9.9	10.7	6.1
Poland/*Polska*	18.2	22.0	19.7	22.6	19.1	15.4	17.8	-2.3
– fisheries/*rybołówstwo*	-	-	-	0.0	0.1	0.0	0.0	-
– aquaculture/*akwakultura*	18.2	22.0	19.7	22.6	19.0	15.4	17.7	-2.4

Source/*Źródło*: [FAO 2017a]

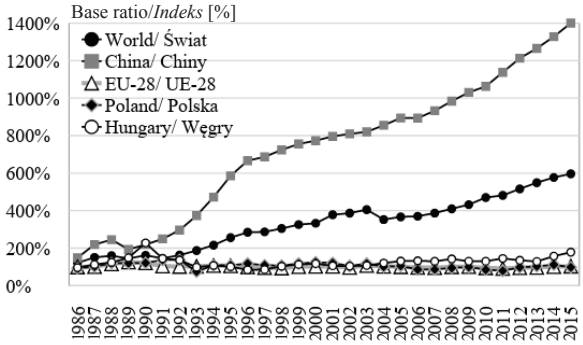

Figure 2. Global carp production (capture & aquaculture) (base: 1985=100%)
Rysunek 2. Globalna produkcja karpia (połów + akwakultura) (indeks, 1985=100%)
Source/*Źródło*: [FAO 2017a]

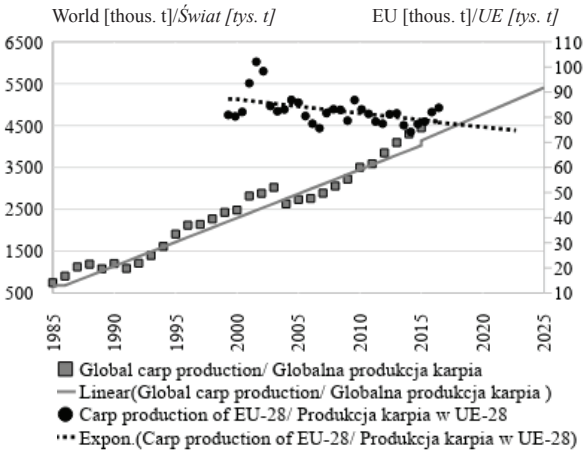

Figure 3. Tendency and forecast of global and EU-28 carp production (1985-2025)
Rysunek 3. Trendy i prognoza produkcji karpia na świecie i w UE-28 (1985-2025)
Source/*Źródło*: [FAO 2017a]

While the global production of carp products increased between 1985 and 2015, production in the European Union relatively stagnated during this period, showing 3.5% growth, but a significant decrease of its share in international production (from 10.9% to 1.9%). In the case of the largest carp producers of the European Union, it can be concluded that the Czech Republic was ranked first with its 20.9 thousand tonnes of production in 2015, closely followed by Hungary and Poland. For this reason, these two latter countries can be considered direct competitors of each other in terms of carp production and trade.

The output of the TOP-3 countries amounted to 67.7% of the carp production of the EU-28, and this proportion constantly increased in the examined period, despite the fact that while Hungary increased its carp production by 78.3% between 1985 and 2015. However, the yearly production decreased by 2.3% in Poland, mainly due to the Koi herpes virus diseases (KHV) (fig. 2). Based on the obtained data, it can be observed that the carp production of both countries originates mainly or entirely from aquaculture. However, since 2015, carp production in Hungary has been provided entirely by extensive pond farm fish production as a result of the ban on inland fisheries [FAO 2017a].

Based on the data of the examined 30 years, a 10-year forecast was prepared in relation to global and EU carp production. This forecast helps to estimate production between the minimum and maximum values of the future trend line drawn on the basis of the preceding years, also considering risks (fig. 3). Based on this forecast, global production will follow the current increasing tendency and global carp production is likely to be between 4.3 and 5.2 million tonnes (4.7 million tonnes, based on the trend line) by 2020 and between 4.7 and 5.9 million tonnes (5.3 million tonnes, based on the trend line) by 2025. However, a decreasing trend is expected at the EU level. Compared to the respective value in 2015, the average production is expected to be 76.2 thousand tonnes (ranging between 56.4-85.7 thousand tonnes) by 2020 and 74 thousand tonnes by 2025. It is important to note that these ranges are becoming increasingly wider due to the increasing uncertainty of such estimations over time.

