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STATUS AND DEVELOPMENT TENDENCIES OF FRESHWATER AQUACULTURE PRODUCTION IN BULGARIA

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Abstract

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The present article surveys the status and the tendencies in the development of the freshwater aquaculture in Bulgaria under the conditions of market economy, and specific attention is paid to the structure and the type compound of the cultivated water organisms, the present state of the production, their actual price for realization, as well as the consumption of fish. Bulgaria possesses a comparatively rich water fund of about 70 000 ha, which accompanied by the climatic conditions in the country creates good conditions for aquaculture development.The main objects for cultivation are the carp (*Cyprinus carpio*) and the trout (*Oncorhynchus mykiss*), having in mind that the herbivorous fish species, like silver carp (*Hipophthalmichthys molitrix*), bighead carp (*Aristhichthys nobilis*) and grass carp (*Ctenopharingodon idella*). With good perspectives for increasing the production capacities are the *Acipensaridae*, the European wels (*Silurus glanis*) and the channel catfish (*Ictalurus punctastus*). Fish consumption per capita is 4.6 kg, which ranks Bulgaria among countries with low fish consumption.

Key words: aquaculture, status, Bulgaria

Introduction

Aquaculture is one of the most rapidly developing branches of agriculture in the world. According to the data of FAO (2007) the yield of water organisms scores a continuous growth and in the 2004 reaches 140.5 Mill t. For a period of 30 years a double increase of the general quantity of hydrobionts is reported, which are offered at the market, and a considerable part of it is due to the gross development of aquaculture. In the prognosis of FAO in 2020 half of the general production of water organisms will be because of the cultivated species.

The sector takes an important place in the structure of agriculture, as a producer of valuable protein food, which is an important element of providing food for the population. It is of big importance for regions, in which the basic means of survival are fishing and processing of fish and fish products and in some respects it can be defining for the means of livelihood of a considerable part of the local population. These are a number of settlements along the river Danube and the Black Sea**,** as well as in some inland regions, where the fish-rearing farms and the dam lakes are situated. As a whole the sector contributes little for the employment at the national level (0.38% of the employed

in the country), but it provides considerable employment at a regional level.

At thorough usage of the production powers and the capacities of the specialized objects for freshwater and marine aquaculture, of the Black Sea and the Danube River catches, as well as the potentialities for fish-rearing in the small and middle-sized dam lakes (up to 200 ha) and in the big dam lakes (over 200 ha), the general acquired and realized fish production reaches not more than 1% of the GIP of the country. The general income from fishery in the economy of the country is about 14.3 Mill Euro.

In comparison to many other countries Bulgaria is with relatively low experience in the sphere of aquaculture. The first steps in these directions are made before a little more than 100 years (Zaikov, 2006). After 1950 a lot of dam lakes are built and the cadastral water area of the country reaches 70 000 ha (Grozev at al., 1995). Besides the purposes of the irrigation agriculture, the dam lakes are used for fish rearing, which leads to the increase of the general volume of the fish production in the country. In the second half of the last century 3700 ha warm-water and 40 ha cold-water pools are constructed, as well as 170 000 m^2 freshwater cage farms (Grozev et al., 1995; Grozev et al., 1999; Zaikov, 2006), a big part of which function at present.

The condition of the freshwater aquaculture in Bulgaria is defined by the influence of a complicated complex of economic, hydro geographic, social and other factors, but the economic ones are of crucial importance. After the changes in the economic system in1989, a specific push is expected after the country is being accepted in the European Union. For the period 2007 - 2013 it is planned in this sector to be invested about 160 000 000 Euro, 80 000 000 Euro of which will be granted by the European Fund of Fishery. In the sphere of aquaculture the aim is its stable development to be ensured by the improvement of the quality of the production and enhancement of the technical level, diversification of the production, implementation of good practices, constructing a system for inspection of quality and hygiene-sanitary norms and etc. In this direction of Priority branch 2 "Development of aquaculture production, processing industry and marketing of fish products" of the National Plan for Development of Fishery and Aquaculture, the farmers are granted for:

- Support of the traditional aquaculture and diversification of the production by implementing new fish species
- Production of species with good market prospective
- Granting investments for building, enlarging, equipment and modernization of production and processing installations
- Granting investments for improvement hygiene and the work conditions on the farms, increasing the quality of the final product, introduction of innovations in the production and processing, usage of methods for production, which reduce the negative effects for the environment, marketing of fish products and etc.

