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Database with good practices in aquaculture in partner countries



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1. INTRODUCTION

Aquaculture experiences have been developed in partner countries by different methods and at different levels according to the geography, location, habitat diversification, culture and traditions.

Greece and Turkey have rather long sea coasts and lagoons under the effect of sea which is suitable for farming of marine species; finfish, shellfish and crustaceans while Romania and Ukraine has strengths to perform inland aquaculture due to their rich riverine systems and wetlands. All these experiences have longer historical background and need to be shared by the countries having lesser capacities on specific fields to maximise their production capacities over new investments implemented on new farming sites. For example Romania and Ukraine may need marine farming in shallow waters and offshore farming while Greece and Turkey may need to improve fish farming production in natural lakes, dams and small reservoirs used for irrigation. Some partners may need the use of cage net farming in suitable water reservoirs and some others may find mussel and oyster culture attractive as an alternative production systems.

On the other hand, location of the partner countries has an advantage of being closer to European, Ukrainian and Russian markets. Market oriented fish farming is the main requirement for fish production. At present, citizens of the partner countries are aware of the value of fish in nutrition, especially in younger and older ages. Aquaculture may increase consumption of per capita and provide a considerable support to reduce unemployment rates due to be based on various sub sectors as feed industry, manufacturing of essential production materials (tanks, cage frames, nets, automatic feeders and cleaners, remote sensing devices, plastic boxes and containers, etc.), services (veterinary, consultancy, vaccines and vaccinations), and fish processing and marketing.

One of the main results of the Covid-19 outbreak is to remind nations the importance of food production and its sustainability. There should be a good planning and encouragement system to promote aquaculture sector by competitive legal, technical and financial instruments as one of the integral part of the blue growth, of course considering conservation of the environment.

In order to increase capacities in aquaculture in partner countries, exchange of the experiences might be very useful for the entrepreneurs from different countries to improve their existing competences and develop the new ones that they may need in future both for production and marketing. This report contains the good examples in the field of aquaculture in partner countries as an initial step for the investors.

Selection of good examples are rather different in partner countries based on their historical development, experiences, capacities and diversity of the species farmed, and finally the development level of the country. For instance Greek partner used a set of criteria based on transparency, citizen and stakeholder participation, credibility and consistency. Romania prioritise sustainability; continuous incomes from farming, equality for the benefits and costs, promotion of job creation and wellness, continuous food supply to commons, to be in good relation with environment, and finally to ensure development of aquaculture together with the authorities and the industry on well organised basis. Turkey has selected 5 successful companies of which 2 from other parts and 3 from the Black Sea according to the size of the company, export potential, innovative production and marketing methods, fast growing rate, integrated production and creation of jobs. Ukraine used the



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criteria for the companies awarded by the funds over projects supported from different donors, production capacities and employment in the sector.

2. GREECE

Aquaculture is one of the fastest growing sectors in Greece and in the Region of Eastern Macedonia and Thrace in recent decades taking advantage of land, sea areas, modern biotechnology and the need for investment in new sectors. Products from Greek fish farms are now recognized worldwide (APC, 2009). Fish farmed in marine waters account for 97% of the volume in total, while only 2% comes from fish farming in inland waters. In Greek lagoons, the main species produced are the gilthead sea bream, the sea bass and the flathead grey mullet, while the most common-farmed fish is the rainbow trout. The average annual productivity per hectare of Lake Vistonida was 54.8 kg/ y/ ha. In four lagoons of the river Nestos (Vasova, Eratino, Agiasma, Keramoti), it was found to be 100.8 kg/ ha/ y. In five lagoons of Rodopi (Xirolimni, Mavrolimni, Alyki, Ptelea - Elos), the average annual productivity per hectare was estimated at 24.1 kg/ ha/ y (K. Σωφρονίδης, A.K. Κοκκινάκης 2019, Sofronidis & Kokkinakis 2018, Kokkinakis & Sofronidis 2018). In the last decade, according to the latest available data from the Federation of Greek Maricultures (FGM), there has been a slowdown in growth and a slight reduction in production. However, the climate has already begun to reverse and the industry slowly recovers and returns to growth since this activity has become one of the most competitive for Greece. Greece maintains one of the leading positions in the production of Mediterranean fish not only in Europe, but also in an international level (ΣΕΘ, 2019).

Greece has a natural environment that makes it a geographical place with ideal conditions for aquaculture, offering remarkable land and sea areas for the development of aquaculture. Special climatic conditions, geomorphology, the variety of "water sources" (rivers, lakes, sea, etc.), financial support from various agencies, and rapid and successful in many cases introduction of technology and know-how, contributed to the development of Greek aquaculture. The development of aquaculture in recent decades in Greece is impressive. 62% of the domestic fishery production comes from aquaculture and 38% from fishing. The rapid increase in production, the spectacular penetration of international markets, the production and export of know-how, all contribute to the establishment of the industry as a productive activity of great importance to the national economy. Its economic dimension creates new economic opportunities and more specialized jobs, more efficient use of local resources and opportunities for productive investment. It is worth noting that aquaculture is the second largest export sector in the country, with 70% of all Greek fish being exported. Investments made in recent years by large companies, as well as partnerships and acquisitions, create other growth opportunities and give the industry a new momentum (ΣΕΘ, 2019). Aquaculture in Greece focuses on the production of two main species of fish (sea bream and sea bass), while in recent years significant quantities of meagre and red porgy have been produced. At the same time, Greek aquaculture produces three species of inland aquatic fish (trout, carp and eel) and two species of bivalve mollusks (mussels and oysters). The main species produced are fish farmed and shellfish. In recent years, intensive marine fish farming (mainly sea bream and sea bass) has emerged in the Greek aquaculture sector. Now, the units are gradually becoming autonomous, verticalizing their production and acquiring large-scale industrial characteristics, with vertical integration of production (Μπασιούλη Ιωάννα, 2014). In 2016, the total production of fishery products amounted to 133,990



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tons worth 587.9 million euros. 62% of domestic production of fishery products comes from aquaculture and 38% from fishing. The aquaculture sector creates 12,000 direct and indirect jobs, mainly in coastal or remote areas. In Greece, mainly fish and shellfish are cultured, accounting for 83% and 17% of total production, respectively. In 2017, breeding of sea bream and sea bass amounted to 112,000 tons worth 545.9 million euros, representing 96% of the volume and 97% of the value of fish farming. The sector's exports in 2017 are estimated at 91,000 tonnes, of which 98% were channeled to EU markets. Fish and fisheries products represent the country's most important export sector, concerning animal production.

2.1. Good practices in aquaculture in Greece

2.1.1. The Hellenic Aquaculture Producers Organization (HAPO)

HAPO was established in 2016, when the first 21 Members united their resources to form a collective, national identity for Greek aquacultured fish, in order to successfully promote them in selected domestic and foreign markets. Today, HAPO accounts 23 Members whose overall production represents around 90% of the total Greek aquaculture production. Beyond its sophisticated promotional network, HAPO also provides active support and a wide range of benefits to its Members, from mutual collaboration and networking, to development, consulting, training, liaising with the authorities and more. The purpose of the organization is to differentiate fresh Greek fish with the identity “Fish From Greece” opposing to the fish of other countries, and to highlight it as a leader in fish farming. This goal is achieved through the creation and consolidation of the Greek identity and the superior characteristics of fresh Greek fish that are grown with exceptional care in their natural environment, in units located in ideal locations on the Greek coast, by specialized professionals with experience, knowledge and always in accordance with the European standards. The Fish From Greece Certification Standard is based on 6 central pillars to ensure quality. Specifically:

1. Principles for ensuring the special characteristics and high quality of the products,
2. Principles for the health and well-being of farmed fish,
3. Principles and framework of institutional shielding for food safety,
4. Principles for minimizing the environmental impacts of the activity and the protection and preservation of the natural environment and biodiversity,
5. Principles for the support of the societies, on which the production facilities are based,
6. Criteria that companies meet, which they will choose to implement, as well as the Quality Assurance Control Process Requirements.

The Fish from Greece collective label represents the new seal of confidence for seafarers and consumers around the world. The label certifies quality and safety, freshness of a maximum of 48 hours and high nutritional value, the well-being of the fish that have grown up in a clean environment, good working conditions, and states that the fish bearing the signal come from experienced producers with high level know-how and specifications and always in accordance with EU rules and standards. What makes the product unique is the transparency that governs each stage of the production process, so that consumers are sure that the fresh Greek fish that they choose has all the remarkable characteristics that synthesize its exceptional quality. HAPO focuses on creating



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codes of Good Practice and innovative programs with the main concern of animal capital, man, the environment and society. The members of HAPO bear all mandatory certificates for their legal operation, thus ensuring the quality of the products through a series of good practices, continuous control of the breeding process, thorough and strict quality controls, monitoring of the environment and a complete traceability system, from the sea to the point of sale. The FISH FROM GREECE ID will practically be applied to the label that, gradually, will carry all the products of the units that have received the certification based on the Standard Private Certification Form “Fish from Greece”¹.

2.1.2. Organic aquaculture

In recent years there has been an increased demand for products that are produced by organic methods. This is a result of the interest shown by consumers in health issues, environmental degradation and overfishing. Organic fish production requires control of the entire production process, from eggs to adult fish, feed and water quality. Wild populations cannot be considered organic fish as it is not possible to control their life cycle. Organic aquaculture is a completely controlled process with the aim of producing the highest quality final product possible. Organic aquaculture aims at a sustainable management system that respects the environment, systems and cycles of nature, maintaining and improving soil condition, responsible use of energy and natural resources, especially water and air, recycling of waste and by-products of animal and plant origin. In the context of sustainability and the application of the principles of responsible aquaculture, i.e. sustainable and environmentally friendly, with good quality final product and contribution to local development, organic aquaculture is included. Organic fish farming is the organic farming of fish based on specific patterns and specifications. The basic principles on which organic aquaculture is based are summarized below:

- No alteration of natural habitats and ecosystems,
- Absolute water quality control,
- Enhancing multiculturalism,
- Physical reproduction,
- No gene intervention,
- Low fish densities,
- Optimization of raw materials in the diet,
- Welfare of farmed organisms,
- No genetically modified substance used in the whole production cycle.

One of the main pillars of organic aquaculture is the supply of fry i) Organic aquaculture is based on the breeding of new animals originating from biological brood stock and biological farms, ii) When there are no new animals from biological brood stock or biological farms, it is permitted to import animals that have not been bred using biological methods, under special conditions. With regard to the origin of aquatic animals, indigenous breeds and types of animals should be preferred. When selecting breeds or types of animals, the ability of animals to adapt to local conditions, their vitality and disease resistance should be taken into account. Also, breeds or types of animals should be selected in order to avoid specific diseases or health problems associated with certain breeds or

¹ <https://fishfromgreece.com/>



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types used in intensive production. The species grown are mainly salmon, produced in Ireland and Scotland, trout, produced in Scotland and Germany, carp and freshwater species, produced in Austria and Germany, blue mussels produced in Ireland, sea bream and sea bass produced in France and Greece. Slow initial development of organic aquaculture is due to the lack of internationally and universally accepted regulations and criteria for the production of organic aquaculture products. Recently, with the new adoption of a regulatory framework in the European Union, Regulation (EC) No 710/2009 on organic aquaculture, it is necessary to further investigate the criteria of organic aquaculture and to set standards and regulations for the production and processing of its products.

Organic fish farming accounts for an extremely small percentage of Greek production, as the demand for organic fish farming products remains limited. According to the available data, the production of organic sea bream and sea bass in 2018 amounted to a total of 800 tons, representing only 0.75% of the total production of these two species. Of these, 65% were sold as organic fish (almost 530 tons), while the rest of the production was sold as conventional fish farming. The main reason for the low demand for organic fish is their price, which is almost 60% more expensive than conventional farmed fish. In 2018, the average price of organic sea bream and sea bass ranged from € 8/ kg. The production volume compared to 2017 remained stable, while no change is expected in 2019. Organic production is done by 2 certified units belonging to 2 fish farming companies, while there are also 3 private Control and Certification Organizations in the field of organic fish farms (Biohellas, COSMOCERT, GMCERT) who have been approved and supervised by the Hellenic Agricultural Organization "Dimitra"(ΣΕΟ, 2019). Sustainable management plan of organic aquaculture should be controlled by clear rules of control by a government agency and a principle of control at regular intervals. The environmental monitoring of the activity should be applied and sampling and laboratory testing should be carried out at all stages of production, as well as on the quality of the final product. For the further development of organic aquaculture, the specifications that will apply to organic production should be renewed based on research results and research work, as a contribution to transparency, in creating trust in consumers and in creating a harmonized conceptual perception of sustainable production².

2.1.3. Aquaculture Stewardship Council (ASC)

The challenge for fisheries production is to use new technologies to optimize products according to European certifications and consumer requirements. The Aquaculture Stewardship Council was founded in 2010 by WWF by the Sustainable Trade Initiative (IDH), which promotes good practices that minimize the environmental and social footprint of the aquaculture industry. The above mentioned principles (minimizing of the environmental and social impact) are the basis for the certification of the Head of Aquaculture Stewardship Council (ASC), an independent non-profit organization. It cooperates with producers in the field of aquaculture, fishing processors, retail and catering companies, academic institutions, non-governmental organizations, environmental groups and consumer organizations. ASC's vision is to make aquaculture environmentally sustainable and socially responsible by using effective market mechanisms that create value throughout the chain. ASC is a traceability standard applied to the entire fishing supply chain.

² <https://www.organiclife.gr/>



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As mentioned, such practices are now absolutely necessary, as the rapid growth of the industry and the growing demand for farmed fish make it increasingly imperative to protect marine ecosystems and try to keep our seas alive, minimizing the effects of aquaculture to them. The effects of aquaculture on fish populations, marine ecosystems, water quality and, consequently, society can be significantly reduced and measurable when responsible practices are applied.

The requirements of the standard are Quality, Environmental Management and consequently Sustainability and Sustainable Trade. The new model is adapted to the requirements of the Mediterranean species and focuses on the environmental and social effects of the activity through 7 principles. These are:

1. Compliance with the existing legal framework,
2. Preservation of the natural environment and biodiversity,
3. Protection of the health and genetic integrity of wild fish populations,
4. Environmentally responsible use of natural resources,
5. Management of diseases and pests in an environmentally responsible way,
6. Operation in a socially responsible way,
7. Cooperation with the local community.

Each company participating in the supply chain must have the certification based on the standard. This ensures that fishery products originate from certified sustainable aquaculture sites. The creation of a model by the international certification body ASC for the Mediterranean sea bream and sea bass has a dual purpose: the certified units that will follow responsible practices will gain a commercial advantage and at the same time reduce the pressure on the marine environment. Given that there is currently a high demand in Europe and the United States from sensitized consumers for fish produced by responsible aquaculture, businesses in the industry that will choose the ASC certification, will have an advantage in their exports. In Greece, some fish farming companies (e.g. Kefalonia Fisheries SA, Nireus Aquaculture SA, Selonda Aquaculture SA, Galaxidi Marine Farm, Biotrout SA, etc.) have already certified their products (sea bass, sea bream, trout, etc.) with the ASC Standards, while the same has been done by various companies in the supply chain³.