Based on the performed forecast and the observation of carp production, it can be concluded that, considering the bottom and top limits of the trend, global yearly carp production is expected to increase by 2.5% in the next 10 years, while a 0.4% decrease is expected in the

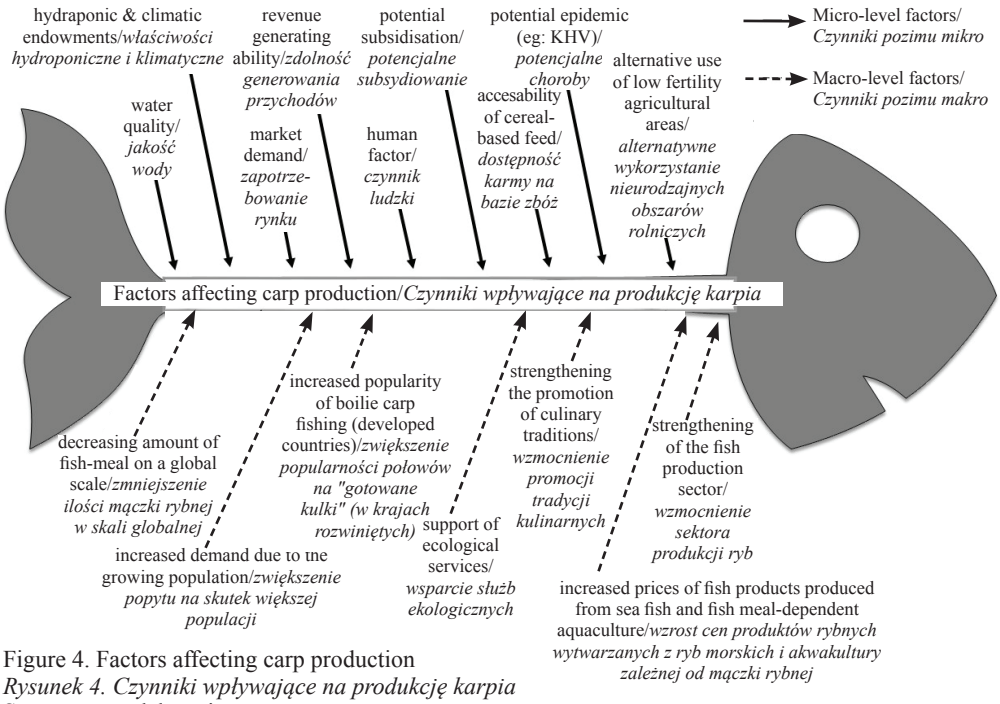

Figure 4. Factors affecting carp production
Rysunek 4. Czynniki wpływające na produkcję karpia
Source: own elaboration
Źródło: opracowanie własne

European Union. Based on these data, our hypothesis can only be partially accepted, since this global carp production potential is going to increase in a sustainable way, thereby confirming our hypothesis, but the decrease of production in the EU is in contradiction with this statement. In Europe, carp production is affected mostly by the stagnation of demand and the prevailing animal health situation, since the damage caused by the Koi Herpes Virus (KHV) is a threat to the economic sustainability of carp pond farms.

International trade of the carp sector

The volume of the international trade of carp is significantly below than that of more popular fish products, which is partly because carp meat is bony, it often leaves an unwanted aftertaste and the level of its processing is insignificant. In addition, some of the produced live carps are not sold on the markets, but they are used to populate fishing ponds. Carp export and import are primarily focused on the trade of live fish, while a small quantity of fresh and chilled or frozen carp also appear in international trade. On a global scale, the trade resulting from the production in China is the most significant on the market, but its international trade is focused only on its surrounding countries, since the transport of live fish and fresh fish products to more distant countries is difficult to organise. The European carp market mainly relies on domestic production and there is no need for any significant import, since more than 50% of the demand of the biggest markets for fresh fish are covered by their own production. Of the EU Member States, Poland, Germany and Romania are the biggest importers, while the Czech Republic can be considered the biggest exporting country, as it sells a significant part of its own production on foreign markets, mainly in Germany (Bavaria/Saxony). Hungary and Croatia also carried out significant export activity in 2015 [Sterniša et al. 2017]. In Poland, which is the most significant importing country within the European Union, the import of live fish increased 3.7 times between 2005 and 2015, reach-