It is expected for the period 2007-2013 in the listed directions 46 000 000 Euro to be invested. The present article surveys the status and the tendencies in the development of the freshwater aquaculture in Bulgaria under the conditions of market economy, and specific attention is paid to the structure and the type compound of the cultivated water organisms, the present state of the production, their actual price for realization, as well as the consumption of fish.

Material and Methods

For the present research are used articles, bulletins, account and prognosis reports and other official materials of different authors, including institutions, such as Ministry of Agriculture and Food, National Agency of Fisheries and Aquaculture, National Statistical Institute. Additionally personal data of a great number of fish-producers are used, gathered by the authors.

Results and Discussion

The total production of hydrobionts is formed by two major sectors in Bulgaria: aquaculture (freshwa-

ter and seawater) and catch (freshwater and seawater).

The marine aquaculture is practically poorly developed, but there is a define tendency for increase in the production. In the Bulgarian aquatory of the Black Sea basically black mussel (*Mytilus galloprovincialis*) is bread.

The freshwater aquaculture is divided in two groups - warm water and cold water. At the present level it is entirely recovered with the freshwater fishery, as an object of cultivation is the fish only. The offered at the market quantities of crayfish (*Astacus leptodactylus*) and frogs (*Rana ridibunda*) are catches from natural reservoirs.

Production facilities in the aquaculture

Various production capacities are used in the production of different fresh-water fish species, like dams, ponds, concrete facilities, net cages, etc. Concerning specialized water capacities, the ponds are prevailing, which are mainly used in fresh-water aquaculture for carp rearing in various poly-cultures. The concrete facilities are considerably smaller in number and are mainly designed for trout breeding. In 2006, in the net cage fish-farms, 499 net cages, having various shape and size have been used, their total area amounting to 216 100 m^2. The net cage fish-farm production potential, particularly concerning the more expensive and delicacy fish species, like trout and sturgeons, has been very great. Together with this we should seek a balance between the fish production and the auto purification capacities of the dam lakes, in which the net cage fish-farms have been situated. The establishment of such normative has a significant importance for the environmental protection.

The dams have a great significance as production capacities for freshwater aquaculture. The greatest share is that having areas greater than 500 ha (62.5%), which are little used as fish-farms and are mainly used for angling or net cache fish-farms have been built in them. The dam lakes with average area (200-500 ha) occupy 9.5% of the total area of the dams, and the small ones with an area of less than 200 ha - 28%. The last one is mainly used as ponds for fish rearing. The total dam lake area used for the purposes of fish rearing in 2006 is 33 164 ha.

The size of fish farms in Bulgaria is comparatively small. More than 29% they have realized their activity upon a production area smaller than 10 da. The average size fish-farms, with a water area between 10 and 100 da comprise 42% of the total number of fish-farms in the country. The fish-farms, which use water areas of more than 200 da is very small - about 34.

According to NAFA data, more than 250 fish-farms have been registered in the country for rearing aqua-organisms, most of which being used for trout breeding and carp for consumption. The specialized fish-farms for the production of fish stocking material have been considerably smaller in number and an insignificant part of them possess high-quality spawners. The fish-farms of a mixed-type are very limited in number, i.e. for breeding warm-water, as well as cold-water fish species.

