BIODIVERSITY, ABIOTIC, ANTHROPOLOGICAL FACTORS AND PECULIARITIES OF ACCLIMATIZATION IN FISH FARMING – EVOLUTION AND POTENTIAL

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Abstract. The paper presents the estimated results of the study and the characteristics of the fisheries sector (field) in the world and in the Republic of Moldova. It was ascertained that nearly 90% of the world's marine fish stocks have been found to be exploited, overexploited or depleted. Nearly 200 million jobs are linked to the fisheries sector. Global fishing in marine waters amounted to 80.4 million tons in 2019 and is dropping by 5.0% compared to 2018, but overall, the volume of fishing in marine waters continues to be stable in the last years. The share of fishing in freshwater, in the total global fishing production, remains around 13%. The fisheries sector has significantly expanded in the last decades, the production increased mostly from aquaculture which from 1990 until 2018 increased by + 527%. In 2019, it represented 48% of the total production of aquatic animals originated from fishing and aquaculture. The largest consumers of fish and fishery products in the world are the European Union, the United States and Japan. About 580 aquatic species are currently cultivated worldwide. The aquaculture production in EU is largely focused on a few species, of which the most important are mussels, salmon, sea bream, rainbow trout, perch, oysters and carp. In 2019, 89% of the total fishery and aquaculture production was used for human consumption, while 11% was meant for non-food products. 44% of fish intended for human consumption was in the form of fresh fish. The amount of inland fish that originated from aquaculture in the last 10 years, has increased by 1.7 times. Currently, the aquaculture production in the Republic of Moldova represents 25% of the value of the entire fish production consumed in the country. Although the potential of the fishery branch is double compared to the current one, it is not enough to satisfy the needs of the population anyway. Thus, the Republic of Moldova is and will continue to remain an importer of fishery products, especially those of marine origin. Although fish consumption per capita in the Republic of Moldova increased from 17.8 g/day (6.49 kg) in 2005 to 23.6 g/day (8.61 kg) in 2017, it is lower than the fish consumption per capita worldwide which in 2018 was 20.5 kg. The habitats of fish species are threatened by both anthropological and abiotic factors. It was estimated that the decline of ocean's health induced by the climate and unsustainable fishing, generated the danger of emptying the planet ocean from fish and it would cost the global economy USD 428 billion per year by 2050. In order to avoid an imminent economic crisis, the widespread devastation of communities, hunger and conflicts related to the resources in the coming decades, the health of oceans shall be restored and focus will be placed on building a fair and sustainable blue economy. For preventing a major catastrophe in the aquatic biodiversity, sustainable fish farming activities must be put into practice and mechanisms for the conservation of the gene pool and to maintain functional the animal reproduction must be developed and implemented.

Keywords: fish farming, biodiversity, environmental factors, conservation, sustainability.

