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DACIAT

Black Sea CROSS BORDER COOPERATION

Summary

Consolidated Report on State of the Art Analyses in the field of aquaculture

Table of Contents

I. Consolidated Report on Aquaculture in all Partner Regions

STATE OF AQUACULTURE IN GREECE, ROMANIA, TURKEY & UKRAINE

1. STATE OF AQUACULTURE IN GREECE, ROMANIA, TURKEY & UKRAINE

1.1. Summary

Farming of fish, shellfish and aquatic plants is known as aquaculture or fish farming in more general concept. It is one of the world's fastest growing food sectors, already providing the planet with about half of all the fish consumed. Aquaculture production has increased almost 12 times in the last 30 years, with an average annual increase of 8.8% (FAO, 2018). At present FAO also declared that aquaculture is the fastest and constantly growing sector among all food production sectors. Global capture fisheries from the seas and inland waters have been at a relatively stable level, at 90 million tons in recent years; On the other hand, aquaculture production is constantly increasing. World aquaculture production was 172.7 million tons in 2017; 92.5 million tons (53.6%) of this production was obtained from fishing and 80.1 million tons (46.4%) from aquaculture (FAO, 2019).

According to scientific research, it is estimated that the investment in aquaculture will expand further in coming years, the amount of production obtained by aquaculture will be equal to the amount of captured production in 2030 and in the long term, aquaculture production will surpass fishing. Therefore, importance of the seas and inland waters has been increasing in the world day by day and shows that aquaculture will be the sector of the future to provide food. However, this target is closely related with essential measures taken for the protection of the environment and better use of water resources in planned manner for the sustainable reduction of the environmental impacts.

According to the latest projections, world population of 7 billion will reach 8 billion in the next 20 years; the increase in the demand for seafood is inevitable. By 2050, it is estimated that the world food production will need to be doubled in order to feed the growing world population adequately and balanced. In terms of food value, animal foods are of great importance in human nutrition. In addition to being a good source of protein, seafood contains vitamins A, D, B and K, as well as calcium, phosphorus and many rich minerals.

Under these circumstances every country should implement some actions to produce more food, increase employment and offer fish and other aquatic products for the nutrition of the society. Due to diverse water resources, different ecosystems, aquaculture production can be improved by good measures in the partner countries. Moreover, this intention is the motivation source of DACIAT project to implement common actions to improve aquaculture business and production in partner countries.

According to the latest statistics Greece has 133990 tons of aquaculture production, which constitutes 62% of the total fishery production, with a value of €588 million. Farmed fish and shellfish production have shares of 83% and 17%, respectively. Sea bream and sea bass play an important role in fish farming with 112000

tons of production that is worth €546 million. Industry creates 12000 direct and indirect jobs mainly in coastal and remote areas. There are 5648 fish farms across country.

In Romania, inland fish farming is carried out due to geographical and ecological caharacteristics of the region. Total inland aquaculture production is 1554 tons in 2018; mostly formed from Asian (61.3%) and indigeneous (32.1%) Cyprinids, 2.4% trout, 2.6% predatory species, and 1.6% sturgeons produced in 72 farms in various districts of the South-Eastern Region of Romania.

Aquaculture is very well developed in Turkey; total production of fish farms is higher than the captured fish in 2018 with a total production of 314537 tons from aquaculture (in 2100 farms) and 314094 tons from fishing. The share of the Black Sea from aquaculture is 29586 tons (9.4% of country total, from 427 farms). The share of mariculture is higher than inland fish farming. Production of rainbow trout in marine cages has an increasing trend by harvesting big trout mainly for export. Also fish farming in net cages is becoming popular in dam reservoirs. So, these farms employ 10500 workers and create more jobs at supporting services as transportation, packaging, marketing etc. About 80% of the production is exported from the Black Sea. Considering the whole country, Turkey is the top finfish producer and exporter to EU; total value of exports is over 1 million US$.

Ukraine has similar conditions as Romania regarding the potential to improve inland fish farming; especially in the western part of the country, in wetlands and lakes along the Danube River and its branches. In the classic form, commercial aquaculture in the region functions in pond farms built on projects. Despite the sufficiently developed network of pond farms, the volumes of marketable fish production in farms are extremely low; 1007 tons in 2018 (approximately 9-12% of the catch in inland reservoirs) and mainly consist of herbivorous fish species (silver carp, white cupid). There are 11 fish farms on the territory of the region with 1500 hectares of cultivation ponds and 11 hatcheries with the capacity of up to 700 million larvae. Four farms have breeding status and carry out breeding of white and mottled silver carp, Ukrainian scallop carp, white carp and paddlefish. Innovative aquaculture methods suitable according to the nature of the existing water resources are needed. Commercial capture fisheries can be carried out together with aquaculture if the appropriate farming methods could be applied for Ukraine.

1.2. Main Features of Aquaculture Industry, Entrepreneurship and SMEs Status In Each Partner Territory

Due to geographic, climatic, topographic, ecologic variations, the development of aquaculture has progressed in different directions, with different targets and speed due to the limitations (protective status, physical boundaries such as lower depths), and finally decisions of the governing bodies regarding priorities for a given site. From this point of view, Romania and Ukraine have similarities as much as Greece and Turkey do for the development of aquaculture. Therefore it would be better to analyse the aquaculture sector having in mind each country's specific perspective.

1.2.1. Greece

Aquaculture in Greece is a very important sector for the economy. Marine fish farming is dynamic and contributes significantly to the national economy. Commercial fish aquaculture has evolved into one of the most developed sectors in the last decade. Today Greece ranks first in production of cultured fish between the European Union and the Mediterranean countries, and the sector ranks second in export of "food-soft drinks".

Twenty years ago, sea bass and sea bream production practically did not exist, but in 1981 as a result of good climatic conditions, and the extensive and protected coastline, private, national and European investments in

the sector, coupled with advances in reproduction technology and feed formulation, contributed to the growth of the industry and production reached 115000 tons by 2008, equivalent to € 376 million. About 70% of this production and 90% of its value comes from sea fish. Shellfish production accounts for 25%.

In Greece the dominant species, from 1956 onwards, was rainbow trout (about 3000 tons per year), while for the past 15 years there have been attempts to breed eel, sturgeon, mugilidae and ornamental fish. Gilthead seabream, *Sparus aurata*, European seabass, *Dicentrarchus labrax* are the basic species in Greece. In addition, 910 tons of fish, equivalent to € 5 million, were produced in lagoons. Producers make a significant effort to differentiate other species as well with the production of *Diplodus puntazzo, Dentex dentex, Pagrus pagrus, Diplodus sargus, Pagellus erythrinus,* and *Solea solea*, with the total production of these species in 2008 reaching 1800 tons. For these species the production of fry at fish hatcheries was developed.

About 80% of Greek aquaculture production is exported, mainly to Italy and Spain. Fish, mainly sea bass and sea bream, are the second exported agricultural product after olive oil, and are considered by the Greek Government as a strategic product. Production is mainly carried out using sea cages and production costs are among the lowest in Europe due to favorable farming conditions (temperature, drought, long coastline, etc.). Production sites exist throughout the Greek coastline, with higher concentration in the central areas near good infrastructure and road network.

The main fish species currently grown in Greece are the following, in descending order of production:

1. Gilthead seabream (*Sparus aurata*),
2. European seabass (*Dicentrarchus labrax*),
3. Rainbow trout (*Onchorynchus mykiss*),
4. European eel (*Anguilla anguilla*),
5. Sharpsnout seabream (*Diplodus puntazzo*),
6. Red sea bream (*Pagrus major*),
7. White seabream (*Diplodus sargus*),
8. Atlantic bluefin tuna (*Thynnus thynnus*),
9. Common sole (*Solea solea***)**,
10. Flathead grey mullet (*Mugil cephalus*),
11. Common dentex (*Dentex dentex*)

The first two species account for 95% of total production in Greece, with the rest being produced in very small quantities. Aquaculture is an important sector in Greece, accounting for more than 50% of total fishery production (Μπασιούλη Ιωάννα, 2014).

The following fish and mussel - shellfish businesses are operating in the Region of Eastern Macedonia and Thrace (Table 1.1).

In the framework of this study a questionnaire was compiled and distributed to aquaculture companies operating in REMTH. The questionnaire surveyed the key issues of aquaculture in the REMTH area, such as the Keramoti of Kavala and the Fanari of Rodopi. Businesses operating in these areas grow and sell mussels. The owners said they produce 80-100 tons per year, the cost per kilo is 0.30 € and businesses have both family members and external partners. These establishments do not send on veterinary or health care and do not use hormones, vaccines and antibiotics and shellfish feed is taken from the environment naturally.

Table 1.1 Aquaculture businesses in the Region of Eastern Macedonia and Thrace:

Fish Businesses				
Owner/Organisation	**Location**	**Area (acre*)**	**Species**	**Capacity tons)**
"G.MPERMPERIDIS & STURGEON GREECE SA"	Kefalari, Doxato Drama	10,7 (10.768)	Sturgeon	80
"G.MPERMPERIDIS & STURGEON GREECE SA"	Lake Thisavrou Drama	20	Carp	87
SOUFLERIS KONSTANTINOS	Vathirema Drama	5	Rainbow trout	50
SYMVOLI SA	Vathirema Drama	4,68		40
THALASSELIS NIKOLAOS	Paradise Nestou Kavala	8		121
MICHAILIDOU MARIA	Nea Karvali Kavala	39	Sea bream, sea bass, euryhaline species	120
SIDIROPOULOS KYRIAKOS	Nea Karvali Kavala	22		120
KIRANTZI OSMAN – ISMET TSAOUS	Oraio Mykis Xanthi	10	Rainbow trout	10
Enterprises of shellfish - shellfish farming				
ZAMPAKI PANAGIOTA	Keramoti, Kavala	**20**	Mussel farming	**147**
AFENTOULIS A&X O.E		44		316,575
MPELEZI DIMITRA		20		126
ZAMPAKI PANAGIOTA		10		92,4
TSALKIDOU ELENI		10		86,4
AFENTOULIS ATHANASIOS	Agiasma, Kavala	20		148
AFENTOULIS CHARALAMBOS		20		148
KALOGEROPOULOS MICHALIS		20		140
TSALKIDIS AGGELOS		30		193,2
A.TSALKIDIS – K. PARCHARIDOU O.E.		30		168
TSOUTSOULI MARIA		20		126
PAPANIKOLAOU VASILIKI		48,12		441
ALEXANDRIDIS IORDANIS	Iraklitsa Kavala	50	Mussels-Oysters-Scallops-Cydonia-Achivada	328
PAPTSIKI FRENTZEL MARKOU	Bistonic Bay Rodopi	15,5	Musses farming	86,4
OSTRAKA RODOPIS E.E		22,22		150
OSTRAKA RODOPIS E.E		20,26		158
OSTRAKOKALLIERGIES VISTONIKOU O.E.		23,05	Oysters-Kydonia-Achivada	120
ALEXANDRIDIS GEORGIOS		20	Mussel farming	158
ALEXANDRIDIS IOANNIS		23	Oyster, Kydonia-Achivada	145

* 1 acre = 0.4 ha.

1.2.2. Romania

In Romania, as well as in the South-East Region, aquaculture is carried out on the basis of Emergency Ordinance no. 23/2008 with further modifications and completions and consists of breeding and cultivation of aquatic animals using techniques aimed at increasing the production of organisms beyond the natural

capacity of the environment, in a framework in which the respective organisms remain the property of a natural or legal person for the entire period of breeding/cultivation and harvesting.

According to the normative act, aquaculture can be practiced in fish farms, in artificial aquatic ecosystems represented by: ponds, artificial breeding stations, floating cages, reservoirs for aquaculture and other aquaculture facilities. Aquaculture can also be practiced in natural aquatic ecosystems nominated by order of the Minister of Agriculture and Rural Development, at the proposal of the National Agency for Fisheries and Aquaculture, such as: Territorial Danube, Danube Delta and Floodplain; Razelm-Sinoe lagoon complex and coastal lakes; mountain/hill/plain streams, rivers and lakes of mountains, hills, plains and their flood zones, as well as dead arms of rivers; natural ponds and lakes without hydro technical installations for water supply, retention and drainage; accumulation lakes, with their flood-prone areas; the network of master channels in hydro-ameliorative, navigation and hydro-energy systems and their branches; inland sea waters, territorial sea, the contiguous area, the exclusive economic zone of Romania.

For the smooth running of the activities, the fish farms/establishments have assets, such as: dams, monks, pumping stations, water supply installations, water drainage systems, water supply channels, water drainage channels, hatching and breeding halls, administrative centers, primary processing units, stores for sale within the aquaculture farm, feed warehouses, material and fishing gear storage warehouses, as well as other constructions related to an aquaculture farm that are necessary in order to ensure its functionality.

Most of the fish farms/establishments belonging to the public domain are granted to the private administrators who register the unit in the Register of Aquaculture Units (RUA) and receive an aquaculture license, issued by the National Agency for Fisheries and Aquaculture. At the same time, for the functioning of the farms/establishments, the private administrators are required to obtain an environmental authorization, issued by the National Agency for Environmental Protection and a management authorization from "Romanian Waters". At the end of 2019, in the South-East Region of Romania there were 87 units with an aquaculture license, active in the field of aquaculture, distributed by county as follows (Table 1.2., Figure 1.1.):

Table 1.2. Distribution of aquaculture licenses by counties in Romania, 2019

County	# License	%
Tulcea	36	41
Constanța	20	23
Brăila	15	17
Galați	9	10
Vrancea	4	5
Buzău	3	4

Most of the aquaculture units in the South-East region are located in the rural area, with the exception of 7 (seven) units, which are located in the urban area, in small towns from Brăila, Vrancea, Constanța and Tulcea counties.

Out of the 87 aquaculture units, 71 carry out their activity in fish farms/establishments with public ownership, 11 in fish farms/establishments with private owner and 5 in fish farms/establishments with mixed public-private ownership (the public owner having the land of the facility, and the private owner the assets).

The main public owners of the fish farms/establishments in the South-East region, distributed by county, are given in Table 1.3.

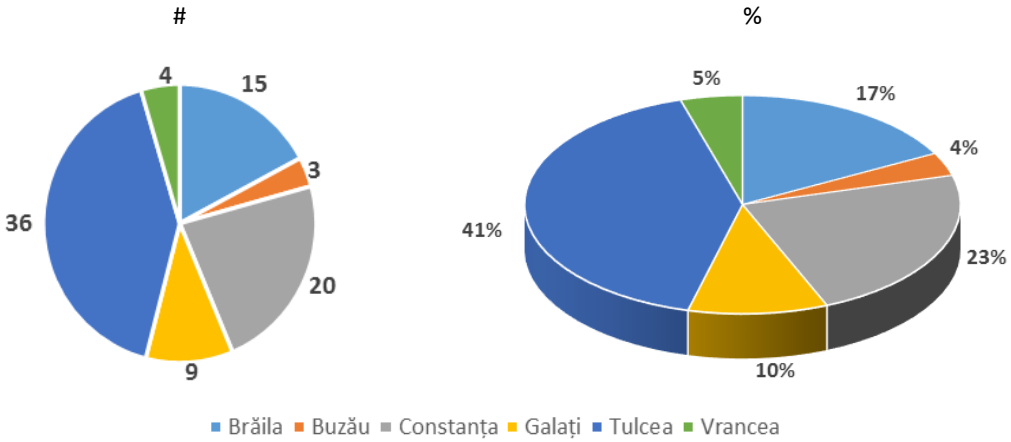


Figure 1.1. Licensed aquaculture units in Southeast Region by 2019

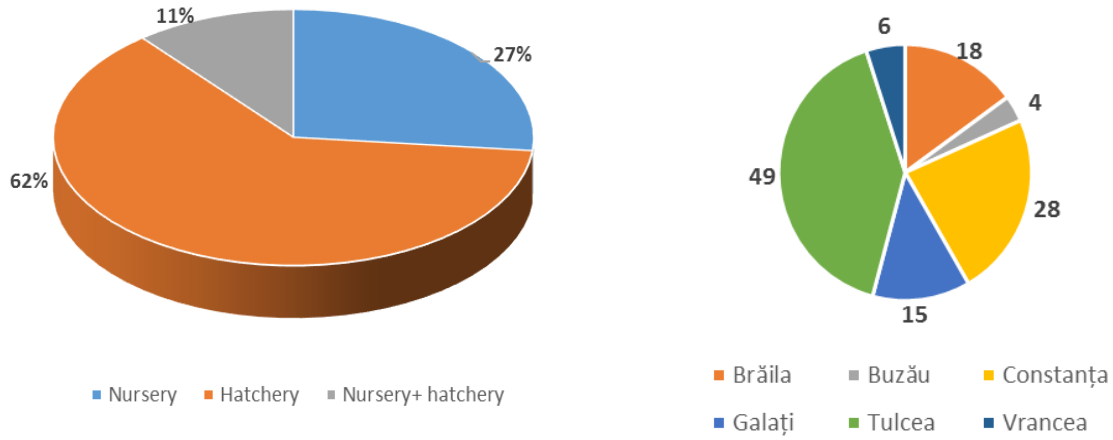
Table 1.3. Distribution of fish farms/establishments in the South-East Region of Romania by counties

County	National Agency for Fisheries and Aquaculture	County Councils / Local Councils	Forestry Directions	The National Administration "Romanian Waters" / Autonomous Public Services
Brăila	5	6	0	0
Buzău	1	1	1	0
Constanța	12	3	0	0
Galați	5	2	0	1
Tulcea	2	27	0	2
Vrancea	1	1	1	0
TOTAL	**26**	**40**	**2**	**3**

The structure of the administrators of the fish farms/establishments is different from the structure of the owners, considering the fact that there are 83 private administrators (eg commercial companies, individual companies, associations, etc.) and only 4 public administrators (research institutes, forestry directions, etc.).

At the end of 2019, the 87 aquaculture units owned 120 licenses, out of which 62% licenses for hatchery, 27% licenses for nursery and 11% licenses for both hatchery and nursery, distributed by county as follows (Figure 1.2):

- Tulcea - 49 licenses, out of which 30 licenses for hatchery, 14 licenses for nursery and 5 licenses for both hatchery and nursery;
- Constanța - 28 licenses, out of which 17 licenses for hatchery, 6 licenses for nursery and 5 licenses for both hatchery and nursery;
- Brăila - 18 licenses, out of which 13 licenses for hatchery, 3 licenses for nursery and 2 licenses for both hatchery and nursery;
- Galați - 15 licenses, out of which 10 licenses for hatchery and 5 licenses for nursery;
- Vrancea - 6 licenses, out of which 4 licenses for hatchery and 2 licenses for nursery;
- Buzău - 4 licenses, out of which 1 license for hatchery, 2 licenses for nursery and 1 license for both hatchery and nursery.



A B

Figure 1.2. Share of aquaculture licenses by type (A) and number by counties (B) in 2019

The areas on which aquaculture is practiced based on these licenses, represented by 34.503,92 ha (3.109,04 ha nurseries, 23.415,16 ha hatcheries and 7,979.72 ha nurseries + hatcheries), are distributed by county in Table 1.4:

Table 1.4. Total area of farms according to production types by counties

County	Nursery areas (ha)	Hatchery areas (ha)	Nursery + hatchery areas (ha)	Total areas (ha)
Brăila	406.73	1 750.22	7.10	2 164.05
Buzău	75.54	803.25	72.72	951.51
Constanța	711.12	5 572.82	2 963.36	9 247.30
Galați	151.97	1 430.46	0.00	1 582.43
Tulcea	1 752.25	13 691.04	4 936.54	20 379.83
Vrancea	11.43	167.37	0.00	178.80
TOTAL	**3 109.04**	**23 415.16**	**7 979.72**	**34 503.92**

Aquaculture in the South-East Region of Romania is carried out in freshwater and is characterized from a technological point of view by the following directions: extensive and semi-intensive growth of cyprinids in polyculture and intensive growth of salmonids.

Breeding cyprinids in polyculture is carried out at most farms/establishments in earthen ponds, in extensive or semi-intensive regime. There are also farms that breed cyprinids in floating ponds, concrete ponds or thermostated basins with recirculated water systems (SAR).

The areas of many fish farms/establishments have the status of NATURA 2000 sites, benefiting for this reason from various financial facilities for the loss of production due to ichthyophagous birds or for the protection of the fauna of the area.

Many of the extensive fish farms/establishments are multifunctional farms where other social and environmental services are provided: ecological tourism, recreational fishing, educational activities related to the knowledge and protection of aquatic biodiversity, improving water management.

Salmonid farming is practiced mainly in trout farms located near the natural course of a mountain river, through intensive farming, for brood, consumption and even sport fishing. There are also farms that practice intensive farming of trout along with sturgeons in a recirculating system.

1.2.2.1. Fish species in aquaculture

The following fish species are prevalent within the fish farms/establishments:

Cyprinidae

Indigenous Cyprinides – common carp (*Cyprinus carpio*), Prussian carp (*Carassius gibelio*), tench (*Tinca tinca*), common bream (*Abramis brama*), white bream (*Blicca bjoerkna*), common barbel (*Barbus barbus*), asp (Asp*ius aspius*), common roach (*Rutilus rutilus*), common rudd (*Scardinius erythrophthalmus*)

Asian Cyprinids – silver carp (*Hypophthalmichthys molitrix*), bighead carp (*Hypophthalmichthys nobilis*), grass carp (*Ctenopharyngodon idella*)
Siluridae – Wels catfish (*Silurus glanis*)
Percidae – zander/pike perch (*Sander lucioperca*), European perch (*Perca fluviatilis*)
Esocidae – northern pike (*Esox lucius*)
Acipenseridae - sterlet (*Acipenser ruthenus*), beluga/great sturgeon (*Huso huso*), Danube sturgeon/Russian sturgeon (*Acipenser gueldenstaedti*), starry/stellate sturgeon (*Acipenser stellatus*), bester, best beluga, American paddlefish (*Polyodon spathula*)
Salmonidae – trout (*Salmo sp*.), rainbow trout (*Oncorhynchus mykiss*), brook trout (*Salvelinus fontinalis*).

In addition to these fish species, crustaceans – crayfish (*Astacus sp*.) and batrachians – frogs (*Rana sp*.) are collected in some farms.

In terms of production, the biggest share belongs to Tulcea and followed by Constanta and Brăila (Figure 1.3). In 2018, out of the total production sold in the South-East Region of Romania (1 554 tons), the highest value was registered in Tulcea (624 tons, 40.15% of the total), Constanța (385 tons, 24.77% of the total) and Brăila (326 tons, 20.98% of the total) (Figure 1.3).

Cyprinids (Asian and native), are the dominant species in the production with the share of 93% while the predatory species, trout and sturgeons have very low percentages (Figure 1.4).

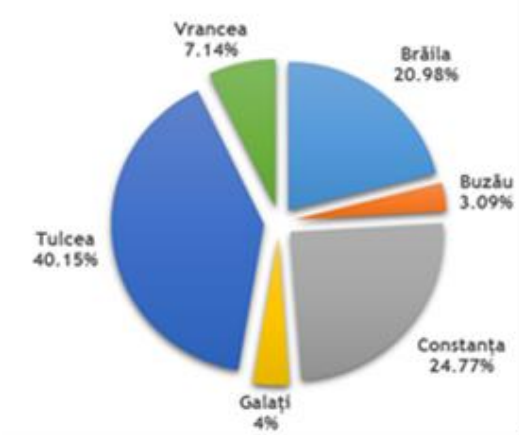


Figure 1.3. Production sold by counties in 2018

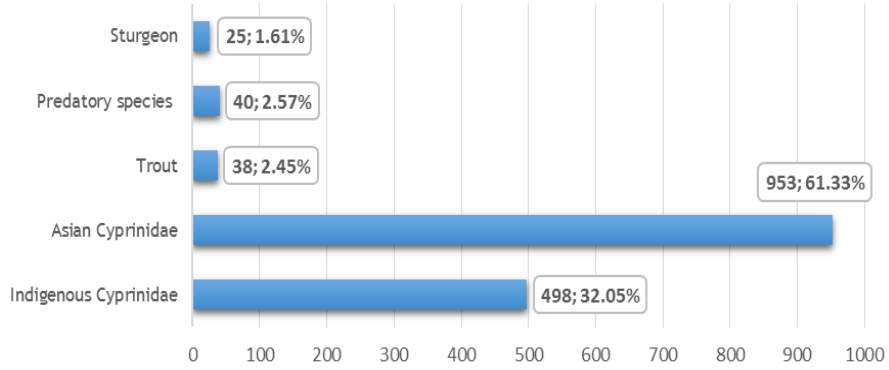


Figure 1.4. Production sold by species (ton/ percentages) in 2018

During 2016-2018, the production sold in the South-East Region of Romania showed an overall decrease each year, reaching from 2064 tons in 2016, to 1 932.70 tons in 2017 and 1554 tons in 2018. The evolution of the production sold by species during 2016-2018 is given in Figure 1.5.

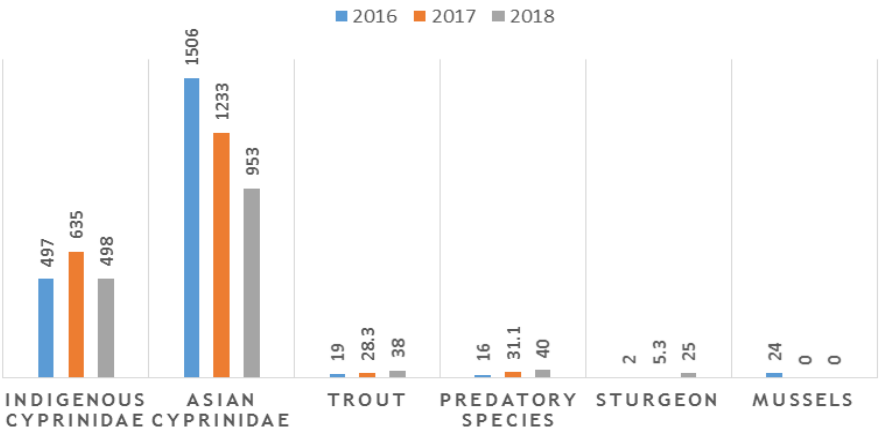


Figure 1.5. Evolution of the production sold by species during 2016-2018 (tons)

According to the data reported to ANPA, the egg and fry production in every county from the South-East Region of Romania during 2017-2018 is given in Table 1.5:

Table 1.5. Egg and fry production by counties

County	2017		2018	
	Egg production (million)	Fry production (number)	Egg production (million)	Fry production (number)
Brăila	625 000		14 650 000	409 000
Buzău			0	0
Constanța		46 345 000	0	6 980 000
Galați		525 000	300 000	0
Tulcea		132 829	0	0
Vrancea	350 000		2 000	0
TOTAL	**975 000**	**47 002 829**	**14 952 000**	**7 389 000**

The evolution of the number of active aquaculture units during 2016-2019 in the South-East Region of Romania is presented in Table 1.6 and Figure 1.6, showing a slow but increasing trend.

Table 1.6. Number of fish farms in the South-East Region of Romania

County	Number of aquaculture units 2016	Number of aquaculture units 2017	Number of aquaculture units 2018	Number of aquaculture units 2019
Brăila	11	11	14	15
Buzău	5	5	3	3
Constanța	21	21	20	20
Galați	7	6	8	9
Tulcea	25	33	23	36
Vrancea	4	4	4	4
TOTAL	**73**	**80**	**72**	**87**

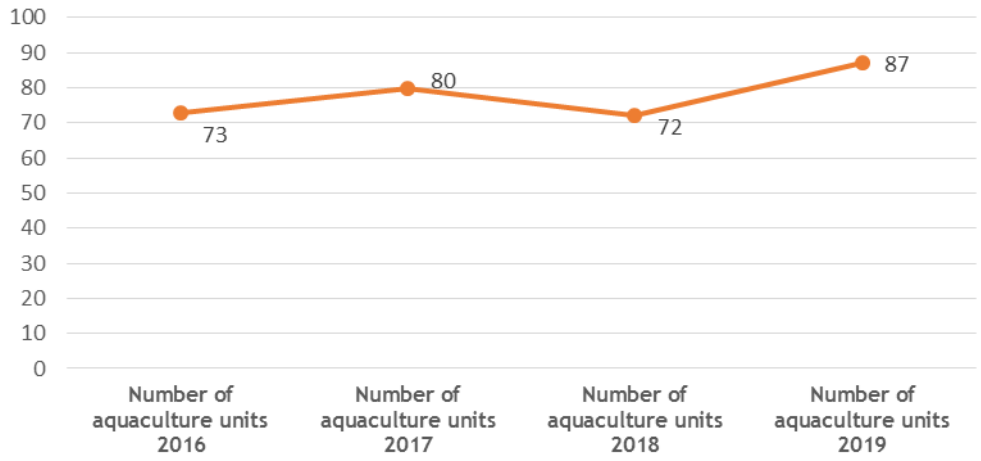


Figure 1.6. Evolution of the number of aquaculture units during 2016-2019

1.2.2.2. Employment

The average number of employees per aquaculture unit in the South-East Region of Romania was 7 in 2016, considering that within the 80 active aquaculture units there were 565 employees and 6 in 2018, the 72 active aquaculture units registering a total number of 422 employees (Table 1.7).

Table 1.7 Number of employees in fish farms

County	2017			2018		
	Number of aquaculture units	Total Number of employees	Average number of employees per aquaculture unit	Number of aquaculture units	Total Number of employees	Average number of employees per aquaculture unit
Brăila	11	83	8	14	92	7
Buzău	5	8	2	3	11	4
Constanța	21	139	7	20	45	2
Galați	6	37	6	8	45	6

Tulcea	33	270	8	23	202	9
Vrancea	4	28	7	4	27	7
TOTAL	**80**	**565**	**7**	**72**	**422**	**6**

The main income of the aquaculture farms comes from fish sales (wholesale and retail), generally registering values in the range of 40-70% of the total income and in some cases even over 70%. The rest of the revenues, registering lower percentages, come from egg and fry sales, brood fish sales or production incentive revenues. Some of the aquaculture farms in the region also carry out other activities, which add value, such as processing, farm restaurant, recreational fishing or agriculture.

Regarding the unit fish production costs, excluding fixed investment expenses, the highest percentage is registered by the feeding costs, the feed supply used being generally either prepared in the farm, or combined (both industrial and prepared in the farm), labour costs and taxes. Rent costs (for land, building, water and water area, etc.) also have a significant share of the total costs, reaching values over 5%. Other expenses, such as egg and fry purchase, service procurement costs (diagnosis, consulting, analysis fees, etc.) or research and development expenses generally account for less than 5% of the total unit costs of fish production.

1.2.2.3. Investments, Research and Supporting Institutions

In order to develop the activity of the aquaculture units, to modernize the fishing facilities or to support the aquaculture sector, the commercial companies and research institutes took advantage of the financing opportunities existing in the field of aquaculture. According to the website of The General Direction for Fisheries – Managing Authority for the Operational Programme for Fisheries and Maritime Affairs (DGP-AMPOPAM)[1], the following commercial companies/research institutes have accessed non-reimbursable funds under the Operational Programme for Fisheries and Maritime Affairs 2014-2020 for the development/support of the aquaculture sector (Table 1.8):

Table 1.8. Commercial companies/research institutes that have accessed non-reimbursable funds in the aquaculture sector in Romania

Measure	Beneficiary	Project value (RON)	Project title	Locality	County
Productive Investments in Aquaculture	SC AGRI DELTA SERV SRL	19 797 144.91	Establishment of Dunavăț II Fish Farm	Murighiol	Tulcea
	SC ANGHILA IMPEX SRL	11 262 697.70	Modernization of ESNA Fish Farm through the purchase of specialized machinery and equipment	Movila Miresei	Brăila
	SC MARFISHING SRL	8 951 539.09	Increasing MARFISHING SRL's Competitiveness by Making Investments in Developing Complementary Activities	Mărășești	Vrancea
	SC ATLANTA ENTERTAINMENT SRL	3 282 626.33	Establishment of the Aquaculture Unit and Developing Complementary Activities within SC ATLANTA ENTERTAINMENT SRL	Gura Teghii	Buzău
	SC FLORENA HOUSE SRL	197 373.40	Modernization of FLORENA Fish Farm	Pecineaga	Tulcea
	SC ECO DANUBE SRL	4 925 027.43	Modernization of Iazurile 1,2 Fish Farms	Murighiol and Iazurile	Tulcea
	SC MASIVA SRL	954 158.12	Productive Investments within Chilia I - Chilia II Fish Farm	C.A.Rosetti	Tulcea

[1] https://www.ampeste.ro

	SC PISCICOLA TOUR AP LUNCA SRL	15 053 353.13	Increasing the Production Capacity of SC PISCICOL TOUR AP LUNCA SRL	Jurilovca	Tulcea
	SC DANUBE RESEARCH - CONSULTING SRL	1 685 230.01	Modernization of Horia Fish Farm	Horia	Tulcea
	SC FISH TOUR DELTA SRL	18 277 082.39	Modernization of Fish Farm within SC Fish Tour Delta SRL	Crișan	Tulcea
	SC GELMIN SRL	1 633 041.50	Investments in Periprava Fish Farm	C.A. Rosetti Commune - Popina – Periprava colony	Tulcea
	SC ROMNAȚIONAL SRL	20 694 951.49	Productive Investment in Aquaculture within Făclia Fish Farm	Peștera	Constanța
	SC RABOLUS SRL	7 361 747.81	Productive Investments in Aquaculture within Iortmac - Saharlale – Ceamurlia Fish Farm	Lipnita	Constanța
	SC ELDORADO SRL	20 725 126.66	Productive Investments in Aquaculture within Chilia I Fish Farm	Chilia Veche	Tulcea
	SC FISH TOUR DELTA SRL	20 712 962.60	Cleaning the Canals of Obreția II Fish Farm	Tulcea	Tulcea
	SC OBRETIN SRL	20 722 139.91	Modernization of AP OBRETIN Fish Farm and Increasing Accommodation Capacity	Crișan	Tulcea
Measure	**Beneficiary**	**Total project value (RON)**	**Project title**	**Locality where the project is implemented**	**County where the project is implemented**
Management, Relief and Advisory Services for Aquaculture Farms	RESEARCH - DEVELOPMENT INSTITUTE FOR AQUATIC ECOLOGY, FISHERIES AND AQUACULTURE GALAȚI (ICDEAPA)	632 448.22	Center for Management, Relief and Advisory Services within ICDEAPA Galați for Aquaculture Farms in order to Improve their Performance and Competitiveness	Galați	Galați
Measure	**Beneficiary**	**Total project value (RON)**	**Project title**	**Locality where the project is implemented**	**County where the project is implemented**
Measures on Animal Health and Welfare	RESEARCH - DEVELOPMENT INSTITUTE FOR AQUATIC ECOLOGY, FISHERIES AND AQUACULTURE GALAȚI	528 370.56	Guide to Good Practices on Post-Embryo Reproduction and Development of Freshwater Fish Species from Romania - Basic Model for the Development of the National Fisheries Sector	Galați	Galați
Measure	**Beneficiary**	**Total project value (RON)**	**Project title**	**Locality where the project is implemented**	**County where the project is implemented**
Aquaculture Providing Environmental Services	SC EURO FISH SRL	4 702 441.77	Aquaculture Providing Environmental Services in Babadag Fish Farm	Babadag	Tulcea
	SC AQUAROM ELITE DISTRIBUTIONS S.R.L.	10 263 407.34	Aquaculture Providing Environmental Services in Oltina Fish Farm	Oltina	Constanța

	SC COMPLEX GRUP S.R.L.	8 159 433.71	Sustainable Aquaculture at Natura 2000 Site – Bugeac I Fish Farm	Ostov	Constanța
	SC DELTA SAMITUR SRL	512 752.00	Sustainable Aquaculture in Ghiolul Pietrei Fish Farm - Natura 2000 Sites ROSCI0065 and ROSPA0031	Murighiol	Tulcea
	SC DANUBIU ELITE SRL	1 987 533.86	Aquaculture Providing Environmental Services in Dunăreni Fish Farm	Aliman	Constanța
	SC ESOX PROD S.R.L.	1 046 793.55	Aquaculture through Biodiversity Conservation in NATURA 2000 Sites: ROSCI0005 and ROSPA0004 – Amara Fish Farm	Balta Albă	Buzău
	SC PISCICOLA TOUR AP LUNCA SRL	4 699 492.35	Compensation of Income Losses Caused by the Compliance with the Restrictions and Management Requirements Related to Natura 2000 Site in Lunca Fish Farm	Jurilovca	Tulcea
	SC Obretin SRL	1 288 766.18	Conservation of Natural Heritage in Obretin Fish Farm, Part of the Natura 2000 Community Network Rospa0031 Danube Delta and Razelm Sinoe Complex	Crișan	Tulcea
	SC SINGAMA SRL	767 029.03	Stimulating Sustainable and Efficient Knowledge-based Aquaculture in Sovarca Fish Farm	Oancea	Galați
	SC GELMIN SRL	1 608 591.79	Conservation of Natural Heritage in Popina-Periprava Fish Farm - Part of the Natura 2000 Network - ROSPA 0031 Danube Delta and Razelm Sinoe Complex	CA Rosetti	Tulcea
	SC MON-AL SRL	2 394 856.88	Conservation of Natural Heritage in Tauc Fish Farm, Part of the Natura 2000 Community Network ROSPA 0031 Danube Delta and Razelm Sinoe Complex	Sarichioi	Tulcea
	SC ELDORADO SRL	6 775 132.29	Compensation for Biodiversity Conservation in Chilia I Fish Farm	Chilia veche	Tulcea
	SC DELTA FISH SRL	1 580 108.16	Aquaculture Providing Environmental Services in Babadag Fish Nursery	Crișan	Tulcea
	SC MASIVA SRL	534 172.49	Conservation of Natural Heritage in Chilia I-Chilia II Fish Farm - Part of the Natura 2000 Network - ROSPA 0031 Danube Delta and Razelm Sinoe Complex	Chilia veche	Tulcea
	SC GIP EST SRL	2 643 576.25	Aquaculture Providing Environmental Services in Chilia I-Fish Farm 4	Chilia Veche	Tulcea
	SC ECODELTA SA	1 227 948.21	Aquaculture Providing Environmental Services in Toprichioi Fish Farm	Babadag	Tulcea
	SC STUPINA SRL	705 058.32	Conservation of Natural Heritage in Lunca 3 Fish Farm, Part of Natura Network	Jurilovca	Tulcea
	SC FISH TOUR DELTA SRL	165 904.63	Conservation of Natural Heritage in Obretin II Fish Farm - part of Natura 2000 Network-Rospa 0031 Danube Delta and Razelm Sinoe Complex	Tulcea	Tulcea
	SC RABOLUS S.R.L.	3 699 456.19	Aquaculture Providing Environmental Services in Iortmac - Saharlale – Ceamurlia Fish Farm	Lipnita	Constanța
	SC VICKI POND S.R.L.	2 979 836.34	Compensation of Income Losses Caused by the Compliance with the Restrictions and Management Requirements Related to Natura 2000 Sites in 6 Martie 2 Fish Farm	Sălcioara	Tulcea

	SC HER & STRA CYPRINUS SRL	2 986 405.88	Compensation of the Income Losses Caused by the Natural Area Protected by Community Interest Regime of 6 Martie 1 Fish Farm	Jurilovca	Tulcea
Measure	**Beneficiary**	**Total project value (RON)**	**Project title**	**Locality where the project is implemented**	**County where the project is implemented**
Processing of Fishery and Aquaculture Products	SC ANGHILA IMPEX SRL	8 629 720.56	Fish and Fishery Products Processing Factory	Movila Miresii, Esna Village	Brăila
	SC BLACK SEA STURGEON SRL	2 184 112.61	Processing of Fishery Products at SC BLACK SEA STURGEON SRL	Sfântu Gheorghe	Tulcea
	SC ECO DANUBE SRL	1 921 629.69	Establishment of Fish and Fishery Products Processing Unit	Murighiol	Tulcea
	SC MIADMAR HDP SRL	4 607 805.06	Modernization of the Fish Processing Unit	Tulcea	Tulcea
	S.C. SAT VACANTA GURA PORTITEI S.R.L.	5 346 362.38	Establishment of Fish Processing Factory	Jurilovca	Tulcea

1.2.3. Turkey

1.2.3.1. Aquaculture investments in Turkey and the Black Sea

Turkey is a rich country by means of surrounding seas and inland waters sources hosting diverse fish species. Turkey has long coastlines (8333 km) and wide sea surface area (24 million ha), as well as 200 natural lakes, 822 dams and 507 small irrigation lakes (more than 1.4 million ha), 33 big rivers (177714 km in total length) (DSİ, 2019).

Total number of fish farms in Turkey is 2100 with the total capacity 486786 tons per year. Number of farms producing marine fish species are 426 with the capacity of 254430 tons while there are 1860 farms in inland waters with the total annual capacity of 232356 tons (BSGM, 2018). According to the 2018 data, total aquaculture production is 314537 tons where 209370 tons from marine and 105167 tons from inland aquaculture.

Total of 25175 tons were produced in the Black Sea provinces (8 %), of which 13257 tons in marine and 11918 tons in inland farms.

There are 20 marine fish hatcheries with an annual capacity of 815 million juveniles and 55 inland water hatcheries with a capacity of 541 million juveniles in Turkey. According to the records of the General Directorate of Fisheries and Aquaculture (GDFA), 5 of the 20 marine fish hatcheries run by private sector and produce only sea bream and/or sea bass. Other marine hatcheries produce fish species such as meagre (*Argyrosomus regius*), common dentex (*Dentex dentex*), turbot (*Psetta maxima*), red porgy (*Pagrus pagrus*), sharpsnout seabream (*Diplodus puntazzo*), brown meagre (*Sciaena umbra*), shi drum (*Umbrina cirrosa*), pink dentex (*Dentex gibbosus*), Red banded sea bream (*Pagrus auriga*), sand steenbras (*Lithognathus mormyrus*), axillary sea bream (*Pagellus acarne*), horse mackerel (*Trachurus trachurus*), grey mullet (*Mugil cephalus*) (BSGM, 2018).

Aquaculture in Turkey has rapidly developed over the years both in marine and inland area and reached to 209370 tons in sea and 105167 tons in inland waters, giving the total of 314537 tons as aquaculture production (Table 1.9).

Table 1.9. Fisheries production (tons) and values (TL) in Turkey

Years	Aquaculture Production	Capture Fisheries

	Marine	%	Inland	%	TOTAL	Value	M +I*	Value
2000	35646	45.1	43385	54.9	79031	139 552 950	503345	367 840 650
2001	29730	44.2	37514	55.8	67244	173 890 600	527733	490 719 350
2002	26868	43.9	34297	56.1	61165	212 248 000	566582	630 759 100
2003	39726	49.7	40217	50.3	79943	415 575 800	507772	878 154 800
2004	49895	53.1	44115	46.9	94010	520 603 300	550482	1 120 965 400
2005	69673	58.9	48604	41.1	118277	704 283 000	426496	1 574 988 300
2006	72249	56.0	56694	44.0	128943	766 229 750	533048	1 706 983 300
2007	80840	57.8	59033	42.2	139873	839 762 500	632450	1 323 151 750
2008	85629	56.3	66557	43.7	152186	850 646 080	494124	1 097 178 400
2009	82481	52.0	76248	48.0	158729	952 935 500	464233	837 387 880
2010	88573	53.0	78568	47.0	167141	1 066 778 000	485939	1 078 515 200
2011	88344	46.8	100446	53.2	188790	1 270 028 140	514755	1 143 272 172
2012	100853	47.5	111557	52.5	212410	1 605 293 700	432442	1 209 028 426
2013	110375	47.3	123018	52.7	233393	1 704 471 151	374121	1 188 432 525
2014	126894	54.0	108239	46.0	235133	2 150 070 890	302212	1 099 738 850
2015	138879	57.8	101455	42.2	240334	2 569 208 590	431907	1 246 810 168
2016	151794	59.9	101601	40.1	253395	3 239 416 760	335318	1 340 901 947
2017	172492	62.4	104010	37.6	276502	4 049 199 270	354318	1 535 702 592
2018	209370	66.6	105167	33.4	314537	5 606 828 410	314094	1 852 664 426

(BSGM, 2018; TURKSTAT, 2018)(Marine+Inland)

This quantity is slightly over than the capture fisheries (314094 tons). The share of aquaculture production was 10% in the early 2000s, increased to 20%, 25%, 44% and 50% in 2005, 2010, 2017 and 2018, respectively, similar to trend of aquaculture in the world. While capture fisheries production has been fluctuated from year to year, aquaculture production has increased every year after 2002. Initially inland aquaculture in soil and concrete ponds had the largest share, then, due to advances in technology and farming methods, aquaculture in the seas became more dominant and production rapidly increased due to use of net cages which can be installed in a short time, and allow production in large capacities. The share of production in the seas reached 66.6% in 2018.

Aquaculture is one of the main social and economic drivers in the Black Sea due to lack of industry, employment and commerce possibilities. Rivers discharging to the Black Sea and spring waters encouraged local citizens to be interested in trout farming since 1960's. Due to climate and topography of the region, entrepreneurs started trout farming even in small capacities up to 5 tons per year. Rivers born from highlands host endemic brown trout (*Salmo trutta*) and sea trout (*Salmo labrax*), which are popular in the region. When aquaculture developed in other regions of Turkey, the share of the Black Sea started to decrease due to small capacities and lower production even though the number of farms is higher. Figure 1.7 and Table 1.10 show the development of fish farming from 2000 to 2018.

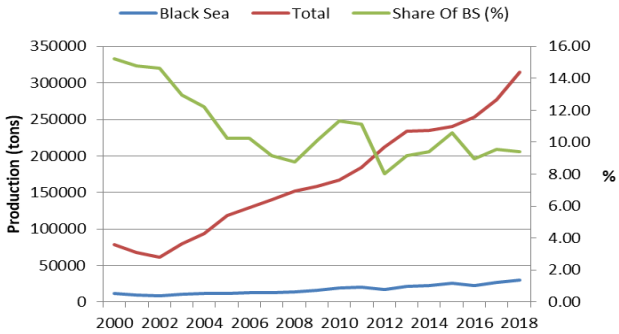


Figure 1.7 Total and Black Sea aquaculture production in Turkey

Table 1.10 Aquaculture production in the Black Sea (tons, %)

Years	Black Sea	Turkey Total	Share of BS *
2000	12030	79031	15.22
2001	9932	67244	14.77
2002	8944	61165	14.62
2003	10350	79943	12.95
2004	11465	94010	12.20
2005	12112	118277	10.24
2006	13233	128943	10.26
2007	12784	139873	9.14
2008	13370	152186	8.79
2009	16008	158729	10.09
2010	18905	167141	11.31
2011	20441	183790	11.12
2012	17063	212410	8.03
2013	21384	233394	9.16
2014	22069	235133	9.39
2015	25454	240334	10.59
2016	22754	253395	8.98
2017	26466	276502	9.57
2018	29586	314537	9.41

*As geographical region defined by TUIK

In 2000, the share of the aquculture production was 15% and gradually decreased to 9% in spite of the improvement of the aquaculture by cage culture in dams and sea. There is a higer increase in the production of farmed species all over the country.

Trabzon is one of the most important provinces by means of total aquaculture production with 5541 tons out of which 5155 tons comes from marine and 386 tons from inland farms. With such marine production, Trabzon is the top producer in the Black Sea (Table 1.11).

Table 1.11 Aquaculture production by selected provinces in the Black Sea

Province	Marine	Inland	Total
Kırklareli		152	152
Bartın		17	17

Sakarya		700	700
Düzce		92	92
Karabük		35	35
Kastamonu		105	105
Sinop	1506	11	1517
Samsun	3951	2715	6666
Ordu	2645	310	2955
Giresun		188	188
Trabzon	5155	386	5541
Rize		1098	1098
Artvin		3229	3229
Bayburt		870	870
Gümüşhane		2010	2010
TOTAL	13257	11918	25175
TURKEY	209370	105167	314537
%*	6.33	11.33	8.00

*Selected provinces from the Black Sea

Rainbow trout (*Oncorhynchus mykiss*) is the most important fish among other trout species due to fast growth rate and high resistance to handling in aquaculture processes. Total amount of production reached to 112427 tons in 2018. The amount of trout (*Salmo trutta*) production was 2070 tons in total (BSGM 2018). Sea bream and sea bass production have reached to 76680 tons and 116915 tons, respectively. Overall production of these two species has significantly increased in the last five years (Table 1.12).

While aquaculture investments and production increases, naturally, there was an increase in the number and capacities of the facilities. The number of farms has increased from 1245 in 2002 to 2326 in 2016. By 2019, the number of active farms is 2100 and 427 of it located at the Black sea coasts (Table 1.13). Majority of farms are family businesses and followed by the medium scaled ones owned by the SMEs.

The highest number of aquaculture enterprises in the Black Sea region is located in the provinces of Trabzon (72), Artvin (43), Rize (40), Tokat (37), Giresun (36) and Gümüşhane (36) (Table 1.3.14).

Rainbow Trout (*Oncorhynchus mykiss*)

Rainbow trout is the dominant species in fish farming in the Black Sea. The total number of farms raising Rainbow trout in the Black Sea region is 418. The highest capacity is 1800 tons (Table 1.15; 1.16). About half of the farms have capacities of less than 10 tons due to land and water limitation and they all are run by family enterprises. Some of them add value to their production by selling/serving in their fish restaurant.

Table 1.12 Aquaculture production by species in Turkey (Ton/year)

Fish species	2010	2011	2012	2013	2014	2015	2016	2017	2018
INLAND WATER									
Rainbow trout	78165	100239	111335	122873	107533	100411	99712	101761	103192
Trout (*S.trutta*)	-	-	-	-	450	755	1585	1944	1695
Common carp	403	207	222	146	157	206	196	233	212
Sturgeon	-	-	-	-	17	28	6	13	2
Tilapia	-	-	-	-	32	12	58	8	12
MARINE									
Rainbow trout	7079	7697	3234	5186	4812	6187	4643	4972	9235

Trout (*S.trutta*)	-	-	-	-	798	685	1073	980	375
Seabream	28157	32187	30743	35701	41873	51844	58254	61090	76680
Seabass	50796	47013	65512	67913	74653	75164	80847	99971	116915
Red porgy	-	-	-	-	106	143	225	20	2
The shi drum	-	-	-	-	39	61	20	125	30
Meagre	-	-	-	-	3281	2801	2463	697	1486
Dentex	-	-	-	-	113	132	43	51	24
Pink dentex	-	-	-	-	75	90	61	107	70
Atlantic Bluefin tuna	-	-	-	-	1136	1710	3834	3802	3571
Mussel	340	5	-	-	-	3	329	489	907
Others	2201	1442	1364	1575	58	102	46	239	129
TOTAL	**167141**	**188790**	**212410**	**233394**	**235133**	**240334**	**253395**	**276502**	**314537**

(BSGM. 2019; TURKSTAT. 2019)

Table 1.13 Fish farms and their capacities in the Black Sea in 2019

Capacity (tons)	# farms in Turkey	# farms in Black Sea	% of BS in total
<10	591	165	28
10-29	679	141	21
30-50	71	14	20
50-100	122	10	8
100-250	188	39	21
250-500	176	21	12
500-1000	185	29	16
1000-2000	63	8	13
2000-3000	24	0	0
3000-4000	1	0	0
TOTAL	**2100**	**427**	**20**

Black Sea salmon (Salmo labrax)

Total number of fish farms producing Black Sea trout is 22 and their capacities vary between 5 to 590 tons (Table 1.17).

Table 1.14. Number of fish farms and their capacities (tons) in the provinces located in the Black Sea Region

Provinces	< 10	10-29	30-50	50-100	100-250	250-500	500-1000	> 1000	Total
Amasya	3	0	0	0	0	0	0	0	3
Artvin	15	12	2	3	3	0	8	0	43
Bartın	5	0	0	0	0	0	0	0	5
Bayburt	2	7	1	0	1	1	0	0	12
Bolu	20	8	1	0	0	0	0	0	29
Düzce	18	2	2	0	0	0	0	0	22
Giresun	31	5	0	0	0	0	0	0	36
Gümüşhane	6	10	2	0	15	3	0	0	36
Karabük	0	4	0	0	0	0	0	0	4
Kastamonu	2	5	1	2	0	0	0	0	10
Zonguldak	4	1	0	0	0	0	0	0	5

Ordu	12	9	2	0	3	3	2	0	31
Rize	13	20	1	4	0	2	0	0	40
Samsun	8	4	2	0	4	5	13	0	36
Sinop	0	2	0	0	0	0	2	2	6
Tokat	7	16	0	0	6	7	1	0	37
Trabzon	19	36	0	1	7	0	3	6	72
TOTAL (N)	**165**	**141**	**14**	**10**	**39**	**21**	**29**	**8**	**427**
TOTAL (%)	**38.64**	**33.02**	**3.28**	**2.34**	**9.13**	**4.92**	**6.79**	**1.87**	**100**

Table 1.15. Fish farms cultivating Rainbow trout and their capacities

Capacity (ton)	N
<10	210
10-29	98
30-50	12
50-100	12
100-250	40
250-500	28
500-1000	14
>1000	4
TOTAL	**418**

Sea bass

The capacity of sea bass aquaculture farms is between 100 tons and 1667 tons and the total number of enterprises is 22 in the Black Sea, Trials with sea bream were not successful due to lower sea water temperatures comparing with the Aegean Sea, More attention was given to sea bass to cover the demands from the region (Table 1.18).

Others

There are one sturgeon, 2 mussel, 3 mirror carp and 1 sea bream producer farms in the Black Sea (Table 1.19).

Table 1.16 Bigger enterprises (SMEs) farming rainbow trout in net cages in the Black Sea Region

Owner/Company	Location	Capacity (tons)
VADİ Aquaculture, R&D, Tourism & Feed Industry Limited	TRABZON	1800
OMEGA 61 Aquaculture Limited	TRABZON	1600
KARSOM Aquaculture and Trading Ltd	TRABZON	1500
YAKAMOZ Aquaculture Limited	TRABZON	1500
YOMRA Aquaculture Limited	TRABZON	1000
KUZEY Aquaculture Limited	SAMSUN	960
SAMSUN Fisheries and Aquaculture Ltd	SAMSUN	950
SAGUN Aquaculture Inc,	SİNOP	950
Black Sea Trout Aquaculture, Marketing & Int, Trade Ltd	TRABZON	950
LADİK AKDAĞ Aquaculture Limited	SAMSUN	922
AYHAN ÇAKIR Aquaculture Limited	SAMSUN	900
MUHAMMET ALİ AKYAZ Aquaculture Ltd	TRABZON	800

OMEGA 61 Aquaculture Limited	TRABZON	800
KIYAK BROTHERS Aquaculture & Int, Trade Ltd	SAMSUN	700
SAMSUN Fisheries and Aquaculture Ltd	SAMSUN	700
KIZILIRMAK Fisheries Ltd	SİNOP	666
DOĞU KARADENİZ Aquaculture and Trading Inc,	TRABZON	600
ARDE - SOM Fisheries and Aquaculture, Marketing & Trading Inc,	ARTVİN	500
LAZONA Marine Fisheries Limited	ARTVİN	500

Table 1.17 Number of Black Sea salmon farms and their capacities (tons)

Owner/ Company	Location	Environment	Capacity
DOĞU KARADENİZ Aquaculture Inc,	TRABZON	Net cages	590
KUZUOĞLU Aquaculture and Trade Limited	ARTVİN	Net cages	500
GÜMÜŞ Aquaculture Ltd	ARTVİN	Net cages	500
YOMRA Aquaculture Ltd	TRABZON	Net cages	500
İBRAHİM BİBEROĞLU	ARTVİN	Net cages	250
TANER YILDIRIM	GÜMÜŞHANE	Net cages	250
ABU Aquaculture Limited	RİZE	Concrete ponds	250
ŞEMSETTİN KELEŞ	GÜMÜŞHANE	Net cages	240
DEVRİM ALTINTAŞ	GÜMÜŞHANE	Net cages	200
ARDE-SOM Aquaculture, Marketing & Trading Inc,	RİZE	Concrete ponds	150
ARSLAN ALTINTAŞ	GÜMÜŞHANE	Net cages	140
ŞEMSETTİN KELEŞ	GÜMÜŞHANE	Net cages	100
ŞEMSETTİN KELEŞ	GÜMÜŞHANE	Net cages	100
MUHAMMET KURU	RİZE	Concrete ponds	15
AHMET ÇOLAK	RİZE	Concrete ponds	14
OFİS Food Inc.	RİZE	Concrete ponds	14
İBRAHİM ÇAVUŞOĞLU	RİZE	Concrete ponds	11
MİSİNA Fisheries Limited	RİZE	Concrete ponds	10
TURGE Limited	RİZE	Concrete ponds	10
SELİM KURU	RİZE	Concrete ponds	9
FATİH KİBAR	TRABZON	Concrete ponds	6
YÜKSEL BİLİR	ARTVİN	Concrete ponds	5

Table 1.18 Sea bass producer companies in the Black Sea

Owner/Company	Location	Environment	Capacity (tons)
Kizilirmak Fisheries Ltd	SİNOP	Net cages	1667
Kizilirmak Fisheries Ltd	SAMSUN	Net cages	709
Doğu Karadeniz Aquaculture & Trade Inc,	TRABZON	Net cages	600
Kizilirmak Fisheries Ltd	SAMSUN	Net cages	591
Kizilirmak Fisheries Ltd	SAMSUN	Net cages	532
Noordzee Fisheries and Export Inc,	SAMSUN	Net cages	450
Samsun Fisheries and Trade Inc,	SAMSUN	Net cages	450
Altaş Aquaculture Inc	ORDU	Net cages	400
Karsom Fisheries Ltd	TRABZON	Net cages	300
Yakamoz Aquaculture Ltd	TRABZON	Net cages	300
Altaş Inc,	ORDU	Net cages	250

Kiyak Kardeşler Aquaculture Ltd	SAMSUN	Net cages	250
Samsun Fisheries Ltd	SAMSUN	Net cages	250
Yomra Aquaculture Ltd	TRABZON	Net cages	250
Marnero Aquaculture and Export Inc,	ORDU	Net cages	249
Lazona Seafood and Turism Ltd	ORDU	Net cages	225
Vadi Aquaculture, R&D and Feed Ltd	TRABZON	Net cages	200
Vona Fisheries Ltd	ORDU	Net cages	175
Muhammet Ali Akyaz	TRABZON	Net cages	150
Omega 61 Fisheries Ltd	TRABZON	Net cages	150
Özbek Fisheries Ltd	ORDU	Net cages	100
Omega 61 Fisheries Ltd	TRABZON	Net cages	100

Table 1.19 Sturgeon, mussel, mirror carp and sea bream farms and their capacities in the Black Sea

Owner/Company	Location	Environment	Species	Capacity (tons)
Mavi Damla Fisheries Ltd	KARABÜK	Concrete pond	Sturgeon	15
Rüstem Mert	GIRESUN	Concrete pond	Mussel	12
Ali Aktürk	TRABZON	Concrete pond	Mussel	4
Burhan Yilmaz	SAMSUN	Soil pond	Common carp	30
Fikri Saygılı	SAMSUN	Small dam	Common carp	10
İsmail Atmaca	SAMSUN	Soil pond	Common carp	29
Kizilirmak Fisheries Ltd	SAMSUN	Net cages	Sea bream	148

Companies were obliged to establish hatcheries and all marine farms have to provide all fry/juveniles from those hatcheries established. In addition, in order to compete with other countries, Turkey has increased supply to cover the demand from consumers and export.

The culture of new species has been emphasized and commercial production of many species such as sturgeon, turbot, red porgy, common dentex, white grouper, sharp snout sea bream, shi drum, brown meagre, white sea bream, sand steenbras, meagre, horse mackerel, tuna, grey mullet, pink dentex, carp species, catfish, mangar, African catfish, tilapia, Mediterranean mussel, crayfish, shrimp, leech, frog, snail, Black Sea trout, red-spotted trout have been started with the support of R&D studies. Projects and trials are carried out in the hatcheries of the Ministry and the private sector for the introduction of new species into aquaculture business. One of the good examples is the turbot culture project which was jointly carried out by the Ministry of Agriculture and Forestry and Japanese International Cooperation Agency (JICA). Although the project finished, hatchery and on-growing units have been still running to supply small turbots to the investors and some bigger ones used for the enhancement of the Black Sea to restore the overfished turbot stocks.

Another important fish species is the Bluefin tuna (*Thunnus thynnus* L), fattened in marine cages in the southern Aegean Sea. According to the quota allocated by ICCAT[2] the fish is caught from nature and fed in net cages from May to mid-autumn. There are currently 6 fattening farms in the Mediterranean where tuna fish is fed in net cages.

The project "Horse mackerel (*Trachurus mediterraneus*) Farming" supported by TAGEM[3] was carried out between 2010 and 2013. It has been observed that horse mackerel fish can be collected from nature and

[2] The International Commission for the Conservation of Atlantic Tunas is an inter-governmental fishery organization responsible for the conservation of tunas and tuna-like species in the Atlantic Ocean and its adjacent seas.
[3] DG Agricultural Research and Policies, Ministry of Agriculture and Forestry

transferred to the cage environment and will not have any difficulty in feed intake. According to this result, it is determined that horse mackerel fish can be grown as fattening (Başçınar et al., 2013).

Technological advances, combined with governmental strategy, and scientific know–how, has facilitated an increase in national aquaculture production in recent decades. The rapid growth of the aquaculture sector has made Turkey the leading producer in the Mediterranean Sea. Currently, Turkey produces large quantities of European sea bass, gilthead sea bream, and rainbow trout. Turkish production extends also to the Black Sea, where sea-raised trout and European sea bass are cultivated. One of the typical characteristics of aquaculture in Turkey is that it is mostly based on intensive aquaculture and new investments are increasing year by year in the Black Sea.

Due to risky character of the business, active work power is very essential in order to be able to apply daily routines for feeding, monitoring ponds, net cages, outdoor on-growing tanks, indoor nursery tanks and incubators, to clean up and remove the dead ones, regular temperature check, water flow, any failures of water intake and electricity cuts.

Another comparison can be made on the capacities: 70 % of the farms have capacities lover than 50 tons in the Black Sea, most of them produce rainbow trout in concrete tanks. In recent years the capacity of new farms established in dam reservoirs and sea has enourmously increased due to farming in net cages. A few small ones are specifically working as a hatchery instead of producing fish for markets. There is a big demand for fry from the marine and inland farms using net cages.

1.2.3.2. Fish Species in Aquaculture

Although the number of fish species used in aquaculture business is about 20 in Turkey, the farms in the Black Sea produce only rainbow trout, brown trout, sea trout and sea bass on commercial scale.

Sea bass (*Dicentrarchus labrax*)

Sea bass is valuable fish species of economic importance in Turkey as well as in other Mediterranean countries, having a great marketability across the world. The stocks in the nature have decreased due to overfishing and environmental pollution. Research studies were started on reproduction, larval feeding and growth after 1985 In Turkey. It is carnivorous and prefers to live in shallow waters where prey fish is abundant. Lagoons and river mouths are the other habitats preferred by sea bass. After late spring, it migrates to the coastal waters and lagoons for reproduction.

Sea bass is eurythermal and euryhaline fish. Optimum growth temperature is 22-24ºC, the growth stops at 7-10ºC, prefers 13-15ºC water temperature during spawning period. They are also very tolerant to salinity changes. They can survive waters between 3-35‰ salinity.

Sea bass has a long life. They can reach a weight of 15 kg (1.5-6.0 kg on average) and 1 m total length (0.5 m on average). It was found that males grow slower than females. In temperate seas, the growth in the first age group is quite fast and reaches a weight of 250-350 g.

In the Mediterranean and Aegean Seas, males reach sexual maturity at 2-3 years and 25-30 cm in length while females start reproduction at 3-5 years old and 30-40 cm in length.

Eggs are 1.0-1.4 mm (mean 1.15-1.16 mm) in size, spherical and pelagic. The diameter of the oil drop is 0.33 - 0.36 mm. Its fecundity is around 300000 eggs per kg live weight. Eggs hatch in 4-5 days. The first larval length is about 3 mm. Larvae, which consume their food sacs within three days, start to feed on zooplankton.

Rainbow trout (*Oncorhyncus mykiss*)

Rainbow trout is native to Pacific region of North America, particularly Mc-Cloud-River, one of California's mountainous rivers. This species was transferred to other parts of North America and, after 1880, was taken to Europe and then to other countries. This enhancement was initially carried out with the aim of enriching the fauna and then selection studies were carried out in order to obtain forms which grow fast and easy to obtain eggs by artificial fertilization.

As a result of cultivation and intensive selection, different varieties with different colors were obtained but it always keeps its characteristic rainbow coloration. The male rainbow trout is darker in color. In the reproductive period and especially in elderly individuals, a hook-shaped lower jaw is observed.

They reach sexual maturity at 2-3 years. They live in nature for 5 or 6 years, but in exceptional cases have lived 18 years or more. It is generally between 1 and 5 kg, with a maximum weight of 24 kg and a length of 120 cm. Reproduction usually takes place between November and February. Egg yield varies between 1500-3000 pieces per 1 kg live weight and the suitable water temperature for spawning is 7-1°C. Egg size is 4-6 mm. The length of the larvae after hatching is 12-15 mm. Larvae, which consume yolk sac in 2-3 weeks, reach up to 25-30 mm in length. Salinity resistance of trout increases as fish grows, so rainbow trout culture is possible at seawater concentration.

The Black Sea trout (Salmo labrax)

The Black Sea trout is a member of the Salmonidae family and can be distinguished from other subspecies by the presence of a distinct black spot on the gill cover, the presence of irregular black spots on their bodies and the presence of distinct white rings around the red spots.

They spend most of their lives in the sea, where they grow and thrive. They migrate to freshwaters during reproduction periods. They can reach up to 100 cm in length and weight up to 26 kg in the Black Sea. The characteristic feature is that the parents return to the waters where they lay eggs. Because of their reproductive characteristics, these ecotypes migrate between sea and fresh water. In the autumn months, they enter the fresh water flowing into the Black Sea and lay their eggs in the nests they open between the sand and gravel. Hatchlings stay in fresh water for a year and then migrate to the sea. They lay their eggs on a suitable ground at a depth of 20-25 cm.

Fecundity varies between 1500-2000 eggs per kg live weight and the suitable water temperature for spawning is 8-10°C. Egg size is 5-6 mm. The length of larvae hatching is 13-15 mm. The larvae consume their food sacs in 3-4 weeks and reach up to 25-30 mm.

It has been farmed for food in the last 20 years and there is also the production of fry for enhancement of natural stocks.

1.2.3.3. Practices/System of culture

According to the practices in the aquaculture business in the Black Sea, there are two types of farming system in case of Rainbow trout.

Farming for portion fish (about 150-250 g): fish from the hatchery of the farm or supplied from other hatcheries is fed till reaching the market size in concrete ponds.

Farming in dam and marine cages (over 1200 g): Juveniles of 2-3 g in weight are transferred from the hatcheries to the cages in dams in April- June. They are fed and kept in dam cages till 150 to 250 gr for live sales to the consumers or transferred to the marine cages in September -December. If the fish is kept in dam cages it can reach the weight of 1-1.5 kg in the following year and is transferred to marine cages in September -December. Small sized trout reach 1 to 1.5 kg and are sold to fish markets from March to June

according to the demand. Big sized ones are fed in marine cages and harvested at 3-5 kg in May-June and are especially sent to the processing plants to be gutted and cleaned, deep frozen for the export.

The new policy of Turkey is to export big sized trout under the brand name “Turkish Salmon” or “Black Sea Salmon”. Due to feed with carotene additives, the color and taste of fish is similar to the Norwegian Salmon, therefore there is an increasing demand from foreign markets.

Unfortunately, the exports are stopped due to Covid-19 pandemics and farmers try to harvest majority of fish to keep frozen for the future opening of the trade possibilities. At present big supermarkets like Migros, Makro Centers and Carefour organize campaigns to sell this valuable fish to the consumers.

In case of *Salmo trutta* culture, fish farms in inland are hatching and on-growing this fish up to the same size as rainbow trout, and apply the similar procedures as to transfer them to the cages in dam and sea. But the growth rate is lower than the rainbow trout and it is marketed with maximum 700 -800 g in size.

There is no sea bass hatchery in the Black Sea, therefore juveniles are supplied from the hatcheries located in the Aegean Region at the size of 2-3 g and transported in oxygenated tanks by trucks in May. Main sea bass cage farms are established in Persembe Bay, Ordu Province. Sea bass are grown up till 350-450 g portion size and marketed all year long.

About half of the farms have capacities less than 10 tons due to land and water limitation and they all are run as family enterprises. Some of them add value to their production by selling/serving in their fish restaurant.

The types of fish farms in the Black Sea can be classified as:

Small businesses with several concrete ponds, water intake from river, spring, or both, buy juveniles and feed them to grow. Main species is trout and it is marketed at 180-220 g (average 200 g, portion size).

Farms having hatcheries and concrete on-growing ponds, cover their fry needs, if production is high, sell the excess to the other farmers.

The main characteristics of these 2 are: they mostly use their own lands to establish farms, or rent the land from the government.

Inland farming in net cages is mainly carried out in dam reservoirs and natural lakes, cages made from different material (wooden, PE, PEE) in different shapes (square, rectangular, circle) and in different dimensions (2x2 to 5x5 wooden, 10-30 m Ø circle),

Marine farming in net cages is aimed to produce big sized fish, with mechanized feeding system, good for intensive fish densities, capacities calculated for the last harvesting target, up to 100 tons of fish in circular offshore type cages, 20-50 m Ø, and strong mooring system.

The last 2 systems need logistic support: stores in the nearest port, support ships to carry feeds with the feed pump onboard, to pull in or out cages to/from port for loading small fish and used in harvesting operations, employs skillful trained staff. Also they have trucks with oxygenated tanks onboard to transfer fish from/to cages.

In the other regions, there are fish farms using earthen ponds to produce carp and shrimp in various dimensions which they are called semi intensive fish farms. On the other hand there are several intensive culture farms with closed system and use recirculated water, fully controlled temperature, lightning, feeding and water renewal in different life stages of the fish. Also the latter and the hatcheries produced marine species other than trout should have phytoplankton and zooplankton, artemia and rotifer production units

for the essential feeding of the larvae after the consumption of yolk sac. Therefore such investments could be made by only big companies (5 private) and by the hatcheries operated by the government.

In order to produce Mediterranean mussel in aquaculture business, different type of investment is needed. It is rather simple comparing the fish farms; basic need is the allocation of sea area according to the capacity foreseen in the project prepared. There are several systems for mussel culture. The basic one is the raft and rope system. After collection of spats from nature on ropes, they are transferred to the other ropes hanged where they were grown up. The main requirement is the rarefaction of the ropes as the mussels grown up.

1.2.3.4. Human Resource

In aquaculture business there are several types of staff working at various farming stages. By 2018, 10500 workers are employed in aquaculture business. These staff can be classified as;

- Service workers (feeding, cleaning, nursery)
- Technicians (electricity, mechanics, fisheries),
- Engineers (Fisheries, Food, Agriculture),
- Veterinaries (fish diseases and vaccines),
- Biologists (live food production, genetic studies),
- Divers (cage maintenance, net changing, fish harvesting, monitoring).

Number of staff is closely related of the capacity of the farms. Due to fact that the majority of farms have the capacity lower than 50 tons per year, farms are mostly family businesses, employ 1-2 workers and some have small restaurant facility.

Minimum staff employment obligation is determined by the MAF (Aquaculture Regulation) in order to safeguard of the aquaculture business. Main source of the engineers, biologists and veterinaries are the university graduates which are over the potential labor need. At the beginning of the development period in 1970's only the workers and technicians were seen sufficient to produce fish with the consultant support. But, nowadays, graduates who have secondary and tertiary degree, especially on genetics, molecular biology, fish physiology, nutrition, reproductive biology and farm management are employed.

1.2.4. Ukraine

Aquaculture is a major component of the fisheries and agro-industrial sectors. Aquaculture production is a strategic resource of the State, as a source of high quality production mainly at the places of its consumption, which does not require high costs for its transportation (in comparison with the sea and ocean). In the current conditions of sharp reduction of ocean catch and critically depressed state of inland water bodies, the actualization of the aquaculture segment in Ukraine objectively becomes a sign of an alternative strategic vector of development of the fisheries sector. However, with its rich natural resource potential for large-scale development of fisheries, the state loses these advantages due to the lack of necessary institutional conditions. Thus, according to the State Agency for Fisheries, out of 250 thousand hectares of aquaculture suitable for aquaculture, only half are involved in modern conditions. Of these, 60% are inefficiently used and therefore have low fish productivity.

In the activity of the fishery complex of Ukraine of the Soviet period, a significant shift towards marine and ocean fisheries was planned at the expense of the development of its own resource base of natural and artificial inland water bodies. As noted above, fisheries in extraterritorial waters accounted for up to 74% of the total catch of fish, in the fishing zone of Ukraine (in the Azov-Black Sea basin) - up to 16%, the share of aquaculture production varied within 7-12%, and fisheries in inland waters accounted for only 3% of total production.

The Odessa region is part of the Primorsky region of Ukraine, which owns a large stock of fishery reservoirs (lakes, reservoirs, sea estuaries, estuaries of large rivers Danube, Dniester, Dnipro) and is the main fishing region. The main fish processing facilities are located here, as well as scientific and educational institutions of the fishing industry. The enterprises of the coastal region produce more than 90% of the total volume of fish and seafood produced by Ukrainian enterprises. This region of Ukraine in the last 10 years provides from 42.5% to 30.9% of the total fish catch in inland waters of Ukraine.

Oceanic fish (mackerel, sardines, horse mackerel, cod) and seafood (crustaceans, molluscs, etc.) harvested in the 200-mile coastal waters of other countries are the major part of the ocean catches of enterprises in the region.

1.2.4.1. Resource potential

The resource potential of the fishery food subcomplex of Odessa region is the largest in Ukraine. The specificity of the region is the presence of large inland reservoirs - coastal lakes and estuaries, two of which are the largest lakes in Ukraine. Most of the reservoirs of Odessa region - ponds, reservoirs, lakes, estuaries, reservoirs-coolers of power plants, special gardens and swimming pools are suitable for fishery use. The fishery reservoirs of the area in which industrial fishing of aquatic living resources (VZR) is carried out, includes 16 inland water bodies (lakes, estuaries, reservoirs and floodplains) with a total area of 175.6 thousand hectares (Table. 1.20), below the rivers. The Danube and the Dniester, as well as about 5500 km^2 of the high-productivity water area of the northwestern Black Sea.

Official data on the number of reservoirs in the Odessa region indicate the presence of 1010 ponds and small reservoirs with a total area of 14300 hectares, most of which (up to 50%) are unfit for fishery use. Table 1.21 shows the results of the inventory conducted by specialists of the Western Black Sea Fisheries Protection Department, which showed that the total area of the ponds currently used or can be used for fisheries needs is approximately 9.9 thousand hectares. This fund includes 211 ponds and small reservoirs, located in the basins of small rivers and, as a rule; they are of a complex purpose: fish breeding, irrigation, livestock breeding, and population resting places. These reservoirs are rented out by local authorities. Also, 7 pond fisheries have been built in the region, where the area of feed ponds for the production of commercial fish is 2 thousand hectares, and the ponds for the cultivation of fish planting material - almost 1 thousand hectares. Three pond farms have the status of state breeding nurseries under the authority of the State Fisheries Agency.

Thus, aquaculture activity in the Odessa region is carried out today on reservoirs with an area of 12.9 thousand hectares, which is 7.6% of the total fishery fund of region`s reservoirs. There is an adequate reserve of reservoirs, the use of which has not yet been translated into the channel. Among them are 42 reservoirs of local importance, with a total area of water mirror of about 2 thousand hectares, which is almost 58% of the real number of water bodies of local importance. The ratio of fishery uses of reservoirs in the region is presented in Table 1.22.

Table 1.20. The largest fisheries in the Odessa region

Water basin	Area ha
Lake Cahul	8 200-9 300, 9 000
Lake Cartal	1 400
Lake Kuhurlui	8 200, 9 400
Lake Yalpug	14 900
Lake Catlabug (SCF)	6 000

Lake Saf`yany (SCF)	400
Lake Cytai (SCF)	5 000
Lake Sasyk	20 500
Tuzlovski floodplains	20 000
Shabolatsky estuary	3 000
Dniestrovskyi estuary	36 000
Hajibeyskyi estuary	7 000
Tiligulskyi estuary	15 000-17 000

Table 1.21. Structure of use of the fishery reservoirs fund in Odesa region

Water basin	**Area**		**The dominant species of fish**
	1000 ha	**%**	
Inland reservoirs in which fishing is carried out under quotas	83,5	49	carp; herbivorous[4]; pelengas; sturgeons
Natural reservoirs with the introduction of SCF	74,9	44	carp; herbivorous; crucian; pelengas
Inland reservoirs (ponds, reservoirs) for rent	9,9	5,8	carp; herbivorous
Pond farms built on projects (in-house)	2,0	1,2	carp; herbivorous

Artificially created riverbeds include reservoirs with status of both national and local importance. The rates are either rented or under the SCF regime, or combine a lease relationship with the SCF regime. The SCF modes are set for 7-10 years. Aquaculture enterprises are mainly in the form of LLC (Limited Liability Company) and CJSC (Closed Joint Stock Company).

The finding of the availability of reservoirs in the area of suitable fisheries is not representative and sufficient in terms of transparency and efficiency of regional management of this sector. According to experts of the industry, at present all suitable water bodies are actually used, but with different degree of legalization of this business in accordance with the basic law. The use is carried out arbitrarily or on the basis of previously concluded leases of land under water. The new aquaculture requirements require that such agreements be brought into line with the basic law, but this process is poorly motivated for tenants and is not accompanied by a clear mechanism for implementation. As a result, regional fisheries management authorities do not have reliable information regarding the number, forms of organization and ownership of aquaculture enterprises, production productivity, etc.

The fishery use of water bodies of Odessa region is characterized by the following directions:

- aquaculture directly;
- reservoirs in the mode of special commercial fisheries of SCF;
- special use of aquatic bioresources under established limits and quotas (Black Sea, Danube River, Dniester estuary and lower Dniester, marine estuaries of the northwestern Black Sea and Kuchurgan reservoir).

Odessa region has a powerful fishery complex with developed infrastructure, which includes the Black Sea seaport, 6 fish processing plants and factories, 104 fishing enterprises belonging to different forms of ownership, 5 large pond fisheries (with a total area of 5 - 5,5 thousand ha), 7 fish farms, four of which have breeding status. The enterprises of fishery complex (FC) are unevenly located on the territory of the region according to the geographical location of the water lands. All fish and fish processing companies, as well as

[4] Silver carp, carp and white cupid

ponds, are located in nine southern regions of the region - Reni, Bolgrad, Izmail, Kili, Tatarbunar, Belgorod Dnestrovsky, Bilyaev, Ovidiopol and Kominternovsky (Table 1.22).

Table 1.22 Dynamics of fishing in Ukraine [5]

The name of the water body	Approved catch limit t / year			Actual catch, t / year		
	2014	2015	2016	2014	2015	2016
Black sea with bays	*	*	*	2976	3431,0	**3662,9**
River Danube	*	*	*	245,7	241,1	**477,1**
Lake Cahul - Kartal	1152	1151,5	1151,5	527,554	824,86	**906,367**
Lake Yalpug-Kugurlui	1181	1181	1181	869,512	895	**901,5**
Stentivska floodplain		*	*	0	0	**0**
Lake Kotlobukh	348	388	348	195,023	222	**246,374**
Lake Cytai	238	233	238	123,438	189,21	**148,98**
Lake Sasyk	1257	1286,5	1257	836,523	248,44	**431,7841**
Dniester estuary and the lower reaches of the Dniester river with lakes	*	*	*	576,6	854,1	**1551,0**
Kuchurgan reservoir	*	*	*	6,4	7,7	**18,83**
The Hajibeysky estuary	1030	1281	1030	883,401	421,01	**1005,12**
Tuzlov group of estuaries	*	*	*	5,9	0	**0**
Shabolshatsky estuary	*	*	*	21,12	37,85	**89,414**
Grigoryevsky estuary		*	*		0	**0**
Kuyalnytsky estuary	*	*	*	0	0	**0**
Dauphinsky estuary	60,5	60,5	60,5	10,763	7,41	**1,5**
Tiligulskyi estuary	*	*	*	395,2	773,0	**0**
Kohanivsky pond No1			20			**0**
The reservoir of Zapalisia			112			**0,25**
Perelit·s'ke reservoir			39,12			**0**
Total by area				**7673,4**	**7654,68**	

* - the limit is determined by individual fish species or species are not limited, according to the Office of the State Fisheries Agency in Odessa region (letter from 09.06.2017 No567)

The imbalance of development of FC of Odessa region is manifested in the paradoxical increase in the number of personnel of the main production against the background of the decrease of production capacity.

Aquaculture opens wide prospects for the development of fishery complex in Odessa region. Its formation and development here is facilitated by a whole gamut of natural conditions: a huge area of shallow shelf ACB, rich feed base; Danube and Dniester rivers with deltaic systems; small rivers, lakes, estuaries, reservoirs, ponds; large number of warm sunny days per year, developed agriculture. The coastal sea waters of Odessa region have favorable conditions for the cultivation of shellfish (mussels, oysters), the industrial cultivation of which does not require the cost of artificial feed. From one raft with an area of 16x25 m, from which 600 ten-meter collectors are hung, it is possible to obtain more than 4 tons of oyster meat per year. At the same time, since the life of molluscs is related to the filtration of water, they purify water and improve the quality of the aquatic environment. The filtration rate of large healthy oysters can reach 450 liters of water per day.

[5] https://menr.gov.ua/files/docs/eco_passport/Одеська область 2016_r_k.pdf

Organization of mariculture production of mussels and oysters in the coastal regions of Odessa region is constrained by lack of funds, poor coordination of work between organizations, lack of long-term concept of development of mariculture.

At present, in the Azov-Black Sea basin, and in particular in the Odessa region, there is a discrepancy between the production (fish-producing and fish-processing) capacities existing in the region and the state of stocks of the main industrial facilities, especially in the areas of traditional coastal fishing. In this regard, it is advisable to build complex fish farms to increase the population of mullet and flounder fish with a total capacity of up to 300 million units / year of viable rejuvenation.

The problem of reproduction of sturgeon in the Azov and Black Seas is of particular importance for the coastal regions of Ukraine. The capacity of the country's sturgeon factories and fish farms is around 8 million units. Recharge, and in 2010 their required capacity should be at least 35 million units. Sturgeon rejuvenation is promising in the basin and also the construction of complexes for cultivation, production and processing of seaweed and grasses.

Over the last two decades in the commercial fisheries of Ukraine and the Odessa region there has been a decline (more than 70%) in volume of cultivation and fishing of commercial fish. This is due to the large reduction (more than 10 times or about 90%) of the use of artificial fish feeds due to their high cost, high tax burden, poor crediting in seasonal conditions and a two-year production cycle. According to the current regulatory documents, a part of a fish that has not reached the marketable status is considered as work in progress until its transfer to the finished product category. The most important components of work in progress are fish planting material, this year and two years.

The region has a developed pond network, but pond fish production is declining annually. The main reasons for the decline in pond fisheries are the increase in the cost of feed, electricity and fuel, as well as payments for water use, with a slight increase in prices for pond fish.

Ignoring the integrity of natural ecosystems leads to direct and indirect damage. The fishing of the Danube lakes was a compulsory measure to compensate for the consequences of harmful projects. The Institute of Hydrobiology of the Academy of Sciences of Ukraine has developed a program, the implementation of which provided for the periodic water exchange of the Danube lakes and their fishing with carp and silver carp. This also applies to recent actions - the implementation of a canal transport project at the mouth of the Bystre (spawning place of 95% of the Danube herring) adversely affects the fishing potential of the Danube.

The current level of inland farming is far behind not only the scientifically sound volumes, but also the planned indicators. There are 11 fish farms on the territory of the region with 1500 hectares of cultivation ponds and 11 hatching shops with a design capacity of up to 700 million larvae. Four farms have breeding status and carry out breeding of white and mottled silver carp, Ukrainian scallop carp, white carp and paddlefish. In addition, there are 937 water bodies (lakes, reservoirs, ponds) in the region, which can be used for fish production. The large coastline of the Ukrainian coast allows the development of marine aquaculture, which is the basis for many years of research in a number of scientific institutions.

It should be noted that in Ukraine there is a fairly rich experience of fisheries, formed in the Soviet times, the analysis and systematization of which can compare the main types of aquaculture with the types of water bodies and forms of economic activity on them.

Aquaculture activities are characterized by high environmental risks that are associated with the impact on the status of water bodies and land of the water stock, the risk of genetic contamination and the genetic degradation of natural fish species. Another important fact is that some of the water bodies in Ukraine are

transboundary, which imposes additional requirements on aquaculture enterprises. In this regard, the organization of veterinary control and environmental safety is of particular relevance.

The current socio-economic crisis situation in Ukraine significantly corrects pre-crisis regional management and requires active search and offering to local authorities a set of effective management, economic, organizational and other mechanisms for creating effective regional economies on the principles of decentralization of management. Aquaculture as a sector of economy has serious resource preconditions to get into the mainstream of regional development of Odessa region.

In the Odessa region 90 industrial users are engaged in industrial catching, which use 838 units vessels and 21,000 fishing gear. Specialty commercial fisheries use 11 water bodies with a total area of 74 803 ha, use 178 vessels for 5581 fishing gears. For aquaculture, 38 reservoirs (31 ponds and 7 reservoirs) are used with a total area of 4021.1 ha and a potential cultivation capacity of 3000 tons (Table 1.23., 1.24).

Table 1.23. Industrial fishing in Odesa region

Water object	List of enterprises	Catch volume (t)
Black Sea	SE "Experimental Cephalic Fishery", ISTC "ISTR", MSB "Albina", MSB "Korsar", MSB "Kunashir", PE "VKF Maiaki-2007", PE "Danube", PE "Kalkan", PE "Olymp", South Bessarabia LLC, PE Tiligul, PE Tiligul Plus, PE Jaguar-2005, LLC Sargan, PSC Piskar, AC KRAP Zarya 2, Mercury Aqua LLC, LLC Bora, Vidrodjennia LLC, Red Fisherman LLC, Poseidon LLC, Prydunavie LLC, Brikk Private Company, Kholod-Service LLC, Liman Firm LLC, IE Dunaenko O.A., IE Kedrovsky V.D., IE Morgun O.V., IE Kharkovsky S.V., LLC Terraport, LLC Southern coasts, LLC Ozerne-2012, LLC Krystal Pivden', Zarya, LLC Welk, LLC Ribcomflot-2.	1503,06
Danube river	SE Corsair, SE Kunashir, PE Danube, PE Equator, PE Olymp, PSC Piskar, FC Novonekrasovsky, AC Danube Field, LLC Vilkovskiy Fishery Plant, LLC Odessa sturgeon complex", LLC "Southern Bessarabia", LLC "Pridunavie", LLC "Krystal Pivden'", AC "Orchid", LLC "Soyuzugprom", IE Semenenko V.M., IE Morgun O.V., IE Shevcheneo G.P., ISTC "ISTR", LLC "Southern Shores", LLC "Terraport", LLC "Ozerne-2012"	165,66
Lower Dniester River with lakes and Dniester estuary	Mercury Aqua LLC, Experimental Cephalic Fish Breeding Company, VKF Beacons 2007, PE Chernomorets O.V., PE Dniester, PE Kalkan, Jaguar 2005, Pridnestrovets RS, AC "KRAP Zarya-2", KRAP "Zarya", LLC "Red fisherman", PE "Fishing Enterprise Resolving", PE "Brick", LLC "Triton", PE "Fishing Union Ukrribeksport", LLC "Kholod-Service", LLC Crystal South, IE Kedrovsky V.D., IE Kedrovsky P.D., IE Andronaki V.F., IE Kharkov S.V.	500-1500
Kuchurgan Reservoir	AC "Pridnestrovets"	16
Shabolatsky estuary	PE "Kalkan", AC "KRAP Zarya2", LLC "HTMO", SE "Experimental mullet breeding", PE "Jaguar-2005"	13,53
Tiligul estuary	LLC "Firm Liman", PE "Tiligul", PE "Tiligul plus", PE "Chernomorets OV", LLC "Bora"	5,98

In the classic form, commercial aquaculture in the region functions in pond farms built on projects. Despite the sufficiently developed network of pond farms, the volumes of marketable fish production in aquaculture farms are extremely low (approximately 9-12% of the catch in inland reservoirs) and mainly consist of herbivorous fish species (silver carp, white cupid) (Table 1.25):

Table 1.24. Special commodity fisheries of Odessa region

The name of the water body	Area 1000 ha	Enterprise	Provision

Lake Cahul	8,5	RIF-2012 LLC	craft: 13 units; fishing gear: 498; fishermen: 59
Lake system Yalpug-Kugurlui	22,8	Repida LLC	craft: 51 units; fishing gear: 2456 pcs. fishermen: 117
Katlabug Lake	6,5	Prydunaiska Niva AFC	craft: 13 units; fishing gear: 213; units fishermen: 43
Lake Sasik	20,0	Navy-10 LLC	craft: 66 units; fishing gear: 1182 units fishermen:156
Lake Cytai	5,0	Soyuzugprom LLC	craft: 16 units fishing gear: 122 units: fishermen: 47
The Hajibeiskyi estuary	11,0	SE "RDEK"	vessels: 19 units ; ishing gear: 466 units fishermen;28
Dauphinsky estuary	0,6	FG "Voskhod"	No data available
Zaplazs'ke reservoir	0,177	LLC Zaplazskoe economy	fishing gear: 223 units; fishermen: - 10
Kohaniv pond	0,029	IE Bakin Y.V.	fishing gear: 136 units fishermen: 5
Krychunivski rates	0,06	KPL-LTD LLC	fishing gear: 90 units fishermen: 10
Adamovsky pond	0,019	Law Corporation	fishing gear: 12 units fishermen: 3
Perelit·s'ke reservoir	0,172	Fisherman's Wharf LLC	fishing gear: 183 units fishermen: 6

Table 1.25. Production of commodity aquaculture products in Odessa region

Years	1995	2000	2005	2007	2011	2012	2013	2015	2016	2017	2018
Volume of products of commercial aquaculture, t	802	994	610	798	1330	653	905	1967	1718	1187	1007

Reasons for regressing commercial aquaculture are based mainly on organizational and economic basis: lack of access to water bodies; increase in prices for feed, electricity, fuel and lubricants and more. Many farms in the region have diversified their activities from fisheries to crop production using pond areas.

1.2.4.2. Specialized Commodity Fisheries (SCF)

In order to increase the use of fisheries in the region, a network of specialized commercial fisheries was established. In the Odessa region there are 8 SCFs, which are single users (Lake Katlabukh - "Pridunayska Niva", Lake Cytai - "Blue Field", Dauphinsky Estuary - "Voskhod", Lakes Yalpug-Kugurluy - LLC Yalpug-Kugurlui", Tuzla Group of Estuaries - Poseidon LLC), and 2 others are associations, which included not only fishing but also processing enterprises.

The number of founders of associations can be quite significant. So 17 founders are in the association "Tuzlovsky estuaries". The special regime of water use is developed separately for each SCF by the Odessa branch of the Southern Institute of Marine Fisheries and Oceanography, is coordinated by the State Administration of Ecology and Natural Resources in the Odessa region and the basin body of fisheries, and is approved by the State Inspectorate for Conservation, Reproduction of Water Resources and Fisheries Regulation.

An analysis of the work of the SCF indicates that, despite some of the shortcomings associated with the imperfection of the regulatory framework governing their activities, specialized commercial fisheries are by far the most effective form of large-scale fisheries.

Aquaculture is performed in the Great Lakes of the Danube Region in the SCF mode (Table 1.26):

Table 1. 26. Catching of fish by SCF enterprises on Danube lakes (2018)

The name of the water	Company	Fishing for fish, t

body		reasonable	Actual
Cahul	RIF-12 LLC	940	268
Kartal	"ALLA"	95	21
Yalpug-Kugurlui	Repida LLC	1169	899
Katlabukh	Prydunaiska Niva AFC	227	138
Cytai	Soyuz Yug Prom LLC	238	169
Sasik	LLC "VNS-10"	1093	355

CJSC "Odesaribhosp" remains the leader in the Odessa region, which assimilates the introduction of new valuable species of fish (channel and European sheatfish, sterlet, beluga, black carp, multicolored carp).

1.2.4.3. Fish processing base

The Odessa region has a powerful processing base (Fishery Cooking Plant, BelgorodDnestrovsky, Izmail and Vylkovsky fish-canning factories, LLC “Istok” fish factory and “Krasnyj fisher” fish factory). It is believed that the production of canned fish is the most profitable of all types of canned food.

Canning production of fish and other aquatic living resources in the Odessa region is carried out by such entities as: Aquafrost LLC, IE Korolkov Sergey Vladimirovich, LLC Danube Fish Cannery, Mariko LLC, Southern RKK LLC, Fisherman LLC and others.

The main problems of the processing enterprises of the Odessa region are the lack of working capital for the purchase of raw materials and the availability of a significant amount of imported and illegally produced products in the markets of the Odessa region. A serious problem is also the deterioration and poor utilization of canned fish production capacities. Due to a significant decrease in production, fish processing companies are in a difficult financial state.

Three enterprises are engaged in the reproduction of fishery resources in the Odessa region: Bestis System LLC, Frog Agroservice LLC, Yug-Akvaprom LLC, which specialize in growing carp, herbivores and other species.

In the state program "Selection in fisheries and reproduction of aquatic living resources in inland reservoirs and the Azov-Black Sea basin" fishery enterprises of the Odessa region take a small part. Most of the reason for this is the fragmented payments by the state to the enterprises for the fulfillment of the state order, which is a significant motivator for the desire to participate in the program. Thus, in 2005, the funds for the implementation of budgetary fisheries were not allocated, 2006 - the budgetary fishery was performed "Krasnyi fisherman" and "Pridnestrovets", 2007 - the funds for the implementation of budgetary fisheries were not allocated, 2008 - year - the funds for the implementation of budgeting were not allocated, 2009 - budgetary funds were used for LLC "HTMO", "Krasnyi fisherman" and LLC "Odessa sturgeon complex", but for the accomplished volumes of fishing, the funds are not fully transferred; 2010 - funds were not allocated; 2011th year - LLC «Odessa Sturgeon Complex» was involved; 2012th year - “HTMO” LLC, “Red Fisherman” JSC were involved; 2013th year - no funds were allocated.

However, in 2019, the Kuchurgan reservoir was started to be fished. The implantation is carried out at the expense of the user of aquatic bioresources in accordance with the regime of fishery exploitation of reservoirs ("Pridnestrovets"). Yes, 100 thousand units of carp were released into the reservoir, average weight 40 grams / units. Also in the near future it is planned to give another 50 thousand units of carp and 450 thousand herbivorous fish species. Control over the implementation of aquatic bioresources was carried out by employees of the Odessa Fish Guard Patrol. This is the third reservoir of Kuchurgan reservoir in the last 10 years. For the first time, the reservoir was inaugurated in 2014 and replenished with 20 thousand

units of fry. The next event took place in October 2018. And now 600 thousand units will be released into the reservoir, valuable species of fish.

