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FISH FARMING IS A PROMISING BRANCH OF ENSURING FOOD SECURITY OF THE EARTH'S POPULATION

Abstract

Based on marketing research, it has been proven that aquaculture is one of the fastest growing branches of food production in the world. The main method of increasing fish productivity in ponds is fish feeding, which is an objective reality with high intensification of fish farming. With the intensification of production processes, the role of feeding is constantly increasing, and the cost of feeding in the cost price of fish is about 40% and has an upward trend. In this connection, the problem of rational feed use becomes extremely important. It is justified that the use of high-quality feed and feed additives in the diet of fattening animals significantly increases the productivity and profitability of the operation of livestock, poultry, and fish farms. 160 factories are engaged in the compound feeds production in Ukraine, the production capacity of which is 7.5 million tons per year. The specified indicator should be realistically increased to 15 million tons of finished products per year. It is established that we will need to produce 60 percent more food by 2050 to feed the world's 9.3 billion people according to estimates compiled by the Food and Agriculture Organization (FAO). Therefore, animal protein production is expected to increase with this increase. According to IFIF estimates, the world production of compound feeds has reached more than 1 billion tons per year. Top 10 countries in world compound feed production in 2021–2022 are presented (according to Alltech Agri-Food Outlook 2023). The structure of compound feeds production by types of agricultural animals and poultry in the world in 2022 is summarized. It is proved that the production of fish compound feeds continues to grow in all the world regions. In the world (as well as in Ukraine), fishing and aquaculture play and will play a significant role in the coming centuries in ensuring the food security of the global population. It is necessary to make changes in policy, management, stimulate innovation and investment to the industry to ensure the food security of the planet through fisheries and aquaculture. It is established that the world volume of aquatic bioresources production is constantly growing and in 2022 reached the value of 176 million t/year. More than 150 million tons of aquatic biological resources were used for human consumption. In the conditions of the formation of market relations, against the background of significant costs for feed, feeding fish should be based on careful calculations, the logical conclusion of which should be economic expediency. On the basis of the marketing research of the situation on the market of feed supplements, a shortage of protein vitamin supplements and complete feeds for domestically produced fish was revealed. The restraining factors for the use of foreign supplements are their cost and interruptions in supply.

Key words: fish, complete feeds production, fish farming, industrial producers, world consumption and production, aquaculture.

Introduction

The compound feed industry of Ukraine is quite important in the agro-industrial complex of the country. It is the key to the development of animal husbandry, poultry farming, fishing and the food industry, in particular the production of meat and sausage products.

The compound feed production technology includes various types of operations that must be carried out in order to achieve the maximum realization of the potential feed value of feed components. This involves changing the ingredients of such components in order to bring their natural value to the maximum and get a return from their use [1].

Today, aquaculture is one of the fastest growing branches of food production in the world. The share of aquaculture in world fish production is growing annually. Over the past 50 years, the volume of fish farming in the world has increased by more than 50 million tons, while the growth of the volume of world fish catch stopped in the 80s of the last century.

Therefore, now the most important are the technologically complex methods of fish farming intensification. These include industrial forms of fish farming in cages, pools, closed containers, which provides a high concentration of fish per unit area, and accordingly, full

feeding [2].

The functioning of all the animal body systems is largely determined by the quantitative and qualitative characteristics of the consumed feed. All necessary elements of the fish diet for normal growth and development are obtained from the natural feed base and additional feed.

Feed should be available in terms of particle size, acceptable in taste, have the proper consistency, chemically complete structure, be easily digested and assimilated in order to ensure the energy and plastic needs of the body, high growth rates of fish under normal development.

Based on the above, the main method of increasing fish productivity in ponds is fish feeding, which is an objective reality with high intensification of fish farming. With the intensification of production processes, the role of feeding is constantly increasing, and the cost of feeding in the cost price of fish is about 40% and has an upward trend. In this connection, the problem of rational feed use becomes extremely important.

As for the form of compound feeds production, it is definitely granulated compound feeds [3]. The use of compound feeds, especially in granulated form or in the form of crumble feeds, allows to exclude the possibility



of selective consumption of individual feed products by animals, poultry and fish [4-5].