Rezumat. Biodiversitatea, factorii abiotici, antropologici și particularități de adaptare în piscicultură – evoluție și potențial. În lucrare sunt prezentate rezultatele studiului de estimare și caracteristica sectorului piscicol în lume și în Republica Moldova. S-a constatat că aproape 90% din stocurile de pești marini din lume sunt exploatate, supraexploatate sau epuizate. Aproape 200 de milioane de locuri de muncă sunt legate de sectorul piscicol. Pescuitul mondial în apele marine a constituit 80,4 milioane de tone în anul 2019 și este în scădere cu 5,0% față de anul 2018, dar în general, volumul pescuitului în apă marină continuă să fie stabil în ultimii ani. Ponderea pescuitului în apă dulce în producția totală de pescuit la nivel global rămâne în jur de 13%. Sectorul piscicol s-a extins semnificativ în ultimele decenii, cea mai mare parte a creșterii producției a provenit din acvacultură care, din anul 1990 până în anul 2018, a crescut cu + 527%. În anul 2019 aceasta a reprezentat 48% din producția totală de animale acvatice provenite din pescuit și acvacultură. Cea mai mare piață de consum a peștilor și a produselor pescărești din lume este Uniunea Europeana, Statele Unite ale Americii și Japonia. Aproximativ 580 de specii acvatice sunt cultivate în prezent în întreaga lume. Producția de acvacultură din UE se concentrează în mare măsură pe câteva specii, cele mai importante fiind midii, somon, dorada, păstrăv curcubeu, biban, stridii și crap. În anul 2019, 89% din producția totală de pescuit și acvacultură a fost utilizată pentru consumul uman, 11% au fost destinate produselor nealimentare. 44% din pești destinați consumului uman a fost sub formă de pește proaspăt. Cantitatea de pește autohton provenit din acvacultură în ultimii 10 ani s-a mărit de 1,7 ori. În prezent producția de acvacultură în Republica Moldova constituie 25% din valoarea întregii producții piscicole consumate în țară. Deși potențialul ramurii piscicole este dublu față de cel actual, oricum acesta nu este suficient pentru a îndestula necesitățile populației. Astfel, Republica Moldova este și va continua să rămână importatoare de produse piscicole în special a celor de origine marină. Cu toate că, consumul de pește per capita în Republica Moldova a crescut de la 17,8 g/zi (6,49 kg) în anul 2005, la 23,6 g/zi (8,61 kg) în anul 2017, acesta este inferior consumului de pește per capita la nivel mondial care în anul 2018 a constituit 20,5kg. Habitatele speciilor de pești sunt amenințate atât de factorii antropologici cât și de cei abiotici. Se estimează că scăderea sănătății oceanelor indusă de climă și pescuitul nesustenabil generează pericolul ca oceanul planetar să rămână fără pește și va costa economia globală 428 miliarde USD pe an până în anul 2050. Pentru a evita o criză economică iminentă, devastarea pe scară largă a comunităților, foamea și conflictele legate de resurse în următoarele decenii, trebuie să restabilim urgent sănătatea oceanelor și să ne concentrăm pe construirea unei economii albastre echitabile și durabile. Întru prevenirea unei catastrofe majore în biodiversitatea acvatică este necesar de a practica activități piscicole sustenabile și de a elabora și implementa mecanisme de conservare a fondului genetic și de menținere funcțională a reproducției animalelor.

Cuvinte cheie: piscicultură, biodiversitate, factori ambientali, conservare, sustenabilitate.

INTRODUCTION

The name of our planet does not correspond to reality. We call it Earth, but over 71% of its surface is covered by the ocean. The ocean is a planetary superpower. It hosts spectacular ecosystems and inestimable wild fauna and supports the life of billions of people. It feeds us, regulates our climate, produces half of the oxygen we breathe and feeds the water cycle that produces rain and fresh water. Year by year, the Human Being, through its activities, goes beyond the limits of ocean sustainability and, in doing so, has caused a series of problems (of economic, social, biological, medical, ecological, climatic nature, etc.) that have strong and long-lasting "boomerang" effects on its activity. The list of ocean's problems is long and requires immediate attention.

Nearly 90% of the world's marine fish stocks are now fully exploited, overexploited or depleted. The fish, molluscs and crustaceans are increasingly taking up more room in our plates. Fish represents 17% of all animal proteins consumed in the world and 26% of those consumed in the poor and least developed countries and feeds about 3.2 billion people on the planet (***. UNITED NATIONS, 2018).

The ocean is also an important source of income. Almost 61.04 million people (15% of them women) work in fisheries and about 200 million jobs are directly or indirectly related to the fisheries and aquaculture sector, whose value was estimated in 2016 at USD 362 billion, and in 2019 - at USD 406 billion. Fish remains one of the most traded food worldwide, and 54% of this trade comes from the developing countries. For these countries, the trade in fish generates more revenue than most of other foodstuffs put together.