There are three specialized state-owned fish-farming enterprises in the Odessa region:

- "Regional Experimental and Experimental Complex" (Bilyaivskyi district, Paliyovo village)
- 670 hectares of levered plot in Hadzhibei estuary, SCF regime
- "Experimental Cephalic Fishery" (Belgorod-Dnestrovsky district, Belenke village)
- four ponds of 25 hectares, pumping station, channels for water intake from the Dniester
- "Dniester fish breeding farm" (Belgorod-Dniestrovsky district, Udobnensk village council, Sturgeon site) – 39 ha.

Another group of enterprises in the region that is involved in the process of reproduction of these aquatic bioresources - fishery enterprises with their own fish farms, for which the cultivation of planting material for further sale is one of the main activities. Thus, the production capacities of individual fisheries, such as the AFC "Prydunayska Niva" (incubation capacity of 500 million copies), "Krasnyi fisherman" (incubation capacity of 497 million units), "Novo-Nekrasivsky" (incubation capacity of 150 million units)), CJSC "Odesibirgas" (incubation capacity of 300 million copies) allow to grow about 40-50 million copies, viable fishery material of carp and herbivores for fishing and enhancing the fish productivity of natural reservoirs of Odessa region. It is advisable to note the practice of artificial reproduction of some species of natural ichthyocomplex of bream and ram on the fish farm of the Prydunayska Niva, from which the Katlabug Lake is up to 10 million units in some years, young bream.

At present, there is only one fish breeding farm operating in the region engaged in the reproduction of the Pilengas - LLC "HTMO" on the Budak Spit of the Shabolatsky estuary. Since 2008, the fish farm has begun to work on artificial reproduction of the Pilengas in the Shabolatsky estuary. In 2009, in the framework of the budget program "Reproduction of aquatic living resources in inland water bodies and the Azov-Black Sea basin", 845.6 thousand units of young Pilengas were released in the Shabolat estuary. It is envisaged that further increase in the capacity of LLC "HTMO" fish breeding complex, introduction of the newest technologies in fisheries would allow ensuring stable release of young fish in the salt-water estuaries of Odessa region and in the Black Sea.

Built in 2007, the LLC "Odessa Sturgeon Complex" with the use of modern technologies for artificial reproduction of sturgeon species of fish started from 2009, the year of the Danube River in the youth of Russian sturgeon in the amount of 50 thousand units. Since in 2009, sturgeon species such as sturgeon and stellate sturgeon were additionally included in the Red Data Book of Ukraine, the capacity of the sturgeon complex LLC “Odessa sturgeon complex” should be used to catch the Dniester and Danube in the future up to 1.5 million units young sturgeon per year.

1.3. SWOT analysis for the aquaculture sector in partner countries

Results of SWOT analyses show differences according to the specific conditions of the countries; water resouces available, level of fisheries and aquaculture, resource characteristics-capacities, surface areas, depth, water type as running or stagnant, climate, etc., use and/or protection status, priorities and level of development of the states. On the other hand scope and development process of aquaculture business rather different from EU member countries and non-member ones due to differences and supporting schemes applied in line with current legislations.

1.3.1. Greece

In the framework of this study a questionnaire was compiled and distributed to aquaculture companies operating in REMTH. The questionnaire surveyed the key issues of aquaculture in the REMTH area, such as the Keramoti of Kavala and the Fanari of Rodopi. Businesses operating in these areas grow and sell mussels. The owners said they produce 80-100 tonnes per year, the cost per kilo is 0.30 € and businesses have both family members and external partners. These establishments do not send on veterinary or health care and do not use hormones, vaccines and antibiotics and shellfish feed is taken from the environment naturally. Businessmen have also said that aquaculture remains useful for the economy, increasing employment in this area, promoting blue growth and the proper consumer nutrition. In addition, regarding the strengths, weaknesses, opportunities and threats of aquaculture, the owners reported the following (Table 1.27):

Table 1. 27. SWOT Analyses for REMTH in Greece

STRENGHTS	WEAKNESSES
• The fish-shellfish products have high • nutritional value and are relatively • economical for the final consumer • The water quality is monitored by the state and this reduces the risk mortality	• No compensation is given in case of damage (natural disasters, deaths) • Continuous and long-term engagement is required (labor intensive), • Young people do not want to work in this field • Marine areas suitable for fish farming are scarce • Limited management and sanitation of the lagoons (legal obstacles etc.)
OPPORTUNITIES	**THREATS**
• Promotion and dissemination of this sector abroad • Improvement interventions for the lagoons and their enrichment in spat, shellfish (which thrive in the area) • Lagoons: cultivation of algae and creation – maintenance of overwintering ponds for the fry entering from the sea • Construction of appropriate (packaging – smoking – raw extraction) facilities for fish and shellfish processing and packaging • Creation of cooling facilities for the maintenance and freezing of fish in order to achieve a better market price • Upgrade – replace old equipment with available financial tools (national, European)	• Climate change • Pollution • No upgrading of farm infrastructure

Also, regarding the incentives needed to promote aquaculture entrepreneurship and trade in the REMTH region, the owners stated the following:

Legal Level

- Continuous legal support is required
- Creation of a simpler legal framework for licensing of aquaculture facilities and the use of suitable areas for aquaculture

Administrative Level

- Better coordination between businessmen and competent local administrative bodies

- Need to speed up the installation process and licensing of a farm and to update legislative constraints according to the local specificities of the area

Commercial Level

- Better promotion and dissemination of the sector both in Greece and abroad
- Establishment of additional infrastructure in the fishing shelters and ports of the area
- Mechanization of work due to lack of labor hands

Financing level

- It is not easy to finance shellfish farming
- No insurance coverage
- Financial support is time consuming

Respondents also unanimously stated that they are in favor of international cooperation, the exchange of know-how, the use of innovative technologies in common trade, and stated that they are willing to participate in relevant seminars in the Black Sea region. Regarding their knowledge of the current state of aquaculture in the corporate countries, respondents while fully aware of the situation in Greece are partially aware of the situation in Turkey and not at all aware of the situation in Romania and Ukraine. The main source of information for them is the internet, fisheries associations, organizations and publicized studies. In addition, a table with the values of aquaculture species follows (€/ per kilo) (Δελτία Τιμών ΑΜΘ 2020)(Table 1.28).

Table 1.28. Value of aquaculture species

Species	Retail Average Price in Euro per kg
Mugillidae	5,40
Dicentrarchus labrax	11,08
Oncorhynchus mykiss	5,65
Sparus aurata, fisheries	13,90
Sparus aurata, culture	9,28
Mytilus galloprovincialis	5

Finally, it is worth nothing that the momentum in the fisheries and aquaculture sectors is increasing, as is the support for these sectors with the adoption of good practices by the Region of Eastern Macedonia and Thrace in all the Regional Units. The existence of a dynamic University (Democritus University of Thrace), in combination with other research centers (eg ELGO DIMITRA-INALE) and the scientific potential of the Region's services, contribute significantly to its wider field. This is achieved through the interconnection of scientific research with production and the design of a common policy to produce high value-added products that will stimulate productivity, competitiveness and extroversion in the primary PAMTH sector. In the framework of cooperation, visits are made to local research institutes and aquaculture companies. In addition, the REMTH website provides price information leaflets for citizens and an electronic documentation system for those interested. Also, REMTH is a body which in recent years has been a key partner in co-financed European Union programs and leverages the available European funding tools.

On the other hand, more comprehensive SWOT analyses were done based on data from the Special Spatial Planning and Sustainable Development Framework Study for the country based aquaculture sector and its corresponding sector study (ICAP Group) (Table 1. 29). SWOT analysis is a key strategic planning tool that examines and combines the effects of strengths and weaknesses of an industry in this case, the internal

environment as well as opportunities and threats to the external environment. Through this analysis it is possible to identify and exploit the strengths of the aquaculture sector in Greece, to make new investments in them and to use the opportunities that will arise in the future. It is also possible to identify the threats and risks to be avoided. It is a fact that evaluating the existing situation will help shape a new strategy.

Table 1.29. SWOT Analyses for Aquaculture in Greece

STRENGHTS	WEAKNESSES
• Contribution to the national economy, as aquaculture is the state's second most important export sector • A strong pillar of regional development (employment, support for local communities & economies) • Strengthening of mountain areas with relative activity in inland aquaculture • Ideal climatic conditions, morphology (long coastline, etc.) and geographical location of the country favor the development of aquaculture • Existence of research and technological bodies for staffing the industry with experienced and qualified workforce • Providing expertise in the production of high nutritional value products • Existence of shellfish cultivation with environmentally friendly production methods and focused demand in local markets	• The lack of a national strategic plan despite its strong export character • Inability to set up and operate Producer Organizations • Low level of organization of units • Little co-operation between players in promoting products and finding new markets • High financial requirements of the production process • Slight diversification of types and forms of processing of products • Product sensitivity (short "tradable life") • Late development of new products due to long research and required capital • Continuous reduction of water resources and low level of technology applied in the case of inland aquaculture • Consumers' negative perceptions of the hygiene of shellfish products produced and low demand at national level
OPPORTUNITIES	**THREATS**
• Increasing global demand for fish consumption • Financial opportunities for improving production quality (European Fisheries Fund) • Financial support for market studies / promotions • Incentives to attract new investors to small and medium-sized enterprises • Improvement of methods and techniques of product promotion • Informing and raising consumer awareness of product quality and safety • Development of new technologies, optimization of production protocols to reduce costs as well as production of new products • Improvement of systems for permanent monitoring of environmental parameters and impacts • Implementation of water saving technologies in onshore units to optimize production	• Changes in consumer buying behavior as an impact of the economic crisis • Threats related to the natural environment (liquid waste, strict environmental legislation, rising sea temperatures, etc.) • Vulnerable organisms, susceptible to diseases that can lead to the destruction of the product. • Depletion of fish stocks due to dependence on fish feed (fish meal, fish oil) • Imports of competitive shellfish products to the domestic market • Possible emergence of new competitors from other countries as aquaculture plants are being developed at a significantly reduced production cost

1.3.2. Romania

SWOT analyses for Romanian aquaculture is given in Table 1.30.

Table 1.30. SWOT Analysis for aquaculture in the South-East Romanian Region

STRENGTHS	WEAKNESSES
• real growth potential of the aquaculture sector	• blocking the privatization of fisheries facilities

- nutritionally valuable native species, with tradition in consumption
- the quality of the produced fish and the diversity of the species to be exploited
- dense hydrographic network, favorable for aquaculture
- the possibility of providing the necessary feed for cypriniculture from internal resources
- research institutions in the field
- sustainable activity in accordance with environmental protection/sustainable use of natural biological resources
- newly created jobs that are a financial alternative for commercial fishermen
- reducing the pressure of fishing on the natural environment
- easily certified organic products
- accessible price
- the aquaculture products contribute to human health and food security

- high price for electricity
- unclear laws for the sector
- low financial resources of the aquaculture units for upgrading and increasing production capacity
- insufficient and outdated technological equipment and facilities; insufficiently developed infrastructure in the field
- insufficient staff with proper training in the field
- lack of information on the fish market/ low level of information on the role of fish in human nutrition
- limited access to bank loans and difficult procedures for accessing non-refundable funds
- short-term concession contracts that do not allow for capital recovery in case of major investments
- lack of involvement of the authorities with competence in the field in order to reduce the phenomenon of theft of fish stock

OPPORTUNITIES	THREATS
• large market, high demand for indigenous species • the existence of protected natural areas suitable for fish breeding and feeding • potential for ecotourism and other aquaculture related activities • market niches for certain species • the lands from the existing fisheries facilities are suitable for modernization • financial support from non-reimbursable funds, both for the competitiveness and for the sustainability of the sector • possibility for direct sale from the fish farm • processing of fish in order to provide an easy-to-cook product to the final consumer (evisceration, cleaning, portioning of the fish placed on the market) • forming producer organizations that can negotiate obtaining facilities for the sector (eg legislative, financial, etc.)	• climate change, natural disasters • environmental pollution • use of chemicals and closed recirculation systems • difficult procedures for obtaining permits and authorizations, which discourage new investments • unfair competition arising from tax evasion, fish imports or commercial fishing • losses caused by ichthyophagous birds • excessive bureaucracy with impact on the economic activity • production losses due to the application of environmental regulations • increase of production costs

1.3.3. Turkey

The content of the SWOT analyses were obtained from the questionnaires, interviews, previous reports prepared with the intensive participation of the stakeholders and from the minutes of DACIAT project meetings with the local partners/stakeholders.

According to the results of SWOT analyses (Table 1.31), there are further steps needed to increase aquaculture production, to make the sector attractive for new investors, and clean up the problems reducing the speed of development. It is obvious that all stakeholders agree on the future of aquaculture, important place of aquaculture industry to increase fish production and consumption per capita. If the main problems

defined as weaknesses and threats could be defeated or solved, the production may increase soon up to 500000 tons, exports may reach to 2 billion US$ by 2023 as short term targets.

Table 1.31. SWOT Analyses for Turkey

STRENGTHS	WEAKNESSES
• Strong institutional structure, governance, supporting policies and existence of technology and capacities, • Rich potential of inland and marine waters, rich, diverse flora and fauna, • Existence of suitable areas for aquaculture especially in the seas, • Sufficient knowledge and experience in the sector, • Export potential to neighbor and EU countries and experience, • The presence of dynamic entrepreneurs want to invest in aquaculture sector, • Domestic production of essential materials and equipment, • Developed mixed animal feed technology in domestic industry and presence of feed factories, • Availability of hatcheries and juvenile fish production, • Presence of modern processing, packaging and storage facilities, • Active quality control and residue monitoring program and system, • The presence of new species having high economic value candidate for aquaculture business, • The presence of trained labor force, institutions for education, training and research on aquaculture, institutions on fish farming, aquatic environment and fish health, • Obligation to employ educated/trained staff within the scope of the legislation, • Existence of official farm registry system.	• Lack of efficient/sufficient producer organizations (for market organization, price formation, international trade), • Low success at integrated coastal zone management, • and insufficient attempts to secure potential farming areas under marine spatial planning, conflicting interests with other sectors, • Inadequate extension services, training and public awareness actions on nutritional value of fish to increase consumption, • Insufficient employment of trained staff in the sector, • Lack of efficient traceability program for fish and their feeds, • Inadequate solution-oriented R&D activities, reproduction, larval feeding, live food, • Insufficient attempts for organic fish production and good agricultural practices in fish farming, • Presence of investor orientation towards cheap labor force rather than experience and competences, lower intention to keep well educated, experienced and skillful staff in order to reduce staff costs, • Infrastructure and experienced staff deficiencies on fish diseases and pests, high risks of disease transmission due to uncontrolled transfers of egg and larvae, • Failures to collect safe and reliable data, • Slow/limited introduction of new production methods, lack of poly-culture, targeting on mainly carnivorous species, neglecting bivalves and arthropods in aquaculture,
OPPORTUNITIES	**THREATS**
• Presence of diverse marine and inland water (in GAP[6] and DAP[7] Regions) potential, • High export potential, existence of alternative markets worldwide in addition to European countries, • Fast return of investment costs to income, • Supports for R&D projects, • High population of young and nutritional awareness, • Adequate labor force, • Potential of demand increase for human food, fish feed,	• Climate change and limited efforts to reduce the impact of climate change on aquaculture sector and investors. • High production costs (energy, feed, etc,), • Contraction in the European market (sea bass, sea bream), • Price fluctuations in fish feed and raw materials, • Insufficient fish consumption habits, • Prejudices against fish farms and aquaculture products, negative media pressure on aquaculture and products,

[6] South-eastern Anatolian Project-dam systems on rivers Tigris and Euphrates, 2235 km in total length, 6481 ha natural lakes ve 129987 ha dam reservoirs

[7] Eastern Anatolian Project – established to support development of 14 provinces in the Region

pharmaceutical products from macro and micro aquatic plants,
- Possibility to farm alternative species, richness in terms of biodiversity,
- Development of environmental projects by different disciplines and research units,
- Growth of ecological production practices and began to be adopted in Turkey,
- Having an efficient insurance system "TARSİM8 " for aquaculture companies,
- Existence of many economical crustacean species, especially Mediterranean mussels, in nature and the suitability of aquaculture techniques for Turkey's waters,
- Development of hydro-lysates method in animal waste in feed production,
- Availability of different animal or vegetable protein sources in feed production.
- Though simplified a great extent, the need of approval from other public bodies letting to increase,
- Ongoing discharge of domestic, industrial and agricultural wastes without any treatment, reducing potential clean water resources for aquaculture,
- Conflicts with tourism, historical and natural assets, national parks, protected areas and HEPPs9 on river systems,
- High competition in national and international markets,
- High impact of epidemic fish diseases, pressure on natural stocks (leaks, disease + parasites, chemicals, waste and residues, pressure on the food source),
- Conflicts between degree holder fishery engineers on fish disease and veterinaries authorized by the Veterinary Law,
- Lack of sufficient control and inspection at customs during the import of live species,
- Failure to establish balance of protection and use in terms of ecosystem sustainability

1.3.4. Ukraine

Ukranian SWOT analysis of the aquaculture sector comprises the categories of economic, social, technical, and environmental situation and infrastructures (Table 1.32).

Table 1.32. SWOT Analyses for Ukraine

STRENGTHS	WEAKNESSES
• Cheap labor (average monthly wage in the agricultural sector is $ 180 / month). • Low rental rate (~ US $ 70-120 / ha per rental year). • Privatization: 12 out of 36 state organizations were added to the list of privatizations (including 6 developing state organizations with great potential) • As the state is not an effective owner in Ukraine privatization will help increase the efficiency of companies. • Financial Assistance Programs for Aquaculture • Enterprises Launched No. 300 CMU). As a result, since 2017, businesses can apply for preferential lending. • The fisheries protection reform was implemented, the Fish Patrol was created, which led to a reduction in illegal fishing. • Deregulation measures: businesses need less time and resources to start and run a business Legislative framework for aquaculture businesses has been created. • Business representatives have not yet experienced	• Decrease in aquaculture production in dollar terms Relatively small exports compared to other countries are caused by the following: international retailers require a minimum volume of supply, which is 10 times higher than the production of Ukrainian companies; • Staff: redundancies in state-owned companies (60% of all industry employees are administrativestaff); lack of skilled labor. • Low concentration of firms and relatively low profitability of the industry. The cost of international certification is too high; export products of Ukrainian manufacturers must undergo separate veterinary analysis when exported to each country. • The considerable time required for customs clearance, as well as the lack of differentiation between exports and imports of living and nonliving objects, which leads to the transportation of these goods illegally. • Lack of state support. No VAT refund for fishery since January 1, 2017. • Lack of certification of supply chains.

[8] Agricultural Insurance system
[9] Hydroelectric Power Plants

significant improvements from the initiatives taken.
- Transparency and availability of data.
- Ukrainian aquaculture producers have the necessary business information that can
- The improve market conditions in Ukraine, but not all of the information is useful.
- The largest inland water basin (as of the end of 2015 the reservoirs for commercial fish in Ukraine covered an area of 101,760.6 ha) creates favorable conditions for the development of aquaculture.
- The industry has all the necessary constituents, but it requires additional investment: fish farming and fish processing; restoration and protection of fish stocks; aquaculture ponds and pools; commercial production of fish
- Decline of mechanisms of state regulation of functioning of fishery complexEnvironmental issues affecting fish populations: mass pollution of rivers; lack of land reclamation.
- Lack of farms cultivating fish material. Lack of infrastructure needed for aquaculture.
- Significant deterioration of the material and technical base.
- Lack of cold logistics; it is available for companies in other industries.

OPPORTUNITIES	THREATS
• Introduce VAT refunds or government support for the fisheries sector. • Possibility to stimulate national feed production. • Development of small businesses and farms. • No insurance for the fishing industry. • Introducing licensing procedures in aquaculture. • Establishment of certificates of origin for fish to prevent poaching of fish into the national trade network. • A draft law has been developed that aims to reduce the rent for water of land of the water fund from 3-12% of the regulatory land valuation to 3%. • Strengthen the protection of water bodies and increase penalties that will reduce illegal fishing and increase demand for legal fishing in the future. • Create a legal framework for rental rates. • Establishment of integrated legal structures aqua holdings, aqua parks, research centers and more. • Creating information centers for aquaculture innovation. • Implementation of electronic vessel and catch monitoring. • Development of organic aquaculture. • Increasing the refrigeration and processing capacity of the regional fishery complex. • Develop infrastructure for fisheries and cold logistics. • Creation of aqua farms with development of technologies of cultivation of delicacy products - sturgeon, trout, spearfish, whitefish, crawfish, freshwater giant shrimp, mussels, scallops and oysters. • Creation of marine fish farms for the cultivation of flounder, mullet and other species of fish. • Activation of marketing of domestic fishery products. • Introduction of closed-water aquaculture technologies	• High feed cost (~ 60% of total production costs). • High taxes (businesses claim tax increases and cancellation of VAT refunds. • Increase in the share of the shadow sector due to overregulation and tax burden. • Further possible devaluation of the national currency may lead to higher costs. • Extremely weak competitiveness in foreign markets of domestic fishery products. • Businesses were not informed about the submission of reports. • Lack of a regulatory framework for rental rates. • People's distrust of the State Fisheries Agency. • Difficulties in passing key laws legislative nonregulation of mechanisms for perspective development of the fish farm. • Insufficient consideration of the specificities of the fisheries sector in the legal field. • Low level of institutional capacity of the central fisheries authority to address fisheries regulation. • Imperfection of powers and deficiencies in the status of state fisheries protection bodies. • Lack of proper certification of finished and processed fishery products and, at the same time, the availability of technical barriers to its access to world markets.

using mechanical and biological filters for reuse of water in production

2. GOVERNANCE AT LOCAL, REGIONAL AND NATIONAL LEVEL, MAIN AUTHORITIES INVOLVED IN PARTNER COUNTRIES

2.1 Greece

2.1.1. Public and private institutions

Public and private aquaculture organizations aim to implement research, technological development and innovation projects whose research results are exploited and integrated into value chains for the sector. Their main objective is to create the necessary knowledge basis in the aquaculture sector by enhancing research and technology, in order to promote innovation, increase the competitiveness of the industry and stimulate productive activity at regional and national level. In addition, they seek to develop technical, scientific or organizational knowledge in aquaculture farms, which in particular will reduce the impact on the environment, reduce dependence on fishmeal and fish oils, enhance a sustainable use of aquaculture resources and improve or facilitate new viable innovative production methods, develop or market new aquaculture species with good market prospects, new or significantly improved products, or improve valued management and organization systems, and investigating the technical or economic feasibility of innovations, products or processes.

2.1.1.1. Public Organizations in Greece

2.1.1.1.1. Ministry of Rural Development and Food[10]

The responsibilities of the Ministry of Agricultural Development and Food (Ministry of Agriculture) include, among others, agricultural and livestock policy, vegetable and animal production and veterinary public health (health policy).

2.1.1.1.2. General Secretariat for Agricultural Development and Food:

The responsibilities of the General Secretariat for Agricultural Development and Food include agricultural and livestock policy, vegetable and animal production and veterinary public health (health policy).

2.1.1.1.3. Directorate-General for Fisheries

It is the administrative department of the Ministry of Agricultural Development and Food, which manages the sectors of collecting fisheries, aquaculture and marketing-processing of fishery products. The Directorate-General for Fisheries has a strategic aim of highlighting the primary sector through the development of collective fisheries and aquaculture, with the aim of optimizing the management of fisheries resources, implementing control of activities and promoting issues within the EU and International Organizations.
The Directorate-General for Fisheries is set up by the Directorates (FEK 138 A'15-09-2017) "Organization of the Ministry of Rural Development and Food".

2.1.1.1.4. Directorate of Fisheries Policy and Exploitation of Fishery Products

2.1.1.1.4.1. Department of Planning and Fisheries Applications

[10] http://www.minagric.gr/index.php/el/

2.1.1.1.4.2. Section of the Common Market Policy of the Common Fisheries Policy
2.1.1.1.4.3. Department of International Organizations and Regional Fisheries Management and International Relations Organizations
2.1.1.1.4.4. Department of Fishery Product Development and Promotion
2.1.1.1.5. Directorate of Fisheries and Fisheries Management
2.1.1.1.5.1. Department of Collective Fisheries Development
2.1.1.1.5.2. Department of Collective Fisheries Management
2.1.1.1.5.3. Department of Ecosystem Management of Fisheries Resources
2.1.1.1.6. Directorate of Aquaculture
2.1.1.1.6.1. Department of Aquaculture Development
2.1.1.1.6.2. Department of Aquaculture Management
2.1.1.1.6.3. Department of Extensive Aquaculture
2.1.1.1.6.4. Aquaculture Sector Data Department
2.1.1.1.7. Fisheries Activities and Products Control Division
2.1.1.1.7.1. Department of Coordination of National Audit Activities (Single Audit Authority)
2.1.1.1.7.2. Department of Audits
2.1.1.1.7.3. Department of Data Recording and Management Systems
2.1.1.1.7.4. Department for Combating Illegal, Illicit and Unregulated Fisheries

2.1.1.2. Public Organizations in Region of Eastern Macedonia and Thrace

2.1.1.2.1. Directorate-General for Regional Agricultural Economics and Veterinary Medicine[11]

The Directorate-General for Regional Agricultural Economics and Veterinary Medicine is responsible for coordinating and monitoring the operation of all its organic units and ensuring their proper functioning. It should be in constant cooperation with the Ministry in charge of dealing with the problems and cases of their responsibility better.

2.1.1.2.2. Directorate of Agricultural Economy - Department of Fisheries

The responsibilities of the Agricultural Economy Directorate are in particular the preparation of annual and multiannual regional development programs for agriculture, livestock and fisheries, the preparation and evaluation of relevant policy studies and measures, and the development and quality improvement of agriculture and quality. Livestock breeding in the field of crop production and livestock production respectively, in combination with the measures necessary for the development and modernization of agricultural holdings, n. Communicates with the relevant departments of the competent Ministries and implements national policies in the area of its competence in accordance with their instructions, collaborates, communicates and provides information to the municipalities of the region on the issues of its competence and provides the guidelines regional services, which carry out the responsibilities of agriculture, livestock and fisheries at regional level. In addition, joint events can be organized with the Primary Local Authorities or other bodies to better inform the farmers and serve them in general.

2.1.1.2.3. Directorate Land Policy

[11] https://www.pamth.gov.gr/index.php/el/dioikisi/ypiresies/g-dnsi-perifereiakis-agrotikis-oikonomias-kai-ktiniatrikis

The responsibilities of the Directorate of Land Policy include in particular the allocation of land to legal or natural persons and local governments, the sale, exchange and protection of residential land and the issuance, correction and cancellation of title deeds, the compilation of topographic programs, the establishment of topographic services by technicians, the compilation, maintenance and completion of thematic maps with locally collected data, as well as the periodic updating of local thematic maps with changes made, providing certificates and charts for customer service, as well as investigating construction review dossiers.

2.1.1.2.4. **Directorate of Veterinary Medicine**

The responsibilities of the Veterinary Directorate include in particular the protection of livestock throughout the Region, the safeguarding of animal health, the decision-making on animal diseases that may be epidemic and the taking of public health measures. The Directorate of Veterinary Medicine communicates with the competent services of the responsible Ministries, implements national and Community policies in the areas of its competence, in accordance with their instructions. The Directorate of Veterinary Medicine cooperates, communicates and provides information to the first-level regional TABs on matters of its competence and provides guidance to regional services dealing with Veterinary Medicine at the regional level.

2.1.1.2.5. Directorate of Agricultural Economy & Veterinary (Regional Entity of Drama)

Department of Fisheries

2.1.1.2.6. Directorate of Agricultural Economy & Veterinary (Regional Entity of Kavala)

Department of Fisheries

2.1.1.2.7. Directorate of Agricultural Economy & Veterinary (Regional Entity of Xanthi)

Department of Fisheries

2.1.1.2.8. Directorate of Agricultural Economy & Veterinary (Regional Entity of Rodopi)

Department of Fisheries

2.1.1.2.9. Directorate of Agricultural Economy & Veterinary (Regional Entity of Evros)

Department of Fisheries

2.1.1.2.10. Directorate of Agricultural Economy & Veterinary (City of Orestiada)

Department of Fisheries

The Department of Fisheries in each Regional Unit has a wide range of activities, with the most important being:

- Development of studies and programs for the development of fisheries.
- Management and exploitation of all water lands suitable for aquaculture.
- Determining the duration, beginning and ending of the period of prohibition of fishing in the rivers and lakes of territorial jurisdiction in a specific regional entity
- Monitoring and taking measures in all forms of contamination and pollution
- Recommendations for the preparation of multiannual and annual Fisheries Development Programs
- The approval and modification of the fisheries cooperatives' statutes
- The supervision and control of fisheries in the area of jurisdiction of the municipality.
- Collection and maintenance of aquaculture and inland fisheries data.
- Keeping records of all fish farms.
- Granting a fishing license

• Monitoring and implementation of EU Regulations and National fisheries legislation
• Organizing information meetings with fishermen, aquaculture workers and generally workers in fisheries enterprises

2.1.1.3. Private Organizations

- Professional Organizations (professional fishermen, aquaculture producers, fishery processors, fishery traders - traffickers)
- Environmental Organizations
- Non-Governmental Organizations
- Hellenic Aquaculture Producers Organization

2.1.1.4. Local development agencies

- Aitoliki Development Company SA
- Development Company Dwdekanisou SA
- Development Company Evoia SA
- Development Company Thessaloniki SA
- Development Company Cyclades SA
- Local Development Company Lesvos SA
- Development Company Halkidiki SA
- Pieriki Development Company SA

2.1.1.5. Social and Financial agencies

- Hellenic Association of Development Companies
- Greek network LEADER
- Panhellenic Confederation of Unions of Agricultural Cooperatives
- Geotechnical Chamber of Greece
- Association of Greek Food Industries
- Panhellenic Association of Shipowners of Professional Vessels
- Hellenic Seafood Association
- Panhellenic Association of Small and Medium-sized Fish Farmers
- Panhellenic Frozen Food Business Association
- Hellenic Association of Public Fisheries Professionals
- Athens Central Market Organization

2.1.1.6. Environmental agencies

- Greek Protected Areas Management Network
- Hellenic Society for the Protection of Nature
- WWF HELLAS - World Fund for Nature
- ARCHIPELAGOS Marine Protection Institute
- ARCHELON Association for the Protection of the Sea Turtle
- HELMEPA Hellenic Association for the Protection of the Marine Environment
- Society for the Study and Protection of the Mediterranean Seal
- MEDASSET – Mediterranean Association for the Salvation of Sea Turtles

2.1.2. National, regional and local strategies and programs

The great development of the Greek aquaculture, which took place during a period of thirty years starting in the 1980s, has led to the emergence of Greece as a leader in the relevant markets. According to the data contained in the study of the Special Framework for Aquaculture, in 2009 Greece was the largest producer of sea bream and sea bass in the world and represented about 50% of the total Mediterranean production. This picture has changed in recent years due to the problems faced by the largest business groups in the sector, with the country now ranked second.

The development of the activity resulted in a lack of guidance on the location of the units, but without a specific sectoral policy. The individual licensing of the plants, based on the requests of the stakeholders, has led to the concentration of areas with comparative advantages not only in their physical characteristics, but also in the movement of products and in places where aquaculture has already been shown to be suitable for aquaculture operation of older units. Thus, progressive areas of aquaculture activity were created, reinforced by subsequent legislative efforts to organize this activity. The first such effort was the Strategic Framework for the Development of the Marine Aquaculture in Greece prepared in 2000 at the Ministry of Environment and Physical Planning and the ΠΟΑΥ (Areas of Organized Development of Aquaculture) studies carried out either in the framework of the Fisheries Operational Program 2000-2006 or in the Regional Operational Programs (MIP) 2000-2006 (*Κάρκα, 2013*).

2.1.2.1. Strategies

The Department of Aquaculture and Inland Water at the Ministry of Rural Development and Food, in close cooperation with the relevant public services, research institutes and industry actors, has drafted the "**Multiannual National Strategic Plan for Water Development in Greece 2020"**. The preparation of the strategic plan followed the common strategic guidelines adopted by the European Commission [COM (2013) 229 final / 29.4.2013], taking into account the specific circumstances of the country, the state of the aquaculture sector in Greece and the legislative, institutional and administrative framework governing the operation of the sector. *(Ministry of Rural Development & Food, Multiannual National Strategic Plan for the Development of Aquaculture in Greece, 2014).*

In 2011, the **Special Spatial Planning Framework for Aquaculture** (SEA) was introduced. Organized Aquaculture Development Areas are the key tool not only for the implementation of the SEA but essentially for the development of the industry. The management bodies of the Organized Aquaculture Development Areas are composed of companies, in which chambers, local authorities, etc. can participate. (*Κάρκα Λ., Κανελλοπούλου Κ., 2018*).

The **Zones of Development of Productive Activities** (ZAPD) were introduced by Article 24 of Law 1650/1986. ZAPD were designated areas or areas suitable for the development of industrial, mining, quarrying or tourism activities or for agricultural exploitation. Reference to aquaculture zones was not included unless it could be considered to fall under the category of agricultural holdings.

A systematic approach to the creation of zones for productive activities is attempted in Law 2742/1999. Section 10 of the law that perfects the preceding article 24 of Law 1650/1986 refers to **Productive Activity Development Areas** (PDOs) which generally follow the same philosophy as the previous legal regime. The most interesting element of the new law is its specific references to aquaculture. The special provision for the activity already emerges from the definition of zones: 'Areas of organized productive activity development (CDDP) are defined as marine areas and land areas ...'. A second element of the law that is

worth highlighting is the emphasis placed on the HRDO body and, more generally, the change of philosophy in the treatment of zones.

At the time of the adoption of the Special Framework for Spatial Planning and Sustainable Development for Aquaculture (2011) the situation in the aquaculture sector had changed dramatically with the creation of significant concentrations in some areas. A key issue was now the protection of existing units from abusive practices that jeopardized both the unit's existence itself and the environment in their area from overloading, as well as the protection of activity from competitive uses. The Organized Aquaculture Development Areas were therefore reduced to a tool for delimiting activity and to safeguards aimed at not exceeding environmental strengths as opposed to the past, which provided for only a threshold for capacity generation (at least 500 tonnes). Two large categories of areas were identified in the accompanying Map of the Framework: areas that were considered to be suitable for aquaculture development using macroscopic criteria, and areas for the establishment of aquaculture sites that are highly prestigious and within the PA areas (*Κάρκα Λ., Κανελλοπούλου Κ., 2018, Ειδικό Πλαίσιο Χωροταξικού Σχεδιασμού και Αειφόρου Ανάπτυξης για τις Υδατοκαλλιέργειες ΦΕΚ 2505/Β/2011*).

In the framework of the implementation of Regulation (EU) No. Commission Regulation (EC) No 717/2014 (OJ L190 / 45, 28.06.2014) grants of state aid to the aquaculture sector after the necessary checks have been completed. The amount of the payment is covered by the regular budget to support beneficiaries who have suffered severe reductions in their fishing activities due to adverse weather conditions. Eligible beneficiaries are approved after audits by the Directorate-General for Fisheries of the Ministry of Rural Development and Food.

The Integrated Fisheries Activities Monitoring and Recording System (IPSF)[12] is implemented by the Directorate-General for Sustainable Fisheries in the framework of the implementation of the rules of the Common Fisheries Policy, Control Regulation and the IUU. 90% of the funding for the project comes from the European Commission under Council Regulation (EC) No 861/2006 and Commission Regulation (EC) No 391/2007 as approved by No 011/431 / EU (code Project: EL / 11/01) Commission Implementation Decision and 10% of the RAP, of a total of € 2,070,000 available EU assistance and financing eligibility deadline on 30th / 6/2015. For the implementation of the project signed on 2.3.2012 Programming Agreement with the Information Society SA according to the number 5000.1 / 62/2011 (Government Gazette 3049 / B / 2011) Decision, within the framework of which ISA SA conducted an open international competition and a contract was signed with the association of PWC and IKNOWHOW companies, and no.591 / 63346/2013 (FEK 1299 / B / 2013) was adopted to define the funding framework for IT SA.

In addition, the Greek Government is planning to set up the National Aquaculture Council and to regulate the functioning of the Organized Aquaculture Development Areas. The National Aquaculture Council will deliver an opinion to the Minister for Rural Development and Food on aquaculture policy issues. In particular, it will deliver an opinion on:

- The formulation and implementation of the National Aquaculture Development Program.
- The institutional reforms needed to support the sector's development strategy, through development-financing programs, as well as any other institutional arrangements.
- Any other matter assigned to it by the Minister of Rural Development and Food

[12] http://www.alieia.minagric.gr/?q=ospa

2.1.2.2. Programs

Fish farms are subsidized in Greece and their subsidies are highly absorbent. Greece is the second country to receive subsidies from EU funds. The most important competitor countries of the European Union as a whole are those of Asia and Latin America. For Greece, the biggest challenge comes from neighboring Turkey. The European Commission is trying to set a vision for the sustainable development of aquaculture. The objectives are to promote competition, encourage sustainability and promote the products of fish farming.

The adoption of cage farming technologies by the salmon industry, the increased market demand for these species and the natural conditions provided by the Greek climate and the extensive coastline have made it the country of choice for the development of the sector. Large-scale aid programs by the European Union and private entrepreneurs have led to a sharp increase in production and Greece has become the largest producer of these species (seabass and seabream) in the world (Μπασιούλη Ιωάννα, 2014).

- **National Aquaculture Development Program**

In the aquaculture sector a national development program is referred to as the National Aquaculture Development Program. This program OPAC, within the framework of the European Union's Common Fisheries Policy (EU), comprises the national development objectives, in accordance with the guidelines of national spatial planning. It is approved by a decision of the Minister of Rural Development and Food, following the opinion of the National Aquaculture Council of Article 3. The priorities of the program are:

a. Sustainable aquaculture development to become a key driver of the development of the primary sector and of the Greek economy in general, by improving the productivity of existing aquaculture units, expanding their activity and promoting innovation
b. Settling relationships with other users, especially the coastal zone, to eliminate the conflict of interest and make effective use of land uses
c. Simplify and modernize the institutional framework for licensing, control of activity and relationships between administrative and productive actors, to enhance efficiency and create a friendly environment for attracting new private investment
d. Encouraging research and innovation
e. Promoting social equality and cohesion through :
    i. encouraging the involvement of all stakeholders (management, aquaculture, wholesalers and retailers and consumer associations) in the decision-making process related to the development policy of the sector,
    ii. the production of high quality and nutritional products that meet the current nutritional needs of consumers and
    iii. increasing the employment of science and labor, especially in border regions and remote islands (*LAW 4282/FEK A 182/29.08.2014*)

- **Fisheries and Maritime Operational Program** 2014-2020[13]

The vision is to promote environmentally sustainable, resource-efficient, innovative and competitive fisheries and aquaculture, and to promote blue sea development and maritime skills in Greece.

Basic aims of the program:

a. Improving the competitiveness of the aquaculture and processing sectors

[13] https://www.espa.gr/el/pages/staticOPMaritimeFisheries.aspx

b. The sustainability of marine fisheries and the sustainable development of traditionally dependent areas
c. Protecting and restoring the marine environment and living resources, controlling fishing activities, collecting fisheries data and improving knowledge of the marine environment

- **Innovation in aquaculture of the Fisheries and Maritime Operational Program**[14]

The Program is addressed to research organizations (Universities, Research Centers, Institutes, Technological Bodies) according to the definitions of Law 4310/2014 and Law 4386/2016 as applicable, and to aquaculture companies for the implementation of projects aimed at:

a. Developing technical, scientific or organizational knowledge in aquaculture farms, which will in particular reduce the impact on the environment, reduce dependence on fishmeal and fish oils, enhance a sustainable use of aquaculture resources, improve livelihoods or improve livelihoods new sustainable innovative production methods
b. Development or introduction of new aquaculture species with good market prospects, new or significantly improved products, or improved management and organization systems
c. Investigation of the technical or economic feasibility of innovations, products or processes

- **Operational Program "Competitiveness, Entrepreneurship and Innovation" with Specific Actions "Aquaculture" - "Industrial materials" - "Open innovation in culture"**[15]:

The specific aquaculture action is co-financed by the European Regional Development Fund (ERDF) under the NSRF Competitiveness, Entrepreneurship and Innovation. The action aims to collaborate between dynamic businesses and R&D organizations to implement research, technological development and innovation projects whose research results are valued and integrated into value chains.

2.2. Romania

2.2.1. Public and private Institutions

Public and private institutions in Romania	Main activities
The Ministry of Agriculture and Rural Development (MADR)[16]	The Ministry of Agriculture and Rural Development is organized and activates according to the provisions of the Government Decision no. 30/2017 with further modifications and completions.[17] The Ministry of Agriculture and Rural Development is a specialized body of the central public administration, with legal personality, reporting to the Government, having responsibilities in agriculture and food production, rural development, land improvements, as well as in related fields: specialized scientific research, preservation and sustainable management of soils and vegetal and animal genetic resources. The aquaculture related goals of The Ministry of Agriculture and Rural Development are the following: • ensuring national food safety by increasing and diversifying

[14] https://www.espa.gr/el/pages/ProclamationsFS.aspx?item=3535
[15] https://www.espa.gr/el/Pages/ProclamationsFS.aspx?item=3473
[16] https://www.madr.ro/
[17] http://legislatie.just.ro/Public/DetaliiDocument/188281

	agricultural production, in order to guarantee sufficient, safe and nutritive food products for the population; • increasing the competitivity of Romanian agro-food and fishery products on the European and global markets in order to offset the agricultural trade balance, including through specific information actions; • absorption of Community funds intended for the funding of specific fields; • development of the fishery sector. The Ministry of Agriculture and Rural Development also has the function of Managing Authority for the Operational Programme for Fisheries and Maritime Affairs – POPAM 2014-2020.
General Direction for Fisheries – Managing Authority for the Operational Programme for Fisheries and Maritime Affairs (DGP-AMPOPAM)[18]	The General Direction for Fisheries – Managing Authority for POPAM activates according to MADR Order no. 1656/R/25.09.2018 regarding the approval of the organizational and operational Regulations for the Ministry, with further modifications and completions.[19] DGP-AMPOPAM has the following organizational structure: a) Technical Assistance Department b) Control Department c) Regional Departments d) Contracting Selection Department - Assessment-Selection Office - Contracting Department e) Local Development Department f) Programmes, Methodology and Monitoring Service g) Payments Approval Direction - Beneficiaries Purchases Service - Management Verifications Service The General Direction for Fisheries – Managing Authority for POPAM has duties regarding the development of strategies for the fisheries and aquaculture sector, of the Operational programme for Fisheries and Maritime Affairs 2014-2020 and of other funding programmes for fisheries and aquaculture. DGP-AMPOPAM issues the Applicant Guides for Project Calls, organizes project calls, performs evaluation and selection of funding applications submitted under the projects calls, performs the contracting of projects, approves procurement files and applications for reimbursement/payment, makes project payments and monitors the projects for a period of 5 years after the final payments are made. Project funding in the aquaculture sector can be done by accessing non-reimbursable funds available through the Operational Programme for

[18] https://www.ampeste.ro/
[19] https://www.madr.ro/organizare/regulamentul-de-organizare-si-functionare-al-madr.html

	Fisheries and Maritime Affairs 2014-2020 under the calls for projects launched by DGP-AMPOPAM[20] DGP-AMPOPAM, through the Local Development Department, gives support to Fisheries Local Action Groups (FLAGs) in implementing the strategies for local development of the fishery and aquaculture areas.
The National Agency for Fisheries and Aquaculture (ANPA)[21]	The National Agency for Fisheries and Aquaculture is organized and operates according to the provisions of the Government Decision no. 545/2010, with further modifications and completions.[22] The National Agency for Fisheries and Aquaculture operates under the Ministry of Agriculture and Rural Development and has the following functions regarding/related to aquaculture: • developing and implementing the national strategy and regulations regarding: preservation and management of the living aquatic resources existing in the natural fishery habitats, aquaculture, processing and organizing of the fisheries products market, fisheries and aquaculture structures; • management of living aquatic resources from the natural fishery habitats, except for those within the "Danube Delta" Biosphere Reserve; • inspection and control; • privatization of the trading companies with fishing profile and the fisheries/fish farms within their portfolio; • concession of lands whereon fisheries/fish farms are located, except for those within the "Danube Delta" Biosphere Reserve, as well as other related lands from the public domain of the state, under the terms of law; • sale of lands that are private property of the state, whereon fisheries are built, including special installations located on land; ANPA's duties related to aquaculture: ▪ setting up actions for the higher exploitation of the genetic potential, by introducing some valuable species in aquaculture ▪ setting up actions to increase the quality of aquaculture products; ▪ adopting actions for ensuring aquaculture production in case of force majeure; ▪ setting up actions to ensure animal health and welfare; ▪ setting up actions to adapt production to market requirements; ▪ setting up actions for introducing good practices in aquaculture; ▪ encouraging the application of reproduction and culture technologies for species with high economical value and promotion of organic fishery products; ▪ organizing and updating the Register of Aquaculture Units and issuing aquaculture licenses;

[20] https://www.ampeste.ro/popam-2014-2020/ghidul-solicitantului-popam.html
[21] http://www.anpa.ro/
[22] http://legislatie.just.ro/Public/DetaliiDocument/119997

	▪ setting up other actions required by the needs of aquaculture development, according to the law; ▪ setting up criteria for introducing new species in Romania. Relevant information for aquaculture is available at the website[23].
Administration of Danube Delta Biosphere Reserve (ARBDD)[24]	The Administration of "Danube Delta" Biosphere Reserve is the public institution with legal personality that operates under the Ministry of Environment, Water and Forests, according to the Government Decision no. 1217/2012 regarding the approval of the organizing and operating regulations and the organizational structure of The Administration of Danube Delta Biosphere Reserve, with further modifications and completions. The territory of the "Danube Delta" Biosphere Reserve includes the area of national and international ecological importance provided in art. 1 of Law no. 82/1993 regarding the establishment of the "Danube Delta" Biosphere Reserve, with further modifications and completions, consisting of the following physical-geographical units: Danube Delta, Sărăturile Murighiol-Plopu, Razim-Sinoe lagoonal complex area, the maritime Danube up to Cotul Pisicii, Isaccea-Tulcea sector with its flood zone, the Black Sea coast from Chilia Branch to Capul Midia, the inland maritime waters and the territorial sea, up to the 20 m isobath included. As to administrative territorial organization, the Reserve extends on the territories of Tulcea, Constanţa and Galaţi Counties. The Reserve Administration manages the natural patrimony according to the legal provisions on the legal status of public property, evaluates ecologic condition of the Reserve's natural patrimony and initiates scientific research programmes in the reserve, based the on management plan, ensures the needed actions for preservation and protection of genepool and biodiversity. ARBDD manages the fishery resources within the state public domain, according to the provisions of the management plan and reserve regulations, and fulfills environment authority function, under the terms of the law, on the reserve's territory. Information regarding documents issued by ARBDD for aquaculture development in its competence area is available at the website.[25]
The National Administration "Romanian Waters" ("Apele Române")[26]	Established by the Government Decision no. 107/2002, with further modifications and completions, the entity is the sole operator for natural or arranged surface water resources, regardless of the holder of the development, and for groundwater resources regardless of their nature and related facilities, for which purpose it allocates the right to use the water resources with their natural potential, under the terms of law, except for those expressly provided by applicable specific

23 http://www.anpa.ro/?cat=10
24 http://www.ddbra.ro/
25 http://www.ddbra.ro/accesul-la-informa-iile-publice-de-mediu
26 http://apele-romane.ro/

	regulations. Information regarding the documents issued by the National Administration "Romanian Waters" ("Apele Române") needed to initiate projects/affairs in aquaculture is available.[27]
The National Environment Protection Agency (ANPM)[28]	The National Environment Protection Agency has competencies in implementing the policies and laws in the field of environmental protection, granted on the basis of the Government Decision no.1000 dated October, 17, 2012, with further modifications and completions. ANPM's mission is to take action for ensuring a healthy environment for the population harmonized with the economic development of the country. ANPM has the following duties: • environmental strategic planning; • environment factors monitoring; • approval of activities with environmental impact; • national and local implementing of environmental legislation and policies; • -reporting to the European Environment Agency on the following fields: air quality, climatic changes, protected areas, soil, water contamination. ANPM has 42 subordinated county agencies fulfilling the duties of the National Environment Protection Agency to implement the policies, strategies and legislation in the field of environment protection for each county and Bucharest. The County Agencies issue environmental approvals for the plans to be implemented on their county territory or in Bucharest, giving prior information to the National Environment Protection Agency and carry out the procedure for issuing the integrated environmental authorization. Information regarding documents issued by the National Environment Protection Agency needed to initiate projects/affairs in aquaculture is available[29].
The National Sanitary Veterinary and Food Safety Authority (ANSVSA)[30]	The National Sanitary Veterinary and Food Safety Authority operates as a regulatory authority in the sanitary-veterinary area and for food safety, on the basis of the Government Decision no. 1415/2009, with further modifications and completions. The Authority's mission is accomplished through health protection along the entire food chain – meaning in each stage of the production process from farm to consumer – preventing food from being contaminated and promoting food hygiene and transparent information of consumers regarding food and animals' health and

[27] http://apele-romane.ro/ro/page/informatii-de-interes-public
[28] http://www.anpm.ro/
[29] http://www.anpm.ro/legislatie
[30] http://www.ansvsa.ro/

	welfare. ANSVSA's activities are the following: • Approval and certification in sanitary-veterinary and food safety areas; • Monitoring and control of activities in sanitary-veterinary and food safety areas; • Elaboration of the legal framework and specific regulations for activities in the sanitary-veterinary and food safety areas; • Laboratory testing; • Certification of private laboratories; • Establishing export protocols with third party countries; • Management of crisis situations; • Pesticides monitoring; • Supports fighting against food waste. ANSVSA is represented for each county by sanitary-veterinary and food safety directions, and locally, by area sanitary-veterinary divisions and sanitary-veterinary and food safety divisions. Information on documents issued by the National Sanitary Veterinary and Food Safety Authority is available.[31]
Fisheries Local Action Groups (FLAG)	The Fisheries Local Action Groups are public-private partnerships, consisting of representatives of local public authorities and institutions, private sector and civil society, having the same interests and goals to elaborate and implement a development strategy for fishing and aquaculture. Within the programming period 2014-2020, at national level, DGP-AMPOPAM selected 22 FLAGs[32]. The Fisheries Local Action Groups (FLAGs) that perform their activity in the South-Eastern Development Region: • Association Local Group for Promoting the Integrated Development of the Fisheries Area of Braila County[33] • Association for Sustainable Development „Prut-Dunăre" Galaţi[34] • Association "Local Group for Sustainable Fisheries in the Danube Delta " [35] • Association Fisheries Local Action Group for the Old Danube – Macin Branch[36] • Association FLAG Mangalia Litoral[37] • Association Fisheries Local Group DOBROGEA NORD[38] • Association Fisheries Local Group DOBROGEA SUD[39]

[31] http://www.ansvsa.ro/ansvsa/modele-de-formulare/
[32] https://www.ampeste.ro/docs/POPAM/Ghiduri/FLag-uri_/Lista_FLAGs_contact_teritorii_POPAM_2014_2020.pdf
[33] https://www.pescuitbraila.ro/
[34] https://www.flagalati.ro/
[35] http://www.flagdelta.ro/
[36] https://www.flagbratulmacin.ro/
[37] http://afml.ro/
[38] http://www.flagnord.ro/
[39] http://www.flagsud.ro/

	• Association FLAG DUNĂREA DOBROGEANĂ[40] The fisheries local action groups implement local development strategies, within which projects dedicated to the aquaculture sector may be funded.

2.2.2. National, regional and local strategies and programmes

National, regional and local strategies and programmes	Document description
The National Strategy for the Fisheries Sector 2014-2020 (SNSP)[41]	The National Strategy for the Fisheries Sector 2014-2020, document issued on the basis of a socio-economic study, in conjunction with national policies and the EU Common Fisheries Policy, has as a general objective to contribute to food safety and public health in Romania by increasing production of fish and fish products from internal production, of higher quality, in compliance with the sustainability rules of the sector. Specific goals proposed within SNSP have been structured according to the following directions for action: 1. Encouraging innovative, competitive and knowledge based fisheries and aquaculture, including related processing; 2. Promoting sustainable and efficient fisheries and aquaculture from the point of view of resource utilization, including related processing; 3. Strengthening the control, inspection system and implementing and improving data collecting activities; 4. Increasing employment and territorial cohesion. Specific goals in SNSP regarding aquaculture will be achieved according to the Multiannual National Strategic Plan for Aquaculture 2014-2020. The financial resources needed to implement the actions provided by the strategy will be provided from the National Budget, the European Fund for Fisheries and Maritime Affairs and from the own contributions of the European funds beneficiaries managed by DGP-AMPOPAM.
The Multiannual Strategic Plan for Aquaculture 2014-2020[42]	The general objective of the plan is fostering environmentally sustainable, resource-efficient, innovative, competitive and knowledge-based aquaculture.

[40] http://www.afdd.ro/

[41] https://www.madr.ro/docs/fep/programare-2014-2020/Strategia-Nationala-a-Sectorului-Pescaresc-2014-2020-update-apr2014.pdf

[42] https://www.madr.ro/docs/fep/2015/popam-2014-2020/PSNMA-2014-2020-versiune-oficiala-15.04.2015.pdf

	The strategic objective for the 2014-2020 period is to support the aquaculture sector in order to achieve a fish production of 36 thousand tons. In order to carry out the plan, the following directions for action were established: 1. Upgrade and retooling through technological development, innovation and knowledge transfer. 2. Enhancement of the competitiveness and viability of aquaculture enterprises, including the improvement of safety and working conditions, in particular of SMEs. 3. Promoting a resource-efficient aquaculture. 4. Promoting the aquaculture that provides environmental services. 5. Promoting conversion to eco management and audit schemes and ecological aquaculture. 6. Promoting animal health and wellbeing actions, as well as public health and safety. 7. Development of professional training, new professional skills and lifelong learning. 8. Stimulating innovation in aquaculture in order to develop technical, scientific or organizational knowledge within aquaculture farms that reduce environmental impact, promote the sustainable use of aquaculture resources, improve animal welfare or facilitate new sustainable production methods. The measures regarding the proposed actions for the development of Romanian aquaculture consist of: • Upgrading the existing aquaculture farms, active and inactive, of extensive or semi-extensive type; • Building of new aquaculture farms, including those of intensive type; • Increasing the range of culture species used in the Romanian aquaculture; • Promoting business diversification within aquaculture farms to ensure additional sources of income and sustainable aquaculture growth; • Exploitation of the main competitive factors of the aquaculture sector, represented by the high standards on environment, animal health and welfare and consumer protection; • Sustainable development of aquaculture through coordinated planning of: available land surfaces for building new aquaculture farms and water surfaces in the Black Sea coastal area to locate mariculture farms; • Development of environmental friendly aquaculture technologies; • Development of extensive aquaculture in reservoirs; • Development of ecological aquaculture; • Simplifying the administrative procedures;

	• Ensuring aquaculture stocks by covering losses caused by natural disasters, unfavorable climatic phenomena, sudden changes in water quality beyond farmer's liability and diseases in the aquaculture sector, damage or destruction of production facilities beyond farmer's liability; • Training of producers in Romanian aquaculture regarding EU regulations on aquaculture; • Promoting fair competition conditions for operators by capitalizing on their competitive advantages; Financial resources needed for the implementation of the action plan are supported on a share of about 46% of the European Maritime and Fisheries Fund (EMFF) allocation for Romania, to which the amounts from national budget and own contribution of potential beneficiaries are added.
Operational Programme for Fisheries and Maritime Affairs 2014-2020 (POPAM[43])	The general objective of POPAM 2014-2020 aims: increasing the production in aquaculture and processing; increasing the profitability of operators; preserving biodiversity and environment protection; maintaining and creating jobs, especially in the fisheries area; strengthening the role of scientific and research institutions, including for data collection improvement; improving the organization of the internal market in order to promote local production. Within POPAM 2014-2020, for the aquaculture area, the following types of actions are proposed for funding: *Union Priority 2 (PU2) – Fostering environmentally sustainable, resource-efficient, innovative, competitive and knowledge-based aquaculture* 1. Support to strengthen technological development, innovation and technical knowledge transfer, that will allow the development of technical, scientific or organizational knowledge in aquaculture farms, production diversification with species having a good potential on the market, significant improvement of products, processes and organizational systems at farm level; technical and economic feasibility studies on products and innovative processes. 2. Enhancement of the competitiveness of aquaculture enterprises, including the improvement of safety and working conditions, in particular of SMEs. The aim is the support for achieving a competitive development of aquaculture when establishing and modernizing aquaculture farms. This will include all types of investments related to added value of the products, increase of production and resources efficiency, including waste treatment and complementary activities related to basic activities of aquaculture enterprises. 3. Protection and restoration of aquatic biodiversity and the enhancement of ecosystems related to aquaculture and the

[43] https://www.ampeste.ro/popam-2014-2020/programul-operational-pentru-pescuit-si-afaceri-maritime-2014-2020.html

	promotion of resource-efficient aquaculture through investments leading to increase of energetic efficiency and resources, and reducing the use of water and chemical substances. Also, Romania's intention is to support establishing the real production potential of the aquaculture sites. 4. Promotion of aquaculture having a high level of environmental protection and the promotion of animal health and welfare, improvement of water quality, wet areas and aquatic biodiversity by providing environmental services through farms that are subject to specific management requirements resulted through the appointment of Natura 2000 areas. For PU2 funding, within POPAM 2014-2020, the amount of 89 489 843.00 euro was allocated from the total of 168 421 371.00 euro that will be provided from FEPAM. The applicant's guides for project calls launched by DGP AMPOPAM are available at their website. [44]
Development strategies for FLAGs in the South-East Region	Within POPAM 2014-2020, Union Priority 4-Increasing employment and territorial cohesion, the Fisheries local action groups implement local development strategies, within which projects dedicated to the aquaculture sector may be funded. FLAGs' strategies in the South-Eastern Development Region are available at the following addresses: - Association Local Group for Promoting the Integrated Development of the Fisheries Area of Braila County[45] - - Association for Sustainable Development „Prut-Dunăre" Galaţi[46] - Association "Local Group for Sustainable Fisheries in Danube Delta "[47] - Association Fisheries Local Action Group for the Old Danube–Macin Branch[48] - Association FLAG Mangalia Litoral[49] - Association Fisheries Local Group DOBROGEA NORD[50] - Association Fisheries Local Group DOBROGEA SUD[51] - Association FLAG DUNĂREA DOBROGEANĂ [52]

2.3. Turkey

2.3.1. Public Organizations

2.3.1.1. Ministry of Agriculture and Forestry (MAF)

[44] https://www.ampeste.ro/popam-2014-2020/ghidul-solicitantului-popam.html
[45] https://www.pescuitbraila.ro/wp-content/files/SDL_actualizata_conform_AA4.pdf
[46] https://www.flagalati.ro/strategie/136-strategia-de-dezvoltare-a-zonei-pescaresti-prut-dunare-galati
[47] http://www.flagdelta.ro/popam-2014-2020.html
[48] https://www.flagbratulmacin.ro/wp-content/uploads/2017/07/STRATEGIA-DE-DEZVOLTARE-LOCALA-FLAG-DUNAREAN-VECHE-BRATUL-MACIN.pdf
[49] http://afml.ro/strategia-de-dezvoltare.html
[50] http://www.flagnord.ro/documente/SDL%20-%20FLAG%20DOBROGEA%20NORD%20revizuita.pdf
[51] http://www.flagsud.ro/strategie.pdf
[52] http://www.afdd.ro/strategia-de-dezvoltare.html

MAF with the Provincial Directorates is the designated authority for the fisheries and aquaculture activities: investment, monitoring and control, inspection and monitoring, research and development, marketing and fish diseases in the field of fish farming.

The MISSION of MAF is to:

- achieve accessibility to safe food and quality agricultural products needed in markets,
- ensure sustainable use of agricultural and ecological resources,
- determine and implement policies in order to raise the standard of living in rural areas,

With the VISION as to:

- provide the highest level of producer and consumer satisfaction,
- make Turkey the leading country and to become a global actor in the world.

Sub-directorates in the organogram of MAF related with aquaculture activities are given below.

2.3.1.1.1. General Directorate of Fisheries and Aquaculture (GDFA)

Main functions and responsibilities of GDFA are summarized below:

- to specify and encourage the principles of sustainable fishing, aquaculture and fishing in seas and inland waters,
- to protect fisheries and aquaculture resources, determining the areas of protection, production and aquaculture, and taking essential measures to protect these areas from any kind of losses,
- to determine the principles regarding the fisheries and aquaculture products to be imported and exported and their inputs,
- to carry out activities related to the development of fisheries and aquaculture production resources and to increase efficiency, to carry out controls and audits,
- to take measures regarding the supply of inputs necessary for increasing fisheries and aquaculture production and efficiency,
- to determine the principles regarding the fields of harvest suitable for fisheries and aquaculture, and to determine the minimum qualifications and conditions of rental vehicles, the principles of lease and use,
- to work on fisheries and aquaculture production, development and research projects,
- to establish an information system related to fisheries and aquaculture.

2.3.1.1.1.1. Directorate of Aquaculture (DA)

MISSION of the DA is defined as:

- to protect aquatic living resources and habitats,
- to exploit by considering the balance of protection and use,
- to provide sustainability by establishing an effective control and inspection system.

In order to reach the targeted mission, the VISION of DA is:

- to ensure supply security in aquaculture,
- to increase the income and welfare of the fish farmers,
- to be a competent institution to operate the industry with responsibility awareness.

The duties of the Directorate of Aquaculture are as follows:

- to specify areas suitable for aquaculture development, to make or order to make border determinations of these places,
- to determine the principles of aquaculture investments, to approve projects of real and legal persons,
- to develop and expand environmentally friendly production models,
- to monitor the environmental impacts of aquaculture activities and take necessary measures,
- to prepare joint projects with the aquaculture unions and related sectors about duties,
- to carry out the procedures for leasing aquaculture areas, to prepare or order to prepare and implement projects to ensure the sustainability of resources,
- to develop proposals related aquaculture incentives and supports, and contributing to applications,
- to develop and spread the cultivation of alternative species,
- to determine the egg, juvenile and brood fish qualities and import conditions of the inland and marine fish to be used in aquaculture,
- to certify aquaculture products and to create a registration and follow-up system for them.

2.3.1.1.1.2. Directorate of Resource Management and Fisheries Infrastructures (DRMFS)

Duties of DRMFS are to:

- monitor and evaluate the impact of fish farm and farming activities on the ecosystem,
- determine and apply the principles regarding artificial reef applications in order to increase the resource efficiency of aquaculture,
- carry out the works and transactions related to the lease of aquaculture areas,
- supervise and monitor water quality criteria in water resources,
- evaluate and supervise the activities to be done such as filling, drying, changing its shape, taking sand, gravel in aquaculture areas.

2.3.1.1.1.3. Directorate of Statistics and Information Systems (DSIS)

Duties and responsibilities of DSIS regarding aquaculture is:

- to establish and operate information systems for fisheries and aquaculture,
- to collect and evaluate all kinds of statistical data on fisheries and aquaculture, and create a database,
- to cooperate with internal and external units on data sharing and information exchange,
- to carry out statistical studies on aquaculture support,
- to determine and evaluate the socio-economic situation related to seafood,
- to prepare statistical reports and evaluations about the data collected on aquaculture and fisheries,
- to determine the principles of imports and exports of captured and cultured fish.

2.3.1.1.1.4. Directorate of Administrative Affairs and Coordination (DAAC)

DAAC is responsible to:

- prepare the legislative proposals on fisheries and aquaculture on behalf of DGFA, the subjects falling within the field of duty of the DG, to ensure that opinions are formed about the drafts, to form the opinion of the DG regarding the laws, regulations etc, legal arrangements from other institutions,
- cooperate with the relevant departments of the Ministry in the fields of preparation and realization of national and international training programs of the staff in the projects carried out by the DG,

- ensure coordination in the works related to the delegations and persons to be sent abroad and to come from abroad,
- provide coordination with countries and international organizations in matters within the scope of the DG, to ensure that opinions are formed within the framework of international bilateral and technical cooperation agreements, to help realize the issues stipulated in the agreements in cooperation with the relevant department of the Ministry,
- prepare the annual publication program draft of the DG, to ensure that the works decided to be published are reviewed and printed by the publishing committee,
- ensure the preparation and implementation of annual in-service training programs of the GeneralDirectorate in coordination with the Department of Education, Training and Publications,
- monitor the physical and cash performance of internal and external projects in certain periods, and to send the reports on developments to the relevant units.

2.3.1.1.2. General Directorate of Agricultural Research and Policies (GDARP)

Main function is the research and policy development in agricultural business; with the declared Mission:

- to achieve access to reliable food and quality agricultural products needed by national and international markets,
- to ensure the sustainable use of agricultural and ecological resources,
- to set and implement policies to raise the standard of living in rural areas.

and Vision:

- to ensure the highest level of producer and customer satisfaction in the field of food and agriculture,
- to make Turkey the leader in the region and global actor in the world.

Aquaculture related duties of GDARP can be summarized as follows:

- to determine agricultural research and development strategies and priorities in line with national development plans, to prepare, prepare, implement and implement projects,,
- to develop and register races and variates, and to produce their core materials,
- to protect and develop domestic gene resources, to provide access to gene resources and to share their benefits, work on authorizing, monitoring and auditing works,
- to make researches for the development and rational use of soil and water resources,
- to determine the research targets of the research institutions affiliated to the Ministry and to supervise these organizations,
- to conduct research on vaccines, serum, biolOJical and chemical substances and protection drugs used in animal and plant diseases, and effective and auxiliary substances included in their composition,
- to carry out scientific researches about aquatic organisms in seas and inland waters and to support them,
- to carry out research and development activities in national and international platform and support projects within this scope,

3.3.1.1.2.1. Directorate of Livestock and Aquaculture Research (DLAR)

DLAR aims to:

- prepare, or order to prepare, implement, monitor, and evaluate research projects on the protection of aquaculture stocks in inland waters and seas, increasing production and quality, determining aquaculture production areas,
- to ensure the registration of the results obtained from the research studies, and to maintain the brood stock,
- to prepare or order to prepare, implement, monitor and evaluate projects related to collection, conservation and evaluation of animal husbandry and aquaculture gene resources,
- to cooperate with relevant institutions and organizations in order to extend and transmit the findings and results obtained from the research studies.

2.3.1.1.3. General Directorate of Forestry

2.3.1.1.3.1. Directorate of Nature Protection and National Parks[53]

Duties of this Directorate are to manage terrestrial hunting, biodiversity, nature protection, sensitive areas, natural parks, wildlife.

2.3.1.1.4. General Directorate of Food and Control[54]

Established pursuant to Article 413 of the Presidential Decree No. 1 on the Organization of the Presidency, the duties and authorities of the General Directorate of Food and Control are as follows:

- To provide reliable food and feed supply, to carry out studies for establishing policies in this respect and to inspect the implementation
- To determine the principles for the traceability of food, food additives and substances and materials in contact with foods at all stages of production, processing and marketing
- To specify the qualifications of workplaces producing food, food additives and substances and materials in contact with food and the principles of permission and registration thereof, to make their transactions of permission and registration, to register these workplaces in the food register, to make or have controls and inspections of production and sales places.
- To determine and announce the entrance and exit customs gates of food, food additives and feeds and substances and materials in contact with food by receiving the opinions of relevant institutions; to specify veterinary border control points and their working principles
- To identify and audit the principles regarding the registration, sale and inspection of feed and feed additives
- To determine the approval principles of enterprises engaged in the production and sale of feed and feed additives and to make their approval procedures,
- To establish the animal identification system and to control animal movements,
- To determine health conditions related to the foreign trade of live stocks, plants, animal and vegetable products, food and feed; to identify and carry out border control points and their operating principles
- To take measures for the purpose of protecting consumers and public health by considering plant, animal, food and feed safety,
- To make studies in order to provide animal welfare,

[53] https://www.tarimorman.gov.tr/DKMP
[54] https://www.tarimorman.gov.tr/GKGM/Menus/103/Legal-Basis

- To determine and audit the principles for certification of laboratories operating in animal and plant health and food and feed,
- To carry out control and follow-up procedures related to processing and marketing of animal products and to determine the relevant principles,
- To conduct animal health services and fighting animal diseases and to determine relevant principles,
- To determine and announce the conditions of manufacturing, sale, transportation and storage of therapeutic and protective substances used in animal health and their active and auxiliary substances,
- To specify the principles of institutions and organizations operating in animal health, diagnosis and treatment services, and principles related to animal sales, slaughtering and training places and shelters,
- To protect plant health, to fight against plant diseases and pests and to determine the relevant principles,
- To establish plant passport system, to control plant and plant product movements, to determine the norms and characteristics of the products used in plant protection and principles related to giving approval, to make approval and control procedures,
- To determine the principles of risk management in order to ensure plant and animal health and food and feed safety, to make risk assessment and to ensure risk communication,
- To specify the qualifications, working procedures and principles of the staff to be assigned in the protection of animal and plant health and food and feed control.

2.3.1.1.5. MAF Affiliated Organizations

2.3.1.1.5.1. General Directorate of Meteorology[55]

Fishing and aquaculture is very closely dependant on climatic and daily meteorological parameters. The duty of this organization is:

- to provide uninterrupted, high quality and reliable meteorological products and services that prioritize life and property safety, improve the quality of life, meet sectoral expectations, and provide socio-economic benefits.

- To be a pioneering institution that offers meteorological products and services in a reliable manner at international standards in the light of scientific and technological developments.

2.3.1.1.5.2. General Directorate of State Hydraulic Works (GDSHW)[56]

To provide our country's water resources in accordance with science and technique, and to ensure that our water and related soil resources are developed in line with environmental awareness and sustainability principles.

Their target is to be the leading institution in the protection, development and management of these resources.

In case af aquaculture GDSHW is responsible to determine the area and the place of cage farming in dam reservoirs and permits water intake from the surface or water discharge to the fish farms.

2.3.1.1.6. MAF Related Organizations

[55] https://mgm.gov.tr/
[56] http://en.dsi.gov.tr/

2.3.1.1.6.1. Agriculture and Rural Development Support Institution[57]

Decree on the ARDSI Organization (Presidential Decree No. 4 - Thirty-Fifth Chapter) Law on Services for Supporting Agriculture and Rural Development (Law No. 5648)

2.3.1.1.6.2. National food reference laboratory

The project for the establishment of National Food Referance Laboratory (NFRL) was combined and presented with "The Reconstruction and Consodilation of Food Safety and Control System in Turkey" project and came into effect in year 2005 Turkey National Program with TR 05 03 04 code number.

The tender process was completed with the contruction tender on 27 November 2006, inspection tender on 31 October 2006, procrument tender on 10 August 2007 and at last technical support tender on 15 October 2007. The construction of the building, which officially started on May 29, 2007, was completed on 24 November 2009.

The establishment of the Ministry of Agriculture and Welfare (Food, Agriculture and Livestock) of UGRL in the province of Ankara as a direct provincial organization was decided by council of ministers on 25 February 2008 and published in the Official Journal dated 1 March 2008 / no 26803 according to Article 17 of the Law No. 3046 on 27 September 1984. The Regulation on the Establishment and Duties of the National Food Reference Laboratory Directorate is published in the Official Gazette dated 14 January 2009 / no 27110. The laboratory has been put into service by making the official opening on 11 November 2010. Acredited and performs all kinf of food and feed analyses.

2.3.1.2. Ministry of Environment and Urbanisation (MoEU)[58]

The mission of MoEU is to protect the natural environment, create sustainable cities and settlements, carry out planning, transformation, safe construction, real estate management and all services related to the housing sector and the environment with a regulatory and supervisory approach, which revitalizes the identity of cities and is based on horizontal architecture.

2.3.1.2.1. General Directorate of Environmental Management (GDEM)[59]

As a mission, GDEM aims to take measures to prevent human health and reduce environmental pollution within the framework of sustainable development principles, this provides a healthy use of administrative, legal, financial, human and environmental resources, is to be a respected and pioneering institution that guarantees the right to live in the environment.

In order to reach these targets GDEM try to prevent and control of all disturbing factors affecting environmental pollution for a habitable environment, as vision. In this context, by:

- maintaining air quality; minimizing air pollution, noise and vibration,
- taking the necessary measures regarding global climate change, depletion of the ozone layer and is renewable. To support the use of clean energy, especially energy sources,
- allowing healty ground and ground waters, seas and lands leaving it in a way that can be used comfortably by the citizens,
- establishing and setting up laboratories that will make all kinds of environmental measurement, monitoring, analysis and controls

[57] http://www.tkdk.gov.tr/?lang=en
[58] https://www.csb.gov.tr/
[59] https://cygm.csb.gov.tr/

• being scientifically compatible with the developing and changing conditions of the day,
• classifying, collecting, transporting of all kinds of wastes by minimizing them at the source, temporary storage, recovery, reuse, purification, conversion to energy, disposal and setting an example for other countries on their final storage,
• looking for the ways research in cooperation with international organizations for environmental protection and development make; setting environmental standards; various organizations and local administrations related to environmental protection to ensure coordination between; supporting public institutions and organizations; environmental education to spread environmental awareness by implementing programs
• developing the studies as transparent, accountable, participative and pluralist rational management of environmental resources with improved quality,to be a respected and pioneering institution working for.

2.3.1.2.1.1. Marine and Coastal Management Department (MCMD)[60]

Department carry out duties by the four branch offices:

- Environmental Management of Maritime Operations
- Risk Management and Emergency Response
- Marine Environment Management
- Sea and Coastal Water Quality

Duties of MCMD are as follows:

- In order to use, protect, prevent or eliminate pollution of sea and coastal waters, to set goals, principles and policies, to prepare action plans for pollution removal and control, to determine the procedures and principles, to ensure their implementation,
- To monitor the national and international developments regarding the prevention and protection of pollution of the sea and coastal waters and its environment, to conduct the negotiations, to evaluate and to carry out studies to determine and implement policies and strategies on the subject, to carry out the national focal point tasks before the relevant international organizations,
- To determine and implement the procedures, principles and measures regarding pollutant removal and control of pollutants and pollution in order to ensure the use of marine waters by protecting them, preventing marine pollution with an integrated and ecosystem-oriented approach and establishing a good environmental condition, targets for Turkey's prevention of maritime jurisdiction caused by ships in the area of marine pollution, to determine the principles and policies, to identify the principles and procedures for the removal and control of pollution, making efforts to implement, to create a decision support system, to prepare action plans to prepare,
- To prepare and prepare the national and regional environmental management strategy and action plans in this context,
- Taking into account the ecological structures of the sea and coastal waters, to make the quality classification in order to ensure its sustainability in line with the principles of protection and use, to determine the pressures on these areas, to establish a program of measures to achieve the specified environmental quality targets, to develop technologies, to prepare risk maps, to ensure their implementation. to determine the procedures and principles for controlling the discharges made, to establish the monitoring policy and strategy,
- To determine policies, strategies and procedures and principles regarding the management of coastal waters and prevention of pollution within river basin management plans.

[60] https://cygm.csb.gov.tr/birimler/deniz-ve-kiyi-yonetimi-dairesi-baskanligi/205

- To take the necessary precautions to determine the procedures and principles regarding intervention and compensation of damages in emergency situations, to be prepared, to increase the capacity of intervention and struggle in the pollution of the marine environment with oil and other harmful substances; Within this framework, to make and have emergency response plans, restoration and rehabilitation plans and management plans for accidental wastes,
- To determine the procedures and principles regarding the bottom dredging activities to be carried out in coastal and sea waters and the discharge of dredging materials to be formed as a result of these dredging activities, to carry out the necessary studies,
- To determine the procedures and principles regarding the environmental management of activities that may create pollution risk in marine and coastal waters, especially in aquaculture, oil exploration and the removal of sunken ships, to reveal the effects of such activities on the marine environment, to conduct risk analysis, to identify risky areas, to do the necessary work,
- To protect the waters used for swimming and recreation and to prevent pollution,
- To determine the standards of wastewater discharges to be made to sea and coastal waters, sea discharge and deep sea discharge design principles and criteria, to carry out approval procedures,
- Preparing / preparing strategic action plans for marine litter, determining, applying, implementing the procedures and principles,
- To conduct researches and projects to protect and improve sea and coastal waters.

2.3.1.2.1.2. **Climate Change and Adaptation Department (CCAD)**[61]

Duties of CCAD are to:

- follow up and coordinate national and international studies to combat climate change and to protect the ozone layer, to prepare legislation on necessary issues,
- ensure national coordination and fulfill national focal points, within the framework of international organizations and conventions for combating climate change and protecting the ozone layer,
- carry out legislative studies and other studies on harmonization with the European Union acquis in matters falling within its field of duty,
- prepare or have the national reports that our country is obliged to prepare within the scope of international organizations and contracts,
- ensure the coordination of the Climate Change Coordination Board,
- provide national coordination of efforts to combat climate change at the local level, to organize capacity building activities and develop legislation for the preparation and implementation of climate change action plans on a local scale,
- monitor and evaluate the national and international developments regarding the control, recovery and disposal of substances that cause the depletion of the ozone layer and the alternatives of these substances, and to carry out and make studies for determining and implementing policies and strategies on the subject,
- follow up, control and report greenhouse gas emissions causing climate change on a national scale,
- carry out studies on market-based mechanisms and economic instruments, especially the emission trading system, within the framework of climate change policies,
- ensure the coordination of the works for monitoring and evaluating climate change adaptation policies,
- work towards informing and raising awareness of the public,
- prepare and implement national and international projects on the subjects falling within the field of duty

[61] https://cygm.csb.gov.tr/birimler/iklim-degisikligi-ve-uyum-dairesi-baskanligi/207

Department carries out all these duties with 6 branches:

- Climate Negotiations and International Policies
- Climate Change Policies
- Local Climate Change Policies
- Climate Change R&D and Application
- Greenhouse Gas Emissions Monitoring
- Ozone Layer Protection

2.3.1.3. **Turkish Statistical institute (TURKSTAT)**[62]

The recent form of the Institute was given by the Law No: 5429, dated 10/11/2005, Published in OJ dated 18/11/2005 No: 25997. Institute is officially assigned and authorised to declare, submit and publish all kinds of statistics in Turkey.

Duties and authorities of the Institute are as follows:

- to prepare the Official Statistics Programme,
- to organise the statistical activities specified in the Programme and ensure their realisation,
- to determine the statistical methods, definitions, classifications and standards to be used in the production of official statistics in line with national and international norms,
- to compile, evaluate, analyse and publish statistics in the fields of economy, social issues, demography, culture, environment, science and technology, and in the other required areas,
- to provide scientific and technical explanations to the results of official statistics,
- to follow up the developments in scientific research techniques, and methods and information technologies in the field of statistics and to take relevant measures for the adoption of these developments,
- to determine the areas where statistical data are needed as well as data compilation methods in cooperation with the relevant institutions and organisations, by taking into account the national and international priorities,
- to follow the performance of tasks assigned by the Programme to the institutions and organisations in relation to official statistics, to examine statistics produced by these institutions and organisations in compliance on their international standards, to perform quality control and to provide technical support and ensure coordination in these issues, to coordinate the establishment of a national and international information network and information flow system to ensure the storing of statistical information, its submission to users and development of systems pertaining to these areas,
- to identify the standards for the establishment of the national register systems, implement these standards, and to ensure their observance through inter-agency coordination,
- to follow, evaluate and publish, when needed, the indicators related to other countries or country groups in order to make international comparisons,
- to draft, develop and implement research and technical assistance projects in cooperation with the national and international organisations and institutions for the production of data in the required areas and for the enhancement of existing technical capacity,
- to cooperate with other countries and international organisations, and to organise international meetings in the field of statistics,
- to perform other duties assigned by the Law

[62] http://www.turkstat.gov.tr/UstMenu/yonetmelikler/StatisticsLawOfTurkey.pdf

The Presidency may establish national and international training and research centres regarding its working areas in cooperation with universities and other training institutions where the duties of the higher education institutions are reserved.

Under these general outlines, TURKSTAT collects all fisheries data by collaborating with the MAF, GDFA and disseminate to the public.

Within the context of International relations, activities are carried out on three main topics:

- Within the context of EU coordination studies: cooperation studies with EU, international organizations and national statistical institutes, following up activities on EU statistical standards and conducting studies in order to comply with these standards, and organizing all types of studies on "Statistics" are carried out according to the country policy,
- Within the scope of implementation of international statistical projects in order to harmonize with European Union Statistical Acquis, EU financed programmes and the financial management, coordination, monitoring and reporting activities are being carried out. Some basic activities within the framework of the programmes can be exemplified as managing the tender processes: coordination of consultancy and data collection activities and organisation of local and international training activities. In addition to EU Programmes, TurkStat participates in the third country projects funded by international organizations as an expertise provider.
- In the context of the international cooperation studies: bilateral and multilateral statistical cooperation projects, technical assistance projects/ programs and cooperation protocols directed to the several countries and country groups are being prepared in accordance with the policy of the country, these projects, programs and protocols are being implemented in line with the international agreements, cooperation studies in the field of statistics with international organizations, national statistical offices and regional organizations are being carried out, compliance studies with the international standarts are being coordinated and followed.

2.3.2. Private Organizations

Not only public but also various other private institutions play an important role in the governance of aquaculture business as to support investors by acting/corporating together to implement constructive decisions taken by the government.

2.3.2.1. Central Association of Aquaculture Producers Union (SUYMERBİR)[63]

Aquaculture Producers Central Union is a producer organization established in 2009 with the approval of the Ministry of Agriculture and Forestry according to the provisions of the Law on Agricultural Producers Associations No, 5200. Main aim is to cooperate with member associations, contributing to the development of the sector, helping members to comply with the rules regarding production planning and marketing at the national level, by informing and directing the members,

Duties of SUYMERBIR are to:

- protect the rights and interests of members,
- represent member associations at home and abroad,
- send representatives to the councils and similar organizations established to create agricultural policies,
- contribute to the works to be carried out in the process of harmonization with EU,

[63] http://suymerbir.org.tr/

- prepare projects and take initiatives to get technical and financial support from national and foreign sources,
- carry out meetings and workshops that will ensure the unity and solidarity of the members,
- disseminate information via publications such as books, brochures and magazines

SUYMERBIR has 3 members associations in the Black Sea region: Rize, Trabzon and Samsun-Sinop Aquaculture Producers Associations.

2.3.2.2. Trabzon Chamber of Commerce and Industry[64]

All cities have such institutions to promote business activities and investments in the provinces. With its current structure, "Trabzon Chamber of Commerce and Industry", founded in 1874, is one of the oldest chambers of Turkey. With its 6785 members, 13 units and 37 employees Trabzon Chamber of Commerce and Industry aims to contribute to the trade and economy of the region.

Second half of 19th century is a historically special period for Trabzon. Developments in naval trade, rapid advances in world trade provided many opportunities to Trabzon. Especially, regarding the trade between Europe and Iran, India, Caucasians and Middle East, many struggles are interfered for Trabzon.

After the foundation of Turkish Republic, according the rules and regulations dated 1926 elections are made (March 25, 1926) and the chamber continued its activities till today without a break.

Their Mission was declared as:
- to have an organizational structure that continuously improves, learns and develops by realizing the strategic plan and quality targets of the Chamber,
- to produce efficient and quality services to meet the needs and expectations in order to solve the structural problems of the members,
- to fulfill the socio-economic development of the region with the awareness of social responsibility,
- to fulfill the duties assigned by the legislation in a complete manner, within the framework of member satisfaction principles.

Vision of the Chamber is:
- to improve strong institutional capacity to provide the highest quality service to its members,
- to adopt contemporary approaches in management processes and using the most advanced information technologies,
- to identify the problems correctly and producing effective solutions,
- to play efficient role in the socio-economic development of the region,
- the importance of decision-makers' knowledge,
- to be value creator and leading organization

Chamber has 31 different business committees. Aquaculture is included under the Agriculture, Forestry and Animal Husbandry, Development Cooperatives, Flowers, Plant, Seed, Fertilizers, Pets and Feeds Committee. Due to high importance of fish farming in the Province regarding the volume of investment, employment, export, importance in nutrition, high input to the local economy, Chamber gives special importance to improve aquaculture business in the region. Major activities are to transfer problems to the Government, to produce solutions together with the Provincial Directorate of Agriculture and Forestry, to support SMEs to take part in exhibitions on aquaculture, to organize visits to other countries to increase export and promote big trout in potential countries and prepare sectorial reports in the field of aquaculture. Chamber organized 2

[64] https://www.ttso.org.tr/en/index.php

business visits to Russian Federation and Japan, and supported participation of members to the exhibitions in Dainmark and Russia by opening stands and tasting events in 2019.

Trabzon Chamber of Commerce and Industry is one of the important stakeholders of the DACIAT Project.

2.3.2.3. Eastern Black Sea Union of Exporters (DKIB)[65]

The most important pillar of foreign trade is exports due to its great share in the development of the countries. Any increase in the exports increases the wealth created in the country and causes an increase in production efficiency.

The General Secretariat of the Eastern Black Sea Exporters Association was established in Trabzon in 1998 to serve Trabzon exporters, and Rize, Artvin and Gümüşhane provinces were included in the jurisdiction of the Union, which was later converted into a regional structure by considering the needs of the Region. In this context, association has a status of Regional Union, with Liaison Offices (Branch) in Rize and Artvin-Hopa District as service units.

Duties and functions of DKIB are to:

- protect professional ethics and solidarity,
- try to develop exports in accordance with the country's interests,
- act jointly at the point of adjusting the export of related goods according to foreign demand,
- organize courses and seminars to inform exporters,
- establish foundations, schools, laboratories, build social facilities and companies to serve to increase exports and exporters,
- carry out studies on foreign trade issues and protective and progressive works towards the interests of members in the eyes of public, non-governmental and private sector organizations, and national and international organizations/institutions.
- participate international fairs with members, producers and export companies and provide technical/financial support in international fairs,
- announce the requests from the Commercial Counselors to the relevant sections and members,
- work in cooperation with the Ministries and Trade Counselors in order to solve the problems,
- fulfill the duties assigned by the Ministry of Commerce on export supports,
- perform the approval function of registered export goods,
- announce current export figures to the public,
- protect the commercial rights and interests of its members in the national and international arena,
- establish relationships with members and international organizations in line with Turkey's interests,
- organize and participate local exhibitions to carry out promotional activities,
- support Turkey Exporters Assembly and the Ministry of Commerce in the development of foreign trade policy.

Under this framework of functions, DKIB supports aquaculture production in Trabzon in order to increase exports from Trabzon. On the other hand if the export quantity increase, Rize, Gumushane, Giresun and Ordu provinces may also be benefited due to work jointly in different stages of the production, i.e. hatcheries and juvenile production, growth in lakes and inland ponds, fattening in the sea cages, feed industry, cage and net manufacturers and other service providers. Aquaculture is one of the targeted sectors of DKIB to increase export possibilities of the investors in Trabzon Province.

[65]http://www.dkib.org.tr/tr/default.html

2.3.3. Supporter Organizations (Promotions/Supports/Incentives)

Aquaculture sector is governmentally supported to be spread across country by numbers and capacities, diversification of the number of species farmed, increase the production for more supply to domestic markets and export. All of the actors took place in the designated authority, central and local governing bodies, research institutions, business supporting organizations, service suppliers and funding partners are working in harmony to reach the same target.

2.3.3.1. Agricultural Bank (Aquaculture and Fisheries Loans)

Agriculture Bank is a state-owned bank in Turkey founded in 1863. It is the second biggest Turkish bank since 2012 according to the Bankscope database measured by total assets in USD. Besides agricultural support loans, Ziraat Bank serves citizens in all financial transactions.

2.3.3.1.1. Commerial Credits:

Real persons and companies of which have invested on fisheries and aquaculture activities may apply for fishery credits (aquaculture in sea, lakes, ponds; fishing in the sea and inland waters) for investment and operation. Fisheries loans are the credits allocated to the producers farming fish in cages in the sea and in soil and concrete ponds in inland waters (trout, sea bream, sea bass, etc.), and fishing industry in the seas for financing their investment and operational activities.

Fisheries credits for fish farming and fishing cover to supply juvenile fish, feed, medicine, fuel, labor, boat repair, all kinds of fishing and aquaculture tools and equipment, cold air storage, motor boat, fishing vessel fishing nets, etc.

In the determination of investment loans that can be used for investment expenditures, the size of the investment of the project is evaluated by taking into consideration the amount of equity of income and expense balance and customer credibility. In operational loans, an evaluation is made according to the capital requirement related to the enterprise that continues its production and fishing activities. Loans are allocated according to the evaluation reports applied by the banks, the credit rating of the customer requesting the loan, the loan term, the credit term and the collateral conditions.

Basic Requirements for real persons are:

- National identity card copy,
- Farmer Certificate / From Farmer Registration system
- Documents proving its agricultural property (land registration, rental contract, etc,)
- Documents related to collaterals to be shown against the loan
- Balance sheet and income statement for the last three years from companies operating on a balance sheet basis

For Legal Persons:

- Farmer Certificate / from Company Registry System
- Trade Registry Gazette where the legal entity articles of association (if any) are published
- Chamber registration document
- Tax certificate
- Decisions on the authority of representation of persons authorized to represent the legal entity and notarized circular of signature
- Balance sheet and income statement for the newly established legal entities belonging to the establishment and / or last year, and in others for at least the last three years

- Documents proving its agricultural holdings (land registry, rental contract, etc,)
- Documents related to collaterals to be shown against the loan,

2.3.3.1.2. Subsidized Loan Applications

In order to support investments on selected sectors, it has been decided by the attached decision signed by the President, Ziraat Bank and Agricultural Credit Cooperatives are assigned to implement the Decision on the Use of Low Interest Investment and Business Loans for Agricultural Production pursuant to Articles 3 of Law No, 4603 and Articles 1 of Law No, 5570.

The upper limit of the loan provided by Agriculture Bank in aquaculture business was doubled in 2020 compared to the previous year, reaching 10 million TL, Interest rates are applied in two ways as "INVESTMENT" and "OPERATION" period. According to the decision, encouraging subsidized credits for the fisheries sector could be applied as it was shown in the Table 15 given.

After the interest rate discounts given in Table 14, Ziraat's current 10% interest rate decreases annually by 5% for both periods. On a monthly basis, this rate corresponds to 5/12 = 0,41%, Of course, if you are a young farmer under the age of 40, or woman, in addition to the information above, for women investing in aquaculture, this rate decreases to by 0,16% per month and 2 % per year.

Requirements:

- Fish farmer or fishing license/certificate,
- Identity card and any property or ownership of boat to be deposited,
- Your credit rating should be over 1700 points and above,
- 2 guarantees together with their spouses,
- No debt document from the tax office.

Table 3.1. Discount credits of Agricultural Bank to aquaculture business

Topic	Reduction Rate (%)		Upper Limit of the Credit (Million TL)
	Investment	Maintenance	
Fisheries Sector	50	50	10
Aquaculture	10	10	
Young farmer/entrepreneur(≤40 yrs)	10	10	
Woman farmer/enterpreneur	10	10	
Highest reduction rate applicable	80	80	

2.3.3.2. KOSGEB[66] Grant Incentives

KOSGEB was established in 1990 with the Law No: 3624, to provide services and supports only for the production industry SMEs until 2009, However, due to the increase in the added value production and employment creation potentials of other sectors in Turkey and due to the high requests received from SMEs in such sectors, the target of the KOSGEB had been enlarged to cover all SMEs.

KOSGEB Establishment Law was amended by the Law 5891 to provide essential legal grounds for KOSGEB to support SMEs other than the ones in the production industry sectors. The Cabinet Decree No 15431 on the "Determination of Sector and Regional Priorities of Small and Medium Enterprises that will Benefit from the Services and Supports to be Provided by KOSGEB" was published in the Official Journal dated September 18,

[66] Small and Medium Enterprises Development Organization of Turkey, Ministry of Science, Technology and Industry; https://www.kosgeb.gov.tr/

2009 (No 27353), and with this Decree, the sector and regional priorities related with the enterprises that will benefit from the services and supports to be provided by KOSGEB were determined.

Entrepreneurs can take advantage of KOSGEB grant incentives, regardless of what kind of fishing activity they conduct; importing seafood or exporting domestic fish from the nature or farms, KOSGEB supports everyone who sets up or will start a business as a production partner, by providing the conditions. Some of the sectors and fields are given below as it is indicated by the following NACE codes (Table 16):

Table 3.2. Sectors to be supported by KOSGEB funds

Nace Code	Sectors
10.2	Processing and storage of fish, shellfish and mollusks
46.38	Wholesale trade of foods including fish, shellfish and mollusks
47.23	Retail trade of fish, crustaceans and mollusks in stores dedicated to a particular property

The "Entrepreneurship Support Program" created by KOSGEB for entrepreneurs who want to get support to open a new business has been redesigned from the beginning of 2020, as “Entrepreneurship Development Support Program”, which is now its new main name, includes grant support between 60000 TL and 370000 TL. According to the business model will be established, all entrepreneurs who will start a new business can benefit from these supports.

KOSGEB Entrepreneurship Development Support Program covers 2 kinds of support:

1. Traditional Entrepreneur Support
2. Advanced Entrepreneur Support

The only form that does not change is the “Applied Entrepreneurship Training”, which is the first condition of the application to both programs. However, radical changes were made in these trainings. The most striking one is the training given over the Internet with "Distance Education" technology. Whether it is “Formal” or “Distance Education”, it has become much easier to get an entrepreneurship certificate. However, while taking these trainings, "Distance Education" period was kept a little longer for those who will receive "Advanced Entrepreneurship Support".

KOSGEB Traditional Entrepreneurship Support Program:

It is dedicated to applicants who will start a new business. The program takes place under 2 forms. These are:

- Businesses Established by Real Persons
- Enterprises Established in the Capital Company Status

The business ideas of those who will establish businesses within these two sectors must include the business ideas within the KOSGEB supported Sectors and NACE codes. Applicants must apply the KOSGEB support program if the business idea is not included in the "MANUFACTURING" sector. But if the business idea is within the "MANUFACTURE" sector in the NACE codes of KOSGEB, then the program needed to be applied is the "Advanced Entrepreneur Support" program.