2.2. Good practices in aquaculture in the Region of Eastern Macedonia and Thrace

2.2.1. Institute for Fisheries Research (INALE)

The Institute for Fisheries Research (INALE) belongs to the Greek Agricultural Organization DIMITRA (ELGO - DIMITRA), which is supervised by the Ministry of Agricultural Development and Food. The Institute is based in Nea Peramos Kavala and has been operating since 1995 with main research areas in fisheries, the aquatic environment (coastal, transitional and inland waters), fishery exploitation and aquaculture. The Institute's specialized research and technical staff participates and implements a number of research projects and studies, acts as a consultant in the country's fisheries and environmental policy, provides services to public services and private entities, while contributing significantly to the education of graduate and postgraduate students and fisheries and aquaculture professionals. It is a Scientific Foundation that conducts research regarding the ecosystems of the

³ <https://www.asc-aqua.org/what-you-can-do/take-action/find-a-supplier/>



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marine environment and inland and transitional waters. In particular, through its three Departments operating (Department of Marine Fisheries, Department of Inland Waters -Lagoons and Department of Aquaculture), it implements national and international research projects aimed at marine fisheries and environmental management, fish processing, culture of algae, phytobenthos, invertebrates and fish, in the study and recording of biodiversity, in the protection and enhancement of inland and transitional water ecosystems, in the study of the water quality, the creation of new technologies to support the aquatic environment and finally the sustainable management of water systems and the resources derived from them. The main activities of the Fisheries Research Institute are research, service provision and education of students and pupils. INALE's research activity is funded by research projects and studies commissioned by national and European organizations, other public bodies and private entities⁴.

INALE and the Institute of Marine Biological Resources and Inland Waters of the Hellenic Center for Marine Research in Athens and Heraklion are involved in collecting fishing data and use the IMAS-Fish data platform for import, statistical analysis and export of the data. Data is accessed and managed via the Internet with a password. A security system ensures data confidentiality and supports access level for end users. During the data entry process, a quality control system has been implemented to ensure the accuracy of the imported data (e.g. minimum-maximum value-by-length checks, maturity stages, geographic coordinates). At the same time, a series of parametric tables (coding system) ensures the integrity of the imported information (e.g. list of items, fishing ports, type of seabed, tools).

The Fisheries Research Institute is located about 17 km from the city of Kavala, in the center of an area with rich fishing grounds and high biodiversity in the surrounding coastal areas, lagoons, lakes and rivers (Γενική Διεύθυνση Αλιείας, 2014).

2.2.2. Toxic microalgae surveillance program

The Region of Eastern Macedonia and Thrace monitors the toxic microalgae in the seawater of the fishing and aquaculture areas of bivalve mollusks, i.e. mussels, oysters, clams etc., through a program contract signed with the Aristotle University of Thessaloniki. Monitoring toxic microalgae in the region aims to support exports and trade for these species.

Algae are divided, depending on their cellular structure, into multicellular (macroalgae) and single-celled (microalgae) organisms. The term macroalgae is used to describe larger algae, while microalgae are tiny algae that periodically multiply in freshwater and seawater and cause algal blooms. This is a problem recorded during the summer and autumn in recent years (since 2003) and, according to the results of the Laboratory Unit of Toxic Marine Microalgae of the Department of Biology, AUTH, is related to the presence of toxic microalgal species (i.e. *Pseudonitzschia*, *Prorocentrum*, etc.). These microalgae multiply locally due to the bottom substrate (suitable macrophyte substrate) and the seasonal increase in water temperatures, while their presence is not related to pollution in the area. Their population density can also be influenced by availability of nutrients and transportation by water currents.

⁴ https://inale.gr/en/home_inale_en/



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In the framework of the National Program for the Surveillance of the Production Zones of Live Bivalve Mollusks for the presence of marine biotoxins in bivalves and the phytoplankton in the sea water of these areas, the Veterinary Department carries out weekly sampling (of seawater and bivalves) according to the national program in order to surveille the problem. The examination of bivalves for the presence of biotoxins is performed by the National Reference Laboratory of Marine Biotoxins in Thessaloniki with the methods of biomedical testing in laboratory animals and chemically (HPLC). In case of detection of biotoxins, a decision may be issued to suspend fishing, trafficking, trade and consumption of live bivalve mollusks for the protection of Public Health⁵.

2.2.3. Exports of Mediterranean Mussels

In Europe, the largest producer of mussels is Spain, followed by France and Italy. In 2016, these three countries accounted for 73.83% of the total European production of bivalve mollusks. Greece ranks 5th in the EU in terms of the volume of production of aquaculture (23,290 tons of mussels) and 9th in terms of production value with 7.42 million euros (ΣΕΘ, 2017).

The 2nd most important category of aquaculture is shellfish culture (oysters, mussels, quinces, clams) and in Greece the Mediterranean mussel is produced almost exclusively. This activity takes place mainly in areas of Northern Greece, from where large quantities of mussels are exported mainly to EU countries. Other bivalve species marketed originate, mainly, from fisheries. Mussel culture started in 1970, in the outfalls of the rivers Loudia and Axios and expanded to Pieria, Imathia and Kavala. Oyster and mussel farming account for 90% of production in Europe with a wide variety of techniques: culture at the bottom, on slabs, on wooden stakes, on ropes, baskets, etc.

Mussels are the most versatile species of shellfish in terms of presentation and packaging. They can be sold in bulk, in pre-packaged net or frozen bags, in vacuum packs ready for use. In addition to the Greek domestic market, Greek aquaculture companies also supply Italy, Spain, and France. A large percentage of Greek mussels are exported unprocessed to refrigerated trucks in Italy but also in Spain, France, and the Netherlands. In the destination countries, mussels are cleaned, processed, peeled and standardized, and are eaten at restaurants, hotels and by final consumers. The mussel harvest begins in early May and is completed by the end of August, while it is sold at wholesale prices that can reach 50-55 cents per kilo.

The bivalve mollusks on the market are hygienically tested. In particular, the bivalve mollusks that are cultivated or fished must pass through a Bivalve Shipping Center or a Purification Center (where they are "cleaned") and obtain an identity card, i.e. a document necessary for their movement. Such Centers are usually located near fishing areas.

2.2.4. Sturgeon breeding and production of caviar in Northern Greece

The eggs of the rare fish sturgeon, a Black Sea fish, are referred to as caviar. It is perhaps the most expensive dish in the world, a symbol of prestige and social order, but also an irresistible taste for the world's elite. Only unfertilized and processed sturgeon eggs can be called "caviar". Today, the main production of caviar bears the names of Beluga, Sevruga and Osietra (or Asketra, or Oskietra) from

⁵ <https://www.pamth.gov.gr/index.php/en/enimerosi/diafaneia/deltia-typou-anakoinoseis/pamth/item/33190-853-2004>



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the names of the sturgeon species that are considered the best of their kind. Of the approximately 25 basic types of sturgeon, only the 20 aforementioned are used to produce caviar suitable for industrial processing. The Caspian region, located between Russia and Iran, is the site of the largest production of caviar.

The female sturgeon needs at least eight years to produce caviar. Each female produces eggs that correspond to 10% - 15% of its weight (from 150-200 grams up to 4 kg of caviar in large fish of 25 kg). Caviar is collected with the classic Russian and Iranian technique, which involves killing the fish and extracting its eggs. A different technique (stripping) is being investigated, which does not involve killing the fish. Fish are injected with a hormone that activates the releasing of eggs. In order to avoid killing the female, a caesarean section can be performed to remove the eggs, as well.

Sturgeon is protected by the International Convention on Endangered Species of Wild Flora and Fauna, which obliges states to enact special legislation to protect endangered species. A ban has been imposed on January 1, 2014 on the export of caviar from wild specimens.

Sturgeon farming has taken the place of sturgeon fishing. All the countries that produce caviar have agreed to this, and even Russia has stopped fishing since 2002. Until the mid-1970s, sturgeon was caught in large quantities in Evros. The interventions in the Delta of the river disrupted the ecosystem, but also the sensitive process of reproduction of the sturgeon, destroying its population. Fish farming is a way to save sturgeon, if not in nature, at least in farms, under controlled conditions. Limited sturgeon farming takes place in the lake of Ioannina. In the region of Drama there are fish farms in inland waters (Iron Water, Kefalari) with a strongly export character of one of them (exports to Russia). The environment in Kefalari, with the running clean waters, is ideal for this particular culture. In addition, today, the company "Oxyrrynghos Hellas SA" located in the region of Drama, is one of the few sturgeon breeding and reproduction units in Greece.

"Oxyrrynghos Hellas SA", from its own fry, produces up to 80 tons of sturgeon, three different species, the Russian, the Siberian and the Huso Huso (Beluga). When the fish reach the age of three, males are detected and are brought to the market, while the females enter special tanks, until, with the special food given to them, they reach the appropriate age and weight, in order to give caviar. Pools with concrete walls, barriers and the bottom of the sandstone allow the development of microorganisms and snails that complement the diet of sturgeon to achieve the best possible taste quality of fish. The water that enters the fish farm from the springs reaches 1200 liters per second. Also, in the fish farm there is a breeding laboratory with separate pools for breeding sturgeon. The offspring of fish remains in the laboratory until they reach 5 grams in weight and are then transported to larger pools. Due to the running clean spring water, the taste quality of the sturgeon is very high. The company's vehicles are equipped with plastic swimming pools with oxygen cylinders. Thus, there is the possibility of delivering fish species of sturgeon in live form. All fish in the fish farm are inspected twice a year and accompanied by certificates. The caviar produced has the following characteristics: black, granular, without additives, salinity 3.7%, packaged in special metal food containers of 0.5 and 1kg, from Beluga and Russian sturgeon fish, which also have veterinary control certificates and certificates of the Ministry of Agricultural Development⁶.

⁶ (<http://www.caviargr.com/home.html>, Ευρωπαϊκή Επιτροπή, Wikipedia, Huffington Post, Kathimerini, Voria)



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2.2.5. Innovative carp breeding in floating tanks in the Treasury reservoir (Nestos)

Carp is a domesticated species adapted to breeding systems. This species is resistant to temperature and water quality. It lives in all kinds of slow-moving or stagnant waters. Carp is mainly reproduced in hatcheries. Once hatched, the larvae are transported to small shallow reservoirs or artificial lakes for brood development, filled with water rich in plankton. In the beginning, the natural production of plankton, vegetation and the benthic invertebrates of the artificial lake are enough to feed the young carps. Later, fish often need complementary foods, such as coarse grains or various feed mixtures. In their third year, carps are transported to large thickening tanks. They feed on the food provided by the ecosystem, although their feeding is usually supplemented with grains (semi intensive culture). Depending on their size, they are either selected as broodstock or marketed. As most carps are sold before Christmas, they usually stay for several weeks in clean fresh water, a technique that also helps improve their taste before they are sold. However, more and more carps are fished out at other times of the year, either for immediate consumption or for enrichment of natural waters for recreational fishing activities. A carp can weigh up to 30 kg and be one meter or larger in length. However, commercially available catches are usually 30 to 50 cm long and weigh from 1.5 to 3 kg. This size corresponds to about three to four years of breeding in European weather conditions. Usually, carp breeding is semi-intensive. Carps can be grown in monoculture, polyculture (along with other freshwater species) or as part of integrated farming with other agricultural activities. Artificial carp lakes often play an important role in improving biodiversity, water conservation in the landscape and flood protection. The vast majority of carp production comes from aquaculture. The reservoirs of the Thisauros and Platanovrisi that were created after the construction of the respective dams have acquired lake characteristics and now host large fish populations of various lake-loving species (*Rutilus rutilus*, *Perca fluviatilis*, *Leuciscus cephalus*, *Chondrostoma nasus*, *Cyprinus carpio*, *Alburnus alburnus*, *Carassius auratus* etc.). At a distance of 13 kilometers from Paranesti in Drama, the Thisauros Bridge has been built on the river Nestos. A tall, earthen dam with an impenetrable clay core, a total height of 175 meters (one of the highest in Europe) and a useful capacity of 656 million cubic meters of water, was opened in 1997 by the Public Electricity Company. As a result of the above barrier is the creation of an artificial lake. With the opinion of the Regional Council of Eastern Macedonia and Thrace in 2019, the Decentralized Administration of Macedonia - Thrace approved the Decision of Approval of Environmental Terms regarding the installation and operation of a carp fish farming unit in the Thisauros artificial lake in Drama, by G. BERBERPIDIS & OXYRRYGHOS GREECE SA OE.. This was followed by the leasing of a lake water area of 20.73 acres and the issuance of a permit for the establishment and operation of a floating aquaculture unit (carp fish farming "Cyprinus carpio") in the artificial lake of Thesaurus (Περιφέρεια Ανατολικής Μακεδονίας και Θράκης).

3. ROMANIA

The 2030 Agenda sets aims for the contribution and conduct of fisheries and aquaculture towards food security and nutrition, and the sector's use of natural resources, in a way that ensures sustainable development in economic, social and environmental terms, within the context of the FAO Code of Conduct for Responsible Fisheries (FAO, 1995). A major challenge to implementation of the 2030 Agenda is the sustainability divide between developed and developing countries which has



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partially resulted from increased economic interdependencies, coupled with limited management and governance capacity in developing countries.

To eliminate this disparity while making progress towards the target for restoration of overfished stocks set by the 2030 Agenda, the global community needs to support developing nations to achieve their full fisheries and aquaculture potential⁷.

Worldwide, aquaculture is developing rapidly due to the action of two important factors: the ever-increasing demand for seafood and the low reserves of fish in the world's oceans.

The aquaculture farmers must be equally concerned about environmental safety, economic viability and socially acceptable development, these being the principles of sustainability in their present and future development. A sustainable aquaculture strategy needs:

- a recognition of the fact that farmers earn a fair reward from farming
- to ensure that benefits and costs are shared equitably
- to promote wealth and job creation
- to make sure that enough food is accessible to all
- to manage the environment for the benefit of future generations
- to ensure that aquaculture development is orderly, with both authorities and industry well organized

In the future, we propose three potential innovative projects ready for implementation in Romania and Danube Delta region, or those that are still being implemented and can be multiplied as Good practices in aquaculture entrepreneurship.

3.1. Carp production

Statistical data indicate that common carp production may have come close to its limit. However, common carp will remain an important species in those areas where it is traditionally produced. The FAO Fisheries and Aquaculture Department explains how this fish is produced across the globe.

In temperate zones, one-summer old fish (20-100 g) must be reared up to 250-400 g in the second year. The stocking rate is 4 000-6 000/ha, plus about 3 000 Chinese carp/ha, if only cereals are fed. The stocking rate can be much higher (up to 20 000/ha) if cereals and pellets also used. The daily ration is approximately 3-5 per cent of body weight.