ing 3.1 tonnes by 2015, while the volume of export was 137.7 tonnes (+241.7%, 2005-2015). Live carp export in Hungary reached 3 thousand tonnes in 2015, which is an increase compared to the preceding years. In 2015, nearly 3.2 thousand tonnes of carp products were placed on international markets at a value of 5,352 thousand EUR, 94.5% of which resulted from export. The Hungarian carp export significantly increased in the recent decades, as it expanded 18-fold during the last 10 years and 2.5-fold between 2014 and 2015, which is due to the temporary international short supply resulting from KHV experienced by competitors. In 2015, the biggest buyers of Hungarian live carp were Poland (1,189.9 thousand tonnes per year), Romania (866.4 thousand tonnes per year) and Germany (540.4 thousand tonnes per year). Live fish export mainly focuses within the EU, while only a small amount is sold to countries outside the EU, because the transport of live fish is subject to special conditions which significantly limits transport options [Eurostat 2017, Comtrade 2017]. In addition to logistics difficulties, trade is also hindered by the appearance of KHV. This disease is able to entirely alter the direction of trade, since a main fish exporting country can easily find itself becoming and importer, as even 100% of the diseased fish population may perish. The low amount of produced fish results in a significant increase of the pond-side price of carp in the region due to the high demand [Füllner et al. 2011].

Consumption

As written above, carp is sold only in a fresh, live form on markets, and the demand for frozen or processed products is low. As a result, the supply chain is rather short, since the product is purchased by consumers in live or fresh form and they prepare the food at home. As regards the consumption of carp, it can be observed that this product is less attractive for young consumers, since this group mainly prefers processed and easily consumable fish products. The consumers who do not like carp mostly refer to its boniness, occasional aftertaste (commonly referred to as sludgy taste) and fat content of carp meat. However, the main producing countries offer traditional fish products which can only be prepared using carp. As regards the consumption of this product, wels catfish, African catfish, silver carp, bighead carp and grass carp more or less serve as substitute products [EUMOFA 2016]. In Poland, carp is the most widespread national fish species and it is mostly consumed in the Christmas period, when the demand for carp is the highest. Despite this fact, the yearly consumption of carp is relatively low as it amounted to around 0.5 kg per person per year in 2015, which is considered low in comparison with the total fish production consumption of 12.5 kg per person per year. The carp consumption in Poland is mainly affected by salmon, which can be considered the main competitor product. However, an increasing number of promotional campaigns (Pan Karp) is launched in order to enhance the position of carp food specialties [Rucinski 2016]. Of the EU-28 countries, the Hungarian population has one of the lowest fish consumption values, amounting to 5.3 kg per person per year, of which carp represents 1.04 kg per person per year, which is 20% of the total consumption. The tendency of increasing demand for carp products in the Christmas period can also be observed in Hungary [AKI 2017]. In addition to the demand-supply relation, consumption is mainly affected by consumer prices in

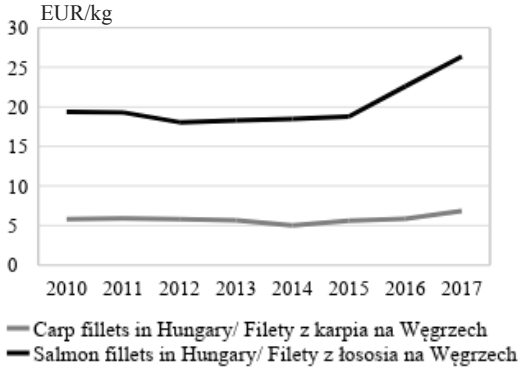

Figure 5. Retail prices of carp and salmon fillet in Hungary (2010-2017)
Rysunek 5. Ceny detaliczne filetu z karpia i filetu z łososia na Węgrzech (2010-2017)
Source/*Źródło*: [AKI 2017]

which a periodical difference can be observed, since production is season-dependent and there is more fish in the winter than in the summer, while the storage of fish is expensive. In the case of Poland, the amount of consumption is greatly affected by the gross price of Atlantic salmon (*Salmo salar*), the competitor product of carp.