While the program provides support for the expenses that previously received for work, machinery and rentals, it now provides support according to the insured premium that applicants employ with the majority,

Businesses Established by Real Persons: (within 1 to 12 months)

As a first establishment support of the workplace, applicant will be given a grant of 5000 TL without question,

According to the SSI[67] premium payments, the workers of the applicant have worked for between 1 and 12 months are given a grant of up to 20000 TL after 12 months. The number of these premium days can be easily calculated. Since there are 365 days in a year but on average 249 days are the working days. If the farm employs 1 person in 1 year, farmer will receive 5000 TL more at the end of the year,

If farm is operated within periods, applicant will receive 10000 TL. If 4 people are employed in periods, applicant will receive 20000 TL grant at the end of that year.

If applicant is younger than 30 years old, or disabled, or female, veteran and martyred, applicant will receive a grant of + 5000 TL after 1 to 12 months.

Thus, if applicant catch the highest premium day at the end of 1 to 12 months after the 5000 TL for the workplace establishment, then he will receive a grant of 20000 TL and a total of 30000 TL in the first year by receiving a grant of + 5000 TL if he is younger than the age of 30 or disabled, veteran or female relative (If you are a company, you will receive a grant of 35000 TL and + 5000 TL establishment support, which was given in the first year).

Businesses Established by Real Persons: (within 12 to 24 months)

If the applicant is disabled person, a relative of a martyr, an entrepreneur under the age of 30, a woman or a veteran, you will receive a grant of + 5000 TL after 12 to 24 months.

According to the number of day premiums for the staff employed, applicant will receive a maximum of 20000 TL at the end of 12 to 24 months.

Accordingly, if the applicant is a private company, after 24 months a grant of 55000 TL in 2 years, with a maximum of 25000 TL will be received. However, if the investment belongs to Capital Company, applicant will receive a maximum of 25000 TL grant at the end of 12 to 24 months, and a grant of 60000 TL with 35000 TL in the first year (Table. 3.3).

Table 3.3. KOSGEB support program

Support	Real Persons	Capital Company
Establishment support	5000 TL	10000TL
	1st Performance period Total premium days	2nd Performance period Total premium days
Performance support	for 180-539 days 5000 TL	For 360-1079 days 5000TL
	For 540-1079 days 10000TL	1080-1439 days 15000 TL
	1080 and over 20000TL	over 20000TL

KOSGEB Advanced Entrepreneur Support Program:

In order to be able to benefit from this program, applicant's business idea should be among some of the business ideas included in the KOSGEB Supported sectors and the "MANUFACTURING" sector located in NACE codes. In addition, new entrepreneurs who have received "Advanced Entrepreneurship Training" shall benefit from "Distance Education" and "Applied Entrepreneurship Training" program. If applicant is active among these sectors and receives training, the grant amount of the business that will be given to the applicant within 1 to 24 months is the same as in the table given above. On the other hand two additional supports can be provided (Table 3.4):

[67] Social Security Institute (Service)

Table 3.4. KOSGEB supports in advanced program

Type of the support	Support amount TL	Support rate %
Machinery*, equipment, software		
Low, low- medium technology level	100000	75
Medium-high technology level	200000	
High technology level	300000	
Mentoring, consulting, business coaching		
Support for consultant and business coaching	10000	75

*if the machinery is made in Turkey, support has increased additional 15%

As it is seen in the table, the machinery needed to buy for the business must be in the first place for the production. In accordance with this requirement and if the applicant's business is in the "MANUFACTURING SECTOR TABLE" grants will be given under the criteria:

- If the technology level is "low", a grant of 75000 TL allocated for the machine cost 100000 TL,
- If the company at the intermediate level, a grant of 150000 TL is received for the expense of 200000 TL,
- Although it is at a high level, 225000 TL grant is given for the cost of machinery for 300000 TL,
- In addition, a 7500 TL grant will be paid within the 10000 TL consultancy support.

Apart from the relevant conditions for the support programs, additional requirements from the new entrepreneur are:

- never received any grant from KOSGEB before,
- presentation of the business idea after "Entrepreneurship Training",
- Then, it is necessary to create and apply KOSGEB registration.

2.3.3.3. Other Support Organizations

Non-refundable credits: grants in brief, farmers in aquaculture business benefit from the grant opportunities up to 80% for their farms established in the selected cities within the scope of IPARD-2, until 2020, Until now, 3 trillion TL and 11000 project owners have been given their livestock investments completely free of charge, IPARD[68]-3 phase is expected to be approved by the European Commission.

Turkish Government provides interest and grants to farmers who are involved in agricultural activities in many areas. These opportunities are sometimes taken into consideration by certain time intervals and sometimes within the budget allocated to farmers. Some of other supporting institutions are:

2.3.3.3.1. **Agriculture and Rural Development Support Institution** (TKDK) Development Agencies[69]

Agriculture and Rural Development Support Institution (TKDK) provides 80% grant on project basis, with the support of 75% European Union funds and 25% of Turkish Government and 80% of grant opportunities are provided to farmers in 2019 with many precaution titles. The institution provides its support within only 42 provinces (Trabzon, Rize, Samsun Ordu, Giresun and Kastamonu in the Black Sea Region).

Support Premium by Ministry of Agriculture and Forestry

[68] EC Instrument for Pre-accession Assistance for Rural Development
[69] announcements can be followed at https://bit,ly/2U0t23V,

Providing the necessary conditions by the Ministry of Agriculture and Forestry, support payments are made to those who officially continue their aquaculture activities upon their application, In this sense, the Aquaculture Support Communiqué has been issued by the MAF and supports are given to the species included the legislation, Various measures are taken for state aquaculture production, especially in issues such as fish species protection and fishing bans. Producers farming fish species determined in the communiqué are supported at the determined unit prices.

In order to benefit from aquaculture supports, it is necessary to produce the one in the listed species, such as trout, mussel, Black Sea trout, red spotted trout, fangri, synagrit, gilthead, yellowtail, yellow mouth, tilapia, eel, leech, shrimp, crayfish species, etc,, “Fish identification cards” supports are provided for fish species produced within the scope of intensive fish farming. In addition, within the scope of aquaculture, there are government grants for good agricultural practices (GAP).

The fish species supported within the scope of good agricultural practices are trout, sea bream and clam by 0,25 TL per kg. Production support is provided for those who are engaged in good agricultural practices, those who are registered in the system, those who make their applications within the application period, who submit their documents completely, those who do not produce juvenile fish and those who do not lose their right to benefit from the supports provided, and the productions made within the scope of agricultural practices are 0,25 TL per kilogram, ,

In addition, 0,25 TL are granted for those producing fish in intensive closed systems. There is no kilogram limitation in the closed system.

In order to take advantage of the support given for aquaculture, it is necessary to meet the following conditions:

- Being farmer or member of a farmer family,
- Operating in rural areas
- Being a real and legal person
- Farming the fish species and mussel
- To have an aquaculture certificate approved by the Ministry (Fig, 5),
- To have received Good Agricultural Practices Certificate from organizations authorized by the Ministry (MAF),
- To produce up to 500 thousand kilograms (There is no production limit for closed system)
- Obligation to register in the Agricultural Information System

Figure 5. Aquaculture certificate

Fish Recognition Card Support

It is also known as label support. Applications will be made to the Provincial / District Agriculture and Forestry Directorates located in the region to be labeled. When the application is made, it is mandatory to issue a Fish Recognition Card Identification minute. However, if the farming is carried out in different provinces, two are issued and one of the documents is delivered to the provincial irectorate in the region where the facility is located. The number of fish in the farm to be supported should be equal with the documents necessary for the label support. The following issues are taken into account in the calculation of labels to be supported:

- 3 pieces per kilogram in sea bream and sea bass production,
- 4 pieces per kilogram in trout, Black Sea trout and spotted trout farming
- 2 pieces per kilogram of new species
- One card is issued for over-kilogram fish farming.

Requirements for Application:

- Fisheries support application statement,
- Fish recognition card invoice,
- Fish catch report/sales certificate,
- Document showing that the harvested product is sold,
- Record report showing that trout harvest is made over kg,
- Fish label fixing report,
- Union or cooperative membership certificate,
- Copy of aquaculture certificate,
- Feed invoice,
- If juveniles are obtained from research institutions, a document proving this is required,

Variety of supports was allocated to fish farmers to promote aquaculture production and to spread fish farming business across country (Table 3.5).

Requests must be done to Provicial/Town Agriculture and Forestry Directorates together with the documents given below:

- Trout support application petition,
- Minutes or sales document showing that the harvested fish is sold,
- Sales document indicating that the product has been purchased or juvenile fish detection document,
- If there is membership to a cooperative on fisheries, partnership certificate
- Feed invoice,

Table 3.5. Incentives for production in Turkey

Type	TL per kg	TL per fish	Remarks
Trout	0.75		≤ 350 tons
New species	1.50		
Closed (intensive) fish farm			
Big trout (>1.25 kg)			
Mediterranean mussel	0.10		
Carp	0.50		
Diseases free trout hatchery brood stok support		60.00	≤ 10000 fish
Aquaculture in soil ponds	1.00		≥ 30 tons

Two percent of support is cut as service costs and the rest of the payment is transferred to the farmers over the accounts of producers through Ziraat Bank. The responsibility for the documents submitted to benefit from the payment belongs to the applicant. In the event that it is determined that an unfair payment is made, as a result of the Law on the Collection Procedure of Public Receivables 6183, these amounts are collected from the person who is paid, together with the delay hikes.

2.3.3.3.2. Insurance for Agricultural Investments (TARSIM)[70]

In addition to the crucial role in regard to the world population, the agricultural sector is extremely sensitive field of activity with its inherent structure, featuring exclusive in economic, social, political, technological and personal risks. To this end, the effective performance in the agricultural activities in the nutrition of the human being is closely related with the management of risks threatening the agricultural production. It is therefore, the developed countries effectively implement the risk sharing and risk transfer operations under various protective policies under the general titles of Risk Management Programs that also accommodates Agricultural Insurance Practices as an important part integral to such programs. In order to provide coverage for the risks threatening the agricultural industry in the country, the implementation of an insurance mechanism has been considered and for this purpose, Agricultural Insurance Code No. 5363 was enforced as of 14/06/2005. The code provides:

- the establishment of Insurance Pool in regard to introducing standard provisions in insurance contracts to be executed to provide the coverage to the risks as referred under the Code, establishing the conditions for transferring risk under reasonable provisions, ensuring centralized payment of the indemnification upon occurrence of the risk, improving and spreading of the agricultural insurances,
- all tasks of this Pool are carried out by Agricultural Insurance Pool Management Company which, was established with equal share of the insurance companies participating in the Pool.
- insurance companies issue insurance policies with their own name however the risk and 100% of the premium must be transferred to Agriculture Insurance Pool. These insurance companies can optionally take share from the Pool through retrocession.
- the Government provides premium subsidy exclusively to insurance contracts executed under the Code, in terms of the premium on behalf of the farmers. The amount of premium subsidy is determined by Council of Ministers on annual basis, with respect to the crops, risk, region and premises scale.

Agricultural Insurance Pool Board of Directors is assigned by The Code, as an administrative apparatus responsible for determining the principles and procedures of the Agricultural Insurance Pool, the loss assessment methods, executing the contract between the insurance companies wishing to take part in agricultural insurance and Agricultural Insurance Pool Management Company, observing due diligence in determining the risks the subsidy to be covered, observing the practical drawbacks and problems and proposing pertinent solutions. The Board consists of total of 7 members, two members from Ministry of Food, Agriculture and Livestock and Undersecretary of Treasury each, and one member from Association of the Insurance and Reinsurance Companies of Turkey, Union of the Agricultural Chambers of Turkey and Agricultural Insurance Pool Management Company each. The Board's first members are assigned by Ministerial approval dated 16.1.2006 for three-year posts.

Main duties and responsibilities are:

- To provide the insurance coverage for such catastrophe risks like drought, frost, etc., that cannot be covered by a single insurance company,

[70] https://web.tarsim.gov.tr/havuz/homePageEng

- To expand the capacity and coverage of reinsurance by encouraging the participation to reinsurances,
- To effectively make use of the information, human and financial resources of the insurance companies jointly,
- To effectively make use of the Government subsidies and excess of loss Protection,
- To prevent unfair competition in the prices,
- To encourage the participation in Insurance.

The Mission of TARSIM is is to promote, spread of Agricultural Insurance and to conduct the necessary applications fast and accurate, in order to protect the farmers against the natural disasters and other risks.

Their Vision is defined as to turn out to be an exemplary organization entrusted by the farmer, capable of providing wide range of agricultural insurance covers as possible to all kind of agricultural crops grown in all agricultural regions of the country.

Species produced in the sea and land based farms; cage and nets that are recorded in the Aquaculture Registration System (ARS) are accepted for insurance following risk analysis and assessment within the scope determined by decision of the President pursuant to Article 12 of the Agricultural Insurances Law Ref. Nr. 5363. The present insurance is effective within the framework of the following Tariff and Instructions.

2.4. Ukraine

2.4.1. Public and private institutions

Aquaculture activity in Ukraine involves institutional interaction of the following parties:

- public authorities that regulate and manage such activities;
- local self-government bodies;
- aquaculture entities - legal or natural persons carrying out fisheries activities in aquaculture.

Key competences of state regulators of aquaculture activities that create a system of relationships and form management competencies and functions throughout the vertical of the sectoral management system (Table. 1.10). The most important, effective were the consequences of reforming and updating the procedure for the provision of fisheries for use on lease for aquaculture purposes. In fact, the basic law changed the procedures and principles for the provision of water bodies in resource use, reinforcing the involvement of local authorities in this process. It is known that the availability of fisheries to water resources is considered a necessary condition for the revitalization of aquaculture business and, as a consequence, a key task of reforming the industry by creating favorable institutional conditions for fisheries. The mechanism laid down in the basic law provides for new organizational relationships in the aquaculture sector, whose implementation is taking place today at the regional level. The main administrative and legal innovations are as follows:

Fisheries water bodies are provided for aquaculture purposes for rental use;

- the object of use under the terms of lease is the land under water within which aquaculture is carried out and the water (water space) provided for use in the complex;
- the rent consists, respectively, of the payment for the land and for the water space;
- leasing of water bodies for use on the lease is carried out in the presence of a water body passport;
- the authority to lease water bodies for use on lease terms within settlements belongs to village, settlement and city councils, and outside settlements to regional state administrations; leasing of the waters of inland sea waters, territorial sea, exclusive (marine) economic zone of Ukraine for the purposes of aquaculture (mariculture) is carried out by the Cabinet of Ministers of Ukraine;

- the tenant is obliged to adhere to the established standards of aquaculture fish production standards;
- in due course to report to the State Fisheries Agency on production volumes of aquaculture products.

The main link of the state fisheries management department is the State Department of Fisheries (State Fisheries) within the Ministry of Agrarian Policy of Ukraine (Table 3.6).

Table 3.6. Distribution of powers of the main state regulators of aquaculture in Ukraine

The governing body	The complex of tasks	Regulatory documents[2]
Cabinet of Ministers	Ensuring public policy in the field of aquaculture. Provision of inland waters (inland waters) for inland sea waters, territorial sea, exclusive (marine) economic zone of Ukraine for aquaculture purposes. Organization of international cooperation in the field of aquaculture.	CMU Resolution of May 29, 2013 No. 420 "On Approval of the Model Lease Agreement for Water Bodies". CMU Resolution "On Approval of the Procedure for the Provision of Hydrotechnical Structures for Aquaculture Purposes and the Typical Form of the Contract for their Use" (Draft).
Ministry for Development of Economy, Trade and Agriculture of Ukraine Ministry of Energy and Environment Protection	Approval of regulations, methodological documents and programs of scientific and technological development on aquaculture.	**Order** of MinAAP № 45 of 30.01.2013 "On Approval of Aquaculture (Fisheries) and Fish Productivity Zones by Regions of Ukraine". MinAAP **Order** No. 414 of 7 July 2012 "On approval of the Procedure of artificial breeding (reproduction), cultivation of aquatic bioresources and their use." **Order** of the Ministry of Ecology № 236 of May 28, 2013 "On Approval of the Methodology for Determining the Fee for Leased Water Facilities."
		Order of the MinAAP No. 742 of December 16, 2013 "On Approval of the Procedure for Development of the Passport of the Fishery Technological Reservoir". Order of the Ministry of Agriculture and Forestry "On Approval of the Procedure for the Implementation of Fisheries Reclamation" (Draft) "On approval of special forms of primary documentation for fisheries entities in the field of aquaculture."
State Fisheries Agency	Development of regulations and programs of scientific and technical development of aquaculture; control of activity and reporting of aquaculture subjects; personnel management; cooperation with international organizations on aquaculture, prevention of environmental pollution.	State Targeted Economic Program for Fisheries Development for 2012-2016
Local state administrations	Leasing of a part of a fishery water body, a fishery technological reservoir for aquaculture purposes for use. Participation in the development and implementation of national and regional aquaculture development programs.	

Local governments	Leasing a part of a fishery water body, a fishery technological reservoir for aquaculture purposes in accordance with the land management authority established by the Land Code of Ukraine.	

The State Fisheries Agency of Ukraine is subject to 4 state fish breeding complexes. The main task of which is the fishing of reservoirs of national importance for different species of fish in the territory of our country, namely:

- State Institution "Kherson Production and Experimental Plant for Breeding Young Fish". The specified fish breeding complex annually releases to the lower reaches of the Dnieper River more than two million specimens of two-year and this year carp, herbivorous species, as well as native species of fish (pikeperch, pike).
- State Institution «Novokakhovsky Fish Farm of partial fish». The fish breeding complex annually releases more than two million specimens of this year and two years of carp and herbivorous fish, more than three hundred thousand specimens of native fish (pikeperch, pike, European sheatfish) to the lower reaches of the Dnieper River and the Kakhovka Reservoir.
- State Institution “Production-Experimental Dnepr sturgeon Fish-Breeding Plant named after Academician S.T. Artyushchika. The only state-owned enterprise in Ukraine which task is to reproduce sturgeon fish species included in the Red Data Book (Beluga, Russian Sturgeon, Stellate Sturgeon, Sterlet) that have spawning sites in the Dnieper River, raising nomadic young and stocking the lower reaches of the Dnieper River and the Black Basin sea. Fish-breeding complex releases more than one million three hundred thousand pieces of sturgeon species each year.
- State Institution “Lopushno Trout Fish Farm. The specified fish breeding complex annually releases to the small rivers of the Carpathian region more than one hundred and twenty thousand salmon fishes (trout stream, rainbow trout).

Control of catch of aquatic living resources in inland fisheries of Odessa region (Kagul lake, Kartal lake, Kugurly lake, Yalpug lake, Sasyk lake, Stentsovsko-Zhebriansky floodplains, Tuzlov group of estuaries, Shabolatsky, Hadzhibeisky, Tiligulsky, Small Adzhalyk estuaries, and Kuchurgan reservoir), the Danube River and the Dniester River with lake-floodplain systems, as well as the exclusive (maritime) economic zone of Ukraine are carried out by the Odessa Basin Directorate for the Protection, Reproduction of Water Living Resources and Fisheries Regulation. The fisheries in the Black Sea and the associated estuaries are also controlled by the State Inspectorate for the Protection of the Black Sea. The cumbersome system for regional fisheries management needed modification and was slightly reformed in 2005.

Licensing conditions for carrying out commercial activities related to industrial fishing in industrial areas of fisheries, in addition to inland reservoirs (ponds) of farms, were approved by a joint Order of the State Committee for Regulatory Policy and Entrepreneurship and the State Department of Fisheries and Agriculture. A necessary condition for the implementation of an effective regional policy in the fisheries complex should be the full implementation of the powers of local authorities and self-government bodies.

Scientific support is provided by the State Enterprise "Odessa Center of the Southern Research Institute of Marine Fisheries and Oceanography" (Odessa), the State Enterprise "Regional Experimental and Experimental Complex" (Bilyaivskyi district, Paliyovo village), the State Enterprise" Experimental mullet fish

breeding farm (Belgorod-Dnestrovsky district, Bilenke village), State enterprise "Dnestrovsky fish breeding farm" (Belgorod-Dnestrovsky district, Odessa-Reni highway, 43 km, Sturgeon section).

The establishment of the **Odessa Regional Association of Fisheries Enterprises** has been declared as a programmatic event in the approved sectoral regional fisheries program in Odesa Region 2014-2017, but special consideration of the interests of the aquaculture sub-sector is required when formulating such documents.

3. RESEARCH AND DEVELOPMENT ACTIVITIES CARRIED OUT IN PARTNER COUNTRIES

3.1. Greece

3.1.1. Educational and research institutions

Educational and research institutions active in Greece in the field of aquaculture support education research and innovation, with applied research, system and product development as well as infrastructure development and support, and technology transfer and entrepreneurship. The following are the main aquaculture educational and research institutions in Greece:

Hellenic Centre for Marine Research[71]

The Hellenic Center for Marine Research has recently been formed by merging the National Center for Marine Research and the Institute of Marine Biology of Crete. The result is a large body with various research centers throughout the country and with an important infrastructure of research vessels and laboratories. The Hellenic Center for Marine Research is a state-owned research organization operating under the auspices of the General Secretariat for Research and Technology (GSRT) of the Ministry of Education, Research and Religions. One of the areas of the Center is the Aquaculture Institute, where research on the issues of the sector is carried out. Areas of research include, among others, new species biology, aquaculture engineering, nutrition and pathology. Main activities of the Hellenic Center for Higher Education is the field, laboratory and experimental interdisciplinary, basic and applied research in various scientific fields related to physics, chemistry, geology, biology, aquaculture and aquatic ecosystems, the interface between the atmosphere and the atmosphere, the atmosphere zone, water column and seabed, maintaining public aquariums and disseminating information and knowledge on significant achievements through a variety of events, undertaking specific pilot studies and the development of management plans for specific issues, and the exploitation of products produced from biological and abiotic resources or from either through contacts with third parties, and the provision of various maritime services. ELKETHE he also acts as a government adviser on oil pollution from marine activities and accidents, issues that shape fisheries policy, water resources management and the implementation of the maritime strategy.

Its main objectives are to conduct interdisciplinary and basic research in the following areas:

- Structure and operation of inland, coastal and marine ecosystems, including ecosystem modeling
- Aquatic biodiversity (at all levels)
- Integrated Observation and Forecasting Systems of the Greek Seas
- The role of climate change in the evolution of aquatic ecosystems (marine and terrestrial)
- Impact of natural and anthropogenic pressures and hazards on the marine environment (eg oil spill, pollution, tsunami, floods, water invasions, harmful phytoplankton outbreaks (HABs), landslides)
- Fish life cycle, catch potential, catch ecology, modeling and management

[71] https://www.hcmr.gr/el/

- Aquaculture
- Population Genetics and Marine Genomics
- Biotechnology applications
- Integrated river basin and coastal zone management

Institute for Fisheries Research[72]

The Institute for Fisheries Research (INALE) belongs to the Greek Agricultural Organization DIMITRA (ELGO - DIMITRA), which is supervised by the Ministry of Rural 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 graduate and postgraduate education fisheries and aquaculture professionals. It is a Scientific Foundation that conducts research into the ecosystems of the marine environment and inland and transitional waters. In particular, through its three Departments operating (Department of Marine Fisheries, Department of Inland Waterways and Lagoons and Department of Aquaculture), it implements national and international research projects aimed at marine fisheries and its fisheries / environmental management, fisheries, fishery 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 quality of water 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 primary and secondary 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 entities.

Department of Agricultural Fisheries and Aquatic Environment, School of Agricultural Sciences, University of Thessaly[73]

The Department was established as part of an innovative initiative to meet the ever-increasing needs in education and research for staffing primary production in the country in the field of aquatic science, in the broad sense of the term. The overarching goal of the Curriculum is the training of scientists capable of developing, implementing and transmitting know-how and technological innovations in the production, processing and disposal of fishery / aquaculture products and the sustainable management of the aquatic ecosystem. The Department's curriculum aims to provide its graduates with both the required specialization and the ability to adapt continuously, so that they are able to meet the ever-increasing needs of the labor market.

Department of Biology of Aristotle University of Thessaloniki[74]

The Department of Biology of the Aristotle University of Thessaloniki comprises the Department of Zoology which covers the field of Morphology, Physiology and Biology of Animal Cells and Organisms and Systematic Animal Distribution. There are such laboratories:

- Laboratory of marine and terrestrial animal diversity

[72] https://inale.gr/
[73] http://diae.uth.gr/
[74] https://www.bio.auth.gr/

- Fisheries Laboratory (http://fishlab.bio.auth.gr/)
- Laboratory of Animal Physiology
- Zoological Museum

Department of Biology of University of Crete[75]

The Department of Biology of the University of Crete was founded in 1981, and today it is an internationally recognized center for modern university education and research in the field of Biology. It provides state-of-the-art university education and training, in an environment of high standards, with excellent scientists providing education that contributes to the knowledge of a biologist, nurtures scientific thinking and provides Greek and International experts in the field of science. The main activities of the Department are research and teaching.

Department of Oceanography and Marine Life Sciences of the University of the Aegean[76]

The Department of Oceanography and Marine Life Sciences is the only Higher Education Institution in the country offering undergraduate degrees, educational and research project in collaboration with leading research institutes and universities. Enshrined in the professional pathways of the Fisheries and Environmentalist, the Department offers a strong degree in both the public and private sectors.

The Department focuses on the theoretical and practical training of scientists, offering:

- International perspectives
- High level of education
- Practical research experience
- Specialized facilities
- Multidisciplinary studies with an economic impact

Department of Animal Production and Aquaculture Science, Agricultural University of Athens[77]

The Faculty of Animal Production and Aquaculture Science belong to the School of Agricultural Production of Infrastructure and the Environment of the Agricultural University of Athens (AUA). The University was founded in 1920 under the name of the Higher Agricultural School of Athens (AGSA) and is the first Higher Education Institution in the field of Agriculture and the third in antiquity after the National and Kapodistrian University and Technical University.

Department of Animal Production of Fisheries and Aquaculture, University of Patras[78]

The Department of Animal Production, Fisheries and Aquaculture was established with the recent incorporation of the University of Patras, Department of Fisheries and Aquaculture Technology, Technical University of Western Greece since 1981 associated with the development and support of the industry in the country. The Department focuses on education and research in the areas of animal production and exploitation of fishery and aquaculture resources, which support a strategic pillar of the primary sector of the Greek economy. Located in Mesolongi, it has infrastructure and scientific equipment distributed in laboratories.
Comparative advantages of the Department are the proximity to Greece's largest aquaculture park (Echinades Islands), the important Mediterranean natural laboratory, which is the Messologi - Aitolikos

[75] https://www.biology.uoc.gr/el
[76] https://www.mar.aegean.gr/
[77] http://zp.aua.gr/
[78] http://www.upatras.gr/el/node/8439

Lagoon, one of the largest inland waterways of the Greek Seaboard) as well as significant activity and tradition in the primary sector.

3.1.2. Research and development activities in the aquaculture sector

In order for the industry to meet the above requirements and to achieve the strategic objectives through the actions outlined above, the contribution of development research is crucial, as it has also contributed to its development to date. In line with the new legislative framework, the research guidelines will result from the National Aquaculture Development Program following the opinion of the National Aquaculture Council. The national program will set medium-term and long-term goals to enhance the competitiveness of the existing activity and lay the foundations for the sustainable development of the industry and the achievement of national strategic objectives (Vision 2030). To this goal, the actions outlined above and summarized below should include[79]:

- Improvement of existing farming methods and production processes
- Development of new farming methods and farming technologies in new fields (eg open sea)
- Breeding new species
- Sustainable fish production
- Promoting the production of biotechnology products
- Protecting the environment and reducing impacts

In 2012, the ΣΕΘ (Federation of Greek Mariculture) cooperated with the European Aquaculture Research and Innovation Platform (EATiP) the sector's vision of 2030 horizon development. For Mediterranean aquaculture and Greek aquaculture, in particular, it was proposed to double the volume of production, in order to satisfy the increasing demand in fish. However, in the period 2012-2016, due to the ongoing restructuring process of the largest companies in the sector, as well as the general financial crisis in the country, the industry implemented a strategy of stabilization and improved profitability, not an increase in production. The result of this strategy was to reduce production so as to maintain sales value at a profitable level. According to the latest update, it is estimated that the average annual growth rate by 2030 will be 4% and production will range to 150,000 tonnes (Federation of Greek Mariculture, Annual Report 2018).

3.1.3. Proposed actions to enhance competitiveness

In order to enhance the competitiveness of aquaculture enterprises in Greece and the sustainable development of the sector, the inhibitory factors mentioned in the preceding paragraph should be addressed with targeted actions and actions. More specifically, actions in this direction will aim to:

- Increase in production
- Reduce production costs
- Quality assurance of aquaculture products
- Strengthen diversification
- Strengthen promotion
- Ensuring environmental protection
- Development research
- Consultancy
- Production of new biotech products

[79] Multiannual National Strategic Plan for the Development of Aquaculture in Greece, 2014-2020.

- Enhancing the competitiveness of SMEs, NATURA 2000 network
- Brackish ecosystems
- Other actions

Increase of production

The strategy for the period 2014–2020, set for 2030, should be based on the creation of new units and the modernization of existing ones in order to increase and improve farm production, identify new development zones and implement research priorities, which will enhance the competitiveness of the industry and introduce innovative processes for managing the natural environment and the well-being of fish populations.

At the same time, as has already been documented by the Market Tracking Mechanism, the gradual increase in domestic production, notably sea bream and sea bass, is imminent as demand is growing at a pace higher than supply worldwide. Also, due to the financial crisis, which has led to a decline in production, a significant market share has been lost. For this reason, the strategic target for annual growth of Greek production by 7%, significantly exceeds the average annual growth rate of 4% set by the EU.

In particular, actions to increase production require:

- Enhance entrepreneurship with the aim of establishing new units and the necessary facilities for the rearing of Mediterranean Sea fish, shellfish, freshwater fish, algae cultivation etc.
- Modernization of existing units and their supporting infrastructures
- Further exploitation and modernization of fish farms operating in lagoons, lakes and rivers.
- Enhancing research & development towards increasing productivity through new farming methods, improved management, etc.

Reduction of production costs

Reducing production costs requires actions and actions that will reduce all the individual costs that burden the production of the finished product. More specifically, the following are mentioned:

- Strengthen the operation of organized aquaculture zones (POWs), with the aim of sharing operational costs through the utilization and exploitation of shared resources and infrastructure, with particular emphasis on remote areas
- Synergies between fish farmers and feed producers to improve the utilization of fish feeds and to develop recommendations for optimal farming results
- Reduce the cost of farming / cultivation / exploitation by modernizing production facilities, focusing on production processes, improving feed conversion ratio and improving productive properties (growth rate, reduction in mortality, etc.) of animal feed
- Actions focused on reducing energy costs & staff costs, and on the safety of staff, facilities and livestock
- Enhance research to reduce farming costs

Quality assurance of aquaculture products

Ensuring and continuously improving the quality of aquaculture products is undoubtedly an important parameter for increasing competitiveness and as such has been greatly promoted by aquaculture companies in our country. In order to achieve the objective of improving quality, as well as protecting suppliers and

buyers and under the pressure of large customers, marine fisheries companies are seeking, on a voluntary basis, to maintain their high export status, their certification. Certification is achieved through food quality assurance or management systems (HACCP, ISO) regarding installation, development, production, maintenance and environmental management.

The International Organization for Standardization (ISO) defines 'quality' as 'a set of features and characteristics of a product (or service)', which contribute to its ability to meet expressed or implied needs (ISO 8402: 1986). In the case of fish and their products, quality relates to safety, gastronomic enjoyment and the correct recording of indications as to the weight, species, origin, value and "perfection" of the products. In international fish trade (FAO), two of the prominent aspects considered are "safety" and "sensory" quality.

"Safety" is achieved when there are no different risks. The "sensory" quality is determined on the basis of organoleptic criteria, size and presentation of the fish. Adherence to the existing institutional framework governing the sector (provisions on safety and hygiene, traceability, product labeling and consumer information) is already contributing towards the 'quality' of quality assurance. The utilization of quality assurance or management standards and systems (HACCP, ISO) has an important role, as well. Furthermore, to improve quality, advanced methods of production and processing (e.g. organic aquaculture, organic products, n-3 enriched products) may be implemented.

Strengthen the diversification of finished products

Enhancing competitiveness through diversification requires actions and actions aimed at developing know-how for breeding new species and at the same time expanding the variety and appearance of finished products. The choice of new species to qualify for farming or cultivation should aim at expanding demand in existing markets and penetrating new ones, but without causing competition with existing products.

Candidate species should cover the full range of products produced, whether intended for human consumption or as a raw material for biotechnological production or for any other purpose. Specifically, species such as: amberjack, oyster, scallops, sea cucumbers, sturgeon, crustaceans, cephalopods, sea urchins, and algae could be added to farmed aquatic organisms. In addition to new species, diversification of products can also be achieved through certified farming such as organic and / or ecological cultivation. Furthermore, in order to enhance diversification, actions aimed at producing traditional products of registered origin should be encouraged.

Finally, processing and final presentation of the product plays an important role in differentiation. For this reason, special emphasis is placed on the certification of packaging and disposal processes, as well as on the final form offered to the consumer (fresh, frozen, smoked, fillet, pre-cooked, etc.), according to the nutritional habits and consumer demands, market trends and applied research to develop appropriate know-how.

Enhancement of promotion

Aquaculture products cover a small proportion of the demand, both at European and global level, which leaves huge room for market penetration. Promoting aquaculture products and with the ultimate aim of enhancing their competitiveness requires both business and collective action by promoting the establishment of producer organizations. Such coordinated efforts can increase the per capita consumption of aquaculture products in existing markets, while introducing these products into new markets. Also, to promote products, there is a need to step up actions to inform consumers, participate in trade fairs, conduct targeted advertising campaigns etc., while at the same time researching market trends is needed internationally, meaning in traditional markets and potential (new) markets, as well.

Ensuring environmental protection

Aquaculture as an activity of the primary sector requires excellent environmental conditions. In particular, in Greece, where the majority of farms are active in marine areas (shellfish and floating marine cages), environmental quality assurance is inextricably linked to their viability. To this end, the strict EU and national legislative framework is in place.

In this context and in order to reduce the negative impacts or enhance the positive impacts on the environment and increase the efficiency of water resources, proposed actions are:

- The promotion of new forms of aquaculture that minimize the impact on the environment as well as the introduction of eco-management & control systems and organic aquaculture methods
- Designation of new areas suitable for aquaculture development
- The use of renewable energy sources
- Restoration of existing aquatic ecosystems, lagoons, lakes, etc
- Modernization of production infrastructures and systems aimed at reducing the environmental footprint
- Improvement of techniques and methods for monitoring and recording environmental parameters in aquaculture sites
- Immediate response to emergencies (eg accidents, shipwrecks, etc.)
- Specific attention is paid to the protection of biodiversity and generally sensitive and protected areas, such as Natura 2000 sites, as well as the monitoring and management of these areas

Research for development

In order for the industry to meet the above requirements and to achieve the strategic objectives through the actions outlined above, the contribution of research to the development is crucial, as it has contributed to the development of the aquaculture sector in the past. According to the new legislative framework for research, the research guidelines will result from the National Aquaculture Development Program following the opinion of the National Aquaculture Council.

The national program will set medium- term and long-term goals to enhance the competitiveness of existing activity and lay the foundations for the sustainable development of the industry and the achievement of national strategic objectives (vision 2030). To this end, the actions outlined above and summarized below should include:

- Improvement of existing farming methods and production processes
- Development of new farming methods and technologies in new fields (eg offshore)
- Breeding new species
- Sustainable fish production
- Promoting the production of biotechnology products
- Protecting the environment and reducing impacts

Consultancy

In the context of achieving the national objectives for the sustainable development of the sector and in order to enhance productivity and competitiveness of aquaculture products, it is important to actively support the players in the sector. This support also includes consulting services to meet the requirements relating to:

- modern management needs at productive, scientific, administrative, financial level,
- compliance with national and EU legislation
- environmental protection and environmental impact assessment

- the implementation of maritime spatial planning
- management needs related to ensuring the health and welfare of aquatic animals and public health
- developing specialized marketing, promotional and business strategies

Production of new biotech products

In the context of innovation and promotion of new species production, emphasis should be placed on aquatic biomass production systems (cyanobacteria, algae, etc.) through actions:

- Collaborative research in order to identify and develop their production methods with neutral footprint in the environment, but also to expand their biotechnological utilization (biofuels, medicine, cosmetic pigments, etc.). Of particular interest is the scientific research activity in the field examining their potential use in biologically superior forms of fish feed.
- Promote actions that choose to produce aquatic biomass production systems in recirculation systems, with the aim of minimizing water use and avoiding biodiversity problems (e.g. genetic pollution from fish escaping).

Enhancing the competitiveness of SMEs, NATURA 2000 network

Implementation of the Natura 2000 management objectives in the areas covered, by actions related to recreation, tourism and marketing of local products and actions aiming at providing solutions to the environmental problems of the areas (e.g. cost-effective solutions for water purification) and the sustainable exploitation of raw materials, in line with the regional conservation objectives, create opportunities for small and medium-sized enterprises (SMEs).

In the context of the development of inland aquaculture in areas of the Natura 2000 network, it is also suggested that:

- Actions that boost production in recirculation systems with the aim of minimizing water use and avoiding biodiversity problems
- Actions aimed at cooperation of producer organizations, in order to contribute to aquaculture environmental management and to ensure the biodiversity requirements of Natura 2000

Brackish Ecosystems

Ensuring the development of brackish ecosystems is proposed through actions aimed at modernizing and productively improving their traditional exploitation methods, always ensuring that their use is environmentally sustainable, in line with their respective protection schemes and in particular with the objectives of the Natura 2000 network, (if the region is integrated):

- Modernizing - improvement actions aimed at the wellbeing and health of organisms (which may include the provision of safe predator protection systems, e.g. protection of fish from birds by surface nets)
- Actions related to specific problems of lagoons, or cultivation in earthen tanks, such as e.g. managing, through appropriate investments, accumulation of deposits, etc.
- Actions aimed at diversifying income into activities in brackish systems (and generally in inland waters), through complementary activities not related to aquaculture and fish farming (eg development of agro - tourism, educational tourism aiming at the environment etc)
- Actions for obtaining technical, scientific, legal, environmental and financial advisory services. In the Natura 2000 network areas the above actions serve to avoid creating an environmental footprint, identifying and mapping specific areas of inland water ecosystem (lake, lagoon etc.) that must be excluded from the Natura 2000 aquaculture activity

- Actions aimed at improving, protecting and managing natural fish farms (and those that are part of the Natura 2000 network), in cases of mass production losses
- Actions related to aquaculture methods compatible with the specific environmental management needs (resulting from the design of the Natura 2000 network or other protection regimes)
- Actions to enhance fish farming or aquaculture activities that include environmental and biodiversity conservation and improvement of traditional aquaculture features
- Finally, actions involving cooperation aiming at the development and successful aquaculture of new species capable of growing with minimal use of fish meal.

Other actions

In addition to the above actions, actions aiming at enhancing the capabilities of human resources involved in aquaculture are also necessary. Actions to be supported:

- lifelong learning - employee training
- disseminating know-how, innovation and best practices
- improving working conditions and worker safety
- insurance of stocks against natural disasters, adverse weather events, sudden changes in the water quality
- covering losses from diseases, damage or destruction of production facilities

3.2. Romania

3.2.1. Educational and research institutions

Research and education institutions	*Brief description*
University "Dunărea de Jos" Galați Faculty for Food Science and Engineering Aquaculture, Environment and Land Survey Department[80]	Established over five decades ago, the faculty in Galaţi, as the only training center for specialists in the fisheries sector, has responded to social and scientific needs, accumulating a real treasure trove of tradition, expertise and achievements both in the teaching and scientific research sector, this tradition being also continued nowadays. As of 2005, within the Faculty for Food Science and Engineering, the education process is organized in the three Bologna type cycles, relevant for the fisheries sector being: • Bachelor's level, engineers, day time study for 4 years – Fisheries and Fish Industrialization area; • Master's level, for 2 years study – Science and Engineering of Aquatic Bioresources. All study programmes organized within the Faculty for Food Science and Engineering are certified by ARACIS (Romanian Agency for Quality Assurance in Higher Education). As a result of implementing a project funded from European funds

[80] http://www.sia.ugal.ro/

	within the Operational Sectorial Programme „Increase of economic competitivity" 2007-2013, in 2014, the Romanian Centre for modelling recirculating systems in aquaculture – MoRAS was established within the faculty.[81] The infrastructure of MoRAS Centre consists of a Recirculating System for aquaculture Pilot Station, that performs applicative researches, being served by 14 laboratories equipped with high performance equipment for research: Extrusion station, Chromatography and microscopy, Cells culture, Histology, Nutrition, Water quality control, Numerical modeling in aquaculture and molecular biology, Bio-economical modeling in aquaculture, Physiology, Mechanical and tribological testing, Polymer materials researches, Gastronomy, Master study researches. Full members and associate members of MoRAS centre are teachers, researchers and auxiliary personnel within the University "Dunărea de Jos" Galați. The main mission of MoRAS Centre is promoting a fundamental and applicable research in aquaculture in recirculating systems, by stimulating cooperation, exchange of ideas and the expertise gained in this area by the academic community within the University „Dunărea de Jos" in Galați. MoRAS declares itself open to scientific cooperation between all profile units in the country and abroad on the basis of two-sided agreements or within national and/or international programmes. MoRAS intends, depending on opportunities, to support, through technological transfer, the implementation of aquaculture recirculating systems and intensive aquaculture technologies developed within the centre, at economic and industrial units level. MoRAS Centre offers a wide diversified range of consultancy, expertise and technological transfer for the social-economic environment: 1.Laboratory services: Water quality tests, biochemical tests (meat, feed), Micro-biological tests (water, fish), Evaluation of fish health condition by analyzing blood metabolic profile, Control of fish physiological health condition; 2. Professional training services in aquaculture; 3. Consultancy services in aquaculture; 4. Research, development and innovation services; 5. Services for drawing up studies/documentation in the aquaculture sector; 6. Experimental development and research services in the aquaculture sector.
The Academy of Agricultural and Forestry	The Research – Development Institute of Aquatic Ecology, Fisheries

[81] https://www.unicer.ugal.ro/index.php/ro/prezentare-moras

Sciences "Gheorghe Ionescu Sisești" Research – Development Institute of Aquatic Ecology, Fisheries and Aquaculture (ICDEAPA)[82]	and Aquaculture GALAŢI was established in 1981 and its mission is to perform fundamental, applicative, technological development and technology transfer activities, to a high quality standard, in its competency areas, both at national and international level.
	
	Specific activities performed within the institute are:
	• Fundamental and applicative research in:
	  ○ Artificial reproduction of various species of fish (sturgeons, esocidae, siluridae, cyprinidae);
	  ○ Culture of biologic material in various technological systems
	  ○ Physiology, nutrition;
	  ○ Amelioration, selection and genetics; Ichtiology;
	  ○ Ichtiopatology;
	  ○ Hydrobiology;
	  ○ Hydrochemistry;
	  ○ Fishing;
	  ○ Mechanization and automation of technological processes in aquaculture and fisheries;
	  ○ Arrangements, buildings and facilities in aquaculture;
	• Evaluation, preservation of aquatic living resources;
	• Environmental impact and balance studies;
	• Development of partnerships with similar national research units in order to integrate them in the European technological system;
	• Development of partnerships with economic agents in the area in order to put new technologies into practice and to extend the research results at a faster pace;
	• "Training" activities;
	• Production of brood selected from species: carp, Asian cyprinidae, sturgeon, catfish, pike, lobsters etc.
	
	Main directions for research – development:
	
	AQUACULTURE
	• Development and improvement of technical systems in aquaculture, fishing tools and mechanized systems;
	• Development of methods for diagnosis, prophylaxis and treatment of fish diseases;
	• Development and improvement of technologies in aquaculture; complex production, diversification and capitalization of the food specific for aquatic living creatures;
	• Acclimatization, development of breeds of culture and hybrids for fish and other aquatic creatures with high productive and quality potential.
	
	EVALUATION, PRESERVATION OF LIVING AQUATIC RESOURCES
	• Knowing the biology of fish species in aquatic ecosystems in order to establish the strategy for their preservation and restoration;
	• Identification of critical habitats and specific habitat needs for

[82] http://www.icdeapa.ro/

	various development stages of endangered, vulnerable, rare fish species, in order to improve and protect them; • Development of methodologies and techniques for the evaluation of the condition of living aquatic resources; • Evaluation of the impact produced by fisheries and aquaculture activities on aquatic ecosystems; • Development of methodologies and techniques for the quality control of the aquatic environment. FISHING IN INLAND WATERS, MECHANIZATION AND AUTOMATION OF TECHNOLOGICAL PROCESSES • Improvement of fishing methods and tools for inland waters; • Development of fishing tools with high selectivity in order to capture fish species with high economic value; • Mechanization and automation of technological flows in aquaculture. INFORMATIONAL SYSTEMS IN AQUACULTURE Development of data basis regarding the management of aquaculture resources. An important asset of the institute is represented by the testing and application of research results within laboratories (Aquatic ecology laboratory, Systems and engineering laboratory in aquaculture and fisheries, Fisheries engineering, arrangements and construction laboratory) and its own farms Brateş and Cotul Chiului.
The Danube Delta National Institute for Research and Development (DDNI) [83]	The Danube Delta National Institute for Research and Development (DDNI) was established in 1970, and its main objective is to perform fundamental and applied research in ecology and environment protection, aiming management substantiation in the Danube Delta Biosphere Reserve and other wet areas of national and international interest for the preservation of biodiversity and for sustainable development. As a result of the offered expertise and contribution to the local, regional and national research and development programmes, DDNI was nominated as: • Centre of Excellence for Deltas and Wetlands; • National Reference Centre for Land Cover and Fisheries; • Scientific Advisor of the Ministry of Environment and Sustainable Development for the implementation of Natura 2000 Network in Romania; • Centre of Technological Information for the Danube Delta of the National Authority for Scientific Research. The research activity of The Danube Delta National Institute for Research and Development is oriented towards achieving the

[83] http://ddni.ro/wps/ro/acasa/

	management objectives of the largest protected area in Romania and Europe: • assessment of the ecological status of natural heritage and elaboration of needed actions to preserve biodiversity; monitoring of flora and fauna and environmental factors; • assessment of natural resources and the exploitation level, in accordance with the regenerating potential and the carrying capacity of the ecosystems; • elaboration of hydrological scenarios to assist ecological restoration actions for the improvement of the water circulation within the existing channels network; • measures for the recovery of endangered species populations – fish, birds, reptiles, mammals; • elaboration of technical solutions for the restoration of abandoned agricultural polders and fish ponds in order to extend the area of natural habitats for fish and bird species; • modeling of basic processes in the functioning of aquatic ecosystems; • supporting studies for the harmonization of socio-economic interests with the concept of preservation of the natural capital and for increasing the quality of life and the standard of civilization; • developing the Geographic Information System for the Danube Delta
The National Institute for Marine Research-Development "Grigore Antipa" (INCDM "Grigore Antipa")[84]	The National Institute for Marine Research-Development "Grigore Antipa" Constanţa performs research-development activities in fields like marine physical oceanography, marine biology and microbiology, marine chemistry and biochemistry, marine ecology and protection, engineering and technology. Relevant responsibilities: • National Oceanographic and Environmental Data Center; • National Operator of the integrated physical, chemical and biological monitoring system of the marine environment; • Regional activity center for environmental aspects of fisheries and other marine fishing resources management; • National scientific responsibilities for fisheries data collection and living marine resources stock assessment; • Coordinator of the environmental professions and fisheries training centres.

3.2.2. Research and development activities in aquaculture sector

Research and development activities performed in aquaculture – research, studies, inventions, projects, etc.	*Brief description*
The University "Dunărea de Jos" Galați/The Faculty of Food Science and Engineering in partnership with economic agents or other universities	

[84] http://www.rmri.ro/

FITOBIOACVA – Optimization of sturgeon intensive rearing technology by using feed additive with plant bioactive compounds[85]	Within the National Plan for Research-Development and Innovation for the 2015-2020 period: *Programme 2 – Increasing the competitivity of Romanian economy through research, development and innovation*, the University "Dunărea de Jos" Galați, as project coordinator, and SC Danube Research Consulting SRL, as partner, implemented the project FITOBIOACVA. The project's aim was the transfer/implementation of a technological solution for the improvement of rearing performance and health physiological condition of culture sturgeons through feed enrichment with bioactive compounds extracted from thyme and sea buckthorn. The project approached a complex, multidisciplinary topic that was materialized in the transfer of an innovative technological solution by using phytobiotics as a source of food additives, aiming to improve the efficient use of food, productive performances, but also the immune response in order to ensure disease resistance for some sturgeon species in the aquaculture system of the economic agent SC Danube Research Consulting SRL. The method by which the sturgeon rearing technology was optimized consisted in using the feed enriched with bioactive compounds extracted from thyme and sea buckthorn, the result materializing in the improvement of biotechnological indicators (food conversion factor, survival percentage). Also, the obtained results indicate that the diet enriched with vegetal extracts from thyme and sea buckthorn had beneficial effects upon metabolic health of sturgeons, highlighting the immunity stimulation which had the following consequences: disease prevention, reducing losses and obtaining a top quality and healthy final product. The research results have innovative character due to the modern technology.
Selection and genetic amelioration technology aiming to increase sturgeon aquaculture profitability[86]	This project was implemented within the National Plan for Research-Development and Innovation for the 2015-2020 period: *Programmme 2 – Increasing the competitivity of Romanian economy through research, development and innovation*, by SC Danube Research Consulting SRL, Bucharest University, the University "Dunărea de Jos" Galați and Silver Sturio SRL. Within this project, various models for sturgeon hybrids rearing were tested aiming to monitor the performances related to the productive parameters and the quality of the final products. Therefore, various production systems were experimented (open and recirculating systems) for the intensive increase of hybrid lines obtained by artificial reproduction using aquaculture broodstock selected from the lots belonging to industrial partners. The biologic material obtained was monitored during 18 months period of rearing in industrial system, part of it being used as experimental lots for a series of studies that have the goal to review the

[85] http://www.fitobioacva.ugal.ro/index.php
[86] http://inovtehnostur.com/

	technological performance of the new obtained hybrid, BestBeluga (BB), and set up optimum conditions for its rearing in intensive systems. Following the development of the project, a selection, rearing and amelioration technology was elaborated for the sturgeon hybrid BestBeluga, resulting from Bester female and beluga male interbreeding, in order to increase competitivity and profitability of aquaculture activities. As a result of implementing the new technology, the trading companies involved as partners within the project estimate an increase of the competitivity and profitability compared to previous achievements. The selected broodstock and their descendants, obtained as a result of controlled reproduction under artificial conditions, have been genetically, biochemically, physiologically and technologically characterized. Therefore, optimum biotechnological and biomolecular parameters needed to increase adaptability and to improve survival and rearing rates for this hybrid line under aquaculture conditions could be identified. The research results are innovative due to the new technology.
Development of a multitrophic integrated system for the production of microalgae and shellfish intended for feeding the sturgeons in aquaculture - SISTRAL[87]	The project funded within the National Plan for Research, Development and Innovation 2015-2020, *Programmme 2 – Increasing the competitivity of Romanian economy through research, development and innovation*, *Sub-programme 2.1. Competitivity through research, development and innovation*, was implemented by SC Silver Sturio SRL, service provider being the University "Dunărea de Jos" in Galaţi. The main goal was to implement a modular facility, accessible pricewise, for the production of living food (i.e. shellfish) used for to feed the sturgeon brood. This multitrophic system consists of two sub-systems, one photobioreactor for the rearing of microalgae and one reactor for shellfish rearing. The field elements (solenoid valves, PH transducer, peristaltic pump and level indicator) are supplied from a 24 V supply source and connected to a control panel ensuring the correct operation of the facility. The control of this multitrophic system is provided by an Arduino development plate whereon the piloting programme was installed. The facility operates without computer to simplify the implementation within industrial environment. The 24V source, Arduino plate and light panel will be individually supplied from 220 V. To achieve the (software's) code, the programme ARDUINO IDE was used, which is an open source programme. The microalgae grown in the photobioreactor will be fed with nutrients resulted from the waste water of the sturgeon rearing

[87] http://www.biosys.ugal.ro/sistral.html

	system and, if needed, this waste water will be enriched with an inorganic substrate consisting of salts with reduced economic value. The photobioreactor will operate under continuous mode, and microalgae suspension will be transferred as food to the shellfish rearing reactor. Evacuation from the photobioreactor will be designed with a bypass in case of fisheries farms that, apart from sturgeon, are rearing other fish species consuming mostly living microalgae. The reactor for shellfish will be designed to operate under semi-continuous mode. In this reactor, shellfish technologically recommended to be used for sturgeon brood rearing will be grown. The reactor for shellfish will be continuously fed with microalgae suspension until reaching a maximum volume. When the airing stops, shellfish sedimenting and their cropping will be allowed, keeping a minimum volume to restart the process. This way, the shellfish reactor will have a sequential operation mode. For optimum shellfish rearing it is necessary to correctly design the reactor dimension in relation to the addition of living microalgae. The microalgae and shellfish species were chosen for freshwater fish, but the facility is expected to be versatile, so it could also be used for salt water shellfish species without being modified. The research results belong to the partners SC Silver Sturio SRL, the University "Dunărea de Jos" in Galaţi and the contracting authority of the programme and it is innovative due to state-of-the-art technology implemented.
Information system for the traceability of fisheries products based on cloud computing technology -TRASIPESC [88]	Within the National Plan for Research-Development and Innovation for 2007-2013 period, Programme 4 – Partnerships in priority areas, Softeh Plus SRL, The National Institute for Marine Research-Development „Grigore Antipa“ Constanţa and the University of Agricultural Sciences and Veterinary Medicine in Bucharest, under the coordination of the University „Dunărea de Jos“ in Galaţi, implemented the project TRASIPESC. TRASIPESC is an information system available in cloud. Access to information related to traceability can be obtained by reading a 2D bar code label. This label is generated when introducing the data in the system by the participants involved in the distribution chain, before product marketing. This system is available on various platforms. The condition to operate is for such platforms to have a WEB browser type application installed. To read the bar code labels, they should have installed an application for reading 2D bar code labels and a bar code reader (in case of a smartphone, the phone camera can be used). A bar code printer is needed for the distribution chain participants to print the 2D bar code labels. TRASIPESC is an online platform that allows facile registration of information about fish and fisheries products within the entire production – supply – sale chain and fast identification of their route by authorities and consumers. The platform provides all

[88] https://trasipesc.softeh.ro/trasipesc/

	facilities for registration and identification of fish and fisheries products for all those involved in this process: first sale centres, aquaculture operators, importers, processers, distributors and consumers. Using the TRASIPESC platform brings extra transparency in fish and fisheries products trading, having a major impact on increasing consumers trust and fast identification of compromised lots. The registered data on TRASIPESC platform is made available to related authorities, with the purpose to facilitate dynamic monitoring of fish and fisheries product lots on the market, as well as for any type of needed statistics. The research results are innovative due to implementing a new product and they belong to the partners: Softeh Plus SRL, the National Institute for Marine Research-Development „Grigore Antipa“ in Constanţa, the University for Agricultural Sciences and Veterinary Medicine in Bucharest, and the University „Dunărea de Jos“ in Galaţi.

3.3. Turkey

3.3.1. Educational and research institutions

There are 25 faculties providing aquaculture training in Turkey; 15 Faculties of Fisheries, 1 Faculty of Water Science, 2 Faculties of Marine Sciences, 2 Faculties of Marine Sciences and Technology, and 5 Fisheries Departments within the Faculties of Agriculture. However, in recent years, a large number of these faculties have not been able to obtain or fill the student quota allocated from the Higher Education Council (YÖK).

Apart from MAF affiliated institutions, scientific and technical research is carried out in 4 institutes affiliated to universities and postgraduate education is provided. These are “Erdemli Marine Sciences Institute” in Mersin (Middle East Technical University); two “Marine Sciences and Technology Institute” in İzmir (Nine September University) and Trabzon (Karadeniz Technical University), and “Institute of Marine Sciences and Management” in Istanbul (Istanbul University).

Regarding the Black Sea region there are 4 faculties of fisheries and one institute in the universities founded in Trabzon, Rize, Ordu and Samsun Provinces. Besides education on primary, secondary and tertiary level, research studies were also carried out on fisheries and aquaculture, different aspects of fish farming and interaction with environment (Table 4.1).

Trabzon Central Fisheries Research Institute established in 1987 by the name of "Trabzon Fisheries Research Institute", sustains applied research activities since 1988. In 1998, the institute got "Central Institute" status by the Ministry and its regional base duties advanced to national level and its name changed as "Central Fisheries Research Institute - Trabzon”. Institute aims to carry out research surveys on fisheries and aquaculture especially in the Black sea and inland waters in Turkey and to ensure the adoption of research results into practice. Aquaculture Department has the facilities of intensive fish culture, closed circuit fresh water and marine fish hatchery, marine aquaculture, inland aquaculture, fish farming technology, fish feeding, and adaptation. Main studies focus on Black Sea trout, Black Sea turbot, flounder, sturgeon and red snapper.

Marine Fish Hatchery has a closed area of 700 m^2 for the production of flat fish, mainly turbot but will be used for the production other potential marine fish species. The mechanical systems, research and

production units are available in the hatchery. Mechanical systems consist of water intake, filtration, sterilization and disinfection, heating and cooling, air conditioning units. Research and production unit has feed, brood, larval production, nursery department and laboratory facilities. Sea water to the production units are taken by three different points (from 18 m, 40 m and 55 m depths).

Recirculation unit has volume of 10 m^3 of water use, capable of operation both in fresh water and sea water. Water exchange rate is 10% daily in the system. The water re-used in the system after cleaned with various physical and biological filters. Oxygen level in water is kept continuously at 7-9 mg/l and monitored as the temperature level supporting by heating and cooling units. So far, egg incubation, pre-feeding and growth studies on sea trout, Rainbow trout, Siberian sturgeon (*Acipenser baerii* Brandt, 1869) were carried out in the unit for 5 years. The new unit of 640 m^2 is still under construction.

Table 4.1. Education, research and development and training institutions in the Black Sea

Education & Research					
Province	**University**	**Institution**	**Degree**	**Experimental Aquaculture Unit**	**Objectives**
Trabzon	Karadeniz Technical University (KTU)	Surmene Faculty of Marine Sciences/ Department of Fisheries Technology Engineering[89]	Bachelor, MSc, PhD	Trout culture	Inland & marine aquaculture, fish diseases, fish processing, marketing, education & research, consultancy
		Institute of Marine Science and Technology[90]	MSc		Fisheries, aquaculture, oceanography
		Technology Transfer Application Research Center[91]			University-industry cooperation services, Intellectual and industrial property rights, Entrepreneurship and corporate services
Rize	Recep Tayyip Erdoğan University (RTU)	Fisheries Faculty[92]	Bachelor, MSc, PhD	Trout culture	Inland & marine aquaculture, fish diseases, fish processing, education & research
Ordu	Ordu University (ODU)	Fatsa Faculty of Marine Science, Department of Fisheries Technology Engineering [93]	Bachelor, MSc		planning of fish farms, culture and feeding techniques, fish disease, diagnosis and treatments
Sinop	Sinop University (SU)	Faculty of Fisheries[94]	Bachelor, MSc, PhD	Inland and marine species	Farming alternative species in both marine and freshwater, mussel culture, fish diseases, diagnosis and treatment, research, training and consultancy,
Research & Training					
Province	**Ministry**	**Institute**	**Facility**	**Objectives**	
Trabzon	Agriculture and Forestry	Central Fisheries Research Institute[95]	Turbot, sturgeon, trout culture hatchery, recirculated	Research, training, ınduced spawning, fry production, extension services to investors, delivery of juveniles,	

[89] http://www.ktu.edu.tr/baltekmuh
[90] http://www.ktu.edu.tr/imst
[91] http://www.ktu.edu.tr/ttoen
[92] http://suf.erdogan.edu.tr/tr/page/su-urunleri-yetistiriciligi-bolumu/1159
[93] http://www.fdbf.odu.edu.tr/
[94] https://sufak.sinop.edu.tr/
[95] https://arastirma.tarimorman.gov.tr/sumae/Sayfalar/EN/AnaSayfa.aspx

			closed system	enhancement of sea and inland waters

Institute has also marine cages in Yomra Fishing Port area for the studies on Black Sea trout, rainbow trout, a few species of sturgeon, sea bass and sea bream culture. Research and development

3.3.2. Research Programs

Under the supervision and coordination of TAGEM, four aquaculture research institutes and one aquaculture department were established and funded. These are Central Fisheries Research Institute (SUMAE) in Trabzon, Mediterranean Fisheries Research, Production and Training Institute (AKSAM)[96] in Antalya, Fisheries Research Centre in Elazığ (ELSAM)[97] and Isparta-Eğirdir Fisheries Research Center (SAREM) Institute.[98]

Since the start of TAGEM's Fisheries Research Project, 202 research projects were carried out. Together with 8 R&D projects launched in 2019, 46 research projects are still in progress. Other projects are funded by Scientific and Technological Research Council of Turkey (TUBITAK) (6 projects), from other public bodies (7 projects), international bodies (4 projects from JICA[99], 2 from FAO). During 6th and 7th Framework Programs of the European Union, TAGEM had participated in the consortia of 3 projects (Anon, 2019a).

Fish breeding and aquaculture research studies are of great importance in terms of rational use of resources, increased production, meeting the increasing demand for seafood, supporting natural stocks, creating new employment opportunities and developing exports. In order to increase sustainable production of seafood in Development Plans providing rational use of natural resources, development of aquaculture and offshore fishing are foreseen. Training and awareness raising activities should be carried out to improve environmental interaction with aquaculture activities. Continuity is important in the training of staff working in aquaculture research. Sources should be obtained from the private sector, national and international organizations for research. Strategies that prioritize quality in addition to increase in production should be supported.

Aquaculture projects were carried out under the name of "Aquaculture Breeding and Husbandry" with the support of Ministry of Agriculture and Forestry in the last decade. It was aimed to farm and create new forms of existing species and culture new species which have high commercial value. There are 23 fish species and Mediterranean mussel used in the aquaculture business in Turkey. Since 5 years the researchers were able to add 8 new marine species to the fish farming industry. The juveniles of these new species are at the distribution level to the farms who demand. At present the production amount of new fish species has reached 6,200 tons in 2018. Studies on the development of culture techniques, feeding trials and enhancement of the resources with these species continue.

The results obtained in the projects carried out with the Black Sea trout have been put into practice and the private sector production has been started farming. It has been widely produced especially in net cages in the Eastern Black Sea Region. Trials are carried out to produce a specific commercial feed to cover all biological needs of fish in order to reduce mortality rate in the early stages and to increase growth rate. Another project aims to determine its nutritional needs as well as establishing the infrastructure for the improvement of the genetics by observing the third (F3) and fourth (F4) generations of brood stock in private farms using molecular genetic methods.

[96] https://arastirma.tarimorman.gov.tr/akdenizsuurunleri/Sayfalar/EN/AnaSayfa.aspx
[97] https://arastirma.tarimorman.gov.tr/elazigsuurunleri/Videolar/Promotional.mp4
[98] https://arastirma.tarimorman.gov.tr/sarem
[99] Japanese International Corporation Agency

Turbot (*Psetta maxima*) is a potential species for aquaculture and enhancement studies. Turbot farming studies were started in 1997 and 5 different projects have been carried out so far. Private companies have been supported by the distribution of eggs and juveniles free of charge, training of staff has been provided, the results of project studies shared, survival rate increased to the level in European countries with more detailed studies on brood stock management, increasing the success of larvae and juvenile production. Studies are carried out on the photoperiod application in reproduction of turbot.

In 2000, in the early sturgeon aquaculture studies in have been started with the collaboration of MAF (TAGEM, SUMAE), and universities (Sinop Faculty of Fisheries, Istanbul Faculty of Fisheries) in Turkey. Fertilized Russian sturgeon (*A. gueldenstaedtii*) eggs were imported from Russia and kept to be released after 2.5-3 months to the Sakarya River.

Another project was carried out between 2006-2009 under the title “Determination of the Current Status of Mersin Fish Populations and Investigation of Farming Opportunities- (TAGEM / HAYSUD / 2006/09/02/01)” to start sturgeon farming and sturgeon releasing program to support threatened sturgeon stocks in the Black Sea.

For the first time in 2013 and 2015, domestic sturgeon species have been hatched by the Ministry of Agriculture and Forestry. Since commercial production is made with eggs brought from abroad, R&D studies for the development of breeding techniques for this species are continuing (Memiş, 2007).

Within the scope of "Development of Sturgeon Culture and Conservation Strategy" project supported by FAO, two different projects have been carried out in Turkey in order to start farming of sturgeon, to carry out egg production and juvenile growth, improve farming techniques, and develop an effective conservation strategy and a management plan specific to sturgeon. Some of the young sturgeons were marked for stock reinforcement and released to their natural habitats, and some were given to private farms in order to encourage farming.

Within the scope of fish nutrition and feed trials, a number of studies have been carried out to determine the feeding characteristics of new species and improve specific feed for specific species which are going to be commercially produced. Feeding trials have been carried out by using different types of raw material, various probiotics or enrichers, live food (Artemia, daphnia and chironomid) together with tout feed have been tried to increase the survival rate of crayfish juveniles. The effects of Zeolite-added feeds in trout feeding and Mannan-oligosaccharide (MOS) in sea bream feeding on growth and meat quality were investigated.

Monitoring studies have been carried out at different periods regarding the determination of environmental impact and carrying capacities in regions where intensive fish farming is carried out. In these projects, it was aimed to contribute to the reduction of environmental impacts of aquaculture. Some experiments have been carried out on reducing waste production and purification of solid wastes. It has been reported that the use of fringed rooted plants is effective by creating a surface-flow artificial wetland in the water exit of the fish farms, and that the use of zeolite in the last resting part may have a chemical improvement in water quality. In another study, the efficiency of the drum filters used in the waste water filter in dense production areas was measured. While these filters reduce the amount of waste from feed, they do not affect the other pollution load.

A pilot study for the implementation of new technology to evaluate utilization of the opportunities for the establishment of databank about fish farms and real-time monitoring of water quality in dams by geographical information system (GIS) and spatial analysis was completed, recently. GIS based digital maps in Artvin, Rize, Trabzon ve Gümüşhane provinces were prepared. Two more studies were concluded for real-

time monitoring of environmental parameters by installing real-time data monitoring systems in the marine and dam environment.

3.3.3. Fund provider institutions for aquaculture research

There are several funding institutions for research and development projects in Turkey.

Scientific and Technical Research Council of Turkey (TUBİTAK) has the largest project support programs for the universities, research institutes and companies (Table 4.2) either individual or joint application basis on aquaculture.

Table 4.2. Grants provided by TUBITAK on project basis

National Funds	
Code	Program
1001	Scientific and Technological Research Projects Funding Program
1002	Short Term R&D Funding Program
1003	Primary Subjects R&D Funding Program
1005	National New Ideas and Products R&D Funding Program
1007	Public Institutions Research Funding Program
1503	R&D Project Brokerage Events Grant Programme
1505	University – Industry Collaboration Support Program
1507	SME RDI Grant Programme
1512	Entrepreneurship Multi-phase Programme
1515	Frontier R&D Laboratory Support Programme
1602	TÜBİTAK Patent Support Programme
3001	Starting R&D Projects Funding Program
3501	Career Development Program (CAREER)
International Support Programs	
	ERA-NET
	COST Actions
International Researchers Felowship Programs	
2221	Fellowships for Visiting Scientists and Scientists on Sabbatical Leave
2216	Research Fellowship Programme for International Researchers
1509	TÜBİTAK International Industrial R&D Projects Grant Programme

3.3.4. Business development

To measure the success of aquaculture business in Turkey, several indices are used for the evaluation: self-sufficiency rate (SSR), import dependency indices (IDI), and exportability index (EI). The first two of these indices are used to measure at what extent which the total supply in a country is met through domestic production or imports. Additionally, the exportability index (IEE) can be used to show how much of the production is exported. Using these indices together to make an overall assessment, despite several shortcomings with respect to the aquaculture industry in Turkey; Turkey in general seems to be in good condition (Table 4.3).

Table 4.3. Self sufficiency indexes for 2018

Parameters	Equations	Values
Production	Production=Fishing+Aquaculture	628631 tons
Imports		98297 tons
Exports		177074 tons
Consumption	Consumption=Production + imports-exports	549584 tons
Self Sufficiency Rate (SSR)	SSR= Production / Consumption	114.3%
Import Dependency Index (IDI)	IDI= Imports / Consumption	17.9%
Exportability Index (EI)	EI= Exports / Consumption	32.2%

In the post-2000 period, the value of SSR did not change much, varied between 95-114%, and it was calculated as 114.3% in 2018. IDI value reached 10% in 2008 and was found to be 17.9% in 2018. The EI value reached 10% in 2011, and in the following period, exports increased faster and became 32.2% in 2018.

According to the existing state of aquaculture, such a business system can be applied to solve existence problems and increase production and exports from the Black sea (Figure 4.1).

In order to provide more progress in the field of aquaculture, weaknesses and threats should be converted strengths and opportunities by rational methods. Level of success will be closely related to positive motivation of all stakeholders to reach short, mid and long term targets determined by the common understanding.

According to the reports on the Black Sea region, climate change will have an impact as the floods. Therefore essential measures should be taken in short and midterm periods to get rid of threat of flood (by fostering the farm borders, changing locations, renewal of water intake and discharge systems).

Efficient lobbying activities needed to reduce pollution risks in river basin and impact of hydroelectric power plants on fish farms.

In order to solve such problems Union of Aquaculture Producers in provinces and top organization Association of Aquaculture Producer Unions (AAPU) need to be more active to communicate with the Ministry of Agriculture and Forestry (MAF) and other public stakeholders. On the other hand AAPU must change organizational structure from bottom up instead of vice versa. If there is need any legal support, a binding regulation should be drafted and proposed to the MAF.

Main problem in the sector is smooth marketing with good price and high costs of feed and fry supply. At present majority of the investors are hardly find fry from the hatcheries across country. If AAPU is able to organize such common action, hatcheries may have chance to produce sufficient amount of fry to cover the need of the industry. Brokerage system could be established on digital platform to bring producers and buyers together for an active service benefit of the all parties. Same type of role can be acted for the feed, material and equipment supply necessary for production with sufficient quantity, in time with lower costs. On the other hand veterinary services, consultancies and training needs may also be provided under this collective system. Actually it will be a typical platform which can act like a producer organization for the benefits of members. Recently, big trout producers have formed a media group to discuss the future of big trout production in the Black Sea Region with the participation of academia, producers, administrative staff, exporters, etc. Their main target is sustainable big trout production, creation of a brand name; increase the attraction towards in the international markets, organization of awareness campaigns to increase domestic consumption.

HATCHERIES

borders. Commo

The most essential component of aquaculture, the farms using spring waters in good quality and have small capacities should work for only fry production.

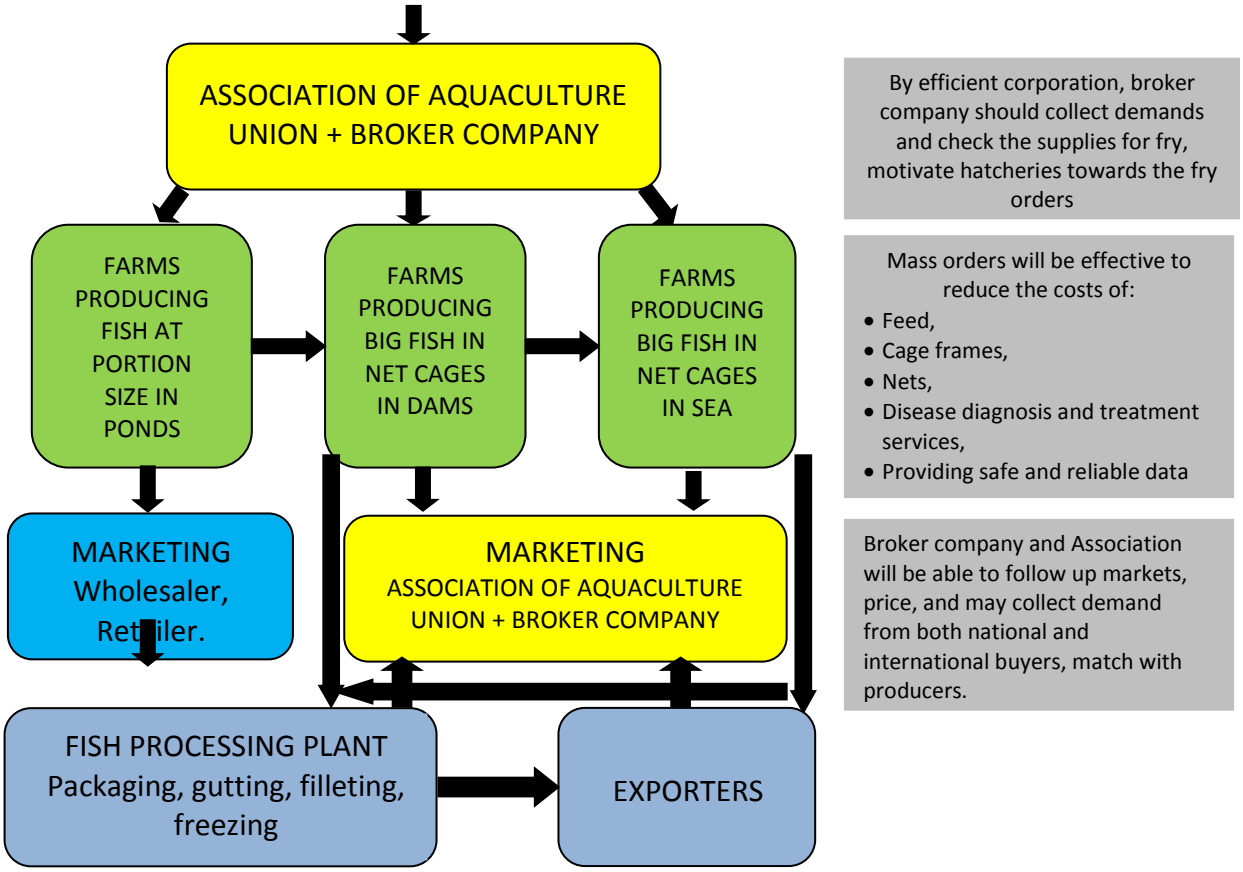


Figure 4.1. An aquaculture business model for the Black Sea of Turkey

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3.3.5. Proposed actions to enhance competitiveness

Increasing production and productivity in aquaculture

- Field work to determine new aquaculture areas in inland and marine ,
- Taking appropriate opinions of the relevant institutions for the new production sites,
- Processing of these areas determined for cultivation in seas, inland waters and terrestrial areas into 1 / 5000-1 / 10000 scaled environmental development plans,
- Implementation of the essential measures for the sustainable aquaculture production
- Within the framework of sustainability, the maximum project capacities should be determined and granted to the producers accordingly,
- Expanding the use of closed circuit production systems,
- Establishment of Agriculture Based Specialized Organized Industrial Zones (ABSOIZ) in regions suitable for aquaculture.

Development of alternative and new species breeding

- Identification of foreign species that may be suitable for breeding,
- Determination of the conditions for bringing and use of the economic new foreign species suitable for breedingaquaculture into the country,
- Investigation of the adaptation and breeding conditions of these species,
- Encouraging omnivorous and herbivorous species farming,
- Providing support schemes for poly-culture,
- Transforming the species suitable for the conditions of our country into investment by making evaluations according to the obtained results,
- Research on farming of new species (cat fish, some local freshwater fish, etc.)
- Building capacities for new species,
- Providing investment incentives,
- Research on the culture of alternative fish species (shrimp, leech, frog, turtle, snail, crayfish, crab etc.),
- Creation of the culture criteria of alternative species that have started to be commercially grown and specified in the legislation,
- Development of marketing strategies of alternative species,
- Determination of economic algae and macrophyte species and production criteria in the waters of our country,
- Determining and mapping the biological and ecological characteristics of macro and micro algae species,
- Providing investment incentives.

Fish diseases, risk analysis and development of management plan

- Identification of existing disease types detected in aquaculture species cultivated in all regions of the country,
- Investigation of diseases that are likely to develop along with existing diseases,
- Creation of national risk maps,
- Creating a risk map of the diseases that can be transmitted from other countries with international trade,
- To determine the costs of drugs used in disease treatments,
- Developing protective methods against drugs and determining their costs,

- Making legal arrangements that give authorization to Fisheries Engineers and Fisheries Technology Engineers on fish health, based on World Animal Health legislation,
- Preparation of the national fisheries health management plan,
- Establishment of a national fish diseases vaccine production laboratory,

Development of feed industry for aquaculture

- Determining the feed requirement of country depending on the growth of the aquaculture industry and planning the feed production,
- To solve feed raw material problems and provide cheaper ingredients,
- Conducting researches on feed development according to aquaculture types,
- Research and implementation of alternative feed raw materials for fish meal,
- Providing support to investors to produce aquaculture feed,
- Production of fish feed in public feed factories, as in other animal feeds, in order to control feed quality and price stability in the market,
- Establishment of a national feed research center.

Development of national and international markets and marketing

- Making an updated marketing project and preparing a strategic plan for marketing inline with the sector growth,
- Establishing promotion offices in foreign countries for promotion and marketing,
- Organising visits to potential markets (EU, Russian Federation, Turkic Republics, Middle East countries etc.,) to carry out product promotion activities to find new ones,
- Increasing participation in national and international fairs,
- Developing logistics infrastructure,
- Developing special brands that appeal to the taste of fish products,
- Giving lectures of branding and marketing for graduate students specific to fisheries and aquaculture under MSc and PhD programs in the Faculties/Departments of Fisheries,
- To train engineers for better background with fluent language, branding and marketing knowledge to carry out marketing activities in targeted countries.

Development of water resources management plans and models

- Determination and monitoring of the present and future usage rates of ground and surface waters by all user groups,
- Investigation, determination and monitoring of the present and future pollution loads has to be created by all parties for water resources,
- Carrying out studies for efficient use of surface water resources

Increasing seafood consumption

- Development of a national plan with the participation all stakeholders to increase continuous supply and consumption,
- Determination of consumption behaviors of all segments of the society (school age children, teenagers, groups having different educational and income levels, citizens living in different geographical regions, etc.) by surveys.
- Organizing promotion and tasting days for the regions where the fish consumption rate is low (Anon, 2019 b).

3.4. Ukraine

3.4.1. Educational and research institutions

Institute of Hydrobiology of the National Academy of Sciences of Ukraine (Kiev)[100]

The Institute of Hydrobiology of the National Academy of Sciences of Ukraine is the leading scientific centre in Ukraine with a great experience of complex hydroecological, hydrobiological, ichthyological, biotechnological, radiobiological researches of freshwater ecosystems of different types.

The Institute's researchers organised in a team of highly skilled specialists who carry out scientific investigations on solving urgent problems related to the discovering of regularities of the freshwater ecosystems functioning in the conditions of increasing anthropogenic impact, assessing the quality of the water environment and factors that determine it, preserving the biodiversity of Ukrainian reservoirs, biotechnological approaches to cultivating of economically valuable species of hydrobionts.

Main scientific directions of the Institute's research:

- Investigation of the biodiversity and functioning of freshwater ecosystems as the basis for the development of technologies for biological indication, monitoring and management of ecological state of the water bodies;
- Investigation of physical and chemical bases of a migration, transformation and biological effects on hydrobionts of radionuclide and chemical contaminations and ways of their regulation;
- Assessment and forecasting of fish fauna state in the water bodies of different types for the environmental management and conservation of fishes diversity;
- Molecular, cellular and physiological researches of aquatic organisms as a basis for the development of highly efficient technologies of aquaculture.

Some of research surveys conducted by the institute is given in Table 4.4.

Table 4.4. Research Projects of the Institute of Hydrobiology of the National Academy of Sciences of Ukraine

Title	Customer/Program	Leader
The research, assessment and development of measures to preserve the biotic and landscape diversity of mountain rivers on the basis of the European Union approaches to the preparation of a river basin management plans (2015-2019)	The complex multidisciplinary scientific research program of the National Academy of Sciences of Ukraine on the development of scientific principles for the rational usage of a natural resource potential and sustainable development (2015-2019).	Afanasiev S.O.
The prognosis and prevention of negative effects of climate change on the ecological status, potential and biodiversity of hydroecosystems of Ukraine (2016-2021)	The complex multidisciplinary scientific research program of the Department of a General Biology of the National Academy of Sciences of Ukraine "Fundamental principles of forecasting and prevention of the negative impact of changes in climatic conditions on the Biotic Systems of Ukraine"	Romanenko V.D.
The structure, biology and phylogeny of amoeba isolated from bentonite clay of Mesozoic	NASU – RFFR Contest	Yuryshynets V.I.

[100] http://www.hydrobio.kiev.ua/en/pro-instytut/napriamky-naukovykh-doslidzhen

sediments (2014-2015)		
The development of principles of complex hydrobiological monitoring of techno-ecosystems of power plants	NNEGC "ENERGOATOM"	Protasov O.O.
The hydrobiological observations. The development of recommendations for the correction of sanitary and ecological criteria to be monitored in the further removal of the cooling pond from exploitation (2015-…).	SSE «Chernobyl NPP»	Gudkov D.I.
The determination of histological, haematological and genetic effects of chronic ionizing radiation on fish and invertebrates in the water bodies of the Chornobyl Exclusion Zone (2014-2015).	University of Portsmouth Higher Education Corporation	Gudkov D.I.

Institute of Fisheries of the National Academy of Agrarian Sciences [101]

The Institute of Fisheries of the National Academy of Agrarian Sciences is the main scientific institution that defines and develops the promising trends in the field of fisheries research, coordinates and performs methodical management of scientific works in the field of aquaculture and fishery in inland water bodies of Ukraine.

The structure of the scientific units of the Institute of Fisheries has been formed according to assigned tasks and with the goal of a comprehensive solution of scientific and research works. The units of the institute are presented on the interactive page Institute Structure.

- The main subjects of the scientific activities of the institute are:
- rational exploitation of aquatic living resources in inland water bodies;
- coordination of the work of breeding farms of Ukraine;
- conservation of the genetic fund and restoration of the populations of rare and endangered fish species;
- selective breeding works;
- biotechnologies in aquaculture;
- studies of the dynamics of genetic structure formation in multiple-breed groups of fish;
- ecology of the hydrosystems of inland water bodies;
- prevention and early diagnostics and treatment of fish diseases;
- development and improvement of fish feeding technologies, creation and selections of fish feed formulas;
- consulting of farm aquaculture;
- development of normative documents regulating fisheries activities in inland water bodies;
- training of the skilled personnel of the highest category;
- analysis of the economic efficiency of business activities of aquaculture enterprises;
- building contacts and partnership for international scientific cooperation.

The Institute network has 4 organizations:

1. SE “Research farm “Nyvka” (Kyiv),
2. SE “Research farm of Lviv research station of the Institute of Fisheries” (Lviv region),
3. Lviv research station (Lviv region),

[101] http://www.if.org.ua/index.php/en/

4. Zakarpattya scientific-research station of salmonid culture and conservation of endangered fishes (Zakarpattia region).

Southern Research Institute of Marine Fishery and Oceanography (PivdenNIRO), Odesa branch

The first research fishery agency of the Black Sea was established in Kerch (the Crimea) in 1922. It was the ichthyological laboratory, later transformed into the Azov and Black Seas Research Institute of Marine Fishery and Oceanography — AzcherNIRO with its branch in Odesa. In 1988 the institute was given the new name of Southern Research Institute of Marine Fishery and Oceanography (PivdenNIRO). In 1996 two earlier independent research agencies — in Berdyansk and Sevastopol — were joined to PivdenNIRO[102].
PivdenNIRO is under the authority of the State Committee for Fishery of Ukraine and is a member of the National Academy of Science of Ukraine. PivdenNIRO is the unique in Ukraine institute carrying out versatile scientific, designing and consulting-expertising studies in the sphere of marine fishery and commercial oceanography. PivdenNIRO carries out studies in the Black and Azov Seas, in the vast areas of the Indian, Pacific and Atlantic Oceans, in the Antarctic waters. The main objective of PivdenNIRO staff is to provide scientific substantiation for present activities and development of marine fishery in Ukraine by means of designing and realizing complex measures for long-term conservation and sustainable utilization of marine living resources.

Odessa State Environmental University, Department of Water Bioresources and Aquaculture

Odessa State Environmental University (OSENU), a multi-campus public university, provides innovative undergraduate and graduate education that contributes to development of the society and the individual through harmonization of mankind-nature relations to facilitate learning through discovery, synthesis, preservation and dissemination of knowledge on the Environment. OSENU is the seat of Environmental Subcommission of the Standing Commission of the Ministry of Education and Science of Ukraine in Biology, Natural Sciences and Mathematics.

Over a long period the main aim of OSENU (founded in 1932) was to train personnel in the fields of environmental quality monitoring and environmental control. In the field of Hydrometeorology OSENU has been training specialists for the World Meteorological Organization for more than 50 years. The curricula for training specialists meet all international standards and are acknowledged by hydrometeorological services all over the world. Since 1957 the University has provided training for some 1600 specialists form more than 70 countries, including circa 150 Candidates and Doctors of Science. Two of OSENU graduates, members of Intergovernmental Panel on Climate Change, Alioune Ndiaye and Oleg Sirotenko were among the awarded the Nobel Peace Prize (2007). For the time being, foreign citizens of 27 countries have been provided education at the University[103].

In 2008 the Department of Water Bioresources and Aquaculture was established at Odessa State Environmental University. Oleksandr P. Mykhailiuk, Doctor of Science (Veterinary), Professor, became the Head of the Department. Since 2012 and for now this department is headed by Pavlo V. Shekk, Doctor of Science (Agriculture), Professor. Young and promising scientists who are interested in the development of the department and science make up the friendly collective of the department.

The Department of Water Bioresources and Aquaculture provides training of bachelors and masters with the speciality 207 Water Bioresources and Aquaculture (Branch of knowledge – 09.02 – Fisheries), as per the

[102] http://rada.com.ua/eng/catalog/9951/
[103] http://odeku.edu.ua/language/en/home/

training programme 090201 Water Bioresources and Aquaculture with the speciality Water Bioresources – specialization: mariculture, aquaculture, decorative (aquarium) fish farming; with the speciality Protection, Management and Sustainable Utilization of Hydrobioresources, specialization: Fishery Protection[104].

Odessa I.I.Mechnikov National University, Department of Hydrobiology and General Ecology[105]

Odessa I.I.Mechnikov National University is one of the oldest in Ukraine. Here you can get acquainted with a rich history of the university and current multifaced educational, scientific and social works of a numerous team of teachers, research fellows and students.

The department was created in 1933. Its first head was Professor N. A. Zagorovsky – an expert on estuaries, one of the initiators of conducting biocenological research in the Odessa Gulf. After his death in 1934 the department was headed by assistant professor A. K. Makarov. Under his leadership researches of fishes and benthos in the North-Western part of the Black Sea, researches of estuaries were carried out.

Fundamental and applied hydroecology, marine and freshwater biology, ichthyology, ecology, protection and sustainable use of biological resources of natural ecosystems are the main topics of the education program. Main directions of scientific activity:

- Complex hydrobiological research of North-Western part of the Black Sea and adjacent waters (study of benthic ichthyofauna, macrozoobenthos, zoo- and phytoplankton, phytobenthos);
- Research in population ecology and population dynamics of wild animals;
- Improvement of methods of differentiation of intraspecific communities of wild animals;
- Research of productivity and biotic balance of coastal ecosystems;
- Development of mathematical models to assess the abundance and biomass of individual species of plants and animals in aquatic ecosystems;
- Research in the conservation of biological diversity of natural ecosystems;
- Development of technological bases of breeding, keeping and guarding of rare species;
- Aquaculture and behavior of fish.

Graduates of the Department gain knowledge of basic and applied hydrobiology, ichthyology, ecology, conservation and sustainable use of biological resources of natural ecosystems. Students study marine and freshwater biology, biology and ecology of various groups of aquatic pelagic and benthic organisms, methods of populational genetics of aquatic organisms, basis of aquaculture and aquariumistics, aquatic toxicology, phycology, etc. Students get acquainted with the methods of quantitative assessment of biological diversity; obtain theoretical knowledge and practical skills for using mathematical algorithms of calculation of biological resources of natural ecosystems, study basic methods of classic hydrobiology research and approaches to conservation of biodiversity of the Black Sea.

3.4.2. Research and Development activities carried out in the field of aquaculture

Institute of Hydrobiology of the National Academy of Sciences of Ukraine (Kiev)[106]

For the first time in world practice, methodological bases have been developed to determine the reference biological components and, accordingly, of a complex system of diagnostics, control and forecasting of the ecological status and biodiversity of aquatic ecosystems, which can be formed as a new scientific and

[104] http://odeku.edu.ua/language/en/odeku/institutes-faculties/department-of-water-bioresources-and-aquaculture/
[105] http://onu.edu.ua/en/structure/faculty/bio/hydrobio
[106] http://www.hydrobio.kiev.ua/en/pro-instytut/fundamentalni-doslidzhennia

technological area - "Bioindication hydroecology". This work is based on the factual material of many years of basic research of hydro-ecosystems of different types, first of all, in the Dnipro and Danube basins.

Based on a multilevel systematic approach, it was first demonstrated that biological indicators for monitoring the effects of global climate change could be both individual indicator species sensitive to changes in the aquatic environment and structural and functional characteristics of major biotic communities of different types of ecosystems. The different in scale and duration climatic changes lead to an increase in the species richness of invasive species of hydrobionts and their role in hydroecosystems. The significant inhibition of production processes in primary producers under abnormally high temperatures was revealed.

The features of ecological and physiological adaptation of invasive and native species of fish and invertebrates to the influence of abiotic factors of the aquatic environment have been established. The differentiation of adaptation mechanisms in different hydrobionts - representatives of the Ponto-Caspian faunal complex is revealed. It has been shown that pre-adaptation of hydrobionts (bivalves and crustaceans) increases their resistance to the stress effects of temperature, salinity and toxicants. Invasive fish species with high adaptive capacity have significant phenotypic variability in physiological and biochemical characteristics and morphometric parameters, depending on their conditions of existence.

For the first time, a new conceptual model for the functioning of rivers of different types has been proposed and the main flows of matter and energy have been quantified including plankton flow, drift and ascending migrations of invertebrates and fish. For small plain and mountain rivers, a balance has been calculated and schemes of biotic flows of matter and energy of ecosystem elements have been constructed taking into account the groups of different trophic levels. The diet and dynamics of nutrition of mass fish species and the role of these processes in the overall energy balance were investigated. The positive role of floodplains as refugiums for the conservation of biodiversity in river systems for plankton and phytophilous fauna communities has been investigated.

Institute of Fisheries of the National Academy of Agrarian Sciences

The research activities, which are carried out and can be proposed for you by our units: ichthyological, physiological-biochemical, hydrochemical, toxicological, hydrobiological, ichthyopathological, microbiological, virological, molecular-genetic, cytogenetic, histological, patent and marketing[107].
Scientific activities of the Institute are carried out according to scientific and technical programs of the National Academy of Agrarian Science of Ukraine. In addition, a significant amount of scientific works is conducted every year in response to orders of the State Agency of Fisheries of Ukraine, Ministry of Agrarian Policy of Ukraine, other ministries and governmental bodies, fisheries related organizations and enterprises as well as according to international agreements and programs.

Southern Research Institute of Marine Fishery and Oceanography (PivdenNIRO), Odesa Branch

The main trends in PivdenNIRO scientific activities: Complex studies in biology of commercial, associated and dependent species in the Azov and Black Seas and in the World Ocean; Scientific justification for long-term conservation and sustainable utilization of bio-resources and monitoring of oceanic, marine and estuarine ecosystems, development of forecasts and recommendations to manage resources and fisheries; Information statistical control over fisheries activities of vessels flying under the Ukrainian flag in the World Ocean, over fisheries in the territorial waters and exclusive zone of Ukraine, collection, processing and storage and provision with fishing statistical data; Nature protective studies in the Black and Azov Seas including

[107] http://www.if.org.ua/index.php/en/

environmental control over the state of marine ecosystem, development of scientific justification for water bodies protection from pollution and assessment of anthropogenic impact on the water body and water organisms; Development and improvement of methods in order to increase commercial productivity of waters by development of mariculture (fish farming, acclimatization, water organism production — mussels, oysters, algae); Development of technologies in order to produce foodstuffs and feeds, medicinal and prophylactic preparations and biologically active matters extracted from water organisms, environmental technology; Development of normative documents (standards, technical conditions) of food, fodder and technical production, medicinal-prophylactic preparations and package; Design of effective and ecologically acceptable gears and methods of commercial fisheries; Development and improvement of software and mathematics provision for monitoring and information-prognostic system; Development, compilation and publication of fishing guidelines, atlases and scientific information reviews; International scientific and technical cooperation[108].

PivdenNIRO takes an active part in the activity of international fisheries organizations and commissions, cooperating with FAO, CCAMLR, NAFO, EUROFISH, INFISH, TACIS, UNEP, BSEP, PHARE and others. PivdenNIRO scientists and staff have carried out and are carrying out collaborating studies with scientists from many countries: Australia, Albania, Egypt, Yemen, Pakistan, Iraq, Kuwait, Cuba, 'Vietnam, France, Mozambique, Republic of Seychelles, Mauritius, Bulgaria, Romania, Turkey, Russia, Georgia, USA, Canada etc.

Department of Water Bioresources and Aquaculture of Odessa State Environmental University

In order to involve junior students in the Department's research work its leading specialists arrange student scientific seminars and circles. Activities of student scientific circle Water Bioresources include the study of key issues related to various fields of hydrobionts use and results in a high level of interest among junior students. Particular attention is paid to a practical side of scientific activities. Typical problems studied by the student scientific circle include: the importance of invertebrates for fish vital activity, fish body shape and its importance in hydrodynamics, adaptation of hydrobionts as an evolutionary process, features of structure and functions sensory organs of herbivorous and predatory fish, the importance of spawning factors for anadromous and semi-anadromous fish, the importance of acclimatization for reproduction of fish resources and fish species, new methods of fish and fish products processing, biology and peculiarities of sturgeon breeding etc. Activities of the circle are led by the Department's teachers.

Each and every student of the department has an opportunity of participating in student competition Water Bioresources the first stage thereof takes place in the university and at the Department of Water Bioresources and Aquaculture. Traditional areas include hydrobiology, ichthyology and fish breeding.

Students of Master's education and qualification level take part in All-Ukrainian competition of student research papers as per the training programme "Biology" and almost all of the department's students, under the guidance of its leading specialists, participate in the competition. Every year students of the department take winning places and their papers participate in the 2nd round of the competition.

In addition, the Department arranges a traditional annual Student Scientific Conference of the Odessa State Environmental University involving students of almost all years of study. All participants have an opportunity of publishing the results of their research papers in the form of abstracts included in a separate collection and the best works are recommended to be published as the articles included in a relevant collection of articles following the student scientific conference of the OSENU.