Common carp can be produced in extensive, natural food and supplementary feed-based monoculture production systems, in stagnant water ponds. Artificial feed-based intensive monoculture production can be carried out in cages, irrigation reservoirs, and running water ponds and tanks, or in recirculation systems.

Common carp are stocked with Chinese carps, and/or Indian major carps, tilapia, mullet, etc., in polyculture systems. This constitutes a natural food and supplementary feed-based production method, in which fish that have different feeding habits and occupy different trophic niches are stocked into the

⁷ . <http://www.fao.org/3/a-i2727e.pdf> - FAO. 2018. The State of World Fisheries and Aquaculture 2018 - Meeting the sustainable development goals. Rome.



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same ponds. The quantity of fish should be in accordance with the productivity of natural food organisms. The frequent application of manure or fertilizers and the proper species ratio, make the maintenance of productive populations of natural food organisms, and the maximal utilization of the productivity of pond ecosystem possible. Synergetic effects between fish species support the production in polyculture ponds.

Carp culture can be integrated with animal husbandry and/or plant production. Integration can be direct (animals above fish ponds), indirect (wastes of animals are used in the ponds as manure), parallel (rice-cum-fish), or sequential (fish production between crops). The sequential cycling of fish/animal/legumes/rice (in 7 to 9 year cycles) is suitable for significantly decreasing the environmental loading of intensive aquaculture/agriculture. Since common carp burrow in the pond bottom, have a broad environmental tolerance and an omnivorous feeding habit, they are a key species in integrated systems.

Common carp can also be stocked into natural waters, reservoirs, and temporarily inundated areas, in order to utilize the natural food production of these waters for enhanced capture fisheries. In this case the fish stocked should be 13-15 cm fingerlings produced in fish farms ('aquaculture-based fisheries') in order to avoid the losses that would occur with smaller fish. Common carp are usually stocked with other cyprinid species, in accordance with the productivity of the water and the intensity of exploitation.

The average profit of carp production in some Hungarian fish farms was € 326/ha (from sales of € 1 652/ha) between 1999-2001, according to a survey by the Research Institute of Fisheries, Aquaculture and Irrigation (unpublished data). In India the net profit from polyculture, in which common carp represented 25 percent of the total fish stocked, was reported to be US\$ 710/ha (from sales of US\$ 1 929) in 1990 (Sinha, 1990). The profit of small scale farmers in Bangladesh was reported to be US\$ 510-1 580/ha (from sales of US\$ 1 540-2 610/ha) from undrainable polyculture ponds, in which the stocking ratio of carp was 20 percent (Gupta et al., 1999)⁸.

3.1.1. Carp growth in Romania

The classic method of growing carp is in land basins (ponds) fish production being different depending on the environmental conditions offered by the fish pond and the conditions offered by the fish farm. The main carp breeding systems are⁹:

3.1.1.1. Extensive production

It is based only on the natural productivity of the basin without intervening with additional fodder. Carp food based on zooplankton, larvae. In this method cannot exceed yields of 250 - 500 kg fish / ha. This growth system is suitable in lakes with large areas where it is not profitable to feed and stimulate with fertilizer the natural productivity.

3.1.1.2. Semi-intensive production

This type of production is intervened with fertilizers (organic or chemical) to stimulate the natural productivity of the basin (zooplankton and phytoplankton) which is used as additional food the classic

⁸ <https://thefishsite.com/articles/production-methods-for-the-common-carp>

⁹ <https://www.scribd.com/doc/78307950/57668826-Cresterea-Intensiva-a-Crapului>



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feeds - mixture of cereals with soybeans or sunflower. This type of growth is suitable in fish ponds with areas from 15 to 100 ha. Fish production can vary between 600 and 2,000 kg / ha depending on the water source, the volume of water in the basin and the quality of the feed. This growth system is most often used in our country, presenting less risk of fish poisoning with ammonia / nitrites due to relatively low yields per volume of water.

3.1.1.3. Intensive production

It is more demanding and requires more attention in terms of water quality. No fertilizers are used because the water quality can deteriorate quickly. In this case, the fish feed is based only on granulated feed with an adequate level of protein for each species. A very important factor is the flow of water that receives the basins, but also the aeration (oxygenation) of the water in order to avoid the ammonia intoxication resulting from the metabolism of the fish and from the degradation of the unconsumed fodder. The water flow is calculated according to the production we want to achieve. Intensive production can be carried out in ponds with small dimensions of up to 1-2 ha because these surfaces can easily be controlled and intervene on the quality of water and dissolved oxygen. Another variant of intensive productions are the floats or floating cages that can be arranged on the course of a river or on the surface of a lake. In the intensive system, productions can be made between 2,000 kg / ha - 20,000 kg / ha.

3.1.1.4. Super-intensive productions

This type of production can be achieved only in systems with recirculation and water thermostatzation. The productions in this system are higher than 20,000 kg / ha but require a rather large initial investment. The super-intensive system is usually made in halls with fiberglass pools and the system is very complex requiring pumps for water recirculation, particulate filters, biological filters where ammonia and nitrites resulting from fish metabolism are neutralized, ultraviolet filters for germ destruction pathogens and water heating and cooling systems. The growth start is very high due to maintaining a constant water temperature, which keeps the fish's metabolism in ideal parameters which results in a good digestion, a good feed conversion, so a rapid growth. In Romania, the type of carp growth in a semi-intensive system, in a 3-year cycle, tends to become unprofitable, and most farmers begin to pay more attention to feed and water quality, thus shortening the production cycle to 2 years.

Intensive growth of carp is an adaptation of similar systems, used worldwide, for trout, bream and salmon, intensive growth in metal cages - ponds, maintained at the surface of floats.

In classical farms, such as the one on Lake Mihăilești, the productions are only 300-500 kg / ha, exceptionally reaching a little bit over 1,000 kg / ha of water. Here, before the repopulation with brood, about 300 t of fish were harvested annually, no more, because the water surface is very large and not all production can be removed, as is the case with small lakes.

Thus, on the farm in Mihailesti, in 2011, the lake was repopulated with 5 million pre-developed seedlings (0.5-2 g / piece), 40 t of summer seedlings (80-90 g / piece), plus 20 t of two-summer seedlings (350-400 g / pc). Harvesting began in 2012. The anticipated production for 2013 is at least 500 t / year.

In an intensive system, the farmer informed us, about 400 times more fish are obtained from the same water surface than in the classic system. Thus, in the pond, on only 2,000 square meters, the



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entrepreneur obtained a production of about 80 t of carp, the equivalent of 400 t / ha. The net profit in such an investment is 1 euro / kg of fish. So, at 80 tons harvested, it means 80,000 euros / year. The investment costs are amortized in a year and a half. All fish are fully recovered, and the workforce is reduced to only one or two employees. At an intensive area of 3,000 square meters, a total production of approximately 130 t of carp per season is estimated.

The ponds are connected to each other by metal bridges. There is another smaller, mobile pond used to transport live fish offshore. It feeds fish with fodder, which contains 30-32% protein and vitamins. As a result, production amounts to over 30 kg of fish per cubic meter of water.

The direct sale of harvested fish is essential to be a successful business. The establishment of a fish store can be done with European money, through the European Fisheries Fund, Axis II, provided it is built inside the farm.

3.2. Sturgeon farming

Several species from the Acipenseridae family are farmed in Europe, including the Siberian sturgeon, Danube sturgeon, Sterlet sturgeon, Common sturgeon and Adriatic sturgeon. Many of the sturgeon species are considered endangered or even critically endangered. Their population has drastically decreased because of the construction of dams cutting migration routes, overfishing and pollution. The farming of sturgeon is important, therefore, not only for producing flesh and caviar but also for restocking these species to the extent that it has a beneficial impact on wild stock conservation.

One of the sturgeons most commonly farmed in the EU is the Siberian sturgeon (*Acipenser baerii*). Rearing systems for Siberian sturgeon were developed in the 1970s in the former Soviet Union. The first specimens were introduced into France at more or less the same time, as part of a scientific cooperation programme.

The reproduction of Siberian sturgeon is complicated in that the females do not ovulate every year and not all at the same time. By controlling water temperature, however, it is possible to obtain eggs over a relatively long period, from December to May.

Siberian sturgeon can be reared in raceways, circular tanks, ponds or cages. They are carnivorous and are fed pellets with fishmeal and fish oil as well as vegetable extracts. The average rearing time for sturgeon cultured for their meat is 14 months, obtaining a fish weighing 700 g. At harvesting time they are caught in nets.

Exploiting sturgeon for caviar production is costly, because the females cannot reproduce until they are at least seven years old. During this period they are reared in tanks of running fresh water. In the past, the females were slaughtered and their eggs removed. However, in recent years, fish farmers have developed techniques to remove the caviar without killing the fish, which reduces production costs by improving the yield per mother fish.

At worldwide level, sturgeon fisheries have almost disappeared as a result of stock depletion. Farming has taken over fisheries, and Chinese aquaculture now accounts for 85 % of the total sturgeon output worldwide. After China, the main producers of sturgeon are Russia and the EU. More Siberian sturgeon is being reared in Western Europe now that there is a ban on exporting caviar from wild specimens in



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order to protect stocks. Statistics for caviar production are not entirely accurate, but it appears that caviar accounts for over 80 % of the value of sturgeon aquaculture. Italy and France are the main caviar producers in the EU. Thanks to the development of aquaculture in Europe, the value of exports of caviar to third countries has now overtaken the value of imports. Intra-EU trade of caviar amounts to half the value of EU production, with main flows from Italy to France, Germany and United Kingdom¹⁰.

In recent years, more and more businesses are interested in super-intensive fish farming in the recirculating aquaculture system, given that raising sturgeons for meat and caviar can be described as a profitable business.

In Romania, sturgeon aquaculture has a short history. The first artificial reproduction with the success of *Huso huso* was achieved in 2004 at Isaccea. The same company opened a farm of sturgeon breeding in 2009 on the Lake Horia. In 2006, the second farm was built at Tămădău. Currently sturgeons are grown in more than 10 areas in Romania.

The most popular species from Romanian farms are *Acipenser stellatus*, *Acipenser gueldenstaedtii*, *Huso huso* and *Acipenser ruthenus*.

Romanian companies produce sturgeons, juveniles, fertilized eggs and, from December 2012, caviar (currently only one company has reached maturity: S.C. Danube Research Consulting S.R.L., (formerly known as S.C Kaviar House).

3.3. The natural reproduction of the Pike perch *Sander lucioperca*

This production is done by depositing eggs on the adventitious roots of willow or other plant substrate, the results being decisively influenced by a complex of natural factors (temperature, water quality, etc.).

DDBRA has signed a contract with INCDDD for the production of 1,000 embryonated nests of the pikeperch species, which were launched in specially arranged spaces in Razim Lake. Within the technology used by INCDDD, each nest contains a number of about 30,000 eggs from which will result a number of 80-100 specimens that will reach maturity. The launch action is annual and is part of the DDBRA's policy of restoring the stocks of this overfished fish species, especially in the Razim-Sinoie Complex.

Given the years of reduced natural reproduction, the process of natural reproduction driven by population with embryonated pikeperch has been shown to be an effective way to support this species. The process of natural reproduction takes place in April and the population with embryonated eggs is carried out in stages.

At the beginning of April, the breeding basins are populated with breeders (80 ♀ and 120♂ are introduced in Enisala type ovens). Mattresses are placed at the same time as the population of breeders. Mattresses are checked daily to replace those that have been found to have spawned. Spawning begins at the beginning of the month (in the first decade) at a water temperature of 10-12°, reaching its peak at the end of April when the water temperature rises to 15° ÷ 18° C, and gradually decreases towards the beginning of May.

¹⁰ Fisheries and aquaculture in Europe, No 56, June, 2012



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The eggs hatch at a period of 110^o days, which means that at a water temperature of 10°C the hatching takes place in 11 days.

The transport of the embryonated nests in the popular areas is done in special crates that ensure the possibility of keeping the fish eggs in a viable state for a period of at least 2 days.

Aquaculture is an economically viable alternative with many opportunities, but it is also a complex and capital-intensive business that requires intensive management. It takes comprehensive initial planning and on-going attention to business finances to be successful.

However the research breakthroughs in terms of new species and production systems are progressing. Likely the greatest growth in the future will be in increased production of marine species for which major production bottlenecks have been overcome and in offshore production, with the many new innovations in offshore production systems¹¹.

3.4. Good examples in aquaculture business in Romania

3.4.1. Anghila Impex SRL

Anghila Impex SRL is a commercial company that, in addition to the main activity, also carries out, according to the acts of operation, activities with NACE 0322 - Freshwater aquaculture and NACE 1020 - Processing and preserving of fish, crustaceans and molluscs. According to the Romanian Aquaculture Units Register, the company owns the following aquaculture licenses:

Fish farm	Type of farm	Location	Area (ha)	Fish species
ESNA Fish Farm	Hatchery	Movila Miresii Commune	230	Indigenous Cyprinids, Asian Cyprinids, predatory species, sturgeons
Fish farm for intensive growth of trout and sturgeons in recirculating system	Hatchery+nursery	Movila Miresii Commune	2.1	Common carp, rainbow trout, beluga, Russian sturgeon, Siberian sturgeon, stellate sturgeon, sterlet and hybrids, pike perch

In order to develop the fish production activity and for the fish processing/capitalization, Anghila Impex SRL implemented the following projects financed within the Operational Programme for Fisheries and Maritime Affairs 2014-2020:

No.	Project title	Implementation period	Total eligible value (lei)	Total public value (lei)
1.	Modernization of ESNA Fish Farm through the purchase of specialized machinery and equipment	17.08.2017-17.08.2019	9,996,477.39	4,988,242.22
2.	Fish and Fishery Products Processing	19.07.2017-	7,310,724.47	3,648,051.51

¹¹ *Aquaculture Businesses: a practical guide to economics and marketing*, by Dr Carole Engle, with Engle-Stone Aquatic\$ LLC and Adjunct Faculty with the VA Seafood AREC of Virginia Tech University, is now available from 5m Publishing.



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Factory

19.07.2019

During 2014-2016, the breeding technology applied by Anghila Impex SRL within the Esna Fish Farm was extensive, in polyculture, without the use of artificial feeds and without the administration of fertilizers in order to stimulate natural feeds, in which case very low productions for consumption were achieved, between 4 and 20 tonnes of fish/year.

In order to increase the production capacity of the farm to approximately 150 tonnes of common carp per year, Anghila Impex SRL purchased specialized machinery and equipment that allowed the company to apply carp breeding technology in an intensive, protected and controlled system, in FRP basins and in floating cages. The benefits of this technology are high fish growth densities and producing products at optimal marketing sizes, which leads to high yields per small area units, and also the provision of healthy and safe products.