The fisheries sector and fisheries' sustainability is essential to the livelihoods of billions of people from the coastal communities around the world, especially in the developing countries where 97% of fishermen live. If we continue to exploit this area to the fullest, one of the main sources of food of the planet would be strained and our aspirations for a better world by the year 2030 would be compromised. The excessive, illegal, unreported and unregulated fishing is a huge global problem threatening the livelihood of people employed in the industry, estimated in 2017 at direct annual losses between 15 and 36 billion USD. It also threatens the vulnerable ecosystems and marine animals such as seals, coastal birds and larger fish that depend on fish as a food source. The world's oceans could be virtually emptied of fish by the year 2048. A study shows that if nothing changes in 2048 we will run out of fish and seafood (***. WEF, 2018; DAMANAKI et al., 2020; ***. WWF, 2021).

The habitats of fish species are also threatened by environmental factors. An increase of 3.2 degrees Celsius in global average temperature would threaten more than half of the habitat for a third of all fish species. This will condition changes in the distribution of fish species, invasive species and extinction, will lead to a reduction in size of the fish body size and will have a negative impact on the amount of young fish produced each year (BARBAROSSA et al., 2021).

Changes must be made in order to preserve the marine biodiversity and the ecosystems of the sea. In this campaign of changing things, scientists are those who should be in the front line. Their contribution, on the one hand, has to combat the illegal, abusive and excessive activities of human intervention on the biological rhythm of nature and, on the other hand, has to propose adequate, concrete and effective measures of protection and preservation of biodiversity and to increase the adaptive capacities and resistance of aquatic animals' bodies to the rapid and often stressful changes in the environmental factors caused by human activity.

Thus, at present, in the process of maintaining biodiversity it is appropriate and indispensable to focus on elaboration and implementation of mechanisms and methods of preserving the genetic fund, to maintain the functional reproduction of animals, including of the male reproductive system as the most vulnerable to the action of environmental factors.

The purpose of the study consisted in the assessment, estimation and characterization of the fisheries sector in the world and in the Republic of Moldova.

MATERIAL AND METHODS

This research is a descriptive evaluation study, where the indirect data collection method focused on the analysis of situation in the last decades of the fisheries sector was applied. The most obvious and accessible information in the aquaculture and fishing sector at the global and national levels is information of up to 2019. An extensive analysis of official data provided by the United Nations Food and Agriculture Organization (FAO), the Ministry of Agriculture and Food Industry, the Ministry of Economy, The National Agency for Food Safety, the Chamber of Commerce and Industry and the Center for Research on Aquatic Genetic Resources "Aquagenresurs" was carried out. The European and national normative acts as well as the scientific and specialized literature were analysed.

RESULTS AND DISCUSSIONS

Fish farming in the world. The world's appetite for fish and fish products shows no sign of slowing down. According to a FAO report, the global fish production will continue to grow over the next ten years, even if the amount of fish caught has stabilized and aquaculture development is moderate. The latest edition of the report *The State of World Fisheries and Aquaculture (SOFIA)*, estimated an increase in fish production originated from fisheries and

aquaculture up to 201 million tons by 2030. This represents an increase of 13% compared to the level of production of 177.8 million tons in 2019.

The fisheries and aquaculture sector has expanded significantly in the recent decades and the total production, the trade and consumption reached a historical record in 2018. However, since the early 90s, the greatest production part came from aquaculture (the aquaculture continues to grow by 90.4 million tons of fish annually), while the fishing production was relatively stable, with a small increase of fishing in the internal waters (Table 1).

Table 1. Increase in global fish production from 1990 to 2018, (%).

No.	Productivity indices	The amount (%)
1	Increasing global fisheries production	+ 14%
2	Increasing global aquaculture production	+ 527%
3	Increasing the total consumption of edible fish	+ 122%

The development of fish production and consumption is determined by population growth, urbanization, income growth and improvement of distribution channels. Global marine food production has been increasing due to evolutions along the coastal sea lines (coastal areas).