[108] http://yugniro.in.ua

Department of Hydrobiology and General Ecology of Odessa I.I.Mechnikov National University[109]

Now on the department the population genetics of fish is covered by associate professor D. B. Radionov. Biology and ecology of gobiid fish studies associate professor, PhD, I. L. Ryzhko and senior lecturer Yu. V. Karavansky. In addition, Yu. V. Karavansky is highly skilled in decorative fish breeding. With his active participation the courses on aquarium fish are opened on the department.

In 1997–2005 the researchers of the department fulfilled three fundamental budget projects. Their main goal was to forecast the changes in physiological and biochemistry processes of unicellular algae in stress conditions. It was revealed that different factors affect the beginning stages of adaptive reactions that are aimed to eliminate influence of negative stressors. The intracellular mechanisms of primary adaptations of organisms to negative factors of environment were distinguished.

In 2007–2011 on the department a study on determining the distribution patterns of gobiid fish and macrozoobenthos under the meteo-, hydrological and hydro-chemical factors in coastal part of Odessa Gulf was conducted. 49 species of fish were noted after five years of research in the Odessa Gulf. New data on the dynamics and size distribution of five species of gobies, rapa whelk, six species of crabs were obtained. It was concluded that the number of rapa whelk on stone ridges in the Gulf remains rather high. A new species of anemones for the Black Sea was found and tubenose goby and stone crab was first recorded in the Odessa Gulf. The results of the studies indicate that coastal marine ecosystem is in good condition. However, they are still under the influence of the aggradation of sand that occurred in 2007 and the bottom biocenoses in shallow area in Odessa Gulf have not recovered yet.

Now V. V. Zamorov studies biology and ecology of Gobiidae fish from the northwestern part of the Black Sea and coastal reservoirs, he works at the thesis for doctor's degree. He has published more than 80 works (Zamorov V., Leonchyk Y., Zamorova M., Dzhurtubaev M. Evaluation of the potential abundance and biomass of commercial benthic fish in the Yalpug and Kugurluy lakes (Ukraine) // Scientific Annals of the Danube Delta Institute. – 2014. – Vol. 20. – P. 101 – 108[110]). Since 2006 he has held a post of the dean of Biological faculty.

In the end of 1990-s and in early 2000-s the department was involved in studies connected with the identification of reasons of mass death of fish-invaders in the Danube Lakes.

[109] http://onu.edu.ua/en/structure/faculty/bio/hydrobio
[110] http://onu.edu.ua/en/structure/faculty/bio/hydrobio/scientific-works

II. Inventory on most valuable fish species in aquaculture in the Black Sea partner territories

1. INVENTORY ON MOST VALUABLE FISH SPECIES IN AQUACULTURE IN BLACK SEA PARTNER TERRITORIES

The list of species used in aquaculture is given in Table 1. In order to provide common understanding, foster the communication between the investors in partner countries, it will be useful for the end users to have the list of farmed fish species with local, scientific and English names in order to get rid of any possible confusion.

This document has been prepared according to the information given in the national reports of partners. Not all of the species used in aquaculture were included in the report. Farming methods of the nine species having high market value are given in the Chapter 2.3. Though there are new species farmed in the countries, farming methods are still private and at experimental stage. But due to similarities in breeding methods, farming of the new and alternative species will be more common in near future.

Table 1. List of farmed species in the DACIAT partner countries

No	Species	Greece	Romania	Turkey	Ukraine
1	American paddlefish (Polyodon spathula)		+		+
2	Asian sea bass (*Lates calcarifer*)				+
3	Atlantic bluefin tuna (*Thunnus thynnus*)	+		+	
4	Beluga (*Huso huso*)	+	+		
5	Bighead carp (*Hypophthalmichthys nobilis*)		+		+
6	Black carp (*Mylopharyngodon piceus*)				+
7	Black Sea salmon (*Salmo labrax*)			+	
8	Brook trout (*Salvelinus fontinalis*)		+	+	
9	Brown bullhead (*Ameiurus nebulosus*)				+
10	Buffalo fish (*Ictiobus spp.)*				+
11	Catfish (*Silurus glanis*)		+		+
12	Channel catfish (*Ictalurus punctatus*)				+
13	Common carp (*Cyprinus carpio*)	+	+	+	
14	Common dentex (*Dentex dentex*)	+		+	
15	Common pandora (*Pagellus erythrinus*)	+		+	
16	Common sole (*Solea solea*)	+			
17	Crayfish (*Astacus spp*.)	+	+		+
18	European eel (*Anguilla anguilla*)	+	+		
19	European perch (Perca fluviatilis)		+		
20	European seabass (*Dicentrarchus labrax*)	+		+	
21	Flathead grey mullet (*Mugil cephalus*)	+	+		+

22	Giant river prawn (*Macrobrachium rosenbergii*)				+
23	Gilthead seabream (*Sparus aurata*)	+		+	
24	Grass carp (*Ctenopharyngodon idella*)		+		+
25	Jade perch (*Scortum barcoo*)				+
26	Mediterranean mussel(*Mytilus galloprovincialis*)	+	+	+	+
27	Northern pike (*Esox lucius*)		+		+
28	Oysters (*Crassostrea gigas, C. angulata, Ostrea edulis*)	+			
29	Pike-perch (*Sander lucioperca*)		+		+
30	Rainbow trout (*Onchorynchus mykiss*)	+	+	+	+
31	Red porgy (*Pagrus pagrus*)	+		+	
32	Russian sturgeon (*Acipenser gueldenstaedtii*)	+	+	+	
33	Sharpsnout seabream (*Diplodus puntazzo*)	+		+	
34	Silver(white) carp (*Hypophthalmichthys molitrix*)		+		+
35	South African mullet (*Chelon richardsonii*)				+
36	Stellate sturgeon (*Acipenser stellatus*)		+		
37	Tench (*Tinca tinca*)		+		+
38	Tilapia (*Tilapia spp.*)				+
39	Turbot/Black Sea brill (*Scophthalmus maeoticus-Psetta maxima)*		+	+	+
40	White seabream (*Diplodus sargus*)	+			

1.1. Brief information about the species used in aquaculture

1.1.1. *Cyprinus carpio* – carp

Body elongated and somewhat compressed. Lips thick, two pairs of barbels at angle of mouth, shorter ones on the upper lip. Dorsal fin base long with 17-22 branched rays and a strong, toothed spine in front; dorsal fin outline concave anteriorly. Anal fin with 6-7 soft rays; posterior edge of 3rd dorsal and anal fin spines with sharp spinules. Lateral line with 32 to 38 scales. Pharyngeal teeth 5:5, teeth with flattened crowns. Colour variable, wild carp are brownish-green on the back and upper sides, shading to golden yellow ventrally the fins are dusky, ventrally with a reddish tinge. Golden carp are bred for ornamental purposes.

Distribution: European lakes and rivers. It has been widely introduced to other parts of the world (North America, southern Africa, New Zealand, Australia, Asia) (Figure 1).

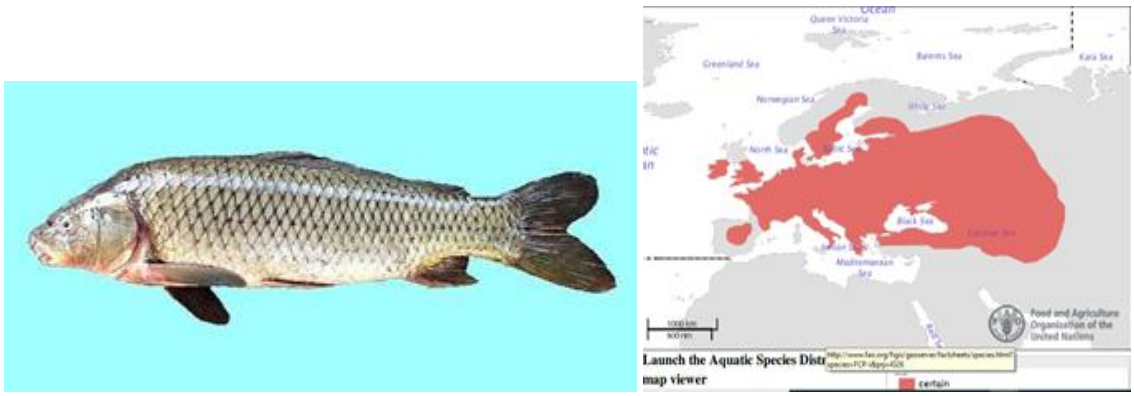


Figure 1.Common carp (Otel 2007) and distribution (Source: FAO FishStat)

Carp (*Cyprinus carpio* Linnaeus, 1758), which is an economically important species of temperate climatic regions, is resistant to cold as well as it likes heat and is very suitable for intensive breeding. It requires a small amount of oxygen and is not sensitive to handling and adapts to water temperature changes between 4-30°C in a short time. Carp is thermophilic. The best increase occurs at water temperature 20-28 ºC. Sexual maturation of the carp occurs at 3-4 years of age. Spawning requires a water temperature of 17-20ºC. Carp is an omnivorous fish, but it gives preference to benthic organisms. Carp weight (about 1000 g) can reach the carp in the second or third years of life.

The natural conditions that suit carp are lowland lakes and rivers where there are abundant vegetation to provide food and shelter. The natural habitat is dams, lakes and rivers. Depending on water temperature and food condition, it is a fast growing fish. They live 20-25 years or even 35-40 years and grow over 1 m length and 25-30 kg weight.

They thrive in warm-water conditions, and require temperatures of at least 18 ºC to spawn. Consequently, the success of populations introduced to northern Europe and the British Isles is dependent on warm weather during spring and summer. Omnivorous, feeds mainly on bottom-living insect larvae, small snails, crustaceans, and some vegetable matter. They are most active at night, and feed little at low temperatures. The diet of the young includes small planktonic crustaceans, but the larvae, after they have utilized the yolk from the egg; feed on minute rotifers and algae, and the young stages of water-fleas.

Carp has an exceptional environmental tolerance. In spite of optimum growth can be achieved above 20 °C, it remains viable sudden temperature changes <1 °C for a long time. Carp grows routinely at ‰ 5 salinity and pH intervals from 5-9. It was observed that carp continues to grow at salinity ‰ 12. It is found in all regions of Turkey and forms the major production in Aegean, Central Anatolia and Southern Anatolia regions with different growth rates. For instance it reaches l350 g in the first, over 1500 g in the 2nd and 2.5 kg in the third year. It reaches market size at the end of second year, while it takes to times more time in the Europe.

In carp culture mainly the mirror carp is used due to high growth rate, less scales and bones, high body depth and good adaptation to culture conditions in Turkey. It has been cultured in Turkey

since 1970 (Çelikkale, 1988). However, in recent years, its production rate reduced around 1 % in the total aquaculture production; it was 55.48% of inland fish farming in 1988.

Carp is an omnivorous fish fed from the bottom. Carp is fed from benthic aquatic animals, plankton, pieces of plant forms and vegetative residues. Taking the small water creatures on the bottom together with the mud, throws the mud back. Therefore, it opens cavities in the mud. Some of the big carp was also observed that they ate fish (Atay & Çelikkale, 1983). Best feed intake and evaluation, 16-25 ° C water at temperatures of 23-24 °C (Çelikkale, 1988).

Carp spawns in groups in the natural environment, in lakes and slow-flowing rivers when the water temperature is 18-22 ^{o}C. Larvae hatch from the eggs adhering to the plants in 3-4 days. Spawning is shallow and abundant when the water temperature reaches 18-20 ºC between May-July. Since the most important factor in the reproduction of the carp is the water temperature, it rarely breeds or does not grow at all in Northern countries. Ovulation is completed in a week. It lays 200-300 thousand eggs per 1 kg of body weight. Their eggs are transparent and sticky and have a diameter of about 1mm. The diameter of the swollen egg is 1.6 mm. Eggs left on aquatic plants are opened in 3-4 days (60-70 days x degree). The length of the larvae after hatching is 5 mm. After staying attached 1-3 days they rise to the surface of the water, fill the swimming sac with air and start swimming and taking bait. They start feeding with plankton (algae, rotifers, and small crustaceans) and after 18 mm length start consuming benthic organisms (Çelikkale, 1988).

Growth is variable with local conditions. In south-eastern Europe (where conditions are optimum) an average length of 51-61 cm a weight of 1.8-4.5 kg is attained; in northern Europe it is rather less. A maximum weight of 32 kg is recorded.

The carp is very popular as a food-fish in Europe (and elsewhere) (Figure 2), and is well suited for cultured in fish farms; carp farming is now a considerable industry. Carp is also a popular anglers' fish and many waters are stocked with large fish. Owing to its popularity as a food or sporting fish. The total catch reported for this species to FAO for 1999 was 75235 t. The countries with the largest catches were Turkey (17797 t) and Thailand (14000 t). In 2009 Romania performed between 2000-5000 tons of carp from aquaculture (Figure 3).

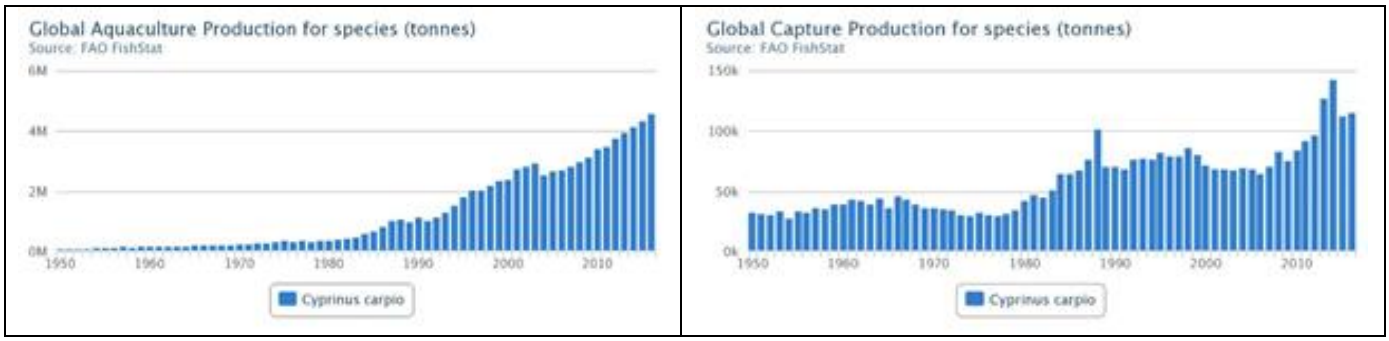


Figure 2. Global capture and Aquaculture Production of carp (Source: FAO FishStat)

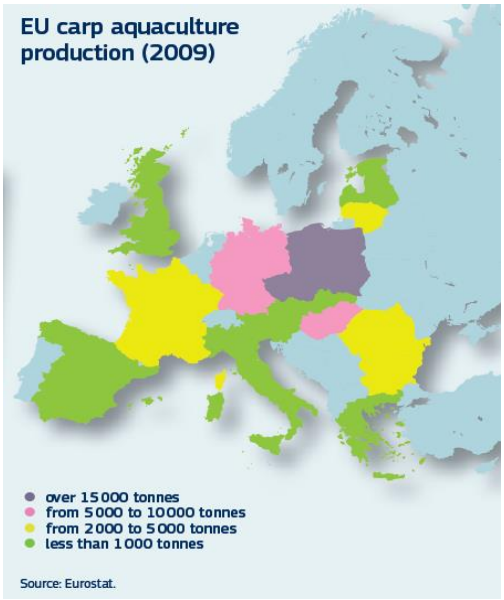


Figure 3 Aquaculture production of carp in EU (Source: Eurostat)

1.1.2. *Hypophthalmichthys molitrix* - silver carp

Body is laterally compressed and deep. Ventral fin is extending from isthmus to anus. Head large, eye small, located on the ventral side of head. Gill rakers are sponge-like. Dorsal fin with 8 rays; no adipose fin. Anal fin with 13 to 15 rays. Lateral line with 83 to 125 scales. Distributed in the Tone River, Manchuria and Mongolia, Canton, Fuchow, China, and Hanoi in Vietnam (Figure 4). Introduced to other parts of the world.

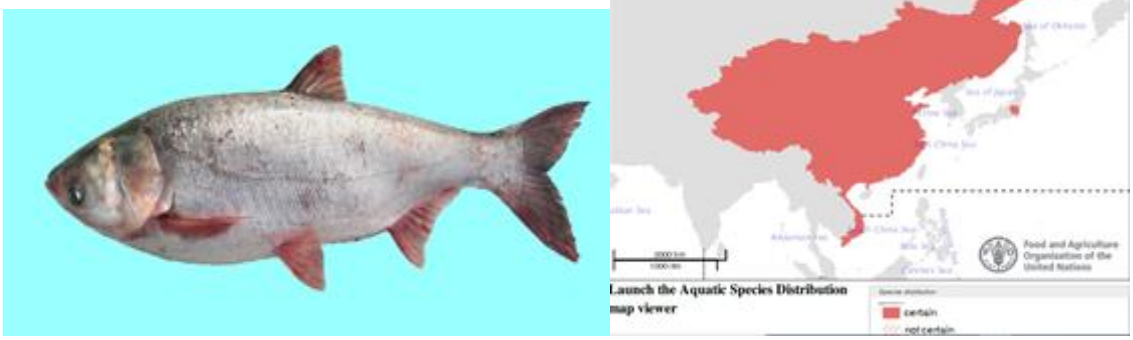


Figure 4 Silver carp species (Otel 2007) and distribution (Source: FAO FishStat)

Requires standing or slow-flowing conditions such as in impoundments or the backwaters of large rivers. Feeds on phytoplankton.

In its natural range, it migrates upstream to breed; eggs and larvae float downstream to floodplain zones. An active species are well known for its habit of leaping clear of the water when disturbed. It swims just beneath the water surface.

Size attains to 100 cm; max. Weight 50 kg. Utilized fresh for human consumption and also introduced to many countries where its ability to clean reservoirs and other waters of clogging algae is appreciated even more than its food value. The total catch reported for this species to FAO for 1999 was 18103 t (Figure 5). The countries with the largest catches were Iran (Islamic Rep. of) (14400 t) and Romania (1308 t).

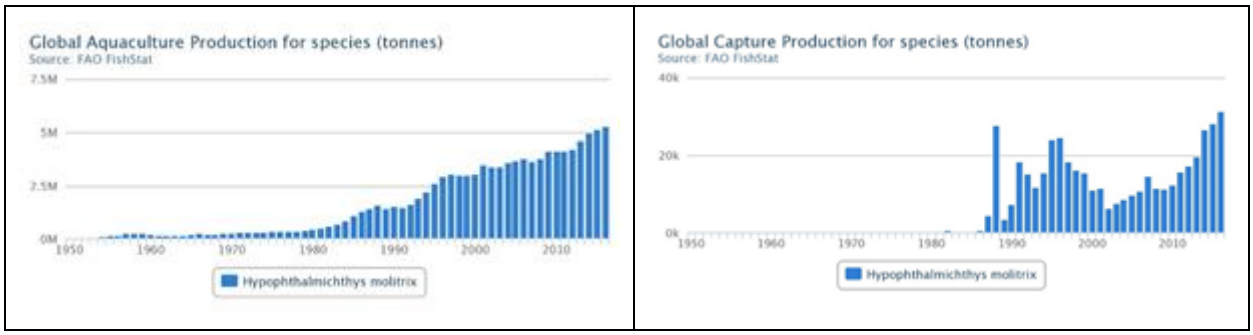


Figure 5 Global capture and Aquaculture Production of Silver carp (Source: FAO FishStat)

1.1.3. *Hypophthalmichthys nobilis* – bighead carp

Freshwater; brackish; benthopelagic; potamodromous; depth range 0 – 1.5 m. Temperate; 1°C - 38°C; 34°N - 21°N, 101°E - 123°E.

Distribution – Asia (Figure 6): China. Introduced to numerous countries and has achieved a near global distribution. However, its breeding requirements are very specialized and stocks are maintained by artificial reproduction or continuous importation. Several countries report adverse ecological impact after introduction. Often confused with *Hypophthalmichthys molitrix*.

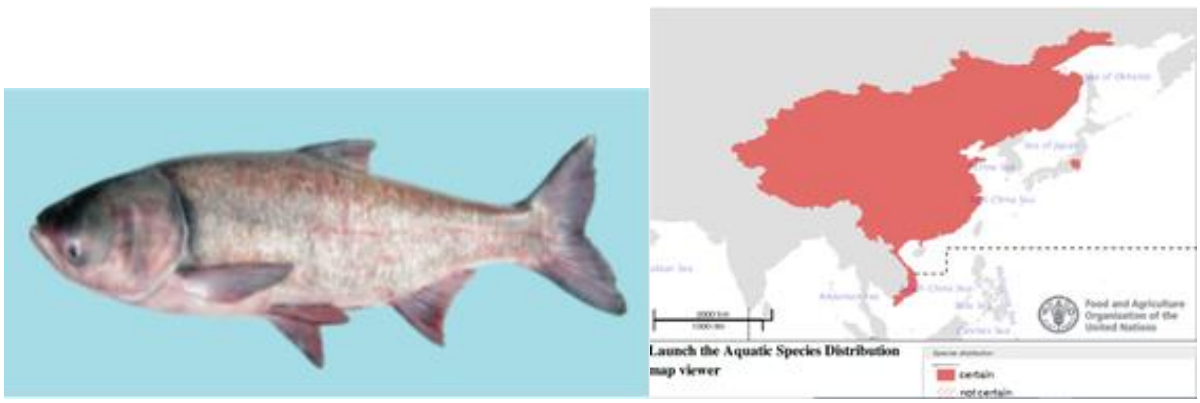


Figure 6. Bighead Carp species (Otel 2007) and distribution (Source: FAO FishStat)

In its natural environment, it occurs in rivers with marked water-level fluctuations, overwinters in middle and lower stretches. Forages in shallow (0.5-1.5 m deep) and warm (over 24°C) backwaters, lakes and flooded areas with slow current. Feeds on zooplankton throughout its life under natural conditions. Breeds in very deep, very turbid and warm water above 18°C (usually 22-30°C), with high current (1.1-1.9 m/s) and high oxygen concentrations. Stocked to large

rivers and almost all still water bodies as lakes and ponds. In aquaculture, adults can survive brackish water (up to 7 ppt) when released into estuaries and coastal lakes. Feeds mainly on zooplankton, but also takes algae as food. Bottom feeding fish. Undertakes long distance upriver migration at start of a rapid flood and water-level increase (in April-July depending on locality). Spawns in upper water layer or even at surface during floods. Spawning ceases if conditions change and resumes again when water level increases. After spawning, adults migrate for foraging habitats, Larvae drift downstream and settle in floodplain lakes, shallow shores and backwaters with little or no current. During autumn-winter, when temperature drops to 10°C, juveniles and adults form separate large schools and migrate downstream to deeper places in main course of river to overwinter.

1.1.4. *Ctenopharyngodon idella* – grass carp

Body laterally compressed and deep. Ventral keel extending from isthmus to anus. Head large. Eye small, on the ventral side of head. Gillrakers sponge-like. Dorsal fin with 10-11 rays; no adipose fin. Anal fin with 10 to 14 rays. Lateral line with 38 to 54 scales. Distributed in the Tone River, Manchuria and Mongolia, Canton, Fuchow, China, Hanoi (Vietnam) (Figure 1.7). Introduced to other parts of the world (Figure 7).

Requires standing or slow-flowing conditions such as in impoundments or the backwaters of large rivers. Feeds on macrophytes.

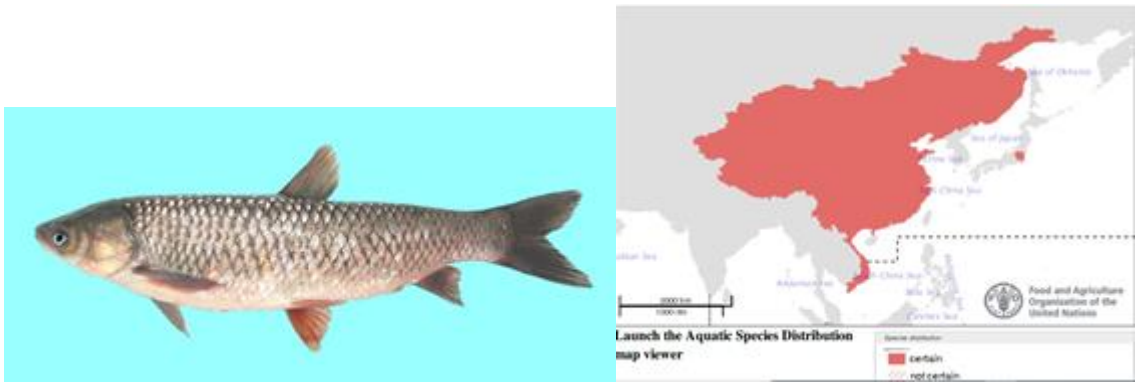


Figure 7. Grass Carp species (Otel 2007) and distribution (Source: FAO FishStat)
Habitat and Biology

Size attains to 150 cm; max. Weight 45 kg. Utilized fresh for human consumption and also introduced to many countries where its ability to clean reservoirs and other waters of vegetation is appreciated even more than its food value.

White (*Hypophthalmihthus molitrix* Val.), bighead (*Aristichthys nobilis*) and grass carp (*Ctenopharyngodon sdella*) belong to herbivorous species of fish. These species come from the Far East in the Amur River basin, acclimatized in our reservoirs.

Silver carp - large pelagic freshwater fish, whose mass reaches 16 kg, length 1 m.

White carp - feeds on polycyclic microscopic algae - phytoplankton and detritus. The white carp is not a competitor to the carp in the field of nutrition, on the contrary there is a mutual positive effect on their mutual cultivation.

The bighead carp is a partially herbivorous species, along with phytoplankton and detritus it also feeds on zooplankton. With significant exceedance of the planting norms can be a food competition carp.

Grass carp – large freshwater fish, up to 32 kg, 122 cm long. It feeds on higher aquatic vegetation. In case of insufficient amount of vegetation it can go to compound feed.

All herbivorous fish are biological ameliorators, fast-growing but more thermophilic than carp. It is recommended to grow herbivorous fish in combination with carp.

1.1.5. *Sparus aurata* - Gilthead seabream

The gilthead sea bream is farmed today on a large scale. It is found widely throughout the Mediterranean but also along the coasts of the eastern Atlantic, from the United Kingdom to the Canary Islands. It is a temperate fish, ie it can withstand large changes in salinity and water temperature.

So, it can live both in the open sea and in estuaries and lagoons. In addition to the sandy bottoms and meadows of posidonia, where it easily finds its food, gilthead sea bream is also found on rocky bottoms bordering the aforementioned ecosystems while it has also been found in underwater caves.

During the spawning season (October to December) adult fish move into deeper waters, so then the younger ones will migrate to coastal waters or river estuaries in early spring. This species is hermaphroditic, maturing as a male during the first or second year of life and then as a female during the second or third year. It is carnivorous and feeds on bivalve mollusks (eg mussels), worms, gastropods, crustaceans, etc. ds). It has the ability to be more easily settled in lakes and lagoons. This happened at Lake Vistonida, where in the late 1980s, when the lake's salinity increased due to declining freshwater and many freshwater species receded into its northern part, smelt settled in the southern part of the lake, creating large populations. Today, it is the most important species in the lake that exceeds the 50% of the total production. It should be noted that the smelt is caught in lagoons and is neither farmed nor reproduced.

1.1.6. *Huso huso* – Beluga

The beluga is a diadromous species that inhabits the Black, Azov, Caspian, and Adriatic Seas. It is more numerous in the Caspian Sea and very rare in the Adriatic Sea (Figure 8).

Spiracle present. Snout moderate and pointed, turning slightly upward. Gill membranes joined to one another to form a fold free from the isthmus. Mouth crescentic. Lower lip not continuous, interrupted at centre. Barbels oval or flat, leaf-like posteriorly reaching almost the mouth. 17-36 rod-shaped gill rakers. D: 48-81; A:22-41 rays. 9-17 dorsal scutes; 37-53 lateral scutes and 7-14 ventral scutes. Dorsal scutes oval, with a longitudinal denticulate comb. First dorsal scute is the smallest. Lateral scutes smooth. Ventral scutes hidden beneath the skin. There are numerous small

bony plates between the scute rows. Back ashen gray or black, gradually transitioning to white toward the underside. Belly white, and the snout is yellowish.

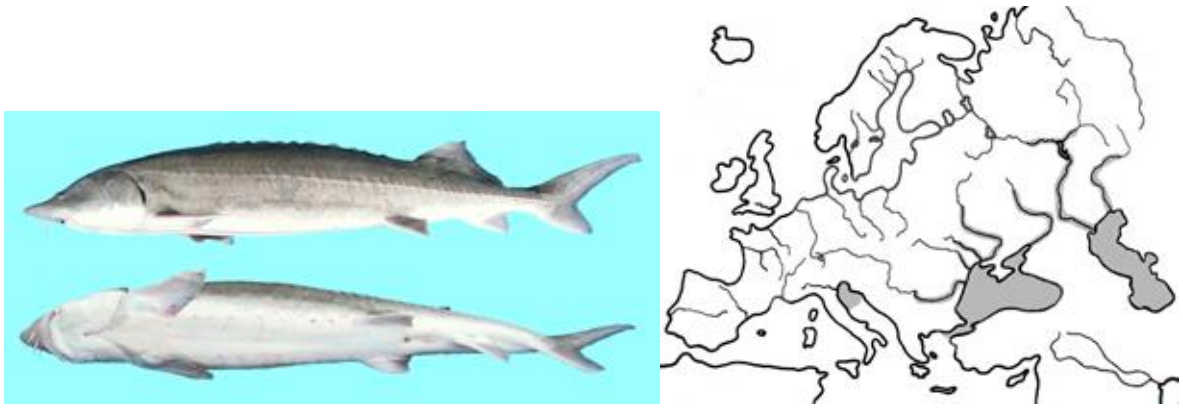


Figure 8. Beluga species and distribution (Otel 2007)

During the period of marine life, the adults mainly inhabit the pelagic zone descending at depths of 160-180 m. During both the seaward and the spawning migration, the beluga usually travels in the deepest parts of the riverbed. Juveniles during the first year of life remain in warmer, shallow habitats. The main food of juveniles appears to be insect larvae, especially of Ephemeroptera, crustaceans (gammarids, mysids, copepods, and cladocerans). Beluga begins preying on fishes, at a very early age (with a length of 24 cm in the lower Danube). Preferent prey items are Alosa spp., anchovy, cyprinids (Cyprinus, Leuciscus, Scardinius, and Aspius). Marine fishes, such as bonito, horse mackerel and sprat are important in it diet between May and September, when the beluga are congregating near the coast prior to entering rivers; during the autumn and winter they descent into deep regions of the sea and feeds mainly on red mullet, whiting, flounder and anchovy.

First sexual maturity is reached by the great sturgeon very late. Most males of the Volga population mature at 14-16 years; most females reach this stage at 19-22 years. Subsequent spawning apparently begins at least 5 years later. The great sturgeon spawns far upstream in all rivers. Spawning period usually coincides with a high water period in spring and begins at a water temperature of 6° to 7 0 °C, and it ceased when the temperature reaches 21°C. The spawning sites are usually in the river bed, at a depth of 4 to 15 m, with a hard, stony or gravelly bottom; the hatchlings at an early age travel to the sea.

Maximum size: about 6 m and a weight exceeding 1000 kg (Berg, 1948). Length of 8 m and weight of 3200 kg have been reported, but they raise doubts. Usually 120-260 cm and to 363 kg.

The beluga was one of the important commercial freshwater fish (Figure 9). The great stocks of the species are concentrated in the Caspian region, but as a result of the presence of dams along the rivers, the natural reproduction of this species in the Caspian watershed has been reduced to a minimum. At present time, the size of the population is being maintained by stocking with cultured fishes (Pirogorskii et al., 1989). Bester, a hybrid of female *Huso huso* and male sterlet *Acipenser ruthenus*, has been successfully cultivated for its high-quality eggs.

Actual commercial fishing is prohibited in Romania since 2006 (Figure 9).

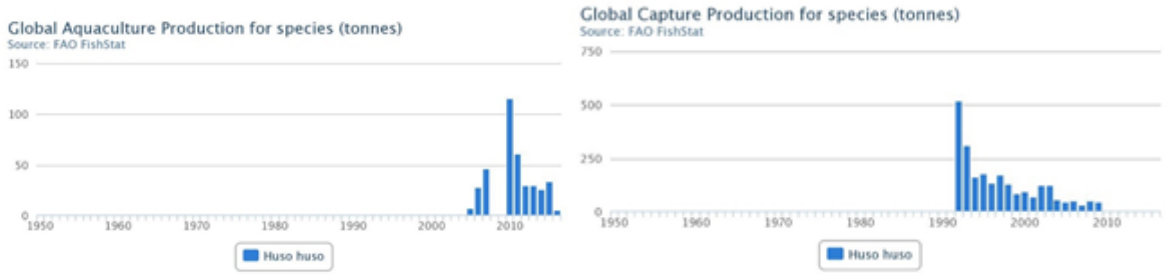


Figure 9. Global capture and Aquaculture Production of Beluga (Source: FAO FishStat)

1.1.7. *Acipenser gueldenstaedtii* – Russian sturgeon

Spiracle present. Snout short and blunt. Gill membranes joined the isthmus. Mouth transverse and lower lip with a split in the middle. The barbels are attached closer to the tip of snout than to the mouth and they are non-fimbriated. 15-51 gill rakers, which are not fan-shaped, terminated by a single tip. D: 27-51; A: 18-33 rays. 8-18 dorsal scutes; 24-50 lateral scutes and 6-13 ventral scutes. Between the rows of scutes there are numerous bony plates. The colouration is greyish black, dirty green, or dark green dorsally. Laterally, it is usually greyish brown, and ventrally, grey or lemon. The juveniles are blue dorsally and white ventrally.

In the sea, the Russian sturgeon (Figures 10 and 11) inhabits shallow waters of the continental shelf; in the rivers it remains at depths from 2 to 30 m.

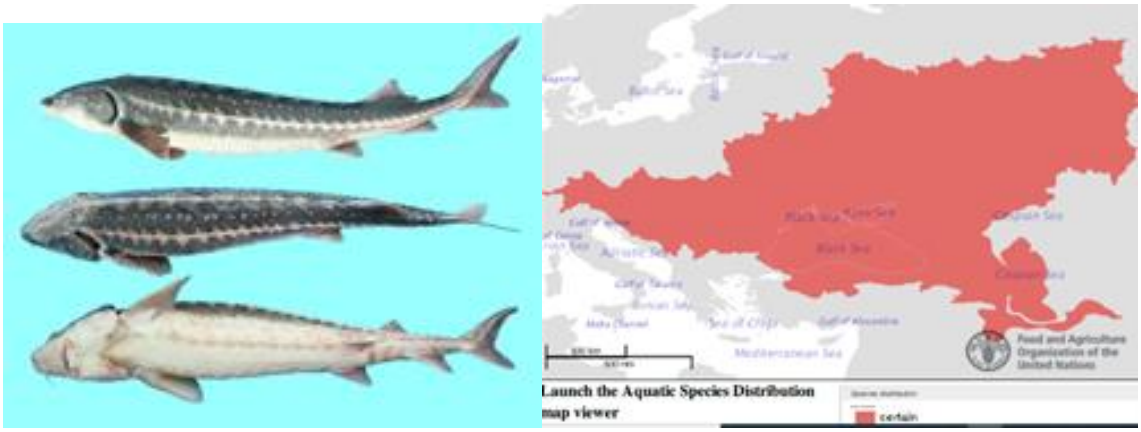


Figure 10. Russian sturgeon species (Otel 2007) and distribution (Source: FAO FishStat)

The larvae are found at considerable depths and in rapid currents. Besides the main diadromous form, a freshwater form that does not migrate downstream to the sea has been reported from various rivers. The Russian sturgeon is a bottom-dwelling mollusk-feeder (Corbulomya, Abra, Cardium, Nassa). They also readily consume crustaceans (shrimps and crabs) fishes (Engraulis encrasicolus, Sprattus sprattus and gobiids) and polychaetes. The main food items of juveniles are crustaceans, including mysids and corophiids, and polychaetes.

The great majority of the males begin to reproduce at an age of 11 to 13 years, while the equivalent age for the females is 12 to 16 years. In the Volga River, the males require two to three years to reproduce again after spawning, while the females take four to five years. Usually, the spawning run of this species into the rivers begins in early spring, reaches its peak in mid to late summer and ceases in late autumn. In the Volga River the spawning period extends from mid-May through early June. The spawning sites are gravel or stony beds at depths from 4 to 25 m. Spawning at water temperatures between 8.9º C and 12º C.

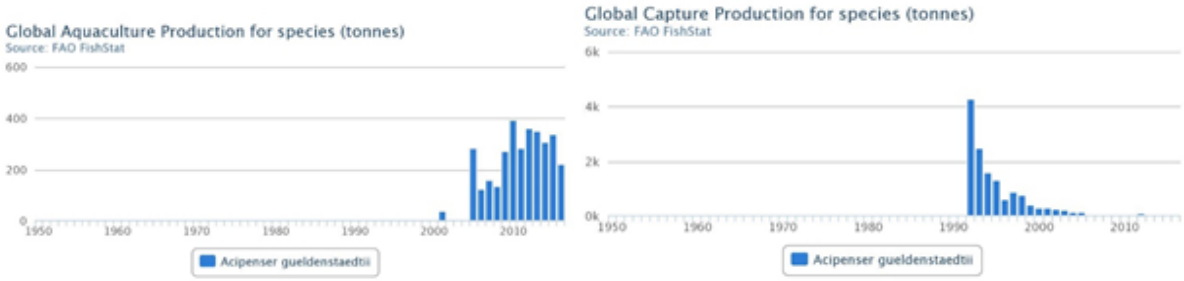


Figure 11. Global capture and Aquaculture Production of Russian sturgeon (Source: FAO FishStat)

Actual commercial fishing has been prohibited in the Black Sea since 2006.

1.1.8. *Acipenser stellatus* – Stellate sturgeon

Spiracle present. Snout greatly elongated and sword-shaped, usually more than 60 % of the head length. Gill membranes joined the isthmus. Mouth transverse and lower lip with a split in the middle. The barbels are short and no fimbriate, not reaching the mouth but nearer to it than to the tip of snout. D: 40-54; A: 22-35 fin rays. 9-16 dorsal scutes; 26-43 lateral scutes; 9-14 ventral scutes. The dorsal scutes have radial stripes and strongly developed spines with the tips directed caudal. Between the rows of scutes, the body is covered by star plates. The body coloration is blackish-brown dorsally and laterally. The belly is light, and the ventral scutes are dirty white colored. During the daytime they are often encountered in the upper layer, while at night, they are generally found at the bottom. The starry sturgeon (Figures 12 and 13) inhabits the coastal sea waters (at depths from 100 to 300 m in the Caspian and Black Sea) over clayey or sandy and clayey sediments, and the lowland section of rivers. Feeding habits vary with size, season and specific features of the water bodies (rivers or sea).

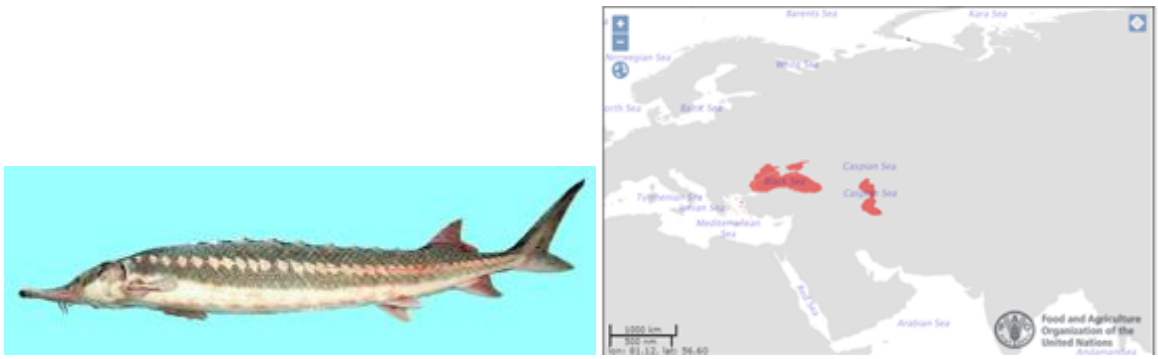


Figure 12 Stellate sturgeon species (Otel 2007) and distribution (Source: FAO FishStat)

The younger individuals feed primarily on crustaceans, while fishes (Gobiidae, *Caspialosa* and *Clupeonella*) become more important in the diet as the grey older. Also molluscs, Polychaeta and other invertebrates. Sexual maturity is reached by males at an age of five or six years. Females mature with an average age of 9.7 years and rarely spawn more than three times in their lives. Enters rivers from April to June with a peak period when the water temperature reaches 10º to 15ºC. Eggs laid on beds of scattered stones, pebbles, gravel and sand. The juveniles stay near the mouth of rivers. Its population is supported by artificial propagation. Spawn from May to September at a water temperature of 12º to 29ºC.

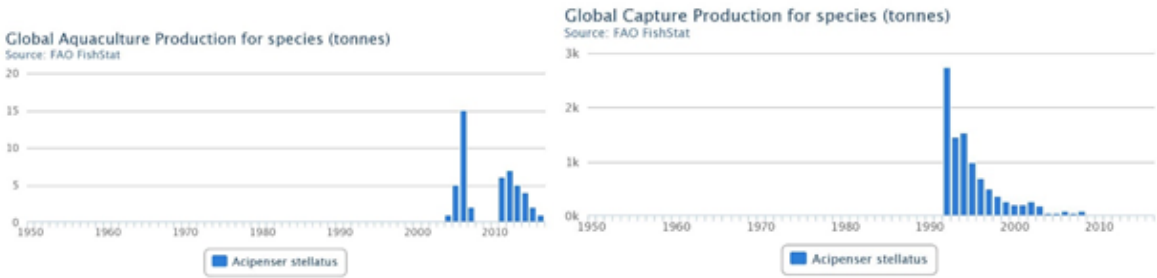


Figure 13. Global capture and Aquaculture Production of Stellate sturgeon (Source: FAO FishStat)

Actual commercial fishing has been prohibited in the Black Sea since 2006.

1.1.9. *Sander lucioperca* – pike-perch

Two dorsal fins, the first spiny and separated by a narrow interspace from the second.

Native to Eastern Europe (from Netherland to Caspian Sea) (Figure 14), but has been introduced to the Rhine catchment and to England. It is now widespread in France and Western Europe, and is rapidly extending its range in eastern and central England. Inhabits rivers. Feeds regularly on fishes, also insects and crustaceans. This species has depleted stocks of native fish in some areas where it has been introduced for angling. Spawn between April to June over sandy or stony bottoms, or among the roots of larger aquatic plants, being earlier in lower latitudes.

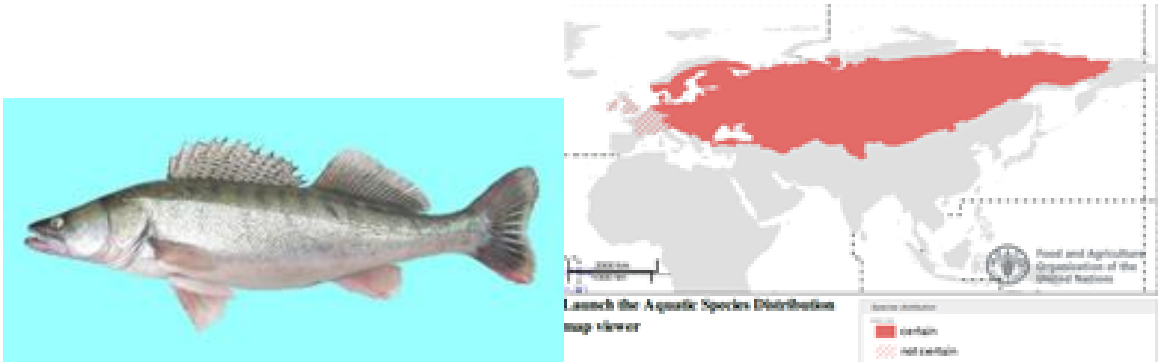


Figure 14 Pike-perch species (Otel 2007) and distribution (Source: FAO FishStat)

Valuable sporting fish, and in inland Europe an important food-fish (Figure 15). Here considerable effort is made to increase the stock in fish farms. The total catch reported for this species to FAO for 1999 was 17 892 t. The countries with the largest catches were Russian Federation (3644 t) and Kazakhstan (3250 t).

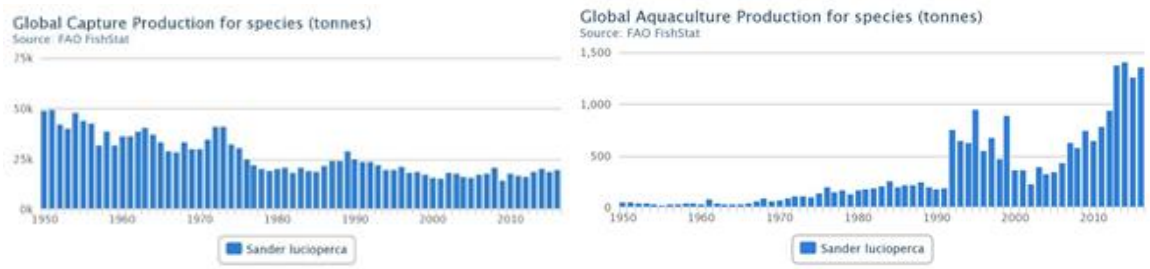


Figure 15. Global capture and Aquaculture Production of Pike-perch (Source: FAO FishStat)

1.1.10. *Oncorhynchus mykiss* - Rainbow trout

Actinopterygii (ray-finned fishes) > Salmoniformes (Salmons) > Salmonidae (Salmonids) > Salmonidae

Marine; freshwater; brackish; benthopelagic; anadromous; depth range 0 – 200 m. Subtropical; 10°C - 24°C; 67°N - 32°N, 135°E - 117°W.

The original homeland of rainbow trout (Figure 1) is the Pacific of North America, rivers and lakes in the region, especially the mountainous rivers of California; Mc- Cloud-River hosts this species. Later it was carried to the other parts of North America for enhancement and in 1880 it was taken to Europe and then to other continents. Farming trials showed that it grows faster than the others and more suitable for farming letting more earnings. Despite years of effort, reinforcement from artificial production stocks only a few rainbow trout races can naturally fertilize and survive in nature forming populationsInhabit clear, cold headwaters, creeks, small to large rivers, lakes, and intertidal areas.

Anadromous in coastal streams. Stocked in almost all water bodies as lakes, rivers and streams, usually not stocked in water reaching summer temperatures above 25°C or ponds with very low oxygen concentrations. Feed on a variety of aquatic and terrestrial invertebrates and small fishes. At the sea, they prey on fish and cephalopods. Mature individuals undertake short spawning migrations. Anadromous and lake forms may migrate long distances to spawning streams. Utilized fresh, smoked, canned, and frozen; eaten steamed, fried, broiled, boiled, microwaved and baked. Cultured in many countries and is often hatched and stocked into rivers and lakes, especially to attract recreational fishers (Figures 16, 17 and 18).

The rainbow trout (Oncorhynchus mykiss), so named because of the many iridescent spots on its skin, is one of the main species raised in freshwater. Rainbow trout is now farmed in almost all European countries.

Figure 16 Rainbow trout and distribution (Source: Fish Base)

Figure 17. Rainbow trout

Rainbow trout is a freshwater fish with a fairly satisfactory level of adaptability to brackish-marine waters. It is resistant to a wide variety of habitats and management modes.

Cultivation with intensive selection caused the formation of different colored varieties; however, it did not lose its characteristic rainbow coloring. This coloration is mainly pink-red band in the middle part of the body and extends to the tail root. There are prominent black spots on the head, body, back and tail fins. The males are darker and have a hook-shaped lower jaw in the reproductive period, especially in older individuals. The long upper jaw extends further back from the posterior edge of the eye.

The species can withstand huge temperature fluctuations (0-27 ° C), but spawning and growth occur in a narrower range (9-14 ° C). The optimum water temperature for its breeding is below 21 ° C. Its growth and maturation are affected by water temperature and food. In optimal breeding conditions, trout usually matures in 3-4 years. It is carnivorous and needs a diet rich in protein. In the proper environment, a trout can reach 350 grams in 10 to 12 months.

Naturally, the larvae of aquatic insects feed on zooplankton, mollusk and small fish.

They reach sexual maturity at the age of 2-3. They live 5 or 10 years in nature, but in exceptional cases it has been observed that they live 18 years and more. It is generally reported that they are between 1-5 kg and reach a maximum weight of 24 kg and a length of 120 cm. Reproduction (artificial milking and fertilization) takes place between October and April in European conditions. As a result of genetic studies, the reproductive period was spread throughout the year. However, it is reported that fish in the southern hemisphere lay eggs with a six-month time difference from the northern hemisphere, since photoperiod difference is observed. Fecundity varies between 1500-3000 eggs per kg live weight, and suitable water temperature for spawning is 7-12 ^{o}C. In their original habitat spawning occurs in shallow parts of the river, and eggs are laid in nests dug into the riverbed by the female. The hatching time of the larvae is 30-32 days at an average of 10 °C. For aquaculture, the ideal water temperature in the larvae and juvenile periods is 8-13 ^{o}C and 12-18 ^{o}C in the fingerling and on-growing stage. Rainbow trout can withstand temperatures 24 ^{o}C and above for a short time, they survive at 20-22 ^{o}C. However, the optimum feeding temperature is between 15-20 ^{o}C. Salinity resistance of trout increases as the fish grow. Salinity value rising from ‰ 3 to ‰ 6 has a positive effect on development of fry in 0.5 g. Values between ‰12-15 may adversely affect those weighing 5 g. In fish weighing 50 g, salinity values between ‰12-15 have a positive effect 70% on development compared to ‰0-1. It is possible to grow in the sea water with the salinity ‰ 30 from fingerling to edible size.

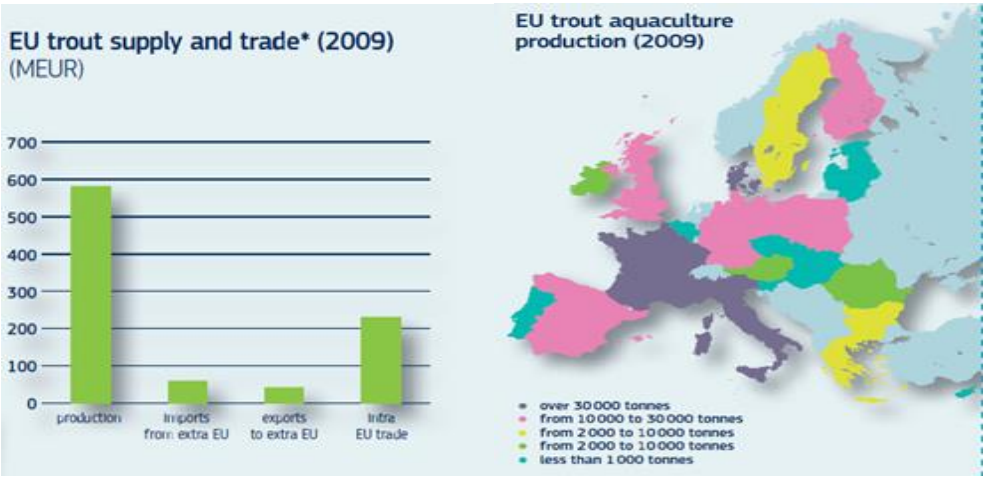


Figure 18. Aquaculture Production of trout in EU (Source: Eurostat)

1.1.11. *Salmo labrax* – Black Sea salmon/trout

The Black Sea trout (*Salmo labrax*) is a member of the Salmonidae family and can be distinguished from other subspecies by the presence of a distinct black spot on the gill cover, the presence of irregular black spots on their bodies and the presence of distinct white rings around the red spots (Figure 19).

They spend most of their lives in the sea, where they grow and thrive. They migrate to freshwaters during reproduction periods. They can reach up to 100 cm in length and weight up to 26 kg in the Black Sea. The characteristic feature is that the parents return to the waters where they lay eggs.

Figure 19. Black Sea trout (*Salmo labrax*)

It reaches sexual maturity between the ages of 2-4. Spawning period of the sea ecotype starts in November-December and continues until the end of February. For spawning, they usually prefer pebbly places and lateral branches at the beginning of the water supply. In the Black Sea trout, spawning continues till the end of October with the temperature between 8 and 10°C. 80% of females lay eggs in November. Fecundity is 2000–3000 eggs per kilogram and Because of their reproductive characteristics these ecotypes migrate between sea and fresh water. In the autumn months, they enter the fresh water flowing into the Black Sea and lay their eggs in the nests they open between the sand or gravel. Hatchlings stay in fresh water for a year and then migrate to the sea. They lay their eggs on a suitable ground at a depth of 20-25 cm. Egg diameter is between 4.8–7.2 mm, hatching of the larvae begins after 60-80 days at 5–7 ° C and the fry appear in April. The period from egg to free swimming can be more than 2 months.

Fecundity varies between 1500-2000 eggs per 1 kg live weight and the suitable water temperature for spawning is 8-10 °C. Egg size is 5-6 mm. The length of larvae hatching is 13-15 mm. The larvae eat their food sacs in 3-4 weeks and reach up to 25-30 mm.

It has been farmed for the last 20 years and there is also the production of fry for fertilization of natural stocks.

While the young individuals of this ecotype have many black and red spots scattered on both sides of their bodies while in fresh water, these colour disappear after migration to the seas and the fish takes on a silvery colour.

The food of smolts in stream mouths and seas are mainly insects. They prefer to consume anchovy, other small fish species and crustacea in the seas, intensely aquatic insects and some animal detritus in lakes and rivers. At the end of the first growing period, juveniles in rivers reach 9.5–16.5 cm in length and 13–50 g in weight. They reach 16-36 cm in their 2nd age and 42.5-57.0 cm in their 3rd age.

Black Sea trout is an anadromous species and is found in many streams in Northern and North-eastern Anatolia in Turkey. It is available on the entire Black Sea coast via Georgia, the Caucasus, the Crimea, the Sea of Azov, Romania and Bulgaria. Its distribution area starts from 40 km east of Surmene, Trabzon and reaches the Georgian border through Coruh River. Fırtına, Çağlayan, Çoruh, Kapistre, Fındıklı, Taşlıdere, İyidere, Baltacı and Solaklı are important rivers inhabited *S. labrax* (Figure 20).

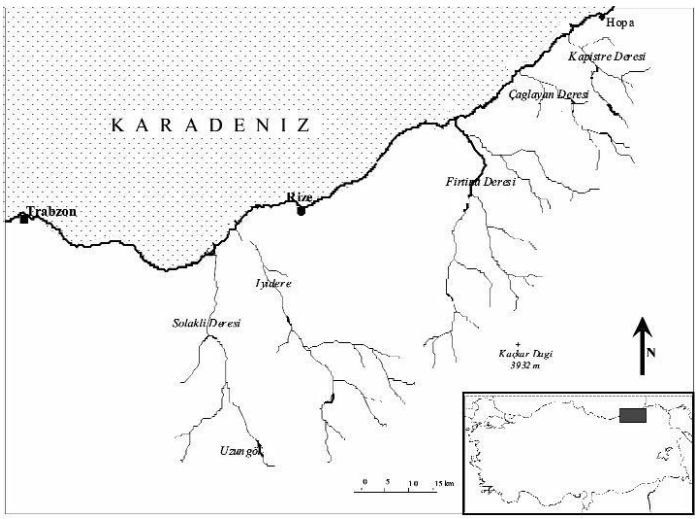


Figure 20. Natural distribution area of Black Sea trout in the Black Sea Region of Turkey (Kocabaş, 2005)

1.1.12. *Scophthalmus maeoticus* - Turbot / Black Sea brill

Actinopterygii (ray-finned fishes)> Pleuronectiformes (Flatfishes)> Scophthalmidae (Turbots)
Marine species; demersal; depth range 10 - 150 m. Temperate; 47°N - 41°N, 27°E - 42°E
Distribution: Europe – Black Sea (Figure 21).
Short description: Bony tubercles generally developed on both sides which are always larger than eye.

Figure 21. Turbot species and distribution (Source: Fish Base)

Brill *Psetta maeotica* Pallas, is one of the most valuable commercial fish in the Black Sea. Spawning of the turbot begins in April-May at a temperature of 7-10^{o}C, and ends in July-August. Reproduction occurs at a distance from the shores in conditions of stable salt and temperature conditions.
The absolute fertility of a turbot varies from 2.5 to 14 million eggs. The spawning stock is dominated by spawning fish. Mature males weigh 0.8-1.3 kg, females over 1.5 kg. In April-May, the turbot fits shallows for foraging and spawning, wintering at depths of 100-120 m. Under natural conditions, no more than 1% of embryos survive so despite the fact that a number of restrictions were imposed on the Black Sea countries, and since 1986.

1.1.13. *Mytilus galloprovincialis* – Black mussel

Mussels are found in a wide variety of habitats, from tidal areas to fully submerged zones, with a broad range of temperature and salinity (Figure 22 and 23). They feed on phytoplankton and organic matter by constantly filtering the sea water and are therefore always farmed in areas that are rich in plankton.

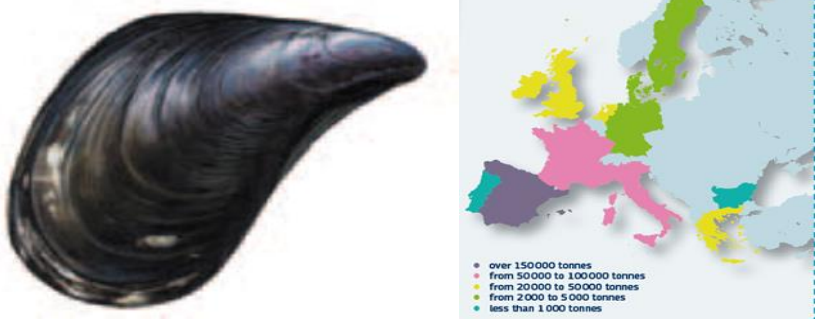


Figure 22. Black mussel species and Aquaculture Production of mussel in EU (Source:Eurostat)

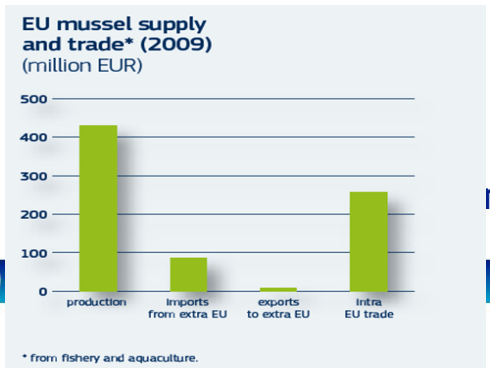


Figure 23. Production of mussel species in EU (Source: Eurostat)

Water quality is a very important factor for mussel rearing. Specific features of mussels are their high fecundity and a mobile larval phase, allowing for widespread distribution. Usually between March and October, depending on the latitude, mussels produce larvae that are carried by currents. In less than 72 hours, the larvae fatten and develop to a stage where they can no longer float. They then settle, attaching themselves to various substrates.

1.1.14. *Crassostrea gigas, C. angulata, Ostrea edulis* - Oysters

Nowadays, farming the endemic *Ostrea edulis* is very limited in Europe. Excessive exploitation and disease have led to the depletion of its reserves. The Japanese oyster (*Crassostrea gigas*), which is native to Japan, was brought to Europe in the 1970s. Thanks to its rapid growth and adaptability to different environments, Japanese oyster is currently the most widespread type of oyster farmed worldwide, including Europe. This species is currently subject to significant mortality rates in several Member States. It began breeding in nature in the northern EU member states- never bred in the past- a fact that has led to its extensive deposition in some coastal areas. Oysters are hermaphroditic and change sex during their growth, by maturing first as males and then conclude as females. Reproduction depends on the temperature and the salinity of the water.

Prior to their deposition, the offspring spend some time in the seabed and are widely distributed through the water currents. Then they change their shape, acquiring the young form of the two-door shell shown above. Oysters are fed by filtering the water.

1.1.15. *Mugil cephalus* - Flathead grey mullet

The flathead grey mullet is found in almost all tropical and subtropical regions of the world. It is a sedimentary species, often found along river estuaries and freshwater and is breed in the sea. It can stand from 4-32 C. Adults fish have been found in waters ranging from zero salinity to 75 ‰, while young individuals can withstand such a wide scale of salinity when they have reached a length of 4-7 cm.

Adults live in schools mainly in shallow waters, with sandy or muddy bottoms and dense vegetation and migrate to the open sea to give birth. The larvae move along the coast in extremely shallow waters, which provide cover for predators as they are a rich food for predators. After reaching 5 cm in length, the young gradually move to slightly deeper waters. The breeding season is from July to October. In optimal conditions, the carp matures in 2-3 years. And it is an omnivorous species as it feeds on zooplankton, dead plant and organic matter, and also filters sandy sediments.

1.1.16. *Dicentrarchus labrax* - Seabass

Sea bass is a valuable fish species of economic importance in Greece, Turkey and other Mediterranean countries. It is a type that is very popular and accepted as a luxury product. It is also preferred in sport fishing. The decrease in natural stocks due to reasons such as overfishing and environmental pollution has led to the initiation of studies on farming. The first activities started in 1905. Commercial production of sea bass in countries such as Italy and France coincides with the 1970s (especially 1976-78). The scientific and commercial studies on the sea bass in Turkey gained

momentum after 1985. At present sea bass farming has been widely carried out in France, Italy, Spain, Greece, Portugal, Turkey and Tunisia.

Sea bass is naturally distributed between 30ºN (North Africa) and 50ºN (Ireland, North Sea and Baltic Sea) latitudes along the Mediterranean, Aegean (even Marmara and Black Sea) and East Atlantic beaches (Figure 24). It is also carnivorous and demersals fish. Sea bass has a fusiform body shape, but the body is flattened from the sides and covered with large ctenoid scales. Cycloid scales are found on the head and cheeks. The nose part is without scales. There are 65-80 scales on linea lateralis. The number of spines on the first gill arch varies between18-27. There is a certain distance between the dorsal fins. The dorsal fin has 8 or 10 hard rays, the second dorsal fin has 1 hard and 14 soft rays. The anal fin has 3 spines, 10 or 12 soft rays.

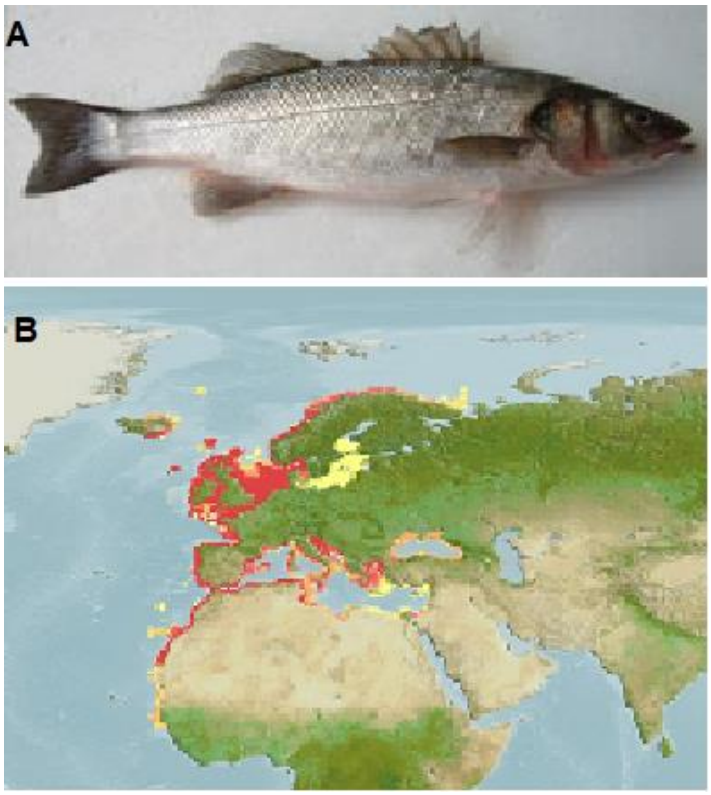


Figure 24. Sea bass (*Dicentrarchus labrax*) (A); natural distribution areas (B) (www.fishbase.org)

The mouth is big and the vomer has half-moon-shaped teeth. There are spiny protrusions on the operculum and pre-operculum. The edge of the gill covers is very sharp and hard. The colour is dark lead on the back, silvery on the sides, and white on the abdomen. The back of the adults is dark with no spots and sometimes with black spots in the youth. There is a blackish spot on the upper part of the operculum. There are also black spots on the eye bone. The prominence of black spots on the body decreases as the fish age. In female fish, the nose is wider and the bodies are wider. Males, on the other hand, are thin, long-bodied and slightly smaller than females. The mouth is wide; there are teeth on the palate and tongue.

Sea bass live in coastal shallow waters. It is also seen in brackish lagoons and river mouths. It usually lives alone. After the end of summer, they migrate to the beaches and rivers.

It is a species of eurythermal and euryhaline. Environmental tolerances to temperature and salinity from the environmental factors are as follows: They live at temperatures between 2-32ºC (usually 5-28ºC). The optimum growth temperature is 22-24ºC, and the temperature at which the growth stops is 7-10ºC. While the upper lethal limit is 34ºC, the lower lethal limit is around 1ºC. If they prefer 12-14ºC water temperature in the spawning period, it is observed that they lay eggs at 10-25^{o}C water temperatures.

They are also very tolerant against salinity changes. Although they can survive even in freshwater and overly salty branches, they generally distributed between ‰ 3-35 salinity.

Although the preferred oxygen level is 7-8 mg/lt, the oxygen level should not be less than 4.5 mg/lt for a comfortable life. They can live at a level of 2 mg/lt O_2 for a temporary period. They like to live in wavy waters. They do not like too turbid and dirty water.

They show uniform distribution on sand, rocky and grass-covered sea beds. Although they can dig tunnels in areas with loose floors, they are less common in muddy areas. They are found in turbid river mouths, sandy beaches and dirty port areas. Embryos are more sensitive than larvae and larvae are more sensitive than juveniles. Sea bass shows low sensitivity to relatively low rates of pollution such as hydrocarbon and insecticide. High turbidity causes irritation of the gills. Fuzzy watery areas should not be considered for sea bass cultivation. It is believed that light intensity does not have a significant effect on the distribution of the perch.

A variety of zooplankton and crustaceans (such as Amphipoda like Gammarus, shrimps like Crangon), Idothea and Ligia are the feed of the sea bass, in line with their predatory and carnivorous features. Adults prefer fish such as sardines, Cephalopodas like Sepia and Loligo, crustaceans such as Palaemon, Carcinus and Portunus, and bivalve mollusks such as mussels and scallops.

The life of sea bass is quite long. They can reach a weight of 15 kg (an average of 1.5-6.0 kg) and 1 m of length (an average of 0.5 m). The ones smaller than 1 kg are locally called “ispendek”, the ones between 1.0-1.5 kg are called “palaz-youngster” and the ones larger than 1.5 kg are called sea bass.

Males grow slower than females and develop more rapidly than those living in warmer regions. In the temperate seas, the growth in the first age group is quite fast and they reach up to 250-350 gr. With the determination of gender characters from the second age, some of the energy received is spent on the development of gonad and the growth rate decreases.

Sea bass are heterosexual. There is no hermaphroditism as it is seen especially in sea bream. They reproduce once a year in the same season. Although males and females are very similar by morphology, they also have some distinctive features as gonads located on the back of the abdomen of the body opens out with genital opening in males and with a genital protrusion in females. Immature individuals, these two structures are not developed. In addition, as a result of a pressure on the abdomen of individuals who have reached sexual maturity in the reproductive period, it is possible to determine the sex by sperm in males and the outflow of eggs in females.

Size and age of sexual maturity vary between locations. For instance in Mediterranean and Aegean Sea sexual maturity of males is 2-3 years, 25-30 cm length, females 3-5 years, 30-40 cm length, but in the Atlantic Ocean males attain sexual maturity at 4-7 years, 32-37 cm in length; females 5-8 years, 38-42 cm in length.

Testis and ovaries are very different from each other in the reproductive period in adult individuals. Ovaries are cylindrical and pinkish or orange in this period. Testis has a triangular structure and their colors are white.

Eggs are spherical and pelagic, in the size of 1.0- 1.40 mm (average 1.15-1.16 mm). The diameter of the oil drop is 0.33- 0.36 mm. The embryo has black pigments. Yellow pigments are then formed and are visible on the embryo, oil drop, and vitellus. Due to the large black pigments, the eggs of the species can be easily distinguished from the others. Their fecundity is very high: the relative fecundity varies between 500000-1000000 eggs per kg.

In the Mediterranean and Aegean, the development of gonads begins in September and continues until December-January. As the water temperature drops to 12ºC, the number of individuals laying eggs increases. Spawning starts in December depending on the water temperature and continues until the beginning of March. On the Atlantic coast, spawning is 2-3 months later (in April) and spawning period is shorter. In general terms, they prefer the coldest months when the water temperature is between 12-14 ^{0}C as the spawning season. It was determined that the salinity rate was not very effective on ovulation time. Day length also has an effect on spawning, and they prefer the shortest and coldest months of the year to lay eggs. Sea bass living in the Mediterranean reach younger and younger sexual maturity than sea bass on the Atlantic coast. They lay eggs in river mouths, lagoons or littoral zone where salinity is high (‰ 35-37). In the spawning period, females shed all their eggs within a few hours.

1.1.17. Tilapia

Tilapia is the common name for nearly a hundred species of cichlid fish from the coelotilapine, coptodonine, heterotilapine, oreochromine, pelmatolapiine and tilapiine tribes (formerly all were in Tilapiini), with the economically most important species placed in Coptodonini and Oreochromini. Tilapia are mainly freshwater fish inhabiting shallow streams, ponds, rivers, and lakes, and less commonly found living in brackish water. Historically, they have been of major importance in artisanal fishing in Africa, and they are of increasing importance in aquaculture and aquaponics. Tilapia can become a harmful invasive species in new warm-water habitats such as Australia, whether deliberately or accidentally introduced, but generally not in temperate climates due to their inability to survive in cold water.

The popularity of tilapia came about due to its low price, easy preparation, and mild taste.

Tilapia typically has laterally compressed, deep bodies. Like other cichlids, their lower pharyngeal bones are fused into a single tooth-bearing structure. A complex set of muscles allows the upper and lower pharyngeal bones to be used as a second set of jaws for processing food (cf. morays), allowing a division of labor between the "true jaws" (mandibles) and the "pharyngeal jaws". This means they are efficient feeders that can capture and process a wide variety of food items. Their

mouths are protrusible, usually bordered with wide and often swollen lips. The jaws have conical teeth. Typically, tilapia have a long dorsal fin, and a lateral line which often breaks towards the end of the dorsal fin, and starts again two or three rows of scales below. Some Nile tilapia can grow as long as 60 cm.

It has been used as biological controls for certain aquatic plant problems. They have a preference for a floating aquatic plant, duckweed (Lemna sp.) but also consume some filamentous algae. In Kenya, tilapia were introduced to control mosquitoes, which were causing malaria, because they consume mosquito larvae, consequently reducing the numbers of adult female mosquitoes, the vector of the disease. These benefits are, however, frequently outweighed by the negative aspects of tilapia as an invasive species.

Tilapia is unable to survive in temperate climates because they require warm water. The pure strain of the blue tilapia, *Oreochromis aureus*, has the greatest cold tolerance and dies at 7 °C, while all other species of tilapia die at a range of 11 to 17 °C. As a result, they cannot invade temperate habitats and disrupt native ecologies in temperate zones; however, they have spread widely beyond their points of introduction in many fresh and brackish tropical and subtropical habitats, often disrupting native species significantly. Because of this, tilapia is on the IUCN's 100 of the World's Worst Alien Invasive Species list.

Other than their temperature sensitivity, tilapia exists in or can adapt to a very wide range of conditions. An extreme example is the Salton Sea, where tilapia introduced when the water was merely brackish now lives in salt concentrations so high that other marine fish cannot survive.

Tilapia are also known to be a mouth-brooding species, which means they carry the fertilized eggs and young fish in their mouths for several days after the yolk sac is absorbed.

1.1.18. *Anguilla anguilla* - Eel

European eel is one of the most delicious and valuable fish species on the world market. Smoked pimple is one of the most delicious delicacies among delicatessen lovers. In addition to being very tasty, eel meat has "renewable" abilities, so fish of this species are in high demand in Asian countries, where a large variety of interesting animal species are consumed. In European countries, for a long time there has been a taboo on the use of acne because of its resemblance to a snake. This is what saved him from complete destruction in European countries. Now acne is listed in the Red Book, so it is better to grow it on special farms in recirculating aquaculture systems (RAS). Acne has a surprisingly complex breeding pattern associated with the passage of a very difficult metamorphosis from larvae to fry, so scientists are still struggling to grow acne in captivity. The caught eel larvae (glass eel) are placed in special conditions, where on artificial fodder fry reach 5-7 cm in size and can already be grown in the conditions of conventional RAS.

1.1.19. *Scortum barcoo/ Barcoo grunter*- Jade perch

Jade perch is a fish of the Terapontidae family, an endemic to Australia. It can be caught in most of the great rivers of the Green Continent, including the Barca River. It is this river that gave the name to this interesting fish. In nature omnivorous, hunts crustaceans, shellfish, insects, fish. It grows to 35 cm, weighing up to 3 kg. The body is brownish green with black spots on the body. It is because

of the greenish skin color of his perch and was called jade. The fish has a very large bony body and a small head. Currently, there is a real boom in the cultivation of this interesting fish. Fish are unpretentious (need to try very hard to kill), very fast growth (1.5 kg in 12 months). Due to the accumulation of internal fat, the meat of this fish is very tender, considered a true delicacy not only in Australia, but also in countries in Asia, America and Europe. Fish meat contains essential amino acids for human nutrition, as well as fatty acids Omega-3, Omega-6, vitamins. The amount of unsaturated fatty acids in jade meat is the highest among all known freshwater fish species.

The technology of jade perch cultivation is virtually indistinguishable from tilapia. Jade perch likes water temperatures in the region of 24-26C (tilapia grows better at 28-30C), feed uses tilapia. The planting density is slightly lower than the planting density of the tilapia (with oxygenation): jade perch - 80-100 kg per m3, tilapia - up to 140 kg per m3.

The minimum project for growing this fish is 20,000 kg per year. The cost of capital is about 200,000 euros. Operating costs will be around EUR 70,000 per year.

Against this background, it is advisable to add that in the Odessa region scientific research in the field of aqua and mariculture has not stopped, the scientific results of long-term researches of marine biology and biotechnology schools have been preserved and multiplied; science has identified priority areas for the region, directions and specific measures for large-scale development of fish, shellfish and algae, there are also economic justifications for the conditions of high profitability of such projects.

1.1.20. *Atherina boyeri* - Smelt

It is a small species with great potential for adaptation to ecosystems that occupy empty habitats (food fields). It has the ability to be more easily settled in lakes and lagoons. This happened at Lake Vistonida, where in the late 1980s, when the lake's salinity increased due to declining freshwater and many freshwater species receded into its northern part, smelt settled in the southern part of the lake, creating large populations. Today, it is the most important species in the lake that exceeds the 50% of the total production. It should be noted that the smelt is caught in lagoons and is neither farmed nor reproduced (Figure 25).

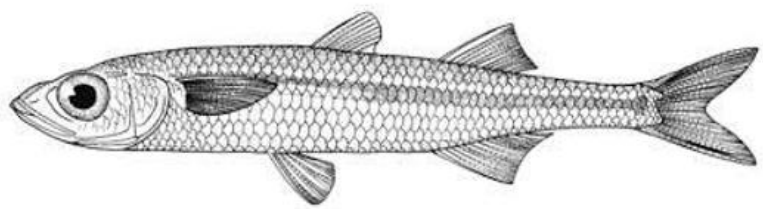


Figure 25. Smelt

1.2. Farming systems

There are several types of common farming systems used for many species in aquaculture.

1.2.1. Intensive culture[111]

An intensive freshwater fish farming site is generally composed of several open-air concrete tanks, raceways or earth ponds of different sizes and depths suited to the different stages of growth of the fish. A race taps river water upstream and returns it to the river downstream after it has flowed through all the tanks. This is what is known as a flow-through system. It is used typically for trout.

1.2.1.1. Pond culture (mono- or/and poly- culture)[112]

Pond culture is a very popular aquaculture production method with many aquatic species cultured in ponds. To have successful pond production, ponds must be properly sited and built, with careful assessment of water availability, quantity, and quality. There are two main types of pond systems: watershed and levee systems (Whitis 2002). The climate and topography of the region in which you are located will determine which type of pond system is appropriate. Areas that have enough rainfall to fill and keep ponds filled will be more suited to watershed pond systems. In an area where the main water source is groundwater, then a levee pond may be more suitable.

Fish culture is classified based on the number of fish species as monoculture and polyculture. This is the culture of single species of fish in a pond or tank. The culture of Rainbow trout is typical example of monoculture. The advantage of this method of culture is that it enables the farmer to make the feed that will meet the requirement of a specific fish, especially in the intensive culture system. Fish of different ages can be stocked thereby enhancing selective harvesting.

Polyculture is the practice of culturing more than one species of aquatic organism in the same pond. The motivating principle is that fish production in ponds may be maximized by raising a combination of species having different food habits. The concept of polyculture of fish is based on the concept of total utilization of different trophic and spatial niches of a pond in order to obtain maximum fish production per unit area. The mixture of fish gives better utilization of available natural food produced in a pond. The compatible fish species having complementary feeding habits are stocked so that all the ecological niches of pond ecosystem are effectively utilised. Polyculture began in China more than 1000 years ago. The practice has spread throughout Southeast Asia, and into other parts of the world. Different species combination in polyculture system effectively contributes also to improve the pond environment. By stocking phytoplanktophagus Silver carp in appropriate density certain algal blooming can be controlled. Grass carp on the other hand keeps the macrophyte abundance under control due to its macro vegetation feeding habit and it adds increased amount of partially digested excreta which becomes the feed for the bottom dweller coprophagous common carp. The bottom dwelling mrigal, common/mirror carp help re-suspension of bottom nutrients to water while stirring the bottom mud in search of food. Such an exercise of

[111] https://ec.europa.eu/fisheries/cfp/aquaculture/aquaculture_methods_en
[112] https://vikaspedia.in/agriculture/fisheries/fish-production/culture-fisheries/types-of-aquaculture/classification-of-fish-culture-on-the-basis-of-number-of-species

bottom dwellers also aerates the bottom sediment. All these facts suggest that polyculture is the most suitable proposition for fish culture in undrainable ponds. Ponds that have been enriched through chemical fertilization, manuring or feeding practices contain abundant natural fish food organisms living at different depths and locations in the water column. Most fish feed predominantly on selected groups of these organisms. Polyculture should combine fish having different feeding habits in proportions that effectively utilize these natural foods. As a result, higher yields are obtained. Efficient Polyculture systems in tropical climates may produce up to 8000 kg of fish per hectare per year.

Combinations of three Chinese carps (bighead, silver and grass carp) and the common carp are most common in Polyculture. Other species may also be used. While fish may be grouped into broad categories based on their feeding habits, some overlap does occur (Prabjeet et al., 1991).

1.2.1.2. Recirculating Aquatic System (RAS)[113]

Another option is water recirculation systems. In such installations, the water remains in a closed circuit and is recycled so it can be 'recirculated' in the tanks using a piping system. One of the advantages of this system is its isolation from the external environment, which means that all the parameters of the water can be controlled: temperature, acidity, salinity, disinfection, etc. It also allows for organic waste to be treated before being disposed of in nature. Its drawbacks, apart from the cost of the investment, include its energy consumption and dependence on a complex technology.

Recirculation has been used for a long time in aquariums and hatcheries. Its use for on-growing is more recent, but is attracting growing interest. In fresh water, this system is mainly used for rainbow trout, catfish and eel, but it is suited to all species, including marine species like turbot, sea bass and sea bream.

1.2.1.3. Cage system[114]

Sea cages hold fish captive in a large pocket-shaped net anchored to the bottom and maintained on the surface by a rectangular or circular floating framework. They are widely used for rearing finfish, such as salmon, sea bass and sea bream, and to a lesser extent trout, in coastal and open waters, in areas sheltered from excessive wave action, with sufficiently deep water and relatively low current speeds. Several cages are typically grouped together in rafts, often housing moorings and walkways for boat access, feed storage and feeding equipment. As the water flows freely to the cages, the openness of the system makes it vulnerable to external influences (i.e. pollution events or physical impact) as well as exposing the adjacent environment to the stock, and the fish farm effluents.

Today cage culture is receiving more attention by both researchers and commercial producers. Factors such as increasing consumption of fish, declining stocks of wild fishes and poor farm economy has increased interest in fish production in cages. Many small or limited resource farmers are looking for alternatives to traditional agricultural crops. Aquaculture appears to be a rapidly expanding industry and it offer opportunities even on a small scale. Cage culture also offers the

[113] https://ec.europa.eu/fisheries/cfp/aquaculture/aquaculture_methods_en
[114] https://ec.europa.eu/fisheries/cfp/aquaculture/aquaculture_methods_en

farmer a chance to utilize existing water resources in which most cases have only limited use for other purposes.

Nowadays, cages, located in lakes, have started to be used for the rearing of valuable species, such as sturgeons, carp rainbow trout. Aquaculture in floating cages systems has started only in the past few years, by accessing European funding through the Operational Programme for Fishing.

1.2.1.4. Flow-through systems (tanks and raceways)

The rearing tanks are the classical water flow tanks used in trout farms and earth basins (stews or ponds) for cyprinids.

1.2.2. Semi-intensive culture (pond)

In a semi-intensive system, the production of the pond is increased beyond the level of extensive aquaculture by adding supplementary feed, usually in the form of dry pellets, to integrate the feed naturally available in the pond, allowing for higher stocking density and production per hectare.

1.2.3. Extensive culture (pond)[115]

Traditional extensive freshwater fish farming is practiced across the whole Europe, and is particularly common in Central and Eastern Europe. This long-established farming method consists of maintaining ponds (natural or artificial) in such a way that they foster the development of aquatic fauna. Every winter, the ponds and lagoons are cleaned and fertilised to stimulate aquatic vegetation and consequently intensify the presence of micro-organisms, small molluscs and crustaceans, larvae and worms, which form the base of the aquatic food pyramid. This encourages the development of 'marketable' animals at a higher yield than that of the natural ecosystem. Production in extensive farms is generally low (less than 1 t/ha/y).

The species produced vary according to regions: whitefish (Coregonidae), pike-perch, pike and different species of carp, catfish, crayfish and frog.

Traditional extensive fish farming in lagoons and coastal ponds is one of the most ancient aquaculture methods, and is still practiced across Europe. It consists of maintaining lagoons in such a way that they foster the development of aquatic fauna. Every winter, the lagoons are cleaned and fertilised to stimulate aquatic vegetation and consequently intensify the presence of micro-organisms, small molluscs and crustaceans, larvae and worms, which form the base of the aquatic food pyramid. This encourages the development of 'marketable' animals at a higher yield than that of the natural ecosystem. Production in extensive farms is generally low (less than 1 t/ha/y).

Depending on their geographical situation, lagoons and coastal ponds provide sea bass, eels and different species of sea bream, mullets, sturgeons, crayfishes and shellfish. In Italian valliculture in the Po and Adige deltas, lagoons are seeded with sea bass and sea bream fry to make up for the increased scarcity of these species in the wild and to compensate for the disappearance of eels. In Spanish (esteros) and in Portugal, this practice has led to testing with new species, including turbot, common sole and Senegalese sole.

[115] https://ec.europa.eu/fisheries/cfp/aquaculture/aquaculture_methods_en

1.3. Farming Methods of Major Species

1.3.1. Trout culture

Similar methods are used for rainbow trout, brown trout and Black Sea trout (or salmon) in the Black Sea. Before starting, assessment of water quality is vital for the site selection. Basic criteria requirements are given in Table 2.

Table 2. Water quality criteria for trout culture

PARAMETERS	VALUES	REMARKS
Water tempetrature °C	9-17; 12-16 (optimum)	-
pH	6.5-8.5 About 7	Slightly acidic Good for intensive culture
Oxygen	9.2-11.5 mg /lt	saturated
Ammonium	0.1 or 0.02 mg/lt 0.005 mg/lt	- For juveniles
Nitrites (NO_2)	1) 0.1 mg/lt, 2) 0.2 mg/lt (=0.03 or 0.06 mg N-O_2/lt 0.012 mg N-O_2/lt	For soft waters Hard waters Closed systems
Nitrates (NO_3)	100 mg/lt 25-35 mg N-O_3/lt	N-O2/lt
Chlorine (Cl_2)	0.01-0.03 mg/lt	
Chloride (Cl-)	50 mg/lt	For incubation
Hydrogen Sulfide (H_2S)	0.002 mg/lt	
Carbon dioxide(CO_2)	25 mg/lt	Not to over this limit is possible
Ozone (O_3)	0.02 mg/lt	
Nitrogen (N_2)	110%	Max gas pressure at saturation
Suspended and sediment materials	15-80 mg/lt	-
Copper (Cu)	0.006 mg/lt, 0.003 mg/lt ABP-2 = 100 mg/lt $CACO_3$	
Zinc	0.005-0.04 mg/lt	Depends water hardness
Iron	1)0.3 mg/lt, 2) 0.1 mg/lt	- For juveniles
Lead	1. 0.3 mg/lt (0.01-0.03 mg/lt)	-
Mercury	1. 0.005 mg/lt 2. 0.0002 mg/lt	- -
Cadmium	0.0004 mg/lt 0.003 mg/lt	For soft waters (ABP<2) Hard waters (ABP>2)
Chromium	0.01 mg/lt 0.05 mg/lt	Hexavalent Trivalent
Cyanide	0.005-0.25 mg/lt	-
Arsenic	0.01-0.5 mg/lt	-
Barium	5 mg/lt	-
Aluminum	0.1 mg/lt	-
Flow rate	0.005-0.03m/s	-
Turbidity	10 JTU	Jackson scale for turbidity

1.3.1.1. Adult Selection

The selection of the individuals who will be devoted to breeding should be done starting from the pre-growing period. By continuing to grow the separated fish, distinctive features should be sought in terms of differentiating fish from the population. These qualities are:

- Good feed utilization with rapid growth,
- Resistance to diseases,
- Smooth and harmonious body form,
- High reproductive efficiency (large number and large diameter eggs, sperm quality, etc.)
- To reach sexual maturity late.

Adult fish selected based on the above characteristics should be fed with fresh pellets, together with fresh fish and shrimp in brood stock ponds. Special care should be paid not to overfeed by keeping fish weight increase approximately 0.5-1.5 kg per year. Overfeeding can cause fat degeneration, especially in eggs.

1.3.1.2. Brood stock keeping

Average weights of three-year-old mature fish are between 1-3 kg. Female fish are used in 4 consecutive reproduction seasons until the age of 6. Fecundity decreases as the live weight increases, ie, in 6-year-old fish, this amount drops below 1200 eggs per kg live weight. However, the larvae of viability are obtained from eggs with larger diameters, which have the advantage of selling more. Therefore, 4-5 year old females have great economic value in all aspects. Studies have shown that sperm of 3-year-old male has never reached the quality of sperm of 4-5-year-old male. But 3-year-old male have more sperm in terms of quantity. In this regard, mature fish is preferred 3-year-old male, taking into account the cost of keeping adult fish in the farm.

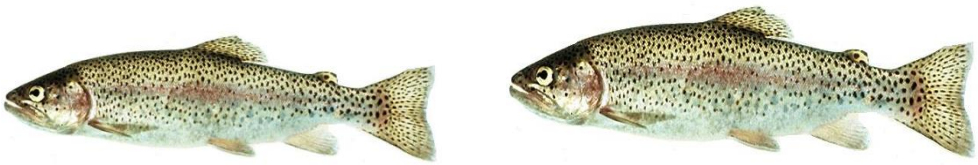
Basic information about the egg production characteristics of female adults can be listed as follows:

- Total amount of eggs obtained from breeding fish increases as the fish grow. For example, at the age of 3, 1800 eggs are obtained from fish weighing 750 g; 2500 eggs are taken from fish weighing 1300 g at age 4.
- As the fish size increases, the proportional amount of eggs per kg body weight decreases. For example, at the age of 3, the number of eggs per kg body weight of 750 g weight fish is 2400 pieces; the number of eggs per kg live weight of the fish weighing 1300 g for 4 years old is 2000.
- The number of eggs can be affected by the amount and quality of the feed.
- The effect of genetic conditions on the difference of the number of eggs in individuals is very large.
- Older and larger fish develop larger eggs compared to younger and smaller fish, thereby providing stronger larvae formation. For example, while the egg diameter of 2 years old fish weighing 178 g is 3.9 mm, the diameter of the egg of 7 years old fish weighing 2700 g is 5.7 mm.

1.3.1.3. Stripping and fertilization

The dry method has been used in trout stripping so far. The variety of tools and equipment to be used in this method varies according to the knowledge and skills of the staff to strip. Brood stock is stunned in 50-ppm MS-222 solution before stripping. Then, it is dried with a towel and eggs are milked by squeezing the belly of the fish into a clean and dry plastic container. After the sperms of at least two male fish are milked on the eggs of each female adult, eggs and sperms are mixed with the help of a hand or soft body and left to wait after 1-2 minutes by adding clean water. The fertilization procedure is given in Figure 26.

The incubation period of salmonids varies depending on the species and water temperature. However, the sum of the water temperatures (day-degrees) measured during the incubation shows close values. The average incubation time for rainbow trout eggs is 310 days - degrees (Çelikkale 1994), although 103 days (361 days-degrees) at 3.5 ° C, 80 days (400 days-degrees) at 5 ° C and 19 days at 15 ° C. (285 days-degrees).



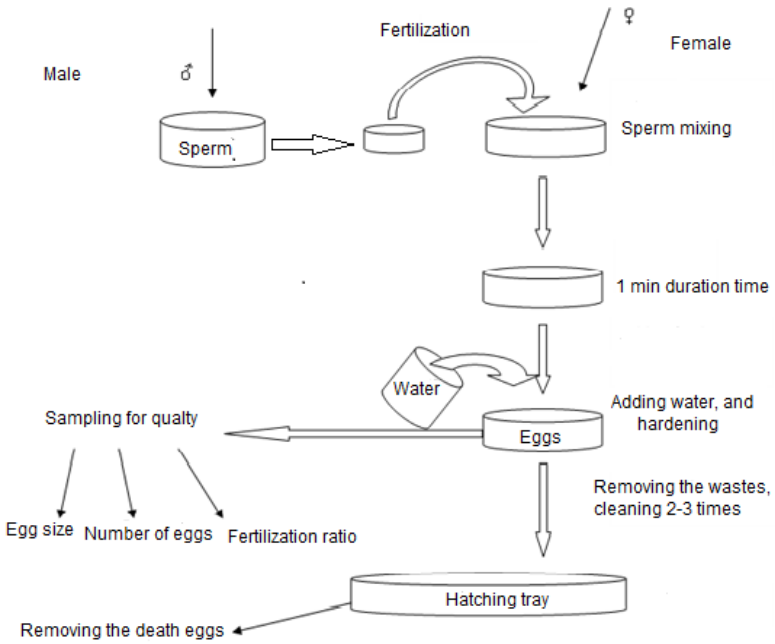


Figure 26. Procedures in fertilization of trout eggs

Incubation cabinets and egg trays are used to hatch fish in the hatchery (Figure 27). Eggs are eyed in 16 to 18 days (Figure 28) and hatching is completed in 32-35 days (Figure 29).

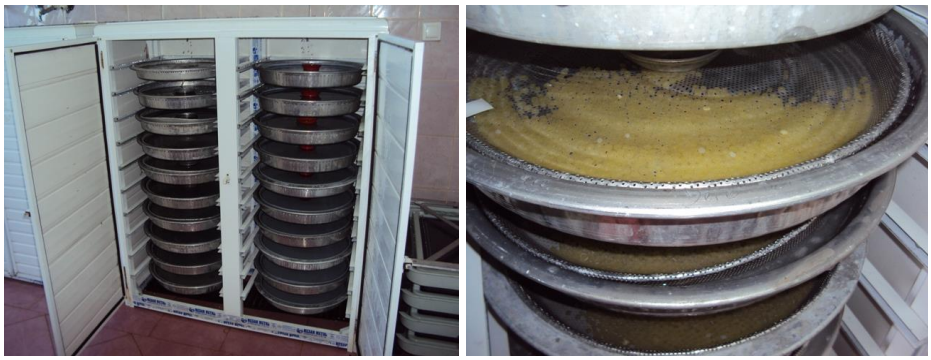


Figure 27. Egg trays and incubation cabinet

Figure 28. Eyed eggs

Figure 29. Hatched larvae with yolk sac

1.3.1.4. Larvae Breeding

When incubation period ends, the larvae hatching is completed from the eggs in 2-3 days at 10 ^{o}C water temperature. Meanwhile, the egg shells in the environment should be siphoned and extracted twice a day so that the holes of the egg trays are not clogged. The larvae hatching from the eggs are called vitellus sacced larvae (Figure 30). They consume their yolk sac in 12-17 days depending on the water temperature. During this period, white colored dead eggs or deceased sacced larvae or deformed and anomaly larvae should be removed by siphoning at least once every two days. If the specified cleaning procedure is not performed, a fungal infection (Saprolegnia sp.) is quickly encountered.

Figure 30. Trout larvae

Reaching the free swimming stage by consuming most of the yolk sac and to start feeding is the most important indicator for the larvae. Feeding should be started when 10% of the vitellus sacked larvae reach the feeding power, or when they consume 2/3 of the food sacs and begin to swim freely. When the larvae reach the specified stage, the chambers between the egg trays are removed in the incubation channels, the larvae in the trays are slowly stocked in the channels.

1.3.1.5. Larvae culture

It is generally defined as “nursery” that the larvae reached the free swimming stage and that are actively moving in the water are grow up to an average of 1 g live weight by taking care and feeding. This stage is completed within 60-80 days. In this period small concrete raceways/tanks are used in the hatchery. The water exchange should be 4-8 times per hour, depending on the stock density and water quality. In the specified conditions, the stock density is 100000 larvae/m^3. Feeding of the larvae is continued every 30-60 minutes for 12 hours a day. The mortality rate in this period is approximately 30-35%. Under optimum production conditions, the target of production in harvest should be 25 kg or 25000 larvae per cubic meter at least 1 g individual weight.

Small concrete raceways; 3-4 m in length, 40-80 cm in width and 30-80 cm in depth are generally used for the nursery of larvae. Although generally reinforced concrete is used, hygienic polyester tanks should be preferred. The stock density of the population depends on the quantity and quality of the water used. The optimum level of water change in these raceways should be 4-8 times per

hour. In these channels, water depth is increased parallel to the fish size. For example, approximately 30000 rainbow trout larvae are stocked in a tank having dimensions 3.60 m lengthx40 cm widthx17 cm depth, about 122000 larvae/m^3. During the feeding period stock density is considered 100000 larvae/m^3, in other words 100 larvae per liter of water. When the specified stock quantities are applied, 1-2 lt/sec/m^3 water is required for water changes 4-8 times per hour. Under these conditions, after 8 days of feeding at a water temperature of 8-10 ^oC, sizing/selection is made in stock as 50000 larvae per cubic meters and after 15 days of feeding 20000-30000 larvae per cubic meters.