Applying this technology implies the observance of special technical conditions for the promotion of animal health and welfare in order to obtain quality products and to ensure food health. Using FRP basins to obtain one-summer old juveniles and floating cages to obtain fish for human consumption has advantages in terms of controlling the technological process, an efficient consumption of the feed provided and, at the same time, the biggest advantage is the elimination of losses due to ichthyophagous birds, present in the area due to the fact that farm is located within the perimeter of the protected area for avifauna ROSPA0048 Ianca-Plopu-Sărat.

Due to this project, Anghila Impex SRL created 6 new jobs (1 electromechanical technician and 5 fish farmers).

At the same time, the company also owns a fish farm in the same area for the intensive breeding of trout and sturgeon in a recirculating system, which provides a considerable production of trout and sturgeon.

For the capitalization of aquaculture products and the development/diversification of activities within the ESNA Fish Farm, Anghila Impex SRL set up a factory for fish and fish products processing. The built hall is compartmentalized according to the phases of the technological flow and equipped with specific processing equipment. The factory obtains about 327.5 tonnes/year of fish products - fish preserved by refrigeration, freezing, smoking, marinating, fish caviar - intended for sale on the domestic or foreign market.

The investment will determine energy savings, by using alternative forms of energy (photovoltaic panels) and will reduce the impact on the environment by small-scale processing of fish waste - the project provides for processing and reuse in the feed of predatory species (wels catfish, pike, pike perch) of a part of the waste resulting from processing.

Six new jobs were created as a result of the project implementation.

The investments are located in Movila Miresii Commune, Brăila County, and have an economic, environmental and social impact by absorbing the existing labour force at local level.



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3.4.2. Marfishing SRL

Starting with 2014, Marfishing SRL capitalized on the ponds resulting from the exploitation of ballast from the perimeter of the former riverbed and terrace of the Siret River and set up, with the help of European funds (Operational Programme for Fishing 2007-2013), a mixed farm for cyprinids and acipenseridae, consisting of:

- 5 basins (EC1-EC5) for breeding sturgeon spawners and breeders;
- 1 basin (EC6) for breeding common carp, silver carp, bighead carp and grass carp, fry intended for the population of the basin for breeding and fattening;
- 1 basin (EC7) intended for breeding and fattening of the common carp, silver carp, bighead carp and grass carp fry obtained from EC6.

Fish farm	Type of farm	Location	Area (ha)	Fish species
Fish farm for Breeding Cyprinids and Acipenserids in a mixed system	Nursery	Doaga, Mărășești	3.825	Indigenous trout, brook trout, rainbow trout, Siberian trout, beluga, Russian sturgeon, stellate sturgeon, sterlet
Fish farm for breeding Cyprinids and Acipenserids in a mixed system	Hatchery	Doaga, Mărășești	22.01	Indigenous trout, brook trout, rainbow trout, Siberian trout, beluga, Russian sturgeon, stellate sturgeon, sterlet

Project title	Operational Programme	Implementation period	Total eligible value (lei)	Total public value (lei)
Fish Farm for Breeding Cyprinids and Acipenseridae in a Mixed System	Operational Programme for Fishing 2007-2013	22.04.2014-22.12.2015	22,191,802.00	13,315,081.20
Increasing MARFISHING SRL's Competitiveness by Making Investments in Developing Complementary Activities	Operational Programme for Fisheries and Maritime Affairs 2014-2020	25.08.2017 – 25.08.2018	8,076,358.24	3,957,415.54

Through the project, a station was also built for the artificial reproduction of sturgeons, the incubation of eggs and the growth of fry to the age of 1 year.

The farm was designed to achieve an annual production of 60 tonnes of fish for sale to third parties (common carp and Cyprinidae - silver carp, bighead carp, grass carp), of 270,000 sterlet and stellate sturgeon fry for sale to breeding units, but also to develop complementary activities – recreational fishing.



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The project, located within two Natura 2000 sites (ROSCI0162 Lunca Siretului Inferior and ROSPA0071 Lunca Siretului Inferior), contributed to the capitalization of the area by promoting alternative practices (aquaculture, tourism, etc.), to the functional improvement of environmental factors (wet habitats) and to the revitalization of the landscape, but it also helped to decrease the unemployment rate at local level.

Based on the success of the business started in 2014, Marfishing SRL continued the investments from own funds but also from European funds accessed within the Operational Programme for Fisheries and Maritime Affairs 2014-2020 and diversified the activities of the fish farm, setting up accommodation units (41 bungalows, 10 houseboats and 26 yurt tents), public catering units (1 fishery restaurant with a capacity of 78 people) and leisure spaces (adventure park, swimming pool, etc.), thus developing the complex Zaga Zaga Land - <https://zagazaga.ro/>. Also, for tourists' rides and for recreational fishing, 20 boats (10 electrically-powered boats and 10 boats with oars) were purchased.

Through the aquaculture activities carried out as well as through the complementary ones (tourism), this successful investment attracts many clients/tourists annually, generating incomes that contribute to the prosperity of the area.

3.4.3. Research - Development Institute for Aquatic Ecology, Fisheries and Aquaculture Galați (ICDEAPA)

The Research - Development Institute for Aquatic Ecology, Fisheries and Aquaculture Galați (ICDEAPA) carries out research, development and technology transfer activities in the fields of aquaculture, freshwater fishing, etc.

The institution purchased, within the consulting center set up with European funds allocated through the Operational Programme for Fisheries and Maritime Affairs 2014-2020, a diagnostic system for aquaculture, unique in Romania, which provides online data from aquatic environments, wherever there is telephone coverage. The diagnostic system allows the collection of data from aquatic environments with the help of sensors, their transmission to the consulting center and the processing of information through software, so that the institute's specialists to be able to issue solutions for rapid corrections on fish production or vegetation, corrections that can be made in real time.

Project title	Implementation period	Total eligible value (lei)	Total public value (lei)
Center for Management, Relief and Advisory Services within ICDEAPA Galați for Aquaculture Farms in order to Improve their Performance and Competitiveness	18.09.2019 - 18.05.2020	632,448.22	632,448.22

The diagnostic system consists of the following elements:

- the field component, a beacon equipped with sensors, which is placed on the water in the basin designed for fish farming and which sends the parameters in real time, via modem, to the laboratory of the institute; the beacon can be placed in any area of the country where there is telephone coverage; once installed, the beacon is autonomous and can transmit data from minute to minute or



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at any interval at which it is set; the setting of the beacon is done up to half a year, when it must be verified;

- the static component, located at the laboratory, consisting of computers, a specialized software-encrypted that transmits to the specialists the data collected from the field in order for them to make diagnoses on technology, chemistry, hydrobiology, ecology, pathology and to propose solutions to the reported problems.

Typically, it would have taken several days, up to a week, to collect data from a fish farm and to determine the measures to be taken in the event of fish outbreaks or exponential growth of aquatic vegetation, during which time field data would have been collected and the information processed, therefore the proposed measures for the problems identified would have been late.

The use of this innovative "fish telemedicine" method can help aquaculture unit owners/administrators to avoid the large losses that would be caused by the microscopic "enemies" from the aquatic environments.

3.4.4. Malina Pond

Located in Galati county, between Sendreni and Smardan localities, Malina pond has a total area of 120.86 ha of which 118.46 ha of water surface.

Having as owner the National Agency for Fisheries and Aquaculture and as administrator SC Grig Impex 94 SRL, the Malina fish farm is registered in the register of Aquaculture Units under no. RUA0024 being licensed for the production of fish for consumption from the species: indigenous and Asian cyprinids and predatory species.

In the spring of 2010, it was populated with two tons of carp between 0.5 and 2 kilograms, with three tons of grass carp between 2 and 15 kilograms, as well as with ten tons of prussian carp and four tons of slightly larger carp, between 3 and 5 kilograms.

The arrangement also includes 8 pontoons, which can be rented for sport fishing in season.

<https://www.facebook.com/BaltaMalina/photos/197788449078236>



Common borders. Common solutions.



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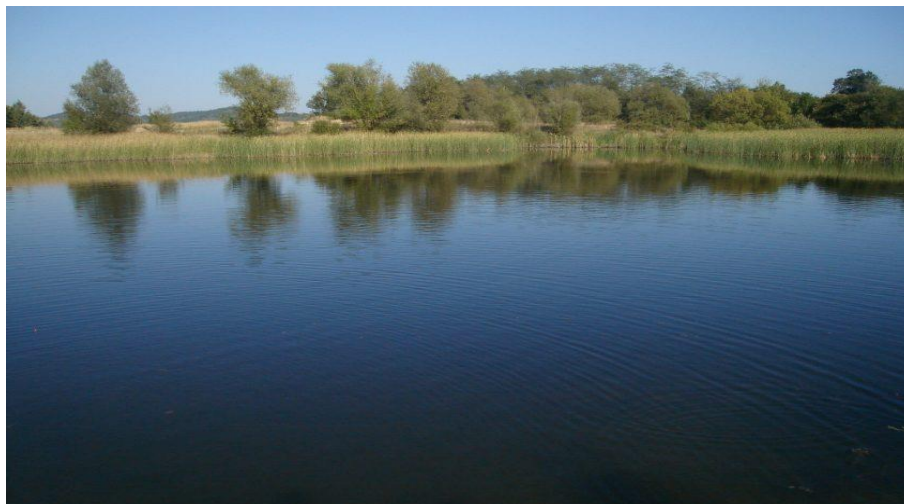
3.4.5. Potcoava 2 pond

Located on the administrative area of Branistea commune, 25 km from Galati city, with an area of 17.3508 ha, Potcoava 2 pond is rich in vegetation and has a lot of reeds being quite deep between 2m on the shore and 4m offshore. Genetically, the Potcoava pond is an abandoned lake of the Siret (or meander), which could not be drained due to the damming of the lower Siret meadow, due to its larger surface and depth and due to the close connection with the groundwater layer. The name of the pond Potcoava comes from the unusual and interesting shape of the water, similar to a horseshoe.

Being included in the special avifauna protection area ROSPA0071 Lunca Siretului inferior, with a wetland habitat, with *Thypha* and *Phragmites* and feeding and breeding habitat for waterfowl and waders, Potcoava 2 pond was until 2019 in the custody of the Association for the Conservation of Diversity Biological Vrancea. The pond is populated with many species of fish, representing a special attraction for fishing enthusiasts.

Currently, Potcoava 2 Pond is leased by SC ADY SRL, aquaculture unit registered in the register of aquaculture units under RUA number 1434 - hatchery. The total area of the pond and the water surface is 17.3508 ha, with 1 single basin. The company is licensed for the production of fish for consumption from the species: indigenous cyprinids: carp, prussian carp, asp and Asian cyprinids: bighead carp, grass carp, sturgeons: Russian sturgeon, sterlet, stellate sturgeon, predatory species: northern pike, pike perch, European perch, catfish and crustaceans: crayfish.

<http://www.informatii-romania.ro/listing/balta-potcoava/>



3.4.6. Zatul Pond Recreational Base (www.spjadppgalati.ro)

Zatul pond is located on the territory of Galati municipality, in the eastern area at the confluence of the Prut river with the Danube river, being the most sought after fishing arrangement in Galati municipality. Located in the Badalan dam, near the river Mile 76 (Cotul Pisicii area on the Danube),



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Zatun pond is part of the Lunca Joasa Natural Park of the lower Prut. The access is made from E87 Galati-Giurgiulesti and continues on the road (DJ 251E) on the Danube defense dam.

Owned and managed by the Galati County Public Service for Public and Private Domain Administration, Zatun Pond is the nearest recreational base for fishermen in Galati County. With an area of 28.95 ha, of which 27 ha, the Zatun pond is registered in the Register of aquaculture units under no. RUA0375, owning 1 basin in which there are various species of fish, from carp and crucian to pike. The unit is licensed for the production of fish for consumption from the species: indigenous and Asian cyprinids, pike perch, northern pike and catfish, being annually populated with 3-5 tons of fish.

The structure has accessed European funding, aiming to develop the production base of fish species of commercial interest, through small investments.

Thus, in 2015, the project Restoring the potential of Zatun pond for fish species of commercial interest, Galati municipality, Galati county, with a budget of 594,592.83 lei, aimed at: restoring the production potential of species of commercial interest, through conservation actions and sustainable management of the local environmental heritage for the Zatun pond, through:

1. Preservation of the local environmental heritage by consolidating and rehabilitating approximately 1900.00 m of the dam of the Zatun pond (Dam surface clearance; Harrowing of plant debris; Transport of soil necessary to complete the leveling of the protective dam, including compaction of the soil, Protection by sowing with perennial grasses),
2. Sustainable management of the local environmental heritage by clearing and cleaning the reeds in the Zătun pond (clearing the entire surface of the Zătun pond, which requires a volume of 117,336.00 m³ of embankments, excavated with various equipment (dragline and bulldozer) and transported to a distance of about 2 km),
3. Involvement of the inhabitants of the area in the actions of conservation and sustainable management of the local environmental patrimony by maintaining 9 permanent jobs and creating 10 temporary jobs, during the project.

From 2020, the repopulation actions of the Zatun pond have started: in the first phase with carp and prussian carp.

<https://www.agerpres.ro/social/2021/03/22/galati-balta-bazei-de-agrement-cu-specific-pescaresc-zatun-va-fi-populata-cu-pest-3-6-tone-de-caras--682708>

<https://www.agerpres.ro/social/2020/03/02/galati-balta-bazei-de-agrement-cu-specific-pescaresc-zatun-a-fost-populata-cu-3-5-tone-de-caras--458272>



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4. TURKEY

There are small trout farms as family running business, some with fish restaurant nearby the farms in the region. Majority of the production comes from net cage farming established in dams (Kürtün and Torul Dams in Gümüşhane, Derbent Dam in Samsun, Borçka Dam in Artvin Provinces). Some of the companies operates farm only in sea or dam. Some others have both or working as joint venture companies. A few companies have processing plants and storage facilities.

As good practices, three companies from the Eastern Black Sea were selected and represented in brief. These companies are the good examples in the region due to raise rainbow trout in both freshwater and sea water as an innovative approach in aquaculture to produce big fish in large volumes not only for domestic consumption but also for export. In the production process these companies are creating new jobs for the local citizens as a partial solution to reduce unemployment rate in the region.

The last 2 companies are operating in the Aegean Region which the 4th one is the biggest sea bass and sea bream producer in Europe. The last company is important due to its establishment as the first closed intensive fish farm in Turkey.

The main species used in the aquaculture business is Rainbow trout, mainly big sized, the Black Sea Salmon *Salmo labrax* and sea bass in the Black Sea, and Sea bass and Sea bream across country. Small share belongs to production in inland aquaculture with the species trout and mirror carp in small volumes.

4.1. Successful companies in aquaculture business in the Black Sea Region

4.1.1. Yomra Aquaculture Limited¹²

This company was established in 2007 to produce rainbow trout in net cages in the sea. But the owner, İlker YILDIRIM had fishing background since 1990 as to collect Rapa whelk from coastal waters of Trabzon and sell to the plant for processing and to be exported to Japan. Additionally, family elders had experience on fishing about two generations. In 1991-1992 he started to catch fish and in 2003

¹² Sancak Mah. No 25/A Yomra, Trabzon, 61250 Turkey, Phone: +90 462 3413646, www.yomrasuurunleri.com Director: İlker Yildirim, ilkery.61@gmail.com



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he was elected as the Head of Yomra Fisheries Cooperative and conducted this position till 2017. He started first aquaculture trials in 2005 in Yomra Fishing Port with a single cage.