Main fish species reared in the aquaculture

The main warm water fish species, which have been an object of breeding in Bulgaria, are as follows: carp (*Cyprinus carpio*), herbivorous species - silver carp (*Hipophthalmichthys molitrix*), bighead carp (*Aristhichthys nobilis*) and grass carp (*Ctenopharingodon idella*). Recently, the production capacity of wels (*Silurus glanis*) and channel catfish (*Ictalurus punctatus*) have been increased.

The relative share of sturgeon species has been constantly increasing, the producers relying mainly on black caviar market realization. It is mainly Russian sturgeon (*Acipenser gueldenstaedti*), beluga (*Huso huso*) and sterlet (*Acipenser ruthenus*) have been mainly bred. In 2006, for the first time stellat sturgeon (*Acipenser stellatus*) has been supplied at the market. The net cage fish-farms have turned to be very suitable for sturgeons breeding.

In 2007, the experimental breeding of African catfish (*Clarias garriepinus*) in the cooling waters of Thermal Electric Stations has been started, and it is expected in 2009 the first 2 t of African catfish with an average weight of about 1.5 kg to be produced.

Concerning the cold-water fish species, the main

traditional object for breeding is the rainbow trout (*Oncorhynchus mykiss*). Besides this species, a limited number of Balkan trout (*Salmo trutta fario*) and brook trout (*Salvelinus fontinalis*) have been bred. An increased interest in breeding land-locked salmon in net cages has been reported. The experiments for breeding kisutch (*Oncorhynchus kisutch*) and some white fish, like peled, have not succeeded to impose the production of these fish species in practice.

In a part of the dams in Bulgaria narrow-clawed crayfish (*Actacus leptodactylus* Esch.) have been bred. Their cultivation by now, has been done at experimental conditions only, and one-summer old narrow-clawed crayfish (*Actacus leptodactylus* Esch.) of 764 kg.ha^{-1} (Zaikov, 2007; Zaikov et al., 2001) and 350-370 kg.ha^{-1} of narrow-clawed crayfish (*Actacus leptodactylus* Esch.) for consumption (Zaikov, 2007; Souty Grosset et al., 2006) have been reported. Frogs (*Rana radibunda*) have been supplied at the market and their quantities have originated exceptionally from natural water-ponds.

Quantity of fresh-water fish produced

During the last 5-6 years a durable tendency for increasing the fresh-water fish production as well as other aqua-organisms in the specialized fish-farms (Table 1) has been reported. It is envisaged that this tendency should be preserved in 2009, too, by reaching a production capacity of 9 000 t (Gaidadzhieva, 2005; Gaidadzhieva, 2008). The production capacity increase in 2008 as regards 2003 has been nearly 2.5 times. For the reviewed period, the average annual production capacity increase has been nearly 20% (19.86%)) and has varied from 14.2% in 2004 as regards 2003 to 25.8% in 2005 as regards 2004.

In 2008, the production capacity of traditional fish species has been the greatest one - the rainbow trout (*Oncorhynchus mykiss*) - 2449.9 t and the carp (*Cyprinus carpio*) - 2263.1 t, having in mind that the second species in increase has been reported by 19.8% as compared to the previous year 2007 and 72.3% as regards 2005 (Table 2, Table 3). In 2008, the first species has occupied 34.2% of the aquaculture production and the second one - 31.6%. The bighead carp (*Aristhichthys nobilis*) and its hybrids have been on the third place - 1038.7 t or 14.5% of the total fish production. As an additional production parallel with the economically valuable fish species and

Table 1

Production of fish and other aqua-organisms for the period 2003-2009

Production	2003	2004	2005	2006	2007	2008	2009*
t	2 898.2	3 310.9	4 165.1	4 909.7	5 897.5	7 162.4	9 000
%	100	114.2	143.7	169.4	203.5	247.1	-