It is estimated that in 2018 the world produced about 179 million tons of fish, of which 82 million tons were produced by aquaculture. Total production value was USD 401 billion of which USD 250 billion from aquaculture. Out of the total volume of fish products, 156 million tons (equivalent to 20.5 kg per capita per year) were used for human consumption. The remaining 23 million tons were used for non-food technical purposes, in particular for the production of fishmeal and fish oil. The aquaculture sector has produced 46% of the total production and 52% of the fish intended for human consumption (***. FAO, 2019; 2021).

From the analysis of data for 2019 (excluding plants and other aquatic animals), it was noted that the global production of fish, crustaceans and molluscs was 177.8 million tons, i.e. a decrease of 1% compared to 2018 (179 million tons). Of this quantity, the capture production counted 92.5 million tons, a decrease of 4.3% compared to the previous year. Aquaculture production was 85.3 million tons, an increase of 3.7% compared to 2018. In 2019, the value of total production was estimated at USD 406 billion, (i.e. 5 billion more than in 2018), of which USD 260 billion from aquaculture production (10 billion more than in 2018).

In 2019, the top seven fishing countries represented almost half of all capture production. China is on the first place and represents 15.1% of total capture production, followed by Indonesia (8.1%), India (5.9%), Russian Federation (5.4%), Peru (5.2%), United States (5.2%) and Vietnam (3.7%).

The worldwide fishing in marine waters accounted 80.4 million tons in 2019 and is dropping by 5.0% compared to 2018. But in general, the fishing volume in marine waters continues to be stable.

The global inland fish production in 2019 reached the highest level ever recorded and amounted to 12.1 million tons. The share of freshwater fishing in the total global fishing production remains around 13%. This stability of fishing production is explained by improved reporting and evaluation at country level and not by the increase in the volume of capture fish.

The fact that the global supply of fish for human consumption has outstripped the growth of population in the last five decades is largely due to the increase in aquaculture. Preliminary estimations show a per capita consumption of more than 20 kilograms, practically double compared to the level of 1960s (9 kg per capita).

The world aquaculture production in 2019 was 56.3 million tons of fish (66.0%), 17.6 million tons of molluscs (20.6%), 10.5 million tons of crustaceans (12.3%) and 977 thousand tons of other aquatic animal species (1.1%). This sector is very important in terms of both food security and environmental sustainability, as around half of the world's aquaculture production of animal (crustaceans and carp) and vegetable origin (including seagrass and microalgae) originated from species that do not require nutrition on behalf of humans.

While China remains by far the most advanced nation in aquaculture (Table 2), this sector is sometimes expanding even faster in other parts of the world. In Nigeria, the aquaculture production has increased nearly 20 times in the last two decades and the entire sub-Saharan Africa is not far behind. Chile and Indonesia also saw a remarkable growth and so did Norway and Vietnam – which are now global exporters. In the last decades, the total volume of fish production has significantly increased on every continent, except Europe and North and South America (***. FAO, 2020).

Table 2. Large aquaculture producers in 2019 (million tons).

No.	Producing country	The amount (million tons)
1	China	48,2
2	India	7,8
3	Indonesia	6,0
4	Vietnam	4,4
5	Bangladesh	2,5
6	Egypt	1,6
7	Norwegian	1,5
8	Chile	1,4
9	Myanmar	1,1
10	Thailand	1,0

The data of table 2 shows that the top ten producers together have produced 75.4 million tons, representing 88.4% of the total world aquaculture, of which 48.2 million tons (56.5%) is produced by China. Aquaculture production in these countries is mainly facilitated by large water basins, lakes and rivers.

The strengths and challenges of aquaculture have an influence on the type of fish that ends up on our plates as well. In terms of value, depending on the share they have in the global trade, salmon and trout represent the goods with the highest share, a position previously held by prawns for decades.