Yomra Aquaculture Company was started fish farming in 2017 within the area of 60 da leased from the State based on the project approved, by setting net cages; 6 pieces in 16m Ø, cage frame carrier pipe thickness 250mm. In order to increase the project capacity, Company aims to change cages with the bigger ones; in 30, 40 and 50m in Ø, with the pipe thickness 315-400 cm. Due to provide continuous supply of fish, Company contracted with one of the companies in Kürtün Dam (Eskitoğlu Trout) as joint venture enterprise. Company rented two farm site in Torul Dam (another dam in Gumushane City) with 2 new projects; on 3.5 da surface area (220 tons capacity) and 1.5 da (140 tons capacity). Company also bought the aquaculture licenses of two companies established on 7 different locations on Kürtün Dam in order to growth of juveniles coming from hatcheries 2-3 g in size to the market size and transport them to the marine cages where the growth rate is tripled.

In order to support production process, 2 steel and 2 wooden vessels are used for various services; pulling, net changing, feeding, repairing, controlling, cleaning, diving and removal of dead fish from the net (Fig. 1).

At present, within the 60 da of sea farm area, the capacity of the cages and real fish production is 1700 tons and 1400 tons, respectively. Trout can reach higher weights in the sea after transportation from dam cages: the larger the fish from the dam transported to the sea, the greater the growth obtained in the sea. In practice, Company transfers trout at 300-400g on June, the following year fish reaches 1-1.2 kg, if fish is over 1 kg, they may grow up to 3 to 5 kg in marine cages.

If there is demand, Company produces *Salmo labrax* by providing the juveniles from the hatcheries at the same size like Rainbow trout, transports to the cages in dams and after 8 months transports them to the marine cages for over growing. Only 20% of their production goes to domestic market; 80 % exported to Japan and Russian Federation.



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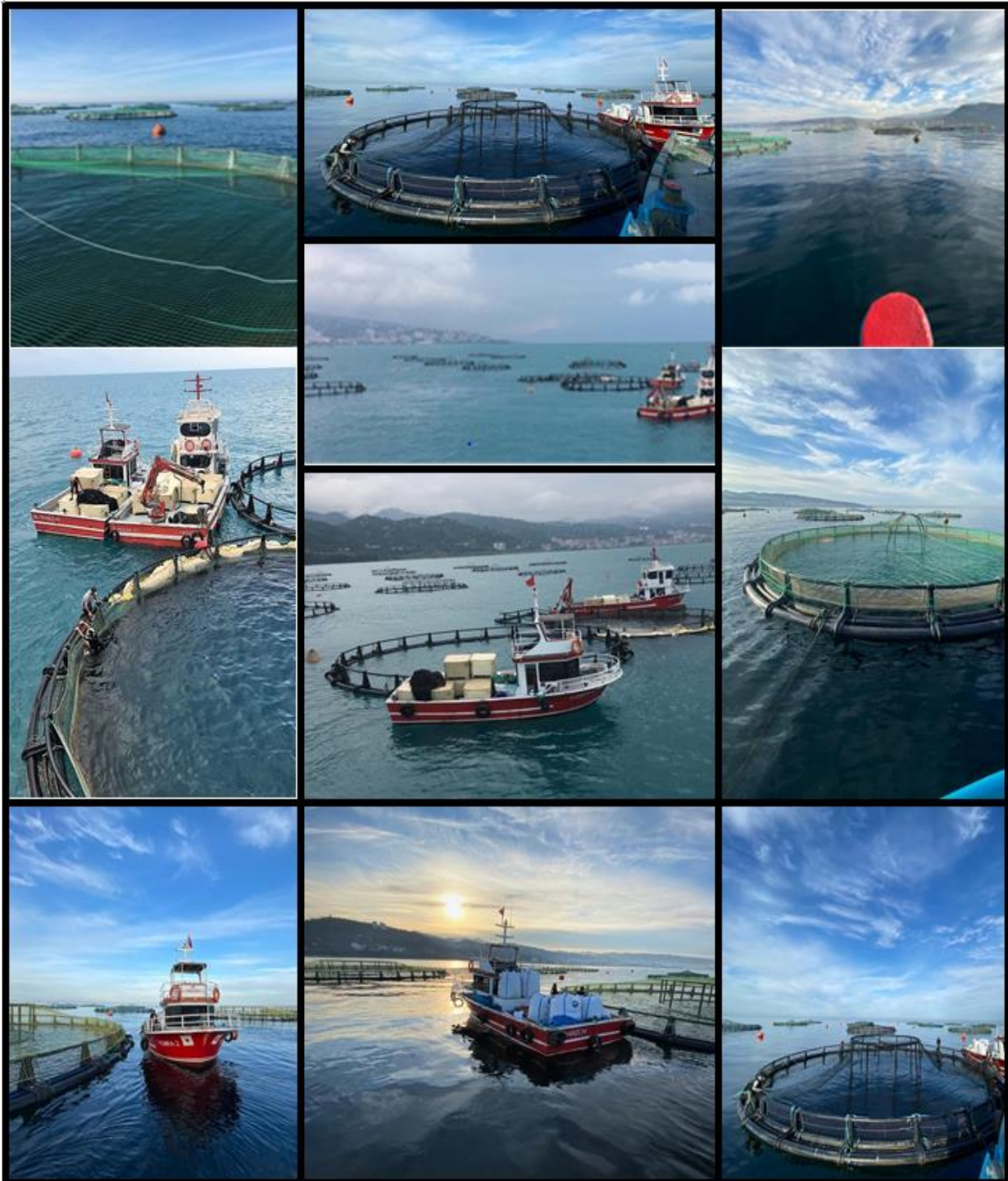


Figure 1. Views from Yomra Aquaculture marine cage system

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4.1.2. Polifish/Politek Inc¹³.

Polifish is a fish processing company founded in 2007 by the fisherman family engaged in fishing, marketing and processing industry. Company has the first and largest cold store operated under the closed area of 3200 m² on the land of 11000 m² in Arsin Industrial Zone.

Company, provides high standards for processing and packaging of captured (anchovy, horse mackerel, bonito, whiting, red mullet) and farmed fish (sea bass and rainbow trout). Processing plant applies high hygiene standards of the European Union, and has export certificate to export fish to various countries of the world. Daily shocking and cold storage capacities are 45 tons and 2000 tons, respectively.

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By keeping the principle of quality production, Company continues to add strength to its power with new technology investments by following the developments in this targeted sector. Fish provided from fishing and/or fish farms, transported to the raw material acceptance section with cold chain in line with the HACCP¹⁴ rules. Essential controls are carried out in order to meet the criteria of ISO 22000 standards for the acceptance of the raw material. At the initial phase of processing, fish are sorted and packed according to the demand of the customer, or transferred to processing for cutting, gutting, cleaning, filleting and packaging units. If the fish will be frozen, different packages can be used. Then, fish are immediately shocked and kept in cold storage for further shipment. Polifish produces wide range of products and marketing to all cities of Turkey with the cold chain (Table 1; Fig. 2.). On the other hand, Polifish supplies fish directly to the hotels, hospitals and cooking factories. The products marketed in different forms from various fish species.

The reason of the selection of this company as one of “good practices” is to their contribution to fish farming, processing, marketing and trade of the Trabzon city. Company is very keen to participate international fairs and exhibitions, business meetings to reach and promote their products to the wide range of markets and importers.

Table 1. Processed fish species and types for marketing in Polifish Company

Species	Marketing type	Standards	Package
Anchovy	Fresh-chilled	90-110 fish per kg	In EPS boxes as 5 & 10 kg
	Frozen whole	90-110 fish per kg, glazed*, in 900 gr PS plates	Boxed in 5, 8, 10 kg blocks
	Frozen cleaned	120-150 fish per kg, glazed, in 700 gr PS plates	
	Frozen fillets	190-210 fish per kg, glazed	in 1000 gr printed bags
	Fresh-chilled & cleaned	0.2-0.4, 0.4-0.6, 0.6-0.8, 0.8-1.0, 1.0-1.5 kg per fish	In EPS boxes as 5,10 & 25 kg
	Fresh-chilled fillets	100-200, 200-300, 300-400, 400-600g per fish	In EPS boxes as 5 & 10 kg

¹³ Arsin Organize Sanayi Bölgesi, 10 No’lu Cadde, No: 10 Trabzon / TURKEY, Phone: +90 462 711 26 80, Director Tayfun Denizer, info@polifish.com.tr, <https://polifish.com.tr>, <https://www.youtube.com/watch?v=ftq4VP3NfrE&feature=youtu.be>

¹⁴ Hazard Analysis and Critical Control Point



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Sea bass	Frozen whole	0.2-0.4, 0.4-0.6, 0.6-0.8, 0.8-1.0, 1.0-1.5 kg per fish , glazed, in 0.75 & 1.00 kg printed bags	In 10 &15 kg boxes
	Frozen cleaned		
	Frozen fillet with skin or skinless	100-200, 200-300, 300-400, 400-600 g per fish, glazed, In printed bags of 500, 750 & 1000g	
Sea bream	Fresh-chilled	0.2-0.4, 0.4-0.6, 0.6-0.8, 0.8-1.0, 1.0-1.5 kg per fish	In EPS boxes of 5, 10 & 25 kg
	Fresh-chilled cleaned		
	Fresh-chilled fillets	100-200 , 200, 300-, 400-600g per fish	In EPS boxes as 5 & 10 kg
	Frozen whole	0.2-0.4, 0.4-0.6, 0.6-0.8, 0.8-1.0, 1.0-1.5 kg per fish, glazed, In printed bags of 500, 750 & 1000g	In 10 &15 kg boxes
	Frozen cleaned		
	Frozen fillet with skin/skinless	100-200, 200-300, 300-400, 400-600 g per fish, glazed, In printed bags of 500, 750 & 1000g	
Trout	Fresh-chilled	0.4-0.6, 0.6-0.9, 0.9-1.2, 1.2-1.75, 1.75-2.4, 2.4-3.6, 3.6-4.8, 4.8- 6.0 kg per fish	In EPS boxes of 5, 10 & 25 kg
	Fresh-chilled gutted/cleaned	0.4-0.6, 0.6-0.9, 0.9-1.3, 1.3-1.8, 1.8-2.7, 2.7-3.6, 3.6-4.5 kg per fish	
	Fresh-chilled filleted	0.2-0.3, 0.3-0.45, 0.45-0.65, 0.65-0.85, 0.85-1.2, 1.2-1.8, 1.8-2.4, 2.4-3.0 kg per fish	
	Frozen whole	0.4-0.6, 0.6-0.9, 0.9-1.2, 1.2-1.75, 1.75-2.4, 2.4-3.6, 3.6-4.8, 4.8- 6.0 kg per fish, glazed, In printed bags of 750 & 1000g,	In boxes of 10, 15 & 25 kg
	Frozen gutted/cleaned	0.4-0.6, 0.6-0.9, 0.9-1.3, 1.3-1.8, 1.8-2.7, 2.7-3.6, 3.6-4.5 kg per fish, glazed, In printed bags of 750 & 1000g	
	Frozen fillet with skin/skinless	0.2-0.3, 0.3-0.45, 0.45-0.65, 0.65-0.85, 0.85-1.2, 1.2-1.8, 1.8-2.4, 2.4-3.0 kg per fish, glazed, In printed bags of 500, 750 & 1000g	
Whiting	Fresh-chilled whole	30-40 fish per kg	In EPS boxes as 5 & 10 kg
Horse mackerel	Frozen whole	30-35 fish per kg, glazed, in PS plates of 900 g	In boxes of 5, 8 & 10 kg blocks
Bonito	Frozen whole	500-750, 750-1000, 1000-1500 g per fish, glazed	In boxes of 10 & 15 kg blocks
	Frozen cleaned	500-750, 750-1000 g per fish	
	Frozen fillet	250-400, 400-500 g	
Red mullet	Frozen whole	20-30 fish per kg, 900 g plates	In boxes of 10 kg
Blue fish	Frozen whole/cleaned	10-15 fish per kg, in printed bags of 750, 1000 g	

*glazed 3%

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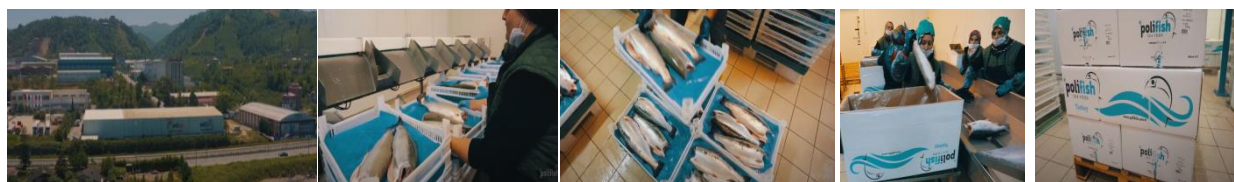


Figure 2. Polifish Inc and some of the products

4.1.3. Northern (Kuzey) Fisheries Industry and Trade Limited¹⁵

Company was founded in Kızkayası Region on Derbent Dam in Bafra, Samsun in 2004, initially started to produce trout with the capacity of 300 tons per year. Capacity increased to 750 tons in 2006 and 960 tons in 2014.

Vision of the Company is to produce healthy and quality of trout by environmentally friendly methods. The main principle is transparency in the whole production and distribution processes with international standards, customer appreciation. In addition, Northern Fisheries aims to contribute to the development of aquaculture in Turkey by following all developments in the sector, and to update company policy according to the progresses to be renewed day by day. Another important component of their vision is to contribute solutions of the problems of big and small companies in the sector.

At present production capacity in Derbent Dam Lake has increased to 3772 tons together with the partner companies (Table 2) while hatchery capacity is 15 million eggs per year. Production is marketed under 3 size class: 250-350 g (portion size), 1-2 kg and 3-5 kg in packages made in processing plant. On the other hand company sells trout to the farms produced big trout in marine cages (Fig.3). On the other hand together with partner companies, there are cage units to produce big trout in 2 different locations with total capacity 5900 tons per year. New production projects were under way (preliminary permissions were taken) for new sites for marine cages of 226000 m². New farms will be active till 2022 and produce sea bass and big trout.

Chairman of the Board Mr Osman Parlak, founder of the companies, is the pioneer of trout culture in net cages in dam lakes in 1991. Another success is to supply cold water from the discharge of dam to use for fry and juvenile growth. Due to shrinkage of gene pool of rainbow trout, he imported diploid trout eggs first time to Turkey and grow them up to 4-5 kg weight, having specific meat colour.