In channel-type concrete or polyester raceways, having 2-4 m^3 volume, 30000-60000 larvae are fed for 6-8 weeks under good level of oxygen. Water entry into these tanks should be 20-40 L/min/m^3 water.

In case of nursery in circular (round) tanks about 5% of slope towards the water outlet located in the center is needed (Figure 31). The water requirement of the round tank with a diameter of 2-3 m and a capacity of about 1.5-6 m^3 should be 0.1-1.0 L/s. When using slightly acidic water in tanks with the specified properties, 100000 larvae with a weight of 0.2-0.4 g; 7500-10000 larvae with a weight of 0.76-1.5 g can be raised. In these stock densities, it is recommended to increase the aeration and water level. When alkaline water is used, the specified stock densities should be halved. It is possible to feed 30,000-70,000 larvae for 6-8 weeks in the polyester or concrete round tanks: with the capacity of 1.5-4 m^3, diameter 1.5-3 m, height 50-80 cm, base slope 10-20%, sluice pipe diameter 10-12 cm. Stock density is 8-15 larvae/lt, water requirement is 15-30 lt/min/m^3. These tanks are also suitable for protective baths against parasites or other diseases.

Figure 31. Round tanks

1.3.1.6. Fingerling culture

In the culture of fingerlings concrete raceways, ponds and net cages can be used. In this stage at least 0.5-1 g in weight, 4-5 cm in length are used. If there are spores of the parasite *Myxobolus cerebralis* causing the whirling disease in the water, minimum length of fingerlings should be at

least 6-7 cm. Because at this length the cartilage parts of the vertebrae and head bones of the fish have become quite durable and become not deformed. The disease parasite eats the cartilage in the skull and spine of trout, deforming their skeleton to cause them to swim in circles, thus the name of the disease. It does not affect humans. Therefore it is mandatory to take hygienic precautions for all the equipment used in the culture of fingerlings before they stocked.

Disinfection is very important and its effect comes first among these measures. There is no approved drug or therapeutic treatment for *M. cerebralis* infection. At least ten candidate drugs have been tested (acetarsone, amprolium, clamoxyquin, fumagillin and its analog TNP-470, furazolidone/furoxone, nicarbazine, oxytetracycle, proguanil and sulfamerazine) (Wagner, 2002). Several of these (furazolidone, proguanil) reduced infection and/or inhibited spore formation; however, none prevented or eliminated infection and some resulted in toxicity (TNP-470) or reduced growth (furazolidone)[116]. Further development of treatments is hindered by regulatory hurdles, and issues associated with application of treatments to wild fish. The appropriate solution is to disinfect ponds, nets and all other equipment used in fingerling culture before start the procedures (CABI, 2020).

1500 ppm solution of Quaternary Ammonium Compound (QAC) or Quat Plus (2 liters of Quat Plus diluted with 62 liters of water provides 64 L of solution which is a practical volume for immersing most field gear) can be used. Disinfection effect depends on temperature. As a general rule, 30 minutes at 20 ^{o}C, 1 hour at 12 ^{o}C and 2.5 hours at 4 ^{0}C are required for the effect of the disinfectant.

In order to better evaluate the available capacity, 7-10 m length, 0.80-1 m width and 0.80-1 m depth concrete raceways are used in the fingerling culture (Figure 32). Depending on the water conditions and exchange of water every 10 minutes, the stock density is 2000-5000 fingerlings/m^3 for initial stocking. In this case, the product obtained at harvest will be 50 kg / m^3 and the individual weights of juvenile fish can reach 10-15 g up to 30 g. Although it takes a lot of time to feed the fingerlings many times in this type of culture. It should also be cleaned twice a day.

Another type of raceway is the 8-10 m length and 1-2 m width and in these channels, water change should take place in at least 5-20 minutes. 3.5 mm diameter perforated material should be used in the outlet. Depending upon the water change, the stock density can be 2000-5000 fingerlings in per cubic meter or higher. According to fish size and water conditions in harvest, 50 kg/m^3 or 100 kg/m^3 fish, especially in better conditions, can be obtained.

[116] https://www.cabi.org/isc/datasheet/59563#todiseaseTreatment

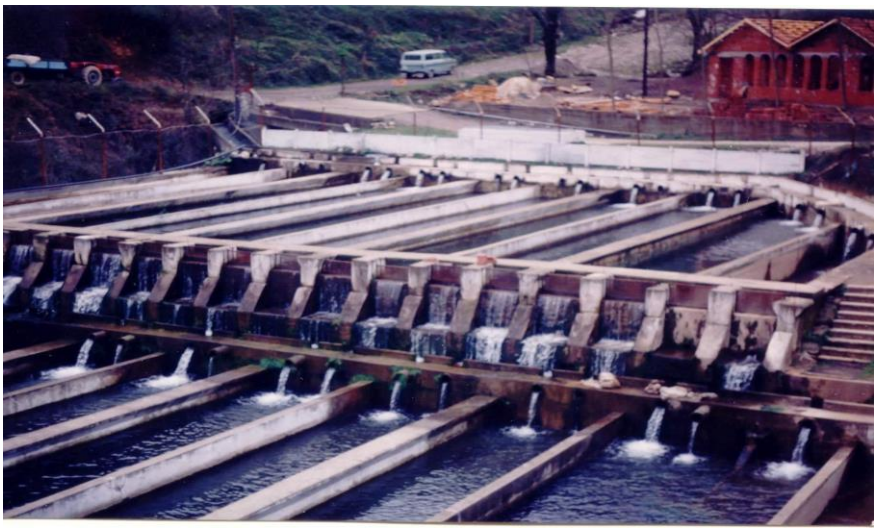


Figure 32. Concrete raceways for fingerling culture

Fingerling culture can also be done in ponds made from reinforced concrete under favorable conditions. The width/length ratios of rectangular pools should be approximately 1/4-1/6. Depending on the quality and quantity of the water used in these ponds, the stock density is arranged as 60-100 fingerlings per cubic meters (at an average depth of 1 m). In this type of production, approximately 10 lt/sec of water is required for 50000 fingerlings. In addition, with a slightly acidic character of 3-5 lt/sec of water, for example, in a pond of 450 m^2 and at a depth of 1.5-2.3 m, under the additional ventilation conditions, 60000-80000 fingerlings average up to 12-15 cm in length (2-3 kg / m^2) can be raised.

In net cages, finger-sized juvenile farming is not as suitable as portion sized fish culture. The main reason is that the mesh size must be small in the cages where fingerling will be fed. Because as the net meshes become smaller, the net becomes clogged more quickly, thus preventing water change. In addition, since the juvenile fish to be stocked in cages are generally pre-fed with an average weight of 1 g, nets should have 4 mm mesh size to avoid fish escapes from the net.

Considering the aforementioned problems, it is more suitable for fingerlings to be stocked in net cages with a minimum weight of 2 g and a mesh opening of 6 mm. In net cages, stocking density of 300-500 fingerlings/m^3 is recommended. In this type of culture fingerlings can be grown up to 8-10 cm length or 50 g weight under suitable water conditions. As the juvenile fish grows, the net bag of the cage should be periodically renewed based on the 1 mm mesh size for the fish length of 1 cm.

1.3.1.7. Portion size trout farming

In this type of culture of it is aimed to grow trout till the various market size in concrete raceways, ponds and net cages.

The size of these ponds varies greatly according to the amount and quality of the water, the topographic condition and soil structure where the ponds constructed. There is no obligation to make concrete ponds if the soil structure is clay and water retention is high, even requires more work comparing with concrete pools, but fixed investment cost is less. In concrete ponds,

disinfection is easier to maintain, feeding and controlling the fish are better, but the cost of construction is high.

The size of the ponds where portion size trout culture is carried out should generally be 20-50 m in length, 4-12 m in width and not more than 1.20 m in depth. Appropriate stock density is determined by water exchange and quality. In addition, it should be taken into account in determining the stock density in factors such as feeding, pond hygiene, use of technical equipment (such as aeration), and production time.

With optimum culture conditions and the use of full-value pellet feed, it should be expected that the portion sized rainbow trout farming can be achieved in 8-months of production period.

The amount of table fish production is generally expressed in kg/m^3. For example, 3-5 kg/m^3 fish can be produced when water change occurs in the ponds 3-5 times a day. In semi-intensive production conditions, this amount increases to 10 kg/m^3. In ponds with a depth of 30-50 cm, 20 kg/m^2 (= 40-60 kg/m^3) fish is produced in case the water change occurs 3 times an hour. Stock quantity can also be calculated based on the amount of water supplied to the ponds. Accordingly, stocking is done for the target of 100-150 kg of table fish will be produced in the harvest according to the water inlet of 1 lt/sec of good quality. Based on the portion trout size of 200-250 g, 400-600 fingerlings are stocked for 1 lt/sec flow rate.

Raceways are the culture facilities with depths of 50-65 cm, widths of a few meters, made of concrete, several hundred meters in length, with water change 2-3 times an hour. Base slope is 10-20 cm at 30 m. These raceways, several hundred meters long, are divided into sections of about 30 m with grids. Production capacities are generally 24-32 kg/m^3 (Steffens 1981). These canal type ponds are suitable for mechanical feeding, disease control and automatic selection. The flow rate of the water should be 1.5-3 lt per second in raising the juvenile fish up to the market size. In a hectare area, 100 tons of trout is produced with 1000 lt/sec water in raceways. This calculation is equivalent to the traditional production amount calculated with 100 kg fish/lt/sec water in the intensive breeding method in the ponds.

Trout culture in net cages is getting popular year by year in Turkey. They can be installed in natural lakes, dam lakes, man–made irrigation lakes, sand-gravel ponds, riverine lakes, and large irrigation channels to produce fish under control in net cages. Cage system is a frame in different shapes and made by different materials such as wood, metal, polyester as net carrier, floats to keep frame on the water surface, anchors to keep frame at fixed position and nets material attached to the frame in bag shape. After trials with culture of sea bass and sea bream in net cages in Turkey, trout farming in net cages has started to become widespread in our freshwater sources by private entrepreneurs in the last decade in the Black Sea region (Atay 1994). In case of trout farming in cages, water quality should be appropriate for the needs of fish.

There must be at least 1 m distance between the bottom of the sea/lake and the lower part of the net. Since the mesh bag of the cage cannot fully maintain its geometric shape in water, approximately 15% of its volume is lost. When the cages are located in the same place for a long time, they may affect the water quality of the lake or pond. Therefore current is needed to get rid of

organic pollution. In shallow lakes, the location of the cages should be changed before each production period. There is no need for displacement in lakes deeper than 10 m. Although the dimensions of the net cages are different, the dimensions of 5 m x 5 m x 5 m are the mostly used in inland waters. The mesh size of the net cage should be 1/10 of the length of the fish. In other words, the mesh size is determined considering 1 mm mesh size equals for 1 cm trout length in practice. Fish at least 40 g average weight are stocked in net cages. Fish stocked in March are harvested in mid-June, and fish stocked in September are harvested in December. Under normal water conditions, the stock density in net cages is planned as 50-100 fish of average weight of 40 g per cubic meter. In this case, the amount of production at harvest is 20-30 kg/m^3. For instance, in Central European lakes and dam lakes, mesh opening is regulated as 14 mm in aquaculture. The stock density is based on 90 fish of 40 g/m^3. In these conditions, for the production of 100 tons of trout, approximately 180 cages of 4x3x3 m dimensions are needed in these countries. Under suitable conditions, stock density can be applied as 100 fingerlings per cubic meter.

In rearing experiments, trout fingerlings stocked at an average of 35 g weight and 17-20 ^oC water temperature in net cages, reached 300 g in weight with high growth rate. In this case, a weight increase of 265 g was achieved in 2.5 months, ie the fingerling grew by 3.5 g per day.

In net cages, it should be aimed to increase the average size of 35-50 g of fish to the table size of 250 g in 90-100 feeding days. For this purpose, 500-1800 fingerlings are sufficient in the cage volume capacity of 20 m^3. When less than 700 fish were stocked in 20 m^3 net cages, growth was slower than 1000 or 1200 fish stock. However, it is not recommended to stock more than 1200 fish in mesh cages with a capacity of 20 m^3. In recent years, the diameters of the cages have reached 20-30 m and their volumes have reached 1000-2000 m^3 (Figure 33).

Figure 33. Trout net cages

1.3.2. Sea bass culture

1.3.2.1. Brood stock and Ovulation

The tanks in which brood stock are kept vary depending on the size and stocking density of mature fish. Large, medium and small volume brood stocks are used in aquaculture units. Large systems are used extensively in Japan and north-east Asian countries in volumes of 50-100 m^3 and are installed outdoors. Tanks of medium size are used in European countries and are located within the farm

facility. The volumes of the tanks are between 15-30 m^3. They also have filtration, heating and cooling systems. Small volume systems are between 10-20 m^3 and are used in countries in the Mediterranean area. All systems of these tanks are under control against environmental conditions. Tanks are usually dark and in cylindro-conical shape.

Fish are stocked as 10-15 kg/m^3. The female to male ratio is adjusted to 1: 1, 1: 2 or 2: 3 kg depending on the condition of the brood stock. Tanks flow rate of 10-20% per hour. Water temperature should be 14-15 0C. Natural seawater salinity is used in tanks. Due to the pelagic structure of the eggs, the water outlets of the tanks are from the surface. İn order to prevent egg losses a filter with a 500 micron mesh size are placed at the top outlet of the tanks.

Eggs can be obtained from the adult fish by natural means, milking method and hormone injection. The milking method is not applied due to the small size of the eggs and low fertilization rate. Taking eggs in a natural period without hormone intervention affects quality. In addition, the use of hormones gives very successful results. In addition, natural spawning periods can be changed by applying photoperiod and eggs can be provided at various times of the year.

1.3.2.2. Egg Properties and Quality Criteria

The egg sizes of bony fishes vary according to the species and some conditions in the species itself. As the egg diameter of the species grows, the number of eggs decreases, the length and survival rate of the larvae increases. Fertilized eggs are pelagic, spherical and transparent. The quality of the egg is proportional to the buoyancy of egg, number of oil drops, the rate of hatching and the amount of normal larvae. Sea bass eggs have an average of 4-5 drops of oil, one of which is centrally located. The average diameter of eggs is 1150 ± 85 µ and the diameter of oil drops is 360-420 µ.

Egg diameters vary by region. On the British coast it is between 1.07-1.32 mm, while it is smaller (1.02-1.296 mm) along the Mediterranean coast. In the North Sea, these values reached up to 1,386 mm. Egg diameter is related to water temperature and nutrient content. It was found that the eggs taken during the natural spawning period at low temperatures in winter months are larger than the eggs obtained at constant temperatures at other times.

The differences in the size of the eggs in the same species depend on the feeding, size, secretion time of hormones, hormone applications, environmental conditions, genetic factors and regional differences which are the common factors affecting quality and quantity. If there is no morphological and genetic disorder in the eggs, when the incubation conditions are the same, the large or small egg does not change the hatching rate of larvae.

The quality of the eggs to be incubated is very important for the future larvae quality. These defects should be identified before and during incubation. If more than 40% of the eggs received from the egg collectors are dead; this group should not be used unless there is obligation. It should be paid attention that the blastomer divisions are equal, and whether there are missing divisions should be determined. Eggs containing a large number of oil drops should not be taken into production unless required. The appearance of particles in the form of dots and the protrusion of the blastopore are other disorders caused by the adverse events that occur during embryonic development.

1.3.2.3. Incubation of Eggs

Eggs released by adults under appropriate ambient conditions are collected precisely from egg collectors. Eggs should be kept in contact with the air as little as possible during the collection, weighing and live-dead separation stages, and the accumulation of large amounts of eggs should be prevented.

If the eggs are to be transported for a long time, 15-20 liter plastic containers are used to carry 20000 eggs per liter for a 24-hour, and 80000 eggs per liter for a 6-hour transport. Transport should be done within the first 24 hours after fertilization. The oxygen value of the water in the transport containers should be increased to 9-11 mg/lt. Water and eggs are placed in 2/3 of the plastic container. Pure oxygen is pressed into 3/1 of the container. As a result of the transportation process, the hatching rate varies between 50-70%.

Eggs should be subjected to disinfection, if necessary before incubation. For this purpose, 10 ml of 5% Iadophor solution is put in a liter of sea water and eggs kept in for 8-10 minutes. In addition, for this process zinc free malachite green at a rate of 5 mg/lt can be applied to eggs for 40-60 minutes.

After the live eggs are supplied, their incubation process begins. The ponds where the incubators will be placed may have in different structures and shapes. The most suitable system for the incubation of eggs is to use race-way types. In addition, this can be done in larvae tanks too. The incubation unit must be separated at the farm to ensure precise work and prevent contamination. The size and equipment of this unit are designed according to the amount of eggs required to hatch. The interior of the tanks where the incubators will be placed are dark colored and gel-fabric covered.

The volumes of the incubators used can vary from 50 to 200 lt. Incubators are made of polyester and have cylindro-conical shape. The cylinder part is covered with 300 m plankton screen and the conical part is polyester. Separate water inlet can be provided from the bottom of each incubator, and water inlet and outlet can be made directly into the ponds where they are placed. The water coming into the tanks first passes through 5 µ and then 1µ cartridge filters, and distributed to tanks.

Studies have shown that sea bass eggs hatch at ‰29-47 salinity. But for better results salinity should be between ‰ 34-38 for both sea bass and sea bream eggs. Salinity under ‰ 34 salinity exhibit semi-pelagic properties and completely collapse under ‰33 salinity. The best incubation temperature for sea bass eggs is between 14-16 0C (Freddi, 1985).

The supplied eggs must be placed in incubator tanks at the same temperature as the medium from which they were taken. The temperature difference should not exceed ± 0.5 °C. Eggs are placed in incubators with an average of 3000-5000 egg/lt. No light is used during the incubation. In tanks with incubators, 40-60% water change is applied per hour. The incubation rates without water change were determined to be 30-40%. In normal running water, the hatching rate is between 75-85%.

1.3.2.4. Prelarval Stage

When the sea bass larvae hatch, their mouth and anus are closed. The larvae are passive; they stand upside down and lead their lives with the energy they provide from their own vitellus sacs. The

length of larvae just after hatching is between 3.4-3.6 mm. The length of the vitellus sac is 1.1-1.3 mm. Oil drop diameter is between 0.5-0.7 mm. Since the mouth and anus are closed, there is no external feeding. This period, which the larva feeds only from the vitellus sac, is called the lecithotrophic period.

1.3.2.5. Post larval stage

Postlarval stage begins with the opening of the mouth and anus at the end of 5th day at 15-16 ^{0}C. During this period, mucocytes are formed in the mouth. These are like epithelial pits covered with mucus at first. The cellular walls are thin. Towards the 7th day, cartilage and muscles begin to form. Since the glands are not fully formed, the digestive mechanism is not perfect. The digestive tube consists of four or six rows of cells in the epithelial structure and its thickness is 45 microns. Towards the 8th day, the number of cell rows reaches six to eight. Meanwhile, intestinal absorbent cells became functional. During this period, 10-11 primitive forms of phanin teeth begin to form on days.

1.3.2.6. Feeding and growth of sea bass larvae

After being stocked in the tanks (150 to 250 larvae per liter should be a correct density), the larvae will continue their development during some days relying only on their yolk sac reserves. Depending on the rearing temperature they will start feeding on living micro-organisms in three to four days from hatching.

At hatching, fish larvae are not yet completely formed and, among other things, lack functional eyes and mouth. Moreover they do not have an active swimming behavior. In the first three to six days after hatching, and depending on water temperature, the fish larva therefore relies only on its yolk sac reserves as food source. At the end of this period the young fish has developed functional eyes, which are recognizable by their dark colour, its mouth has opened and the digestive tract, though still primitive, can now assimilate food. Then, its swimming behavior becomes active and the animal is thus able to keep a horizontal position. At this stage the post-larval stage begins and the young fish starts feeding on live preys, such as rotifer and brine shrimp nauplii (Table 3),

Open circuit and closed circuit systems are used in sea bass larvae culture. In open circuit systems, water criteria are adjusted according to the conditions required by the larvae and sent to the production tanks. The water used by the fish is then discharged. Considering that the water flow rate, which starts with a change of 5% per hour, is 50% per hour at the end of the period, an excess of energy consumption arises depending on the amount of water used.

Salinity reduction technique applied in sea bass larvae culture positively affects the survival rate (Johnson & Katavic, 1986). In addition, the increase in the percentage of air sac formation and the decrease in deformation in parallel with this made this technique even more useful. Salinity is gradually lowered from day one, and on day 5, ‰ 26 salinity is reached from natural seawater salinity. This salinity value remains constant between 5-17 days. In the same way, the salinity is gradually increased between 17-23 days and the level of natural sea water salinity is increased. When air sac hypertrophy is encountered in salinity increase, ‰26 salinity should be returned (Saka, 1995). Oxygen value is 5-6 mg/lt. The amount of turbidity should not exceed 8.5-12 ITU. It is

ideal for production that the nitrite (NO_2) is between 0.013-0.016 mg/lt and the nitrate (NO_3) is 0.062-0.068 mg/lt in the larvae tanks (Equinoxe, 1990).

The pre-larval period ends on the 5th day at 15-16 ° C water temperature, and the postlarval period begins. To clean the oil layer accumulated on the water surface before opening of the mouth, surface cleaners are placed as 1 or 2 pieces according to the tank surface area. This is very important for the development of the air sac. The lightning duration and intensity applied to the larvae affect the development of the larvae, the formation of the air sac and the rate of survival. While the development of larvae increases under increasing lighting conditions, continuous lighting reduces the viability of fish. Lighting is not applied to the larval tanks in the pre-larval stage. The lighting duration and intensity should be set as 12 hours-50 lux on the 5th day, 13 hours-140 lux on the 11th day, 16 hours – 920 lux on the 17th day and thereafter.

In the larval period feeding, nauplii and metanauplii forms of rotifera (*Brachionus plicatilis*), which are live feed sources, and Artemia (Artemia sp.) With various origins are used (Table 3). Artemia eggs of different origins are provided in various parts of the world. Their hatching rates, nutrient contents, egg numbers per gr nauplii lengths after hatching vary. Nauplii lengths of AF type Artemia produced by Artemia Systems and used extensively in larva culture are approximately 460-480 µ and contain more than 10 mg / gr of HUFA.

Since the width of Artemia varies between 165-175 µ, sea bass larvae with a mouth opening of 400-420 µ can also be used from the first day. However, feeding with rotifer in a week affects the survival rate positively. Protein rates of AF type Artemia nauplii vary between 48-52%, fat content 19.3-21%, carbohydrate ratios 12-13%, ash content 8.1-8.7% and humidity 4.8-5.2%. EG type Artemia naupliis, which are also used in the second stage, have lower protein content (45-47%) and less unsaturated fatty acids (5-7 mg/g HUFA).

It is also larger in size and is between 500-520 µ. Artemia forms, which are used as EG1 from the 16th day, are obtained by growing EG type *Artemia nauplii* with SELCO-derived enrichment agents for 24 hours. SELCO products play an important role in the development of larvae, as they contain high levels of HUFA (200 mg / g), vitamins, antioxidants and fats (60-65%). The Artemia that come in the form of metanauplii after 24 hours of culture are between 700-750 microns. The types and survival rates of live feeds given to the larvae are shown in Table 3. According to the culture techniques applied depending on the egg quality at the end of the larval period, the success rate can reach up to 40%.

Table 3. Sea bass larva culture protocol

Day	Temperature (°C)	Salinity (‰)	Flow rate (%/h)	Light duration (h)	Light intensity (Lux)	Feeding (R: Rotifer, AF, EG: Artemia salina pieces per ml))
1	15-16	36	5	0	0	No feeding
2	15-16	34	5	0	0	No feeding
3	15-16	30	5	0	0	No feeding
4	15-16	28	5	0	0	No feeding
5	15-16	26	5	12	50	R= 8 / ml

6	15-16	26	5	12	60	R= 8 /ml
7	15-16	26	5	12	80	R= 8 /ml
8	15-16	26	5	12	100	R= 6 /ml AF=0.5 /ml
9	15-16	26	5	12	120	R= 6 /ml AF=0.5 /ml
10	15-16	26	10	12.5	140	R= 6 /ml AF=0.6 /ml
11	17	26	10	13	140	R= 4 /ml AF=0.6 /ml
12	17	26	10	13	140	R= 4 /ml AF=0.6 /ml
13	17	26	10	13	240	R= 2 /ml AF=0.8 /ml
14	17	26	10	13	450	R= 2 /ml AF=0.5/ml EG=0.5 /ml
15	17	26	15	14	450	R= 2 /ml AF=0.5/ml EG=0.8 /ml
16	18	26	15	15	450	AF=0.4 /ml EG=0.6/ml EG_1=0.1/ml
17	18	28	15	16	920	EG=1.2 /ml EG_1=0.3 /ml
18	18	30	15	16	920	EG=1.2 /ml EG_1=0.3 /ml
19	18	32	15	16	920	EG=1 /ml EG_1=0.5 /ml
20	19	34	20-25	16	920	EG=1 /ml EG_1=0.5 /ml
21	19	36	20-25	16	920	EG=1 /ml EG_1=0.5 /ml
22	20	38	20-25	16	920	EG=1.2 /ml EG_1=0.8 /ml
23	20	38	20-25	16	920	EG=1.0 /ml EG_1=1.0 /ml
24	20	38	20-25	16	920	EG=0.8 /ml EG_1=1.2 /ml
25	20	38	30-35	16	920	EG=0.6 /ml EG_1=1.4 /ml
26	20	38	30-35	16	920	EG=0.4 /ml EG_1=1.6 /ml
27	20	38	30-35	16	920	EG_1 = 2 /ml
28	20	38	30-35	16	920	EG_1 = 2 /ml
29	20	38	30-35	16	920	EG_1 = 2 /ml
30	20	38	40	16	920	EG_1 = 2 /ml
31	20	38	40	16	920	EG_1 = 2 /ml
32	20	38	40	16	920	EG_1 = 2 /ml
33	20	38	40	16	920	EG_1 = 2 /ml
34	20	38	40	16	920	EG_1 = 2 /ml
35	20	38	40	16	920	EG_1 = 2 /ml
36	20	38	40-50	16	920	EG_1 = 2 /ml
37	20	38	40-50	16	920	EG_1 = 2 /ml
38	20	38	40-50	16	920	EG_1 = 2 /ml
39	20	38	40-50	16	920	EG_1 = 2 /ml
40	20	38	40-50	16	920	EG_1 = 2 /ml

At the end of larval period between 38-42 days, sea bass fry starts to feed on artificial feed micro particles. In this stage, 10-15 m^3 tanks are used for culture. Bottom parts of the tanks are conical. The water outlets are central and from the bottom. Depending on the age of the fish, net screens with 500, 1000 and 2000 microns mesh size. There are lighting systems in the tanks area providing 1500-2000 lux light intensity. Lighting time in the unit is 16 hours and it is adjusted with the help of automatic timers. Automatic feeders are used in the distribution of micro particle feeds. Open circuit and closed circuit systems can also be used in this section. As the powder feed entered into the environment, the water quality can be changed very quickly, continuous control of the water quality should be ensured in closed circuit systems. It is more beneficial to use open circuit systems at this stage in terms of reducing disease risks. The water provided to the tanks must be given to the

larvae by passing through the sand and ultraviolet filter. In addition, the presence of pure oxygen inlet, flow meters, saturation columns and surface cleaners in the tanks positively affects the production.

The exercise period of eating micro particles starts at 38-42 days, when the fish reach an average of 19-21 mm of total length and 35-40 mg of weight. During this period, the fish density in ponds is 10-12 fish per liter. In cases where pure oxygen is used, this rate can be increased up to 18-20 fish per lt. Artemia used in the transition period to microparticle eating are in the form of metanauplii II and enriched in terms of HUFA as in the form of metanauplii I in the larval period.

The microparticle feeds used in the smelting of sea bass fish are used in the first period starting from 80-150 microns and up to 500 microns according to larval development. Exercise application continues for 15-16 days. While the amount of artemia given to the larvae is decreased, the amount of microparticle feed is increased. In this period, microparticle feed rate is 8-10% of live weight. The average water temperature during the swearing is 20 ^{0}C and the water flow in the tanks varies between 50-100%. Deaths tend to increase in the early days of the depression due to not being able to adapt to eating powder. Larvae survival rate changes between 80-90% on average if normal conditions are provided (Equipe Merea, 1990). The larvae that complete the starting to eat powdered feed are taken to the nursery unit after staying in this section, on average, up to 350-400 mg.

1.3.2.7. Nursery stage

The technical features of the tanks used in this system are the same as the tanks used in the larva culture unit. The juveniles are sorted and the individuals with and without air sacs are separated from each other. Closed circuit system is not used in nursery stage. Here the fish are grown to a weight of 1.5-2 grams, which is necessary for netting. However, in Turkey, juveniles are taken to the cage systems between 0.5-1 grams. Fish are constantly observed in the nursery unit and necessary precautions must be taken against disease risks.

Cylinder tanks with a volume of 10-15 m^3 are used in nursery unit. The water temperature is 19-21 °C and 16 hours lighting is applied. Natural seawater salinity is used in tanks. 3000-5000 juvenile/m^3 can be stored in tanks. The water change varies between 80-150% per hour depending on the fish size and stock density. Feed rate starts at 6% and decreases by 4%. The survival rate varies between 90-95% during the period when the disease is absent (Table 4).

Table 4. Feeding rates and feed sizes of sea bass according to fish weight and temperature during starting to fed by dry food and nursery period

Period	Feed size (micron)	Fish weight (gr)	Water temperature (^{0}C)	Feeding rate (%)
Transtition to dry feed	80-200	0.03-0.125	19-20	8-10
	150-300	0.125-0.165		8-10
	300-500	0.165-0.420		6-8
Nursery	300-900	0.420-0.640	19-21	5-6

	500-900	0.640-0.950		4-5
	500-1250	0-950-1.200		4-5

1.3.2.8. On-growing period

Net cage culture is used intensively in Turkey. Production from per unit area/volume is very high in cages which can be installed safely in coastal areas, open seas and oceans. At present, 150 tons of production can be obtained in a single system in volumes ranging from 2500-6000 m^3 in offshore cages (Özden et al., 1998). Cage systems are collected in 4 main groups as fixed cages, floating cages, submersible cages and rotating cages (Figure 34).

Depending on the characteristics of the place where it is installed and the quality of the water in the net cages stocking density is between 15-30 kg/m^3. Feed and water temperature play an important role in the development of fish. In feeding regimes, daily feeding should be done by taking into account the weight of the fish as well as the water temperature and the water quality. Feed contains 46-52% protein, 2-3% cellulose, 12-13% crude ash, 10.5-11.5% crude fat, 1.6-2.2% calcium and 1.4-1.5% phosphorus, as well as vitamins and trace elements at adequate level affects growth positively (Table 5).

Table 5. Feed dimensions, feeding rate and net mesh sizes for the on-growing of sea bass

Feed size (mm)	Fish weight (gr)	Water temperature (^{0}C)	Feeding rate (%)	Mesh size (mm)
0.9-1.2	1-3	16-25	5-3	4
1.25-1.5	3-8		2.6-4.1	6
1.5	8-15		2.2-3.5	8
2	15-30		1.5-2.75	12
3.2	30-80		1.2-2.1	15
4.5	80-250		1.1-1.8	20
6	250 -		0.4-0.9	24

Figure 34. Net cage systems for the culture of sea bass

Since the sea bass hatchery in the Black Sea Region is not found due to the unfavorable environmental parameters, the juveniles with 2-3 g are transferred from the hatcheries in İzmir and Muğla provinces with specially designed vehicles. Sea bass is produced in the Black Sea in Ordu and Trabzon cities and Greece in the North Aegean Sea.

1.3.3. Carp culture

1.3.3.1. Water and soil properties in carp farming

In carp culture minimum water requirement is to keep pond full continuously. The losses due to infiltration and evaporation in summer and oxygen consumed in ponds should be recovered with the amount of entering water (0.5-1.0 lt/min/ha). Depending on the characteristics and climatic conditions, the amount of oxygen at the exit of the pond is 5-6 mg/lt; higher oxygen levels permit higher stock densities.

In carp production, streams, spring water, lake water, groundwater or simply all warm waters can be used (Atay and Çelikkale, 1983). Although rivers contain high amounts of oxygen and nutrients, special care should be given to floods, agricultural, domestic and industrial pollution.

Attention should also be paid to falls in the water level. When necessary, the water taken from the stream is needed to be rested before giving to the ponds. Because of stagnant water temperatures, they are the most preferred waters for carp production, especially in the reproduction season. Spring waters are poor in oxygen and they also have the risk of containing toxic gases. They need to be aerated by increasing the falling surface at the water inlet by various simple methods to increase oxygen and get rid of harmful gases. Waters having too much toxic gas may contain heavy metals such as iron and lead, are not suitable for carp culture. Spring waters have no risk of flood, carrying mud to increase turbidity and infections. Artesian waters and groundwater extracted by pumps can also be used in carp production. But, effective cost analyses should be done before starting to use.

Main requirement is the water temperature good for metabolic requirement of the carp without considering the source of water. Successful pond culture depends on the water being rich in natural nutrients. The richness of water is expressed in terms of nutrients; the amount of lime it contains. The lime content of the water is measured by the acid binding capacity (ABC). If 1 liter of water contains 28 mg of CaO, the acid binding capacity of the water is 1. In carp farming, ABC should be 1.5 which is equivalent 42 mg CaO/lt. If ABC is smaller than 0.5 are classified as less efficient, between 0.5-1.5 moderately efficient and greater than 1.5 are productive. However, ABC should not be over 6.

For carp culture, pH should be between 5.5-10.5; optimum 7-8. When the amount of lime in the water increases, the pH value also increases. However, high pH does not always mean excessive lime in the water. The amount of CO_2 in water and pH value increase when phytoplankton and aquatic plants are dense; especially in summer as a result of photosynthesis. As a result, it can be concluded that the water has high lime. If the pH value is between from 6.5 to 8.5 in daily measurements, the amount of lime in the water is sufficient. When the pH is low, the water needs to calcify. Waters are not suitable for aquaculture when 4> pH> 11 in water. It would be costly to make this type of water suitable for aquaculture. Water with pH <4 makes the cells impermeable as

they reduce the feed intake as well as free H^+ ions and cause fish deaths in advanced stages. It also reduces the biological nutritional capacity of water by stopping the development of phytoplankton and zooplankton. Lack of sufficient lime in the water decreases the pH and causes defects in the scales and bone formations of the fish (Atay and Çelikkale, 1983).

The amount of oxygen in carp ponds should not be below 5-6 mg/lt. Most of the oxygen in the pond is provided with a small amount of water (1.5 g O_2/ m^2/ day; 4.8 g O_2/m^2/ day in large lakes) by surface aeration. The higher the oxygen entering the pool means, the higher the stock amount.

In cases where the oxygen of the water is not sufficient, the water is made in the form of waterfalls before the pond entrance, and the amount of oxygen is increased. Since the oxygen in the pond water is consumed not only by the fish, but also by the organic materials, microorganisms and aquatic plants at night, especially in the early summer months, it is critical for oxygen deficiency. As the temperature of the water increases, the oxygen holding capacity decreases. For this reason, it is necessary to constantly monitor the oxygen content in the pond outlet as well as the water temperature in the pond. For a carp weighing 1 kg, 300-500 mg O_2/lt/hour is required.

Water temperature is important for reproduction, nutrition and metabolic activities. Carp cannot find a chance to reproduce in waters where the water temperature does not rise to 18-20 ºC. It grows continuously as it consumes feed intensively at temperatures of 18-20 ºC and above. The growth rate is higher in warm waters; ie. it takes 3-4 years in Europe for portion size, while 1-1.5 years in warmer countries. Because the appropriate growth period is 3-4 months in Central European countries, 6 months in the Black Sea and more than 7-8 months in the Aegean and the Mediterranean region. Therefore, for carp production in Turkey it has very favorable conditions (Çelikkale, 1988).

Domestic and industrial wastewater should not be mixed with waters where carp produced. Especially small amounts of DDT (29.4 mg/lt), Aldirin, Endrin (0.057 mg/lt), Malathion (100 mg/lt), Metasytox and mercury compounds can be lethal. The amount of CO_2 should not be more than 2 mg/lt. H_2S is harmful when it is 0.5 mg/lt and have lethal effect when it is more than 5-6 mg/lt. Nitrite as 1-2 mg/lt has killing effect. 0.2-0.4 mg/lt ammonia is lethal on the juveniles and 0.6 mg/lt ammonia on the small fish. Although the effects of detergents differ according to their types, the amount of 5.0-10.0 mg/lt destroys the eggs and sperm. Phenols are compounds that have a strong poison effect for fish. Heavy metals and compounds such as iron and lead have a lethal effect. Ferrous compounds settle on the eggs and prevent the hatching. Iodine, chlorine and nitrogen gases also cause various diseases. Tar and oils affect the intestines and blood circulation.

The better the soil of the land to be built, the more fertile the pond will be. When the water source is inside the pond land, the water plants that cannot be dried, if they cover the pond bottom, it makes cleaning and disinfection processes impossible. Therefore, such places are not suitable for pond construction. The pond should be constructed in impermeable clay and loam soils. Sandy and permeable soils are also not suitable for pond construction. Soils fed with organic matter are suitable for soil carp rearing ponds. İf the soil is poor in organic matter fertilization with barn manure or agricultural waste can be done. For carp production, farm site should have areas;

- close to the river or water source that will supply the farm with sufficient water throughout the year,
- with natural or artificial obstacles against floods,
- suitable for future expansions and does not take current winds,
- having soil contains clay and calcareous structure, at least 1 m depth to prevent water leakage,
- does not have large stones and tree roots,
- with a slope to allow the water to flow naturally into the pools,
- excavation is easy and does not require much excavation,
- Easy access to the market,
- Choosing a good business location minimizes the costs.

1.3.3.2. Ponds used in carp production

Soil ponds are suitable for the development of phytoplankton, zooplankton and other aquatic organisms which forms a god habitat for carp culture. Half of the nutrients needed for carp culture are provided from soil ponds and second half from artificial feeds. In Israel 20% of feed is from ponds, 20% is from fertilizing and 60% is from artificial feeds. As soil pools are natural food sources, investment costs are also low. It is assumed that yield of 600 kg/ha in extensive production under European conditions comes from the food obtained from the ponds (2/3) and artificial feeds (1/3). Therefore, 3-4 kg of whole grains is necessary to produce I kg of carp.

Ponds for carp culture can be in different shapes;

- Terrace ponds: Established on sloppy lands, three sides are surrounded by walls and the lower wall is higher than the side walls. If the slope is too high, side walls should be high. Due to the risk of flooding, it is not appropriate to build pools in streams and stream beds.
- Dam type ponds: These are four-walled ponds made in streams, swamps and similar flat places. Since the land is soft, its walls are wider than the terraces.
- Rice field ponds: By constructing a transverse wall (embankment) on small river sides or streams that do not have flood hazard. These are ponds similar to the water collection pond.

Ponds in carp culture can be used for different purposes:

- Spawning ponds: They can be in different sizes according to the type of farm, the size and capacity of the land on which it is established. It is important for the spawning pools to be installed in the sunny and windless place. In the middle of the pond there is the grassy part called the spawn beds.
- Dubisch pond is generally 100 m2, rarely 250 m2. The depth of the pond is 30-40 cm in the middle and 60-70 cm in the side channels. Dubisch pond is kept dry outside the spawning season. Until water filling time by planting water-resistant hard meadow grasses (*Lolium perenne*) in the middle of the pond may grow for the attachment of eggs. The length of the plant should be about 10 cm. After spawning water level is lowered, allowing breeds to be collected in herbaceous canals and easily taken from there. The larvae a week after the eggs are hatched and the larvae exit; then collected with water flow.

- Hofer ponds are generally used in cold regions. The walls are 0.8-1.0 m high in front of the water outlet. The pond floor is sloped to the sides. Shallow part is the spawning place of fish and it is covered with aquatic plants. Due to the inclination, the fish have the opportunity to choose the appropriate spawning depth and shelter for sudden weather changes.
- Nursery ponds: They are small and shallow ponds that are 100-1000 m2 in size, where the larvae are kept for 3-8 weeks (usually 4-5 weeks). However, their smallness should be preferred in terms of control.
- Juvenile culture ponds: Juvenile breeding pools; slightly larger than larvae ponds (usually less than 1 ha between 400 m2 and 5 ha) and water inlet-outlet, where the juveniles are kept until 5-6 cm. In places where the winter is cold and does not have a wintering pool, the depth are made of 1.5-2.0 m in juvenile culture ponds in the coastal areas allowing the fish to spend the winter smoothly (Çelikkale, 1988).
- Growing ponds: These are ponds with depths ranging from 1.0-3.0 m, where the old carp are stocked. Their size varies from 4000 m^2 to hectares. However, 400-500 m2 in size is very common due to the easy control. In these ponds carp grows over two years of age, are fed extensively to stock up and reach the market weight (Çelikkale, 1988).
- Wintering ponds: They are used in cold regions where the winter lasts longer. Carp are taken into the wintering ponds when the water temperature drops below 10-12 °C. Since there is no feeding in the wintering pools, the stocking rate is kept high. Depth of wintering ponds is 2-3 m, and the size varies according to the amount of fish to be stocked. Storage in wintering pools can be 5-10 fish/m2 S1 and 2-4 fish/m2 S2. In order not to increase oxygen consumption, plants and mud should not be at the bottom of ponds. Also, good water circulation is needed to be provided; the water inlet and outlet should be made diagonally and the water flow should be high. There should be 45% slope in the pond walls. When the water temperature rises above 10 °C, carp are taken from the wintering ponds.
- Stock and marketing ponds: These are the soil, concrete or stone blockage pools of 500-1000 m2 in size, where the fish harvested from the production ponds are kept for a few days until they are marketed. By giving plenty of clean water to the ponds, possible mud smell in the fish is eliminated. Since the fish kept in the stock and marketing ponds are not fed, attention should be paid not to be too long. Otherwise, the fish may lose weight. Stocking and marketing ponds are stocked at a rate of 5-15 kg/m2. The water flow is regulated to change the pond water at least twice a day. For 1 kg of fish, 10-15 l/min of water flow is sufficient to remove the smell of mud.
- Brood stock ponds: The size of the breeding pools varies according to the capacity of juveniles needed in the farm. Depth is about 1 m. Water should be clean and at 15-17°C. When the spawning time approaches, water temperature is raised to 18-20 °C with various applications.

1.3.3.3. Carp feeds and feeding

The most commonly used method in carp farming is stagnant water cultivation, although it is the oldest. Daily feed amount to be given to carp depends on the amount of natural food available in the pond and the nutrient needs of the fish population.

The amount of natural feed in the pond varies according to the;

- productivity of the pond,
- environmental conditions,
- seasons

The need for nutrients closely related with;

- water temperature,
- fish size,
- stocking rate

Complementary feeding is done in carp ponds by taking these factors into consideration (5):

- Green plants: The carp often consume soft parts of green food. However, green forage crops are not used as supplementary feed alone. They are usually given in ration.
- Juicy food: All kinds of kitchen waste can be used as complementary feed in carp farming,
- Root and tuber feeds: The most commonly used root and tuber feed is potato. Small and shredded potatoes that are not used for human consumption are used in carp feeding. Since the water content of the potato is high, 4 parts of potatoes are equivalent to 1 part of corn.
- Grain feeds: Grains are the most important complementary feeds used in carp feeding. Since the prices vary according to time and region, grain feeds that are of low value and suitable for human consumption are used as fish feed. Grain feeds are given broken or soaked (softened), especially at the beginning of the growing season and when the fish's appetite is still low. When the waters warm up in late summer, they are given wet, without breaking.
  - Legume seeds are rich in protein. For stable animals due to the alkaloids in its composition unsuitable lupine is harmless and highly valuable for carp.
  - Corn is a suitable grain feed for carp. There is no need to grind the corn while feeding with corn. As a result of grinding, its digestion does not increase, but its taste decreases. If corn is to be mixed with roughage, it is useful to grind or break it.
  - Barley should always be soaked. Barley alone as complementary feed; if it is given, there is no need to be grounded except for hard ones.
  - Wheat has 15% protein and 74.3% starch and has almost the same nutritional value as corn. Sometimes it can be broken because it is thrown out without chewing and indigestion. However, the crushing process reduces the flavor, but the consumption amount and weight does not significantly affect its increase. When wheat is used instead of corn, it should be given 7-10% more.
  - Rice is an excellent carp feed and is 85-89% digested. Broken rice and rice scraps not suitable for human consumption can be used as carp feed. 1 kg weight increase is calculated with 4.5-8.0 kg rice.
  - Oats are not used as supplementary feed alone. Because it is delicious, it can be used instead of 3/4 of corn in mixed feeds. When whole corn is used instead, provides weight gain up to 3/4. Oats contain an average of 11.5% protein and the starch value is 58.

Grain feeds should be given in regular rations. Protein-rich foods should be given together with carbohydrate-rich foods. It is appropriate to provide 1/7 - 1/8 of the protein in mixed feeds with grain feeds.

- Milling Remains: Milling residues contain an average of 12% crude protein. Approximately 4 kg of milling residue and 1 kg of carp production are calculated.
- Pellet feeds: They are used as complementary feed or full feed according to the carp production technique. As normal pellet feeds dissolve in water within 1-3 minutes, they lose their superior properties to other feeds. Adding 4-5% wheat gluten flour to mixed pellet feeds ensures that the pellets remain in water for at least 20 minutes. Wheat gluten flour provides protein addition to the ration as well as the pellet binding feature. Since gluten flour is expensive, 10-12% well-ground wheat flour can also be added to the ration. The dispersion of the pellet in water depends on the degree of wetting of the wheat participating in the ration. Pellets pressed with steam at a rate of 3-5% remain in water for about 20 minutes without dispersing. The main drawbacks of using wheat gluten flour as a pellet binder are; it is expensive, because the protein is poor in lysine and methionine, it is difficult to balance and must be used as age. Adding 10-15% fish meal to pellet feed rations affects the amount of production. When the fish meal participating in the ration exceeds 20%, its amount increases significantly. However, it is necessary to evaluate the increase in fish production obtained with the increase of fish flour economically. In addition, there are important problems when fish meal is not used as a source of protein. The most important problem is to find an alternative source of protein, cheaper than fish flour. It is possible to reduce feed with milling residues. In intensive carp production, feeds with high protein and energy content are used. Structural features of carp feeds are given in Table 6, collectively.

Daily feed amount to be given to carp fish is arranged according to;

- fish size,
- water temperature,
- amount of water,
- water quality (O_2 amount of water),
- number of fish stocked,
- feeding duration
- production technique

The amount of feed to be given by fish weight is shown in Table 6. Practically 1/10 of the water temperature (2.5% at 25 ° C water temperature, 2% at 20 ° C water temperature) can be taken as the feed rate according to the fish weight in the pond. The fact that the feed is given in a large number of meals increases the labor force, however, the feed provides good evaluation and increases growth. Two times feeding is applied in morning and evening in carp culture.

Table 6. Structure of carp feeds (%)

Feed	Moisture	Protein	Fat	Ash	Cellulose	Metabolic energy (Kcal/kg)
Corn	13	9	4	2	2.5	3460
Wheat	12	13	2	2	2	3110
Crushed wheat	14	15	3.5	5	10	2120
Soy pulp	13	45	0.5	6	6	2650
Cotton pulp	10	48	1.5	6	5	2650
Fish meal	8	63	10	16	-	3500
Poltry wastes	7	60	13	18	-	3550
Chicken coaster	15	20	2	23	20	1500
Feather meal	9	80	5	3.5	-	2900
Oil	3	-	95	2	-	8000-9000
Pellet		28-40	3-4	10-12	2-6	8000-9000

1.3.3.4. Juvenile production methods in carp culture

There are three kinds of juvenile production methods; uncontrolled, semi-controlled and fully controlled:

1.3.3.4.1. Uncontrolled juvenile production method

In this method eggs and larvae are collected from natural waters. It needs regular check of the plants weather they carry eggs. When spawning takes place, egg attached plants are collected and carried to the breeding ponds. Eggs hatch there and they are collected by meshed scoops. A second application is the collection of larvae where egg carrying plants are put in the pond. Collection of eggs and larvae from natural waters is widely used in Far East countries.

Reproduction in breeding ponds where fish of different sizes are mixed, mature fish spawn in shallow and grassy parts of the pond. Larvae are hatched in the same pond. However, in this method, large amount of eggs and larvae are lost. If there is no grassy part required for spawning in the pond, weed is placed in the shallow parts of the pond. When ovulation occurs, the plants are transferred to another pond for hatching larvae. This method is implemented as semi-controlled method in Japan. Grass and weed-like nylon clippings are attached to the center of the bamboo cane and eggs are allowed to stick. The bamboo cane is placed under the water for the eggs to stick. Artificial weed material is checked frequently at the time of ovulation and transferred to the larvae pools to open the eggs when spawning (Çelikkale, 1988).

In semi-controlled production method, various artificial materials (pine branches, grass or stalk bales) are placed in the pond together with brood fish. When they lay their eggs, artificial spawning materials are placed in another pond and hatching is provided here. Another application is to take the breeder from the pool after ovulation and keep the larvae in the same pool until the feeding period. This process is carried out in the corner of a large pond. It can also be done by arranging a small pool of several square meters. By opening the door of the pool, it is ensured that the larvae, which are ready to feed, are distributed to the large pool.

Dubisch and Hofer are the most used spawning ponds. They stay dry throughout the year. Before taking water into ponds, they are disinfected with lime. Water in spawning ponds when the water temperature rises above 18-20 °C in spawning ponds, breeding fish are taken from their ponds and checked one by one for sexual maturity. They are kept in salt bath for 15 minutes before being placed in spawning pools in order to prevent skin and gill parasites.

Adult fish spawn after 24-28 hours. Ovulation can also be observed from outside the pool. Females are followed by breeding males, female and male fish begin to turn over the plants during follow-up. Foaming appears on the surface of the water before the moment of ovulation. During spawning, water smack is heard. This water slap called spawning game of female fish squirting eggs on plants and male squirt sperms on plants where eggs attached. Ovulation takes 5-10 hours in batches. After this time, plant is controlled. When dense eggs are seen on the plant, it is understood that the ovulation is finished.

On the side of the Dubisch pond of breeding fish is collected by lowering the water level in the pond, providing to descend to the channels without grass. Breeders are easily taken from here.

Larvae stay in the pond for 4-5 days. When they start to consume food sac and fill the air sac with air, they are ready to receive food from outside and are transferred to the larvae ponds.

1.3.3.4.2. Intensive Larvae Production (Artificial Production)

Breeding stock is selected for artificial production according to the criteria given below:

- Fast growing,
- Good feed evaluation,
- Low fat content and
- Resistance to diseases

After the brood stock is selected, male and female fish will be separated and stock density is kept as 500-1000 fish per ha. Fish are fed with pellets containing 20-25% protein of which 15-18% comes from animal protein. Pellet feeds also contain 2% vitamin mix and 1% minerals. Vitamins A and E must be present. Two weeks before spawning, raw meat or hard boiled eggs 5-10% are given to fish. Feeding rate is 2-5% of their body weight per day. Adults have reached sexual maturity at 35- 70 cm length and 2500-10000 g weight in Europe. Females reach sexual maturity at the age of 3-4 and male at the age of 2-3. In tropical and warmer regions sexual maturity has been reached at age 1-2 in females and at age 1 in male. The abdomen of mature female fish is wide; outflow of sperm when pressure is applied is the indicator for males. It is the best time for pituitary injection for the fully controlled artificial propagation in carp culture (Figure 35).

The pituitary gland is removed from the heads of the fish by various methods in winter or best in spring. Fish will be used for extraction of pituitary gland must be 1 kg or more; over 3 years old (Çelikkale, 1978).

The pituitary gland can be removed by twisting between the middle of the two eyes with special auger-shaped tools. Another method is to use the head in a variety of shapes (eg a sharp saw blade or knife by horizontally) opening. Just under midbrain the pituitary is found in the bone chamber

called Cellaturcica. It is in lentil grain size and white color. It is removed carefully with the help of a collet. The removed pituitary gland is kept 10-12 hours in acetone at room temperature and dried and kept in the refrigerator. It is reported that the holding time in acetone for 4-5 hours is suitable for the purpose.

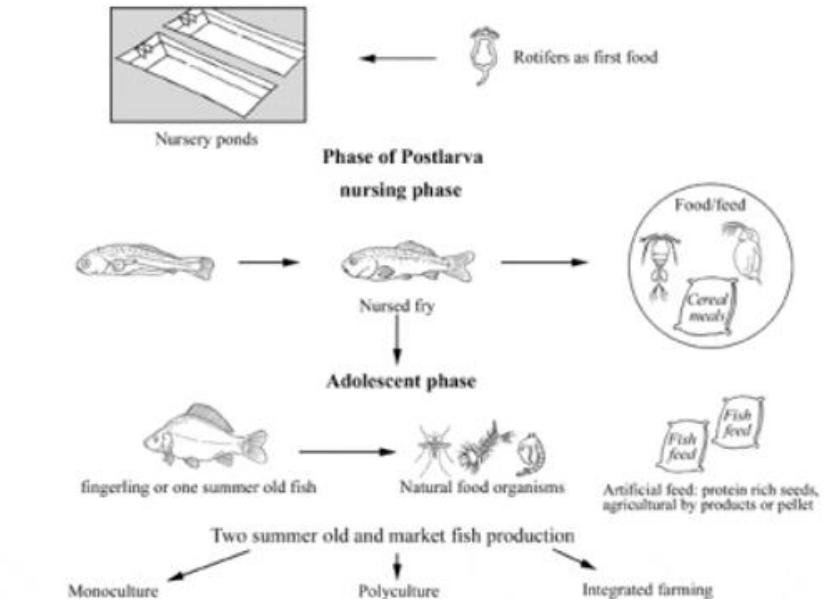


Figure 35. Breeding process of Carp (*Cyprinus carpio*)

Pituitary gland application protocol is given below:

- Fish are moved to the hatchery the day before spawning. Fish to lay are placed in tanks made of inorganic material.
- Female and male fish are separated in the hatchery and taken into plastic or concrete tanks.
- Space requests are 0.5-1 m^2/individual.
- Tanks should be 5-10 m^2 in size and 1-1.2 m in depth.
- Water requirement is 4-6 lt per minute per fish
- The oxygen content of the water should be 6-8 mg/lt.
- The water temperature should be 20-22 °C.
- Stunning can be given before milking; 1: 10.000 MS 222 (Sandoz) is used as tranquilizer.
- Fish are transferred in fresh water tanks containing high levels of oxygen. 5-10 minutes after the sedative is applied,

Carp pituitary hormone is used to promote ovulation in females and sperm production in males. For this purpose:

- The pituitary is given as 4-4.5 mg per kg body weight for females. Carp pituitary is powdered in mortar and dissolved in ‰ 6.5 salt solution. 2 ml salt solution is used for each fish.

- Hormone application to females is done in two stages: 10% of the hormone is applied 24 h before the egg intake, and 90% of the hormone is used 12-14 hours before egg intake, when the water temperature is 21-22 ° C. Injection is done between the back muscles with a fine-tipped needle. Before the needle is pulled, a light massage is applied to the injection site in order to prevent the solution from coming out.
- When ripe eggs come out, egg channel will remain open during the ovulation period; therefore oviduct need to be stitched during the second hormone injection to prevent is done to prevent egg losses.
- Oviduct suturing is done with the tools used in surgeries.
- Hormone application to male fish is done 24 hours before milk intake.
- Fish to be applied hormone should be kept in a quiet and calm environment,

The rules to be followed in egg-milk intake and fertilization processes in carp have been specified as follows:

- One or two male individuals are placed between the females 1 hour before the egg is taken. Since the female and male fish swim along the sides of the tank, they can hit the edges strongly.
- It is expected that in half an hour eggs are completely separated from the ovary wall. After this time, the fish are calmed down. After opening the oviduct, the sutures are removed. Abdominal area of the fish is cleaned with a dry cloth, and the contact of the eggs with water is prevented. If the eggs come into contact with water, they can quickly absorb water and lost their fertilization ability.
- Eggs are collected in 2 liter plastic containers. Eggs are taken with a slight pressure applied to the abdominal area. Milk is taken into test tubes by applying a slight pressure to the abdomen. Eggs should be fertilized as soon as they are removed from the female.
- In fertilization, 10-20 ml of milk is used for 1 liter of eggs. Each egg set should be fertilized with the sperm of at least 3 inactive males.
- Eggs and sperm are mixed without adding water. Until sperm reach all the eggs. Mixing process is done with a plastic spoon. Fertilization can also be done using fertilization fluid (1 lt of water, 4 grams of salt and 3 grams of urea).
- The temperature of the fertilization liquid must be 20-22 ^{o}C. Fertilization liquid prevents eggs from sticking and activates sperm. Add 100 ml of fertilization liquid to 1 liter of egg and mix. Mixing process must be continuous. 100 ml of fertilization liquid is added to the mixture at two-minute intervals. After 10 minutes, fertilization liquid is poured; 2 lt of fresh fertilization liquid is added to 1 liter egg.
- Eggs are poured in 15-20 lt plastic containers with fertilization fluid. Eggs swell 4-5 times their normal volume within 1 hour; fertilization fluid is changed every 10 minutes and stickiness of the eggs is removed. Mixing is done intermittently, gently by hand or mechanically.
- Adhesive on the surface of the eggs, which is concentrated by the previous process.
- 1 hour after the above procedures the eggs are treated with tannic acid to dissolve sticky substance on the eggs.
- Tannic acid solution contains 1.5 g of tannin dissolved in 1 liter of water; Tannic acid solution is applied after the fertilization liquid is poured; 1-2 lt of tannic acid solution is added to the eggs

and mixed immediately. After 10 minutes, water is added to dilute the tannic acid solution. Then the solution is poured.

- Eggs are washed 3 or 4 times with plenty of water and placed in incubation bottles after washing.

The procedures to be applied during the hatching of the carp eggs are as follows:

- Water temperature during incubation should be 20-22 °C.
- 20000 eggs are put in 1 liter incubation bottle. The volume of 20000 swollen eggs is about 200 ml. Since the cell division has begun, strong shaking may damage the egg.
- Eggs are placed in funnel-shaped incubation bottles, filled with water, which the bottles are equipped with a long hose. The function of this hose is to discharge of water from the bottom.
- A medium water flow is provided to the incubation bottles in the first 10 hours. For a 10 liter incubator, 0.8 -1 l / min water flow should be provided. After 10 hours, since the egg's oxygen requirement increases, the amount of water is increased to 1.5-2.5 lt / min. The eggs must float freely at the bottom of the incubation bottle. Since the oxygen requirement of the embryo, it is important to increase the amount of water to 2.5-3 lt / min 4-5 hours before the eggs are opened.
- On the second day of incubation, eggs are treated with malachite green to prevent fungal growth (1:200000). Let the malachite green solution stand in the bottle for 5 minutes, shake slowly rinse with water
- Larvae are expected on the 3rd day of incubation.
- After the first few larvae hatch, the processes are accelerated.

Depending on the movements of the embryo, since oxygen deficiency will disturb the embryo, the egg shell will crack.

When water flow is given after 10 minutes, hatching begins to a large extent. The larvae are transferred to the larvae breeding cups together with the water.

Artificial milking and fertilization, increase the larvae hatching rate up to 756% while the rate is 10-20% in the natural environment. Thus, the number of brood stock to be kept is reduced. Artificial milking and fertilization eliminates the bad effects caused by relative breeding and allows creating new genetic composition.

1.3.3.5. Nursery and feeding larvae

For the nursery of larvae cylindrical containers (50-150 lt glass, plastic or fiberglass), oncrete or plastic circular tanks or net cages can be used.

Cylindrical containers can hold 2000 larvae per 1 liter. Water enters from the bottom and leaves the container from the top. The area overflowing with water can be 10 cm^2/lt. The amount of water (flow rate) will keep the larvae in a suspended position and should be enough not to push. Since small porous gratings will be clogged with egg wastes, tank need to be cleaned at regular intervals.

After the larvae are kept in these containers until they start feeding (3-4 days), they are transferred to the nursery ponds. Since the above processes are the latest developed systems, the larvae are protected under hygienic conditions. There are various types of tanks for larvae rearing;

Containers with water flow

- They are plastic or concrete containers with 60-80 cm depth and 1-2 m^3 capacity.
- To ensure a circular flow, the water is poured from the holes of vertically placed tubes on the opposite sides. The flow rate of the water will ensure that the water flows slowly.
- The transport tube is placed vertically in the center.
- Nylon water overflow screen has 0.8 mm mesh size. There should be 8-10 cm^2/lt flow in the surface area of the screen.
- The oxygen content of the water is increased by spraying to the surface.
- 1000 larvae are stocked per liter of flowing containers.
- The advantage of these containers is that when the proper feeding environment is provided, it allows them to be kept for another day.

Net cages

- The dimension of the cages is 70 cm x 40 cm x 30 cm, made of aluminum or plastic tube frames.
- Cage nets are nylon and have 0.8 mm mesh size.
- Cages are placed in plastic or concrete tanks. There is a need of water current from bottom to top in order to provide current so that larvae can move continuously.
- The discharge is provided by the horizontal pipe at the bottom of the tank and the end of which has a hole. The bottom of the cage should be cleaned the day after hatching to remove dead larvae and egg shells. Base and edges of the cage should be cleaned with a brush every 6 hours to allow the water to pass easily through the cage.
- Water flow rate to the cages should be 4-5 lt/min/cage and sprayed from the surface to increase the oxygen content of the water

Transport and feeding of larvae after hatching

The following procedures are applied in the transplant and feeding of carp larvae.

- The mouth of larvae develops in 3-4 days. The larval stage ends with the first feeding from the outside and at this point the larvae turns into juvenile.
- In this stage, the egg sac will be absorbed to a large extent.
- In this case, the larvae reach the water surface. Also fill the air sac with air, they start swimming horizontally.
- When larvae start to swim, the first food is given to the larva. As first food, boiled egg yolk mixed with water is used. 1-2 ml of this mixture is given for 100000 fish at two hour intervals.
- As soon as the larvae begin to feed externally, they are taken to the on-growing ponds.
- The juveniles fed for 4 days are transported in plastic bags containing water and oxygen.
- 200000 larvae can be kept for 5 hours.100000 larvae in 20 lt water, containing 20 liters of water and 30 liters of oxygen, for 5 hours, 15 ° C.

- If transport requires cooling, the water temperature will be lowered gradually.
- Plastic bags are inflated after filling and tied tightly and oxygen leakage is prevented. The bags are placed inside the plastic box to prevent damage.
- 4-day-old larvae are 6-7 mm length.

Biological and Technical Data

All these information are summarized in Table 7 and Table 8 (Bakos, 1984).

Approximately 90% of the carp produced in Turkey is used to enhance 500 lakes and ponds in 50 provinces every year. Some of the remainder is used to recruit brood stock in state farms (Figure 36).

Table 7. Biological and technical data in carp culture

Parameter	Value
Age of sexual maturity (M/F)	3-4/4-5
Length of mature fish (M/F)	30-60 cm
Weight of mature fish (M/F)	1.5-10 kg
Optimum water temperature	20-24 °C
Sex rate (M:F)	1:1
First hormone injection to females	2.5-3.0 mg (1 pituitary gland)
First hormone injection to males	3 mg/fish
Time between two injections	12 hr
Second hormone injection to females	3-5 mg/lt
Second hormone injection to males	-
Time between 2nd injection and ovulation	240-260 degree x hr
Efficiency of hormone injection to females	75-85%
Dry weight of eggs per females	500-2000 g
Sperm weight per male	10-30 ml
Quantity of sperm to fertilize 1kg of dry egg	10-20 ml
Rate of fertilization of eggs	80-95 %
Egg size (dry/swollen)	1.5-3.0 mm
Number of eggs per kg (x 1000)	700-1000
Volume of swollen eggs in 10 lt of bottle	1.5-2.5 lt
Water flow in bottle	0.5-2.5 lt/min
Incubation time (degree x day)	60-70
Incubation rate (5)	95-100
Larvae period (degrees x day)	60-70
Stock density in larvae pond	2000 larvae/lt
Survival rate of larvae with yolk sac	90-95
Number of larvae started first feeding out of 1 kg eggs	500000-700000 larvae
Size of larvae starting feeding	6-7 mm
Size of first feed	50-200 µ

Figure 36. Carp production and quantity used for enhancement from 2007 to 2019 (blue: total production, orange: quantity used in enhancement of the lakes

Table 8. Biological and technical data in carp larvae culture

Parameter	Value
First feed in hatchery	Boiled eggs
Nursery period	3-4 weeks
Water Temperature	20-25 °C
Culture unit (pond)	100-10000 m^2
Stock density	200-600 larvae/ m^2
Pond maintenance in nursery period	
Organic fertilizers	500- kg/100 m^2
Inorganic fertilizers	(1 kg superphosphate+ 1.5 kg ammonium nitrate)/100 m^2
Protective processes at the end of nursery period	
Formalin	24 ppm
Malachite green	0.1 ppm
Copper chloride ($CuCl_2$)	4 ppm
NaCl solution	3-5 mins with 3-5 % in concentration
Feeding	Feed with 30-40% protein (1kg/100000 fish)
Survival rate (%)	50-60
Larvae length after 1-1.5 months	2.5-3.0 cm

1.3.4. Flathead grey mullet (Mugil cephalus)

Most juveniles used in aquaculture are collected from the sea; especially in the Eastern and Southern Mediterranean, Saudi Arabia and the Gulf countries, and Southeast Asia (Figure 37).

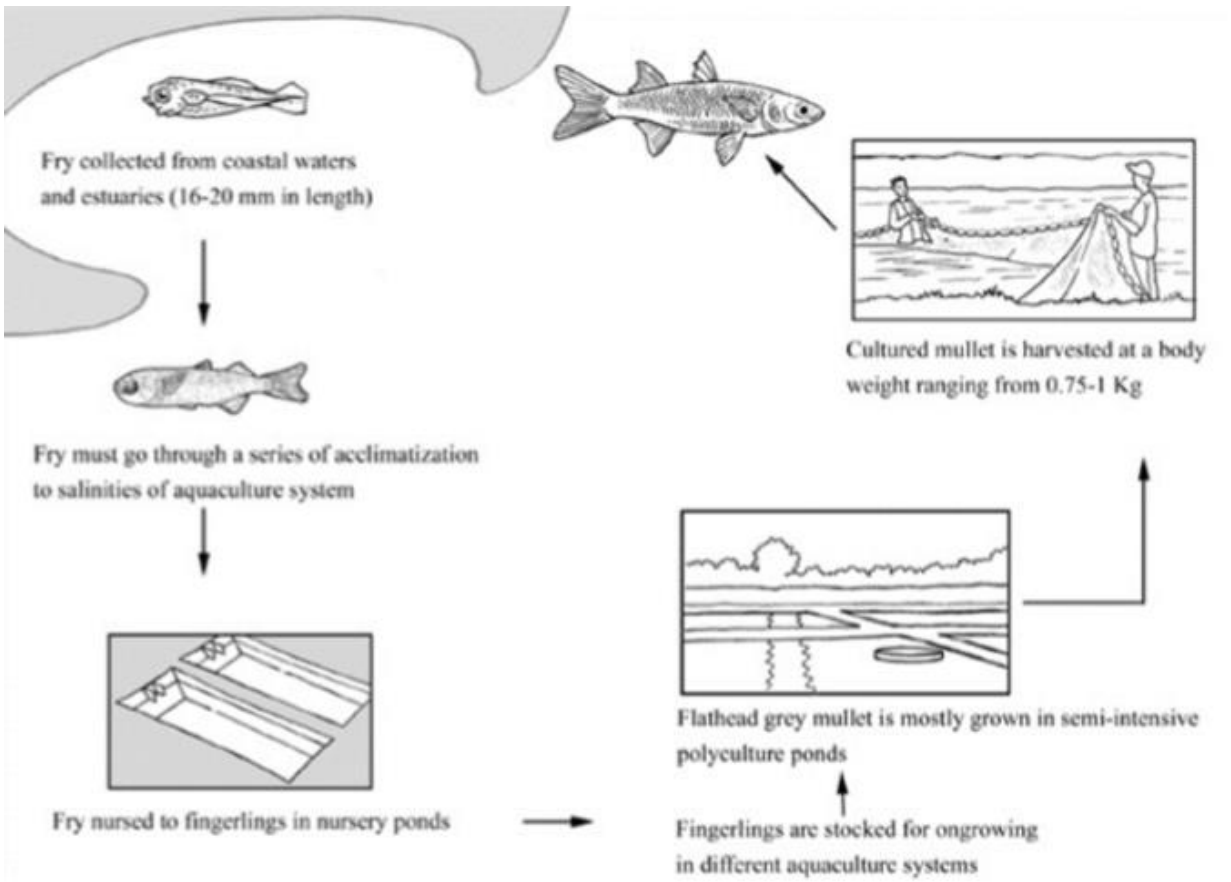


Figure 37. Breeding process of Flathead grey mullet (Mugil cephalus)

During the autumn and winter months, adults migrate to the sea in large concentrations to give birth. Fertility is estimated at 0.5-2.0 million eggs per female, depending on the size of the adult. The hatching takes place about 48 hours after fertilization, releasing larvae about 2.4mm long. When the larvae are 16-20mm, they migrate to coastal waters and estuaries, where they can be collected for aquaculture purposes in late August to early December.

The young are collected in small nets, transported in tanks with sea water for a few hours. They are then transferred to fish farms. Upon arrival, they must be acclimatized, especially in terms of salinity, this happens for several hours, when during this process water is gradually added from the lake and mixed with sea water. The farming takes place in extensive, semi-extensive / semi-intensive production systems and with the use of artificial water collections. Another common breed is together with carps.

The marketable size is between 0.5 and 1 kg in 1-2 years respectively.

1.3.5. Mussel culture

Mussel production is the main activity of shellfish farming in Europe. There are reports of mussel farming in France since 13th century on wooden stakes. The production began off the coast of the

Atlantic with the common mussel (*Mytilus edulis*), then expanded to the Spanish shores of the Atlantic and the Mediterranean with the Mediterranean mussel (*Mytilus galloprovincialis*), which is widely bred up to the Black Sea (Figure 38).

Hybrids of both species are also common in nature. The farming begins with the collection of fertile mussels either taken from the natural bottoms of the sea or from ropes or other collection containers placed in areas selected due to their currents and the presence of microorganisms. The ropes are collected and transported to mussel farms, generally during the period between May and July. Young mussels are dragged from the natural substrates to protected breeding areas near the shores.The three most common breeding methods in the coastal areas of the EU use:

- Long line system (mainly in Spain, Mediterranean, Ireland and the United Kingdom)

The mussels are attached to ropes that are suspended vertically in the water by a fixed or floating structure (rafts). In Spain, rafts are located at the river banks. Some mussel farming activities on the shores of France, Ireland and Belgium is achieved by using long lines.

- Mussels' stake ("bouchots", France)

This type of breeding uses rows of wooden stakes located in the lower tidal zone. Three to five meters of collection rope or tubes filled with broods are wrapped around the stakes and attached to them. Then a net is placed over the entire structure that does not allow the mussels to fall.

- Shallow water areas (in the Netherlands, Ireland and the United Kingdom)

The young mussels are spread over shallow waters, generally in bays or protected areas on the ground. Harvesting takes place 12 to 15 months later.

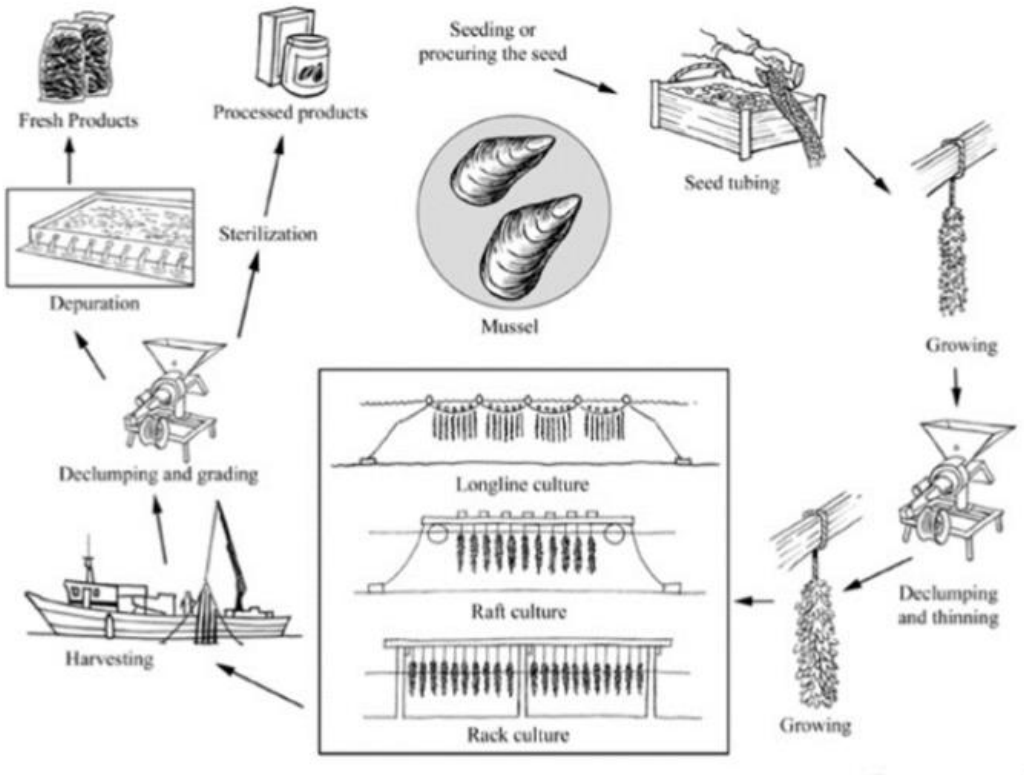


Figure 38. Mussel farming procedure (*Mytilus galloprovincialis*)

1.3.6. Oyster culture

The global supply of oysters is largely based on the production of spat (veligers, ciliated larvae) from the natural environment. However, some oyster larvae come from hatcheries especially in Japan. In this case, the collectors are stored at the sea. At regular intervals throughout the winter, groups of adult oysters are collected and then placed in tanks. The sample is random, because the sex of the oyster is not a determining factor (the oyster is characterized by successive hermaphroditism, that is, it becomes, over time, sometimes male and sometimes female depending on the season and temperature fluctuations.

The release of gametes is achieved in the spring by a thermal shock or by crossing. The gametes of six or more females are fertilized with the sperm of a corresponding number of males. To successfully crown the birth process, the water must have a temperature of about 21 ° C and not be too salty. The larvae are then placed in tanks with closed circuits and they are fed on cultivated algae. Today, most hatcheries pay attention to the production of triploid oysters, ie oysters that are sterilized with thermal shock during fertilization. To harvest them, the oyster farmer uses substrates called collectors which he places in specific spots: plastic substrates (pipes, containers, plates) or Roman tiles, slate piles, and shells.

When the brood is formed, it detaches from the substrate with the help of a knife and is now ready for breeding. In the hatchery, when the larva is ready to attach to a substrate, it darkens and therefore becomes more apparent through its shell's elevations. At this point the oysters are harvested by placing them in the tank of a solid and clean substrate on which the larvae is attached.

There are four basic methods of growing oysters depending on the environment (tide size, water depth) and traditions.

- The oysters' farming takes place in elevated platforms: The oysters are placed in the sea within pockets attached to the platforms which are placed on the ground on the tidal zone.
- Horizontal farming (on the bottom): The oysters are placed directly on the tidal zone.
- Farming in deep water or growing in pots: oysters are distributed in controlled areas (parks) that can be up to 10 meters deep.
- Farming in rows of ropes: The oysters are bred on ropes, like the mussels, a method that allows them to be raised in the open sea. They are constantly submerged in water.

The oysters naturally feed on the plankton contained in the seawater, which they constantly filter. Their breeding can therefore be done only in places that meet certain criteria in terms of currents, depth and water content in plankton, ie generally near estuaries, in lagoons or in coastal lakes. The number of cultivated permits granted is determined by scientific criteria depending on the amount of plankton available. Oysters reach marketable size after 18 to 30 months. Harvesting methods are different for each type of breeding: the oysters grown on elevated platforms are collected by removing the pockets from the stands while the oysters grown on the bottom are collected during the low tide with the help of special tools (rake) or with dredging, which can lift up to 500 kg., if the water level enables it (deep waters).

1.3.7. Sturgeon culture

Several species of the Acipenseridae family are bred in Europe. These include Siberian sturgeon, Danube sturgeon, Sterlet sturgeon, common sturgeon and Adriatic sturgeon. Many species of sturgeon are considered endangered or even critically endangered. Controlled mass breeding takes place in freshwater and is applied to all known production systems. The first successful attempt was made by Ovsianikov in 1869 at the Acipenser ruthenus. Sturgeons can be bred in circular or rectangular tanks, in artificial lakes or cages. Most sturgeon farms use a groundwater or surface water flow system (Figure 39).

The fish, which are used for breeding, are subjected to photo-thermal management. When the water temperature reaches 15 ^{0} C and when previously an egg maturation test is performed, the hormone (LHRH-a) is given to the fish so that in about 36 hours they are ready for reproduction. After the fish are anesthetized, the sperm is collected from the males by a catheter, while in females a small incision is made in the abdomen to remove the eggs. This is followed by artificial insemination. During this process, sperm, eggs and water are mixed for a short time and placed in the special egg hatching containers. The hatching process begins after 7 days and lasts another 4 at a water temperature of 15 ^{0}C. After hatching, the brood is transferred to larger tanks and when the 10th day of their life hits they begin to feed on rotifer and artemia and within a week continue with dry food. The brood is then transported to even larger pre-thickening tanks and when they become 2 months (average length and weight, 12cm and 20 gr, respectively) is ready to be transported to the fish farms for thickening.

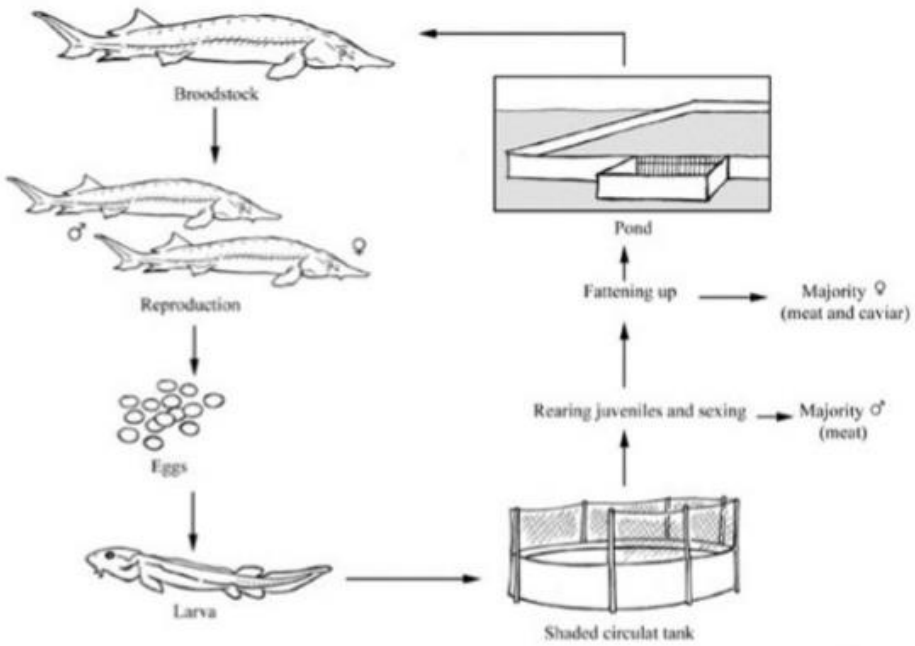


Figure 39. Sturgeon breeding process

There are three breeding methods for the nymph development to the fish development:

- Farming into circular tanks

They are usually circular tanks with a diameter of 2.8-3 m and a height of 0.4-5m and are made of concrete or glass

- Growing in earthen aqueducts

Area of 20 acres and depth of 1.5 m. They are enriched with nutrients and receive the nymphs after having absorbed the vitreous sac.

- Mixed method

The combination of the above two, ie in the first stage, larvae in circular tanks and in the second stage, fish, earth hydropower plants.

The average breeding time of sturgeon commercialized for its meat is 14 months, at which point fish of a commercial size (700 g) are obtained. When caught, it is trapped in nets. However, the exploitation of sturgeon for caviar production is expensive because females cannot reproduce before they are at least seven years old.

1.3.8. Turbot culture

Turbot (*Psetta maxima*) is a potential species for aquaculture and enhancement studies. Turbot culture has been started and carried out as joint project with the Ministry of Agriculture and Forestry, and Japanese International Cooperation Agency (JICA) in 1997. Although the project finished in 2007, hatchery and on-growing units have been still running to supply small turbots to the investors and some bigger ones used for the enhancement of the Black Sea to restore the overfished turbot stocks.

First trials started with Atlantic turbot (*Scopthalmus maximus*) which culture methods are well known world wide and progresses in France, Spain and Portugal. But one of the main aims was to support reduced turbot stocks in the Black Sea. Therefore trials conducted with the Black Sea turbot. At the beginning survival rate was too low. After working with Japanese experts survival rate increased to the level in European countries due to more detailed studies on brood stock management, increasing the success of larvae and juvenile production. Studies are carried out on the photoperiod application in reproduction of turbot.

Since 2008, Ukraine, with the participation of experts from YuzhnNIRO, artificial reproduction of flounder-turbot has been started on the basis of LLC "HTMO". There is some experience when 7000 juveniles were issued to the Black Sea under the 2008 budget program. Young flounder-turbot provided there are sufficient numbers of bottlers, taking into account the improvement of water supply technology and maintaining the optimal salinity of 14-15%, it is possible to obtain about 8 million juveniles weighing 0.5-1 g. The turbot seedlings for artificial reproduction are selected from commercial catches. The holders are kept in recycling systems for 2-3 juvenile/m^2 with 2-3 times daily water exchange. The temperature and salinity of the systems should be consistent with that of the sea during this period.

There were also breeding attempts in Russian Federation, small hatchery on the Black Sea coast. Due to several reasons commercialization of this species could not been succeeded; mainly as high mortalities in the larval period to start feeding live food, long time to reach market size and diseases (specific to Black Sea turbot). On the other hand, reduced turbot stocks in nature, has obliged governments to produce this species for the enhancement activities.

Turbot has a life span of 25-30 years and its length may reach up to 1 m total length. Starting from 5-10 m it can go 300-400 m depths. It is a carnivorous and highly voracious fish. Males may mature and reproduce at the age of 5-6, females at the age of 6-7. Their reproduction in nature lasts from April to June in 10-15 ^{0}C waters. In addition to giving millions of eggs, its taste and efficiency and economic value are very high.

It is one of the fish that is of great interest in breeding in the last vision. Farming studies for successful turbot culture has already been introduced. Two hatcheries in Europe produced 750000 juveniles in 2004 and 750 tons turbot in 2005. The breeding technique is similar to sea bream and sea bass. It is also possible to produce eggs throughout the year with the light control in the water that can be adjusted from the turbot adult about 1.5-2 kg. Recent developments are very promising events in turbot breeding. Fish can reach to the market size in 18-24 months.

1.3.8.1. Juvenile Production

Turbot needs stable water temperatures during culture than any of the other fish species in aquaculture. Therefore during the planning stage of the hatchery, water intake system plays an important role by technical end economic means. After taking water filtration is vital to increase the quality of the sea water. In the Central Fisheries Research Institute in Trabzon, turbot hatchery is supported by 3 units: water intake unit, first filtration and reserve unit, and secondary filtration and sterilization unit. Water can be taken from the sea in various ways. In the Black Sea application, water was provided from two different depths with two pipelines. In order to prevent fluctuations, the water entering the hatchery is under the desired water temperature for the turbot by mixing the sea water from 500 m from the coast at 15 m depth and the second one from 650 m. at 40 m depth. First filtration and reserve unit contains pre-filters (consisting of 100 cm thick anthracite) and reserve tanks. Then water is transferred to the second filtration and sterilization unit. At this stage, sea water is passed through the mechanical sand filter again. Mechanical sand filter contains 0.8 mm Ø anthracite and contains sand of different sizes. Finally sea water flow through cartridge filters and under UV light for the sterilization. After this step water is delivered to all reproduction and ongrowing systems in the hatchery.

Air supply and heating system are the essential. For the better results in larvae production heating system is mandatory. For this purpose, two sets of boiler systems with a capacity of 200 x103 kcal / min and 400 x103 kcal / min were installed in the project to ensure the continuous and reliable operation of the heating system and against any failures that may occur.

In turbot fry production, tanks of different sizes are needed for live feed and fry production. One of the indispensable conditions for these tanks is that their inner surfaces should be smooth. Rough

surfaces are not recommended to ensure hygienic conditions. An annual work plan should include the following activities.

- Facility maintenance and repair
- Equipment maintenance and repair
- Production of natural feed organisms
- Obtaining fertilized eggs
- Fry production

Preparations for the production of new season juveniles begin with the painting of the production tanks in October after harvesting and transferring the fry in September. The next activity is the maintenance and adjustment of algae (phytoplankton) and rotifer stock cultures in the period from November to February. Main activities are equipment maintenance and repair works and disinfection of sea water supply system in February. Intensive algae and rotifers are produced in March just before the breeding season begins. Full capacity larvae production activities are carried out in April and May, including algae and rotifer intensive culture, artificial insemination and larvae breeding. Larvae and juvenile breeding constitute the main activities in June and the following months. In September, the first group of juveniles are harvested and transferred to the farms.

The most important factor in success in the production of turbot fish is feeding. It is necessary to be successful in the production of phytoplankton, Artemia salina nauplii and rotifers used in feeding larvae.

1.3.8.2. Fertilised egg supply

In the production of turbot, adult fish required for egg supply can be obtained from two sources:

(a) Capture from nature,
(b) Selection of fish produced and rose in the hatchery.

Eggs can be obtained from broodstock caught from nature until fish become mature in the hatchery. Brood stock management is very important to obtain high quality fertilized eggs. Promoting the maturation of gamets (eggs and spermatozoa) with hormone application and artificial insemination are important basic techniques.

Turbot in the Black Sea migrate from deeper to shallower waters from mid-March to mid-May. Males over the age of two and females over the age of three can be used as breeding. In this period, the surface water temperature rises from 8.4 ° C in March to 16.9 ° C in May in the Eastern Black Sea (off Trabzon). Adults are captured by trawling.

Fiberglass tanks (i.e. 1 m x 1 m x 0.5 m) are used to transport adults. Approximately 2/3 of the tank is filled with sea water and aerated. The individual weights of fish per square meter of the tank are 2-7 kg. Approximately 4-6 adults can be stocked. The transportation distance of the fish is usually 5-20 km. It takes only a few hours.

Before transferring broodstock tanks preliminary quality checks should be done in order to minimize the risk of disease infectation from fish brought from nature to hatchery. This process can be carried out by determining the fish with the desired features and taking protective measures by

checking whether the fish carry pathogens before they are transferred to the maturation tanks for the artificial fertilization. Each fish is placed in 40 lt containers containing 30 lt of water, separately. The selection mentioned above is done at this stage with ventilation (4 lt / min x 1 air stone) is done until the selection is completed.

Criteria considered in the selection of breeding fish:

1) The health condition of the fish,
2) Fish have normal morphological (physical) features,
3) Attention should be paid to injuries caused by the fish not being injured, especially the use of bottom gill nets along the genital opening edge.

For some parasite species, such as trematodes and nematodes, fish can be visually inspected. However, for protozoa infections, samples taken from gills and skin should be examined under a microscope. When taking the sample from the gill, the operculum is gently opened until the gills appear, and a scraping is carefully done by a spatula. Skin sample is taken by scraping the top of the eye of the fish with spatula. Finally a little mucosa is collected. The samples taken are placed between the lam and lamel and examined under microscope. Some types of protozoa such as Trichodina sp., Icbtyopodo sp. and Scuticiliata sp. are encountered frequently.

The selected adults are placed in quarantine tanks for general observation and disease treatment before they are transferred to the maturation tanks. These preventive measures minimize the risk of any possible diseases and parasites. The selection and use of antimicrobial drugs is extremely important in terms of preventing contamination of the hatchery.

Mature fish are treated in two successive stages: 40 lt plastic tubs are used during this treatment. These plastic basins are filled with 30 l of sea water, and then antiprotozoer drugs are added and mixed (Step 1/ Formaldehyde 100 ppm, copper sulfate ($CuS0_4$. $5H_2O$ 0.5 ppm). After one hour, fish are placed in the other plastic tub for the second stage of treatment, where they are kept for 1 hour (Step 2/Furazolidone 20 ppm or sodium nifurstirenate 10-20 ppm). During the treatment, 0.6 l/min aeration is provided.

One of the first procedures performed during the breeding season is to observe the general appearance of the fish. Fish whose females are swollen and slightly saggy are female, and those that are flat and hard are male. In cases where the gender cannot be determined from the structure of the abdomen, a lighting method can be used with a table lamp.

Light pressure is applied several times, starting from the pelvic (abdominal) fins immediately and close to the urogenital opening. If the fish is fully ripe, liquid and light white milk usually flows out from the urogenital opening. If milk does not come, these fish are either immature or spent milk, and they are not used to fertilize eggs.

Maturity of females can be checked manually by milking or catatering. In mature females, the eggs are easily removed from the genital opening when the abdominal area is slightly pressed. If the fish is ripe, it should be milked immediately. In females that are not yet fully mature, eggs may not come out even if the abdomen is pressed so hard. If no eggs come from the fish, an oocyte sample is taken with a catater; 50 cm in length, thin polyethylene tube (0.7 mm and 1.5 mm in diameter). The

polyethylene tube is gently inserted into the genital opening about 30 cm or until resistance is felt. Oocyte samples are sucked into the tube by mouth siphon and then the cannula is withdrawn. To take oocyte samples from the cannula, a 1 ml syringe with a needle is inserted into one end of the cannula and tightened well. The sample is blown into vials filled with Turbot Ringers solution with syringe and examined under a microscope.

In males sperm activity is examined under a microscope with a magnification of 100. For this purpose, first, a drop of sea water is placed on the slide, and then some milk is added on it and observed under a microscope. The normal viability of the sperm is determined by the action like whipping amoeba after mixing the sea water with the herd.

Some eggs are placed on the slide to measure the oocyte diameter. The measurement can be done under a microscope at a magnification of 40. If the oocyte diameter is larger than 400 mm (n = 100), the fish can be used for spawning, if it is smaller than 400 mm (n = 100), these adults cannot be used for egg retrieval yet, but they are preserved as broodstock.

In maturation tanks salinity should be kept at levels of ‰ 15-18 and the temperature must be controlled. Maturation tank is made of FRP with dimensions of 1x2x0.5 m and is divided sections at the middle. 4 of these tanks can be used in the project hatchery and two of 1x1x0.5 m in size for adaptation. The light intensity in the compartment where these tanks are located is controlled around 100 lux using fluorescent lamps, but it is under daylight effect. The appropriate water exchange rate is approximately 900% per day and ventilation (4 l / min x 1 airstone / m-) is provided. During the breeding period, the temperature is kept at 15 °C using titanium heaters (1kw). First of all, adults are taken into the adaptation tanks (1x1x0.5 m), from the natural sea water temperature to 15 °C within about 1 day and transferred to the maturation tanks. Fish can be stocked in maturation tanks with 2-4 fish per m^2 (individual weight 2-7 kg). To protect the fish from physical stress, excessive stocking should be avoided. To prevent deterioration of water quality due to decay of dead eggs in maturation tanks, tank bottoms are cleaned daily with siphon. The fish are not fed during the spawning period in order to maintain the desired water quality.

1.3.8.3. Artificial propogation

Human chorionic gonadotropin (HCG) and White salmon pituitary gland (WSPG - Salmon pituitary) are thoroughly mixed and homogenized in a ceramic bowl. The prepared hormone is withdrawn by syringe and immediately injected into the fish.

5 mg Luteinizing Hormone - Re-leasing Hormone analogue (LHRH-a: Luteinizing hormone secreting hormone derivative) is mixed with 1 ml of 60% ethanol in a ceramic bowl and then 625 mg of cholesterol is added and mixed well again. The prepared mixture is made of aluminum foil and left for one day at room temperature. The next day, 125 mg of cocoa butter is added and mixed well. The prepared hormone is made into pellets of 30 mg using pellet mold. Each pellet contains 200 mg of LHRH-a hormone. The pelleted hormone is placed in a glass bottle and stored in the freezer until it is used at -20 ° C.

Hormone injection can only be applied to mature males and females with oocyte diameter greater than 400 mm. Hormone dosage for males is 500 IU HCG per kg live weight and 7 mg WSPG for

females: 100 mg pellet LHRH per kg body weight is sufficient. Injection is done with a 10 ml syringe using needle number 18. The hormone is injected intramuscularly into the back of the fish, near the dorsal fin. For this purpose the pellet form of LHRH-a is inserted intramuscularly near the dorsal fin using a metal tube.

First, the fish are taken from the maturation tanks and their bodies are washed with freshwater to remove sticky salts. The fish to be milked is placed on the milking table and their bodies are carefully wiped with a towel. Then, the urogenital and genital opening of the fish is cleaned to remove the urine etc. To prevent the fish from whisking, the head is covered with a towel. Anesthesia is not required.

Males are milked before females, as sperm can be stored longer than eggs. Milk or semen is collected by pressing on the abdomen to the urogenital opening. Milk is collected by syringe in 1.5 mm diameter of silicone tube and kept in ice box until fertilization. Average 1 kg of fish can give 1.3 ml of milk.

In order to have eggs the abdomen is slightly pressed. If blood comes with eggs, milking should be stopped. Ovulation occurs in 2-10 days. In order to understand that ovulation is occurring, females should be checked from time to time by rubbing their bellies, and eggs can be milked daily after the first ovulation. Ovulation of mature and maturing fish ends in an average of 7-13 days. As an average 300000-510000 eggs per kg of fish can be taken.

Insufficient amount of milk obtained from captured mature males from the sea sometimes may create problem for artificial propagation. Sperms kept by cryopreservation (ultra cold preservation) have high fertilization rate and can be a practical method as a solution to this problem.

Dry method is used for artificial fertilization of turbot eggs which are milked in a dry plastic container (0.6 l). Sperm is added onto the milked eggs and mixed using a feather. Optimum amount of sperm for 400 g of eggs is 1 ml. One gram egg mass contains about 900 eggs. Then, some sea water is added to increase the fertilization rate. Eggs are kept in the bowl for about 10 minutes, which is equivalent to the time that sperm can maintain fertilization.