In 2019 the aquaculture of fish species in freshwater was the most important sector in the world aquaculture. Thus, the production of 48.4 million tons of fish from inland aquaculture accounted 56.7% of the total world aquaculture production of aquatic animals which amounted to 85.36 million tons.

World aquaculture production recorded an average annual increase of 5.0% between 2011 and 2015. Subsequently, this slowed down and the annual growth rate decreased to an average of 3.7% in the period 2016-2019. The contribution of aquaculture to the total production of aquatic animals from fisheries and aquaculture has steadily increased from 39.9% in 2010 to 48.0% in 2019. The farming of fish, crustaceans and aquatic plants in the sea or inland waters is one of the fastest growing food sectors in the world. Currently, it already provides the planet with more than half of all the seafood and fish that humans consume.

The world fishing fleet consisted of about 4.29 million vessels in 2019 and is smaller by 310,000 thousand vessels compared to 2016 (4.6 million). This decrease was determined in large part by the systematic reduction of China's fishing fleet.

Globally, about 38% of the fishing fleet is composed of non-motorized vessels. 67% of all fishing vessels were reported to be in Asia, followed by Africa (23%), America, Europe and Oceania. Just below 40% of the global fleet are the boats of less than 12 meters long, while the ships of more than 24 m represented 2% of the total fleet.

Many millions of people around the world find a source of income and livelihood in fishing and aquaculture sector. In 2019, women represented about 15% of the total 61.04 million people employed in the primary sector of capture fishing and aquaculture. Of this total, 38.70 million people were engaged in fishing and 22.34 million in aquaculture. The largest number of employees in the sector are in Asia (85%), followed by Africa (9%), America (4%), Europe (1%) and Oceania (1%).

The largest consumer market of fish and fishery products in the world is the European Union, United States and Japan.

Most biologically unsustainable fisheries (alarmingly) are in the Mediterranean and Black Seas (62.2%), South-East Pacific (61.5%), South-West Atlantic (58.8%). This is especially applicable for large fish such as hake, mullet and bream.

The most sustainable fishing is in the Middle East, Midwest and the Pacific North-East, North-West, and South-West (all of which have less than 17% of over-exploited areas).

Fish farming in the European Union. Aquaculture in EU accounts for around 20% of the EU's fish and shellfish supply and employs directly around 70000 people. The sector consists of around 15000 enterprises, mainly small or micro enterprises in coastal and rural areas.

In the European Union aquaculture is made up of three main sub-sectors that have different histories and characteristics. These are the shellfish farming (57% of total production), freshwater fish farming (18%) and salt water fish farming (25%) (***. EUROPEAN COMMISSION, 2018).

Overall, EU production has been more or less stable since 2000, while global production has grown between 5% and 7% per year. The main EU aquaculture producing countries in terms of volume are Spain, France, Italy and Greece (***. EUROPEAN COMMISSION, 2020).

The aquaculture production is very diverse both in terms of grown species and methods of production (marine cages, ponds, runways, aquaculture systems with land recirculation (RAS)). About 580 aquatic species are currently cultivated worldwide, representing a wealth of genetic diversity both within and between species. More than 45% of aquaculture production in the EU is shellfish, more than 30% of aquaculture production is marine fish, more than 20% of aquaculture production is freshwater fish (***. FAO, 2020).

Despite aquaculture biodiversity, the aquaculture production in EU is largely focused on a few most important species such as: mussels, salmon, sea bream, rainbow trout, perch, oysters and carp. Algae production is still limited in EU, but it continues to grow.

Aquaculture production is subject to authorization and monitoring procedures in EU countries and must comply with the strict requirements of EU legislation in order to ensure that the health of humans and animals and environmental integrity requirements are respected. The most important aspects regarding the ecological sustainability of aquaculture in EU relate to the assessment, monitoring and limitation of the negative impact on biodiversity and environment of aquacultural activities. For example, the evacuation of nutrients and organic matter from aquaculture farms; the use of locally absent or free species; the use of ingredients for feeding carnivorous fish; disease management and the use of veterinary medicinal products and other substances harmful to the environment. Another important aspect is the welfare of animals in the branch of fish farming and the harmlessness of products obtained from fish farming.