Table 2. Northern Fisheries Company and other partner companies in Samsun Province

¹⁵ Kuzey Su Ürünleri, Küplüağzı Köyü Yakakent/SAMSUN or Kuzey Su Ürünleri Bafra / SAMSUN, Phone: +90 362 611 28 26
E mail: sezgin@kuzeyసుurunleri.com.tr. Director: Osman PARLAK <https://en.kuzeyసుurunleri.com.tr/index.html>
<https://www.youtube.com/watch?v=w7uHAoxobys&feature=youtu.be>



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Company/Partner company	Province	Location	Production type	Capacity (tons/year)
Northern Fisheries	Samsun	Derbent Dam	Net cages	960
		Yakakent Town	Packing/cold storage	2000 m ²
Derbent Fisheries		Derbent Dam	Net cages	480
Parlak Fisheries				480
Osman Parlak Fisheries				480
Sezgin Aslan Aquaculture				200
Furkan Fisheries				250
Ladik Akdağ Fisheries				922
		Ladik Town	Hatchery	15 million eggs per year
TOTAL		3772 tons of trout per year		
Marine farming	Sinop	Yakakent Town	Net cages	4000
		Gerze Town		1900
TOTAL				5900
Kızılırmak Fisheries Ltd. (Shareholder)	Samsun	Yakakent	Net cages	3544
	Sinop	Gerze		3500
Mavi Damla Fisheries	Karabük	Yenice	Hatchery Sturgeon farm	N/A

Mr. Osman PARLAK is the Head of Union of Samsun-Sinop Fish Farmers and Vice Director of Central Association of Fish Farmers Producer Unions, member of IPARD Monitoring Committee of Turkey.

Company gives great importance to university-industry cooperation and is a member of the Advisory Board of the Faculty of Fisheries, University of Kastamonu. In addition, he is a member of the Consumption Commission and Chairman of the Great Trout Commission.

Mr. Osman Parlak is the founder and still a partner of Kızılırmak Fisheries LT, which operates mariculture by producing big trout and sea bass in net cages with a capacity of 3544 tons/year in Yakakent and 3500 tons/year in Gerze district of Sinop Province. Some of these products are exported to various countries.

Osman Parlak is also a partner of Mavi Damla Seafood Company located in Yenice district of Karabük province. The company, which has a juvenile trout production facility, also produces sturgeon fish. This Company achieved first time to export sturgeon to Adzerbaican/Nahcivan from Turkey.

All of the companies given in Table 2 have “Good Agricultural Practices” and “Globalgap” certificates. Total production of trout and big trout is about 7000 tons in the last 3 years. Egg production was 40 million in the same period.

Feed is supplied from various companies such as Sibal Ltd., Kılıç Ltd and Gümüşdoğa Ltd. There are 40 workers and 8 fisheries engineers working in the companies.

There is no direct export but they export over exporting companies. In addition to fish they also export trout caviar.



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Usually, sales are made live for restaurants and or to the companies that make large trout farming at sea. In addition, they also sell portion sized trout and big trout over 3 kg to the national markets. In addition, our general distributor sells trout, Big Trout and Colorful Trout. In addition, our live fish sales are carried out to Samsun, Sinop, Çorum, Ordu, Amasya, Tokat and Giresun provinces.

Kızılırmak Fisheries Company, of which Osman Parlak is a partner, has produced around 8000 tons of sea bass, 1500 tons of coloured and over 3 kg trout in the last 3 years. Some of this production has been given to exporting companies. Kızılırmak Aquaculture Ltd. is one of the partners of SASTAŞ Inc., export company, exported some of the big trout to Japan. The company also has whole, fresh, frozen, fish sales.

On the other hand, Mavi Damla Fisheries Ltd, has produced about 10 million trout fry in the last 3 years. Also, Company has 900 females 10-15 kg in weight sturgeon stock in the farm. Company is targeted to produce caviar in near future.



Figure 3. Kuzey Trout Farming Company and produced trout in different sizes

4.2. Best aquaculture practices in Turkey

4.2.1. Kılıç Holding

Kılıç Aquaculture Company established the first fish farm as a small enterprise in Salih Island/Bodrum, Mugla Province 29 years ago, in 1990 and started to produce sea bream, 30 tons, in an unsophisticated facility. Company was founded by Mr Orhan Kılıç, member of a fish trader family from Bodrum. Then he founded Kılıç Marine Fish Farming, Export and Import Company. Kılıç has

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become the only facility in the industry which maintains all the process, producing fish feed as well as fish, performing its sale following the packaging, in a complete self-sufficiency. Company has grown 1600 times in 29 years and reached a production capacity of 65000 tons. Today Kılıç is well recognised not only in Turkey, but also in Europe, as one of the most important companies.

Led by Kılıç, fish culture industry changed the conditions where fish was exclusive to the upper income groups, and introduced it to the public. Company is proud to provide healthy and nutritious marine products to Turkish people and all other customers from more than 50 countries that they export. Company contributed to the aquaculture to become a real industry, helped it to gain export ability, pioneered in many fields in aquaculture techniques.

Being a subsidiary of National Bank of Kuwait to make investments in the Middle East, the Gulf Region and Turkey, NBK Capital signed a partnership agreement with Kılıç in 2010 which motivates the company rapid and stable growth. The increase of the share of aquaculture within the overall fish consumption in Turkey and worldwide due to the raising awareness about healthy living, gives the Company a bright vision and encourage to invest in aquaculture industry across Turkey and overseas companies in the future. Proceeding to be a worldwide company, Kılıç Deniz A.Ş. promises to carry out its duties and responsibilities both in its own industry, in the NGO's and associations, and continue contributing the society and the national economy.

Believing that a healthy nutrition is a right for everybody on earth, Kılıç Holding know how important it is to have access to healthy protein by producing fish since 1991 to achieve this target. The most important mission of the Holding is to contribute the growth of healthy generations with fish they produce. For this purpose, they are investing perpetually and developing delicious and economic products for all people.

Holding operates in their fully integrated facilities with a great environmental care for the sustainable production. With this responsibility and awareness, they consider the reduce carbon emission in their production by aiming to use renewable energy resources.

During their 27 years of aquaculture journey started from Bodrum, along with the big growth Company exports from Muğla to over 63 countries in 5 continents, have exceeded 160 million US \$. With this excellent performance, Company has become the leader in Marine and Animal Products export 8 times in a row. Besides the important contributions to the Turkish economy, Kılıç Holding has also evaluated the investment opportunities abroad in order to take advantage of the logistic benefits towards the foreign markets. Following previous investments in Italy, they recently invested in Albania and started to produce Rainbow Trout, and set up facilities in Dominican Republic to produce Olive Flounder.

Company is among the pioneering companies in Europe and the leader of aquaculture industry in Turkey. Moreover Holding is titled as "the biggest sea bream and Mediterranean Sea Bass producer in the world". Other success stories are to become the first company in the world to produce Bluefin Tuna fish and their extraordinary practice related to nutrition, which is crucial for the future of humanity. The ultimate goal of the Holding is to be the biggest aquaculture company in the world.



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Kılıç Holding has 10 companies involved in every aspect of aquaculture industry, tourism and export and import.

Company is very keen to produce fish by respecting environmental and social rights and responsibilities. Environmental policy of the company includes these principles;

- Keeping the factors causing pollution under control and minimizing the environmental pollution and harm by using the most advanced technology available,
- Taking the accordance to the related laws and regulations as a minimum qualification, Company constantly trying to improve the concordance level to the legal terms,
- Sharing the outcomes of research in the premises of the Company regarding the environmental protection with our employees, clients, suppliers and the society and helping them to adopt these as lifelong principles, organizing trainings in order to increase the environmental awareness,
- Dividing the waste of the company and recycling as much as possible in order to prolong the life of natural resources by reducing their use.
- Reducing the pollutant waste resulting from our operations at its source and act respectful towards humanity and nature.

Company produces fish juveniles after breeding, on- grow, manufacture fish feed, process and marketing.

4.2.1.1. Juvenile fish production

Practicing in all processes ranging from the production of seed fish to packaging, Kılıç has succeeded to become the world leader with its sea bream, sea bass and rainbow trout production capacity in the company premises. Every production steps are monitored. Together with the technology they use and experienced expert staff involved in every aspects of the production, Kılıç supplies juvenile fish demands coming from both domestic and international markets, in a high quality, healthy and economical way. Kılıç supplies juvenile fish to all Mediterranean countries with specially designed ships for the transportation. Having a payload of 5 million juvenile fish, these ships have 700 m³ volume and 80 m overall length. Sea bream and sea bass hatcheries are producing juveniles from eggs in hatcheries in Bafa, Ören, Akarca and Güvercinlik towns of Muğla Province.

There are fully equipped fish health laboratories within all the juvenile fish production facilities.

4.2.1.2. Breeding

When the juveniles reach 3-5 g weight, they are transferred to the HDPE cages of 20 m diameter. The juveniles are fed 5-8 times a day depending on the water temperature. Once they reach 30-40 gr weight, following a careful growing period, they are transferred to 30-50m diameter HDPE cages. Then they are sent to the growth facilities. All of the growth facilities are off shore systems and they are equipped with automatic feeding systems and monitored both surface and underwater cameras. The production of porgy, common seabream, bream, striped seabream, sharpsnout and umbra also continues as alternative species.



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4.2.1.3. Extruder fish feed production

Being the most important factor in fish growth, fish feed is supplied with Aqua K brand from Kılıç's own Feed Factory. With an annual capacity of 120000 tons, Kılıç Fish Feed is Turkey's biggest extruder fish feed manufacturer. Being equipped with the machines, tools and the projects of prominent European companies, the fully automatic facilities produces the needs of both Kılıç and other fish farms under Aqua-K brand. Company have ISO 9001 and 22000 Quality and Food Management Systems and GLOBAL GAP standards, it is possible to ensure absolute quality in every stage of production.

4.2.1.4. Processing and packaging

It takes 16-22 months for sea bass and 13-14 months for sea bream to reach serving size and to be sent to the packaging facilities operating under Kılıç Holding. All the actions performed in the cage management sections, from the fish coming from the hatchery to the moment it is sent for packaging, are recorded and the fish are traceable system-wide.

Fish processing and packaging facilities under Kılıç Holding are located in 3 different locations. The first two facilities are about marine products and located in Milas/Muğla. The third facility is the Rainbow Trout processing and packaging facility in central Kahramanmaraş Province in the south-eastern region of Turkey.

Milestones in the life of the Holding are given in the Table 3.

Table 3. Milestones in the development of Kılıç Holding

Year	Activity
1991	Orhan Kılıç started to produce in Salih Island with 50 tons production capacity per year.
1993	The first export to Italy.
1994	Company name has been changed from Orhan Kılıç to Kılıç Seafood Co.
1997	Production, Kuyucak facility was established and increased capacity of production of Sea bass and Sea bream
1988	Juvenile Fish Production, Kılıç started to produce juvenile fish in Ören facility
1999	Contact office was launched in Italy
2000	First off shore facility came into action in Muğla district.
2001	First packing facility was established in Milas town.
2002	Barka Seafood Co., Çobanoğlu Co. Ltd and Birlik Co. Ltd was bought by Kılıç
2003	Extruder fish feed facility was established in Milas town
2004	Spador SRL, sales and distribution company, was established in Rimini of Italy. The second packing facility was opened by Kılıç and processing facility was renovated.
2005	Kılıç Expanded Polystyren Foam, Hatchery facility in Bafa and Kılıç Erşen Co. were established. Kılıç Seafood Co. got to certificate of quality certificates ISO 9001 and 130001 for fish feed facility
2006	Second off-shore and fish feed factory were established by Kılıç. Branch for sales and distribution was opened in İstanbul for domestic market. Güney Ege Co. was bought by Kılıç. First fish market was established in Bodrum. Kılıç Seafood Co., packing and processing facility, Bafa Co. and facility of Kılıç Seafood Ören got certificates of quality ISO 9001:2000 HACCP 130001. Kılıç Seafood Co., Kılıç Erşen Co., Birlik co. and Barka Co. got to certificate of quality ISO 14001.
2007	Research development of Kılıç Seafood Co. hatchery went into operation in Güvercinlik in Bodrum to produce 10 million juveniles per year. The second fish market chain was opened in İzmir-Bostanlı. Kılıç opened a branch for sales and distribution in Ankara for domestic market.



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2008	Orfoz Seafood Ltd was bought. Trout farm came into action in Kahramanmaraş City. All companies merged under title of Kılıç Holding Company. Kılıç opened a branch for sales and distribution in Antalya for domestic market.
2009	Kılıç started producing Juvenile fish in Akarca Farm. Gençler Co. Ltd, Özmandalinci Co. Ltd, and Başak Co. Ltd were bought out. Trout production started with 20000 tons per year capacity in Sır Dam, Kahramanmaraş.
2010	Export of trout from Turkey to Europe started. Processing plant in Milas qualified with the certificate of quality from BRC (British Retail Consortium). According to İstanbul Chamber of Industry; Kılıç Seafood took place 473th out of 500 top exporter companies in Turkey.
2011	Kılıç Seafood became export champion with 74 Million US \$ exports. According to Fortune Magazine rating/assessment; Kılıç Seafood took place 301th on the list out of 500 companies. Kılıç Seafood started producing smoked trout. Kahramanmaraş trout facility qualified to get certificates of ISO 9001, ISO 22000, BRC and IFS. All processing of trout facilities; breeding, hatchery, packing and processing got certificate of GLOBAL G.A.P.
2012	Kılıç Fish Feed facility qualified to get certificate of Global G.A.P. According to Turkish Exporter Reports; KLC GIDA took place 287th between the biggest exporters in Turkey. Kılıç Seafood became champion with 70 Million US \$ turnover. According to İstanbul Chamber of Industry; Kılıç Seafood took place 271th out of 500 companies. Kılıç took part in the most valuable 100 brands in Turkey.
2013	According to İstanbul Chamber of Industry; Kılıç Seafood took place 264th on the list out of 500 companies in Turkey. Kılıç Seafood became a champion in Aquaculture and Animal products fields with 84 Million dollars Exports. Kılıç 1 which is the world's the biggest of juvenile vessel was bought and added to Kılıç Group. Kılıç started to sale MAP (Modified Atmosphere Packaging) products in marketplace.
2014	According to İstanbul Chamber of Industry; Kılıç Seafood took place 315th out of 500 companies in Turkey. Kılıç Seafood became champion with 105 Million US \$ Exports. Trout production farm was established in Albania.
2015	Kılıç Seafood became champion with 115 Million dollars Exports. Production volume reached to 40000 tons per year. Kılıç started producing value added products in processing facility which is established in Milas. KLC became first Foreign Trade Capital Company in its field by exporting 106 million US \$. Fish meal and Fish oil Facility was established in Mauritania.
2016	Kılıç Seafood became champion with 141 Million US \$.
2017	Kılıç Seafood became champion with 153 Million US \$ turnover. Kılıç started Bluefin Tuna ranching by buying Dardanel Company farms. Total fish production was 65000 tons per year.
2018	Kılıç Seafood became export champion with 175 Million dollars Exports. Kılıç started producing sea bream and sea bass in Dominic Republic facility for sales to U.S.A.
2019	Kılıç sea bass and sea bream won "superior taste award" from International Taste and Quality Institute. Kılıç Deniz and Metro Cash and Carry has started new Project "Metrochef" together. Kılıç Seafood has sea bass/sea bream farms in Dominican Republic and exported large quantity shipment to USA from Dominican Republic. Kılıç Seafood was champion again with 175 Million US\$ Exports. Kılıç started export Hirame to Japan.