The main purpose of the development of hatchery broodstock is to provide continuity in hatchery production, obtain high quality gametes and control the spawning time. After sex separation, body weight and length of fish are measured, recorded in order to determine growth and feed evaluation rates. Initial stocking density for fish of 3-4 years old with an average weight of 2.5 kg is 2-3 kg/m^2 (approximately 1adult per m^2) and 5-6 kg/m for 2 years old fish. The gender (male to female) ratio is equal (1:1).

Frozen whiting and other white meat fish meat can be given to broodstock feed. Feed fish are divided into 1-2 pieces depending on the size of the adults and given without waiting for dissolution. Feeding should be done by feeding the pieces one by one until the fish is full. 3-4 years old fish are fed until 2-3 times a week, and 1-2 years old fish are fed once every morning. Evaluation of frozen whiting as feed is 3 to 7.

As a breeder stock unit, 3 x 20 m^3 concrete outdoor tanks, 2 x 12 m^3 fiber indoor tanks and smaller (13 x 3-4 m^3) fiber tanks were used for research purposes in shturbot culture. The diameter of fiber tanks is 2-4 m, the depth is 1 m, the diameter of concrete tanks is 5 m, the depth is 0.9 m.

The temperature of the sea water varies between 8 °C and 24 ^{0}C in the Black Sea. Salinity is around 15-18‰. For economic reasons, concrete outdoor tanks are supplied with coarse filtered sea water, while indoor tanks are provided with better filtered and sterilized sea water.

Outdoor tanks are covered as a roof to prevent sunlight from algae growth in the tank. The light in the tanks should be low (20-200 lux). The water temperature should be controlled to be lower than 17 ° C during the summer. This temperature could be arranged by mixing the cold water is taken is from 40-50 m depth with warm water taken from 15 m depth. The rate of water change in tanks should be 1000%, ie 10 times a day. In addition, an aeration system should be connected, with 2 air stones per 10 m^2 area.

When it is necessary to control environmental conditions such as water temperature and photoperiod (day length), fiber indoor tanks are used. In these tanks, fluorescent lamps (40 watts x 2) are hung in the upper middle of the tanks for controlled lighting (200lux). In addition, the heating system is installed in the biological filter tanks, which are connected with the broodstock tanks, to control the water temperature.

Diseases may create serious problems for adult fish to be used for reproduction. Typical symptoms of a sick fish are the loss of appetite and unstable swimming behavior. When this type of behavior is observed, fish should be checked for parasites immediately. Symptoms of bacterial diseases are loss of appetite and reduced feed intake. In such cases, skin and gill scraps are removed and any lesions or other problems are reviewed. In order to get rid of parasites and bacterial infections bath treatment can be applied. First, the water coming to the tank is closed, and then the tank water level is reduced to 30 cm, but adequate aeration is provided (12 l / min x 2 airstone / 10 m^2). Another treatment can be done with feed. For this purpose heavily infected fish leave the healthy stock. The amount of water coming to the tank is increased. The volume of water in the tank is kept at a level similar to that of normal growing conditions. The following treatments can be used for fish infections;

- For parasitic infections (eg Tri-chodina, Ichtyobodo, Scuticiliata and Nernatoda)

Treatment: 100-150 ppm formaldehyde + 0.5 ppm copper sulfate (1 hour medicated bath)

- For bacterial infections (eg vibrio sp. and Aeromonas spp.

Treatment: Antibiotics mixed with feed or medicated bath.
Antibiotics:

1) Oxytetracycline (Oxytetracycline - OTC), 50-75 mg per kg fish weight, mixed with feed or 10 ppm, 1-2 hours medicated bath.
2) Oxolinic (Oxolinic) acid, 25-50 mg / kg fish weight with feed.
3) Enroflosacin (Enrofloxacin), 10 mg / kg fish weight with feed or injection.

1.3.8.4. Larvae production

Proper egg incubation is extremely important in terms of keeping the egg quality at high level. For this purpose, cleaning and disinfection of the materials used during the whole incubationperiod, the use of filtered and UV sterilized sea water and daily monitoring of the physico-chemical parameters of the water is essential.

Incubators are disinfected before placing the eggs. The incubators for disinfection, after normal cleaning with detergent, kept in tap water and wait for more than a day by adding 200 ppm (12%) of chlorine. Later, in order to remove chlorine, aeration has started and operated for a few hours. Before use, the chlorinated water in the incubator is drained, washed several times with tap water and several times with sea water. Other equipment such as measuring cylinder, tube, pipette and bucket are kept overnight in disinfectant (10% benzalconium; 10ml) and rinsed with tap water before use.

Eggs are disinfected with iodine solution to prevent microbial or viral contamination via eggs. One minute after fertilization, eggs collected with a nylon net scoop (mesh: 220 µm) are rinsed with water at the incubation temperature to remove remaining sperm, body fluid and mucus and transferred to buckets for disinfection. 50 ppm PVP iodine [50ml PVS iodine solution, (Aqua-iodine: Argent Chemical Laboratory) diluted with 10 lt of sea water] can be used for disinfection. It is done by applying light aeration for 5 minutes. At the end of this period, the eggs are carefully washed using incubation water to remove iodine and transferred to the incubation tanks and aerated around 0.6 l / min.

Depending on the amount of eggs, incubators with suitable volume are used. These are cylindrical tanks with conical bottom, and central drainage is provided by a strainer placed at the bottom. The volume of water in the tank is kept at the desired level by controlling the position of the drain pipe. The drain in the drainage system is made from PVC pipe (3 cm in diameter). The pipe is surrounded by a polyethylene mesh (mesh size: 8 mm) and plankton net (mesh size: 520 µm) to prevent loss of eggs during water change. After the incubation water is filtered up to 1 m, it is subjected to UV sterilization. The rate of water exchange in the incubation tank should be adjusted to be 2000% (20 times) per day. The stocking density is approximately 2000 eggs / l. The water temperature is kept at I5 ° C with about 0.6 l / min aeration allowing the eggs to suspend in the water column. Stronger aeration or higher water exchange rate may cause eggs to hit the tank walls or the strainer placed in the center, causing damage to them. The light intensity of the incubation tank (day-night) is the same as in natural conditions and is around 100 lux during the day.

The fertilized eggs are transparent, spherical and pelagic. They are not sticky, there is no special structure on the shell, contain a single drop of oil and have a narrow perivitellin cavity. Their diameter varies between 1.08-1.21 mm. Hatching eggs occurs at 14-15 °C, approximately 110 hours after fertilization.

The fertilization rate can be estimated 3 hours after fertilization at 15 °C while the eggs are in the 4th cell division stage. In order to estimate the fertilization rate and the total number of eggs, a 50 ml sample is taken from the different parts of the slightly aerated incubation tank 3 times per

beaker. Egg samples are examined under a microscope and fertilized eggs and total eggs are counted. Fertilization rate and incubation using average values calculated from 3 samples taken.

The total amount of eggs according to the water volume in the tank is calculated using the following equations:

Average number of fertilized eggs= Fertilization Rate x 100%/Average total amount of eggs
Average total number of eggs = Number of eggs in the sample x water volume of the incubation tank / Sample volume (ml)

Often, the eggs that have collapsed to the bottom of white are 'dead' even though there are several live eggs between them. Healthy eggs float on the water surface or in the water column. Dead eggs need to be removed as they impair the water quality by causing an increase in bacteria and protozoa in the incubation tank. For this, the vent and water inlet are closed for a few minutes and dead eggs are collected by siphoning after settling to the bottom.

Hatching rate is determined by proportioning the amount of larvae released and the total number of eggs obtained. For the estimation of the number of larvae, 3 samples of eggs (50 ml each) are taken from different parts of the slowly aerated incubation tank. Larvae in the samples are counted using a stereomicroscope. The total number of larvae (TNL) in the incubator is estimated using the average number of larvae obtained from the samples and the water volume of the incubator:

TNL=Mean number of larvae in samples x water volume in incubation tank/sample volume (50ml)

Hatching rate (%) = TLS x 100 / Total number of eggs

The Black Sea turbot shows morphologically important changes during the metamorphosis, which is the transition phase from larval to juvenile. Although fish with deformed and abnormal pigmentation constitute a significant part of production, they reduce the commercial value of juveniles. Therefore, it is considered that the cultivation of this species is much more difficult than sea bass and slightly more difficult than sea bream cultivation. Cultivation based on proper nutrition, ecological, physiological and pathological knowledge requires more practical skills.

The morphological development and behavior of the larvae that are removed during the 70-day growing period at 16-19 °C water temperature. Growth of turbot larvae has three stages:

- Prelarval period: This larval stage lasts 0-2 days after hatching. Larvae with egg sac and oil droplet are symmetrical in shape. The average total length of newly hatched larvae is 2.5 mm. Eyes are not yet colored, the mouth is not opened and the anus is not formed. Depending on its consumption, the larvae grow quickly. However, no nutritional behavior is observed during this time. Pectoral fins are not yet visible. Larvae are suspended upside down near the water surface.
- Post larval period: On the third day (between 3rd and 29th days after hatching), the eyes of the larvae were colored; mouth (0.15 mm wide) and their anus are opened. The mouth width increases as the larva grows. With the opening of the mouth, the first feed intake begins on the 4th day. On day 5, pectoral fins appear. On the 7th day, the digestive tract, which is flat, begins

to expand and curl. On the 10th day, pectoral fins develop well, oscillation and tail movements are strengthened, and larvae sometimes float against the flow. They take their previous positions by dragging back and forth. On the 12th day, the larvae take the S-shape, then suddenly flatten and leap forward like an arrow to capture the organism (rotifers). Active feed intake begins at this stage. The development of fin rays start on the 13th day. On the 20th day, the caudal (tail) fin rays are completed. Dorsal and anal fin rays are carried out on the 25th day. Although not common in this type, it can be seen that after the 25th day, large larvae attack small ones (cannibalism).

- Metamorphosis phase (between 30-70 days; transition from larvae to juvenile stage): Fish takes asymmetric shape and eye migration begins. Accordingly, the fish settle at the bottom of the tank. On the 51st day, it is observed that the number of rays in the pectoral fin is completed like that of adult individuals. At this stage (days 30-70) most of the fish float close to the water surface in a horizontal and oblique (vertical with 45° angle) position. Larvae reach 20 mm total length at 210C water temperature during metamorphosis between 40-42 days.

1.3.8.5. Tanks and equipment

All tanks are placed in a closed area. Since the water flow in the tank is important, the shapes of the tanks can be round, square and ellipsoidal according to the desired purpose. The volumes of the larvae cultivation tanks used vary between 2 and 5 m^3, and their depth is about 0.75 m.

Tanks must be equipped with aeration system. In larvae breeding, the aeration and circulation of the water are the most important factors to be considered. Ventilation and water circulation are often performed at the same time by a well-designed unit. Practically, water is ventilated with several air stones (2.5 l / min) of 5 cm length and 3 cm diameter, light or medium. This application can be preferred to severe aeration with fewer air stones (2-3 pieces per square meter).

1.3.8.6. Water quality

Water is filtered through a 5 µm filter and then sterilized with a UV lamp to ensure proper larvae breeding conditions. With the heating systems placed in the larvae tanks, the water temperature is kept around 18-21^{o}C.

1.3.8.7. Lighting

Lighting is one of the most important factors during the feeding of larvae. The amount of light should be avoided more or less. The facility is illuminated with fluorescent lamps with a density of 200-500 lux between 8:00 and 19:00, but direct sunlight should be avoided.

1.3.8.8. Stocking density in cultivation tanks

The initial stocking density of eggs or larvae to the breeding tanks is approximately 20000-30000 pieces / m^2. done as. When the fertilization rate of the eggs is low, the whole batch is destroyed.

Before transferring eggs or newly hatched larvae to the breeding tanks, the temperature of water in the breeding tank is adjusted to the same degree as the incubation water temperature. Before the transplant process, the incubation tank with eggs or newly hatched larvae is cut off and the other

wastes, together with the damaged and undeveloped eggs and larvae, are deposited to the bottom of the conical incubator. Healthy eggs and larvae swim close to the surface. Undeveloped egg and waste material, which have collapsed to the bottom of the tank, are expelled by siphoning or through the hose connected to the bottom of the incubation tank. Healthy eggs and larvae remaining in the incubation tank are collected from the water surface with sterilized liter beakers.

The rack is transferred gently to the cultivation tanks with 10-15 l sterile buckets.

1.3.8.9. Feeding larvae

Three types of feeds are used in feeding the larvae: rotifer (B. plicatilis), Artemia nauplii and artificial feed.

When the mouth of the larva is opened on the third day, enriched rotifers (B. plicatilis) begin to be given to the breeding tanks. Rotifers are slowly added to the larvae tanks with beaker. The rotifer density in the tanks varies depending on the stage of the larvae and is kept between 2-5 rotifers / ml. The density of the rotifers in the tank is checked twice a day, at 10:00 and 14:00, and when the density drops below the desired value, rotifers are added as much as needed.

The green algae (Nanocbloropsis) density in the larvae cultivation tanks is kept around $0.5x10^6$ cells / ml. These green algae are added to the breeding tanks in order to feed the rotifers, to enable the transparent rotifers to be more easily disposed by the larvae (creating background) and to ensure the homogeneous distribution of the larvae in the tank.

12-15 days after hatching newly hatched Artemia nauplii is given to the turbot larvae. On the 16th and 17th days, the larvae are fed on enriched (one day old) Artemia (metanaupiii) with newly opened Artemia (nauplii). Between 18-40th days, only enriched Artemia is given. The density of Artemia (metanauplii) given to the larvae is increased from 0.2 individuals / ml to 0.4 individuals/ml depending on the consumption of the larvae. Artemia larvae are generally consumed within two hours.

As artificial feed, microparticles or micro feeds have been developed for the larvae. Micro feeds can be started to be given to larvae on the 20th day. When there are found together with live food such as rotifer or Artemia in the environment, larvae prefer live food. As a result, it is very difficult to accustom larvae to artificial food. Therefore, it is recommended that larvae should not be overfed with live food. On the other hand, overfeeding with micro feed may have impact on water quality. Therefore microfeeds also should be used in appropriate quantities. When choosing the micro feed, first of all, the quality of the feed should be considered, because the quality of the feed affects the survival rate and growth of the larvae. The micro feed given to the larvae must meet the following conditions:

- It must meet the nutritional needs of larvae.
- It should be able to suspend in water column for a few minutes.
- Nutrients should not be dissolved in water immediately. Pelletizer should not prevent transfer of nutrients to the water.
- It should not be dispersed quickly in water.

Micro feeds can be divided into three groups according to differences in manufacturing processes and properties.

- microencapsulated feed (MEF),
- micro-bound (micro-bound) feed (MBF), and
- micro-coated (micro-coated) baits (MCF).

Turbot larvae are more sensitive to changes in water temperature in the early stages of their development. Therefore the water temperature in the incubation tank must be the same as the water temperature in the breeding tank during the transfer of eggs or newly hatched larvae. After transfer the temperature of the water in the cultivation tank is gradually increased from 15 °C to 18 °C and then to 21 ° C within four days.

No water changes are made for the first 3 days in the cultivation tanks. On day 4, 30% water change is started in order to maintain adequate rotifer density and prevent deterioration of water quality. Water exchange is achieved by simply allowing the water used as much as the water entering the tank to flow out through the drainage system. The rate of water change is gradually increased 3 times on the 10th day.

In the discharge of water, a 200 mm diameter PVC pipe with perforations placed vertically in the middle of the tank is used. In order to prevent the larvae from escaping on this pipe, a sheath made of polyethylene net with appropriate mesh size is placed depending on the size of the larva. A spiral flexible hose is attached to one end of the pipe. The other end of the hose is connected to the outer edge of the tank and used to control the water level in the tank. The relationship between the larval lengths, mesh size of the net can be increased. It is important to keep the water movement in the tank to a minimum, since the swimming functions of the larvae that have been removed during the initial developmental stages are not fully developed. Since the larvae are not active swimmers, they cannot swim against the current and are trapped on the surface of the polyethylene mesh and as a result, mass deaths can be observed.

The tank bottom is cleaned daily starting from the 5th day. With suitable equipment, dead larvae, fodder residues, feaces and other organic wastes accumulated at the bottom of the tank are siphoned away. It is believed that the waste organic materials accumulating at the bottom of the tank can create a suitable environment for disease agents. The equipment used for cleaning the tank floor can be prepared by connecting a T-shaped cap to the suction end of the 20 mm diameter PVC pipe and a 25 mm diameter spiral hose to the other end. By installing a piece of sponge on the suction tip, the floor is cleaned more effectively. During the siphoning process, the aeration is cut and care is taken not to mix the organic substances accumulated at the bottom of the tank with water and to flush the larvae floating close to the ground. The free end of the siphon hose is kept in 70 l plastic buckets outside the tank, so that dead and escaping live larvae are also collected.

Cleaning of foams and oil from the water surface is crucial. Removing rotifer shells, oil film and organic wastes of protein origin on the surface of the water is one of the important tasks that should be done daily. This type of cleaning process is useful to increase oxygen exchange between the air and the water surface and removes waste materials that cause bacterial growth, and also

facilitates the swallowing of the first air, which is important for the swelling of the air sac. On the other hand, due to the enrichment of live feed with oily emulsions, water surface may be covered with oil layers. Recently, by using air-jet and floating oil collectors, these fatty substances are collected and the inflation rate of the air sac is tried to be increased successfully. Excessive turbulence or turmoil of water in the tank also prevents swelling of the sac in the larvae and causes skeletal disorders. To prevent this undesirable turbulence, it is recommended to place water diffusers or dispensers in each water inlet of the tank. These diffusers are made of PVC pipe and thin meshed polyethylene net attached to the end of the pipe. By this way both water entered into the tank with low turbulence and sudden changes in the water temperature in the tank are prevented. In addition, it is recommended to pass the fresh water coming to the tank through the diffusers made of 200 mm diameter PVC pipe at the entrance of the tank in order to prevent the formation of air bubbles that may cause death if they are accidentally swallowed by the larvae.

The determination survival rate is carried out in the dark environment, when the larvae are homogeneously distributed in water. Larvae samples are taken from various points of the tank with the water column sampling equipment; i.e. 1.5 m in lenght and 50 mm diameter. It is formed by attaching a global valve to the end of the PVC pipe. Samples are taken from five different parts of the tank and collected in a bucket. Sampling is done by taking approximately 2-3 lt of water from the depth close to the bottom so that the sampling device does not touch the bottom of the tank. The amount of larvae in the sampled water volume is counted, accordingly, the total amount of larvae in the tank whose volume is known is estimated and the survival rate in the tank can be calculated based on the initial amount of larvae.

If survival rate is high, the larvae are distributed to several newly prepared tanks to reduce the density in the tank. This transfer is done by collecting the pelagic larvae in the buckets that exhibit daytime school forming behavior. At night or in the dark, positive phototactic larvae can be transferred by siphoning with flexible spiral pipes with a diameter of 50 mm when they are gathered in the lighted corners.

Grading is also important in larvae production. Fish are separated according to their size in order to increase feed efficiency and minimize cannibalism. Sorting is done by using a selector made of nylon or plastic, placed in the tank without fish. The larvae of about 20 mm in total size formed on the surface or corners of the tank are collected by buckets and discharged into the selector. Small individuals go out of the selector, and the big larvae that cannot get out of the selector are transferred to another tank.

1.3.8.10. Juvenile culture

The adaptation and juvenile breeding phase of the artificial feeding begins when the larvae are 40-42 days old. However, the larvae are still sensitive to handling stress. The juveniles are raised in the hatchery until the size of 100 mm (size to market commercial farms). Artificial feeding practice continues from the 40th day to the 110th day. According to the research results, the survival rate of the larvae is above 75% in these 40-110 days of adaptation stage. Increasing the survival rate provides an advantage in reducing the required tank volume and workforce to achieve the targeted production amount in the hatchery.

When turbot larvae reach 20 mm length and when they begin to settle on the bottom of the tank, the floor area of the tank becomes more important than its volume. Therefore, the bottom area of the tank is taken into account when calculating the stocking density for this stage. Larvae are raised in fiberglass tanks and concrete ponds 0.3-0.5 m in depth. Round, square or rectangular tanks with a surface area of 5-7 m can be used in breeding. Tanks should be well designed to dispose of wastes in the water and detritus that settle to the bottom with the water circulation system. To increase water circulation, sea water should be supplied to the tank through a simple PVC diffuser. In its simplest form, the mouth of the diffuser PVC pipe is 5 mm. It can be made by compressing and heating in such a way that the opening remains. The change of water in the tank is carried out by two vertical PVC pipes placed inside the tank. The perforated pipe on the outside prevents the escape of larvae from escaping, while the internal perforated pipe adjusts the water level.

The juvenile tanks are aerated with air stones placed at the center and close to the wall as 2pieces/m^2.

Tanks are illuminated with fluorescent lamps placed on the upper part between 08:00 and 19:00 and the light intensity is tried to be kept between 200-500 lux. Oxygen level should not fall under 4 mg/lt.

Fish are sized in the juvenile stage using small grading trays for the following reasons:

- Removal of larvae deformed and having pigmentation disorders,
- Size grouping,
- Determination of the exact stock density of larvae,
- Ensure the cleanliness of the tanks.

Only normal fish seperated and graded size groups are transferred to new tanks with buckets. Grading should not be done too often as it will cause stress and injuries the fish.

If the stocking density is low, the amount of feed should also be reduced. The stocking density varies depending on the size of the fish and the carrying capacity of the water. Stock densities for the larvae at 20-50 mm, 50-80 mm, 80-100 mm are recommended as 400-500, 250- 300 and 120-150 larvae, respectively.

Larvae are initially feed on granulated feeds 0.7-1 mm in diameter. As the fish grow, the granule feed size is gradually increased and pellet feeds are started. The amount of feed consumed by juvenile turbot tends to be affected by the particle or pellet size of the feed. Consumption decreases when using very small or too large feed. Fish of size 20-50 mm are fed 4-6 times a day. When the fish goes over 50 mm legth, the number of meals is reduced to 3-4 times a day. Larvae are fed until they reach visual saturation. This can be understood by the cessation of feed intake activity. Daily feed consumption of Black Sea turbot larvae starts from 4-5% of body weight when it is 20 mm in size and is gradually decreased to 2-3% until it reaches 100 mm length.

Turbot needs a very high level of protein, such as 55%. On the other hand, the oil requirement of the fish is below 15%. High quality feed ingredients such as whiting flour is used as a source of protein and fat. In addition, it is recommended that the pH of the feed is between 7.1-7.5.

Artificial feeds used in fish feeding should be carefully selected as they will directly affect the survival, growth and feed rate of the larvae and consequently provide economic income. While evaluating the feed, not only its price but also its quality should be taken into consideration. Feed quality is evaluated according to criteria such as fish survival rate (S), growth in total height (GR) and feed efficiency rate (FER):

S (%) = (Number of fish available / Number of fish at baseline) x 100
GR (mm/day) = (Current size in total length (mm) - Initial size (mm)) / period (# of days)
FER = Total amount of feed consumed/(final weight - initial weight)
For example, in ideal working conditions, S, GR and FER are expected to be above 90%, 1.2 mm/day, respectively.

Due to the use of artificial feed during the care of the juvenile tubot and increasing the amount of feed as the fish grow, the probability of degradation of water quality is very high. Therefore, in this phase, continuous fresh sea water intake should be provided to improve water quality and in tanks. The water exchange rate should be at least 15 times a day. Water temperature and salinity vary between 18-24 °C and 0 and 18‰. In addition, the bottom of the tanks should be cleaned twice a day, in the morning and afternoon.

1.3.8.11. Growth

Growth of juveniles is affected by tank maintenance, feed quality and the initial condition of the stocked larvae. Under normal conditions, the juvenile reaches 100 mm of total length from 20 mm in about 70 days, at which stage the growth of the juveniles shows linear regression and growth can be monitored daily. Growth should be followed by periodic observations of length, height and weight measurements. If there is a tendency to slow down, the breeding process and fish condition should be checked.

The relationship between body weight (BW) and total length (TL) is formulated as follows:
$BW = 0.008 \times TL^{3.145}$ ($r^2 = 0.99$) (BW: body weight, TL: total length)

1.3.8.12. Harvest and transport

Juveniles reached 50 mm in length are highly resistant to various treatments. Therefore, they can be harvested using scoops after the water is lowered. At this stage, the fish are once again divided into 3 groups as normal, abnormal and abnormal pigmented.

Feeding the fish should be stopped 24 hours before harvest and transportation. Fish smaller than 50 mm can be placed directly into the transportation tank (approximately 1- 1.5 m^3 capacity), but it is recommended that fish larger than 50 mm should be placed in the transport tank with in plastic baskets which are fixed to the tank to prevent it from turning inside the tank.

In short or long-distance transports, vehicles equipped with pure oxygen, air and cooling systems and large-volume transport tanks can be used. The water temperature in the transport tank is kept 5 °C lower than the harvest water temperature. Oxygen concentration should be above 4 mg/l.

Stock density in transport tank varies according to the fish size. Practically fish in 50 mm length can be transported with a density of 5000 fish/m^3 and 100 mm of total length with a density of 1500

fish/m^3. In long-distance transport, the water should be changed without causing osmotic and temperature shock. When the farm is finally reached, the water temperature of the transport tank should be close to the temperature of the tank to be stocked. For this purpose, some water is discharged from the transport container and added to the farm water instead. The transplanted fish should not be fed for a few days after being placed on the new farm.

1.3.8.13. Ongrowing

In turbot culture, very successful production studies are carried out using closed circuit intensive breeding systems. IDE FOOD in production as edible for turbot cultivation in Çanakkale province, Turkey. Within the scope of a project carried out with the Japanese researchers at the Central Fisheries Research Institute (CEFRI)[117], the production of the turbot juveniles were successfully realised for the first time in Turkey. It has been reported that 30000 of the hatchlings were released to the nature as the first enhancement trial in 2003, with the aim of enriching reduced turbot stocks. Some of the juveniles were sold to IDE FOOD Company and used for breeding.

Various studies have been carried out on turbot breeding in closed circuit. For example, it is observed that there are positive studies in this regard in Spain. In this system, by keeping temperature and salinity fixed in the tanks, ongrowing process can be shortened and enable continuous production. Also closed system enables large amounts of fish to be grown in the structure to be built on a small land. For example, it is possible to establish a system where 500 tons of fish will be grown in a small area. The system is 49 m. It contains a round but deep round pool. An important part of this round pond is deeper than the ground. From the outside, it gives the impression that it is working in a low building.

Indoor ponds are in the form of two parallel and shallow channels 20 cm in depth. Circular canal pools were constructed towards the outer part of the circular building. There is a medium in the middle part; the juvenile fish are subjected to fattening from 10 gr to 200 gr. Development works are carried out in the other 5 meter deep pond.

In this system, feeds are made automatically. Daily feeds are given according to the weight of the fish by adjusting the feeding times from the feed store established outside the building. Both in the canals and in the large pond, fish are tried to get a little more feed than they need. In this way, the development period is tried to be shorter. Feeding robots are moved on a rail system built on the pool and the feed is done by automation. The interior of the pool consists of 9 shelves.

As mentioned before, the fish remain in the canal section up to 150-200 gr. Then it is placed on a floor in the breeding pool, which is from 9 floors. When the fish reaches 300 grams, they are taken upstairs with an air-operated system. In this subtraction, they are subjected to selection by fitting the fish of a certain size and can be classified according to their weight. When the fish reaches the marketing size, they are harvested on the top floor.

With an appropriate filter cleaning method, 90% of the organic materials in the water are cleaned and eliminated with the help of the ozonizer. Wastes collected at the bottom are sucked in vacuum

[117] CEFRI assigned as finfish aquaculture demonstration center by GFCM and may play an important role as training center for the beneficiaries from DACIAT partner countries.

and sent to the treatment plant. In water cleaning, ozanizer plays an important role in cleaning water from ammonia and nitrite. The system has cooling units for summer and heating units for winter. The system for cleaning the water is quite complicated. Therefore, no further details will be given here. The point we want to emphasize here is that the process can be done. When necessary, entrepreneurs will be able to learn the issue in detail by doing more on this issue. The main water problems are the level of oxygen and ammonia. The water circulating in the tanks changes in one hour. However, the water used is the same and filtered. As the density increases, more contamination may be occured, so care must be taken in this regard. Therefore, there is a completely computer controlled monitoring system is necessary and should not be neglected. The amount of oxygen, nitrite and ammonia is under control at any time and depends on the system alarm system. In some cases, adding water to the system can be as little as the supplement of the lost water, as well as a certain ratio with an appropriate filter cleaning method, 90% of the organic materials in the water are cleaned and eliminated with the help of the ozonizer. Wastes collected at the bottom are sucked in vacuum and sent to the treatment plant. In water cleaning, ozanizer plays an important role in cleaning water from ammonia and nitrite.

Therefore, there is a completely computer controlled monitoring system and this should not be neglected. The amount of oxygen, nitrite and ammonia is under control at any time and depends on the alarm system. In addition to adding water to the system in some cases, it can be planned to add only a small amount of clean water, as well as to supplement the lost water. In some systems, daily water change can be up to half in normal seasons. In very cold weather, it will be more economical to use warm water in filter order, as it will be quite expensive to heat it by taking water from outside. Water is generally supplied to the tanks from above.

Artificial feeds are used in turbot farming as for other marine fish; and feed ingredients can be developed according to the requirements of turbot and successful results can be obtained.

Since positive results could not be obtained from breeding turbot fish in net cages, it was preferred to grow in ponds. In other bottom fish like flaunder culture, net cage farming is also not successful (Alpbaz, 2005).

1.3.9. Sea bream culture

Gilthead sea bream can be bred in extensive, semi-extensive or intensive systems. Originally, the farm was mainly concerned with capturing young fish, but now most of the sea bream production comes from young fish produced in technologically advanced hatcheries, which require specialized staff.

Hermaphroditism makes it necessary to properly manage the parents. Adult fish prepare for spawning by controlling their exposure to sunlight (photocontrol) and temperature. The male fertilizes the eggs of the female, which float on the surface of the sea. They are then collected and transported to incubation tanks, where they hatch 48 hours later. After three or four days, the offspring have absorbed their leukocyte sac and can begin to feed: first with a diet of tiny algae and zooplankton, then with artemia and finally with inactive protein-rich food. In expansive systems, gilthead sea breams are mostly bred along with mullets, sea bass and eels and are fed naturally. In

semi-expansive systems, the breeding zone is enriched with fertilizers to increase the availability of natural food, supplemented by industrial foods. In intensive systems, sea bream is thickened with industrial food in the form of a compound in tanks on land or, for most of its production in the Mediterranean and the Canary Islands in cages at sea.

On average, sea bream reaches a market size of 350 gr within 12 to 15 months. Farming cycle of sea bream is given in Figure 40.

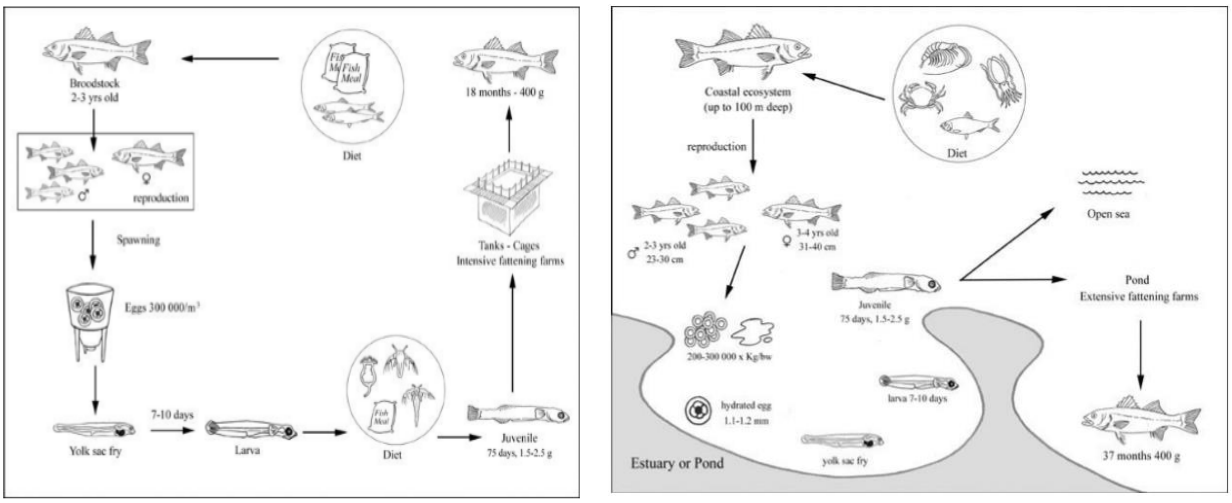


Figure 40. Sea bream culture with larva produced from brood stock or collected from the nature

III. Common Guidelines for aquaculture entrepreneurs in Greece, Romania, Turkey and Ukraine

1. GREECE

1.1. Background information

Aquaculture is a very important and integral part of Greece. It covers the breeding of aquatic organisms, marine and fresh water, such as fish, molluscs (oysters, mussels), crustaceans (shrimp, crayfish) and plants. It is an activity that is in full swing, being one of the most important sectors of the primary animal production sector; it presents significant prospects for job creation and meets real demand from consumers. Indicatively, in 1980 only a 2% of the domestic supply of fishery products came from aquaculture (2,000 tons) and the remaining 98% from commercial or traditional fishing (105,651 tons). This ratio began to change and according to the latest available data from the FAO for 2017, it is estimated that 62% of the fishery products' domestic production came from aquaculture and the remaining 38% came from commercial fishing.

Having experienced a decade of slow development and a slight decline in production, Greek aquaculture is now on a developing path. In Greece, since 1981, when the first experimental units were created, the industry reached, in 2018, to hold on the first place worldwide for the breeding of Mediterranean fish. More specifically, in the Greek seas, Mediterranean species are bred, mainly gilthead seabream and European sea bass, but also species such sharp snout seabream, seabream, meagre, common dentex etc.

Shell farming is also an important pillar of Greek aquaculture. This activity takes place mainly in areas of Northern Greece. The first grant for mussel farming was recorded in 1955 and concerned a staggered system unit in the NE bay of Thessaloniki. In 1970, more systematic mussel farming began, in parts of the Loudia and Axios rivers and then expanded to Pieria, Imathia and Kavala. Initially, the staggered system was used, which is suitable for shallower waters, and then in 1985 the long line was used for deeper waters, resulting in a large increase in the number of units from 70 to 600. In addition to marine aquaculture (fish and shellfish), a special position is held by the aquaculture of inland waters, developed in a small area adequate for the purpose, mainly in Epirus and Western Macedonia, being the main or complementary employment for the inhabitants of the mountainous and remote mainland areas.

On a business level, throughout Greece there are currently 63 companies operating with 320 units. Most of them are family, small and medium-sized enterprises, while there are also larger groups with vertical companies which, apart from breeding fish, they also produce spawn, food and fixed equipment.

In terms of competition, it is still becoming more and more intense due to the rapid increase in the production of third countries, mainly Turkey. On a European level, there has been an increase in the production of both species (gilthead sea bream, European sea bass) for all Mediterranean countries, yet this doesn't seem to affect the Greek sales. The Mediterranean fish industry's outward

orientation covers the 80% of the production exported and the remaining 20% is available in the local market. Greek fish farming products are available in 32 countries worldwide. However, the main markets are in the E.U. where traditionally Italy, Spain and France absorb almost most of the Greek production (59% in 2018).

1.2. Common Guidelines for Aquaculture Business in Greece

1.2.1. Institutional framework

The Ministry of Rural Development and Food is responsible for aquaculture in Greece. It defines the National Water Strategy, distributes production quotas and, through EU funding programs, manages all national and Community funds available in the sector. On a local level, the Prefectures are licensing aquaculture activities and provide coastal and marine areas for farming. The regional veterinary services are responsible for hygiene and safety issues and regularly monitor the operating procedures and hygiene conditions of aquaculture.

Marine fish farmers are affiliated with the Federation of Greek Maricultures, which accounts for about 70% of total Greek production. The smaller producers are represented by the PanHellenic Association of Medium-sized Fish Farmers.

1.2.2. Legal Framework

The framework for the common spatial planning for aquaculture provides guidelines and criteria for the development of aquaculture and ensures the protection of the environment and the competitiveness of the sector118. Giving specific guidelines for each type of practical aquaculture, the framework also explains legal and administrative changes to the action plan in the future.

In 2014, the law on the development of aquaculture was passed in order to simplify the complex administrative procedures. The National Aquaculture Council was established to advance the water cultivation priorities, to simplify the access to public land and water, and the procedures for the establishment of aquaculture by imposing of sanctions on violators. The National Council of Aquaculture (NCA) inform the Minister of Rural Development and Food on policy issues. In particular, it advises on:

- The formation and implementation of the National Program for the Development of aquaculture.
- The institutional reforms required to support the sector's development strategy, through development-financial programs, as well as for any other institutional regulation.
- Any other matter assigned to it by the Minister of Rural Development and Food.

The legislation governing aquaculture in Greece is the following:

- Law N.4282/2014 (ΦΕΚ 182/A/2014) "Aquaculture development and other provisions" http://www.alieia.minagric.gr/sites/default/files/basicPageFiles/%CE%A6%CE%95%CE%9A%20182%20%CE%91%20%CE%BD4282%20_2014.pdf

[118] Joint Ministerial Decision No. 31722/2011, Government Gazette 2505, ratified on November 4, 2011

- Law N.Δ.420/70 “Fisheries Code” (Government Gazette-GG) 27/A/31-1-1970 http://www.alieia.minagric.gr/sites/default/files/basicPageFiles/2-Ydat/70_0027A.pdf), as supplemented and replaced by the provisions of Law N. 1740/1987 (GG 221/A/14-12-1987 http://www.alieia.minagric.gr/sites/default/files/basicPageFiles/2-Ydat/87_0221A.pdf) and Law N. 2040/1992 (GG 70/A/23-4-1992 http://www.alieia.minagric.gr/sites/default/files/basicPageFiles/2-Ydat/92_0070A.pdf).
- Decree B.Δ 142/1971, Article 1 “Fishing for aquatic organisms ... and their protection” (GG 49/A/12-3-1971 http://www.alieia.minagric.gr/sites/default/files/basicPageFiles/2-Ydat/71_0049A.pdf).
- Law N. 1845/1989, article 32, par. 7 (a), on “leasing of water areas” (GG 102/A/26-4-1989 http://www.alieia.minagric.gr/sites/default/files/basicPageFiles/2-Ydat/89_0102A.pdf).
- Law N. 3208/2003 Article 19, paragraph 11, (GG 303/A/24-12-2003 http://www.alieia.minagric.gr/sites/default/files/basicPageFiles/2-Ydat/03_0303A.pdf).
- Ministerial Decision 140476/2004 “Defining the concession procedure… and the granting of the license for the establishment and operation of units” (GG 357/B/19-2-2004 http://www.alieia.minagric.gr/sites/default/files/basicPageFiles/2-Ydat/04_0357B.pdf).
- Ministerial Decision 9232.1/1/11/11-01-2011 “Regulation of licensing of marine and fish farms” (GG 136/B/09-2-2011 http://www.alieia.minagric.gr/sites/default/files/basicPageFiles/2-Ydat/11_0136B.pdf).
- Law N. 3199/2003 on “Water protection and management - Harmonization with Directive 2000/60 / EC of the European Parliament …” (GG 280/A/9-12-2003 http://www.alieia.minagric.gr/sites/default/files/basicPageFiles/2-Ydat/03_0280A.pdf).
- Law N. 4014/2011 on “Environmental licensing of projects and activities …” (GG 209/A/21-9-2011 http://www.alieia.minagric.gr/sites/default/files/basicPageFiles/2-Ydat/11_0209A.pdf).
- Presidential Decree 28/2009 on "Sanitary requirements for aquaculture animals and their products… in accordance with Council Directives 2006/88 / EC and 2008/53 / EC of the EU Commission (GG 46/A/16-3-2009 http://www.alieia.minagric.gr/sites/default/files/basicPageFiles/2-Ydat/09_0046A.pdf).
- Ministerial Decision K.Y.A 31722/4-11-2011 on “Approval of a Special Framework for Spatial Planning and Sustainable Development for Aquaculture …” (GG 2505/B/4-11-2011 http://www.alieia.minagric.gr/sites/default/files/basicPageFiles/2-Ydat/11_2505B.pdf).
- Law N. 3852/2010 “New Architecture of Local Government and Decentralized Administration - Kallikratis Program” (GG 87/A/7-6-2010 http://www.alieia.minagric.gr/sites/default/files/basicPageFiles/2-Ydat/10_0087A.pdf).

- Ministerial Decision 521/53656/16-05-2015 K.Y.A. " Terms, conditions and scoring process for the lease of marine and lake water areas..." (GG 1780/B/23-05-2015 http://www.alieia.minagric.gr/sites/default/files/basicPageFiles/%CE%A6%CE%95%CE%9A%201780%20%CE%92%202017.pdf) as corrected by Government Gazette 2069/B/15-06-2017 http://www.alieia.minagric.gr/sites/default/files/basicPageFiles/%CE%A6%CE%95%CE%9A%202069%20%CE%92%202017.pdf.

1.2.3. Aquaculture business development procedures in Greece

Greek fish farms are funded and the relevant subsidies are immediately absorbed. Greece is the second in EU subsidies. The most important competitors of the European Union, as a whole, are those of Asia and Latin America. For Greece, the biggest challenge comes from the neighbouring Turkey. The European Commission is working to establish a vision for sustainable development of aquaculture. The goals are to promote competition, encourage sustainability and highlight the products of fish farming.

The adoption of cage farming technologies by the salmon industry, the increased market demand for these species and the natural conditions provided by the Greek climate as well as the extensive coastline have made the country a choice for the development of the sector. Major aid programs from the European Union and private entrepreneurs have led to a rapid increase in production and Greece has become the largest producer of these species in the world. (*Μπασιούλη, 2014*).

In 2014, with the enactment of the Law 4282 on the "Development of aquaculture", a process of modernization of the institutional framework for the establishment and operation of units began because it was complex and bureaucratic, creating ambiguities and overlapping responsibilities between the services involved and the grant of a license could last up to two years. In 2016, the processing of the Ministerial Decosion of L.4282 continued, authorizing provisions that are pending. The legal framework, which was applicable until 2016 and concerned the establishment and operation of the units, was complex and bureaucratic, creating ambiguities and overlapping responsibilities among the Services involved. The main problems were the increased number of licenses required to set up a unit, the involvement of many services, the non-compliance with the deadlines, the heavy administrative burden on services and the significant financial burden on investors to conduct studies and sampling required in various stages of licensing of units. According to the available data from the G.A. of Fishing, the average time to complete the licensing process is twenty-five (25) months and varies depending on the region and the species. During the period of 2007 to 2013, a total of 72 applications were submitted for the granting of new licenses, out of which the 25% were finally fully satisfied (*ΣΕΘ, 2017*).

Based on the Government Gazette 2284 05/07/2017, the required documents issuing the issuance, renewal or modification of a license for the establishment and operation of aquaculture units are determined. These include:

1. **Pre-approval of lease of water area**

the interested party submits to the competent Directorate of Rural Affairs of the relevant Decentralized Administration:

a. Application of the individual or legal person
b. Short technical and economic report
c. Map of the wider area on a scale of 1: 50,000, where the location of the requested water area will be noted
d. Topographic diagrams of the requested water area as well as the location and layout of the facilities by a qualified mechanical member of TEE.

2. The Directorate of Agricultural Affairs of the Decentralized Administration, submit the file for opinion to the competent services.
3. After the issuance of the pre-approval decision for lease, the interested party submits to the Directorate of Rural Affairs of the relevant Decentralized Administration a file with the following supporting documents, for the granting of a license for the establishment and operation of a floating aquaculture unit:
   a. Application of the interested individual or legal person.
   b. An Environmental Impact Study (EIA) accompanied with the necessary supporting documents (including the issuance of a Decision approving Environmental Terms). Prior to the submission of the EIA, the process of opinion may be optionally followed by the submission of a file for the Preliminary Determination of Environmental Requirements (PPPA). In the case of installation and operation within a protected area of the NATURA 2000 network, the provisions of Article 10 of Law 4014/2011 shall also apply.
   c. A statement of the designer or of the interested body with the necessary supporting documents, as these are specialized in the joint ministerial decision No. 50129/1392 / 26.9.2013 (B '2405).
   d. The supporting documents concerning the water use permit, where required. in the case of the use of seawater and / or in the case of extraction of water from the sea, regardless of the distance from the shore no water use permit is required. For the land units which serve as support facilities, a certificate of ownership or a lease contract or a decision to grant real estate or a relevant contract for the use of third party facilities is submitted on a case-by-case basis. Building permit or similar approval from the urban planning, if required, is submitted after the issuance of Approving Decisions of Environmental Terms.
   e. In cases of land areas that fall under the forest legislation, the provisions of Law 998/1979 (A '289) and of the decision no. 15277/2012 (B' 1077) are applied.
   f. If the boundary lines of the seashore and the beach have not been determined in the area of establishment of the unit, the interested body shall submit a copy of the relevant application for their determination, which would have been previously submitted for this purpose. If the seashore and the beach have been already pre-determined, the Official Gazette of their publication is submitted.

g. For the construction of greenhouses for the of aquaculture and / or for the above-ground tanks regardless of their construction materials, a certificate of deviation from the building standards is needed.
h. Documents relating to health control for livestock-fish and their products.

4. In **order to grant a license for the establishment and operation of a water farming unit exclusively in land breeding facilities**, the interested party submits to the Directorate of Agricultural Affairs of the relevant Decentralized Administration a file with the following supporting documents.
   a. Application of the individual or legal person.
   b. A certificate of ownership or a lease agreement or a decision to grant real estate as well as a building permit or similar approval from the competent urban planning, are required. The building permit or similar approval is submitted after the issuance of AEPO. Especially in the case of forest areas, an act of characterization of the area where the installation of the project is proposed (as well as its conclusive), or determination of the forest form of the area, according to the current provisions of the forest legislation for these concessions. In such cases (forest areas) the provisions of law 998/1979 (A '289) and of the decision no. 15277/2012 AEPO (B'1077), as applied.
   c. If the boundary lines of the seashore and the beach have not been determined in the area of units' establishment, the interested body shall submit a copy of the relevant application for their determination, which has been previously submitted for this purpose. If the seashore and the beach have been pre-determined, the Official Gazette of their publication is submitted.
   d. For the construction of greenhouses for the aquaculture and / or for the above-ground tanks for fish farming, regardless of their construction materials, a certificate of deviation from the building standards.
   e. Short techno economic report.
   f. Map of the wider area on a scale of 1: 5,000, where the location of the land area of the facilities will be noted.
   g. A site layout plan on a scale of 1: 200 to 1: 1,000 with illustration of the proposed projects and installations by a qualified mechanical engineer of TEE.
   h. An environmental Impact Study (EIA) with the necessary supporting documents, for category A 'units of Law 4014/2011 (A' 209), in which the issuance of a Decision for the Approval of Environmental Terms is required. Prior to the submission of the EIA, the process of opinion may be optionally followed by the submission of a file for the Preliminary Determination of Environmental Requirements (PPPA), in accordance with the provisions of Law 4014/2011.
   i. The relevant statement of the designer or the interested body with the necessary supporting documents, for water cultivation units of category B 'of law 4014/2011, which are subject to Standard Environmental Commitments (PPD).

j. The requiring documents concerning the water use permit, if necessary. No water use permit is required in the case of the use of seawater and / or in the case of extraction of water from the sea, regardless of the distance from the shore.
k. The documents relating to health control for the livestock-fish and their products.
l. Travel permit or certificate of closed installation by the Fisheries Service of the relevant Regional Unit, concerning the cases of using species unfamiliar to the local environment. (In order to secure this document, the interested party submits a relevant request, with a technical report file to the Fisheries Service of the relevant Regional Unit.

5. The Directorate of Rural Affairs of the Decentralized Administration shall formally fill officially the file of the supporting documents with the pre-approval of the lease of the water area and by turn forward it to the competent services.
6. Having all permits/ approvals issued and the interested party submitted the construction permit or the appropriate approval of the competent urban planning and as well the proof of the process of the seashore and beach determination, **the Directorate of Rural Affairs propose to the Secretary General Decentralized Administration the issuance of the license for the establishment and operation of the aquaculture unit.**
7. The Directorate of Agricultural Affairs of the Decentralized Administration transmits the file of supporting documents to the competent services.

The procedure currently in force for the issuance of a license for the establishment and installation of aquaculture in Greece includes the submission of the requiring documents to the Directorate of Rural Affairs, the submission of a file for the Preliminary Determination of Environmental Requirements, the use of a mechanical engineer, the issuance of Approving Decisions of Environmental Terms, the requiring documents related to the health control for aquaculture species and their products, act of area's characterization where the installation of the project in case of forest areas, the application for determination of the boundaries of the seashore and the beach, the movement permit or a certificate of closed installation by the Fisheries Service of the relevant Regional Unit for the cases of using foreign species, and others, are proposed.

To expand the activity and productive innovation of the industry, it is necessary to simplify the administrative procedures, by giving emphasis on the simplification of licensing procedures and the reduction of the required time and cost. It is therefore proposed a one-stop shop at the Directorate of Rural Affairs of the relevant Decentralized Administration which will be responsible for obtaining the necessary supporting documents from the competent construction service and the Fisheries Service, as well as for obtaining the necessary justifications. Also, the Identification of the Environmental Requirements, the water use permit, the issuance of Approving Decisions of Environmental Terms, the act of characterization of any forest area, and the determination of the shoreline and the beach boundaries. The supporting documents for the approval of the lease of water area and for the granting of a license for the establishment and operation of the aquaculture unit will be submitted simultaneously to the Directorate of Rural Affairs.

1. Approval of the water area's lease: the interested party submits to the competent Directorate of Agricultural Affairs of the relevant Decentralized Administration:
   a. Application of the interested individual or legal person.
   b. Short technicoeconomic report
   c. Map of the wider area on a scale of 1: 50,000, where the location of the requested water area will be noted
   d. Site layout plan of the requested water area as well as the location and layout of the facilities by a qualified mechanical engineer.
2. The Directorate of Agricultural Affairs of the Decentralized Administration, transmits the file for opinion to the competent services.
3. After the issuance of the pre-approval decision for lease, the interested party submits to the Directorate of Rural Affairs of the relevant Decentralized Administration a file with the following supporting documents, for **granting a license for the establishment and operation of a floating aquaculture**
   a. Application of the individual or the legal person.
   b. Environmental Impact Assessment (EIA) with the necessary supporting documents.
   c. Designer's relevant statement of the interested body with the necessary supporting documents, as they are specialized in the joint ministerial decision No. 50129/1392 / 26.9.2013 (B '2405).
   d. For the land support facilities of the unit, a certificate of ownership or a lease contract or a decision to grant real estate or a relevant contract for the use of third-party facilities is submitted on a case-by-case basis. Construction permit or similar approval from the competent construction service, if required, is submitted after the issuance of AEPO.
   e. In cases of land areas that are subject to the forest legislation, the provisions of Law 998/1979 (A '289) and of the decision no. 15277/2012 as valid
   f. For the construction of greenhouses for the farming of aquatic organisms and / or above-ground tanks for the farming of the aquatic organisms, regardless of their construction materials, a certificate of deviation from the construction provisions.
   g. Documents relating to health control for aquatic animals and their products.
4. In order to grant a license for the establishment and operation of a water farming unit exclusively in land breeding facilities, the interested party submits to the Directorate of Agricultural Affairs of the relevant Decentralized Administration a file with the following requiring documents:
   a. Application of the individual or legal person.
   b. Certificate of ownership or lease agreement or decision to grant real estate as well as a construction permit or similar approval from the competent construction service, if required.
   c. For the construction of greenhouses for the aquatic organisms' farming and / or above-ground tanks for the aquatic organisms' farming, regardless of their construction materials, a certificate of deviation from the construction
   d. Short techno-economic report.

e. Map of the wider area on a scale of 1: 5,000, where the location of the land area of the facilities will be noted.
f. Site layout plan of the requested water area as well as the location and layout of the facilities by a qualified mechanical engineer.
g. Environmental Impact Study (EIA) accompanied with the necessary documents, for category A 'units under the Law 4014/2011 (A' 209), in which the issuance of a Decision for the Approval of Environmental Terms is required
h. Urban planning layout of a scale of 1: 200 to 1: 1,000 with illustration of the proposed projects and installations by a qualified mechanical engineer.
i. Relevant statement of the designer or the interested body with the necessary supporting documents, for water farming units of category B 'of law 4014/2011, which are subject to Standard Environmental Commitments (PPD).
j. Documents relating to health control for aquatic animals and their products.

5. The Directorate of Rural Affairs of the Decentralized Administration shall formally fill in the file of the documents with the pre-approval of the lease of the water area and forward it to the competent services.

6. After the issuance of all permits / approvals, and after the interested party submits the construction permit or the appropriate approval of the competent construction service and the receipts for the determination of the seashore and beach (if required), **the Directorate of Rural Affairs proposes to the Secretary General of the Decentralized Administration that the permit for the establishment and operation of the aquaculture unit be issued**.

7. The Directorate of Agricultural Affairs of the Decentralized Administration submits the file to the competent services.

1.2.4. Financial instruments for aquaculture business

1.2.4.1. National funding

The development of aquaculture companies in Greece through funding is promoted by the following National Programs:

- **National Aquaculture Development Program**:

A national development program is being implemented in the field of aquaculture, which is referred to as the National Aquaculture Development Program (NADP). The NADP, in the framework of the Common Fisheries Policy of the European Union (EU), includes the national development objectives, in accordance with the directions of the urban spatial planning plan. The NADP is approved by the Minister of Rural Development and Food decision, following the opinion of the National Council of Aquaculture (NCA) of the article 3. The priorities of the NADP are:

a. The sustainable development of aquaculture, so as to be a key lever for the development of the primary sector and the Greek economy in general, by improving the productivity of the existing aquaculture units, expanding their activity and promoting innovation.

b. Establishing relationships with other users, especially in the coastal zone, to eliminate the conflict of interest phenomenon and make an effective use of land.
c. The simplification and the update of the institutional licensing framework, the control of activity and the relationships between administrative and production bodies, for the efficiency's enhancement and for the creation of a friendly environment to attract new private investment.
d. The stimulation of research and innovation
e. The promotion of social equality and cohesion through:
    i. encouraging the involvement of all stakeholders (management, aquaculture, wholesalers, retailers and consumer associations) in the decision-making process regarding the development policy of the
    ii. the production based on high standards and nutritional value, which meet the modern nutritional needs of consumers and
    iii. the increase of the job vacancies for scientists and labor, especially in border areas and remote islands (LAW 4282 / Government Gazette A 182 / 29.08.2014).

- **Maritime & Fisheries Operational Program 2014-2020**[119]

The vision of OP focuses on the strengthening of the environmentally sustainable, efficient in terms of resources, innovative and competitive fishing and aquaculture, as well as on the promotion of blue growth and marine skills in Greece. Objectives of the OP form:

a. The improvement of the competitiveness of aquaculture and the processing industries.

b. The sustainability of marine fishing and the sustainable development of areas traditionally dependent on fishing.

c. The protection and the restoration of the marine environment and of the living resources, the control of fishing activities, the collection of fishing data and the improvement of the awareness for the marine environment's conditions

- **Innovation in aquaculture of the Maritime & Fisheries Operational Program**[120]

The Program is addressed to research organizations (HEIs, ATEI, Research Centers, Technological bodies) according to the Law 4310/2014 and the Law 4386/2016 as in force, and to aquaculture companies for the projects' implementation aimed at:

a. developing technical, scientific or organizational knowledge concerning aquaculture farms, which will specifically reduce the impact on the environment, will reduce the dependence on fishmeal and fish oils, will strengthen a sustainable use of water resources, will facilitate or improve livelihoods or will facilitate to the new sustainable innovative production method.

[119] https://www.espa.gr/el/pages/staticOPMaritimeFisheries.aspx
[120] https://www.espa.gr/el/pages/ProclamationsFS.aspx?item=3535

b. developing or introducing to the market new types of aquaculture with good market prospects, new or significantly improved products, or improved management and organization systems
c. investigating the technical or economic feasibility of innovations, products or processes.

1.2.4.2. Private funding

Business and private equity financing is relatively underdeveloped in Greece. There are 21 mutual fund ventures in Greece (members of the Hellenic Capital Funds Association54) with about € 1.2 billion under management, but only a few of the funds are currently open for investment. However, investment in business capital in Greece was close to 0% of GDP in 2016 and, despite the emergence of a vibrant entrepreneurship and of the ecosystem technology's financing over the past five years, mutual funds remain extremely low compared to those of other European countries (*European Investment Bank, 2018*)

As part of the private funding, there are institutions that promote the development of aquaculture companies. Indicatively, the following are mentioned:

1. Blue Hackathon: Patra's science Park, with the support of the Blue Innovation Hub, organizes the Blue Hackathon for the development of ideas in the fields of Blue Development, such as aquaculture, fishing, coastal and maritime tourism, etc. The Blue Hackathon can be attended by young people, students, new teams - startup companies or in general those who are interested in developing pilot applications in the fields of Blue Development. The awards include the ability for businesses to join a pre-incubator phase and to use the co-working space and the workshop for 2 months[121].
2. Blue Growth Marine Challenge: The maritime and water economic activities in order to make full use of their potential, synergies, innovation and sustainability principles are needed. The Blue Growth Marine Challenge is looking for original innovative business ideas for any products and services within the frame of Information and Communication Technologies, Environmental Protection and Energy Saving, Fisheries, Sustainable Maritime Tourism, Water Use, Transportation & Logistics. The awards include business services worth 5,000 euros and free admission to an incubation / acceleration program[122].

In addition, banking institutions in Greece provide financial instruments to aquaculture companies.

1.2.4.3. European grant funding

The development of aquaculture companies in Greece realized through the European funding is promoted via the Operational Program **"Competitiveness, Entrepreneurship and Innovation" with Special Actions in "Aquaculture" - "Industrial materials" - "Open innovation in culture"[123]** . The action "Aquaculture" is co-financed by the European Regional Development Fund (ERDF) in the framework of the OP "Competitiveness, Entrepreneurship and Innovation (EPANEK)" of the NSRF.

[121] https://bluehackathon2019.weebly.com/
[122] http://www.bluegrowth.gr/
[123] www.espa.gr/el/Pages/ProclamationsFS.aspx?item=3473

2. ROMANIA

2.1. Background Information

The presence on the Romanian territory of a uniformly distributed hydrographic network favored aquaculture development. In lowlands, where the ambient temperature is high and the summers are long, carp and some species adapted to these environmental conditions are practiced in aquaculture farms, and in mountainous areas, where the temperatures during the summer are average and those during very low winters, salmonids are raised on salmonid farms.

In the aquaculture of Romania, cypriniculture and salmonid farming are the most important branches in aquaculture field. Between 1960 -1990 were built many farms to increase ciprinidae in lowlands and hills and a small number of salmonid farms in mountain areas. Thus, in the counties of Constanţa and Brăila, significant areas of salted lands, poorly productive for agriculture, degraded pastures, cyprinid farms were built in.

At the end of 1989, the areas destined for fish farming amounted to approximately 100,000 ha, of which 15,500 ha were nurseries, 84,500 ha were farms where about 37,000 tons of fish for consumption and about 7,000 tons of broods were produced.

Of the 100,000ha used in aquaculture in 1989, approximately 60,000 ha of water gloss were under the coordination of the Central Fish Production and Industrialization, Bucharest (CPIP) and approx. 40,000 ha were located in the Danube Delta and were coordinated by the Danube Delta Station, Tulcea. In both cases, the aquaculture farms were organized according to the structure of state-owned enterprises.

In 1990, the state fishing enterprises that belonged to CPIP Bucharest were transformed into joint stock companies, establishing a number of 34 companies with an area of approximately 63,000 ha, on which were located the aquaculture farms and land related to them. The majority shareholder was the State Property Fund with 70% of the shares and SIF (FPP) Transilvania with 30% of the shares. Until the year 2000, no company was privatized due to the land's legal status lack of clarification on which the aquaculture farms were located.

In 2001, the aquaculture farms were exploitation of both of the fish companies (approximately 99%), but also of the IAS type ones that had besides the agricultural and zoo-technical farms and some ponds, or even aquaculture farms.

At the establishment of the State Domains Agency (ADS), by Law 268/2001, the packages of shares and lands in the exploitation of fishing companies and those of IAS type, passed into ADS administration for privatization through the sale of shares and land concession.

The commercial/trading companies with fish profile exploited an area of 63,671.68 ha, and those of IAS type had in operation 2512.58 ha.

During this period, some of the companies were privatized and the land leased to shares or assets buyers, another part remaining so far, not privatized. Many of the companies mentioned above have entered insolvency proceedings, bankruptcy, thus being removed from the trade register. Aquaculture farms were bought from liquidators and by the direct assignment method, the owners

of assets such as pier, dams, canals, hydrotechnical installations, leased land from the Romanian state or have files submitted to the National Agency for Fisheries and Aquaculture (ANPA), some of them still waiting for their solution.

In 2003, by Law 192/2001, the National Fisheries Fund Management Company (CNAFP) was established, which took over a number of approx. 40 aquaculture farms and the lands on which they were located, with an area of approximately 18,000 ha, from fish companies that were not yet privatized in Constanța, Tulcea, Brăila counties.

In 2004, by OUG no. 69/2004, CNAFP took over from ADS, the privatization and concession contracts, the share packages and the lands under water luster exploited by the commercial companies with fishing profile and from IAS type agricultural companies.

During the CNAFP administration period, 70% of the aquaculture farms taken over in 2003 were privatized and the lands on which the aquaculture farms were located were leased by means of direct award method.

By OUG no. 23/2008, CNAFP was dissolved, and the lands under water luster and the companies with fish profile passed again in the administration of ADS, so that in 2010, by Law 317/2009, to be transferred to the ANPA administration and portfolio.

At the time of takeover, ANPA was subordinated to the Ministry of Agriculture and Rural Development, but subsequent legislative changes transferred this institution in 2012 to the Ministry of Environment and Climate Change - Department of Water, Forests and Fisheries.

At the end of 2014, ANPA is again transferred to MADR, where it is currently located.

A brief overview of the Register of Aquaculture Units data shows that only half of the aquaculture farms built during the 60s and 90s, works in accordance with current legislation, and some have expired licenses due to the change of owner, which results in the impossibility farmers to invest in aquaculture farms, including by accessing European funds for aquaculture.

2.2. Common Guidelines for Aquaculture Business in Romania

2.2.1. Institutional Framework

The current administrative framework provides for the involvement of the following two main institutions, responsible for the development and implementation of the national strategy and regulations on fisheries, aquaculture, processing and market organization of fishery products, fisheries and aquaculture structures, namely:

- National Agency for Fisheries and Aquaculture (NAFA/ANPA)
- Danube Delta Biosphere Reserve Administration (DDBRA/ARBDD)

Side bodies involved in issuing documents (authorizations) underlying aquaculture licensing are:

1. National Administration of Romanian Waters (ANAR)
2. National Agency for Environmental Protection (ANPM)
3. National Sanitary Veterinary and Food Safety Authority (ANSVSA).

The overall responsibility for the design and for the development and implementation of the fisheries policy falls under the auspices of the National Agency for Fishing and Aquaculture (NAFA), which is a public institution entirely financed from the state budget. NAFA is part of the Ministry of Agriculture and Rural Development.

NAFA delegates part of its duties related to the management of fisheries resources in the Danube Delta Biosphere Reserve to the Administration of the Danube Delta Biosphere Reserve; part of the duties related to mountain waters are delegated to the Ministry of Environment and Forests.
NAFA draws-up the strategy and the legal framework for fisheries in Romania. NAFA is also responsible for the technical implementation of measures and for the control of regulations and activities in fisheries and aquaculture.

In order to achieve its objectives, NAFA has the following main tasks:

3. To draw-up the strategy for the development of the fisheries, aquaculture and marketing operations, according to the government's economic policies.
4. To act as a Managing Authority for the structural policies in the field of fisheries and aquaculture.
5. To regulate the specific legal framework.
6. To control and inspect.

In order to implement its functions, NAFA has two Directorates (Strategy, Regulation and Structural Policy, Control and Inspection) and nine regional branches. The Strategy, Regulation and Structural Policy Directorate has the following main duties:

- To draft laws.
- To draft development programmes including the EFF OP.
- To collect data on the fishing, aquaculture and fish processing activities.
- To provide the database and statistical reports for internal and international institutions.
- To manage the Fishing Vessel Register.
- To manage the Aquaculture Production Units Register.
- To manage the Processing Units Register.
- To maintain the satellite VMSTo strengthen the control system conducted by the territorial inspectors within the Control and Inspection Directorate within NAFA.

2.2.2. Legal Framework

2.2.2.1. EU level

Due to being members of EU, Greece and Romania are applying similar legislations prepared by different aspects of CFP, Environment, health and welfare, consumer rights etc. So effective policies and legal instruments at EU level are:

- **The Common Fisheries Policy (CFP):**

The CFP aims to ensure that fishing and aquaculture are environmentally, economically and socially sustainable and that they provide a source of healthy food for EU citizens. Its goal is to foster a dynamic fishing industry and ensure a fair standard of living for fishing communities over four main policy areas; fisheries management, international policy, market and trade policy, and funding of the policy European Maritime and Fisheries Fund (EMFF) 2014-2020124.

- **Strategic Guidelines for the sustainable development of EU aquaculture (COM/2013/0229 final)[125]:**

In the context of the reform of the Common Fisheries Policy, the European Commission published in 2013 a series of strategic guidelines on the common priorities and general objectives at European level for the sustainable development of aquaculture in the EU. Four priority areas were identified in consultation with all relevant stakeholders:

  - Simplify administrative procedures;
  - Securing sustainable development and growth of aquaculture through coordinated spatial planning;
  - Enhancing the competitiveness of EU aquaculture;
  - Promoting a level playing field for EU operators by exploiting their competitive advantages.

According to the document, EU countries have been asked to set up multiannual plans to promote aquaculture and operational programs covering the period 2014-2020, identifying the actions they intend to finance through the European Maritime and Fisheries Fund EMFF.

The European Commission has also been designated to facilitate cooperation, coordination and exchange of good practices between Member States.

Through the same document, it was proposed to set up the Aquaculture Advisory Council which should allow the Commission and the Member States to benefit from the knowledge and experience of all stakeholders.

- **Regulation (EU) No 1303/2013 of the European Parliament and of the Council of 17 December 2013[126]**

The Regulation establishes common provisions on the European Regional Development Fund, the European Social Fund, the Cohesion Fund, the European Agricultural Fund for Rural Development and the European Maritime and Fisheries Fund and lays down general provisions on the European Regional Development Fund, the European Social Fund, the Cohesion Fund and the European Maritime and Fisheries Fund and repeals Council Regulation (EC) No 1083/2006.

- **Regulation (EU) No 1380/2013 of the European Parliament and of the Council of 11 December 2013, with subsequent amendments[127]:**

[124] https://ec.europa.eu/fisheries/cfp_en
[125] https://eur-lex.europa.eu/legal-content/EN/TXT/?qid=1477555805378&uri=CELEX%3A52013DC0229
[126] https://eur-lex.europa.eu/legal-content/EN/TXT/?qid=1398847168566&uri=CELEX%3A32013R1303
[127] https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:02013R1380-20190814

The Regulation establishes provisions on the Common Fisheries Policy, amends Council Regulations (EC) No 1954/2003 and (EC) No 1224/2009 and repeals Council Regulations (EC) No 2371/2002 and (EC) No 639/2004 and Council Decision 2004/585/EC.

- **Regulation (EU) No 1379/2013 of the European Parliament and of the Council of 11 December 2013, with subsequent amendments[128]:**

The Regulation establishes provisions on the common organisation of the markets in fishery and aquaculture products, amends Council Regulations (EC) No 1184/2006 and (EC) No 1224/2009 and repeals Council Regulation (EC) No 104/2000.

- **Regulation (EU) No 508/2014 of the European Parliament and of the Council of 15 May 2014[129]:**

The Regulation establishes provisions on the European Maritime and Fisheries Fund and repeals Council Regulations (EC) No 2328/2003, (EC) No 861/2006, (EC) No 1198/2006 and (EC) No 791/2007 and Regulation (EU) No 1255/2011 of the European Parliament and of the Council and presents the objectives, the fields of application, the implementation of the programs at national level, measures financed from the European Maritime and Fisheries Fund. In case of aquaculture European Maritime and Fisheries Fund (EMFF) contributes to the following aquaculture objectives:

(a) promoting competitive, environmentally sustainable, economically viable and socially responsible aquaculture;

(c) promoting a balanced and inclusive territorial development of aquaculture areas;

Articles 45-57 presents the types of operations in the aquaculture sector that can be financed through EMFF, respectively:

- Innovation;
- Productive investments in aquaculture;
- Management, relief and advisory services for aquaculture farms;
- Promotion of human capital and networking;
- Increasing the potential of aquaculture sites;
- Encouraging new aquaculture farmers practicing sustainable aquaculture;
- Conversion to eco-management and audit schemes and organic aquaculture;
- Aquaculture providing environmental services;
- Public health measures;
- Animal health and welfare measures;
- Aquaculture stock insurance.

Articles 58-69 mentions that EMFF supports the sustainable development of fisheries and aquaculture areas through the implementation of local development strategies under the

[128] https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A02013R1379-20150601
[129] https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=uriserv%3AOJ.L_.2014.149.01.0001.01.ENG

responsibility of the community, elaborated and implemented by the Local Action Groups in the field of fisheries.

The objectives related to aquaculture, which can be financed under the local development strategies placed under the responsibility of the community, are the following:

  - adding value, creating jobs, attracting young people and promoting innovation at all stages of the supply chain of fishery and aquaculture products;
  - supporting diversification inside or outside commercial fisheries, lifelong learning and job creation in fisheries and aquaculture areas;
  - enhancing and capitalizing on the environmental assets of the fisheries and aquaculture areas, including operations to mitigate climate change;
  - promoting social well-being and cultural heritage in fisheries and aquaculture areas, including fisheries, aquaculture and maritime cultural heritage;
  - strengthening the role of fisheries communities in local development and the governance of local fisheries resources and maritime activities.

- **Environmental issues:** EU Water Framework Directive[130]. Environmental Impact Assessment – EIA[131], Provisions on Invasive Alien Species in the EU[132]

- **Health and welfare:** Animal health conditions of aquaculture animals and products[133], Provisions on live animals[134], Provisions on animal feed including hygiene and medication[135], Medicinal products for veterinary use[136], Animal welfare[137], Provisions on food hygiene and food-borne diseases[138]

- **Trade:** Exporting from the EU[139], Import into the EU[140]

- **Consumer information**: Labelling, presentation and advertising of foodstuffs[141], The common organisation of the markets in fishery and aquaculture products[142]

2.2.2.2. National Level

There are also several national legislations regulating aquaculture business in Romania:

[130] https://eur-lex.europa.eu/legal-content/EN/TXT/HTML/?uri=CELEX:32000L0060&from=EN
[131] https://ec.europa.eu/environment/eia/eia-legalcontext.htm
[132] https://ec.europa.eu/environment/nature/invasivealien/index_en.htm
[133] https://ec.europa.eu/food/animals/animalproducts/aquaculture_en
[134] https://ec.europa.eu/food/animals/live_animals/aquaculture_en
[135] https://ec.europa.eu/food/safety/animal-feed_en
[136] https://ec.europa.eu/food/animals/health/veterinary-medicines-and-medicated-feed_en
[137] https://ec.europa.eu/food/animals/welfare_en
[138] https://ec.europa.eu/food/safety/biosafety/food_borne_diseases/tse_bse_en
[139] https://madb.europa.eu/madb/indexPubli.htm
[140] https://ec.europa.eu/trade/import-and-export-rules/import-into-eu/
[141] https://ec.europa.eu/food/safety/labelling_nutrition/labelling_legislation_en
[142] https://ec.europa.eu/fisheries/cfp/market/consumer-information

- **Government Urgency Ordinance no. 23 dated March 5 regarding fishing and aquaculture with further modifications and completions[143]:**

This urgency ordinance regulates protection, preservation, administration and exploitation of aquatic living resources, aquaculture activity, processing and trading of products obtained from fishing and aquaculture, when such activities are performed on the Romanian territory.[144]

The implementation of the actions provided by this ordinance is done by the National Agency of Fisheries and Aquaculture. According to the ordinance, aquaculture includes all activities of animal or vegetal production within the aquatic environments and should be developed taking into account the following issues:

- Aquaculture is performed in arranged aquaculture farms and aquatic ecosystems, with their owner/administrator consent, and only in designated, natural identified ecosystems, under the terms set by order of the Ministry of Agriculture and Rural Development, upon proposal of the National Agency for Fisheries and Aquaculture, on the basis of the multiannual national strategic Plan for aquaculture.
- Aquaculture development aims diversity of quantity and quality offer for fish and other aquatic creatures highlighting all fisheries, irrespective of their owner.
- Using water for aquaculture activity within fisheries is done under the applicable terms of law for waters.
- The period for concession is set by the concession provider on the basis of an opportunity study, in order to ensure legal safety and predictability of any kind of contracts regarding the aquaculture activity for any purpose, as well as to stimulate investments in aquaculture.
- Public institutions, as well as trading companies mostly with state owned capital, that own fisheries, have the obligation to communicate on yearly basis, by the 30th of November, to the National Agency for Fishing and Aquaculture, the inventory of fisheries of any kind that are used or can be used for aquaculture activities, according to this Urgency Ordinance.
- The level of royalty/rent required for fisheries will take into account the categories of fisheries creditworthiness existing in Romania, established on the basis of some studies issued by specialized institutions in the fisheries sector. On the basis of such studies, the level of royalty/rent required for aquaculture activity will be established according to the provisions of art. 4 in the Government Urgency Ordinance no. 54/2006 regarding the status of concession agreements for public property goods, approved with modifications by Law no. 22/2007.

Aquaculture development is performed by the following actions:

- encouraging the extensive and semi-intensive aquaculture which creates environmental values;

[143] http://legislatie.just.ro/Public/DetaliiDocument/90207
[144] http://legislatie.just.ro/Public/DetaliiDocument/93609

- improvement of trading and consumers information system;
- training of aquaculture producers;
- implementing good practices actions in technological processes in order to ensure bio-safety and food safety of aquaculture products;
- insurance of aquaculture production for force majeure events;
- aquatic environment and biodiversity safety;
- development of research and technological progress;
- protection and encouragement of aquaculture producers through specific regulations;
- homologation/certification/approval of fishing nurseries.

The actions for aquaculture development aim:

- upgrading of processes for reproduction and culture of fish species and other aquatic creatures, in relation with the environment safety norms;
- ensuring the access to waters and space for operators in aquaculture, under the terms of law;
- setting quality indicators and ecological, economic and social sustainability indicators;
- proper use of fisheries;
- marine and continental aquaculture development, under the conditions of ensuring animal health and welfare;
- ensuring long-term employment in aquaculture, especially in fishing-dependent areas;
- other actions required by the aquaculture development needs.

The Register of Aquaculture Units of administrative kind, including all production capacities, is set within the National Agency for Fisheries and Aquaculture. Any modification related to the change of the owner or administrator, as well as modifications related to change of production capacity and cultured species should be communicated to the National Agency for Fisheries and Aquaculture, in order to update the Register of Aquaculture Units and issue a new aquaculture license, as applicable.

The production units in aquaculture are registered in the Register of Aquaculture Units and receive aquaculture licenses, issued by the National Agency for Fisheries and Aquaculture.

The registration in the Register of Aquaculture Units and the issue of aquaculture licenses are done under the terms set by the Ministry of Agriculture and Rural Development, approved by Order of the Ministry of Agriculture and Rural Development, upon the proposal of the National Agency for Fisheries and Aquaculture.

Partial or total change of production capacities destination in aquaculture is done on the basis of some assessment studies on environmental impact and will be approved by Order of the Ministry of Agriculture and Rural Development.

The introduction of exotic or locally absent species in culture in open system fisheries is made with the approval of the Ministry of Agriculture and Rural Development and the Ministry of Environment,

Waters and Woods, on the basis of some studies establishing also the terms for quarantine and control in order to avoid escapes into natural environment.

Recovery of assets and fisheries located on the state public/private domain is done, if applicable, by concession, lease, rent or other forms provided by law.

Marine aquaculture is performed in fish wells located in natural aquatic environments.

Marine aquaculture is done through concession of the marine water surface area and the access to it, by the administrative authority responsible for waters management, for a 10 years period, with possibility for extension, under the terms of law.

The terms and conditions for issuing and withdrawal of the approval for marine aquaculture are set by Order of the central public authority that is responsible for fishing and aquaculture, through the National Agency for Fisheries and Aquaculture.

The introduction of fish species and other cultures into marine fisheries, irrespective of their origin, is made with approval from the central public authority in charge with fisheries and aquaculture and the central public authority in charge with the environment.

- **Market organization for fishery products**

Upon proposal of the National Agency for Fisheries and Aquaculture, the Ministry of Agriculture and Rural Development sets actions regarding the trading and processing of products obtained from fisheries and aquaculture, especially for:

- compliance with quality standards for fishery products during the entire trading process period in order to ensure transparency on the market and to make the proper information of consumers possible, especially regarding the origin of the products;
- compliance with the norms related to trading of products resulted from fishery and aquaculture, according to the norms for preservation and safety of living aquatic resources;
- encouraging and support of fishery products processing;
- quality improvement and promoting of fishery products;
- increasing the extent of use and added value for the raw material obtained from fisheries and aquaculture.

- **Trading of fishery products**

It is forbidden to trade fishery obtained products, of any origin or source, which has a lower size or weight than the one provided by the applicable regulations or their obtaining manner is not according to the established norms or is against the sanitary-veterinary norms.

- **Liabilities and penalties**

Failure to comply with the dispositions of this urgency ordinance by natural or legal persons results in administrative, civil, or criminal liability, if applicable.

In order to ensure the compliance with the laws in the field of fisheries, aquaculture, processing, transport, trading of fishery products and other related activities, the National Agency for Fisheries and Aquaculture organizes permanent actions of inspection and control through fishery inspectors.

The persons who are subject to control have the obligation to allow access to the headquarters and branches of the controlled units, to all fishing ships/crafts, fishing tools and installations, aquaculture farms and installations, annex-buildings, vehicles, processing, trading and public feed units and to provide for the personnel with rights for inspection and control all the documents and means needed to fulfill their inspection and control function and also to provide statistical data according to the activities provided by community statistic programs and legal documents in the fishery sector.

Order no 332 dated May, 24, 2008 of the Ministry of Agriculture and Rural Development, regarding the registration of the aquaculture production units in the Register of Aquaculture Units and the issuing of the aquaculture license, with further modifications and completions[145]: The Order stipulates the operation of the Register of Aquaculture Units (RUA), within the National Agency for Fisheries and Aquaculture, having administrative kind and including all production capacities.

The aquaculture production units are registered in the Register of Aquaculture and receive a license for aquaculture issued by the Agency.

As per the Order, the aquaculture license is not transmittable and is issued for non-determined period.

Any modification regarding the change of owner/administrator, production capacities and cultured species will be communicated to the Agency within 30 days after occurrence, in order to update the Register of Aquaculture Units and issue a new aquaculture license, if applicable.

Upon proposal of personnel with rights for inspection and control, the aquaculture license is cancelled/suspended for a 90 days period, in case the economic operator does no longer comply with the conditions that were the basis of releasing the aquaculture license or uses the production capacity for other purposes than the ones declared.

The production units in aquaculture for which the aquaculture licenses were cancelled will be excluded from the Register of Aquaculture Units.

- **Romanian Government Decision no. 1016 dated September, 3, 2008 regarding the amount of the fees for licensing and approval in fisheries and aquaculture[146]:**

This decision sets the amount of fees charged by the Romanian State for the approval of fisheries and aquaculture activity, for issuing of permits, licenses and approvals by the National Agency for Fisheries and Aquaculture. A fee amounting to 150 lei (approximately 31 euro) is paid by the administrator or approved representative for the issuing of an aquaculture license.

- **Romanian Government Decision no. 748 dated September, 20, 2018 regarding the set-up of a state aid scheme for reducing the excise duty on gas oil used in aquaculture, with further modifications and completions[147]:**

[145] http://legislatie.just.ro/Public/DetaliiDocument/93609
[146] http://legislatie.just.ro/Public/DetaliiDocument/97179
[147] http://legislatie.just.ro/Public/DetaliiDocument/205095

This Decision sets up a state aid scheme for enterprises that perform their activity in production, processing and trading of products obtained from aquaculture. This scheme is applied on the entire Romanian territory. Scheme beneficiaries may be small and medium-sized enterprises that perform their activity in aquaculture, respectively:

- certified natural persons, individual and family type enterprises, established according to the provisions of the Government Urgency Ordinance no. 44/2008 regarding the performance of economic activities by certified natural persons, individual and family type enterprises, approved with modifications and completions by Law no. 182/2016;
- legal persons.

The state aid scheme means reduction of excise duty that is granted as reimbursement. The amount of reduced excise duty for gas oil used for activities in aquaculture is 99 498 lei/1 000 litres (approximately 20 728 euro/1 000 litres).

In order to access the state aid scheme, the beneficiaries provided in art. 3 should meet all the following eligibility criteria:

- are recorded in the Register of Aquaculture Units;
- provide ANPA with statistic data regarding surfaces and achieved production, according to the activities provided in European statistic programs and legal documents for fisheries sector.

Law no. 28 dated 2019 regarding the approval of the Program for supporting the producers in the fisheries and aquaculture sector[148]: The law sets up a state aid scheme aiming the implementation of the Program for supporting the producers in the fisheries and aquaculture sector, in order to improve the performance and sustainability level of the aquaculture farms, through production improvement.

The state aid is granted to beneficiaries producers in the fisheries and aquaculture sector, as follows:

- certified natural persons, individual and family type enterprises, established on the basis of Government Urgency Ordinance no. 44/2008 regarding the performance of economic activities by certified natural persons, individual and family type enterprises, approved with modifications and completions by Law no. 182/2016;
- legal persons.
- The eligible expenses needed to make investments based on the provisions of this law are:
- building of reproduction centres for fish species used in aquaculture or species that are about to be introduced;
- upgrading and/or extending of existing centres for fish reproduction;
- purchasing or leasing of machinery and equipment;

[148] http://legislatie.just.ro/Public/DetaliiDocument/209956

- general costs related to investments provided at letters a)-c), such as fees for specialists and consultants, fees for counseling regarding environmental and economic sustainability, including feasibility studies;
- purchasing or development of software;
- investments aiming to decrease the negative impact or increase the positive effects upon the environment and increase the efficient use of resources;
- investments resulting in a considerable decrease of the impact of aquaculture enterprises on water use and quality, by reducing the chemicals, antibiotics and other drugs used or by improving the resulted water quality, including by using multitrophic aquaculture systems.

(1) The extent of the state aid for the eligible expenses provided above is 40% of the total eligible expenses.

(2) The intensity of the state aid can be increased by 20%, but not more than 90%, for the eligible expenses provided at letters a)-f), for:

- farmers who have worked for at least 5 years in aquaculture and young farmers;
- investments that are done in areas facing natural or other specific restraints;
- members of aquaculture producer organizations.

- **Order of the Ministry of Agriculture and Rural Development no. 267 dated April, 9, 2019, for the approval of the eligibility conditions, eligible expenses, the manner of funding, as well as the manners of verification and control on the application of the provisions of Law no. 28/2019 regarding the approval of the Program for supporting the producers in the fisheries and aquaculture sector**[149]**:**

The Order sets up the eligibility conditions, eligible expenses, the way of funding, as well as the manner of verification and control on the application of the provisions of Law no. 28/2019 regarding the approval of the Program for supporting the producers in fisheries and aquaculture sector.

- **Order of the Ministry of Agriculture and Rural Development no. 171 dated April, 19, 2002 regarding the approval of the commercial names of fish species and other aquatic living creatures that can be exploited on the Romanian territory, with further modifications and completions**[150]**:**

The Order sets up the commercial names of fish species and other aquatic living creatures that can be exploited on the Romanian territory. Economic Agents trading fish species and other aquatic living creatures have the obligation to comply with the commercial names provided by this order.

- **Order of the Ministry of Agriculture and Rural Development no. 772/2007 regarding the criteria for the recognition of producer organizations in fisheries and aquaculture sector, with further modifications and completions**[151]:

[149] http://legislatie.just.ro/Public/DetaliiDocument/212930
[150] http://legislatie.just.ro/Public/DetaliiDocument/36064
[151] http://legislatie.just.ro/Public/DetaliiDocument/86176

The fishing areas and the minimum volume of annual production, measured in tons reached/number of members/represented trading fishermen, that are required to recognize producer organizations in aquaculture produces minimum 30% in weight from the total production for a species or group of species in aquaculture, at national level as provided.

Although the framework is created at the level of the EU, Romania is still struggling with operationalization of the opportunities aroused in the sector. Different business was created by the private investors and also different research projects were realized by the research institutes but the gap between those two types of initiatives still exists. Therefore, the starting of the POPAM program https://www.ampeste.ro/ came as a starting and sustainability tools for the future business development in the aquaculture in Romania.

2.2.3. Procedures to establish fish farms

2.2.3.1. Main procedures

According to art. 2 of the Government Emergency Ordinance no. 23/2008 on fishing and aquaculture, with subsequent amendments and completions, aquaculture is the activity of growing or cultivating aquatic animals with techniques designed to increase over the natural capacity of the environment of the production of aquatic organisms, these being the property of an individual or legal person.

Aquaculture production units are registered in the Register of aquaculture units and receive an aquaculture license, issued by the National Agency for Fisheries and Aquaculture.

The conditions regarding the registration in the Register of aquaculture units and the issuance of the aquaculture license were established by the Ministry of Agriculture, Forests and Rural Development, by Order of the Minister of Agriculture, Forests and Rural Development no. 332/2008, at the proposal of the National Agency for Fisheries and Aquaculture.

For the registration in the Register of aquaculture units and for the issuance of the aquaculture license, the applicants must submit to the territorial branches of ANPA the following documents:

- application form:
- aquaculture production unit sheet;
- concession / lease / association contract and other documents certifying the ownership / administration in order to carry out the aquaculture activity;
- the sketch and the plan for framing in the area of the aquaculture unit;
- copy of the identity document of the owner / administrator and / or copy of the statute of the company that manages the production unit, from which to show that it has aquaculture in the object of activity;
- copy of the fiscal registration certificate;
- copy of the environmental permit, for the working point for which the aquaculture license is requested;
- copy of the water management authorization, for the working point for which the aquaculture license is requested;

- sanitary-veterinary registration;
- ascertaining certificate with the declaration of the working point issued by the trade register office;
- the consent of the legal owner of the accumulation lake, from which it may result that he may carry out aquaculture activities;
- proof of payment of the licensing fee.

According to the Order of the Minister of Agriculture, Forests and Rural Development no. 240/2009 for the amendment and completion of the Order of the Minister of Agriculture and Rural Development no. 332/2008 on the registration of aquaculture production units in the Register of aquaculture units and the issuance of the aquaculture license, it is issued for an INDEFINITE period.

The licensing fee is established in accordance with the provisions of Government Decision no. 1016/2008 on the amount of licensing and authorization fees in fisheries and aquaculture (in force since 08.09.2008).

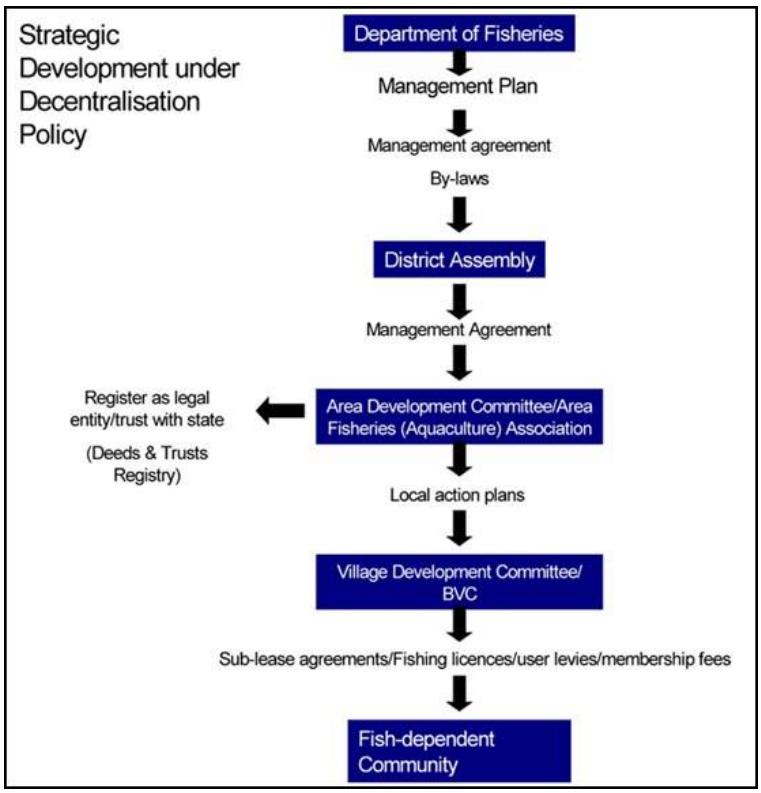
2.2.3.2. Procedure and administrative acts of secondary authorities engaged in aquaculture activity

According to Order no. 332/2008, applicants must attach to the application for the aquaculture license the following documents, in original or in copy according to the original:

a) the water management authorization, for the working point for which the aquaculture license is requested;
b) the environmental permit, for the working point for which the aquaculture license is requested;
c) sanitary-veterinary registration.

2.2.3.3. Business plan example.

Proposal regarding designing the one stop aquaculture licensing as tool for sustainable aquaculture business (http://www.fao.org/3/a0038e/a0038e06.htm):



2.2.4. Financial instruments for aquaculture business

2.2.4.1. National funding

According to the Operational Programme for Fisheries and Maritime Affairs for the period 2014-2020, allocated funding from the European Fisheries and Maritime Affairs granted to Romania for the 2014-2020 of EUR 168 421 371[152]

2.2.4.2. Private funding

The private own business represents the only private funding operational in Romanian at this moment. Although different financial instruments such as: business angels are developing currently, aquaculture is not yet an area in which this type of investment to be found. Aquaculture business found a new opportunity in setting up different association that are developing new projects for funding and sustained the aquaculture sector such as: ARIAP-an independent association for innovation in aquaculture and fishery from Romania[153]

2.2.4.3. European grant funding

- Operational Program for Fisheries and Maritime Affairs 2014-2020
- Integrated territorial intervention (ITI Danube Delta)

[152] https://www.ampeste.ro/
[153] http://www.ariap.ro/

- "HORIZON 2020" program
- European Union Program for Employment and Social Innovation (EASI)
- European Union Solidarity Fund (EUSF)
- LIFE +

2.2.4.4. International grant funding

2.2.4.5. Others

Starting from the current problems of aquaculture, specific to the sustainable development of the sector, in line with the European Union's economic and social policy, whose main objective is to reduce disparities and reduce development gaps between regions, investments have been promoted since 2007 through public and private participation. Restructuring and modernization processes were imposed because in the area of aquaculture, the main added value of the primary sector (aquaculture) at the level of all the regions of the country was lower than that of the secondary sector (the fish processing industry). Primary sector values reflect the very low level of labour productivity due to poor equipment and equipment, excessive fragmentation of privatization and poor management of some private aquaculture farms. Another phenomenon present in current aquaculture is the growing population/ repopulation of aquaculture farms, as owners are interested in turning traditional aquaculture farms into recreational / sport fishing. Thus, many artificial breeding stations of cyprinids have lost their activity. This situation was also determined by the lack of capital for the annual purchase of predeveloped larval and brood and market orientation towards imports.

Promoting environmentally sustainable aquaculture and ecological aquaculture ensures the protection, conservation and restoration of biodiversity in aquatic ecosystems, and conversion from traditional aquaculture to ecological aquaculture, requiring financial support and compensation for losses during conversion to organic aquaculture. The competitiveness of aquaculture is also ensured by the quality of human capital involved in the relevant activities of this field. In this regard, the strategy envisages a sustained intervention to increase the qualities and professional competencies of all categories of staff working in this important fisheries area which target specialized education activities organized within the fisheries, zoo technical education units and / or of veterinary medicine, as well as continuous training for all categories of staff. Given that the financial availability of aquaculture operators and those wishing to develop a business in this sub-area is in most cases limited in order to ensure co-financing of investments in aquaculture, it is intended to facilitate access to financial resources complementary banking through financial engineering techniques. The key condition for financially supporting the development of the aquaculture sector is strict compliance with relevant national and EU regulations. The European Commission has committed itself to implementing a coordinated management plan at different levels without compromising the objectives of the Birds and Natura 2000 Directives, which also protect fish stocks and aquatic ecosystems. It is envisaged: -the numerical increase of the aquaculture farms, respectively the afforested area, implementing additional environmental measures; -support by granting compensation to aquaculture farms located in and around Natura 2000 sites; -support for aquaculture farms providing social and environmental services, ecological tourism, recreational /

sport fishing, educational activities related to knowledge, protection and conservation of aquatic biodiversity, improvement of water management; -the use of multispecies populations that increase the quality of production; -periodic maintenance and hygiene of aquaculture basins (discoloration). The sustainable development of aquaculture is one of the main priorities of the EMFF. The money allocated to this priority may include: -innovative equipment investments, upgrading to improve productivity, to limit negative environmental impacts and maximize positive effects; -farm management and consultancy services; -training and certification of staff; -identifying and mapping appropriate aquaculture areas to improve territorial planning; -support for new farmers entering the sector -consultancy and support for conversion into environmental management schemes; -the provision of additional environmental services in favour of revenue growth based on production; -eradication of diseases and schemes to improve the health and welfare of animals. Although, for 2014-2020, approximately 20% of the European Fisheries Fund and Maritime Fund (FEPAM) funding was planned to be invested in the aquaculture sector and each Member State has developed an operational program adopted by the Commission, there are still gaps in addressing strategic priorities for sustainable jobs and growth in the aquaculture sector, in line with multi-annual strategic plans.

3. TURKEY

3.1. Background information

Aquaculture business was started with trout farming in ponds at the end of 1960s in Turkey. Later, it was followed by the fattening of eels collected in lagoons in soil ponds. Carp culture in old river beds became popular after 1970's. Aquaculture in the sea begun with the on-growing of the fish collected from nature in the 1980s in cages and soon after it was forbidden by Law in order to protect fish populations in nature. There was significant relationship between capture fisheries and aquaculture.