In 2019, 89%, or over 158 million tons of the total fishery and aquaculture production was used for human consumption. The remaining 11% (20 million tons) were intended for non-food products, mainly for manufacturing the fishmeal and fish oil. 44% of fish intended for human consumption was in the form of fresh fish.

Much of the entire fish production, about 37%, was exported in 2019. In the same year, the global fish and fish products exports reached USD 162 billion. This represents a decrease of 2.1% compared to the highest world record reached in 2018.

Between 1976 and 2019, the global fish trade increased with an annual growth rate of 6.6% in nominal terms and 4.1% in real terms.

In 2019, 67% of the total value of imports of fishery products was registered in the developed countries - United States of America and Japan, representing 15% and 11%. Imports to the European Union countries accounted for a share of 33% of total world imports. Thus, the European Union remains the largest market for fish products in the world.

China is the main exporting country, followed by Norway, Vietnam and India. The top ten exporters, six of which are developing countries, accounted for 51% of total exports in 2019.

The share of developing countries in the total of fishing exports was approximately 54% in terms of value and 61% in terms of quantity in 2019. The net fishing exports of the developing countries (i.e. the total value of their exports minus the total value of their imports) have shown a continuous growth trend in the recent decades, increasing from USD 18 billion in 2000 to USD 29 billion in 2010 and USD 35 billion in 2019. These figures were significantly higher than those for other agricultural products such as rice, coffee and tea.

Salmon and trout became the most important commodity traded in terms of value in 2013 and represented about 18% of the total value of fish products traded internationally in 2019. Other main groups of exported species were the prawns, about 16%, followed by background fish (10% hake and 9% tuna). In 2019, fishmeal represented approximately 3% of the value of exports and 1% of fish oil.

Fish farming in the Republic of Moldova. Currently, fish farming in Moldova is one of the areas of the agricultural sector that is constantly developing. In the Republic of Moldova, there are over 4000 artificial lakes (ponds and reservoirs), of which 28 with a volume of over 1 million m^3. Out of the total number of artificial lakes, 47 are managed by the entity responsible for water management, the rest are managed by the local public administration authorities, 42 ponds are intended for irrigation-fish farming and 5 – fish farming. On 01.01.2020 the number of ponds with sanitary and veterinary authorization issued by the National Food Safety Agency in the Republic of Moldova was 424 (***. ANSA, 2021). The total surface area of aquatic basins, used for fish farming, is 20507 ha. The vast majority of the quantity of native freshwater fish and its products are obtained from fish farms and only a small part (0.3%-1.7%) originate from natural aquatic ponds (CURCUBET et al., 2016).

The following fish farming technologies are used in the Republic of Moldova:

extensive - based on the natural productivity of the pond only, without interfering with additional feed;

semi-intensive - with the use of fertilizers (organic or chemical) for stimulating the natural productivity of the pond (zoo and phytoplankton) and as supplementary feed is used the classical feed;

intensive - where no fertilizer is used and the food of fish is based only on feed with a regulated level of protein for each separate species;

super-intensive - it is used in halls with fiberglass pools, where the system is very complex requiring pumps for water recirculation, filters from solids, biological filters where ammonia and nitrites resulted from fish metabolism are neutralized, ultraviolet filters for the destruction of pathogenic germs and water heating and cooling systems (USATÎI et al., 2021).

Since 2002, a continuous increase of the native quantity of fish originated from aquaculture was recorded in the country. According to the data presented by FAO, in 2015 - 11246 tons, in 2016 - 12091 tons, in 2017 - 12163 tons, in 2018 - 12610 tons and in 2019 - 12650 tons of fish were produced in the Republic of Moldova. This fish is entirely intended for the internal market for human consumption (***. FAO, 2020).