Sports fishing is an active type of recreation without harming the environment. In 1939, the International Game Fishing Association (IGFA) (International Sport Fishing Association) was founded in Denmark Beach, Florida (USA), which today is the highest authority in the world for the conditions and control of sport fishing. According to the requirements, various types of baits and mixed feeds are used in sports fishing to achieve the goal of catching fish and then releasing them. The composition of such products is strictly regulated and must not harm both the fish itself and the environment.

Most of the manufactured feed additives for sports fishing can be classified as protein vitamin supplements. They are not the main type of feed and are used only during competitions and regulate the amount of fish caught.

Protein vitamin supplements (PVS) are homogeneous mixtures of purified and ground to the required size and, if necessary, specially processed high-protein, mineral feed and biologically active substances, which are produced according to scientifically based recipes, intended for the compound feed production at feed plants with a simplified technological cycle when using local feed raw materials [6-7].

The use of high-quality feed and feed additives in the diet of fattening animals significantly increases the productivity and profitability of the operation of livestock, poultry, and fish farms.

160 factories are engaged in the compound feeds production in Ukraine, the production capacity of which is 7.5 million tons per year. The specified indicator should be realistically increased to 15 million tons of finished products per year [8].

Purpose and objectives of the analysis

The purpose of the study was to substantiate the feasibility of fish feed production, marketing research and analysis of the fish feed market.

Results and its discussion

We will need to produce 60 percent more food by 2050 to feed the world's 9.3 billion people according to estimates compiled by the Food and Agriculture Or-

ganization (FAO). Therefore, animal protein production is expected to increase with this increase. Such demand for animal proteins suggests that the extremely important role of the compound feed sector will also grow. The feed industry is the most important element in the sustainable development of livestock production, and compound feeds play an important role in the global food industry, as they provide safe and nutritious sources of animal protein. Every increase in animal protein production requires achieving a significant increase in feed production for sustainable livestock production.

According to market reports, increasing livestock population worldwide, increasing prevalence of animal diseases, and increasing population, especially in developing countries, will contribute to the growth of the compound feed market in the coming years. In addition to this, rising demand for quality dairy and meat products, rapid growth in industrialization, and focus on progress are other important factors that are expected to drive the growth of the compound feed market.

According to IFIF estimates, the world production of compound feeds has reached more than 1 billion tons per year. According to the Agri-Food Outlook 2023, the volume of compound feeds production worldwide in 2020 amounted to 1,207.9 million tons. This volume reached 1235.5 million tons with an increase of 2.3% in 2021 and 1266.35 million tons with a decrease of 0.42% in 2022 (Tab. 1). 142 countries and more than 28,000 compound feeds enterprises took part in the assessment.

The top 10 feed producing countries worldwide, representing 64% of total global feed production, produced 808.8 million tonnes of feed in 2022. Overall, feed production in these countries fell by 0.4% against a global decline of 0.42%.

China, the USA, Brazil, India, Mexico, Russia, Spain, Vietnam, Argentina and Germany are among the top 10 countries in world compound feed production in 2022 (Tab. 2). The largest increase in the world compound feed products production was shown by Vietnam, which in 2022 entered the list of TOP-10 feed-producing countries. In terms of production volumes, it overtook Argentina and Germany, and also displaced Turkey on the list, which in 2021 only entered the list of the top 10 fodder-producing countries [9].

Table 1 - Distribution of volumes of world compound feeds production by region in 2021 - 2022

Region	Sum of 2021 total feed production (MMT*)	Sum of 2022 total feed production (MMT)	Growth (MMT)	Growth (%)
Africa	44.506	42.788	-1.718	-3.86%
Asia-Pacific	467.922	465.540	-2.382	-0.51%
Europe	276.114	263.232	-12.882	-4.67%
Latin America	187.904	190.910	3.006	1.6%
Middle East	25.484	31.785	6.301	24.73%
North America	259.367	261.639	2.272	0.88%
Oceania	10.433	10.466	0.033	0.32%
Grand Total	1,271.731	1,266.350	(5.381)	-0.42%