When the fish was abundant in the nature and harvested products sufficient for the nutrition of the citizens and supplied with considerably low prices, any attempts for fish farming failed due to incompatible prices or remained on trial base; especially on the species under thread in the nature since 1970's. In addition there were very limited cold storage facilities and marketing chains resulting mainly fresh consumption and low prices if the supply is over the demand. Due to environmental pollution, impact of invasive species, climate change and over fishing fish production by capture fisheries declined sharply at the end of 1980's, aquaculture investments and production have started to increase. Today, extensive aquaculture farms, converted to semi-intensive or intensive farms to produce large quantities.

Turkey, at present, has a comprehensive experience on aquaculture and application procedures due to early investments started since 1971 with the implementation of Fisheries Law (No 1380). Initial regulations were prepared according to the articles related with aquaculture in the Law. There are very big differences between the procedures in the early years and at the present time, oriented by the problem based solutions in the mean time. Main developments are provided due to harmonization process to EU legislations on aquaculture, water and meat quality, environmental conditions, establishment of fish farmer producer organisations which is very effective to provide

communication between fish farmers and central administration. On the other hand demand from domestic and international markets is another driving factor for the development in the sector by simplifying and standardizing all the procedures starting from first application till the implementation and marketing phases. In order to reach this target strong corporation has been provided between government, relevant ministries, applicants, NGO's, universities and research institutions.

In this text, all procedures are given in details for who intend to invest for fish farming in Turkey.

3.2. Common guidelines to start fish farming

3.2.1. Institutional framework

Designated authority on aquaculture sector is the Ministry of Agriculture and Forestry. Directorate of Aquaculture under DG Fisheries and Aquaculture is the main responsible unit in the organization of the Ministry. Other supporting units are Directorate of Resource Management and Fisheries Infrastructures, Directorate of Statistics and Information Systems and Directorate of Administrative Affairs and Coordination.

Directorate of Livestock and Aquaculture Research of General Directorate of Agricultural Research and Policies is responsible to determine agricultural research and development strategies and priorities in line with national development plans, to prepare, or order to prepare, implement and order to implement projects, to develop and register races and varieties, and to produce their core materials, to protect and develop domestic gene resources, to provide access to gene resources and to share their benefits, work on authorizing, monitoring and auditing works, to make researches for the development and rational use of soil and water resources, to determine the research targets of the research institutions affiliated to the Ministry and to supervise these organizations, to conduct research on vaccines, serum, biological and chemical substances and protection drugs used in animal and plant diseases, and effective and auxiliary substances included in their composition, to carry out scientific researches about aquatic organisms in seas and inland waters and to support them, to carry out research and development activities in national and international platform and support projects within this scope.

General Directorate of State Hydraulic Works is efficient when farms are going to be established in dam reservoirs and when water intake is necessary from the dam. This DG is responsible to determine the area and the place of cage farming in dam reservoirs and permits water intake from the surface or water discharge to the fish farms.

Effects of farms to the environment or environmental problems affecting water resources are the main scope of Ministry of Environment and Urbanization. Ministry aims to monitor, inspect and take essential measures to reduce such effects by General Directorate of Environmental Management (Marine and Coastal Management Department and Climate Change and Adaptation Department).

Turkish Statistical Institute (TURKSTAT) is responsible to collect, compile and announce data regarding aquaculture sector; production by species, years, export, import volumes and values by cooperating with the DG Fisheries and Aquaculture.

3.2.2. Regulatory framework

- **Fisheries Law, No: 1380[154]**

Main Act is the Fisheries Law, No: 1380, enacted in 1971. More details are given in Fisheries Regulation to be used to manage all kind of implementations, services, operations and precautions. As the aquaculture sector grows this regulation could not be able to cover all aspects of aquaculture sectors; therefore aquaculture regulation has been updated when/where needed.

Law is about 50 years old and amended several times due to update the contents in line with the changes by international conventions, FAO fisheries management principles (Code of Conduct), harmonization with EU Common fisheries Policy after 2000 and other international initiatives (marine pollution, climate change, biodiversity, invasive species, etc.). The last update was done on 06/11/2019 to be active on 01,01,2020 with the Law 7191.

Fisheries Law is formed by 9 chapters and 39 articles. First chapter defines the scope and aim of the Law and some of the terms mentioned in the related articles to prevent any possible confusions. Second Chapter regulates fishing activities: certification, renting public sites for fishing and aquaculture (short and long term, to be detailed in aquaculture regulation), procedures to clarify the borders of aquaculture site, measures need to be protecting natural habitats (determined by MAF). Article 4 and 13 regulates aquaculture investments more briefly:

“The areas in the sea and inland waters needed to be used for aquaculture either owned by the Treasury or the General Directorate of State Hydraulic Works, or under the jurisdiction of the State, for the construction of the farms on land or inland waters, or other aquaculture investments to be made on the basis of the project by rehabilitating these areas, the leasing method and technical conditions, duration and annual costs of the aquaculture permissions in the sea and inland waters are determined by the Ministry of Agriculture and Forestry, taking into account the characteristics of the production sites, These places can be leased by the Ministry of Agriculture and Forestry, to real or legal entities, incomes to be transferred to Provincial Special Administrations, and to the Office of Investment Monitoring and Coordination if they are absent”.

The lease transactions of the terrestrial areas that will be needed for the investments to be made with a project, within the framework of the provisions of this article; If the immovable is registered, it is made by the owner of the property, and if it is among the areas that are under the terms of the State, and by the units of the General Directorate of National Real Estate.

Appropriate opinion is obtained from the Ministry of Environment and Urbanization and the Ministry of Culture and Tourism when determining aquaculture areas on land by taking water from sea and inland waters or from these places; if no response is given within sixty days, appropriate opinion is deemed to have been given.

The procedures and principles regarding the commercial, amateur, recreational hunting and fish farming activities to be carried out in the areas where the right of lease is rented, and the types that are rented out, are determined by the regulation issued by the Ministry of Agriculture and Forestry.

[154] https://www.resmigazete.gov.tr/arsiv/13799.pdf; https://www.resmigazete.gov.tr/eskiler/2019/11/20191122-1.htm

Chapter 3 is focused on development, incentives and protection, In order to increase production, investors are encouraged by the MAF, if they are involve in research and development activities for the new species, or subsidized in order to support business to increase production sites and capacities.

- **Fisheries Regulation**[155]

This regulation has been prepared by the Ministry on the basis of Article 13 of the Fisheries Law No, 1380, and published in the Official Gazette Dated: 29,06,2004, No: 25507, The purpose of the Regulation is to use potential of water resources of Turkey with the most productive way ensuring sustainability in aquaculture, by protecting the environment and providing aquaculture investments in a planned way for quality / safe food supply, and effective inspection and monitoring during production processes.

It covers wide range of aquaculture investments to be established in seas, inland waters and adjacent localities, site selection, implementation method and evaluation process of demands, preliminary permit, project approval (final permission), project cancellation, project changes, trial production, mandatory site changes, establishment of integrated facilities, project transfers to third parties. Bluefin tuna fattening farms, organic seafood culture, certification process for aquaculture farms, import of egg, juveniles and brood fish, employment of technical staff, health and sanitation issues, environmental impacts, and protection and control issues.

- **Aquaculture Regulation (Dated 29.06.2004, OJ No: 25507)**[156]

Regulation is prepared for the sustainable use of water resources to produce fish and other aquatic organisms within sustainability principles. Regulation aims to reduce bureaucracy to the minimum level, to encourage citizens to invest in aquaculture sector, to guide investors how to start, implement, operate and market farm products. There are many details in the Regulation; therefore Directive on the Implementation of Aquaculture Regulation (2006/1) had been announced to give more clear instructions to the investors in relation with the Amended Regulation on the Fish Farm Implementation dated 15.10.2005, OJ No: 25967. Some articles of the Directive have been reorganized and the procedures and principles regarding implementation are given more briefly.

- **Directive on the Implementation of Aquaculture Regulation**[157]

This Directive has legal basis on amended Fish Farm Implementation Regulation dated 15.10.2005, No: OG 25967. Some articles of the Directive have been reorganized and the procedures and principles regarding implementation are given more clearly.

- **The regulation on the aquatic animals for health conditions and diseases against diseases**[158]

[155] https://www.mevzuat.gov.tr/mevzuat?MevzuatNo=4988&MevzuatTur=7&MevzuatTertip=5
[156] https://www.mevzuat.gov.tr/mevzuat?MevzuatNo=5217&MevzuatTur=7&MevzuatTertip=5

[157] https://www.tarimorman.gov.tr/Belgeler/Mevzuat/Genelgeler/2006_1genelge.pdf

This regulation aims:

- to regulate the health conditions to be applied for aquatic animals or their products while they are imported, or transit process and presented to the market.
- to increase the awareness of the competent authority, fish farmers and parties in the processing industry regarding minimum preventive measures,
- to take inimum control measures in case of suspect to any fish diseases or carry out the protocols if any diseases occur.

Scope of the regulation covers the registry of fish farms, species, processing plants and their activities; measures to control fish diseases, health conditions for fish and products to be applied in farm, processing plant, in market and imports. Other aquaculture activities such as production of ornamental fish, animals raised in non-commercial aquariums, wild aquatic animals collected or caught directly from the nature such as pets kept in pet stores, garden ponds, commercial aquariums or wholesalers, in establishments without direct contact with the country's natural waters or in enterprises with a waste treatment system that reduces the risk of disease contamination to natural waters to an acceptable level, are not covered by this regulation.

This Regulation is based on the Veterinary Services, phytosanitary, food and feed Law No. 5996 dated 11/6/2010; The European Union Council Directive on the Animal Health Requirements and the Prevention and Control of Specific Diseases in Aquatic Animals and Animal Health Requirements for Aquatic Animals and Products dated 24/10/2006 and numbered 2006/88 / EC; In parallel with the Commission Decision dated 12/12/2008 and numbered 2008/946 / EC on the Requirements for Quarantine Aquatic Animals.

- **Regulation on the requirements of fish wholesale and retail sales**[159]

This Regulation has been prepared in order to ensure that the fishery products are supplied to the consumer in fast and reliable manner in accordance with the hygiene, quality and standards in free competition conditions.

Its scope is to cover the minimum requirements on general, technical, hygienic, physical and infrastructure conditions to be complied with in the wholesale markets and retail shops to be established by municipalities and / or natural and legal persons, and the establishment, their operation, management and the procedures and principles regarding the conditions that employees in the sales places should have, and the matters of control and inspection. This Regulation has been prepared on the basis of Articles 23 and 26 of the Fisheries Law No. 1380, amended by Law No. 3288 (OJ dated 19/06/2002, N0:24790).

- **Circular on Granting Work Permit to Fish Processing Plants**[160]

[158] https://www.mevzuat.gov.tr/mevzuat?MevzuatNo=15854&MevzuatTur=7&MevzuatTertip=5; https://www.tcmevzuat.com/normlar /yonetmelik/ su-hayvanlarinin-saglik-kosullari-ile-hastaliklarina-karsi-korunma-ve-mucadele-yonetmeligi/#

[159] https://www.tarimorman.gov.tr/Belgeler/Mevzuat/Yonetmelikler/suurunleri_toptanveparekende_satisyerleri_yonetmeligi.pdf

[160] https://www.tarimorman.gov.tr/Belgeler/Mevzuat/Genelgeler/suurunlericalismaiznigenelge.pdf

It is very important today to establish fish processing facilities in accordance with technical and hygienic conditions, to carry out the processing process within the framework of these conditions, and to supply quality and safe seafood products suitable for human consumption to the market. In order to ensure these, aquaculture plants must firstly meet the infrastructure, technical and hygiene conditions specified in the fisheries legislation. If the facilities are in compliance with the required conditions and will work within these conditions, it is documented with the facility work permit. Accordingly, the circular has been prepared in order to enable the processing facilities to start working before they become operational, to determine the procedures to be followed with the work permit, and to clarify the procedures to be performed in this direction for the operating facilities and to provide unity in practice (Circular No. 2002/17).

- **Environment Law**[161]

Environment Law (No: 2872) enacted in 1983 (OJ dated 11/8/1983, No: 18132) aims to protect the environment, which is the common asset of all living things, in line with the principles of sustainable environment and sustainable development. Inland and marine waters, soil, air and water pollution, pollutants, ballast waters, invasive species, treatment, biodiversity, habitat and habitat conservation, special protected and marine protected areas are the components of Environment Law.

- **Regulation on water pollution monitoring**[162]

Aim of this Regulation is to determine the legal and technical principles necessary to achieve the prevention of water pollution in line with sustainable development objectives, in order to protect the country's potential for underground and surface water resources and to ensure its best use.

This Regulation covers the quality classifications and uses of water environments, planning principles and prohibitions for the protection of water quality, the principles of wastewater discharge and discharge permits, the principles regarding waste water infrastructure facilities, and the monitoring and inspection procedures and principles to be carried out to prevent water pollution (OJ dated 31.12.2004, No: 25687).

- **Communique on the determination of areas where fish farms could not be installed in closed bay and gulfs**[163]

Communiqué clarifies is the principles for the determination of sensitive areas with high risk of eutrophication in closed bay and gulf areas, in accordance with the clause (h) of Article 9 of the Environmental Law No. 2872 dated 9/8/1983 and the temporary second article (OJ dated 24.01.2007; No: 26413). According to the legislation, cage units can only be installed at the places over 30 m depth, 0.6 nautical miles off the coast and minimum 0.1 m per second current speed (OJ dated 24.01.2007, No: 26413).

- **Communique on monitoring of fish farms in the seas**[164]

[161] https://www.mevzuat.gov.tr/MevzuatMetin/1.5.2872.pdf
[162] https://www.jmo.org.tr/mevzuat/mevzuat_detay.php?kod=135
[163] https://www.mevzuat.gov.tr/mevzuat?MevzuatNo=11034&MevzuatTur=9&MevzuatTertip=5

This Communiqué regulates the principles for the monitoring of the pollution that may result from fish farming activities of installed or to be installed in the seas. It has been prepared based on the relevant provisions of the Environmental Law No. 2872 dated 9/8/1983 and Article 54 of the Water Pollution Control Regulation published in the OJ dated 31/12/2004; no 25687.

It describes the method locating the cage units regarding current direction, water sampling from production sites and store conditions, analyses and parameters used in monitoring process (OJ dated 13.06.2009, No: 27257; amended OJ 09.04.2010, No: 27547).

- **Communique on water quality standards related to shellfish farming**[165]

This Communiqué aims to determine the quality standards of waters in which shellfish farming will be carried out, to protect the waters production site from various harmful effects of pollutants discharged into these waters, improve the quality of waters by creating monitoring and pollution reduction programs.

It covers the issues related to the determination of the water quality standards of shellfish farming sites, water sampling and monitoring protocols, determination of the suitability of the waters for shellfish farms established in future as well as protection and pollution reduction action programs together with inspection methods.

This Communiqué has been prepared based on the provisions of the Fisheries Law No. 1380 dated 22/3/1971 and the Environmental Law No. 2872 dated 9/8/1983 (OJ Dated 06.11.2009, No: 27398).

- **Statistics Law**[166]

The purpose of this law is to determine basic principles and standards concerning the production and organisation of official statistics; and to regulate the formation, duties, and authorities of the Turkish Statistical Association (TURKSTAT); previously was Turkish Statistical Institute, which is to compile and assess data and information, produce, publish and disseminate statistics on the areas that country needs, and to ensure coordination among institutions and organizations that are involved in the statistics process prescribed in the Official Statistics Programme.

Official statistics are produced, disseminated and published by the Presidency of the Turkish Statistical Institute and institutions and organisations specified in the Programme. The Programme shall clearly define the duties and authorities of the institutions and organisations regarding the compilation, evaluation and publication of data relating to official statistics in the context of their work areas. These institutions and organisations are obliged to submit any compiled data to the Presidency on time, upon request. The principle of confidentially is duly observed in the maintenance and protection of data and information submitted to the Institute by determining the confidentiality principles in other legislative arrangements. The Presidency is authorised to publish and disseminate the official statistics compiled by institutions and organisations.

[164] https://www.mevzuat.gov.tr/mevzuat?MevzuatNo=13117&MevzuatTur=9&MevzuatTertip=5
[165] https://cygm.csb.gov.tr/tebligler-i-441
[166] http://www.turkstat.gov.tr/UstMenu/yonetmelikler/StatisticsLawOfTurkey.pdf

The work carried out by institutions and organisations in statistical areas which are not covered by the Programme and the results of censuses or surveys conducted by real persons and legal entities under special law shall not be considered official statistics.

In case the real persons or legal entities under special law who conduct surveys containing statistical outcomes and make their results public through the media, they are obliged to inform the public about the coverage, sampling method, sampling volume, data compilation method and implementation time together with the survey results.

3.2.3. Procedures for the establishment of fish farms

Aquaculture Regulation contains detailed information for wide range of aquaculture investments to be established in seas, inland waters and adjacent localities, site selection, implementation method and evaluation process of demands, preliminary permit, project approval (final permission), project cancellation, project changes, trial production, mandatory site changes, establishment of integrated facilities, project transfers to third parties, Bluefin tuna fattening farms, organic seafood culture, certification process for aquaculture farms, import of egg, juveniles and brood fish, employment of technical staff, health and sanitation issues, environmental impacts, and protection and control issues.

- **Terms and Definitions**

First chapter explains the purpose, scope, legal basis and the terms. In order to implement all of the issues mentioned in the regulation it is better to define some technical terms related with the procedures:

Aquaculture: the activity of producing and / or growing) aquatic living organisms, in intensive, semi-intensive or extensive conditions in fish farms,

Commission: Establishment of the Commission which its working principles and procedures are determined by the Ministry Central Organization,

Common fish farming area: Area designated for more than one marine and inland aquaculture farms in aquaculture business

Entrepreneur: The real and legal persons who want to establish and operate fish farms,

Extensive fish farming: Low production, based on the natural efficiency of water, with inventory control

Fish farm: Places where aquaculture process is carried out,

Filtration System: Units to keep wastes in water by using different types of filters in production process,

Fish farming: Cultivation of aquatic plants and animals in sea and inland waters and their eggs (except for the animals covered by the Terrestrial Hunting Law No, 4915),

Fish Farming Certificate: The document issued by the Central Organization of the Ministry for the farmers engaged in aquaculture production activities,

Hatchery: Facilities established to obtain eggs and fry from brood stocks,

Inland waters: Places of production and cultivation in natural and artificial lakes, lagoons, dam lakes, embankments, regulators, canals, arcs, streams, rivers, etc,

Intensive fish farming: Intensive cultivation based entirely on external feeding,

Juvenile fish farms: Farms produce fish up to 30-50 g after hatching to transfer the facilities in the sea, inland waters and offshore cages,

Juvenile fish on-growing site: Aquaculture sites allocated for on-growing of juveniles in the sea, inland waters and on land,

Ministry Central Organization: General Directorate of Agricultural Production and Development (DCAPD),

Ministry: Ministry of Agriculture and Forestry (MAF),

Net Pond (Net Cage): Frame units with mesh covers made from wood, iron or plastic materials for fish farming in seas and inland waters,

Offshore aquaculture: Fish farms outside of the closed bays and gulfs in the seas, established at water depth over 40 m to produce fish in net cages using suitable technologies,

Production ponds: Soil, concrete and net ponds, and other similar units made from plastic or similar material for aquaculture purposes,

Project: The set of documents containing all essential information about the species to be farmed, location of the site, nature, financial aspects, architectural drawings and constructional plan and calculations for aquaculture facilities, cost for investment in detail, farming methods and production plan, supporting documents provided from public institutions and organizations, and all kinds of documents and information related to the business as whole.

Provincial Directorate: Provincial administration offices of the Ministry Provincial Directorates of Agriculture and Forestry,

Semi-Intensive fish farming: Fertilization and breeding based on complementary feeding

- **Requirements to establish fish farms**

General issues related to the sites to establish fish farms are explained in Chapter 2, Article 5 of the regulation as:

a) In order to permit an establishment of a new farm which will use the same water resource together with one or more farms on land, sufficiency of the quality and quantity of water and occurrence of any adverse effect due to new farm to the other farms should be approved and reported by the expert institutions i,e Fishery Faculties and Research Institutes. If the issued report is found appropriate, the request is forwarded to the Ministry's Central Organization together with the opinion of the provincial directorate and it is decided whether to establish a new facility on the water supply, However, if deemed necessary, a decision is made by the Commission, based on the report prepared by providing a re-examination of the issue,

b) Farm facilities to be established on land, in cases where there is no negative effect of the plants by means of hygiene and sanitation (providing the water from a separate source or receiving it through a separate channel from the same water source), the minimum distance condition between the facilities is not required,

c) For the efficient use of inland water resources, in the facilities to be installed on water bodies with a flow rate of 100 lt / sec and less, a farm must have a production capacity that can use the entire production, No farms with a capacity of less than 25 tons / year can be established on water resources with a flow rate greater than 100 lt / sec, However, in regions where it is not possible to find sufficient space for the farm to be established, this condition is not sought if the provincial directorate gives opinion in this direction,

e) The distance between aquaculture investments in net cages in dams is determined by the Ministry's Central Organization, taking into account the opinion of the Provincial Directorate created based on the criteria such as the area to be allocated to farming, project capacity, water depth, and flow rate, provided that the distance between the farms is not less than two hundred meters,

f) The size of the area to be allocated for production in net cages is determined by taking into consideration the project capacity, the type and technique of cultivation to be applied, provided that it is not less than twice the area to be occupied by the cages in the seas and inland waters,

g) In order to ensure all kinds of life and property safety in the sea and inland waters, the area where the net cages and water intake and discharge systems of the hatcheries should be marked with buoys and lightning buoys. It is indicated by IALA (International Association of Lightning Authorities) standards in terms of navigational safety at sea by day and night obstacle signs. The place of buoys and lightning buoys cannot extend beyond of the leased area,

h) In the seas, as a result of the environmental planning works, the distance between the aquaculture areas allocated for aquaculture is determined by the Central Organization of the Ministry, taking into account the opinion of the Provincial Directorate on project capacity, water depth, flow rate and aquaculture techniques, In areas where environmental planning is not carried out, the distance between two tuna fattening farms and net cage farms and tuna fattening farms in the seas is should not be less than two kilometers; in case of the two finfish farms the distances should not be less than one kilometer based on the opinion of the Provincial Directorate regarding the criteria on project capacity, water depth, flow rate, which is approved by the Central Organization of the Ministry.

I) The distance between hatcheries or between hatcheries and other aquaculture farms is determined by the Ministry's Central Organization taking into consideration the report prepared by the fisheries faculties and research institutes together with the opinion of Provincial Directorates about capacities, water intake and discharge systems, and production methods, However, if it is necessary, a re-examination of all process may be asked by the Commission,

j) In order to ensure the efficient use of the aquaculture areas, the minimum capacities of the projects are determined by the Central Organization of the Ministry,

k) If there is threat of freezing for cold-water fish farms or high temperature risks over 20 ° C, a production management plan is needed to be prepared considering approximate start and end dates,

l) Off-shore aquaculture is permitted only in the seas, out of closed bays and gulfs, over minimum 40 m depths by using appropriate technologies, on the other hand, if the project capacity, depth of water, current speed and technology used in aquaculture process is suitable, the permit can be given to establish marine farms for fish production in cages at shallower depths with the decision of Central Organization of the Ministry,

m) The size of areas on land needed to support mariculture farms for logistics and management purposes is determined by the Central Organization of the Ministry and / or the Provincial Directorate,

n) Determination of common aquaculture sites and their planning is done by the Provincial Directorate after the approval of the Central Organization of the Ministry, The procedures and principles regarding aquaculture activities including mandatory location changes are regulated by the directive to be prepared by the Central Organization of the Ministry,

o) The authority to permit aquaculture certificate for the application of new technologies other than existing ones is the Ministry Central Organization and its directive prepared on the procedures and principles regarding the implementation,

p) The procedures and principles for crustaceans, arthropods and mollusks farming are determined by the directive to be prepared by the Central Organization of the Ministry,

q) The procedures for the juvenile fish production facility is executed in accordance with the provisions, Other procedures and principles needed for juvenile fish growing areas and facilities are determined by circulars to be prepared by the Central Organization of the Ministry.

- **Implementation of Farms, Permits, Approval and Project Process (Chapter Three)**
  - **Application**

The procedures and principles for the evaluation of the applications are given below (Art. 6):

a) Entrepreneurs who want to establish an aquaculture business must apply to the relevant Provincial Directorate and obtain permission from the Central Organization of the Ministry.

b) The entrepreneurs who want to establish fish farms, apply to the Provincial Directorate with a written statement by adding to a 1/25000 scaled field map on which the place where the facility will be established is marked. Provincial Directorate conducts a local investigation within 15 days by a technical team to be formed. It is ensured that water samples are duly taken from the water source or production sites to be used in the aquaculture facility, and necessary analyses are carried out by the investor in the certified laboratory designated by the Ministry. If the analyses are all positive and acceptable for water quality, water surface, land and other criteria (i,e, depth of water, distance between plants, appropriate aquaculture techniques and environmental effects) determined by the Central Organization of the Ministry, for all inland water and marine farming

facilities need to prepare " Preliminary Study Report ", and farms with hatcheries has to prepare "Hatchery Preliminary Study Report" together with Attachment -2, A sketch showing the location of the facility, water source, road and settlement status of other facilities and the distances related to them, is also prepared and added to the preliminary study report(s) by the Provincial Directorate.

Provincial Directorate demands preliminary permission for the applicant from Central Organization of the Ministry by handling all documents; 1/25000 scaled map of the facility will be established, with the application statement of the investor, water analysis result report, sketch and other documents to be provided by the investor together with the appropriate opinion of the Provincial Directorate (Additional last sentence: OJ-30/5/2009-27243) Procedures related to the preliminary permit requests are finalized within twenty one days by the Ministry.

c) Eight months of period from the date of application is given to the investor to provide all of the documents for preliminary permit by the Provincial Directorate, If the essential documents could not be completed within this period, the application of the investor is removed from the transaction, However, if the reasoned request of the applicant is deemed appropriate, an additional period may be given by the Provincial Directorate in accordance with the reason.

d) If there are more than one application for farming in the same area both in marine and inland waters, other applications are kept for evaluation until the first application is concluded, If the first application does not take place, other applications are evaluated according to the order of application.

e) If it is the first application for fish production in net cages in dam lakes, the opinion of the General Directorate of State Hydraulic Works is taken by the Central Organization of the Ministry and the transactions are carried out accordingly (Fig 1).

- **Preliminary Permission**

Article 7 - General provisions regarding the preliminary permission for the establishment of aquaculture plant are described below:

a) In case of completing the procedures in Article 6, the entrepreneur is given a twelve-month pre-authorization by the Ministry's Central Organization and/or Provincial Directorate to prepare his project, During this period, the preliminary permission of the entrepreneur who does not prepare his project and deliver it to the Provincial Directorate is canceled by the Ministry's Central Organization upon the proposal of the Provincial Directorate, However, if the reasoned request of the entrepreneur who declares an excuse on this matter is notified to the central organization of the Ministry with the approval of the Provincial Directorate, an additional period may be given by the Ministry's Central Organization.

b) When the entrepreneurs who have received a preliminary permit or who are in the stage of obtaining a preliminary permit, wants to make changes in their previous applications, they apply to the Provincial Directorate with a petition, Subsequent transactions are carried out in accordance with the principles laid down in Articles 6 and 7, Considering the nature of the requested change, documents that have been previously supplied by the operator and are still valid, new ones are not required from the operator, However, the first application date is taken as the application date.

c) Entrepreneurs who have applied for a preliminary permit and whose transactions are still in progress and those who have received a preliminary permit cannot transfer their rights to another entrepreneur.

- **Project Approval**

Article 8 - General provisions regarding approval of fish farming projects are described below:

a) Entrepreneurs who want to establish a fish farm and get preliminary permission must have their projects approved by the Ministry's Central Organization and / or Provincial Directorate.

b) While preparing the project, the project preparation instruction and disposition determined by the central organization of the Ministry are taken as basis, Discovery-quantity charts of the application project prepared by real and legal persons authorized to prepare the project are calculated by considering the increase rate to be announced by the Ministry of Public Works and Settlement, if these prices are not disclosed. The project is delivered in five copies to the Provincial Directorate for approval. Entrepreneurs are obliged to add a notarized copy of the specification regarding the project subject, sent to the Provincial Directorates by the central organization of the Ministry in each project copy.

c) For the approval of the projects of fish farms, the condition of conformity with the relevant provisions of the "Environmental Impact Assessment Regulation" is sought and the document confirming that this requirement is met is added to the project,

d) Approval authorities of aquaculture projects to be implemented in seas and inland waters are determined by circulars to be prepared by the central organization of the Ministry,

e) For the projects whose approval authority is the Provincial Directorate, a copy of the project remains at the Provincial Directorate, and another copy is sent to the Central Organization of the Ministry within fifteen days after the date of approval. If there is a lease for the projects approved by the provincial directorate, the lease offer is made to the relevant institution together with the project and the Ministry's central organization is informed as a result. The other two copies of the approved project are given to the investor.

g) Authorization to approve: After the projects approved by the Central Organization of the Ministry, one copy is kept in the Central Organization of the Ministry, If the lease for the approved project is in question, one copy of the project is sent to the Provincial Directorate in order to be used during the application to be made for the lease, two copies are given to the operator and one copy is kept in the archive of the Provincial Directorate.

- **Aquaculture Certificate**

The procedures and principles to be applied in issuing aquaculture certificate to fish farms are explained below (Article p):

a) After completing the water and / or area rental operations for the aquaculture plant and / or hatchery and starting production, an application is made to the provincial directorate within a month to obtain the Aquaculture Certificate and / or Aquaculture Hatchery Certificate, Within

fifteen days after the application, an inspection report is issued by the Provincial Directorates, and the Aquaculture Certificate and / or Aquaculture Hatchery Certificate is sent to the Ministry's Central Organization together with the audit report to be approved. The procedures regarding the approval of the Aquaculture Certificate are finalized within twenty days,

b) "Aquaculture Certificate" is issued one for each facility. The approved original document is given to the operator; a certified copy of each is filed in the Central Organization of the Ministry and the Provincial Directorate,

c) The copy of the certificate is hanging on in a place where easily visible in the administrative building of the facility,

d) In case of project change, project transfer, name change, etc,, in order to issue the Aquaculture Certificate suitable for the new situation by canceling the old certificate, after the allocation procedures completed to the new investor, a new "Aquaculture Certificate" issued in accordance with the new situation are sent to the Central Organization of the Ministry together with the "Audit Report",

e) Aquaculture Certificates of fish farms, whose activities are terminated for any reason, are sent to the Central Organization of the Ministry by the Provincial Directorates for cancellation,

f) The entrepreneurs who will interrupt production for any reason shall apply to the Provincial Directorate by attaching the original of the certificate document to their statement explaining the reason and duration of the break, Originals of the breeding documents of these facilities are kept in the Provincial Directorates until the facility in question starts production again, Central Organization of the Ministry is informed by the Provincial Directorates about the situation in question,

g) Entrepreneurs apply to the Provincial Directorate within one year from the date of publication of this Regulation to replace the certificate documents previously issued by the Ministry's Central Organization and / or Provincial Directorate,

h) Entrepreneurs are required to apply to the Provincial Directorates to get visa for their aquaculture certificates in every three years,

ı) Due to administrative and technical problems, if the documents regarding the renewal or visa issuance of the farms cannot be supplied and the reasoned request of the operator is relevant, the breeding certificate can be visa or renewed,

If the documents regarding the renewal or visa issuance of the fish farm cannot be supplied due to administrative and technical problems, and the reasoned request of the investor is relevant, the aquaculture certificate can be approved for visa or renewed.

- **Cancellation of the Project**

Article 10 defines general provisions requiring cancellation of aquaculture plant projects are as follows:

a) Regarding the establishment of the fish farm, completion of leasing procedures is essential to invest and start production within one year after the last completed lease transaction by accepting

as the start date, the project is cancelled. If the entrepreneur's reasoned request and this request is found appropriate by the Central Organization of the Ministry, this period is extended for one time only. If the period is exceeded, the cancellation of the projects is made by the Provincial Directorate if approval is done by the provincial directorate and notified to the Central Organization of the Ministry, Approval of the projects done by the Central Organization of the Ministry is done by this central organization upon the proposal of the Provincial Directorate,

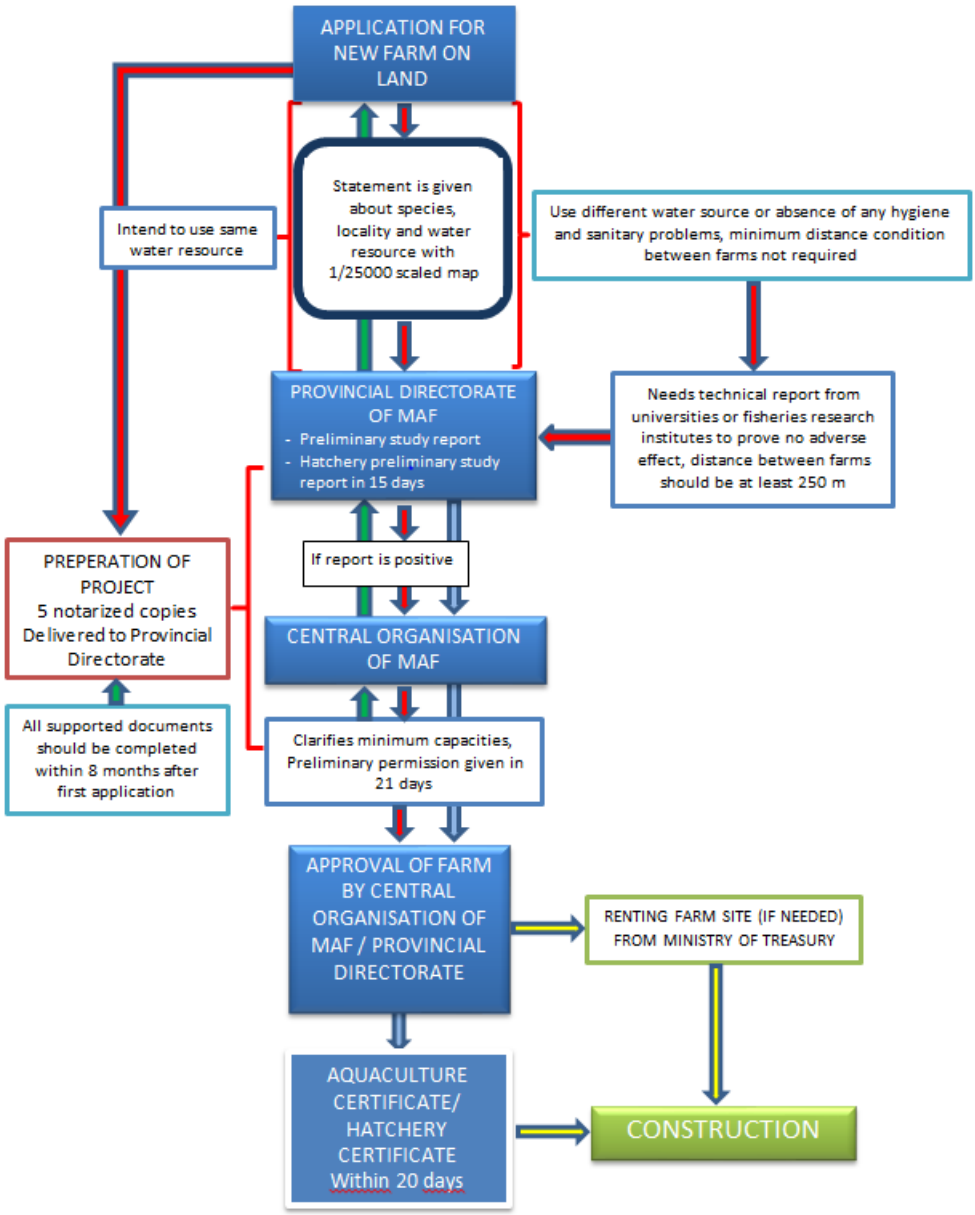


Figure 1. Flow chart diagram of the procedures to establish fish farms in Turkey

b) Exceeding the period stated in item (a) due to any environmental, physical and chemical factors or natural disasters, which may have a negative effect on aquaculture, or which may be understood later, is not considered as a reason for project cancellation. In this case, the investor is given a six-month decision-making period, and the project is canceled after six months if a new proposal is not received from the entrepreneur with the solution to eliminate the restrictive situation or change the location, If an activity proposal is received to eliminate this restrictive situation and this proposed activity is deemed appropriate, an additional time sufficient for the proposed application is given. In the six-month decision-making period, if the entrepreneur proposes changes to the project, the provisions of Article 11 of this Regulation are applied. The decision authority regarding the projects covered by this article is the authority that approved the project,

c) In case the fishing grounds are rented with a project for fish farming procedures for the cancellation of project is carried out by the Central Organization of the Ministry, if the promised investments to be made for each year in the proposed and approved plan are not fulfilled without reason, even one year after of that year based with the report prepared by the Provincial Directorate,

d) If the lease contract is terminated due to the entrepreneur's failure to fulfil his obligations, project certificates are also cancelled. Cancellation of the projects whose are approved by the Provincial Directorate are made by the Provincial Directorate and notified to the Central Organization of the Ministry. If approval is done by the Central Organization of the Ministry cancellation is also done by the same organization.

- **Modifications in the Project**

The procedures and principles to be applied in case of changes in aquaculture projects are as follows (Art.11):

a) The entrepreneurs who want to make any changes in their projects such as the type, location, capacity and area increase/decrease, and setting up an additional unit and change of location should apply to the Provincial Directorate where the facilities are located, Regarding these applications, transactions are made in accordance with the principles stated in the 6th, 7th and 8th articles,

b) Considering the nature of the requested change, the documents that have been previously supplied by the investor and if they are still valid are not requested from the applicant again,

c) New project is required for any change of species while revised project is requested to install additional units and capacity increase / decrease, No project is requested for space increase / decrease and relocation of the farm realized with the documents related to the navigation and rentals, In cases where capacity increase / decrease and space increase / decrease are involved, both revised project documents related to navigation and rentals are requested,

d) The entrepreneurs are subject to have permission about any changes that will not spoil the merits of their approved projects (shape, size and number of cages / ponds, biological characteristics of farmed species apart from the changes during the establishment of the fish farm

or at post production stage, and have the site plan suitable for the new situation. The authorization and approval authority for these changes is the authority that approves the project,

e) After the aquaculture projects are approved, the entrepreneurs are obliged to apply to the Provincial Directorates with a petition for their changes in their annual production planning, If the requests for changes are deemed appropriate by the provincial directorates, this will be notified to the Ministry within 15 (fifteen) days.

- **Obligatory Location Changes**

There might be obligatory location changes of the farms due to outsider reasons (Article 12). In case of notification from the Ministry's Central Organization and / or the Provincial Directorate due to legal, technical, security and similar compulsory reasons, entrepreneur should apply with a petition to the Provincial Directorate at the place where their facilities will be moved, at the latest one month, Documents related to transfer and new settlement plan are provided in case of compulsory place changes to be made without changing the size of surface area and / or capacity increase / decrease provided that they are within the same city borders, Other transactions are evaluated within the scope of the relocation of the projects and are carried out in accordance with the principles in Article 11, In case of the compulsory relocation requires moving to an area within the boundaries of other provinces, the transactions are carried out in accordance with the principles in Article 11.

- **Trial Production**

The general provisions regarding the trial production to be applied in the aquaculture farms are stated in Article 13 of the Regulation as:

a) The entrepreneurs who want to make trial production in a part of their existing facilities apply with a petition containing a detailed report including the purpose, reason, material, method and duration related to the trial production, Such applications are forwarded to the Central Organization of the Ministry by the Provincial Directorate by specifying their opinion, The authority to allow trial production belongs to the Central Organization of the Ministry.

b) Entrepreneurs whose want to make trial production without having any facilities, apply to the Provincial Directorate where the trial facilities will be established with a petition, Regarding these applications, transactions are made in accordance to the principles stated in Articles 6, 7 and 8, However, while preparing the aquaculture project, the project disposition prepared by the Central Organization of the Ministry is taken as basis.

- **Transfer of the Projects/Ownership**

Article 14. The procedures and principles to be applied in the transfer processes of aquaculture plants and projects are as follows:

a) Entrepreneurs who want to transfer their aquaculture facilities to real or legal persons apply to the Provincial Directorate where their facilities are located, by submitting the documents to be determined by the Central Organization of the Ministry, with a petition.

b) Proposals related to the transfer processes of the projects which have been approved by the Ministry Central Organization are notified by the provincial directorates to the Ministry Central Organization within seven days, After the approval of the transfer process by the Ministry Central Organization, the demand for the transfer is conveyed by the provincial directorate to the institution authorized for the leasing, and then the result is reported to the Central Directorate of the Ministry by the provincial directorate. The proposals regarding the transfer processes of the projects whose project has been approved by the provincial directorate are notified to the Ministry's Central Organization within seven days with the approval of the provincial directorate, These proposals are evaluated within fifteen days and sent to the relevant institution within seven days by the provincial directorate, if deemed appropriate by the Ministry's Central Organization, After the transfer, the Ministry Central Organization is informed about the issue.

c) Real or legal persons who take over the project submit a notarized copy of the specification to the Provincial Directorate, A copy of the specification is sent to the central organization of the Ministry by the Provincial Directorate,

d) For the transfer of the enterprises to real or legal persons that will be engaged in aquaculture for the first time, the condition of obtaining an Aquaculture Certificate is required.

Chapter three covers the requirements for other aquaculture activities

- **Bluefin tuna fattening**

Procedures regarding the establishment and operation of bluefin tuna fattening farms will be carried out according to the this directive and the Communiqué on "Bluefin Tuna (Thunnus thynnus) Fishing and Fattening" published in the Official Journal dated 23/03/2003. No: 25057 (Article 15).

- **Organic Aquaculture**

It is defined in Article 16. Transactions related to organic aquaculture projects are carried out in accordance with the relevant articles of this Regulation. Regarding production, the legislation in force regarding the principles and implementation of organic agriculture is complied with.

In regions where fisheries employed the procedures and principles regarding fisheries and aquaculture in natural lakes, ponds, dam lakes, rivers and branches are determined by the Ministry (Article 17).

- **Establishment of Integrated Plants**

Only the part of the aquaculture industry, which includes the aquaculture plant and other related activities, is evaluated, and the relevant procedures are carried out in accordance with the principles stated in the Articles 6, 7 and 8 (Article 18).

- **Import of egg, fry and adult fish**

Chapter five regulates import of eggs, fry and brood fish. The procedures and principles regarding the import of the eggs and brood fish is going to be used in fish farms are determined by the Ministry (Article 19).

- **Employment of technical staff**

Chapter six aims to organize technical staff employment in fish farm. The provisions regarding the employment of technical personnel in aquaculture plants are as follows (Article 20):

a) In fish farms, depending on their production capacity, at least 4 years of faculty graduates who have education on aquaculture or those who have worked in the public for at least 5 (five) years are employed as technical personnel provided that they document their status (Amended: 15/10/2005 - 25967 Article 7). The number of technical staff to be employed in the facilities is determined by the circulars to be prepared by the central organization of the Ministry, taking into account their production capacities. One of the technical staff employed is assigned as "Technical Responsible Manager".

b) In hatcheries, at least one technical staff is employed and regarded as "Technical Responsible Manager" regardless of capacity.

c) In the aquaculture plants or hatcheries, if the owner of the facility meets the conditions of the technical personnel whose characteristics are stated in item (a) of this article, this operator is considered as the technical personnel.

d) Fish farms and hatcheries, technical personnel employment and technical responsible manager appointments that are currently in operation, shall notify the Provincial Directorate within six months by filling the "Technical Responsible Manager Appointment and Technical Personnel Employment Form"(Attachment -10),

e) Fisheries aquaculture facilities and hatcheries to be established will fulfill their obligations regarding the employment of technical personnel and appointment of a technical responsible manager during their application to the Aquaculture Certificate,

f) As the production capacity, which is accepted as the basis for the employment of technical personnel, issued before the issuance of a breeding certificate for enterprises that have just started production; For the enterprises currently in production, the production amount in the most recent audit report belonging to that enterprise is taken from the annual audit reports, In the following years, the production capacity, which is periodically prepared every year, is taken as the basis for production capacity, which is considered as the basis for the employment of technical personnel.

- **Fish Health and Welfare**

Article 21 of Chapter 7, regulates the Measures to be taken for the Protection of Fish Health and Welfare;

a) The Ministry is authorized to take all kinds of measures to protect the fish and fish health in farms where aquaculture is carried out,

b) Dead fish in farms are collected and burned regularly or buried in lime pits,

c) In case of a suspicion or finding of a disease in the breeding facilities, the entrepreneurs must report this situation to the Provincial Directorate where the facility is located as soon as possible,

d) When the disease notice is received, the breeding facility is monitored by the Provincial Directorates, Entry and exit of live or dead seafood products and all kinds of tools, equipment, tools and equipment that may spread the disease are subject to the permission of the provincial directorate officials; Provincial Directorates ensure that the necessary samples are taken from the facilities where the disease is received, sent to the relevant laboratory for examination and testing, and ensures that other enterprises that have the possibility of infection are taken necessary measures,

e) If the disease occurred in the aquaculture facilities on land, all pools are evacuated for cleaning and disinfection processes, All eggs, fish or other aquaculture products that show signs of clinical disease are destroyed under the supervision of the provincial directors of the Provincial Directorate and again with the method recommended by the authorities,

f) After removing or disposing of fish, eggs, gametes or other aquaculture, pools, equipment and all kinds of materials, tools and equipment that may infect the disease, eliminating any risks that may lead to the emergence, spread or survival of the Province, It is cleaned and disinfected in a manner recommended by the authorities of the Directorate,

g) The activity of the breeding facility is not allowed until the risk of the disease disappears and the necessary precautions are determined and notified by the Provincial Directorate,

h) Disease investigation, measures taken, applications and results are reported to the central organization of the Ministry in a report by the Provincial Directorate,

i) All kinds of medicines and similar chemicals used in hatcheries and aquaculture plants are used depending on the veterinarian prescription, If necessary, medication can also be used with a magisterial prescription, One copy of the prescriptions of the drugs used in the facility is kept,

j) Procedures and principles regarding fisheries welfare are regulated by the circular to be prepared by the Central Organization of the Ministry.

- **Environmental Impact and Protection**

The precautions need to be taken regarding environmental impact and protection in aquaculture plants are as follows (Article 21-Chapter 8):

a) The requirement of conformity with the relevant provisions of the "Environmental Impact Assessment Regulation" is required in the projects of aquaculture plants,

b) Entrepreneurs must take measures to protect the environment during the establishment and operation phase of aquaculture plants, In this context, facility wastes are not released to the water environment in which they are located; All kinds of materials and materials that will impair the quality of water, harm the environment, human and aquaculture health are not used,

c) While the aquaculture activities are carried out, all kinds of precautions that will not cause visual pollution are taken, In this framework, in particular, bags and other wastes used in aquaculture are

regularly removed from the facilities, In addition, the structures on the land are designed in harmony with the environment they are in and their exteriors are painted in accordance with their environment,

d) Necessary measures are taken to prevent the species produced in aquaculture facilities from escaping into nature,

e) The waters left to the receiving environment in the aquaculture plants and hatcheries on the land must comply with the values reported in the Fisheries Regulation, and purification systems that will meet these conditions are established in the facilities,

f) Enterprises that do not currently have a purification system have to make the necessary changes in the layout plans and submit them to the relevant Provincial Directorates to approve the new settlement plans in which these units are included and their technical specifications are specified, The approval authority regarding these changes is the authority that approved the project, These facilities have to fulfill this obligation within one year from the publication of this Regulation,

- **Auditing**

Supervision for fish farms and the provisions regarding the inspection of aquaculture plants are as follows (Article 23):

a) Provincial Directorate officials inspect aquaculture plants within the framework of this Regulation and related legislation,

b) Routine inspections in aquaculture facilities are carried out by the Provincial Directorates in April, May and June of each year, and in March for hatcheries, an inspection report is prepared, Audit reports are sent to the Ministry central organization for hatcheries at the latest in April and for breeding facilities until the end of July,

c) It is obligatory to give a copy of the inspection reports to the facility where the inspection and control is carried out,

d) The provisions of the Fisheries Law No, 1380 and the provisions of the relevant legislation are applied for the provisions of this Regulation and the aquaculture facilities that are contrary to the other legislation referred to by this Regulation and the products produced by them,

Effectiveness and Execution measures are given in Chapter 10. The Central Organization of the Ministry is authorized to issue communiqués, circulars and instructions in order to ensure, facilitate, complete or explain the implementation of this Regulation, Matters not included in the Regulation (Article 26).

In cases where there is no provision in this Regulation, the operation is made according to the general provisions (Article 27).

- **Other provisions**

- **Directive on the application of Aquaculture Regulation (AR)**

This Directive has also brief clarifications on the application of some articles in the Aquaculture Regulation in order to simplify the procedures for farm implementations.

- **Implementation Principles of Article 5 (j) of AR-Capacities:**

In order to ensure the efficient use of the areas allocated for aquaculture investments, the capacities in net cages will not be less than 250 tons / year in sea and 25 tons / year in dams and natural lakes. However, the capacity condition is not required for the projects of marine fish culture farms in earthen ponds and in net cages in streams and small irrigation lakes. The procedures regarding fish culture in small irrigation lakes will be carried out within the framework of the instructions notified to the Provincial Directorates.

- **Implementation principles of Article 6 (b) of AR-Water quality criteria.**

The water criteria tables to be considered in the applications for aquaculture in inland waters and seas are specified in ANNEX-1-a, b, c.

- **Implementation Principles of Article 8 (b) of AR- Essential documents:**

Information and documents to be included in the fisheries project file:

- Information and documents required for the Pre-Permission,
- Letter of preliminary permit issued by the Ministry,
- Regarding the area where the facility will be established;
  - A document from the local Health Organization (Provincial Health Directorate, Environmental Health Directorate, etc.) stating that it does not have any health problems.
  - (Amended: 2006/1) Document obtained from the relevant institution (General Directorate of Highways or General Directorate of State Railways or the Provincial Organizations of these organizations) that there is no objection in terms of transportation,
  - (Amended: 2006/1) Document received from the relevant institution (General Directorate of State Hydraulic Works (requested at the preliminary permit stage), General Directorate of National Real Estate or the Provincial Organizations of these organizations) that there is no problem in using the water to be used in the facility,

Documents to be obtained from other relevant organizations if deemed necessary:

- Trade Registry Gazette for legal entities (Company, Cooperative, etc.),
- Project feasibility report
- A document indicating whether there is any objection according to the EIA regulation
- Compliance with project preparation disposition
- Draft Technical Specifications

- **Implementation Principles of Article 8 (d) of AR-Approval of the capacities**

Regardless of their capacities, production projects of trout, carp, sea bream and sea bass fish and inland water and marine hatchery projects (including 2,000,000 fry/year) with production capacity up to 2,000,000 pieces / year are approved by the Provincial Directorates.

Regardless of the capacity, the production projects for the cultivation of the turbot, sturgeon, eel, frog, aquatic plants, crustaceans and molluscs, and other species, trial production and organic aquaculture together are approved by the Ministry's Central Organization.

(Amended 3rd Paragraph: 2006/1) Projects to be implemented in small natural or irrigation lakes will be approved by Provincial Directorates.

Projects to be implemented for aquaculture in fishing areas and / or restoration projects are approved by the Ministry's central organization.

A copy of the projects approved by the Provincial Directorates will be sent to the Ministry's Central Organization within 15 (fifteen) days in accordance with the clause (e) of Article 8 of the Regulation.

- **Principles of implementation regarding article 9 (a) of AR-Certification**

For the entrepreneurs who are engaged in aquaculture, the "Fish Farming Certificate" and the "Aquaculture Hatchery Certificate" will be arranged as appropriate.

The documents need to be changed will be sent to the Ministry together with the new "Fish Farm Audit Report".

If an aquaculture certificate is issued for the first time, only the “Fish Farm Inspection Report” will be sent to the Ministry and the aquaculture documents will be filled in by the Ministry and sent to the Provincial Directorates after approval. The validity period of the aquaculture documents is limited to the rental period and the lease transactions of the entrepreneurs will be checked by the Provincial Directorates.

The old certificates are still in force and will be sent to the Ministry with the necessary documents by the Provincial Directorates to be replaced with the new document on the first visa date. During the visa of the documents, leases will be checked.

- **Principles of implementation of Article 11 (e) of AR-Modifications**

Entrepreneurs who want to make changes in the quantities of the species to be produced without changing the approved project, related to the species specified in the project, the project capacity remains the same due to economic reasons such as supply-demand, juveniles and sales prices; they have to get permission from the Provincial Directorates with the petition they attach to their annual production planning before that production season. This situation will be reported to the Ministry within 15 (fifteen) days.

- **Implementing Principles of Article 14 (a) of AR-Other documents**

In addition to the Aquaculture Regulation;

- Trade registry newspaper sample of legal entities who want to take over the project,
- Signature circular of the person or persons authorized by the person who wants to take over,
- Authorization certificate sample,
- Copy of the company's establishment document.

In order to transfer of the aquaculture certificate to the new applicant, transfer permission, the lease agreements (water, area, etc.), will be issued by the relevant institution on behalf of the new applicant.

- **Principles of implementation regarding Article 17 of AR-Leasing**

Issues to be considered in leasing transactions;

The order, which determined the Procedures and Principles Regarding the Areas to be Leased by the Special Provincial Administrations numbered SÜDB/250 11 10 11–426–1379 dated 30.01.2004, has been canceled and the principles to be followed in projects and non-project leases are as follows:

- Leasing of Fisheries Production Areas will be made according to the "Communiqué on Leasing of Fisheries Production Places" published in the Official Gazette No. 25348 dated January 16, 2004.
- Whether the aquaculture production areas will be opened for use for the first time with or without a project is determined by the Ministry's Central Organization with the proposal of the Provincial Directorates.
- After the notification of the rental value determined according to the lease notification to the tenant every year, the provincial directorate is sent to the Ministry's Central Organization within 15 days.

- **Amendment: 2006/1- Certificate of origin:**

In accordance with the circular that regulates commercial fishing, the information regarding the origin and fishing areas that should be arranged for the fishing areas in inland waters, as requested in the Fishing Area Information Form, will be written taking into account the stock amounts, and if no certificate of origin has been issued, it will be indicated on the form. In this context, the instructions regarding the submission of documents of origin dated 02.03.2005 and numbered SÜDB / 250 11 10 12–819–2835 and the instructions registered in their interests were cancelled.

- **Supplementary Article: 2006/1-Mapping of farm sites:**

It is applied to the Provincial Directorates with a petition attached to the map where the coordinates are specified by the entrepreneurs who want to establish net ponds in the seas. These documents will be sent to the Ministry's Central Organization to obtain the necessary permission in terms of voyage.

- **Additional Article: 2006/1-Leasing sites**

The short-term operation of the lagoons and net ponds without a project will be made in accordance with the principles of the Communiqué No: 2003/46 on the Lease of Aquaculture Production Areas published in the Official Gazette No. 25348 dated January 16, 2004.

- **Additional Article: 2006/1- Project preparation**

Operation of the lagoons and net ponds as projects will be done as follows:

- 6 months before the end of the lease term, in order to ensure the sustainable use of the lagoons, it is announced in accordance with the Communiqué No. 2003/46 on Leasing Fisheries Production Sites.
- The applications made are evaluated by the Provincial Directorates and those deemed appropriate are sent to the Ministry together with the project summaries.
- Preliminary permission is granted to those who are eligible for applications submitted to the Ministry.
- Projects to be prepared by the entrepreneurs within 3 months at the latest after the preliminary permit is submitted to the Provincial Directorates.
- Projects; It is examined under the chairmanship of the Provincial Directorate, with the participation of the University and Research Institutions, if necessary, by the Commission established at its location.
- The projects or projects deemed appropriate by the Commission are sent to the Ministry for evaluation together with the Commission report.
- Projects or projects approved by the Ministry are sent to the Provincial Directorates to be offered to participate in the lease tender to be opened by the Special Provincial Administration in accordance with the Communiqué No. 2003/46 on the Lease of Fisheries Production Areas.

The project of the applicant, who won the lease tender to be opened by the Special Provincial Administration, will be implemented and other preliminary permits and projects will be deemed to have been automatically canceled.

- **Implementing Principles of Imports inquires regarding Article 19 (Amended: 2006/1):**

Applications regarding the import of fingerlings, eggs and breeders will be made to the Provincial Directorate for Aquaculture. The Circular numbered SÜDB / 250 11 10 12 / 2619–5589 on this issue was annulled.

According to this;

- Import application; Plants with Fish Farming Certificates (Hatcheries can only import eggs and breeder), enterprises that have trial production permission and Universities and Research Institutions that want to import for scientific purposes.
- Import applications are made with a petition to the Provincial Directorate where the enterprise is located.
- Documents to be sent to the Ministry's Central Organization for import permission:
  - Petition

It must be signed by the authorized person or notary, authorized personnel from the notary and company stamped,

  - Control Certificate:
- While preparing the Control Certificate, it should be prepared in 3 (three) copies by the company in the format in accordance with the principles of the Standardization Communiqué published every year and the G.T.IP number should be left blank,

- It must be signed by the company's stamp and official or authorized personnel,
- If signed by the company representative, the company signature circular is notarized and 1 (one) copy, if the control certificate is signed by the authorized personnel, a notarized copy of the notary and 1 (one) approved by the company,
    - Invoice or offer invoice;
- Original and 2 (two) copies and certified 3 (three) copies translated into Turkish by sworn translation agencies,
    - Health Certificate;
- Original copy and 2 (two) copies and 3 (three) copies of them translated into Turkish by certified translation agencies,
    - Certificate of Origin;
- Original copy and 2 (two) copies and 3 (three) copies of them translated into Turkish by certified translation agencies,
    - Requirement Document;

The amount of fingerlings, eggs and broods to be imported is determined by calculating according to the type and capacity in the fish farming document or the regulation made in accordance with the clause (e) of article xi of the Regulation.

- Calculation of the product to be imported; In the import of the fingerlings, 4 individuals for 1 kg of production amount of the species to be imported, 5 eggs for 1 kg production amount in trout import, and the brood fish specified in the approved project for the brood import are taken into consideration.
- The amount of fingerlings, eggs and broods that will be imported annually will not exceed the amount calculated according to the type and capacity included in the aquaculture certificate of the facility. But; In accordance with Article 11 (e) of the Regulation, in case of a change in production planning, the final situation will be taken into consideration.
    - Trade Registry Gazette;
- 1 (one) copy of the related company's announcement in the trade registry newspaper,
    - Fish Farming Certificate;
- 1 (one) copy of the farming document of the relevant company
    - Commitment;
- All documents are true and as it is original,
- Letter of undertaking to be prepared not to use the material written in the control document other than its intended purpose.

    - **Implementing principles for Article 20 (a) of AR- Employment of Technical staff**

Fish farms, according to their project capacities, will employ at least 4 years of Faculty graduates providing training on fisheries or technical staff who have worked in the public for at least 5 (five) years. According to this; At least 1 for 50-249 tons / year, at least 2 for 250-499 tons / year, at least 3 for 500-749 tons / year, at least 4 for 750-999 tons / year, and 1000 tons / year and more at least 5 technical staff will be employed in the above facilities. The facilities that are still in operation will also employ technical personnel in accordance with this requirement within 6 months from the date of implementation of the Aquaculture Regulation Implementation principles.

(Additional Article: 2006/1) The official letter (s) received from the relevant institution (s) will be taken as basis in order to employ 5 years of public service in the facilities.

One copy of Fish Farming Regulation will be sent to the Ministry's Central Organization within 15 (fifteen) days after delivery to the Provincial Directorates.

3.2.4. Financial instruments for aquaculture business

Aquaculture sector is governmentally supported to be spread across country by numbers and capacities, diversification of the number of species farmed, increase the production for more supply to domestic markets and export. All of the actors took place in the designated authority, central and local governing bodies, research institutions, business supporting organizations, service suppliers and funding partners are working in harmony to reach the same target.

- **Agricultural Bank (Aquaculture and Fisheries Loans)**

Agriculture Bank is a state-owned bank in Turkey founded in 1863. It is the second biggest Turkish bank since 2012 according to the Bankscope database measured by total assets in USD. Besides agricultural support loans, Ziraat Bank serves citizens in all financial transactions.

  - **Commercial Credits:**

Real persons and companies of which have invested on fisheries and aquaculture activities may apply for fishery credits (aquaculture in sea, lakes, ponds; fishing in the sea and inland waters) for investment and operation. Fisheries loans are the credits allocated to the producers farming fish in cages in the sea and in soil and concrete ponds in inland waters (trout, sea bream, sea bass, etc.), and fishing industry in the seas for financing their investment and operational activities.

Fisheries credits for fish farming and fishing cover to supply juvenile fish, feed, medicine, fuel, labor, boat repair, all kinds of fishing and aquaculture tools and equipment, cold air storage, motor boat, fishing vessel fishing nets, etc.

In the determination of investment loans that can be used for investment expenditures, the size of the investment of the project is evaluated by taking into consideration the amount of equity of income and expense balance and customer credibility. In operational loans, an evaluation is made according to the capital requirement related to the enterprise that continues its production and fishing activities. Loans are allocated according to the evaluation reports applied by the banks, the credit rating of the customer requesting the loan, the loan term, the credit term and the collateral conditions.

Basic Requirements for real persons are:

- National identity card copy,
- Farmer Certificate / From Farmer Registration system
- Documents proving its agricultural property (land registration, rental contract, etc,)
- Documents related to collaterals to be shown against the loan
- Balance sheet and income statement for the last three years from companies operating on a balance sheet basis

For Legal Persons:

- Farmer Certificate / from Company Registry System
- Trade Registry Gazette where the legal entity articles of association (if any) are published
- Chamber registration document
- Tax certificate
- Decisions on the authority of representation of persons authorized to represent the legal entity and notarized circular of signature
- Balance sheet and income statement for the newly established legal entities belonging to the establishment and / or last year, and in others for at least the last three years
- Documents proving its agricultural holdings (land registry, rental contract, etc,)
- Documents related to collaterals to be shown against the loan,

  - **Subsidized Loan Applications**

In order to support investments on selected sectors, it has been decided by the attached decision signed by the President, Ziraat Bank and Agricultural Credit Cooperatives are assigned to implement the Decision on the Use of Low Interest Investment and Business Loans for Agricultural Production pursuant to Articles 3 of Law No, 4603 and Articles 1 of Law No, 5570.

The upper limit of the loan provided by Agriculture Bank in aquaculture business was doubled in 2020 compared to the previous year, reaching 10 million TL, Interest rates are applied in two ways as "INVESTMENT" and "OPERATION" period. According to the decision, encouraging subsidized credits for the fisheries sector could be applied as it was shown in the Table 4.1.

After the interest rate discounts given in Table 4.1. Ziraat's current 10% interest rate decreases annually by 5% for both periods. On a monthly basis, this rate corresponds to 5/12 = 0,41%, Of course, if you are a young farmer under the age of 40, or woman, in addition to the information above, for women investing in aquaculture, this rate decreases to by 0,16% per month and 2 % per year.

Requirements:

- Fish farmer or fishing license/certificate,
- Identity card and any property or ownership of boat to be deposited,
- Your credit rating should be over 1700 points and above,
- 2 guarantees together with their spouses,
- No debt document from the tax office.

Table 4.1. Discount credits of Agricultural Bank to aquaculture business

Topic	Reduction Rate (%)		Upper Limit of the Credit (Million TL)
	Investment	Operation	
Fisheries Sector	50	50	10
Aquaculture	10	10	
Young farmer/entrepreneur(≤40 yrs)	10	10	
Woman farmer/enterpreneur	10	10	

Highest reduction rate applicable	80	80	

- **KOSGEB[167] Grant Incentives**

KOSGEB was established in 1990 with the Law No: 3624, to provide services and supports only for the production industry SMEs until 2009, However, due to the increase in the added value production and employment creation potentials of other sectors in Turkey and due to the high requests received from SMEs in such sectors, the target of the KOSGEB had been enlarged to cover all SMEs.

KOSGEB Establishment Law was amended by the Law 5891 to provide essential legal grounds for KOSGEB to support SMEs other than the ones in the production industry sectors. The Cabinet Decree No 15431 on the "Determination of Sector and Regional Priorities of Small and Medium Enterprises that will Benefit from the Services and Supports to be Provided by KOSGEB" was published in the Official Journal dated September 18, 2009 (No 27353), and with this Decree, the sector and regional priorities related with the enterprises that will benefit from the services and supports to be provided by KOSGEB were determined.

Entrepreneurs can take advantage of KOSGEB grant incentives, regardless of what kind of fishing activity they conduct; importing seafood or exporting domestic fish from the nature or farms, KOSGEB supports everyone who sets up or will start a business as a production partner, by providing the conditions. Some of the sectors and fields are given below as it is indicated by the following NACE codes (Table 4.2):

Table 4.2. Sectors to be supported by KOSGEB funds

Nace Code	Sectors
10.2	Processing and storage of fish, shellfish and mollusks
46.38	Wholesale trade of foods including fish, shellfish and mollusks
47.23	Retail trade of fish, crustaceans and mollusks in stores dedicated to a particular property

The "Entrepreneurship Support Program" created by KOSGEB for entrepreneurs who want to get support to open a new business has been redesigned from the beginning of 2020, as "Entrepreneurship Development Support Program", which is now its new main name, includes grant support between 60000 TL and 370000 TL. According to the business model will be established, all entrepreneurs who will start a new business can benefit from these supports.

KOSGEB Entrepreneurship Development Support Program covers 2 kinds of support:

1. Traditional Entrepreneur Support
2. Advanced Entrepreneur Support

The only form that does not change is the "Applied Entrepreneurship Training", which is the first condition of the application to both programs. However, radical changes were made in these

[167] Small and Medium Enterprises Development Organization of Turkey, Ministry of Science, Technology and Industry; https://www.kosgeb.gov.tr/

trainings. The most striking one is the training given over the Internet with "Distance Education" technology. Whether it is “Formal” or “Distance Education”, it has become much easier to get an entrepreneurship certificate. However, while taking these trainings, "Distance Education" period was kept a little longer for those who will receive "Advanced Entrepreneurship Support".

- **KOSGEB Traditional Entrepreneurship Support Program:**

It is dedicated to applicants who will start a new business. The program takes place under 2 forms. These are;

- Businesses Established by Real Persons
- Enterprises Established in the Capital Company Status

The business ideas of those who will establish businesses within these two sectors must include the business ideas within the KOSGEB supported Sectors and NACE codes. Applicants must apply the KOSGEB support program if the business idea is not included in the "MANUFACTURING" sector. But if the business idea is within the "MANUFACTURE" sector in the NACE codes of KOSGEB, then the program needed to be applied is the "Advanced Entrepreneur Support" program.

While the program provides support for the expenses that previously received for work, machinery and rentals, it now provides support according to the insured premium that applicants employ with the majority,

Businesses Established by Real Persons: (within 1 to 12 months)

As a first establishment support of the workplace, applicant will be given a grant of 5000 TL without question,

According to the SSI[168] premium payments, the workers of the applicant have worked for between 1 and 12 months are given a grant of up to 20000 TL after 12 months. The number of these premium days can be easily calculated. Since there are 365 days in a year but on average 249 days are the working days. If the farm employs 1 person in 1 year, farmer will receive 5000 TL more at the end of the year,

If farm is operated within periods, applicant will receive 10000 TL. If 4 people employed in periods, applicant will receive 20000 TL grant at the end of that year.

If applicant is younger than 30 years old, or disabled, or female, veteran and martyred, applicant will receive a grant of + 5000 TL after 1 to 12 months.

Thus, if applicant catch the highest premium day at the end of 1 to 12 months after the 5000 TL for the workplace establishment, then he will receive a grant of 20000 TL and a total of 30000 TL in the first year by receiving a grant of + 5000 TL if he is younger than the age of 30 or disabled, veteran or female relative (If you are a company, you will receive a grant of 35000 TL and + 5000 TL establishment support, which was given in the first year).

Businesses Established by Real Persons: (within 12 to 24 months)

[168] Social Security Institute (Service)

If the applicant is disabled person, a relative of a martyr, an entrepreneur under the age of 30, a woman or a veteran, you will receive a grant of + 5000 TL after 12 to 24 months.

According to the number of day premiums for the staff employed, applicant will receive a maximum of 20000 TL at the end of 12 to 24 months.

Accordingly, if the applicant is a private company, after 24 months a grant of 55000 TL in 2 years, with a maximum of 25000 TL will be received. However, if the investment belongs to Capital Company, applicant will receive a maximum of 25000 TL grant at the end of 12 to 24 months, and a grant of 60000 TL with 35000 TL in the first year (Table. 4.3).

Table 4.3. KOSGEB support program

Support	Real Persons	Capital Company
Establishment support	5000 TL	10000TL
	1st Performance period Total premium days	2nd Performance period Total premium days
Performance support	for 180-539 days 5000 TL	For 360-1079 days 5000TL
	For 540-1079 days 10000TL	1080-1439 days 15000 TL
	1080 and over 20000TL	over 20000TL

- **KOSGEB Advanced Entrepreneur Support Program:**

In order to be able to benefit from this program, applicant's business idea should be among some of the business ideas included in the KOSGEB Supported sectors and the "MANUFACTURING" sector located in NACE codes. In addition, new entrepreneurs who have received "Advanced Entrepreneurship Training" shall benefit from "Distance Education" and "Applied Entrepreneurship Training" program. If applicant is active among these sectors and receives training, the grant amount of the business that will be given to the applicant within 1 to 24 months is the same as in the table given above. On the other hand two additional supports can be provided (Table 4.4).

As it is seen in the table, the machinery needed to buy for the business must be in the first place for the production. In accordance with this requirement and if the applicant's business is in the "MANUFACTURING SECTOR TABLE" grants will be given under the criteria:

- If the technology level is "low", a grant of 75000 TL allocated for the machine cost 100000 TL,
- If the company at the intermediate level, a grant of 150000 TL is received for the expense of 200000 TL,
- Although it is at a high level, 225000 TL grant is given for the cost of machinery for 300000 TL,
- In addition, a 7500 TL grant will be paid within the 10000 TL consultancy support.

Apart from the relevant conditions for the support programs, additional requirements from the new entrepreneur are:

- never received any grant from KOSGEB before,
- presentation of the business idea after "Entrepreneurship Training",

Then, it is necessary to create and apply KOSGEB registration.

Table 4.4. KOSGEB supports in advanced program

Type of the support	Support amount (TL)	Support rate (%)
Machinery*, equipment, software		
Low, low- medium technology level	100000	75
Medium-high technology level	200000	
High technology level	300000	
Mentoring, consulting, business coaching		
Support for consultant and business coaching	10000	75

*if the machinery is made in Turkey, support has increased additional 15%

- **Other Support Organizations/Funds**

Non-refundable credits; grants in brief, farmers in aquaculture business benefit from the grant opportunities up to 80% for their farms established in the selected cities within the scope of IPARD-2, until 2020, Until now, 3 trillion TL and 11000 project owners have been given their livestock investments completely free of charge, IPARD169-3 phase is expected to be approved by the European Commission.

Turkish Government provides interest and grants to farmers who are involved in agricultural activities in many areas. These opportunities are sometimes taken into consideration by certain time intervals and sometimes within the budget allocated to farmers. Some of other supporting institutions are:

- **Agriculture and Rural Development Support Institution (TKDK)[170]**

Agriculture and Rural Development Support Institution (TKDK) provides 80% grant on project basis, with the support of 75% European Union funds and 25% of Turkish Government; 80% of grant opportunities are provided to farmers in 2019 with many precaution titles. The institution provides its support within only 42 provinces (Trabzon, Rize, Samsun Ordu, Giresun and Kastamonu in the Black Sea Region).

- **Support Premium by Ministry of Agriculture and Forestry**

Providing the necessary conditions by the Ministry of Agriculture and Forestry, support payments are made to those who officially continue their aquaculture activities upon their application, In this sense, the Aquaculture Support Communiqué has been issued by the MAF and supports are given to the species included the legislation, Various measures are taken for state aquaculture production,

[169] EC Instrument for Pre-accession Assistance for Rural Development
[170] announcements can be followed at https://bit,ly/2U0t23V,

especially in issues such as fish species protection and fishing bans, Producers farming fish species determined in the communiqué are supported at the determined unit prices.

In order to benefit from aquaculture supports, it is necessary to produce the one in the listed species; such as trout, mussel, Black Sea trout, red spotted trout, fangri, synagrit, gilthead, yellowtail, yellow mouth, tilapia, eel, leech, shrimp, crayfish species, etc,, “Fish identification cards” supports are provided for fish species produced within the scope of intensive fish farming, In addition, within the scope of aquaculture, there are government grants for good agricultural practices (GAP).

The fish species supported within the scope of good agricultural practices are trout, sea bream and clam by 0,25 TL per kg, Production support is provided for those who are engaged in good agricultural practices, those who are registered in the system, those who make their applications within the application period, who submit their documents completely, those who do not produce juvenile fish and those who do not lose their right to benefit from the supports provided, and the productions made within the scope of agricultural practices are 0.25 TL per kilogram.

In addition, 0.25 TL are granted for those producing fish in intensive closed systems, there is no quantity limitation in the closed system,

In order to take advantage of the support given for aquaculture, it is necessary to meet the following conditions;

- Being farmer or member of a farmer family,
- Operating in rural areas
- Being a real and legal person
- Farming the fish species and mussel
- To have an aquaculture certificate approved by the Ministry (Figure 4.2),
- To have received Good Agricultural Practices Certificate from organizations authorized by the Ministry (MAF),
- To produce up to 500 thousand kilograms (There is no production limit for closed system)
- Obligation to register in the Agricultural Information System

Figure 4.2. Aquaculture certificate

- **Fish Recognition Card Support**

It is also known as label support, Applications will be made to the Provincial / District Agriculture and Forestry Directorates located in the region to be labeled, When the application is made, it is mandatory to issue a Fish Recognition Card Identification minute, However, if the farming is carried out in different provinces, two are issued and one of the documents is delivered to the provincial directorate in the region where the facility is located, The number of fish in the farm to be supported should be equal with the documents necessary for the label support. The following issues are taken into account in the calculation of labels to be supported;

- 3 pieces per kilogram in sea bream and sea bass production,
- 4 pieces per kilogram in trout, Black Sea trout and spotted trout farming
- 2 pieces per kilogram of new species
- One card is issued for over-kilogram fish farming.

Requirements for Application:

- Fisheries support application statement,
- Fish recognition card invoice,
- Fish catch report/sales certificate,
- Document showing that the harvested product is sold,
- Record report showing that trout harvest is made over kg,
- Fish label fixing report,
- Union or cooperative membership certificate,
- Copy of aquaculture certificate,
- Feed invoice,
- If juveniles are obtained from research institutions, a document proving this is required,

Variety of supports was allocated to fish farmers to promote aquaculture production and to spread fish farming business across country (Table 4.5).

Requests must be done to Provincial/Town Agriculture and Forestry Directorates together with the documents given below:

- Trout support application petition,
- Minutes or sales document showing that the harvested fish is sold,
- Sales document indicating that the product has been purchased or juvenile fish detection document,
- If there is membership to a cooperative on fisheries, partnership certificate
- Feed invoice

Two percent of support is cut as service costs and the rest of the payment is transferred to the farmers over the accounts of producers through Ziraat Bank, The responsibility for the documents submitted to benefit from the payment belongs to the applicant, In the event that it is determined

that an unfair payment is made, as a result of the Law on the Collection Procedure of Public Receivables 6183, these amounts are collected from the person who is paid, together with the delay hikes.

Table 4.5. Incentives for production in Turkey

Type	TL per kg	TL per fish	Remarks
Trout	0.75		≤ 350 tons
New species	1.50		
Closed (intensive) fish farm			
Big trout (>1.25 kg)			
Mediterranean mussel	0.10		
Carp	0.50		
Diseases free trout hatchery brood stok support		60.00	≤ 10000 fish
Aquaculture in soil ponds	1.00		≥ 30 tons

3.2.5. Insurance for Agricultural Investments (TARSIM)[171]

In addition to the crucial role in regard to the world population, the agricultural sector is extremely sensitive field of activity with its inherent structure, featuring exclusive in economic, social, political, technological and personal risks. To this end, the effective performance in the agricultural activities in the nutrition of the human being is closely related with the management of risks threatening the agricultural production. It is therefore, the developed countries effectively implement the risk sharing and risk transfer operations under various protective policies under the general titles of; Risk Management Programs; that also accommodates; Agricultural Insurance Practices as an important part integral to such programs. In order to provide coverage for the risks threatening the agricultural industry in the country, the implementation of an insurance mechanism has been considered and for this purpose, Agricultural Insurance Code No. 5363; was enforced as of 14/06/2005. The code provides:

- the establishment of Insurance Pool in regard to introducing standard provisions in insurance contracts to be executed to provide the coverage to the risks as referred under the Code, establishing the conditions for transferring risk under reasonable provisions, ensuring centralized payment of the indemnification upon occurrence of the risk, improving and spreading of the agricultural insurances,
- all tasks of this Pool are carried out by Agricultural Insurance Pool Management Company which, was established with equal share of the insurance companies participating in the Pool.
- insurance companies issue insurance policies with their own name however the risk and 100% of the premium must be transferred to Agriculture Insurance Pool. These insurance companies can optionally take share from the Pool through retrocession.
- the Government provides premium subsidy exclusively to insurance contracts executed under the Code, in terms of the premium on behalf of the farmers. The amount of premium subsidy

[171] https://web.tarsim.gov.tr/havuz/homePageEng

is determined by Council of Ministers on annual basis, with respect to the crops, risk, region and premises scale.

Agricultural Insurance Pool Board of Directors is assigned by The Code, as an administrative apparatus responsible for determining the principles and procedures of the Agricultural Insurance Pool, the loss assessment methods, executing the contract between the insurance companies wishing to take part in agricultural insurance and Agricultural Insurance Pool Management Company, observing due diligence in determining the risks the subsidy to be covered, observing the practical drawbacks and problems and proposing pertinent solutions. The Board consists of total of 7 members, two members from Ministry of Food, Agriculture and Livestock and Undersecretary of Treasury each, and one member from Association of the Insurance and Reinsurance Companies of Turkey, Union of the Agricultural Chambers of Turkey and Agricultural Insurance Pool Management Company each. The Board's first members are assigned by Ministerial approval dated 16.1.2006 for three-year posts.

Main duties and responsibilities are:

- To provide the insurance coverage for such catastrophe risks like drought, frost, etc., that cannot be covered by a single insurance company,
- To expand the capacity and coverage of reinsurance by encouraging the participation to reinsurances,
- To effectively make use of the information, human and financial resources of the insurance companies jointly,
- To effectively make use of the Government subsidies and excess of loss Protection,
- To prevent unfair competition in the prices,
- To encourage the participation in Insurance.

The Mission of TARSIM is to promote, spread of Agricultural Insurance and to conduct the necessary applications fast and accurate, in order to protect the farmers against the natural disasters and other risks.

Their Vision is defined as to turn out to be an exemplary organization entrusted by the farmer, capable of providing wide range of agricultural insurance covers as possible to all kind of agricultural crops grown in all agricultural regions of the country.

Species produced in the sea and land based farms; cage and nets that are recorded in the Aquaculture Registration System (ARS) are accepted for insurance following risk analysis and assessment within the scope determined by decision of the President pursuant to Article 12 of the Agricultural Insurances Law Ref. Nr. 5363. The present insurance is effective within the framework of the following Tariff and Instructions.

4. UKRAINE

4.1. Background Information

Aquaculture is a major component of the fisheries and agro-industrial sectors. Aquaculture production, as a source of high quality production mainly at the places of its consumption, which

does not require high costs for its transportation (in comparison with the sea and ocean), is a strategic resource of the state. In the current conditions of sharp reduction of ocean catch and critically depressed state of inland water bodies, the actualization of the aquaculture segment in Ukraine objectively becomes a sign of an alternative strategic vector of development of the fisheries sector. However, with its rich natural resource potential for large-scale development of fisheries, the state loses these advantages due to the lack of necessary institutional conditions. Thus, according to the State Agency for Fisheries, out of 250 thousand hectares of aquaculture suitable for aquaculture, only half are involved in modern conditions. Of these, 60% are inefficiently used and therefore have low fish productivity.

Official data on the number of reservoirs in the Odessa region indicate the presence of 1010 ponds and small reservoirs with a total area of 14300 hectares, most of which (up to 50%) are unfit for fishery use. The total area of the ponds currently used or can be used for fisheries needs is approximately 9.9 thousand hectares. This fund includes 211 ponds and small reservoirs, located in the basins of small rivers and, as a rule, they are of a complex purpose: fish breeding, irrigation, livestock breeding, population resting places. These reservoirs are rented out by local authorities. Also, seven pond fisheries have been built in the region, where the area of feed ponds for the production of commercial fish is 2 thousand hectares, and the ponds for the cultivation of fish planting material - almost 1 thousand hectares. Three pond farms have the status of state breeding nurseries under the authority of the State Fisheries Agency. Thus, aquaculture activity in the Odessa region is carried out today on reservoirs with an area of 12.9 thousand hectares, which is 7.6% of the total fishery fund of region`s reservoirs. There is an adequate reserve of reservoirs, the use of which has not yet been translated into the channel, lease relations. Among them are 42 reservoirs of local importance, with a total area of water surface area of about 2 thousand hectares, which is almost 58% of the real number of water bodies of local importance. Artificially created riverbeds include reservoirs with status of both national and local importance. The rates are either rented or under the Special Commodity Fisheries (SCF) regime, or combine a lease relationship with the SCF regime. The SCF modes are set for 7-10 years. Aquaculture enterprises are mainly in the form of LLC (Limited Liability Company) and CJSC (Closed Joint Stock Company).

The finding of the availability of reservoirs in the area of suitable fisheries is not representative and sufficient in terms of transparency and efficiency of regional management of this sector. According to experts of the industry, at present all suitable water bodies are actually used, but with different degree of 1 Silver carp, carp and white cupid legalization of this business in accordance with the basic law. The use is carried out arbitrarily or on the basis of previously concluded leases of land under water. The new aquaculture requirements require that such agreements be brought into line with the basic law, but this process is poorly motivated for tenants and is not accompanied by a clear mechanism for implementation. As a result, regional and regional fisheries management authorities do not have reliable information regarding the number, forms of organization and ownership of aquaculture enterprises, production productivity, etc.

The fishery use of water bodies of Odessa region is characterized by the following directions:

- aquaculture directly

- reservoirs in the mode of special commercial fisheries of SCF

- special use of aquatic bioresources under established limits and quotas (Black Sea, Danube River, Dniester estuary and lower Dniester, marine estuaries of the northwestern Black Sea and Kuchurgan reservoir).

Odessa region has a powerful fishery complex with developed infrastructure, which includes the Black Sea seaport, 6 fish processing plants and factories, fish processing plants, 104 fishing enterprises belonging to different forms of ownership, 5 large pond fisheries (with a total area of 5 ponds - 5,5 ponds thousand ha), 7 fish farms, four of which have breeding status.

Aquaculture opens wide prospects for the development of fishery complex in Odessa region. The coastal sea waters of the Odessa region have favorable conditions for the cultivation of shellfish (mussels, oysters), the industrial cultivation of which does not require the cost of artificial feed. From one raft with an area of 16x25 m, from which 600 ten-meter collectors are hung, it is possible to obtain more than 4 tons of oyster meat per year. At the same time, since the life of molluscs is related to the filtration of water, they purify water and improve the quality of the aquatic environment. The filtration rate of large healthy oysters can reach 450 liters of water per day. Organization of mariculture production of mussels and oysters in the coastal regions of Odessa region is constrained by lack of funds, poor coordination of work between organizations, lack of long-term concept of development of mariculture. In this regard, it is advisable to build complex fish farms to increase the population of mullet and flounder fish with a total capacity of up to 300 million units / year of viable rejuvenation. Of particular importance for the coastal regions of Ukraine is the problem of reproduction of sturgeon in the Azov and Black Seas. The capacity of the country's sturgeon factories and fish farms is around 8 million units. recharge, and in 2010 their required capacity should be at least 35 million units for sturgeon rejuvenation.

Promising in the basin is also the construction of complexes for cultivation, production and processing of seaweed and grasses.

There are 11 fish farms on the territory of the region with 1500 hectares of cultivation ponds and 11 hatching shops with a design capacity of up to 700 million larvae. Four farms have breeding status and carry out breeding of white and mottled silver carp, Ukrainian scallop carp, white carp and paddlefish. In addition, there are 937 water bodies (lakes, reservoirs, ponds) in the region, which can be used for fish production. The large coastline of the Ukrainian coast allows the development of marine aquaculture, which is the basis for many years of research in a number of scientific institutions. It should be noted that in Ukraine there is a fairly rich experience of fisheries, formed in the Soviet times, the analysis and systematization of which can compare the main types of aquaculture with the types of water bodies and forms of economic activity on them. Aquaculture activities are characterized by high environmental risks that are associated with the impact on the status of water bodies and land of the water stock, the risk of genetic contamination and the genetic degradation of natural fish species. Another important fact is that some of the water bodies in Ukraine are transboundary, which imposes additional requirements on aquaculture enterprises. In this regard, the organization of veterinary control and environmental safety is of particular relevance. The current crisis socio-economic situation in Ukraine significantly corrects pre-crisis

regional management and requires active search and offering to local authorities a set of effective management, economic, organizational and other mechanisms for creating effective regional economies on the principles of decentralization of management. Aquaculture as a sector of economy has serious resource preconditions to get into the mainstream of regional development of Odessa region.

4.2. Common Guidelines for aquaculture business in Ukraine

4.2.1. Institutional Framework

Aquaculture activity in Ukraine involves institutional interaction of the following parties:

- public authorities that regulate and manage such activities
- local self-government bodies
- aquaculture entities - legal or natural persons carrying out fisheries activities in aquaculture.

Key competences of state regulators of aquaculture activities that create a system of relationships and form management competencies and functions throughout the vertical of the sectorial management system. Distribution of powers of the main state regulators of aquaculture in Ukraine:

- **Cabinet of Ministers**: Ensuring public policy in the field of aquaculture. Provision of inland waters (inland waters) for inland sea waters, territorial sea, exclusive (marine) economic zone of Ukraine for aquaculture purposes. Organization of international cooperation in the field of aquaculture (CMU Resolution of May 29, 2013 No. 420 “On Approval of the Model Lease Agreement for Water Bodies”. CMU Resolution “On Approval of the Procedure for the Provision of Hydrotechnical Structures for Aquaculture Purposes and the Typical Form of the Contract for their Use” draft)
- **Ministry for Development of Economy, Trade and Agriculture, Ministry of Energy and Environment Protection:** Approval of regulations, methodological documents and programs of scientific and technological development on aquaculture (Order of MinAAP № 45 of 30.01.2013 “On Approval of Aquaculture (Fisheries) and Fish Productivity Zones by Regions of Ukraine”, MinAAP Order No. 414 of 7 July 2012 "On approval of the Procedure of artificial breeding (reproduction), cultivation of aquatic bioresources and their use." Order of the Ministry of Ecology № 236 of May 28, 2013 "On Approval of the Methodology for Determining the Fee for Leased Water Facilities", Order of the MinAAP No. 742 of December 16, 2013 “On Approval of the Procedure for Development of the Passport of the Fishery Technological Reservoir”. Order of the Ministry of Agriculture and Forestry "On Approval of the Procedure for the Implementation of Fisheries Reclamation" (Draft) "On approval of special forms of primary documentation for fisheries entities in the field of aquaculture.").
- **State Fisheries Agency**: Development of regulations and programs of scientific and technical development of aquaculture; control of activity and reporting of aquaculture subjects; personnel management; cooperation with international organizations on aquaculture, prevention of environmental pollution (State Targeted Economic Program for Fisheries Development for 2012-2016).

- **Local state administrations**: Leasing of a part of a fishery water body, a fishery technological reservoir for aquaculture purposes for use. Participation in the development and implementation of national and regional aquaculture development programs.
- **Local governments**: Leasing a part of a fishery water body, a fishery technological reservoir for aquaculture purposes in accordance with the land management authority established by the Land Code of Ukraine.

4.2.2. Regulatory Framework

4.2.2.1. EU Legislation

The State Fisheries Agency of Ukraine refers to the following documents[172]:

Regulation (EU) No 1380/2013 of the European Parliament and of the Council of 11 December 2013 on the Common Fisheries Policy, amending Council Regulations (EC) No 1954/2003 and (EC) No 1224/2009 and repealing Council Regulations (EC) No 2371/2002 and (EC) No 639/2004 and Council Decision 2004/585/EC

COM(2002) 511 final (COMMUNICATION FROM THE COMMISSION TO THE COUNCIL AND THE EUROPEAN PARLIAMENT A Strategy for the Sustainable Development of European Aquaculture) 2002

Association Agreement between the European Union and Ukraine31[173] involves the process of approximation and implementation of only one directive; Council Directive 92/43/EEC of 21 May 1992 on the conservation of natural habitats and of wild fauna and flora.

The Habitats Directive (more formally known as Council Directive 92/43/EEC on the Conservation of natural habitats and of wild fauna and flora) is a European Union directive adopted in 1992 as an EU response to the Berne Convention[174]. It is one of the EU's directives in relation to wildlife and nature conservation, another being the Birds Directive[175] . It is one of European nature's policies that establishes one organised network — Natura 2000[176], which intends to protect nature and wildlife. The Habitats Directive requires national governments to specify areas that are expected to be ensuring the conservation of flora and fauna species. The directive assures the conservation of endangered native animal and plant divisions. It aims to protect 220 habitats and approximately 1,000 species listed in the directive's Annexes. These are species and habitats which are considered to be of European interest, following criteria given in the directive. It directs member states of the EU to take measures to maintain the "favourable conservation status" of protected habitats and species[177]. Overall, however, it is relatively easy to conclude that EU law and policy pertaining to aquaculture remains highly prescriptive, diffuse and requires further reform with a view to ensuring that it is internationally competitive. Specifically, measures need to be adopted urgently to address

[172] Управління у сфері аквакультури (darg.gov.ua)
[173] https://www.kmu.gov.ua/en/yevropejska-integraciya/ugoda-pro-asociacyu
[174] BERNE CONVENTION, AS REVISED (cornell.edu)
[175] http://archive.jncc.gov.uk/default.aspx?page=1372
[176] https://ec.europa.eu/environment/nature/natura2000/sites_hab/biogeog_regions/index_en.htm
[177] https://academic.oup.com/jel/article/28/2/221/2404189

the seafood supply deficit in the EU that is currently served by the import of aquaculture products from third countries to the detriment of the industry in the Member States. Although it is beyond the scope of this chapter to canvas in any great detail the substance and form of future reform measures, there are nonetheless a couple of obvious axis for EU legislative intervention.

4.2.2.2. National Legislation

In the course of fisheries reform, in recent years, the legislative framework for the functioning of the industry has been significantly updated, which has contributed, among other things, to a certain actualization of business interests in aquaculture in Ukraine. In the Law of Ukraine "On Fisheries, Industrial Fisheries and Conservation of Aquatic Bioresources[178]", aquaculture defined as the deliberate use of fisheries aquatic objects (parts thereof) to obtain maximum amounts of useful biological agricultural products (fish, molluscs, invertebrates, algae, other aquatic organisms) by their artificial breeding and keeping.

According to Art. 1 of the Law of Ukraine "On Fisheries, Industrial Fisheries and Conservation of Aquatic Bioresources" Fisheries - an economy whose task is to study, protect, reproduce, cultivate, use aquatic bioresources, their extraction (extraction, capture, harvesting), sale and processing for the purpose of obtaining food, technical, feed, medical and other products, as well as ensuring the vessels navigation safety of the fishing industry fleet. The basis of fisheries is fishering farming and fishing.

It should be noted that current legislation uses the terms "**fisheries**" and "**aquaculture**" as synonyms. In particular, in Art. 1 of the Law of Ukraine "On the National Fisheries Development Program of Ukraine for the period up to 2010" enshrines two identical definitions of the concepts of fisheries (sub-sector of fisheries) and aquaculture. A broader and more detailed definition of these concepts is contained in Art. 1 of the Law of Ukraine "On Aquaculture", according to which aquaculture (fisheries) - agricultural activities for artificial breeding, keeping and cultivation of aquaculture objects in wholly or partially controlled conditions for obtaining agricultural products (aquaculture products) and its sale, production of feed, bioresources reproduction, breeding work, introduction, resettlement, acclimatization and reacclimatization of hydrobionts, replenishment of aquatic bioresources, conservation of their biodiversity and providing recreational services. Thus, it can be concluded that the legislation contains a broad and narrow definition of aquaculture.

This rule separated aquaculture from other types of possible activities on water bodies, combined by the definition of "special use of aquatic bioresources". However, in order to regulate the legal, economic, social and organizational principles of aquaculture in the complex, a special separate document was required, which became the Law of Ukraine "On Aquaculture", which came into force on July 1, 2013 (hereinafter - the basic one) Law). This document gives aquaculture the status of a separate type of agricultural activity in the system of agro-industrial production, - activity related to the cultivation of aquatic bioresources under controlled conditions, which consists in "artificial breeding, keeping and cultivation of aquaculture objects in wholly or partially controlled conditions for obtaining and sale of agricultural products (aquaculture products), feed production,

[178] https://zakon.rada.gov.ua/laws/show/3677-17

reproduction of bioresources, in breeding work, introductions, resettlement, acclimatization and re-acclimatization of hydrobionts, replenishment of aquatic bioresources, conservation of their biodiversity, and provision of recreational services." Thus, aquaculture is differentiated from other fisheries, which is due to the characteristics of aquaculture activities, which is significantly different from fishing, requires greater human intervention in production and, as a consequence, requires a separate management approach. The technical assistance of the Government of Ukraine through the State Fisheries Agency of Ukraine in the development of the Law on Aquaculture was provided by FAO specialists within the framework of the technical cooperation program TCP / UKR / 3301; Development of a new law on aquaculture in Ukraine.

According to the legislation, aquaculture can be carried out in inland water bodies (parts thereof), fishery technological reservoirs, inland sea waters, territorial sea and exclusive (maritime) economic zone of Ukraine, as well as on land areas of the territory of Ukraine, specially allocated for aquaculture purposes. For a systematic understanding of the specificity of aquaculture, key characteristics were classified as:

Sign	Types of Aquaculture	Contextual content characteristic
Types of cultivation environment	Freshwater	Breeding, maintenance and cultivation of facilities in lakes and reservoirs
	Brackish water	Breeding, keeping and growing aquaculture facilities in estuaries and lagoons
	Mariculture	Breeding, maintenance and cultivation of aquaculture objects in inland seawater, terriapia sea and exclusive (maritime) economic zone of Ukraine with the use of floating gardens, other technological devices using seawater
Consumption of finished products	Food	Used for direct consumption or processing for food fish.
	Non-food	It is used for production of forages, for reproduction of bioresources and replenishment of their stocks, for carrying out breeding and breeding work.
The level of production intensification	Intensive	It is made from compacted plantings with intensive artificial feeding of compound feeds, balanced in composition according to the biological needs of particular hydrobionts, other forages with high nutrition.
	Semi- intensive	It is carried out with the use of certain means of intensification, including with limited artificial feeding of feeds of different nutrients
	Extensive	It is carried out using natural fodder resources of fisheries water bodies without the use of intensification means
Organizational and technological forms of fisheries	Grazed	Extensive cultivation through the introduction of aquatic aquaculture diverse age groups into fisheries water bodies to enhance the utilization of their bioproductive potential
	Pond	Breeding, maintenance and cultivation of aquaculture facilities using fish ponds, artificially created reservoirs, separated from mother bodies of water, estuaries, flooded peat quarries and the like
	Industrial	Breeding, keeping and growing with the use of fishing and floating gardens, fishing pools, other technological devices, including the use of installations of closed water supply (UZV).