** Prognostication*

Table 2

Production of carp (*Cyprinus carpio*) and carp fishes for the period 2003-2008

Species	Fish, t					
	2003	2004	2005	2006	2007	2008
Carp *(Cyprinus carpio)*	1091	881.2	1313.2	841	1889.1	2263.1
Bighead carp (*Aristhichthys nobilis*)	281	521.1	428.1	298	655.5	1038.7
Silver carp (*Hypophthalmichthys*	72	10	10.3	5.3	6.2	54.2
Grass carp (*Ctenopharingodon idella*)	63	71.6	110.5	73	257.5	204.5
Crucian carp (*Carassius spp.*)	4.5	28	7.8	15.1	30.5	77.5
Total	1511.5	1511.9	1869.9	1232.4	2838.8	3638

particularly in the dams, considerable quantities of crucian carp (*Carasiuss* spp.) has been produced, one part of it being supplied at the market.

Concerning warm water fish-farms, besides the fish species indicated in considerably smaller quantities (less than 1% of the total production), black carp (*M. piceus*), channel catfish (*Ictalurus punctatus*), wels (*Silurus glanis*), pike (*Esox lucius*), tench (*Tinca tinka*), brook trout (*Salvelinus fontinalis*) etc. have been bred (Table 4). The channel catfish (*Ictalurus punctatus*) and the black carp (*M. piceus*) have been mainly bred in the dam of Ovcharitza. A comparatively good share in the total quantity of fish species cultivated has been occupied by the channel catfish (*Ictalurus punctatus*), with a maximum production capacity of 171.2 t in 2005 and 236 t in 2007. A continuous increase in the production capacity has been marked by the European wels (*Silurus glanis*) by reaching in 2007-2008 quantities of 103.9-120.1 t.

Buffalo fishes (*Ictiobus* spp.), sander (*Sander lucioperca*), black carp (*Mylopharingodon piceus*) and some other fish species have no practical significance for the aquaculture because of the small quantities, which have been produced at this stage.

Because of the rapid development of net cage fish rearing, a variation in the range of fish species produced has been observed, by including the russian sturgeon, beluga, stellat sturgeon, sterlet, syberian sturgeon, paddle fish etc. (Table 5). Of the *Acipenseridae* species, the highest relative share belongs to the russian sturgeon, and its production has reached in 2005 281 t, which amounts to 6.74% of the fish quantity produced in the country. This is the year with the highest production of *Acipenseridae* amounting to 309.7 t. A considerable increase has been reported as regards beluga - 3.7 t in 2004 and 21.5 t in 2005.

The main representative of the Black Sea aquaculture, which has been bred in the coastal aqua-areas, this is the black sea mussel (*Mytilus galloprovincialis*). Its production in the fish farms has marked a continuous increase - from 117.7 t in 2003

Table 3

Production of trout (*Oncorhynchus mykiss*) and trout species for the period of 2003-2008

Species	Fish, t					
	2003	2004	2005	2006	2007	2008
Rainbow trout *(Oncorhynchus mykiss)*	880	1555.4	1549.2	1553	2146.4	2449.9
Balkan trout (*Salmo trutta fario)*	4.4	4.4	8.2	5.8	10.5	7.9
Brook trout (*Salvenilus fontinalis)*	144	18.6	4.8	5.5	5.3	3.3
Land-locked salmon *(Salmo salar)*	0.05	0.1	-	-	-	0.3
Total	1028.45	1578.5	1562.2	1564.6	2162.2	2461.4

Table 4

Production of additional warm water fish species

Species	Fish, t					
	2003	2004	2005	2006	2007	2008
Black carp (*Mylopharingodon piceus*)	0.04	-	-	1.2	-	-
Channel catfish (*Ictalurus punctatus)*	174	-	171.2	60	236	158
Wels *(Silurus glanis)*	6	17.8	39.8	18.3	120.1	103.9
Pike (*Esox lucius*)	2.4	3.9	3.9	7.0	15.8	34.0
Sander *(Sander lucioperca)*	-	0.5	0.4	-	7.80	16.9
Tench *(Tnca tinca)*	0.4	-	0.3	-	-	-
Total	182.84	22.2	215.6	86.5	379.7	312.8

to 595.4 t in 2008, or 5 times increase has been reported.