The amount of native fish in aquaculture in the last 10 years increased by 1.7 times and in comparison to the year 2000 - by 6.1 times. Currently, the aquaculture production is 25% of the entire fish production value and of fish products consumed in the country. For obtaining this quantity of fish, 1000-1200 tons of juvenile fish are produced annually. The potential and gene pool existing in the Republic of Moldova allows to obtain in the next 10-12 years 25.000 tons of local fish (CURCUBET et al., 2013, 2016). According to the data submitted in the National Strategy of Regional Development of the Republic of Moldova 2022-2027, in 2020, 13.800 tons of fish were produced in the Republic of Moldova.

This data is consistent with the data presented by ȚURCANU et al. (2021) which confirms that during the years 2005-2017 there was a tendency of increasing fish consumption from 17.8 g/day (which is 6.49 kg) in 2005, to 23.6 g/day in 2017 (which is 8.61 kg). On average the consumption per capita was 19.68 g/day, including 97.3% of the average consumption was: herring/sardines - 6.46 g/day (32.8%), carp - 4.14 g/day (21.0%), unspecified species - 3,09 g/day (15.7%), mackerel - 1.61 g/day (8.17%), hake - 1.10 g/ day (5.6%), blue whiting - 0.953 g/day (4.84%), salmon - 0.824 g/day (4.19%), codfish - 0.745 g/day (3.78%), pollock - 0.22 g/day (1.14%), tuna - 0.09 g/day (0.47%). Fish consumption for the period 2005-2017 had a tendency of continuous growth. The population of the Republic of Moldova consumes 26 different species of fish, of highest demand were herring/sardines and carp, with a share of 32.8% and 21.0%, respectively. However, 15.7% remain uncertain because the species were not identified.

The tasks of the National Program of Strengthening and Development of the Aquaculture Sector in the Republic of Moldova for the years 2020-2026 and of the Action Plan on implementing it for the years 2020-2022 are to

create conditions for the development of aquaculture, as well as to preserve and restore the genetic fund, develop the scientific and technological potential, introduce innovative technologies in the field of aquaculture and capture fishing of aquatic biological resources; process and store raw materials of finished products; ensure the efficiency of state authorities' activities in aquaculture and improve the legal regulatory framework.

Most of the fish farming technologies currently applied in the Republic of Moldova were developed in the last decades of the last century, based on the economic and ecological conditions existing in that period. These technologies are archaic and do not meet the current technological requirements for practicing modern aquaculture. Currently, the national fish farming is in shortage of innovative technologies and innovative projects adapted to the climate changes, to the need of preserving the biodiversity, as well as to the current economic and social status. This situation imposes the need of developing and applying measures that would improve the biological potential of aquatic basins by introducing new species of fish (phytophagous species), by developing and implementing advanced technologies for reproduction, by farming fish and developing an additional and natural fodder base (STOROJENKO et al., 1986).

For the purpose of harnessing the aquatic farms in the Republic of Moldova, it is necessary to:

1. develop the material base by restoring, modernizing and arranging aquatic basins;
2. expertise the water basins on the usefulness of their use in aquaculture;
3. use specific technologies for each aquatic basin resulting from the hydrobiological potential;
4. implement advanced technologies of natural and artificial reproduction, as well as nutrition in the fisheries sector;
5. improve the well-being and viability of juvenile fish;
6. undertake effective veterinary and sanitary measures to prevent and control diseases in fish;
7. combat the phenomenon of "water bloom" ("Algal bloom") by using phytoplanktonophagous fish;
8. revitalize the reservoirs and ponds used for fish farming purposes by emptying and dredging them once every 5-6 years;
9. adapt and introduce new and highly productive species of fish.