*Million metric tons

**Latin America includes all Central American countries, including Mexico

***North America includes Canada and the U.S.



Table 2 - Top 10 countries in world compound feed production in 2021 - 2022 (according to Alltech Agri-Food Outlook 2023)

Country	Sum of 2021 total feed production (MMT*)	Sum of 2022 total feed production (MMT)	Growth (MMT)	Growth %
China	268.343	260.739	(7.604)	-2.83%
United States	237.977	240.403	2.426	1.02%
Brazil	81.239	81.948	0.709	0.87%
India	44.059	43.360	(0.700)	-1.59%
Mexico	39.684	40.138	0.454	1.14%
Russia	33.000	34.147	1.147	3.48%
Spain	35.838	31.234	(4.604)	-12.85%
Vietnam	20.920	26.720	5.800	27.72%
Argentina	26.719	25.736	(0.983)	-3.68%
Germany	24.506	24.396	(0.110)	-0.45%

The industrial production of complete feeds is a dynamic sector with slow but steady growth in the past years. This reflects the growing dependence of livestock and aquaculture farmers on effective compound feeds that meet high productivity and quality requirements.

According to the structure of compound feeds production by types of agricultural animals and poultry in the world in 2022 (Fig. 1), the first place belongs to compound feeds for broilers (28.74%), the second place - to compound feeds for pigs (25.22%), then to laying hens (12.78%), dairy cattle (10.57%), meat cattle (9.32%), fish (4.18%), domestic animals (2.79%), horses (0, 64 %) and others (5.76 %).

If we compare the volumes of the world compound feeds production in 2021 and 2022 (Tab. 3), then a general growth trend can be seen for all types, except for compound feeds for pigs, dairy and beef cattle. Feed for pets has grown the most in percentage terms.

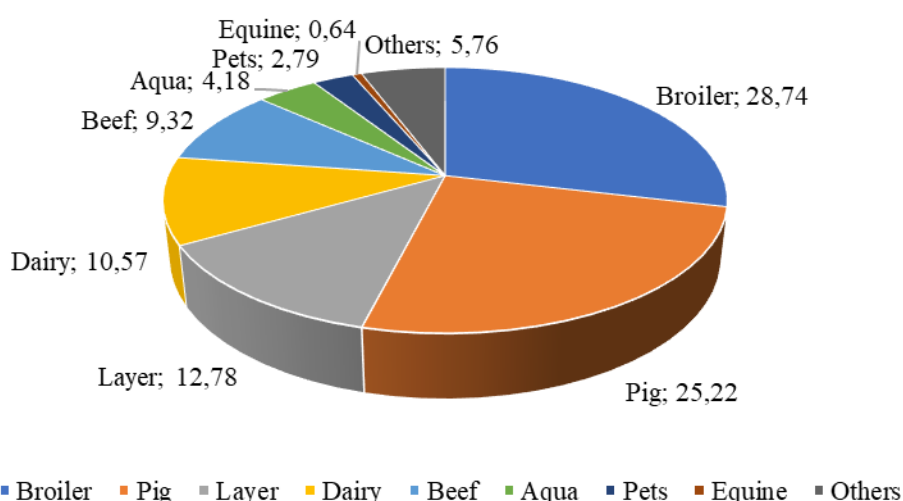


Fig. 1. The structure of compound feeds production by types of agricultural animals and poultry in the world in 2022

The production of fish compound feeds continues to grow in all the world regions. The total increase in 2022 is 2.72%. Global aquafeed production, which was 51.5 million tons in 2021, will reach 52.9 million tons in 2022 with this increase. The largest regional share in the aqua feed production belongs to the Asia-Pacific region with 38.3 million tons (Tabl. 4) [9].