According to NAFA in 2006, the fish production for consumption has marked a considerable decrease as compared to 2005 and it has hardly reached 3041.5 t, i.e. a decrease of 26.98%. This refers to the greatest degree to the main fish species, like the carp (a decrease of 35.6%), the big-head carp (30.4%), the Russian sturgeon (59.79%), the channel catfish (64.96%) and some other species. I makes an impression that during the last 3 years the trout production has been preserved - about 1 550 t, of which 908 t have been produced in net cage fish-farms. An increase, as compared to 2005, has been marked by the production of some species having a smaller share in the total fresh-water fish production, like beluga, pike, etc. In 2006, for the first time, the production of 15.1 t of stellat sturgeon has been indicated.

These data have indicated that the main hydrobiont quantity, which has been supplied at the Bulgarian market as aquaculture production has been formed of a few fish species only. The production of such highly valuable hydrobionts like the sander, brook trout, starlet, pike, freshwater crayfish, etc. have been included symbolically only, or have not been included in the official statistics at all until 2008.

We should underline that the official data cannot cover 100% of carp production for two reasons, at least: NAFA-MAF statistic system has been a rather recently established and does not cover all production facilities; many of the production facilities in the country have not been registered yet or have not provided real production data. According to the non-official data by the branch organization of fish producers, carp species production has been nearly twice more than has officially been counted. All trout production facilities have been registered and their production yield has been correctly counted. It is expected that in 2009, more than 90% of fish production will be counted by NAFA statistic system.

Fish prices

By reporting the fact that at an average about 85%

Table 5

Production of sturgeons from the aquaculture

Species	Fish, t					
	2003	2004	2005	2006	2007	2008
Russian sturgeon *(Acipenser gueldenstaedti)*	144	6.7	281	113	147.1	129.1
Sterlet *(Acipenser ruthenus)*	0.3	0.1	2.2	2.5	4.6	-
Beluga *(Huso huso)*	3.4	3.7	21.5	27.7	46.2	-
Paddlefish *(Poloyodon spathula)*	-	2.3	0.05	-	-	-
Stellat sturgeon (*Acipencer stellatus)*	-	-	-	15.1	-	-
Total	147.7	12.8	304.75	158.3	197.8	129.1

Table 6

Trade and retail prices of the main fresh-water fish species produced in Bulgaria

Fish species	Average wholesale prices				Average retail prices			
	2007	2008	2009		2007	2008	2009	
	BGN/kg	BGN/kg	BGN/kg	US $/kg	BGN/kg	BGN/kg	BGN/kg	US $/kg
Bighead carp	2.1	1.2	1.2	2.11	1.2	3.12	1.3	1.2
Carp	1.3	1.4	5.6	1.3	1.4	1.5	1.5	1.4
trout	1.7	7.7	1.7	6.5	1.8	1.8	1.8	1.6

of the annual fish production in the fish-farms of the country has been determined mainly by carp, bighead carp and trout species, we have traced the dynamics of their trade and retail prices for the last 3 years (Table 6).

Of these data it is evident that for 2008, as regards 2007, the trade and retail prices have increased more significantly as regards bighead carp, respectively by 26.8-36.8% and carp by 25.7-28.9%. During the first six months of 2009, the average retail prices have been higher in comparison with the previous years. The tendency for more significant prices increase as regards bighead carp by 13.7% (3.40 BGN/kg or 2.58 US D/kg) has been preserved. Concerning carp the prices increase has been by 7.3% (5.74 BGN/kg or 4.36 US D/kg) and as regards trout by 2.2% (8.65 BGN/kg or 6.57 US D/kg) The increase of prices at the home market has been influenced to a great extent also by the great range of various fish species, most often imported, which have higher prices.