4.2.1.5. Products of the Company




Company produces wide range of fish species (Table 4).

Table 4. Production in the company premises



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Species	Remarks
<p>Mediterranean Sea Bream</p> 	<p>This fish of the Mediterranean's unique taste has been consumed since ancient times. It is preferred due to its hard and white flesh, good for grill.</p> <p>People who want to enjoy grilled Mediterranean Sea Bream usually prefer our cleaned whole package.</p> <p>On the other hand, Mediterranean Sea Bream fillet is preferred by reckless people who want to enjoy it in a practical way.</p> <p>Instructions for Use: Various types of cooking, (oven, grill, pan, salt) can be applied.</p> <p>Nutrition factors: Mediterranean Sea Bream is a good source of protein. It is an Omega3-rich product.</p> <p>Weight 100/200 ;200/300; 300/400; 400/600; 600/800; 800/1000 g/piece</p> <p>Shelf life Fresh: 14 days, Frozen:18 months</p> <p>Nutritional Facts (for 100g) Energy: 564 kJ (134 kcal)</p> <p>Fat: 5,48</p> <p>Saturated fatty acid: 1,13 g; polyunsaturated fatty acid: 1.85 g; monounsaturated fatty acid: 2.50 g</p> <p>Carbohydrate: < 1 g, Protein: 20,44 g, Sodium: 0.02 g, Salt: 0.06 g, Fiber: 0 g</p> <p>Packaging EPS packages (6, 10 kg); Cardboard</p>
<p>Mediterranean Sea Bass</p> 	<p>Mediterranean Sea Bass... the preference of sea enthusiasts in attentive dinner tables.</p> <p>An elegant way to extend the enjoyment on the table by combining a nice chat with flavor is decorating the plates with a Mediterranean Sea Bass cooked as a whole.</p> <p>Nutrition facts: Mediterranean Sea Bass is a good source of protein. It is also an Omega3-rich product.</p> <p>Weight 100/200 ;200/300; 300/400; 400/600; 600/800; 800/1000 g/piece.</p> <p>Shelf life Fresh: 14 days, Frozen:18 months</p> <p>Nutritional Facts (for 100g) Energy: 483 kJ (114 kcal)</p> <p>Fat: 2,47</p> <p>Saturated fatty acid: 0,54 g; polyunsaturated fatty acid: 0,83 g; monounsaturated fatty acid: 1,10 g</p> <p>Carbohydrate: < 1 g, Protein: 22,25 g, Sodium: 0.05 g, Salt: 0.12 g, Fiber: 0 g</p> <p>Packaging EPS packages (6,10 kg); Cardboard</p>
<p>Brown Meagre</p> 	<p>Instructions for Use: Various types of cooking, (oven, grill, salt) can be applied.</p> <p>Nutrition facts: Brown Meagre is a good source of protein. It is also an Omega3-rich product.</p> <p>Weight 200/300, 300/400, 400/600, 600/800, 800/1000, 1000/1500 1500/2000, 2000/2500, 2500/3000 g/piece</p> <p>Shelf Life Fresh: 14 days, Frozen:18 months</p> <p>Nutritional Facts (for 100g) Energy: 392 kJ (93 kcal)</p> <p>Fat: 2,04</p> <p>Saturated fatty acid: 0,64 g; polyunsaturated fatty acid. 0,68 g; monounsaturated fatty acid: 0,72 g</p> <p>Carbohydrate: < 1 g, Protein: 18,00 g, Sodium: 0.02 g, Salt: 0.06 g, Fiber: 0 g</p> <p>Packaging EPS packages (6,10, 20 kg); Cardboard</p>

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<p>Rainbow Trout</p> 	<p>Prepared in serving sizes. It is cooked directly after cleaning. Instructions for Use: Various types of cooking, (oven, grill, pan, salt) can be applied. Nutritional facts: Rainbow Trout is a good source of protein. It is also an Omega3-rich product.</p> <p>Weight On demand</p> <p>Shelf life 7 days (0; +4 C)</p> <p>Nutritional Facts (for 100g) Energy: 549 kJ (130 kcal)</p> <p>Fat: 5,01</p> <p>Carbohydrate: < 1 g, Sugar: < 1 g, Protein: 21 g</p> <p>Packaging Styrofoam box</p>
<p>Bluefin Tuna</p> 	<p>Tunny is a delicious fish from Scombridae family. It breeds in the cool and deep waters of Mediterranean. It has a round body with a larger front section and thinning rear. It is an exceptionally large swimmer The upper side of its body is dark blue or black, and the sides are silvery white. It is a rich source of Omega 3 and protein. It can be consumed every season. The weight of a mature Bluefin Tuna fish can grow up to a ton and 5-6 m.</p>
<p>Salmon Trout</p> 	<p>Salmon Trout originated from the North America is a member of the Salmonidae family and distributes in fresh and cool waters. Very rich in protein and Omega 3.</p> <p>It is one of the most important farmed species that has a wide range in the market and known as being the most preferred freshwater fish in our country. Very rich in protein and Omega 3. Preferred size of Salmon Trout is between 1000 g and 3000 g. It is especially preferred because of bright, reddish meat color and has a less bony structure. Trout has a wide range of consumption, from grilling to baking, from casserole to preparation of pita. Easily accessible and tasty in whole seasons.</p>
<p>Olive Flounder (Hirame)</p> 	<p>Paralichthys Olivaceus is one of the highest valued finfish in the world. It became important aquaculture species due to high growth rate, feed efficiency, and tolerance to water temperature changes and resistance to diseases. It grows up to about 1 meter long and 10 kg. Olive flounder can be used for any cooking application but they are highly esteemed for use as sushi and best for sashimi.</p>

All processing plants are pursuant to the national and international food safety criteria (Turkish Food Codex Regulation and Codex Alimentaris Commission) and have the health approval number issued by the EU. Ensuring the cold chain is protected until fish comes to the dish; Kılıç also operates in compliance with ISO 9001 Quality, ISO 14001 Environmental Management System, HACCP and ISO 22000 Food Safety Management System, IFS (International Food Standard), BRC (British Retail Consortium) and Integrated Global G.A.P standards. In processing facilities, fish are classified and packed naturally according to their weight. Fillet products, on the other hand, are packaged freshly in chilled or frozen state and prepared for shipping. However, all the packaging options of the demand of customers are available in frozen, MAP (Modified Atmosphere Packed) and boxed forms. A packaging system which is using EPS (Expandable Polystyrene) produced by Kılıç is used in the processing plants. Being in compliance with EU and US basic nutritional regulations, EPS is an insulation material which serves perfectly in duties that are expected from it.

4.2.1.6. Rainbow trout breeding

Kılıç's Rainbow Trout breeding activities continue in Kahramanmaraş Sır Dam, Kayseri Bahçecik Dam and Gaziantep Karkamış Dam lakes. With the experience gained in marine farming, Company became Europe's leader in Rainbow Trout production in a short time as their primary goal.



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4.2.1.7. Delivery

After 3 decades of experience without compromising their principles, they supply “Kılıç” and “Captain Kılıç” branded fresh products to the customers. Kılıç Company exports 70% of the annual production (65000 tons) more than 60 countries. With a wide range of products, company has been becoming the export leader in its field for 8 years. 75 % of the deliveries are done via land route and they start with route planning before the shipment. 13% of products are delivered by airway; especially for distant destinations. When available, Company prefers to use scheduled cargo flights as faster transportation to deliver fish as much as fresh and without leaving extra carbon footprint on earth. 12% of the exports are done by ships; especially the frozen products. The shipments are organized using special containers (Fig. 4).



Figure 4. Delivery of the products

4.2.1.8. Certificates

Companies of the Holding have various certificates namely; ISO 9001:2015 Quality Management System; ISO 14001:2005 Environmental Management System; ISO 22000:2005 Food Safety Management System and HACCP principles; GLOBALG.A.P. in Turkey for 30 cage facilities, 6 hatcheries, 2 packaging and processing Facilities and Fish Feed Factory; BRC (British Retail Consortium) for food safety; IFS (International Featured Standards) created by German, French and Italian retailers for food safety; ASC for environmental sustainability and social responsibility.

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KILIC SHOPS:



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Kılıç Market-Bodrum: Cumhuriyet Mahallesi, Kıbrıs Şehitleri Caddesi No:200/A-5 Phone: +90 252 317 0015

Kılıç Market – İzmir: Bostanlı Balık Mr. Cemal Gürsel Cad. No:520/B Bostanlı / İzmir Phone: +90 232 336 5484

https://www.youtube.com/channel/UCAQbsEM7ttGO_CeJdXdjUA/videos

4.2.2. IDA Food & Foreign Trade Limited

4.2.2.1. Company

Company has been founded as a fish production facility in 1997 in the village of Kemiklialan, Lapseki town, in Çanakkale (Dardanelles) province as an intensive fish farm to produce marine fish juveniles in closed system (Fig. 5). After company's partnership status has changed in 2005, İda Food continued its operations with a fresh spirit and diversified its product range. Since 2005, a series of renovation and extension investments were made in İda Food Fish Production facilities. Today, total area of the facilities has reached to 7000 m² indoors and 21000 m² outdoor ponds. Main species targeted with the license of MAF are sea bream and sea bass (40 million) juveniles.

Nowadays, it produces sea bass and sea bream juveniles in its hatchery. The R&D and production studies of the other fish species with economic value has continued.

Turkey's economy grew by performing to a significant increase in the aquaculture field and foresight to increase exports, İda Food developers took necessary steps related to further increase in the quality and investing.

İda Food, observing the principles of full environmental awareness and equity to its employees aims to be an exemplary facility in the aquaculture sector.



Figure 5. Location of İDA Food & Foreign Trade Limited

As quality and food policy, company targeted:

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- Continuous improvement in every field in accordance with national and international regulations and in line with the demands of our customers,
- To ensure the satisfaction of our employees and to give importance to their training,
- To produce the highest quality and reliable juvenile fish without sacrificing quality and food safety by continuously improving our system,
- It is a company that has committed to fulfill its responsibilities to the nature and society of the region in which it operates, to protect every value of the region and to add value for sustainable development.

4.2.2.2. Production

Company produced about 22 million sea bass and 8 million sea bream juveniles as an average of 2016-2020 period, 30 million in total (Table 4). It is the 3rd biggest producer in the aquaculture sector and covers 6% of total production (Table 5).

Table 4. Number of juvenile production of the company by years

Year	Sea Bass	Sea Bream	Total
2016	26.698.000	9.320.000	36.018.000
2017	33.256.000	4.645.000	37.901.000
2018	17.035.000	10.338.000	27.373.000
2019	23.910.000	5.580.000	29.490.000
2020	7.440.000	11.850.000	19.290.000
TOTAL	108.339.000	41.733.000	150.072.000
MEAN	21.667.800	8.346.600	30.014.400

Considering the operational costs, main items are feed, live food production and staff payments (65%) (Fig. 5).

Production units in the facility in the farm (Table 6):

Table 5. Juvenile producers in aquaculture sector in Turkey (million)

Rank	Company	Total # juveniles(10 ⁶)	Rank	Company	Total # juveniles (10 ⁶)
1	Kılıç	200	9	Akvatec	20
2	İlknak Çandarlı	60	10	Abalıoğlu	15
3	IDA Food	30 (6%)	11	Egemar	12
4	Demircili	30	12	Hatko	12
5	Fjord	25	13	Olivka	11
6	Nordzee	25	14	Mavi Tuna	5
7	Çamlı	25	15	Akvatur	5
8	Sürsan	25			
TOTAL					500

- Live food production Department (Fig. 6)
 - Alg production



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- Rotifer production
- Artemia production
- Brood stock keeping and hatchery systems
 - Brood stocks
 - Sea bass
 - Sea bream
 - Alternative (new) species
- Larvae production
 - Sea bass larvae production system
 - Sea bream larvae production system
- Nursery systems
- Adaptation and on-growing units
- Fish delivery and transportation facilities
- Sea water treatment/purification systems

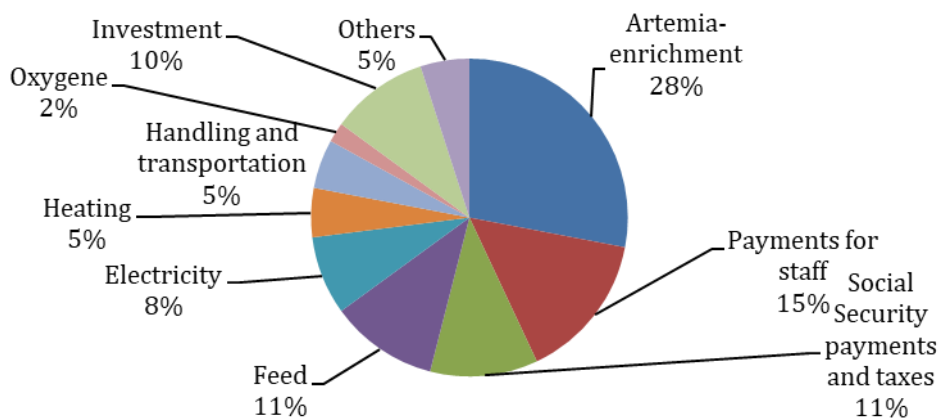
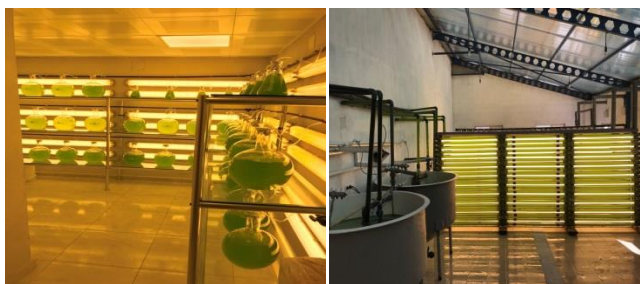
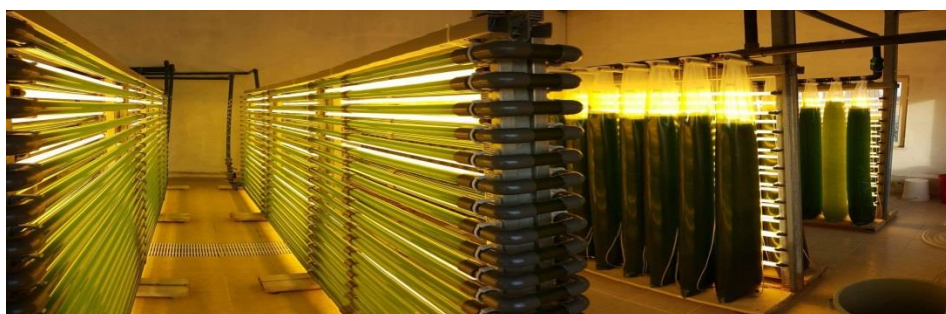


Figure 5. Main costs in production

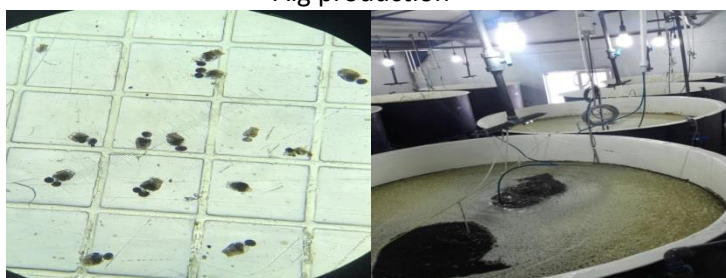




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Alg production



Rotifer production

Figure 6. Live food production unit

Total water volume used in production cycle is 4130 m³. Various types of tanks and ponds are used in the hatchery, nursery and on-growing sections (Fig. 7). Brood stocks are kept in outdoor ponds (Fig. 8).