Table 3 - The share of compound feeds by species in total production in 2021-2022

Sector	2021 feed tonnage (MMT*)	2022 feed tonnage (MMT)	Growth (MMT)	Growth %
Broiler	359.387	363.960	4.573	1.27%
Pig	329.185	319.383	(9.802)	-2.98%
Layer	161.356	161.849	0.493	0.31%
Dairy	135.616	133.823	(1.793)	-1.32%
Beef	118.441	118.042	(0.399)	-0.34%
Aqua	51.510	52.914	1.403	2.72%
Pets	32.884	35.270	2.430	7.25%
Equine	8.091	8.159	0.068	0.83%
Grand Totals*	1,271.731	1,266.350	(5.381)	-0.42%

**Table 4 - Distribution of world fish feeds production by region in 2021-2022**

Region	Sum of 2021 aqua feed tonnage (MMT*)	Sum of 2022 aqua feed tonnage (MMT)	Growth (MMT)	Growth %
Africa	1.484	1.449	(0.035)	-2.38%
Asia-Pacific	37.350	38.340	0.990	2.65%
Europe	4.605	4.687	0.082	1.78%
Latin America	5.652	5.922	0.271	4.79%
Middle East	0.500	0.566	0.066	13.14%
North America	1.730	1.750	0.020	1.16%
Oceania	0.190	0.200	0.010	5.26%
Grand Total	51.510	52.914	1.403	2.72%

Table 5 – The volume of world fisheries and aquaculture, (million tons/year)

Species	1990	2000	2010	2020	2022
Industrial fishing	89	90,9	91,1	90,3	86
Aquaculture	21,8	43,5	71,5	87,5	90,0
Total	110,8	134,4	162,6	177,9	176

Table 6 - TOP-10 countries of the volume of sea industrial fishing products production

Countries	1980	2000	2010	2020	2022
China	3,8	12,4	13,2	11,8	11,6
Indonesia	1,7	4,4	6,0	6,4	6,6
Peru	4,1	8,0	5,1	5,6	5,4
russia	1,5	3,2	4,3	4,8	4,6
USA	4,5	4,8	4,9	4,2	4,0
India	1,7	3,0	3,6	3,7	3,6
Vietnam	0,5	1,7	2,7	3,3	3,2
Japan	10,6	4,4	3,5	3,1	3,4
Norway	2,2	2,5	2,3	2,5	2,4
Chile	4,5	4,0	2,2	1,8	2,1
Total	35,1	48,4	47,8	47,2	46,9
The whole world	72,1	81,6	79,8	78,8	75,1

Fish farming is one of the rather promising and economically profitable areas of agribusiness development for small and medium-sized farms, and is also of considerable interest to investors. Fish farming is divided into fishing, which involves catching fish and aquatic animals, and fish farming, which has the task of preserving and improving fish stocks in natural and artificial reservoirs.

Fishing is divided into private and industrial. Sports fishing refers to private fishing and is one of the most favorite pastimes and a popular sport. The main principle of this type of sport is "catch-release", which implies careful treatment of fish [10, 11].

In the world (as well as in Ukraine), fishing and aquaculture play and will play a significant role in the coming centuries in ensuring the food security of the global population [11].

Aquaculture is the breeding, maintenance and cultivation of fish, other aquatic animals and plants, which are carried out under human control and serve to replenish industrial stocks or obtain marketable products. The use of existing global and domestic experience in the formation and development of this industry, the level of scientific development and the possibility of mastering new technologies are the starting point for the progress of aquaculture. Today, global aquaculture is one of the most dynamically developing areas of production [12].

It is necessary to make changes in policy, management, stimulate innovation and investment to the industry to ensure the food security of the planet through fisheries and aquaculture.

The world volume of aquatic bioresources production is constantly growing (Table 5) and in 2022 reached the value of 176 million t/year. Since 2000 the volume of sea industrial fishing products production has been decreasing at the same time (Table 6). This indicator varies between the leading countries, but China has been in first place for the past 20 years. In China fish consumption will increase to 38% of the total world consumption volume in 2030 according to

FAO forecasts, which is explained by the rapid growth of the country's population.

More than 150 million tons of aquatic biological resources were used for human consumption. The other 26 million tons were directed to the production of fish meal and fish oil (16 million tons). In the period from 1961 to 2022, the global consumption of food fishery products grew by an average of 3.0% per year, which is almost twice the rate of annual growth of the world population (1.6%) during the same period. Per capita consumption of fish products grew by approximately 1.4% per year - from 9 kg in 1961 to 22 kg in 2022 [11].