In 2008, 113 t of live fish have been exported, of which 109.3 t or 96.7% of fresh-water fish species (carp or trout fish species): in Romania - 79.5 t at the value of 418 407 US D or 5 263 US D/t; in Macedonia - 28.2 t at a value of 74 483 US D or 2 641 US D/t; in Greece - 1.6 t at a value of 25 450 US D or 15 911 US D/t.

Fish consumption

In 1982-1983, in Bulgaria the greatest quantity of fish has been produced, respectively 16 885-15 280 t (Hadjinikolova and Rusenov, 2006; Zaikov, 2006). During this period, fish consumption has reached up to 6 kg/capita annually, but in the 90^{ties} it has sharply decreased up to 3 kg/capita annually. The reasons, which have lead to this position have been several ones: the lack of tradition to consume fish; the seasonal character of fishing, explained by the specific climatic conditions in the different regions; the lack of well-organized fish and fish products market infrastructure and insufficient advertisement; the high prices of fish products in comparison with the poultry; the high prices of fish products imported as regards the average income of the population.

Since 2004 onwards, a certain increase in fish consumption has been noticed on behalf of the population. According to National Statistic Institute data, in 2004, the average annual fish consumption has increased by more than 13% in comparison with the previous year, reaching a value of 4.3 kg per capita, and in 2008 it has reached 4.6 kg (Table 7). The data indicated do not include the quantities consumed in the catering establishments.

During the period 2001-2005, the annual consumption of fish and other aqua-organisms and of their products has been at an average of 16.4 kg/capita/annually worldwide, while for the EC countries it has been 25.7 kg/capita/annually. In Western Europe, the three countries having the greatest consumption of fish and other aqua-organisms and their products are as follows: Island (91.6 kg/capita), Portugal (58 kg/capita) and Norway (53 kg/capita). The lowest consumption of fish and fish products has been recorded in Austria - 14.2 kg/capita. As regards the Central and Eastern European countries, the greatest fish consumers are: Lithuania (59.8 kg/capita), Estonia (21.2 kg/capita) and Russia (18.6 kg/capita). Bulgaria occupies one of the last positions as regards fish consumption amounting to about 4.3 kg/capita/annually (2006-2007), while for 2008 an increase of 0.3 kg has been reported. It is expected until 2010, the fish consumption per capita to exceed 5 kg mainly on the account of aquaculture.

In the cities, fish and fish products consumption has been greater in comparison with the small villages

Table 7

Consumption of fish and fish products in Bulgaria

Year	2000	2001	2002	2003	2004	2005	2006	2007	2008
kg per capita	3.3	3.3	3.5	3.8	4.3	4.2	4.3	4.3	4.6

and towns. The reasons for this are the higher consumers' income in cities and the lack of a well-developed distributor' network, which limits fish consumption in the country. This negative feature has been gradually overcome by the establishment of the great market chains, recently. Fish and fish products diversity has increased either by the constantly increasing import (of live fish from the neighboring countries, included), or by means of fish production development in net fish-farms.

Conclusions

Bulgaria possesses a comparatively rich water fund of about 70 000 ha, which accompanied by the climatic conditions in the country creates good conditions for aquaculture development. The main objects for cultivation are the carp (*Cyprinus carpio*) and the trout (*Oncorhynchus mykiss*), having in mind that the herbivorous fish species, like silver carp (*Hipophthalmichthys molitrix*), bighead carp (*Aristhichthys nobilis*) and grass carp (*Ctenopharingodon idella*). With good perspectives for increasing the production capacities are the *Acipensaridae*, the European wels (*Silurus glanis*) and the American wells (*Ictalurus punctastus*). Fish consumption per capita is 4.6 kg, which ranks Bulgaria among countries with low fish consumption. The aquaculture in Bulgaria has a good perspective for development, especially having in mind that during the period 2007-2013, 46 000 000 EUR has been envisaged to be invested in this trend, mainly from the European Fish Funds.

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