By examining (fig. 5) how many kg of carp fillet can be purchased from the price of 1 kg salmon fillet based on the Polish and Hungarian consumer prices, the following conclusions can be drawn: based on Polish prices, the price of fresh salmon was 6.9-9.7 € per kg in 2015 and it significantly increased in the subsequent years, amounting to 12.8 € per kg in 2017. At the same time the price of 1 kg live carp was 3-3.4 € in 2015 and 3.5-4 € in 2017. However, in Hungary, where salmon consumption is less significant, the price of 1 kg of salmon fillet was 13.5 € in 2010 and 19.5 € in 2017, while that of carp fillet was 6.9 € in 2017. As a result, it can be estimated based on these data that consumers can purchase around 2.5-4.0 kg carp fillet from the price of 1 kg of salmon in both countries [AKI 2017].

Summary and conclusion

The production of carp, which is one of the most significant fish species produced in aquaculture, has been showing an increasing tendency in the recent years. However, based on the observed 30-year-long data, an increasing volume of production can be seen only in global terms, as production is constantly decreasing in the EU. The current forecasts show the same tendency for the next 10 years, which may help carp gain its market share on a global scale, potentially reaching 4.7-5.9 million tonnes per year by 2025. Altogether, as a result of the decreasing amount of production in the EU, carp production is predicted to decrease to 46.9 – 84.1 thousand tonnes in the European Union by 2025. Carp is sold in live or fresh, chilled form, which limits international trade to the surrounding European countries and the main outlets are Poland, Germany and Romania. The import of Poland increased 3.7 times and its export increased 2.4 times in the last 10 years. The export of Hungary on the other hand, increased 18-fold, which is due to the short supply faced by competitors as a result of fish diseases. The consumption of carp products can be considered low, it is only 4% of the total fish consumption in Poland, which is greatly affected by the demand of salmon fillet as a competitor product, even though 2-3 kg of carp fillet can be purchased at a price of 1 kg of salmon fillet. In Hungary, the proportion of carp consumption is 19.6% of fish consumption, which is due to the popularity of traditional carp foods mainly during the Christmas period.

Based on our hypothesis, it is necessary to examine which factors influence the economic, social and ecological sustainability of carp production the most. Figure 4 shows these factors categorised on the basis of micro- and macro-level factors. Also, these factors are closely related to each other and they mainly describe production in the European Union. As regards small-scale, i.e., micro-level factors, production is mainly affected by the availability of cereal-based feed, which contributes to the sustainability of carp species management. The potential outbreak of epidemics is also an important factor, since they caused a high proportion of carp species mortality in Europe in the recent years. Of macro-level factors, it is important to pinpoint the decreasing amount of fish meal on a global scale, which represents an opportunity for increasing carp production, since demand for fish products increases globally due to the popularity of traditional foods produced from fish. The increasing price of fish products is also significant, similarly to the increasing demand for processed products as a result of the strengthening fish processing sector.

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Streszczenie

Karp zwyczajny (Cyprinus carpio) jest jednym z najdłużej hodowanych przez człowieka gatunków ryb słodkowodnych, którego globalna produkcja stanowi około 3,4% (4,4 mln ton w 2015 r.) światowej produkcji ryb. Karp jest trzecim pod względem ważności gatunkiem ryb w światowej produkcji sektora akwakultury, a 97,3% globalnej produkcji karpia pochodzi z akwakultury. Produkcja karpia stanowi 8,3% światowej produkcji ryb w sektorze akwakultury. Technologia produkcji pasz dla karpi jest niezależna od mączki rybnej i opiera się głównie na zbożach. Największymi producentami karpia w Unii Europejskiej są Czechy, Polska, Węgry, Niemcy i Chorwacja. Łączna produkcja w 2015 roku czołowej trójki producentów karpia w UE (Czechy, Polska, Węgry) stanowiła 67,7% całej produkcji w UE-28. W handlu pomiędzy państwami UE wykorzystywane są głównie żywe ryby, a w drugiej kolejności wstępnie przetworzone karpie.

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