The volume of fish production has almost halved since 2014 according to the data of the State Statistics Service in Ukraine (Fig. 2). This is due to insufficient stocking of reservoirs; the inadequate state of stocks of the main commercial fish species in the Azov-Black Sea basin; insufficient number of fishing vessels, their



unsatisfactory technical condition, etc. The data are given without taking into account the temporarily occupied territory of the Autonomous Republic of Crimea, Sevastopol and part of the temporarily occupied territories in the Donetsk and Luhansk regions.

The average annual consumption of fish is approximately 13 kg/person in Ukraine. The consumption stock mainly consists of imports, which are adversely affected by the unstable political situation in the country since the beginning of 2014 and the full-scale war from 2022 until now. The dynamics of fish products consumption in Ukraine is positive and the population increasingly prefers fish and seafood at the same time. This is influenced by the spread of proper nutrition trends and a healthy lifestyle. However, Ukrainians have not yet reached the recommended consumption rate of the World Health Organization (20 kg).

The consumption of fish and fish products fluctuates significantly and depends on the availability of water bodies and consumer fish prices in the regions (Fig. 3).

It is necessary to support the development of domestic aquaculture of inland water bodies at the state level to ensure Ukraine's food security.

Today in Ukraine, the traditional objects of aquaculture remain carp species of fish: carp, white and variegated carp and their hybrids, and white carp. However, other species have been actively cultivated recently: rainbow trout, European catfish, pike, clary catfish, crucian carp, tench, and among sturgeons the most common are sterlet, Russian sturgeon, sevruga, beluga, bester, paddlefish, etc. [14-16].

The presence of internal water bodies allows the breeding of carp species throughout the territory of Ukraine. There is an infrastructure for growing carp, crucian carp or white carp in almost every region.

The same applies to the cultivation of crucian carp, pike, European catfish and native fish species. This is also explained by the presence of artificial water bodies that can be used for aquaculture throughout the territory of Ukraine (Fig. 4).

A significant number of people around the world participate in recreational fishing - an average of 6.7% of the population according to FAO. Recreational fishing is called amateur and sport fishing in Ukraine. There are about 10 million amateur fishermen in Ukraine according to various estimates [13].