Table 6. Production units and characteristics

Units	#tanks/ ponds	Unit (m ³)	otal volume (m ³)	Type
Rotifer production	22	2.5	55	Cylindrical PES
Artemia Production	20	2	40	Cylindrical PES
Sea bass brood stock	8	15	120	Circular ponds
Sea bream brood stock	6	25	150	Octagonal ponds
Sea bass larvae production	24	5	120	Circular ponds
Sea bream larvae production	36	20	720	Circular ponds
Sea bass on-growing	9	25	225	Octagonal ponds

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Sea bream on-growing	24	20	480	Rectangular ponds
Sea bass adaptation	12	100	1200	Octagonal ponds
Sea bream adaptation	17	60	1020	Rectangular ponds
TOTAL WATER VOLUME			4130	

There are several types of filtering and water treatment systems used in the facility: Hydrotech filters, ozonizing systems, sand filters, 10 microns bag filters, 1 micron bag filters and UV water purification system (Fig. 9).

In fish diseases laboratory, regular follow-up and controls are carried out by fish health team. In order to increase productivity and quality, parasite controls, bacterial disease detection, antibiogram studies are routinely performed (Fig. 10).

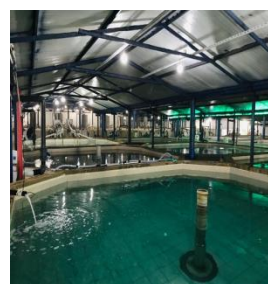
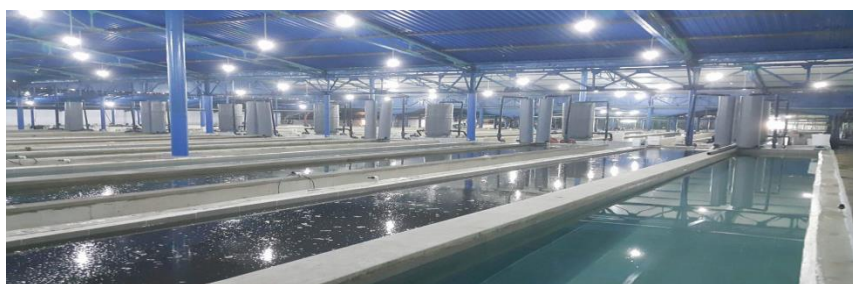


Figure 7. Nursery and on-growing indoor ponds



Figure 8. Outdoor tanks for brood stock



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Figure 9. Water treatment systems



Figure 10. Fish health laboratory

4.2.2.3. Marketing

Fish are grown within the framework of contracts arranged in accordance with the satisfaction principles of the customers and delivered to rearing facilities. Basic considerations for marketing are:

- Fish variety, quality and traceability
- Average size (0.5 gr -1.0 g -2.0 g- 5.0 g)
- Length distribution
- Deformation standards
- Delivery

Juveniles, which meet the standards requested by the customers, are checked under their supervision and loaded into the desired number of transfer trucks or transfer ships. The water quality is checked and delivered to the growing facilities in the presence of a trained staff that look after fish health until the destination (Fig. 11).



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Figure 11. Fish delivery from the farms

The farming of Meagre *Argyrosomus regius* is still rather experimental and involves intensive production, in land-based tanks and sea cages. There are few facilities established mainly in southern France where they are in the Camaguey, Cannes, and Corsica, in Huelva, Spain, and at La Spezia and Ortobello in Italy, IDAGIDA has started meagre production in the farm.

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<http://idagida.com.tr/index.php/en/videos/>

5. UKRAINE

Ukraine has similar geography with Romania which is good for inland aquaculture due to abundant natural lakes and wetlands fed by the Danube River and other rivers. In order to have progress in fishing and aquaculture industry, Ukraine aims to use international funds over various projects.

The European experience in setting up fisheries support funds provides an opportunity to gain better experience on the sources of formation of such funds and priority funding actions. The experience of European countries shows that considerable attention is paid to the research support of the fisheries functioning on the basis of sustainability and consultative support the enterprises of industry.

Ukraine has allocated € 8.6 billion¹⁶ of total budget (from EU+national) to support integrated maritime policy, sustainable fishing, improve aquaculture, implement the provisions of the updated CFP, marketing and processing and increase employment and consolidate the territories. Main part of the budget is funded by European Maritime Affairs and Fisheries Fund (EMFF). One of the purposes of the fund is to use European experience to support aquaculture sector in the country.

¹⁶ http://www.ribaki.org.ua/docs/darg/koncepcia_fond.pdf



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In the future, three potential innovative projects needed to be proposed which is ready for implementation in Ukraine and Odessa region, or those that are still being implemented and can be multiplied as Good practices in aquaculture entrepreneurship. Organization of a sturgeon farm with an annual productivity of 2 tons of black caviar and 10 tons of sturgeon using the technology of closed water supply (CWS)¹⁷. The aim of the project is to organize a sturgeon farm with an annual productivity of 2 tons of black caviar and 10 tons of sturgeon using the technology of closed water supply (CWS).

CWS allows you to significantly speed up the process of growing fish to the level of commercial readiness and get black caviar, not inferior in quality products obtained from sturgeon fish in natural conditions. The technology for growing fish in closed water supply (CWS) devices is close to the industrial technology of animal husbandry and poultry farming. It provides for increased density of fish landing during rearing, as well as mechanization and automation of the main production processes. A project is proposed with the assistance of the Latvian company SIA AKVA AGRO, which has extremely positive experience in the construction of closed water supply systems. The technology is recommended to be implemented on the basis of modern imported equipment. The power of the sturgeon farm consists of two independent ultrasound. The first CWS for artificial cultivation of 10 tons / year of sturgeon. The second CWS on artificial cultivation and maintenance of broodstock of sterlet weighing 15 tons, with a productivity of 2 tons / year of black caviar (intravital method of obtaining caviar). An additional commercial product is fresh fish obtained in the process of growing broodstock by dividing the livestock into males and females, as well as culling those that are very slow in growth. The basis of the products quality obtained are: clean water, in which fish is grown, highquality feed, for feeding fish, constant monitoring of fish farmers, and the availability of an automated system that monitors the fish habitat and technological processes around the clock.

The main objectives of the project are:

- Creation of a competitive and highly profitable enterprise with a powerful production base. - Occupation of a significant share of the Ukrainian market for sturgeon species of fish and black caviar.
- Adaptation at the Ukrainian sturgeon farm of advanced European business and technological processes for the production of sturgeon fish in a closed system.
- Development of technology for growing fish in the ultrasonic testing in the Kiev region and establishing an effective farming system.
- Production of high quality products that meet state standards.
- Meeting the needs of the Ukrainian market for sturgeon and caviar.
- Attracting highly qualified specialists in this industry to work.
- Getting good financial results.
- Increase in enterprise value.

¹⁷https://proconsulting.ua/uploads/files/business_plan_pdf/%D0%9E%D1%81%D0%B5%D1%82%D1%80%D0%BE%D0%B2%D1%8B%D0%B5%202018%20%281%29.pdf



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Thus, the implementation of the project will: Exit and gain a position in the market for sturgeon fish and black caviar in Ukraine. Create and strengthen the image of the enterprise as a manufacturer of high-quality fish products. Profit from the sale of high-quality, environmentally friendly products.

5.1. Good examples in aquaculture business in Ukraine

5.1.1. The project “Clarium Catfish”¹⁸

Clary catfish meat is characterized by delicious white meat, tender and lack of scales and small bones. A large number of culinary products are prepared from meat of clarius catfish, including smoked, baked, dried catfish, etc. Clari catfish is characterized by its unpretentiousness to growing conditions, water quality, and food and is characterized by rapid growth. Clarium catfish is one of the promising aquaculture facilities with high profitability. Clarium catfish are planned to be grown in closed water supply (CWS) plants. Clarium catfish is a thermophilic aquaculture; the temperature for growing is 20 - 36°C (the optimum temperature is 28°C). Clarium catfish perishes at a water temperature below 12°C. When applying the correct diet for half an hour, it reaches a marketable weight of 900 - 1000 g. Feed consumption is 1.2 kg of feed per 1 kg of finished product. The estimated wholesale price of Clari som is 35 - 40 hryvnia per kilogram. In the Baltics, clari som is sold in stores at 8 - 9 euros per kilogram (about 90 UAH / kg). The main advantage of this project is the lack of seasonality in the supply of fresh fish and its environmental safety of the product (due to the use of special feeds and ensuring optimal parameters of the water regime in the pools where fish is grown). Basic figures:

- cost of the ready-to-operate module with installation - 12 000 euros;
- electricity consumption - 0.75 kW;
- amount of bioloading t - 3 m³ ;
- amount of feed per year t - 10 000 kg;
- water flow rate - 15 m³ / h;
- the cost of growing 1 kg of catfish - 1.5-1.8 euros;
- maintenance staff - 1 person.

For the production of table fish (1000-1200 grams) it is proposed to use 5 grams of fry. Growing time is 120-140 days depending on water temperature. To install this system requires a warm space of 32-36 square meters. This project is ideal for small family-run restaurants and cafes where you can sell farmed fish with good margins, which can significantly increase your profitability. Catfish also need warm water for active growth.

5.1.2. Project Shrimp¹⁹

Deciduous crustaceans, shrimps, lobsters, crabs and lobsters are grown on an experimental, semi-industrial and industrial scale in many countries of the world. In industrial scale, extensive and intensive methods of cultivation can be used in mono - and polyculture.

¹⁸ <http://vismar-aqua.com/proekt-klarienvyj-som-10.html>

¹⁹ <http://vismar-aqua.com/proekt-krevetka-5.html>



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Shrimps are widely distributed in the oceans from the polar and Antarctic regions to temperate and tropical waters. They are found in marine, brackish and freshwater reservoirs, and some species even in cave reservoirs. Most shrimp live in marine areas, but their young are often found in estuaries, where seawater is heavily desalinated. At the same time, some species of freshwater shrimp migrate to seawater for reproduction. Shrimps belong to the deciduous decapod crustaceans, but in some individuals (*Pandalus kessleri*, *P. borealis*, etc.), there is a tendent hermaphroditism with a change in sex in young individuals. In the second year of life they become males, and in the third year - females. With the extensive method of shrimp cultivation, the control over the growing medium and incoming planting material from natural reservoirs, planting density, competitors and predators is minimal. The cultivation process is reduced to the launching of shrimp into the cultivation ponds (rice checks, small ponds, fenced natural areas of the sea, etc.) and their capture after a certain time. In such farms shrimp are grown on a natural forage base, so the magnitude of production is low compared to the productivity of shrimp farms operating on intensive technology. In Japan, a mixed type of shrimp farms is also practiced, where shrimp *Penaeus japonicus* is produced under artificial conditions, and its further cultivation is carried out in protected, warming shallow bays and bays, as well as in specially prepared littoral zones using a natural forage base. Intensive technologies of shrimp cultivation allow to receive up to 20 t / ha of marketable production. In semi-intensive farms, the produce usually does not exceed 2-3 t / ha. Basic figures:

- capital costs for construction and project - 80,000 euros (polyethylene greenhouse 500 square meters, collapsible heated pools, heating, etc.);
- equipment - EUR 40,000;
- average electricity consumption - 5kW (220);
- production cycle - 100-120 days;
- amount of feed per year - 9 000 kg;
- oxygen generator - 2.7 kg per hour;
- water exchange rate - 3 m³ / h;
- the cost of growing 1 kg of shrimp weighing 22 to 25 grams (40 pieces per kg) - 15,00 euros;
- retail price per kg - 40 euros (Europe), USA - 40 dollars;
- maintenance staff - 1 person;
- profitability level (wholesale) - 27% per annum;
- larvae cost - \$ 40 per 1,000 pieces, minimum order - \$ 100,000.

With competent management, this project gives the opportunity to increase the amount of shrimp grown to 7-9 tons per year and to receive 3.5-3.8 crops per year. The cost of realization of this project turnkey - 120 000 euros (excluding land works), which includes construction works, materials, equipment, installation, start-up, etc. One 40-foot container is required to install accessories (compressor, oxygen generator, etc.). The area of the plot for cultivation - 600 sq.m. Plus, you need water heating.



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This project is ideally suited for small family-owned restaurants and cafes where you can sell well-grown shrimp with a good margin, which can significantly increase your profitability (up to 60%).

5.2. Enterprises participating in cross-border agricultural or agro-industrial business events

During Fish Business Ukraine 2019 achievements in the field of fisheries and industry (aquaculture, production of fishery products, equipment and technologies for storage of raw materials, etc.), recreational fisheries (fishing equipment, clothing, fishing bases, fisheries), trade (logistics), franchises, banking, importers and exporters of fishery products, retail), international cooperation, science and more were presented⁵. The exhibition was organized by the State Fisheries Agency of Ukraine and Euroindex. Participants of the exhibition were: State Agency for Water Resources of Ukraine, National University of Life and Environmental Sciences of Ukraine, SAFPI EU project "Support to implementation of agricultural and food policy in Ukraine", Niras A / S Project "Technical assistance to support the implementation of the operation Ukraine ", Jupiter APC (Warm Seas), Alaska Seafood Marketing Institute, IFC (Aquamarine, INTERKRILL, SANTA BREMOR), InternationalTradeCanada, Western Fish Company, LLC Zabolotnyi Yu.V. (KIND FISH), the Khmelnytsky Industrial Agricultural and Fish Farming Company, Irklyevsky Nursery of Carnivorous Fish, and others. In cooperation with the State Fisheries Agency of Ukraine, a rich program of activities has been formed, bringing together a series of panel discussions on fisheries policy, economics, ecology, regulation and control. These events brought together representatives of government agencies, international organizations, industry associations and businesses at the Fish Business Ukraine 2019.



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