CONCLUSIONS

From the data presented, both at global and national level, it is obvious that fish farming (fishing, aquaculture, fish matter processing etc.) is a branch of major importance in the economy of many countries, due to the creation of millions of jobs and by satisfying the population with nutrients of animal origin. The aquatic foods are increasingly recognised as having an important role in the sustainable food system from the nutritional and environmental point of view. Proposals to increase aquatic food production often focus on over-exploitation of natural and aquaculture reserves, which are contradictory to the ecological situation of ecosystems and are far from sustainable. Meanwhile, most species and aquaculture systems suffer from large differences in performance, which means that the channelled investments and interventions could significantly stimulate the supply with aquatic food and access to nutritious food, without a concurrent increase of pressure on the environment and biodiversity. Here, we support the idea that discussions around aquatic food should pay greater attention to identifying and implementing interventions for improving the productivity and environmental performance of low-value species, which have been relatively overlooked in this regard to the present day. At the same time, we must determine the available technical and institutional intervention options and assess their potential for the increase of production and environmental performance of global aquaculture. For a future increase of fish production, in addition to the task of strengthening fisheries management regimes, reduction of losses and of waste and addressing of issues such as illegal fishing, pollution of the aquatic environment and climate change, one should also focus on the conservation of the fish biodiversity genetic-fund and create a bank of reproductive material of vulnerable and endangered species. It is important to create fish breeds resistant to environmental stress factors (abiotic, biotic and anthropogenic) and methods that would increase the resistance and adaptive capabilities of the body.

When too many fish are removed from aquatic biodiversity, an imbalance is created that can destroy the food web and lead to the loss of other important aquatic lives. In the recent years, significant changes have been observed in the ecosystems of water basins, as a result of which the number of fish has decreased. In this regard, the main source of formation and maintenance of fish stocks has become their artificial reproduction. However, at present, there is a decrease in the dimension of artificial reproduction. One of the reasons is the lack of possibility of selecting breeders with performant indicators that would improve the fish stocks productivity. Different approaches must be developed regarding the use and conservation of the gene pool of breeder populations adapted to the local conditions for the purpose of artificial reproduction of fish.

Currently, the cryopreservation remains one of the most attractive directions for the conservation of valuable species that are on the verge of extinction. The preservation in cryobanks of representative genetic collections of fish genomes and juveniles makes it possible to preserve the genetic diversity of valuable species.

Some methods of cryopreservation of fish reproduction products have been developed over the years but, nevertheless, the research results are often not reproducible and do not always provide a sufficient survival rate for thawed spermatozoa. This is due to the fact that the cryopreservation process is influenced by a large number of factors: the physiological condition of breeders, the quality of gametes, the individual characteristics of fish of different

populations, physical factors etc. In addition, the negative temperatures have an unfavourable effect on the cells, so it is very important to develop effective cryoprotective environments. Therefore, given the situation, the question of preserving the gene pool of fish by freezing remains relevant (KOPEIKA, 1986; TSVETKOVA et al., 1997; LINHART et al., 2000, 2009; DOKINA et al., 2019).

While in the past the traditional conservation of environment strategies was based more on a utilitarian philosophy, anchored in the economic value of the components of biodiversity, and was only considered a source of goods and services through a few visible components and was managed in order to maximize the herds of only a few species,it is currently admitted that all components of biodiversity are important. The biological side must be combined with the non-biological one, so that their contribution to the growth of biodiversity would increase more and more.

The problem of preserving the diversity of fish fauna and applying the necessary measures to maintain it is still not fully defined. Its complexity and difficulty is summed up on the one hand by the need of an ecosystem approach, and by the need to apply concrete actions for each species on the other hand. Currently, such drastic changes are made to the natural environments, that some species, which are still relatively abundant, may disappear or become rare only in a few years (most stenotopic species).

Under these conditions, a hierarchy of species is required according to: their current status (in relation to the previous situation, mandatorily, at the level of decades or even centuries), the magnitude and intensity of threats to which they are subjected and the prospects of future evolution of populations in time and space. Depending on this picture, appropriate protection measures for each species can be established (BULAT et al., 2017).

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