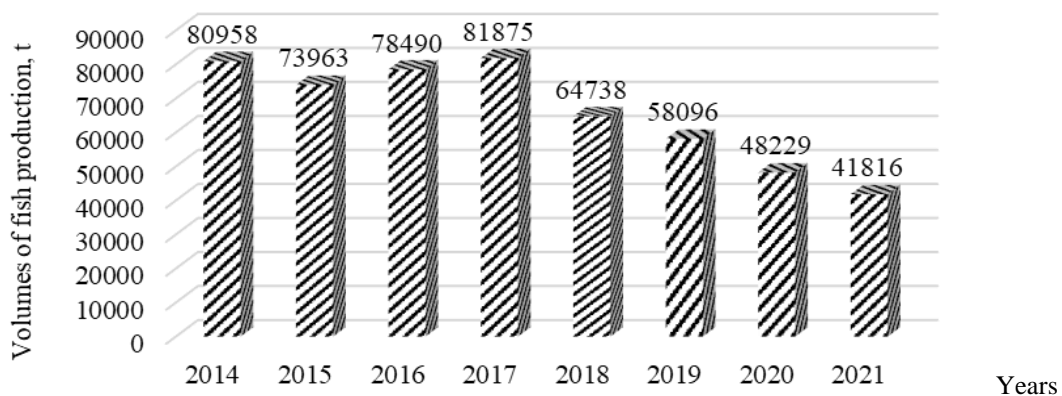


Fig. 2. Dynamics of changes in the fish production volume in Ukraine

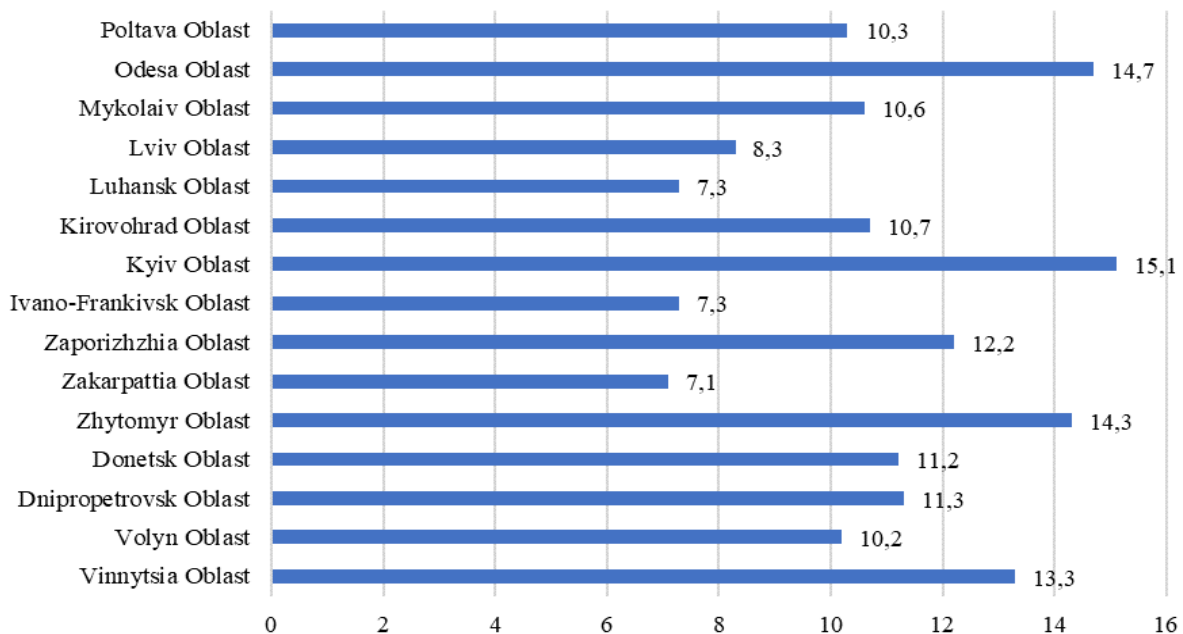


Fig. 3. Average annual level of fish and fish products consumption in the Ukraine regions (kg/person) (data of the State Statistics Service in Ukraine) [13]

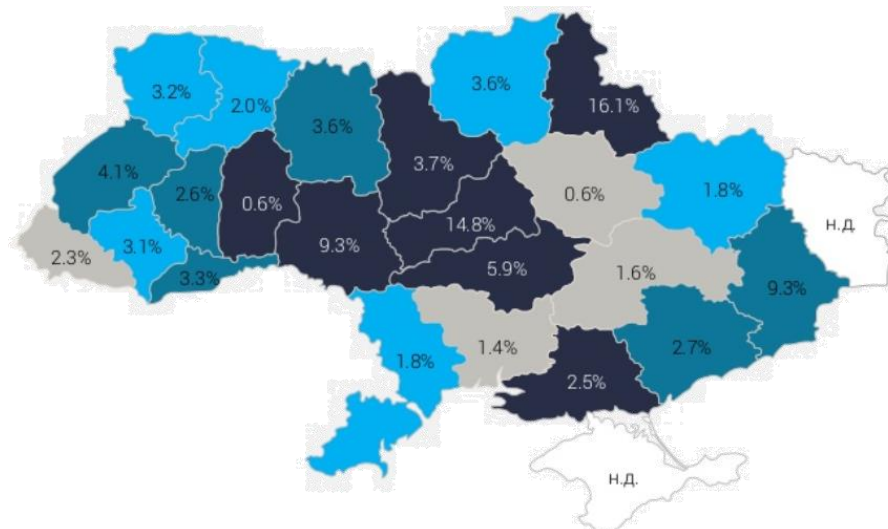


Fig. 4. Regional structure of the fishing industry of Ukraine, %

Breeding fish in conditions where it does not consume natural feed puts it in direct dependence on the balance and quality of compound feed fed to it by the keeper. Providing fish with complete nutrition makes it possible to realize the genetically laid potential with minimal feed consumption and preservation of young.

A significant share of the fish feed market in Ukraine is imported due to the lack of investment in feed production. In addition, a large amount of fodder is in the shadow segment, as producers of fish products, in order to save money, produce their own fodder for their own use [17].

Conclusions

In the conditions of the formation of market relations, against the background of significant costs for feed, feeding fish should be based on careful calculations, the logical conclusion of which should be economic expediency.

On the basis of the marketing research of the situation on the market of feed supplements, a shortage of protein vitamin supplements and complete feeds for domestically produced fish was revealed. The restraining factors for the use of foreign supplements are their cost and interruptions in supply.

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РИБНИЦТВО - ПЕРСПЕКТИВНА ГАЛУЗЬ ЗАБЕЗПЕЧЕННЯ ПРОДОВОЛЬЧОЇ БЕЗПЕКИ НАСЕЛЕННЯ ЗЕМЛІ

Анотація

На підставі маркетингових досліджень доведено, що аквакультура є однією з найбільш швидкозростаючих галузей виробництва продуктів харчування в світі. Основним методом підвищення рибопродуктивності в ставках є годівля риби, що є об'єктивною реальністю при високій інтенсифікації рибництва. З інтенсифікацією виробничих процесів роль годівлі постійно зростає, а собівартість годівлі в собівартості риби становить близько 40% і має тенденцію до зростання. У зв'язку з цим надзвичайно актуальною стає проблема раціонального використання кормів. Обґрунтовано, що використання високоякісних кормів і кормових добавок у раціоні тварин на відгодівлі значно підвищує продуктивність і рентабельність роботи тваринницьких, птахівничих і рибних ферм. Виробництвом комбікормів в Україні займаються 160 заводів, виробнича потужність яких становить 7,5 млн тонн на рік. Зазначений показник має бути реально збільшений до 15 млн тонн готової продукції на рік. Встановлено, що до 2050 року нам потрібно буде виробляти на 60 відсотків більше продовольства, щоб прогодувати 9,3 мільярда людей у світі, згідно з оцінками, зібраними Продовольчою та сільськогосподарською організацією ООН (ФАО). Тому очікується, що виробництво тваринного білка збільшиться з цим збільшенням. За оцінками IFIF, світове виробництво комбікормів досягло понад 1 млрд тонн на рік. Представлено топ-10 країн зі світового виробництва комбікормів у 2021 – 2022 роках (за даними Alltech Agri-Food Outlook 2023). Узагальнено структуру виробництва комбікормів за видами сільськогосподарських тварин та птиці у світі у 2022 році. Доведено, що виробництво рибних комбікормів продовжує зростати у всіх регіонах світу. У світі (як і в Україні) рибальство та аквакультура відіграють і відіграватимуть у найближчі століття значну роль у забезпеченні продовольчої безпеки населення планети. Необхідно вносити зміни в політику, управління, стимулювати інновації та інвестиції в галузь для забезпечення продовольчої безпеки планети за рахунок рибальства та аквакультури. Встановлено, що світовий обсяг виробництва водних біоресурсів постійно зростає і у 2022 році досяг значення 176 млн т/рік. Для споживання людиною було використано понад 150 млн тонн водних біоресурсів. В умовах становлення ринкових відносин, на тлі значних витрат на корми, годівля риби має ґрунтуватися на ретельних розрахунках, логічним завершенням яких повинна бути економічна доцільність. На основі маркетингового дослідження ситуації на ринку кормових добавок виявлено дефіцит білково-вітамінних добавок і повнораціонних комбікормів для риби вітчизняного виробництва. Стримуючими факторами використання зарубіжних добавок є їх вартість і перебої з постачанням.

Ключові слова: риба, виробництво повнораціонних комбікормів, рибне господарство, промислові виробники, світове споживання та виробництво, аквакультура.

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