The basic law also states that aquaculture activities are aimed at increasing the production of useful biological agricultural products (fish and other aquatic bioresources), preserving biodiversity and replenishing aquatic bioresources in fisheries water bodies (their parts) of Ukraine, as well as on the implementation of fisheries activity by environmental means. That is, in a single regulatory field,

two types of fisheries are combined - reproductive and commodity, significantly different from each other in terms of goals, technologies, regulatory mechanisms, etc.

The reproduction of living aquatic biological resources (JWRS) has traditionally remained one of the priority tasks for the state in the field of environmental management, regardless of the fact that the process of reproduction to aquaculture has been referred to by the law and is the most normatively regulated. Reproductive fisheries are aimed at preserving the diversity of the WSSD, maintaining the ecological balance in aquatic ecosystems - that is, predominantly nature conservation. The main directions of state support for fisheries (aquaculture) and fishing farming are defined respectively in Art. 22 of the Law of Ukraine "On Aquaculture" and Art. 53 of the Law of Ukraine "On Fisheries, Industrial Fisheries and Conservation of Aquatic Bioresources". Commodity fisheries, in turn, is aimed at providing the population with food fishery products and has the characteristics of agricultural activities. As a consequence, there is a corresponding imbalance of interests when attempting to regulate all components of aquaculture within the framework of a single basic law, which is most clearly manifested at the regional level.

Aquaculture in Ukraine, unlike many other leading countries in the world, is not subject to licensing (!) In the classical form, this can be considered as a certain preference for national aquaculture enterprises. However, the legislation provides for other mechanisms of state regulation of aquaculture: such as conducting state registration of concluded contracts for the use of fisheries water bodies, fishery technological reservoirs; submission of information regarding intentions of breeding and cultivation of alien and non-native aquatic species, production volumes of aquaculture products; coordination of project documentation for construction of objects used in aquaculture. That is, the legislator specifies that individuals should be registered as entrepreneurs. Depending on the particular type of economic activity in the fisheries sector, the legislation defines additional requirements for business entities. It is obligatory to have positive veterinary and sanitary assessments of the status of industrial sites of fisheries water bodies of national importance and indicators of safety of fish, other aquatic living resources, etc. The Basic Law lists the directions of state support for aquaculture (Art. 22). Most of them relate to only one component of aquaculture - the reproduction of living aquatic bioresources (WSWR), so they create a certain imbalance of interests. An additional reason for this is the reinforcement of individual measures of state support by budget programs, namely, "Reproduction of aquatic living resources in inland waters and the Azov-Black Sea basin", "Selection in fisheries and reproduction of aquatic bioresources in inland waters and the Azov-Black Sea basin", "Organization of activities of fish protection bodies and fish breeding complexes". These documents provide mechanisms for the financial and organizational implementation of such areas as, for example, breeding works, including the creation and maintenance of tribal subjects, breeding herds and gene pools of aquaculture objects; restoration of populations of rare and endangered species of aquatic organisms and the like. As for the state support of commodity aquaculture, the basic law provides directions of stimulating nature only, without their specification and constructive mechanisms of implementation. For example, the declared promotion of the development of national feed production for aquaculture facilities; promoting the production of quality and environmentally friendly aquaculture products that are competitive in the domestic and foreign markets. Fishery and fishing farm products are agricultural

products. According to the Law of Ukraine “On stimulating the development of agriculture for the period 2001–2004” fish and seafood are attributed to agricultural products, fisheries and fishing farming to agricultural enterprises. The ownership of fisheries entities by producers of agricultural products is a form of state support.

The said provision was also enshrined in the Law of Ukraine "On Fisheries, Industrial Fisheries and Conservation of Aquatic Bioresources"37[179], according to which the subjects of the fishery complex, the activity of which is related to the industrial capture of aquatic bioresources at water bodies of national importance, breeding, cultivation and processing of own production, are recognized as producers of agricultural products (Article 53).

Fisheries and fishing farming are characterized by specific object composition. The list of objects of legal relations in the field of fisheries (aquaculture) and fishing farming is enshrined in the Law of Ukraine "On Fish, Other Aquatic Living Resources and Food Products" whose life is impossible without being in the water. Aquatic living resources include: freshwater, marine, anadromous and catadromous fishes at all stages of development; cephalopods, algae and other aquatic plants.

In pursuance of Art. 11 of the Law of Ukraine "On the Protection of Animals from Cruelty", the Cabinet of Ministers of Ukraine Decree No. 1402 of November 16, 2011 approved the Rules for the Transport of Animals, which set requirements for the carriage of animals by air, road, rail, sea and river. In the item 65-78 of the said Rules defines the peculiarities of transportation of fish and other aquatic organisms.

According to Part 1 of Art. 14 of the Law, a fishery water body for aquaculture purposes is leased to a legal or natural person in accordance with the Water Code of Ukraine. Paragraph e) of Part 2 of the Final and Transitional Provisions of the Law of Ukraine “On Aquaculture” was set out in the new wording of Art. 51 " Use of water objects on lease terms " Water Code of Ukraine. It provided for approval by the Cabinet of Ministers of Ukraine the Model Agreement on the Lease of Water Resources as well as the approval by the central executive body that provides the formulation of state environmental policy Methods of determining the amount of payment for leased water bodies. It should be noted that these tasks have been fulfilled for today: the Decree of the Cabinet of Ministers of Ukraine May 29, 2013 No. 420 approved the Model lease agreement for water bodies, and the order of the Ministry of Ecology and Natural Resources of Ukraine dated May 28, 2013 № 236 approved the Methods of determining the amount of payment for leased water bodies. Thus, we can state positive changes in the process of leasing the use of fisheries.

4.2.2.3. Requirements to invest for fish farming

In Ukraine, such a field of activity as fishing and the organization of fisheries, regulates the issuance of a number of permits, which is mandatory for obtaining permission to engage in one or another type of activity.

The following are the most common types of documents that are issued in accordance with the Law of Ukraine No. 3677-VI.

[179] https://zakon.rada.gov.ua/laws/show/3677-17

- Permission for the special use of aquatic biological resources in fishery water bodies (their parts)

This type of permit is issued by the central and territorial divisions of the state body responsible for the fisheries of Ukraine. The deadline for issuing permits established by law is up to 30 calendar days from the date of submission of the order on limits. Also during this period, a decision can be made to refuse to issue a permit. To obtain permission for special use, it is necessary to prepare a package of documents, a complete list of which is established by the Cabinet of Ministers. However, there are a number of reasons for official refusal. These are factors such as: errors or false information in the documentation provided by the business entity; filing an application in the absence of scientific justification for the use of biological resources; subject of households activities systematically violated the laws of Ukraine; there is no free share of the water limit; various non-payments, delinquencies in fines, taxes, etc.; inefficient use of resources; court decision, liquidation of an economic entity and other grounds.

Issuance of permits for the special use of biological resources is necessary for enterprises and individual business entities organizing economic activities for the purpose of commercial fish farming. The full procedure for issuing is determined by the Resolution of the Cabinet of Ministers No. 801 of October 30, 2013, as well as the Order of the Ministry of Agrarian Policy No. 414 of 07/07/2012.

- Permission for the special use of aquatic biological resources outside the jurisdiction of Ukraine

This type of economic activity, such as industrial fishing, involves fishing in various geographical locations. These are water resources of Ukraine, and biological resources related to the jurisdiction of foreign states. Law No. 3677-VI regulates the procedure for issuing permits for the special use of aquatic biological resources outside of Ukrainian jurisdiction, the features of which are defined in Cabinet Decision No. 800 of October 30, 2013. These biological resources include fishing facilities outside Ukrainian territories, which include: exclusive economic zones of other countries; areas in which economic activity is carried out on the basis of a convention agreement; open sea space.

Industrial fishing outside the Ukrainian jurisdiction is controlled by the method of state supervision in various fields. In particular, permits are issued, the receipt of which is mandatory for legal fishing. Obtaining this permission is based on a decision of the Central Executive Authority that administers fisheries. In addition, this type of document can be issued by the territorial divisions of this body.

- Registration form for catches (re-export) of Antarctic and Patagonian donkeys

This type of permits is based on the International Code governing fisheries and related environmental requirements. The design of this document is paid. The amount of payment is established by the CMU in accordance with the calculations of the central management of the relevant authority responsible for fisheries.

To obtain permission to register catches or re-export, you must submit an application to the appropriate fisheries authority, which within 30 days makes a decision, which can be either positive or negative. In the case of a negative answer, it is provided to the applicant in writing. The state

establishes strict requirements for imported products, so one of the common reasons for refusal may be the lack of necessary supporting documents and certificates.

The validity of the permit to register catches of the Antarctic and Patagonian donkeys is five years. To register this type of fish product, a special form has been developed, which must be completed in strict accordance with the rules. The full procedure for issuing permits is described in the Resolution of the Cabinet of Ministers No. 760 of August 15, 2012.

Permission to import and export specimens of species of wild fauna and flora, certificate for traveling exhibitions, re-export and introduction from the sea of these specimens that are subject to regulation of the Convention on International Trade in Endangered Species of Wild Fauna and Flora, regarding sturgeon and fish of which products.

A wide category of permits for various uses of biological resources, the full list of which is mentioned in the section heading, is regulated by the Law of Ukraine "On Fisheries, Industrial Fisheries and the Protection of Aquatic Biological Resources", as well as resolutions of the Cabinet of Ministers, which establishes, among other things, the necessary list of documents for provision by the applicant. The current procedure is established by the Resolution of the Cabinet of Ministers of Ukraine No. 953 of July 25, 2007.

In the case of a positive decision to grant permission to the business entity, a corresponding certificate is issued that indicates the official right to organize an exhibition or allows you to engage in the import and export of relevant products into Ukraine. The decision, both positive and negative, can be made within a month from the date of application.

Without a state certificate, the implementation of these types of activities related to rare types of plant products and representatives of endangered species of the water world is impossible. The mandatory procedure for processing this type of permit is stipulated by the Law of Ukraine "On Fisheries ...", which is the fundamental document in the field of water resources control.

- Confirmation of the legality of the removal of aquatic biological resources from their habitat and the processing of fishing products (if necessary, the business entity to carry out foreign trade operations).

Fisheries of Ukraine has its own central executive authority, which is engaged in the preparation of permits of various kinds. One of the most important types of mandatory certificates is official confirmation that the available aquatic biological resources were obtained legally. Such a document may be required if the subject of fisheries is engaged in the implementation of foreign economic relations.

The organization of international trade in biological resources of water origin is carried out in strict accordance with the Law of Ukraine No. 3677-VI, as well as CMU Resolutions on the lists of necessary documents and the procedure for registration. Such biological resources are fish catch, as well as products of its processing. Currently, such an order is determined by Cabinet Decision No. 596 of July 4, 2012.

Confirmation the legality of biological resources withdrawal of water origin can be issued both by the central authority of the Ukrainian fisheries and its regional units. This type of permit document is drawn up and issued free of charge.

Until recently, fishery activity in water bodies of national importance was carried out on water bodies of Ukraine in the industrial fishing regime under the limits of special use of aquatic biological resources, or in the fishery operation regime of a water body with an approved fishery exploitation regime.

- Fisheries in the regimes of PTS.

According to Article 17 of the Law of Ukraine “On the Animal World” and the requirements of Article 3, 59 of the Land Code of Ukraine, the receipt of a lease on land of a water fund does not provide the right to introduce and use fish and other aquatic biological resources in fishery water bodies. That is, in addition to the water fund land lease agreement, it is necessary to have appropriate permits for fisheries activities at water bodies, which are issued by a specially authorized central executive body on fisheries.

The most common type of fisheries activity at small water bodies of national importance was their use in the regime of fisheries exploitation (PTS). Now the situation with fish farming in inland water bodies has changed.

If the water body is leased, fisheries activities on it can be carried out as aquaculture or by the regime of “PTRX”. In accordance with Art. 27 of the Law of Ukraine "On Fisheries, Industrial Fisheries and the Protection of Aquatic Biological Resources" of the use of aquatic biological resources located within isolated natural or artificially created water bodies provided for the needs of aquaculture use, does not apply to special use and is carried out in the manner determined by the owners of these aquatic bioresources.

With the adoption of the Law of Ukraine “On Aquaculture”, fisheries activities in water bodies where commercial fishing of quotas is not carried out can be carried out both in the Special Use Mode (through the establishment of the PTS) and in the procedure for conducting aquaculture, which is not related to special use and is determined by the subject of aquaculture. In this case, it is necessary to proceed from the requirements of the law, according to which the subject of aquaculture can be a user with mandatory conditions:

- Obtaining a water body for use (lease or property).

According to Art. 14 of the Law of Ukraine “On Aquaculture”, a fishery water body for aquaculture purposes shall be leased to a legal entity or individual in accordance with the Water Code of Ukraine. It should be noted that reservoirs (except reservoirs for complex purposes), ponds, lakes and enclosed natural reservoirs are provided for use on a rental basis in accordance with and in the manner provided for in Art. 51 of the Water Code of Ukraine, for fishery needs, cultural, recreational, therapeutic, recreational, sports and tourism purposes, conducting research.

In accordance with Art. 1 of the Water Code of Ukraine, a complex reservoir - a reservoir, which in accordance with the passport is used for two or more purposes (except recreational). Water objects

used for drinking purposes, located within the territories and objects protected under the Law of Ukraine “On the Nature Reserve Fund”, as well as rivers, streams, canals, are not subject to transfer for use on lease for fishery needs.

The lease purpose must indicate the purpose of the lease - for the purposes of aquaculture (farming) (Article 13 of the Law of Ukraine “On Aquaculture”).

- Availability of a permit for special water use (Article 51 of the Law of Ukraine “On Aquaculture”);

The availability of a technical design or a water body passport (The procedure for developing a water body passport was approved by order of the Ministry of Ecology and Natural Resources of Ukraine of March 18, 2013 No. 99, registered with the Ministry of Justice of Ukraine on May 18, 2013 No. 775/23307);

The reservoir on which fish farming (aquaculture) activities are carried out must be isolated (Article 21 of the Law of Ukraine “On Fisheries, Industrial Fisheries and the Protection of Aquatic Biological Resources.”

In addition, attention should be paid to paragraph 2.1 of the order of the Ministry of Agrarian Policy and Food Of Ukraine dated January 30, 2013 No. 45, registered with the Ministry of Justice of Ukraine on February 11, 2013 No. 240/22772 "On approval of aquaculture (fish farming) and fish productivity zones in the regions of Ukraine", where, in order to ensure the rational use of fishery water bodies (their parts) when providing water bodies (their parts) for fish breeding purposes norms of fish productivity of aquaculture zones (fish farming) and zonal fish productivity in the regions of Ukraine.);

Users carrying out their business activities in fish farming (aquaculture) must provide reports in the form No. 1A - fish (order “On approval of the reporting form No. 1A-riba (annual)“ Production of aquaculture products for 20__ .. ”and instructions for its filling in ”of the Ministry of Agrarian Policy and Food of Ukraine dated March 21, 2012 No. .141, registered with the Ministry of Justice of Ukraine on April 9, 2012 No. 514/20827).

- The regime of special use of water bodies.

If the conditions stipulated by law cannot be fully met, then the relevant fishery reservoirs are unlawfully attributed to aquaculture and the Law of Ukraine “On Aquaculture” does not apply to them. Fishery activities in such reservoirs can be carried out by creating a PTSF, the activity of which is not limited to any conditions other than those specified by the Instruction on the procedure for the artificial breeding, cultivation of fish, other aquatic living resources and their use in special commodity fisheries, approved by order of the State Committee of Fisheries of Ukraine dated January 15, 2008 No. 4, registered with the Ministry of Justice of Ukraine on January 28, 2008 No. 64/14755.

The aforementioned Instruction does not foresee the lease of a water body or the conclusion of an agreement on cooperation in fisheries in the regime of PTS, since according to the lease agreement, a water body is provided to users for use and they are water users. During fisheries activities in the

regime of PTS, a resource of national importance is used - aquatic biological resources and, accordingly, they are users of aquatic biological resources. At the same time, the Regimes are approved by the specially authorized central executive authority for fisheries (currently - the State Agency of Ukraine), and the lessors of water bodies are the Cabinet of Ministers of Ukraine, state administrations, and regional councils.

According to paragraph 1.1, instructions on the procedure for the artificial cultivation, cultivation of aquatic living resources and their use "Artificial cultivation, cultivation of aquatic living resources and their use is carried out without withdrawing water and discharging used (waste) water at fishery water bodies...".

Permission for special water use gives the right to use water resources and includes: a limit on water withdrawal, a limit on water use and a limit on discharge of pollutants (Article 48 of the Water Code of Ukraine). The resolution of the issues of conducting fisheries activities in water bodies with a permit for special water use is not provided, since fish and fodder organisms belong to another type of natural resource.

By the method of full draining of water, fishing can be carried out only in bodies of water that are built and operate specifically for the purpose of commercial fish farming, as well as in those where aquaculture has been introduced.

Monitoring compliance with the contractual conditions for the lease of water fund lands, as well as over payment and compliance with the conditions for using the water fund lands and the condition of the property leased, in accordance with applicable law, lies with the body that concluded the relevant agreement - so far these are district state administrations.

In accordance with clause 2.1 of the Instructions for approval of the Regime, it is necessary to submit to the central executive body that implements the state policy in the field of fisheries (State Fisheries Agency of Ukraine) a draft regime for the fisheries exploitation of a water body, agreed by the territorial fishery authority; scientific and biological substantiation; an application agreed with the territorial body of fish protection, in the control zone of which there is a fishery water body; a map of the location of the CTX; certificate of state registration of a business entity (copies certified in the manner prescribed by law), a license for the right to economic activity related to industrial fishing in industrial areas of fishery water bodies (for water bodies more than 1 million m^2). The draft regime of fisheries management and the scientific and biological justification are developed by the corresponding specialized scientific institution, which has an approved program of work in this area.

The fishery exploitation regime assumes the whole complex of fishery measures, starting from the calculation of the introduction of valuable fish farming objects in accordance with the fishery indicators, water bodies (forage base condition, the presence of predatory fish species, etc.) to fishery land reclamation measures - mowing vegetation, sanitation of spawning grounds, and so on like that.

It should be noted that since the economy in the CTX regimen relates to the special use of aquatic biological resources, the limits for capture are set for indigenous species of fish (living in the

reservoir but not inhabited by the enterprise), and for the species - invaders (stocking objects) - planned catch indicators.

In addition, in order to support fisheries, the business entity, issued the regime of PTS, has the sole right to carry out fisheries exploitation of a water body.

In general, when choosing any of the areas of inland fisheries should take into account local characteristics. For example, when it is impossible to lease a water body, or if fisheries are planned to be part of the water body (the gulf of the reservoir is separated, which has not lost its hydrological connection with the main water body), or the body of water is not a drain, it is better to draw up the fishery management regime for the water body. In cases of small bodies of water equipped with operating spillway systems, aquaculture directions should be preferred.

IV. Overview of markets and marketing strategies in Greece, Romania, Turkey and Ukraine

1. GREECE

The present study for the overview of markets and strategic marketing in the Region of Eastern Macedonia and Thrace (EMT) and more generally in Greece contains information of the characteristics of the aquaculture sector, the management and promotion of the sector, the marketing strategy in Greece and in the Region of Eastern Macedonia and Thrace.

1.1. Characteristics, Structure and Resources of the sector in Greece

1.1.1. State of the art of the aquaculture sector

The aquaculture techniques used in Greece are the following (*European Commission, 2012*):

- **Extensive aquaculture in brackish waters**: animals that are often carried away by the current are kept in lagoons designed for this purpose. The introduction of the fish born in hatcheries and the provision of dietary supplements enhance the semi-extensive nature of this breeding. This form of aquaculture plays an important role in maintaining the natural heritage in coastal areas. Such examples are: sea bass, eel, common sole, flathead grey mullet, sturgeon, shrimp, shellfish and crustaceans.
- **Marine aquaculture in cages**: fish are kept in anchored cages which are held on the surface by a floating plastic frame. This form of breeding is mainly practiced in protected areas near to the coast, yet the most advanced techniques (diving cages, telecommunications, automatic feeding, etc.) make it possible to remove them. Examples: sea bass, sea bream, gilthead sea bream etc.
- **Intensive aquaculture in cages in freshwater**: concerns mainly fish lakes. Examples: carp, etc.
- **Shell farming** is based on the collection of "wild" offspring (via fishing, brood collectors) or offspring from approved hatcheries, which is fed with the nutrients offered by the environment itself (filter feeding animals). Shellfish and mussel farming account for 90% of the European production using a wide variety of techniques: bottom, slabs, wooden stakes, ropes, baskets, etc. Examples: Oysters, mussels, quinces, clams.

1.1.2. Specific characteristics

Aquaculture in Greece is a very important sector of economy. Marine farming is dynamic and contributes significantly to national economy. In the last decade, commercial fish farming has developed into one of the most developed sectors. Today, Greece ranks first between the European Union and the Mediterranean, in the production of commercial aquaculture fish, and therefore the sector ranks second in the export of "food and beverages". Twenty years ago, breeding sea bass and

gilthead sea bream was virtually non-existent, but in 1981 as a result of the good climatic conditions and the extensive and protected coastline, a number of private, national and European investments were made in the sector, which combined with advances in hatching technologies and food, took off the industry by reaching a production of 115,000 tons by 2008, corresponding to € 376,000,000 gains. About 70% of this production and 90% of the value comes from marine fish. Shellfish production accounts for 25% (*EUMOFA, 2018*).

In Greece, the predominant species, from 1956 onwards, is the rainbow trout (about 3,000 tons/ year), while in the past 15 years an attempt has been made to breed eel, sturgeon, mullet (Mugilidae) and ornamental fish. Sea bream (Gilthead seabream, *Sparus aurata*) and sea bass (European seabass, *Dicentrarchus labrax*) are the main species bred in Greece. In addition, 910 tons of fish farmed in lagoons corresponding to 5,000,000€ gains. The producers make significant efforts to differentiate themselves by trying to farm other species such as sharpsnout seabream (*Diplodus puntazzo*), common dentex (Dentex dentex), red porgy (*Pagrus pagrus*), white seabream (*Diplodus sargus*), common Pandora (*Pagellus erythrinus*) and common sole (*Solea solea*), with a total production reaching 1,800 tons in 2008. For these species, the production of offspring in fish-generating plants was developed.

About 80% of Greek aquaculture production is, mainly exported to Italy and Spain. Fish, mainly sea bass and gilthead sea bream, is the second most exported agricultural product after olive oil, and is considered as a product of a strategic significance by the Greek government. Production is mainly achieved with the use of sea cages and the production costs are among the lowest in Europe due to favorable breeding conditions (temperature, leeward bays, long coastline, etc.). Production sites exist throughout the Greek coastline, presenting a higher concentration in the central areas close to proper infrastructure and road network.

The main species currently farmed in Greece are the following, with a declining production volume:

1. Gilthead seabream (*Sparus aurata*)
2. European seabass (*Dicentrarchus labrax*)
3. Rainbow trout (*Onchorynchus mykiss*)
4. European eel (*Anguilla anguilla*)
5. Sharpsnout seabream (*Diplodus puntazzo*)
6. Red porgy (*Pagrus pagrus*)
7. Common pandora (*Pagellus erythrinus*)
8. White seabream (*Diplodus sargus*)
9. Atlantic bluefin tuna (*Thynnus thynnus*)
10. Common sole (*Solea solea*)
11. Flathead grey mullet (*Mugil cephalus*)
12. Common dentex (*Dentex dentex*)

The first two species cover 95% of the total production in Greece, leaving the rest being produced in very small quantities. Aquaculture is an important sector in Greece, accounting for more than 50%

of total fisheries production. In 2008, the production amounted to 115.000 tons, corresponding to € 376,000,000 (*Μπασιούλη, 2014*).

Research on aquaculture for the Greek Ministry of Rural Development and Food is carried out by the Center for Fisheries and Aquaculture Research in Kavala under the auspices of the National Agricultural Research Foundation.

Through the AQUAEXCEL network, Greek researchers have access to the European research aquaculture infrastructure. Through the Regional Platform of Greek Aquaculture and Innovation Platform (HATiP), Greece contributes to the European Water Innovation Platform (EATiP) supported by the AQUAINNOVA action of EU FP7. In this way, the industrial vision for sustainable future development is linked so as to satisfy the demand of seafood, always with the aim for research and development. As a result, Greece's leading position is expected to strengthen. Nevertheless, the average level of education for most of the workers employed in aquaculture remains low and the industry is still considered by many to be a primary, non-specialized industry[180].

1.2. Market research

1.2.1. Selling fingerlings to other producers

In Greece, fish producers are supplied by fish farms, mainly private or public (iridescent rainbow trout). Fish hatcheries are land facilities with high-tech systems and constructions, where the reproduction of fish takes place in a natural way and the brood is produced, and their water supply is done by the sea or by drilling. The collection of eggs by the breeders leads to hatching and breeding so that they can be turned into fish, which will then be supplied to producers. Most hatcheries have departments for:

- Brood stock
- Phytoplankton
- Zooplankton (rotifers)
- Artemia hatching
- Egg hatching
- Larval rearing
- Weaning
- Development
- Ongrowing

The total duration of fish farming in hatcheries usually ranges from 90 to 120 days, until they reach a weight of 1.5 - 2 grams and are then ready to be transferred to the fattening units.

In Greece, according to the latest data published by the Federation of Greek Maricultures (FGM), there are 29 marine fish hatcheries in Greece, and in 2018 they produced about 446.8 million fingerlings with a total worth of 111 million euros, with the unit price ranging from 0.2 euros for sea bream up to 0.4 euros for meagre. Almost 97% of them, represent the production of sea bream and sea bass and 3% the production of fry for all other Mediterranean species (sharp snout seabream,

[180] https://www.aquaexcel2020.eu/, http://eatip.eu/

pagrus, meagre). Compared to the previous year, there is a slight decrease of 2.7% in volume. More specifically, in terms of production of sea bream and sea bass, in 2018 a total of 432 million fish worth 86.4 million euros were produced. Almost 86.5% of them were placed in units in Greece and the remaining 13.5% were distributed in other countries (Spain, Croatia, Egypt, UAE, Tunisia).

More specifically, 250 million sea bream fish were produced, where compared to 2017 there is a decrease of 2.3% in terms of production volume. In terms of sea bream exports in 2018, a total of 40 million fish were exported, of which 45% in European countries (mainly Italy and Spain) and 55% in third countries.

Regarding the production of sea bass offspring, 182 million were produced, where compared to 2017 there is a decrease of 4.7% in terms of the number of fish. A total of 18 million fish were exported to other countries. According to the available data, in 2018, about 5.5 million sea bass fingerlings and 7.4 million sea bream fingerlings were imported to Greece from France. In 2019, the production of sea bream and sea bass decreased by 2.08% and a total of 423 million fingerlings were produced. In particular, 245 million sea bream and 178 million sea bass fingerlings were produced for each species (*ΣΕΘ, 2019*).

The Hellenic Statistical Authority (ΕΛΣΤΑΤ) announced that, in its research for the year 2018, production of trout offspring increased by 56.8% compared to 2017. Specifically, trout fingerlings in 2018 amounted to 9,384 thousand fish, compared to 5,983 thousand fish in 2017. Concerning other fish species, such as the sharp snout sea bream and the meagre increase by 8.2% in 2018 was observed, compared to year 2017. Specifically, the fry of other fish species in 2018 amounted to 16,679 thousand fish, compared to 15,408 thousand fish in 2017.

The areas where fish hatcheries operate are the following prefectures: Thesprotia, Fokida, Evia, Fthiotida, Lesvos, Chios, Etoloakarnania, Attica, Boeotia, Dodecanese and Kefallinia (Fig 1). Fish hatcheries are mainly located in coastal areas and usually belong to companies that also have floating fish farms of Mediterranean fish species and which have proceeded to verticalize their production (fingerling production, breeding and fish packing) (Υπουργείο Αγροτικής Ανάπτυξης και Τροφίμων, www.minagric.gr).

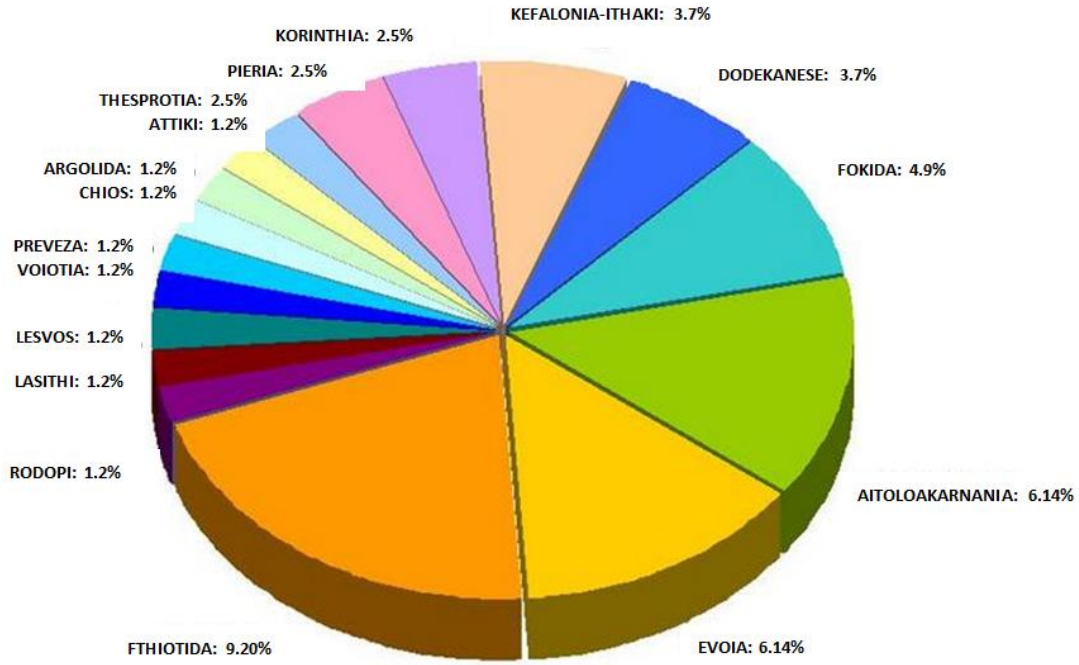


Figure 1: Geographical distribution of marine fish hatcheries (source: Gaiapedia)[181]

In addition to the above mentioned hatcheries owned by the private sector, State Hatcheries are Special Decentralized Fisheries Services of the Ministry of Agricultural Development and Food were established in 1990 (ΦΕΚ 159Α/ 28-11-1999) in order to implement programs of the Fisheries Directorate[182]. Their main activity is the production of fingerlings to enrich internal aquatic ecosystems, support new producers as well as those who have suffered certain damage from unusual disasters, carry out research in methodology of production and educational programs, implement new programs, support watercourses, support fresh water fish production, the reproduction of wild trout and other indigenous freshwater species for future enrichment of natural fish populations. The supply of fish from the State Hatcheries to producers is free of cost, under certain conditions. State Hatcheries in Greece are located in Ioannina, Pella, Drama, Preveza and Arta and produce trout, iridescent trout, golden trout, sea bass and carp, either for water enrichment or for supply to producers. The request for free procurement of fingerlings from the producer is addressed to the State Hatcheries and through the Directorate of Fisheries Applications and EAP is approved by the Secretary General of the Ministry. The General Directorate of Fisheries, taking into account the need to protect natural wildlife populations in the rivers of Greece and the need to avoid disruption of aquatic ecosystems, approves the granting of trout fingerlings for enrichment only in artificial lakes and dam areas.

Main hatcheries belong to State are:

181 http://www.gaiapedia.gr/gaiapedia/index.php/Υδατοκαλλιέργεια)
182 http://www.alieia.minagric.gr

Fisheries Station of Ioannina Address: 45500 Chani Terrovou – Ioannina Tel/fax: 26540-71297, e-mail: isioanninon@gmail.com	Experimental Cypress Farm – Eel Farm Address: 47100 Psathotopi - Arta Tel /Fax: 26810-42102 e-mail: pirki@otenet.gr
Fisheries Station of Pella Address: 58200 Edessa Tel /Fax:: 23810-20688/25578 e-mail: ispella@otenet.gr	Fisheries Station of Preveza Address: 48100 Pogonitsa - Preveza Tel /Fax: 26820-24016/25628 e-mail: ixsprevezas@yahoo.gr
Fisheries Station of Drama Address: 66100 Drama Tel /Fax: 25210-3579 e-mail: ixsdramas@gmail.com	

1.2.2. Street markets

Open-air street markets in Greece are active throughout its territory, and supply citizens and professionals with land food products, fresh sea/ freshwater/ aquaculture fishery products, processed food products - frozen food, etc. All open-air/ public street markets operate in every Region, Prefecture and Municipality of Greece. In order to be able to sell fish and other products from the producer through open-air street markets, it is required to issue a professional outdoor trade permit for Fresh seafood, freshwater, aquaculture. (*http://www.opengov.gr/ypoian/?p=7872 Υπουργείο Ανάπτυξης και Επενδύσεων*). A list with the open-air/ public street markets can be found on the website of the Panhellenic Federation of Associations of Producers of Agricultural Products of Sellers of Public Markets, where someone can search based on the day and/ or the location where the open-air street markets are active http://www.laikesagores.gr/laikh/agora/road/list?mode=list.

Public Fish Auction Halls are managed within the framework of fishing legislation. Their meaning and definition is mentioned in article 24 of Law 420/1970 (ΦΕΚ 27/ Α/ 31-1-1970). The Minister of Agricultural Development and Food, as a representative of the State, may assign the administration and management with the signing of a contract and specific operating conditions. At this day, the sole management body is CMFO SA (Central Markets and Fishery Organization). Fish Fish Auction Halls are eleven and are located in Piraeus (Keratsini), Thessaloniki (Nea Michaniona), Patras, Kavala, Alexandroupolis, Kalymnos, Preveza, Chalkida, Chania (Souda), Chios and Messolonghi [183].

Fish Auction Halls:

Fish Auction Hall of Piraeus Vassilis Katsiotis, Manager Tel: 210 4007880, 210 4325838 Fax: 210 4007827 Email: ixth-pir@otenet.gr	Fish Auction Hall of Chalkida Anastasia Voliotou, Manager Tel: 22210 25323 Fax: 22210 76323 Email: ixthxalk@otenet.gr	Fish Auction Hall of Kalymnos Konstantinos Pizanias, Manager Tel: 22430 23023 Fax: 22430 50853 Email: ixth1@otenet.gr
Fish Auction Hall of Thessaloniki	Fish Auction Hall of Chios Konstantinos Stoupos,	Fish Auction Hall of Preveza Ioannis Tolias, Manager

[183] *http://212.205.18.150/node/40, http://www.alieia.minagric.gr*

Dimitris Argyriadis, Manager Tel: 23920 35911, 23920 35913 Fax: 23920 35910 Email: ix-thes@otenet.gr	Manager Tel: 22710 24376 Fax: 22710 27171 Email: ixth-xio@otenet.gr	Tel: 26820 23090 Fax: 26820 24364 Email: ixth-pre@otenet.gr
Fish Auction Hall of Kavala Charalampos Mantas, Manager Tel: 2610 321792, 2610 324258 Fax: 2610 324258 Email: ixth-pat@otenet.gr	Fish Auction Hall of Alexandroupolis Nikoleta Torosiadou, Manager Tel: 25510 25121 Fax: 25510 25120 Email: ixth-ale@otenet.gr	Fish Auction Hall of Chania Tel: 28210 80195, 28210 80194 Fax: 2821080215 Email: xanixth@otenet.gr
Fish Auction Hall of Patra Charalampos Kantzaris, Manager Tel: 2610 321792, 2610 324258 Fax: 2610 324258 Email: ixth-pat@otenet.gr		

CMFO's fishmongers' branches throughout Greece make possible (for fishermen-traders as well as consumers) the supply of the country with fresh of good quality fish. At the same time, the local economy of each region is stimulated through commercial activity that develops in and around them, assisted by value-added services, such as packaging and processing plants, which increase the value of the raw material, for the benefit of the producer and trader and facilitating export process through facilities certified by the competent services of the EU.

Fish marketed on Auction Halls and originating from fish farming accounts up to 20% of the total catches, while 10% is imported. According to the existing data of CMFO for 2019, more than 8,500 thousand tons of sea bream and sea bass, which originated from aquaculture in the country, were distributed by the Auction Halls of Piraeus, Thessaloniki, Kavala, Patras, Preveza, Chalkida, Chania[184].

1.2.3. Selling live or processed fish to restaurants

The size of the market with fresh fish and seafood in value appears to reach € 1,230.8 million on an annual basis and is traded mainly through the retail channel (fish markets, S/M) and much less through Food Service (markets of mass catering). In recent years, freshwater distribution channels have expanded and consumers can find fresh fish not only in fish markets, but also in specially designed areas in organized retail (HM/ SM). The Retail channel (SM/ HM/ Discounters/ Small Retail, C&C, Specialized Retail) concerns the distribution of products through retail chains to final consumer and the annual turnover is estimated at € 142m. The Food Service channel accounts for 56% of the total turnover of frozen fish in the domestic market (*Enterprise Greece, 2015*).

Aquacultured fish are found as whole fish but also as processed in retail in Greece and in countries where they are exported, primarily on large-scale retail stores. Fish is a highly valued product for

[184] *https://www.okaa.gr/*

most fishmongers and restaurants. The price of wild euryhaline species can exceed 25 euros/ kg, while the aquacultured sea bass is generally priced below the 10 euro/ kg limit [185].

Fish remain in cages until they reach the desired size and are fished out. The first commercial size of fish is between 300-400 grams after 1.5 to 2 years. After having been removed from the fattening units, fish are transported to the packaging plant where they are selected and sorted by size and then packaged in Styrofoam boxes, processed or not. The processing of fish concerns the process of the removal of internal organs (gutting – evisceration) and/ or exfoliation, as well as in some cases filleting. In the Greek market, sea bream and sea bass are mostly sold through large retailers, but also specialized retailers, especially in markets such as the Varvaki Central Market in Athens, although limited. Although sea bass has a lower price than sea bream for the Greek consumer, there is a great demand in the field of catering and cash & carry chains such as Metro, The Mart and Masoutis [186].

According to data from the European Commission's Directorate-General for Maritime Affairs and Fisheries, 37% of Europeans and 75% of Greeks prefer products of fisheries and fish farming from their own countries. The vast majority of consumers buy fish and fish products from fishmongers and supermarkets, while fewer consumers suggest fish products from popular markets or fish markets and fish auction halls[187].

Most super markets have a specialized department for the sale of fish, which has a direct impact on the overall level of consumption. Since the end of 2014, freshly cleaned (gutted) sea bass has been offered in the Greek market and packaged. A large chain of super markets (LIDL) has developed a series of "FRESH FISH TODAY" which includes sea bass and sea bream. Cleaned sea bass (weighing 350 grams) was sold for 3.99 euros/ piece, i.e. 11.40 euros/ kg in February 2018 (sea bream was sold for 9.14 euros/ kg, at the same time). This large-scale retail company sells cleaned sea bream for 13.20 euros/ kg [188].

1.2.4. Groceries or live for pond stocking

This activity does not take place in Greece. It is worth noting that the enrichment of lakes with fish has in the past raised several reactions due to adverse changes in biodiversity that it may cause.

1.2.5. Food-size sport fish or ornamental fish

Amateur-sports fishing is governed by the provisions of ΠΔ 373/85 (FEK 131/ A/ 1985), of Regulation (EC) 1967/2006, as well as by those of the General Port Regulation, as it applies to the area where such fishing activity takes place. Amateur-sports fishing is fishing that aims for entertainment or sport and not for human consumption or income. Amateur fishermen must be provided with an individual amateur fishing license issued by the Port Authority. Amateur fishermen fishing on land are exempt from this obligation (*Γενικός Κανονισμός Λιμένα, άρθρο 232*).

[185] https://www.euromonitor.com/
[186] www.eumofa.eu
[187] https://ec.europa.eu/
[188] https://www.euromonitor.com/

Amateur fishermen are not allowed to use sliding nets, circular nets, grids, boat drags, motorized drags, branch nets, ragged nets and a combination of bottom nets. The use of setlines for highly migratory species is also prohibited in amateur fishing.

According to Regulation (EC) No 1967/2006, Member States ensure that:

- Amateur fishing should be conducted in a manner consistent with the objectives and rules of management measures for the sustainable exploitation of fisheries resources in the Mediterranean.
- Catches of marine organisms derived from amateur fishing should not be placed on the market. However, exceptionally, it may be permitted to trade items caught at sporting events on the condition that proceeds from their sale are donated to charity.
- Measures are taken to regulate submarine fishing with a sniper rifle, in particular in order to meet the obligations set out in Article 8 (4) of this Regulation, that fishing rifles are prohibited if used in conjunction with submarine breathing apparatus (or during the night, from sunset to sunrise[189].

The activity of amateur sport fishing is very promising and with economic benefits for Greece. Despite the fact that Greece has the natural wealth, so far it has not developed much. It is typical that there are several amateur fishing clubs that organize annual competitions and sport fishing festivals. Such activities take place in areas where they meet the specifications such as the artificial lake of Polyphytos in Kozani, where exclusively carp fishing takes place under certain conditions. Similar events take place in the lakes of Ioannina, Plastira and the springs of Aoos. It is worth noting that amateur sport fishing is not for commercial purposes, but is based on the "catch and release" philosophy.

1.3. Promotion and business-oriented approach in Greece

1.3.1. Marketing strategy

Some of the key conclusions on which marketing strategy and tactics are based are as follows:

- The price of the product (sea bream - sea bass) has been stabilized in recent years and is not offered as a field of intense competition.
- The product market is divided into internal and external. Domestic demand for sea bream and sea bass has been growing in recent years. The demand from abroad has to do mainly with the effort of Greek companies to be active in new markets. Thus, while the presence of Greek products in some markets (Italy mainly, but also Spain and France) has been established, an effort is being made to expand to new ones.
- In the period 2001-2005, many changes in the industry occurred; many companies were acquired while others merged, with the result that the industry now consists of a few very strong group companies and a number of other smaller companies. Entry barriers are very strong for a new company that wants to play a leading role in the industry and gain a market share of 5% -8%.

[189] http://www.alieia.minagric.gr/node/19

- Companies that are already active do not significantly use advertising or any other of the marketing tools in order to promote the product. There is no differentiation in any way of the product, as it is considered as one and common. The promotion of the product is based on personal contacts and the power of the distributor (commercial company, wholesaler) with which the respective company or the privately owned distribution network that some of the companies have developed over the years.
- The aid provided by the Greek state and the European Union is sufficient. But companies need to focus on quality and environmental protection in order to take advantage of these benefits. Largest companies in the industry are ISO and HACCP certified while some of them (e.g. Selonda) are AGRO 4-1 and 4-2 certified.
- The future for the wider aquaculture sector is very favorable. As the living standard in Greece and in the rest of Europe is constantly improving, fish consumption is playing an increasingly important role in daily diet and expenses of Greek households for fresh fish are increasing (*Γεωργακόπουλος, 2006*).

1.3.2. Product - variety, quality, design, features, brand name, packaging, services

Greece is the main producer of Mediterranean fish and accounts for about 40% of the world production. The main species of marine fish farms in Greece are sea bream with about 55% of total fish production, sea bass with about 40%, and sharp snout sea bream, pagrus, red snapper, meagre, common dentex, tuna and others with about 5%. The size of the total domestic production of sea bream - sea bass increased in the two years 2017-2018 with an average annual rate of 6%, after an eight-year continuous (almost) decrease. Sea bream covered about 57% of domestic production in the two years 2017-2018, and sea bass the remaining 43%. Exported quantities of sea bream and sea bass covered 78% -80% of total domestic production in recent years, with Italy being the main destination for the products under review (45% of total exports) over time, followed by Spain, France and Portugal. Imports are at very low levels, and domestic consumption has risen slightly in recent years. According to the results of the ICAP study, the leading position of Greek fish farming companies in the European market of sea bream and sea bass is a strong point for the examined sector. The fact is that the climatic conditions of Greece and its morphology (large coastline, many islands) favor the development of aquaculture. Weaknesses include the large production cycle of products, which requires high capital needs in conjunction with limited fish life (available as fresh) (*ICAP, 2019*).

Sea bream is a fish of the Sparidae family that is found in the Mediterranean and the coasts of the Northeast Atlantic. In terms of nutritional value, along with sea bass, they are among the most valuable fish in the Mediterranean as they are rich in omega-3 fatty acids. It is one of the main fish species suitable for aquaculture and the most farmed species in the Mediterranean. The sea bream is usually 35 cm long. The sea bass belongs to the Serranidae family and is found in the Mediterranean and off the coast of the Northeast Atlantic. The sea bass usually has a length of 40-65 cm and a weight of 5-7 kg. The products of Greek aquaculture companies are intended as ready meals or fresh fish in super markets, restaurants and catering, fish shops and refrigerators of standard fish products. In addition, fish are transported whole, filleted, cleaned (gutted) or frozen.

Organic aquaculture accounts for an extremely small percentage of Greek production as the demand for organic aquaculture 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 aquaculture fish. The main reason for the low demand for organic fish is their price, as it is almost 60% more expensive than conventional aquaculture fish. In 2018, the average price of organic sea bream and sea bass ranged at around € 8/ kg. The volume of production compared to 2017 remained stable, while no change was expected in 2019. Organic production is done by 2 certified units belonging to 2 aquaculture companies, while there are 3 private Control and Certification Organizations in the field of organic aquaculture (BIOHELLAS, COSMOCERT, GMCERT) who have been approved and supervised by the Hellenic Agricultural Organization "Dimitra" (ΣΕΘ, 2019).

The trend in the wider industry is that most companies do not link their brand to the available product. In this way, the end consumer does not have direct information about the company responsible for producing these fish. The product is considered as one and companies rely on the bargaining power of intermediaries in order for their product to be promoted for sale in fish shops, super markets, catering companies, catering, etc.

Large aquaculture companies (Fig 2) have developed a traceability system that covers raw materials, internal traffic, intermediate products, processes, and finished products. Many companies in the industry implement quality systems such as ISO and HACCP and follow the AGRO 4-1 and AGRO 4-2 standards, which are supported by the Agricultural Products Certification and Supervision Organization (AGROCERT).

The AGRO 4-1 standard includes general requirements for compliance with national and Community legislation and specific requirements for generators, the origin of the fish population, fry, fish density, breeding conditions, diet, health of the fish, treatment, veterinary monitoring, development, storage, transportation, training, hygiene and safety of staff and facilities, and compliance with traceability. Based on the standard, the company is obliged to keep books and records regarding the observance of all these specifications.

AGRO 4-2 includes general requirements for compliance with national and Community legislation and special requirements for facilities, sanitary facilities, plant operation programs, cleaning and disinfection of workplaces, occupational hygiene rules and medical certificates, staff training, product evaluation criteria, packaging terms and conditions, production, storage, compliance with packaging facilities and for manufactured and stored products, and traceability. As with the previous standard, the company must keep records and books on compliance with all these specifications (*Γεωργακόπουλος, 2006*).

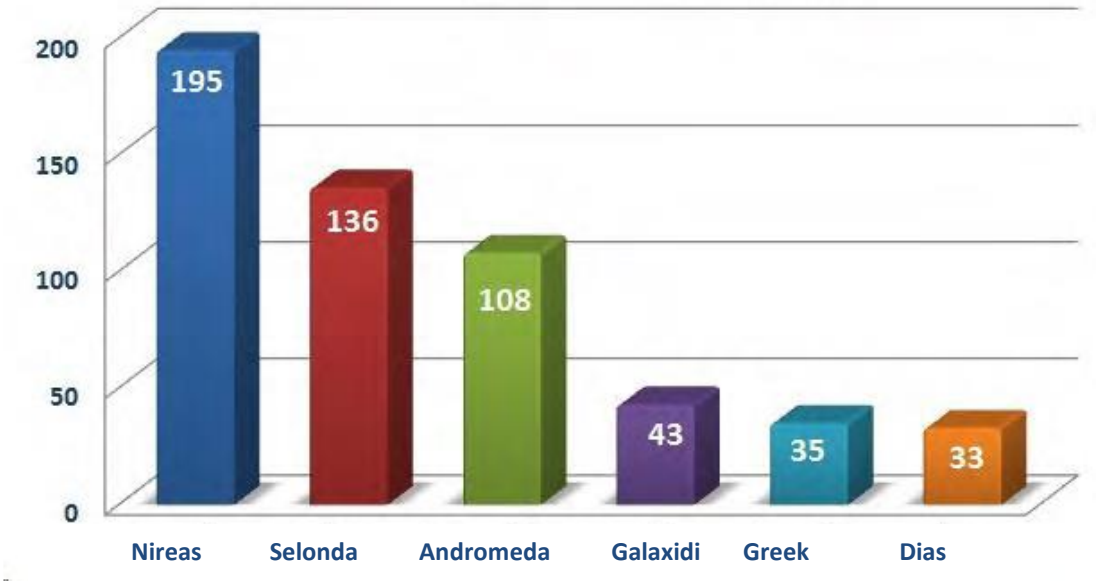


Figure 2. The largest Greek aquaculture companies based on sales 2014 (Γεωργακόπουλος, 2006)

1.3.3. Price - list price, discounts, incentives, payment period, credit terms

Factors that mainly affect the prices of the products are the seasonality of the demand and supply, the prices of the competitors but also the weight of the final product. The demand for fish is increasing during summer months mainly due to the increase in tourist traffic while decreasing respectively during winter months. Also, a large part of the production of fish farming companies is available in the market during the fall, which results in prices being under pressure during this period. Depending on the weight of the fish, the selling prices are also determined.

Aquaculture fish are considered commodity products, with volatile prices even at weekly levels, but also volatile production which depends on unbalanced factors. In 2012, the average price of sea bass amounted to € 5.10/ kg, which was an increase compared to € 4.20/ kg in 2011. Respectively, sea bream prices in 2012 were € 5.08/ kg compared to € 5.40 € in 2011 (*Χαβέλας, 2015*).

Prices for sea bass and sea bream in Greece in 2018 showed a declining trend for both species compared to the previous year. The average selling price of sea bream was € 4.53/ kg, showing a decrease of 1.5%, while for sea bass the average selling price was € 4.97/ kg, reduced by almost 6%. According to the available data, this trend is expected to continue, possibly fall of prices for both species, in 2019, due to the expected increased supply from third countries (Fig 3).

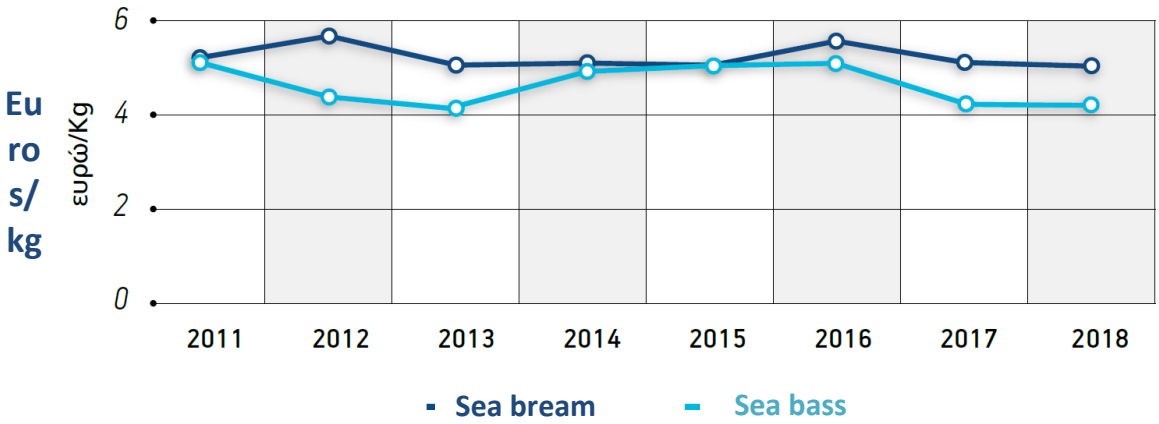


Figure 3: Average price for sea bass and sea bream during the years 2011-2018 (ΣΕΘ, 2019)

In addition to the domestic Greek market, Greek aquaculture companies also supply Italy, Spain, and France. For these countries, prices are shown below (Fig 4). The average price of sea bream in Italy in 2018 was 4.45 €/ kg, i.e. reduced by 4.91% compared to 2017. The value of exports (at producer prices) amounted to 101.9 million euros, an increase of about 1.09% compared to 2017 (100.8 million euros). The average price in sea bass was 5.04 €/ kg, i.e. reduced by 7.01% compared to 2017 (Fig. 5). The value of exports (at producer prices) amounted to 100.97 million euros, a decrease of 1.94% in relation to 2017 (102.97 million euros).

The average price of sea bream in Spain in 2018 was 4.36 €/ kg, i.e. reduced by 1.13% compared to 2017 (Fig 6). The value of exports (at producer prices) amounted to 38.37 million euros, a decrease of 1,49% compared to 2017 (38.95 million euros). The average price of sea bass ranged from € 4.26/ kg, down 9.55% from 2017 (Fig. 7). The value of exports (at producer prices) amounted to € 25.32 million, a significant decrease of 6.18 % compared to 2017 (26.99 million euros).

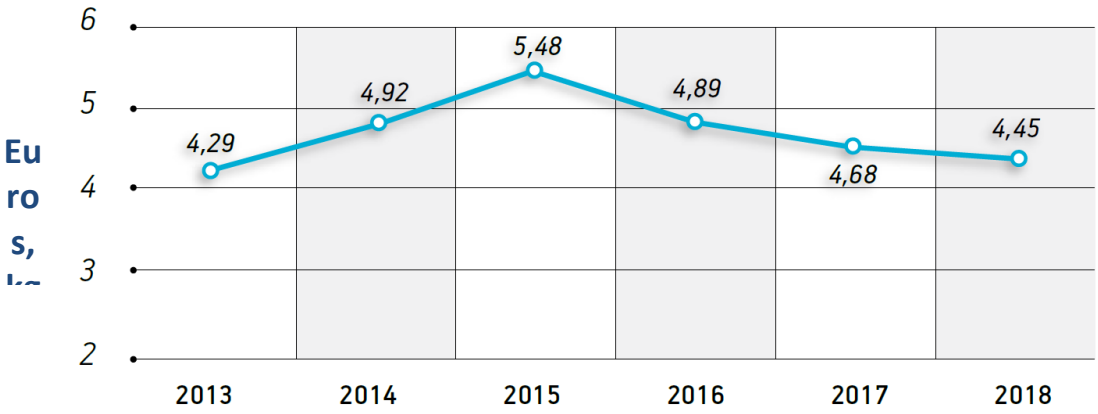


Figure 4: Average price for sea bream in Italy over the years 2013-2018 (ΣΕΘ, 2019)

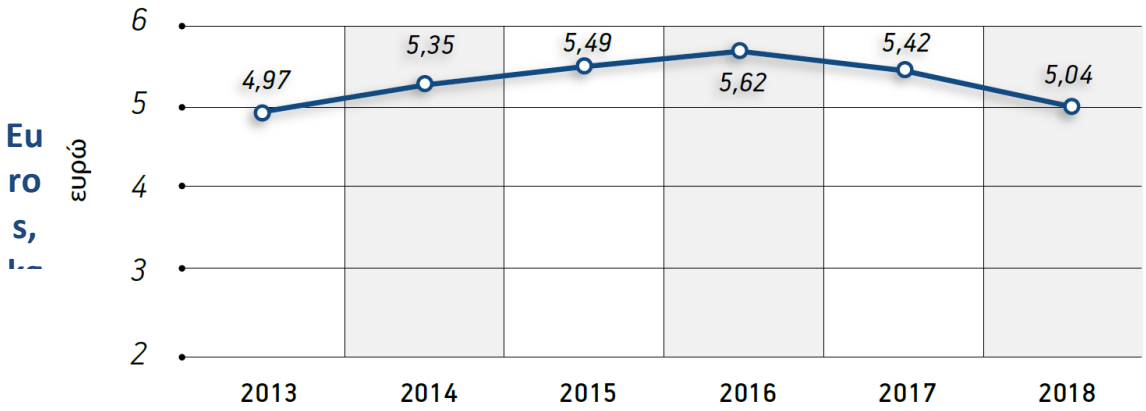


Figure 5: Average price for sea bass in Italy over the years 2013-2018 (source: ΣΕΘ, 2019)

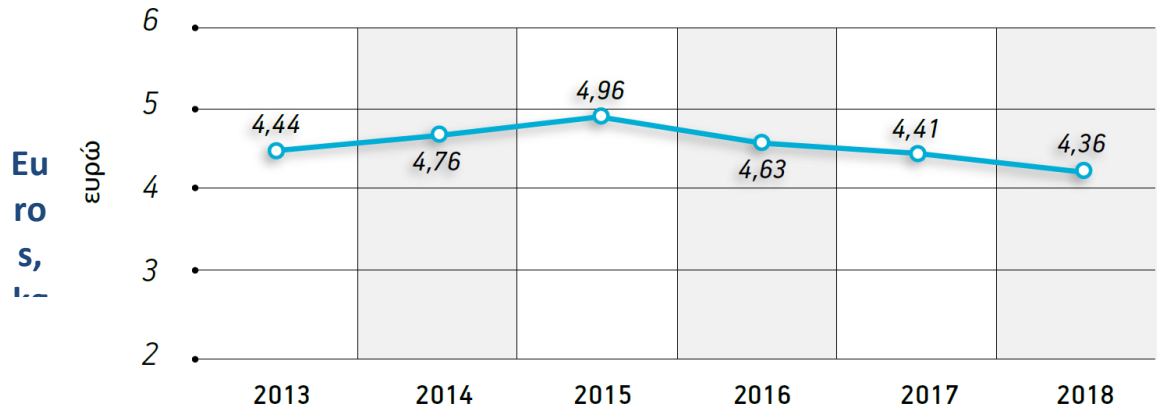


Figure 6: Average price for sea bream in Spain over the years 2013-2018 (ΣΕΘ, 2019)

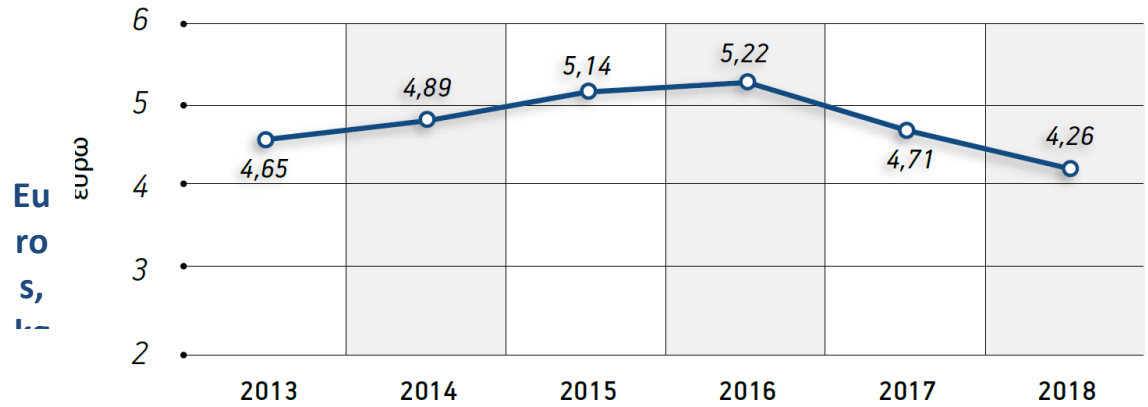


Figure 7: Average price for sea bass in Spain over the years 2013-2018 (ΣΕΘ, 2019)

The average price of sea bream in France in 2018 was 4.5 €/ kg, i.e. reduced by 2.17% compared to 2017 (Fig. 8). The value of exports (at producer prices) amounted to 31.4 million euros, a decrease of 6,8% compared to 2017 (33.7 million euros). The average price of sea bass ranged from 5.52 €/

kg, down 2.47% from 2017 (Fig. 9). The value of exports (at producer prices) amounted to 23.53 million euros, down 1.75% from with 2017 (23.95 million euros).

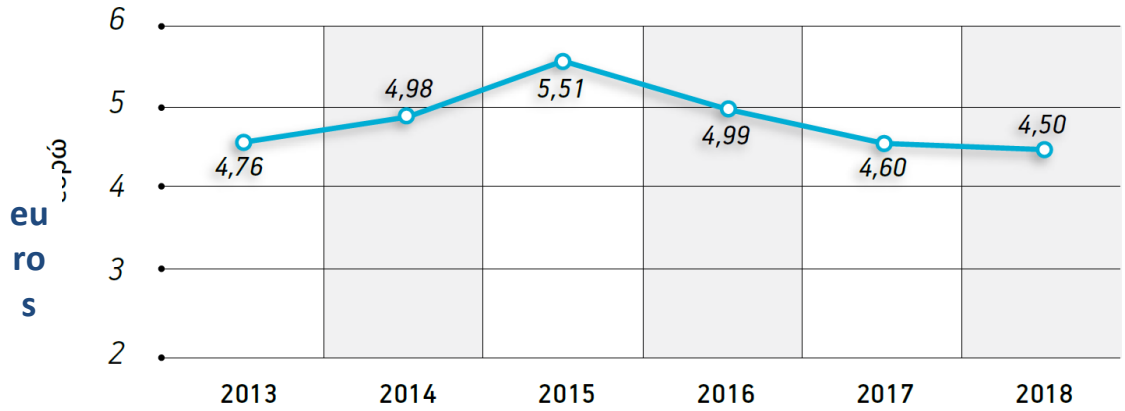


Figure 8: Average price for sea bream in France over the years 2013-2018 (ΣΕΘ, 2019)

Figure 9: Average price for sea bass in France over the years 2013-2018 (ΣΕΘ, 2019)

The terms of payment of customers as well as any granted discounts, due to the type of products and the size of the companies with which the companies cooperate, depend mainly on the quantities of orders of each customer. An average company in the market at the moment collects its receivables within 4 months (by checks with duration of usually 2 to 4 months). The company's goal is to be able to offer credit for up to 4 months, but not longer, in order not to be classified as unsecured. In addition, companies take into account certain quality characteristics, such as customer solvency, duration of cooperation, percentage of participation in sales. In any case, the need for companies to have sufficient liquidity is taken into account, so that they can cover their short-term liabilities.

1.3.4. Place - channels, coverage, assortments, locations, inventory, transportation, logistics

The location of an aquaculture unit is one of the most important features for the success of the unit. The choice of location is made after taking into account two basic requirements: a) requirements for a suitable maritime space, and b) requirements for a suitable land area to meet the broader needs of the project. Great significance is given to the correct choice of the maritime space that the

unit will be installed at, due to the fact this choice greatly affects the final result of the investment plan.

As already mentioned, the aquaculture industry uses various channels for the distribution of the final product: fish markets, fish auction halls, wholesalers, commercial companies and super markets. Many large companies-groups in the industry that have strengthened their presence in the market have extensive distribution networks as well as subsidiaries.

Deliveries of basic supplies (fingerlings, food and boxes) are made directly to plant facilities. The transport obligation is usually borne by the respective suppliers and is done by road with the transport means of suppliers themselves, while transport cost is included in the agreed prices. The total responsibility for the condition of the product until they are delivered to the unit is borne by the supplier. Transport of other supplies is made either privately owned by companies (private car) or by suppliers.

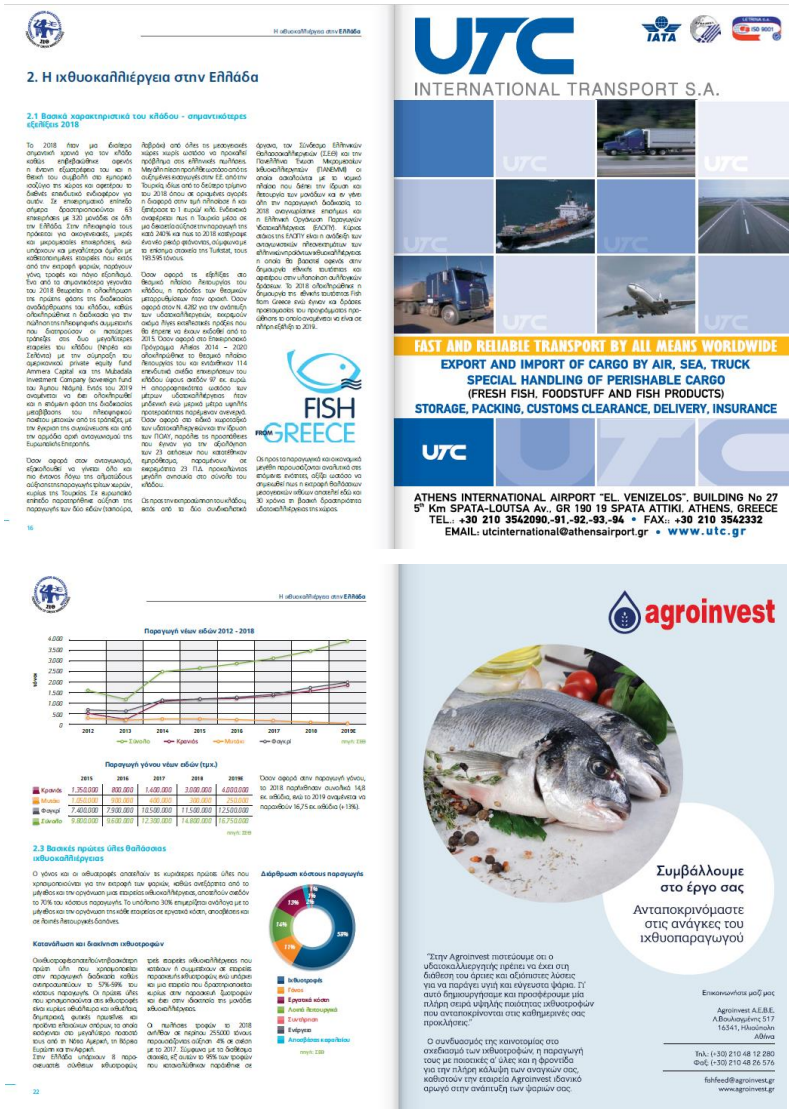
Supplies that need adequate storage space are food and packaging boxes. Boxes are usually stored in a space inside the packaging plant, while fish food is stored in a specially designed storage space. In addition, there is usually a general warehouse where the rest of the unit's equipment and supplies are stored (*Γεωργακόπουλος, 2006*)

1.3.5. Promotion - advertising, personal selling, sales promotion, public relations

In order for companies to promote their product, they use various elements of the promotion mix. Penetration and stay of a company in the market, due to the competition that prevails, requires the development of an intensive and effective plan of communication and sales promotion.

Personal Sale: This is the only tool in the mix used by most companies. It is the only way for a company operating in the industry to provide customers and especially intermediaries who will promote its products. In this context, personal sale emphasizes the advantages that customers will gain from the use of the product, such as increasing or maintaining profit margin (for all involved retailers-wholesalers), consistency in agreements, high product quality, etc.

Advertising: Some companies advertise their products/ services in periodicals (industry and content related to their subject matter). The purpose of these advertisements is mainly the recognition of the brand of the company by the final consumer but also by the other companies in the industry as well as by all those involved with the specific industry. A typical example is the registration of advertising by companies supporting aquaculture (transport, fish farming companies, fish farming equipment companies and fish farms, etc.) in the Annual Exhibitions of the Hellenic Marine Association (ΣΕΘ).



Publicity - Public Relations: The activities of this tool include the cooperation of units with university faculties (e.g. departments of biology, aquaculture, etc.) and technological institutes, providing facilities to students for the preparation of diploma and dissertations. The purpose of these activities is to create strong ties with the local community.

Website: Businesses develop their own website in order to provide complete information about the processes they use and their products. Through the website, customers of the company are given the opportunity to express their opinion about the product, as well as any complaints that have to do with it. In addition, there is the possibility of using websites as a platform for receiving electronic orders (*Georgakopoulos, 2006*).

Companies are judged not only by their financial results and the quality of their products and services, but also by their contribution to society as a whole. The actions of corporate social responsibility concern people, the environment and society. Social activities of the aquaculture

companies in Greece mainly concern the support of local communities, cultural events, support with for non-profit organizations, contribution to educational programs through University Institutions and Student Organizations, and sponsorships. (*Andromeda Group* https://www.andromedagroup.eu/, *Ιχθυοκαλλιέργειες Νηρεύς* http://www.nireus.com/1_1/arxikh-selida, *Ιχθυοτροφεία Σελόντα* http://selonda.com/).

1.4. Marketing strategy in the Region of Eastern Macedonia and Thrace

The effort for the development of Greek Regions goes through the possibility that they have to attract investment interest and to develop their priority sectors. Important elements are the general economic environment, legislation on the creation and operation of enterprises, the level of infrastructure, capabilities of human resources in an area, economic concentrations, geographical location, and more. However, marketing strategy also plays an important role. In the case of marketing a regional economy, the object (product) of marketing is the overall region, which as a "producer" offers products and services (*Kotler and Gertner 2002, Moilanen and Rainisto 2008*). Marketing strategists are primarily local actors such as regional and municipal authorities in collaboration with a number of other local actors (e.g. business associations, cooperatives, universities). Target groups, i.e. the recipients or the marketing market of a region, can be consumers, multinational companies, organizations, specialized human resources, tourists and citizens for their permanent establishment, research centers, educational institutions, etc (*Rainisto 2003*).

Competitive advantages have been developed in the Region of Eastern Macedonia and Thrace in terms of promoting the region's aquaculture companies.

1.4.1. Regional Agri-Food Partnership in the REMTH

At the end of 2018, the Regional Council of Eastern Macedonia and Thrace approved the establishment of the "Agri-Food Partnership" of the Region of Eastern Macedonia and Thrace. The aim of the Partnership is to record, group and promote the local products of the Region in the domestic and international markets in cooperation with local bodies, through the organization or participation in annual exhibitions and actions that bring producers and postprocessing businesses in contact with entrepreneurs. The priority of the Cooperation of the Region with the involved bodies is the promotion of the agri-food products produced in the area and the assurance of their surplus value, through the promotion of the comparative advantages of the products included in the regional "Basket", with the aim of improving the local economy and the development of the region.

It is a civil non-profit company created under the auspices of region REMTH. It is sought to give a regional dimension to the promotion of the products and a consultation group is created that proposes specific products for the "Basket of the Region", which in turn will form a network for their promotion. In this new Basket, the Region plans to include PDO and PGI but also new products that even if they do not have a specific designation, have those properties that make them valuable and competitive, and of course the conditions to become PDO.

The economic resources of the Agri-Food Partnership initially originated from the capital of the participating shareholders and in succession the Partnership supported by community programs. The main partner is the Region with a percentage of 49%, while the company can include Chambers, Municipalities, Production Groups and Associations of Agricultural Cooperatives, private companies that are active in the agri-food sector of the region. Working groups per regional unit are responsible for selecting local products, which are included in the basket of the Region [190].

1.4.2. Fisheries Cooperative of the Prefecture of Kavala

It is worth noting that the first modern constructions in Greek lagoons began in 1980 in Kavala, such as the technical interventions in the lakes of Delta Nestos that helped to implement the Italian technology, with the construction of the first modern fish trapping facilities. Later on, they spread to the rest of the lagoons of Northern Greece and then throughout Greece. Later on, the first wintering basins were created in the lagoons, aiming to protect small sized fish that enter the lagoons for overwintering (Ετήσια Περιφερειακή Έκθεση Επιχειρηματικότητας ΚΕΤΑ ΑΜΘ).

The Agricultural Fishing Cooperative of Lagoons has been active since 1950 in the Lagoon of Keramoti of Kavala, Agiasmata, Eratinos and Vassova, fishing and offering naturally grown fish (sea bass, sea bream, blue crab, mullet, roe), which are available daily from the Fish Auction Hall of Kavala. The members of the Cooperative are about 35 fishermen. Its productive activity amounts to 150 to 180 tons of fish per year. The Cooperative's fish farm is a fenced area of the lagoon, where fishermen open the "trap doors" when the water favors the movement of fish inwards, and close them in order to trap the fish. The blue crab found in Kavala (and nowadays in the whole coastal area of the region) is indigenous in the Atlantic Ocean and thrives in the Gulf of Mexico. It was introduced to the Mediterranean in the mid-20th century. After its last appearance in the North Aegean, the blue crab is growing rapidly in population.

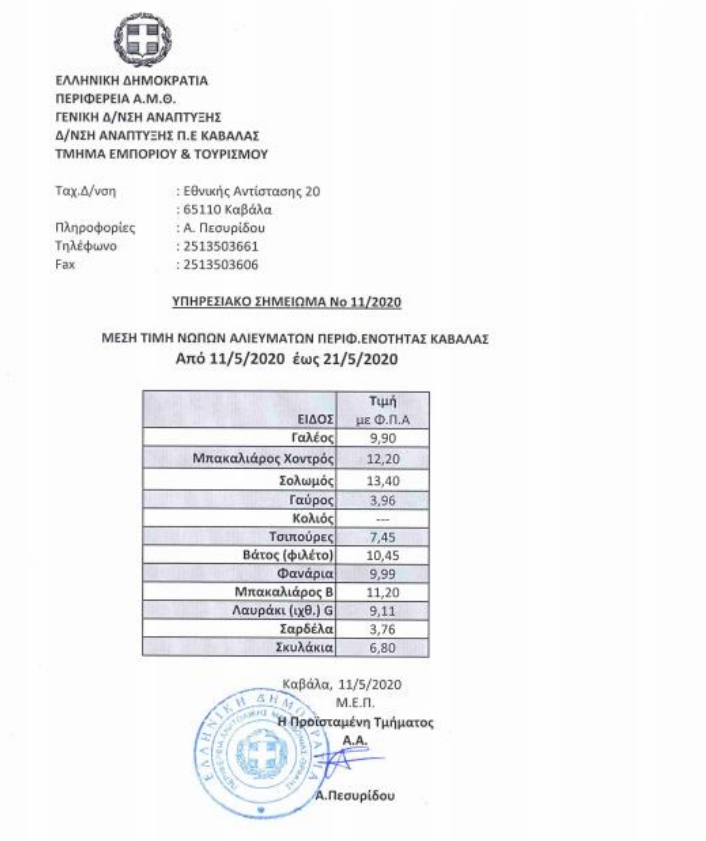
The Cooperative aims to develop its activity by creating a packaging plant with the possibility of smoking fish and packing the roe (“avgotaracho”) according to law. The creation of the packaging plant is expected to increase the value of the products, reinforce the local economy, create new jobs and improve the working conditions of fishermen[191].

1.4.3. Price - list price, discounts, incentives, payment period, credit terms

The most recent record for the average price of fresh fish in the Region of Eastern Macedonia and Thrace concerns the Regional Unit of Kavala for the period from 11/05/20 to 21/05/2020 (Fig.10):

- Sea bream: 7,45€ (per kilogram), Sea bass: 9,11€ (per kilogram)

[190] https://www.ypaithros.gr/agrodiatrofiki-simpraxi-stin-anatoliki-makedonia-thraki/
[191] Contact Information: Tenedou 15 – Fish Auction Hall of Kavala – Office No 17
Tel: +30 2510246572, Correspondence Office Tel: +30 2510222117, Brach Tel: +30 2591051544
Email: o5lt5k@otenet.gr
https://www.kcci.gr/memberpages/details/122/agrotikos-alieutikos-sunetairismos-limnothalasson



ΕΛΛΗΝΙΚΗ ΔΗΜΟΚΡΑΤΙΑ
ΠΕΡΙΦΕΡΕΙΑ Α.Μ.Θ.
ΓΕΝΙΚΗ Δ/ΝΣΗ ΑΝΑΠΤΥΞΗΣ
Δ/ΝΣΗ ΑΝΑΠΤΥΞΗΣ Π.Ε ΚΑΒΑΛΑΣ
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ΥΠΗΡΕΣΙΑΚΟ ΣΗΜΕΙΩΜΑ Νο 11/2020

ΜΕΣΗ ΤΙΜΗ ΝΩΠΩΝ ΑΛΙΕΥΜΑΤΩΝ ΠΕΡΙΦ.ΕΝΟΤΗΤΑΣ ΚΑΒΑΛΑΣ
Από 11/5/2020 έως 21/5/2020

ΕΙΔΟΣ	Τιμή με Φ.Π.Α
Γαλέος	9,90
Μπακαλιάρος Χοντρός	12,20
Σολωμός	13,40
Γαύρος	3,96
Κολιός	---
Τσιπούρες	7,45
Βάτος (φιλέτο)	10,45
Φανάρια	9,99
Μπακαλιάρος Β	11,20
Λαυράκι (ιχθ.) G	9,11
Σαρδέλα	3,76
Σκυλάκια	6,80

Καβάλα, 11/5/2020
Μ.Ε.Π.
Η Προϊσταμένη Τμήματος
Α.Α.
Α.Πεσυρίδου

Figure 10: Average price of fresh fish in P.E. Kavala from 11/05/20 to 21/05/20 [192].

Also, the most recent record for the average price of fresh fish in the Regional Unit of Xanthi concerns the period from 21/04/20 to 30/04/2020 (Fig. 11):

- Aquaculture sea bream: 9,67€ (per kilogram),
- Sea bass: 13€ (per kilogram)

[192] https://www.pamth.gov.gr/index.php/el/enimerosi/deltia-timon/psaria/item/63145-mesi-timi-nopon-alievmaton-no-11-11-5-2020-21-5-2020

ΕΛΛΗΝΙΚΗ ΔΗΜΟΚΡΑΤΙΑ
ΠΕΡΙΦΕΡΕΙΑ Α.Μ.Θ.
Δ/ΝΣΗ ΑΝΑΠΤΥΞΗΣ Π.Ε. ΞΑΝΘΗΣ
ΤΜΗΜΑ ΕΜΠΟΡΙΟΥ & ΤΟΥΡΙΣΜΟΥ ΠΕ ΕΒΡΟΥ

ΘΕΜΑ: ΔΕΛΤΙΟ ΠΙΣΤΟΠΟΙΗΣΗΣ ΤΙΜΩΝ

Οι διαμορφωθείσες τιμές κατά την κατωτέρω αναφερόμενη περίοδο στα παρακάτω αναγραφόμενα είδη που προσφέρονται στις προμήθειες

ΤΙΜΟΛΗΨΙΑ ΑΛΙΕΥΜΑΤΩΝ

ΑΠΌ 21-04-2020 ΕΩΣ 30-04-2020

ΣΗΜΕΙΟ ΤΙΜΟΛΗΨΙΑΣ	Α	Β	Γ	Δ	Ε	ΜΕΣΗ ΤΙΜΗ
ΕΙΔΟΣ						
ΒΑΚΑΛΑΟΣ ΜΙΚΡΟΣ						13,67
ΒΑΚΑΛΑΟΣ ΜΕΓΑΛΟΣ						15,67
ΒΑΤΟΣ						14,67
ΒΑΤΟΣ (ΦΙΛΕΤΟ)						
ΓΑΛΕΟΣ						10,67
ΓΑΡΙΔΑ ΙΧΘ						16,50
ΓΑΡΙΔΑ ΘΑΛ.						
ΓΑΥΡΟΣ						5,00
ΓΛΩΣΣΑ ΦΙΛΕΤΟ ΚΤΨ						9,12
ΓΟΠΑ						
ΚΑΛΑΜΑΡΑΚΙΑ ΚΤΨ						5,03
ΚΕΦΑΛΙΑ ΜΙΚΡΑ						
ΚΟΛΙΟΣ						
ΛΑΒΡΑΚΙ						13,00
ΛΑΒΡΑΚΙ (ΦΙΛΕΤΟ)						
ΜΕΛΟΚΟΠΙ						15,00
ΜΠΑΚΑΛΙΑΡΟΣ ΚΤΨ						6,64
ΜΥΔΙΑ ΣΥΣΚΕΥΑΣΜΕΝΑ ΧΩΡΙΣ ΚΕΛΥΦΟΣ 1kg						7,65
ΠΕΡΚΑ ΦΙΛΕΤΟ ΚΤΨ						7,45
ΣΑΡΔΕΛΑ						5,00
ΣΚΟΥΜΠΡΙ						8,00
ΣΟΛΩΜΟΣ						17,50
ΤΣΙΠΟΥΡΑ ΙΧΘ.						9,67
ΤΣΙΠΟΥΡΑ ΘΑΛ.						
ΦΑΝΑΡΙΑ						14,83
ΧΕΛΙΔΟΝΟΨΑΡΑ						7,00

Figure 11: Average price of fresh fish in P.E. Xanthi from 21/04/20 to 30/04/20 [193]

1.5. Marketing plan

Aquaculture companies aspire to establish themselves as companies whose brand will be synonymous with the consistency and high quality of their products. Their goal is to meet the needs of consumers with high quality products, the continuous modernization of their facilities and the expansion of their activities, so as to create more jobs, but also to use more environmentally friendly technologies, thus reciprocating their economic benefit to consumers.

The purpose is the production and distribution of aquaculture products in the Greek market but also the creation of the appropriate conditions in order to expand the activities in foreign markets. An additional goal is to plan the future course on a long-term basis and perspective (*Γεωργακόπουλος, 2006*).

[193] https://www.pamth.gov.gr/index.php/el/enimerosi/deltia-timon/psaria/item/62933-21-apriliou-2020-30-apriliou-2020

1.5.1. Executive summary – resources existent

There are about 65 fish farming companies in Greece, with 10,000 direct employees and 8,000 indirect employees. The investments of aquaculture companies reach 740,000,000 € (approximately 0.38% of the GDP). In addition, 3,258 licenses have been granted to breeding units, which are mainly located in isolated areas. At the same time, the fish feed market has developed, covering most of the domestic demand. Large companies in the industry have the ability to make direct purchases of fish feed from large foreign companies. The availability of fish feed is considered sufficient and in recent years there have been no shortages.

In order for a company to be able to operate efficiently and economically, it must have secured the availability of raw materials in the quantities described by its production program. In addition, the specific quantities must meet those quality criteria that contribute to the good quality of the final product. The domestic sea bream and sea bass fingerling market has grown rapidly in recent years, covering almost all domestic demand. It is also possible to import fry from abroad without major charges or discounts on quality. As for the quality of the domestic fry, it is characterized as excellent and is now widely recognized. Also, in addition to the supply needs of raw materials, it is necessary to continuously supply electricity, water and packaging materials, mainly during the stages of product collection and delivery to the customer. (*Γεωργακόπουλος, 2006*).

1.5.2. Target consumers

Customers of the products of Greek aquaculture companies can be divided into two main categories: a) domestic customers and b) foreign customers. Every year, a very large percentage of production is exported to third countries while the rest is consumed by the domestic market. Abroad, mainly the largest companies in the industry sell either directly or indirectly through commercial companies that own them. Fish consumers are people of all genders and ages and living standards throughout Greece. Customers of the Greek companies producing sea bream and sea bass also appear to buy products directly from abroad (mainly from Italy). This type of customer-companies has developed an advanced network that surveys the markets that produce products of interest, at a price that ensures profitability. Direct contact with the producer eliminates intermediate costs.

Generally, for an aquaculture business, the customer is not only the end consumer, but also all intermediaries who may seek to market the particular product. Therefore, the categorization of a company's customers could be done as follows:

- **Final Consumers:** They are the final recipients of the product to which all those involved are targeted, either directly or indirectly. Companies in the industry have set up their own retail outlets to sell directly to the end consumer.
- **Commercial Companies - Wholesalers:** They are all those who undertake to supply the market with the product they trade. Many of these companies and wholesalers have closed deals with mainly retail companies and have easy access to them, rendering them as a necessary distribution channel (customer) for many fish farming companies.

- **Retail companies:** They are all the companies - stores from where the final product is purchased by the final consumer (fish shops, super markets, etc.). The sale of the product to them can be done either directly by the production company or indirectly as previously mentioned through wholesalers and commercial companies.
- **Aquaculture companies:** It is very common for large companies in the industry to ask other smaller ones to produce sea bream and sea bass on their behalf, in order to then sell it mainly in foreign markets or process it (*Γεωργακόπουλος, 2006*).

1.5.3. Selling strategy – the concept of unique selling proposition- USP (Unique Selling proposition)

The Unique Selling Proposition refers to the unique benefit of a company, service, product or brand that allows it to stand out from its competitors. The Unique Selling Proposition should be a feature that highlights the benefits of products that make sense to consumers. Typically, uniqueness is provided by a single process, component, or system that produces the described benefit. Businesses use slogans to communicate their Unique Selling Proposition (*Entrepreneur; Laskey, 1989*).

Some examples of slogans used by big companies in the field of aquaculture operating in Greece are "Your nearby sea fisherman" of the Andromeda Group, "A global leader, your local partner" of Nireus Aquacultures, "The original selection from 1981" by Selonda Aquacultures. The communication of the slogan of a company and therefore its Unique Selling Proposition is done through the home page of its website but also in the packaging it uses (*https://www.andromedagroup.eu/*, *http://www.nireus.com/1_1/arxikh-selida*, *http://selonda.com/*).

1.5.4. Pricing and positioning strategy

Once the target market is determined, the corresponding placement strategy is developed, i.e. the image that a company will try to create for its products, so that the target customers recognize the benefits they will have from their consumption. Due to the fact that the target market is the same target market for many competing companies, product placement must create a stronger, more exclusive and clearer image. For this reason, placement is based on the differentiation strategy and usually follows the following strategies:

- **Value for money:** the product is presented as low price and high quality, thus maximizing the value that the customer of the company perceives from its consumption. In order to implement this strategy, low operating costs must be achieved, but not at the expense of quality.
- **Product quality feature:** The product addressed to the final consumer indicates both the name of the company and the date of its catch. The goal of this strategy is to create a direct relationship of trust between the company and the end consumer (*Γεωργακόπουλος, 2006*).

1.5.5. Distribution plan

The aquaculture industry in Greece uses various channels for the distribution of the final product, such as fish markets, fish auction halls, wholesalers, commercial companies and super markets. The largest percentage of production is marketed through wholesalers and commercial companies. These companies procure and resell aquaculture products to other wholesalers or retailers and catering companies. Many large companies-groups in the industry that have strengthened their presence in the market have extensive distribution networks as well as subsidiaries (*Γεωργακόπουλος, 2006*).

Distribution of aquaculture products by the companies of the sector in the domestic market, as well as abroad, is carried out mainly through wholesalers (approximately 85% of the production). The aquaculture sector is among the largest exporting forces in Greece and about 80% of total production is exported to Europe (Fig. 12).

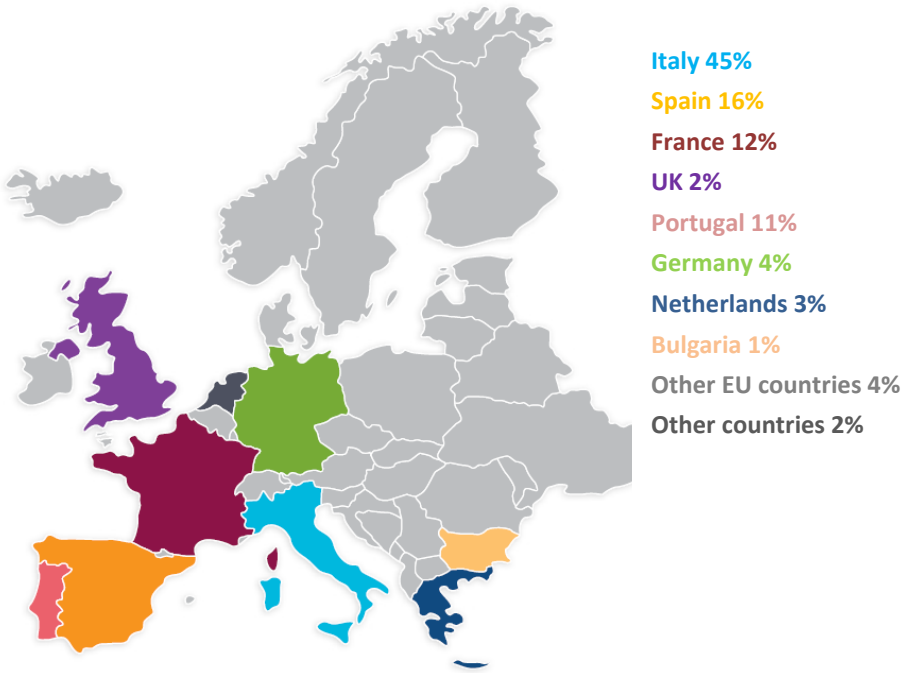

Figure 12. Exports of Greek aquaculture fish in 2018 (ΣΕΘ, 2019)

The largest companies in the sector have organized distribution networks through subsidiaries that promote them mainly abroad. In addition, these companies also sell fish on behalf of smaller companies in the industry that do not have their own distribution network. In addition to wholesalers, some companies in the industry have their products directly in fish markets and super markets (about 15% of production). The final consumer gets fish supplies from aquaculture through fish markets, fishmongers and catering establishments. Fish markets and fishmongers are the most important aquaculture network in retail. The great geographical expansion of super markets has brought significant changes in the structure of distribution networks in recent years, as consumers cover a significant part of their needs through this channel. Super markets are expected to further

expand their market share in the near future, following the conditions and trends prevailing in the European market. Their ability to achieve low prices and credits from producers due to the large volume of orders, allows them to offer lower prices to consumers compared to other points of sale (*ΣΕΘ, 2019*).

1.5.6. Offers

Supplies to aquaculture products in Greece depend on both seasonal demand and supply from the supply channels. Seasonal demand is affected by the fasting periods based on the official religion in Greece, and therefore there is an increase in the supply of aquaculture products during the fast before Easter (40 days), before the 25th of March, during the fast before the 15th of August (15 days) and before Christmas (30 days). During most days during the above fasts, the consumption of meat is prohibited and the consumption of fish, mollusks, shellfish and crustaceans is allowed. In addition, the consumption of these products increases during the summer months, while in the islands they are the first nutritional choice, throughout the year, due to their abundance. Therefore, the supplies of aquaculture depend on the seasonal demand, the seasonal supply, and the location of the enterprises. In addition, as mentioned above, discounts to companies depend mainly on the quantities of each customer's orders. Companies also take into account customer's creditworthiness, duration of the partnership, percentage of the customers participation in total sales, etc. (*Χαβέλας, 2015; Βικιπαιδεία*[194]).

1.5.7. Marketing materials

Promotion of the products of the industry is mainly based on the advantages that have to do with a healthy diet:

- ease of use, due to the wide variety and availability throughout the year
- quality, due to modern fishing methods, but also quality assurance thanks to modern production and packaging methods (labels)

Most common marketing materials that are used to promote aquaculture products to end consumers in Greece are the websites of companies in the industry, and television/ radio commercials mainly during fasting (*Χαβέλας, 2015*).

1.5.8 Promotion strategies

Enhancing competitiveness is the key to the development of the industry, especially in an environment of growing competition from imported third-country products. The Multiannual National Strategic Plan for the development of aquaculture in 2014-2020 envisages several actions with an emphasis on the implementation of collective actions to promote through Aquaculture Producers' Organizations and reduction of production costs, production through research and improvement for innovation, ensuring the quality of aquaculture products, enhancing diversification, etc. As far as the promotion strategy is concerned, the "Hellenic Organization of Aquaculture Producers" was recognized and a few months later the Production & Trading Plan was approved for the years 2018-2019, which includes an integrated promotion program which is

[194] https://el.wikipedia.org/wiki/%CE%9D%CE%B7%CF%83%CF%84%CE%B5%CE%AF%CE%B1

expected to be implemented from 2019 onwards. However, the activation of the measure for the financing of the Production & Trading Plan remained pending in 2018 as well (*ΣΕΘ, 2019*).

Promotion strategies followed by companies in the sector in Greece include online promotion through the websites of the companies but also through internet banners on websites with high user traffic mainly during fasting periods, the organization of events (in places with large concentration of people), the participation at special events related to nutrition (e.g. World Nutrition Day, medical conferences), participation in branch exhibitions/ road shows abroad. Television/ radio advertising is mainly limited to fasting periods.

1.5.9 Financial projection

In 2017, the total production of aquaculture amounted to 125,772 tons worth 534.95 million euros, showing a marginal increase of 0.15% in terms of volume and a decrease of 1.27% in terms of production value compared to the previous year. Taken into account the value of the fish produced by the fish farms, the total value of all aquaculture activities in 2017 amounts to 624.56 million euros. Fish account for the largest share of total production (85% of volume and 99% of value) and are followed by mussels (12% of volume and only 1% of production value).

Fry and fish feed are the main costs, as regardless of the size and organization of an aquaculture company, they account for almost 70% of production costs. The remaining 30% is divided according to the size and organization of each company in labor costs, depreciation and other operating costs (Fig. 13).

Fish feed consists the main raw material used in the production process as it represents 57% -59% of production costs. Raw materials used in aquaculture are mainly fish feed and fish oils, cereals, vegetable proteins and oilseeds, which are mostly imported from South America, Northern Europe and Africa. In Greece, there are 8 producers of compound fish feed, 3 aquaculture companies that own or participate in fish feed companies, while there is also a company that is mainly active in the production of animal feed and owns aquaculture facilities.

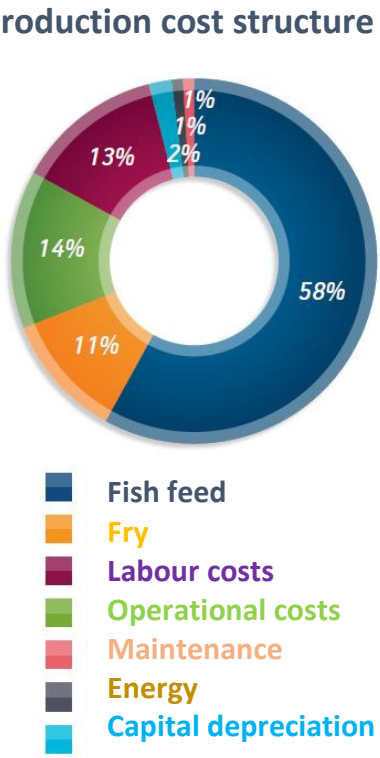

Figure 13. Production cost structure (ΣΕΘ, 2019)

In Greece, there are 29 marine fish hatcheries and in 2018 they produced about 446.8 million fish worth a total of 111 million euros, with the unit price ranging from 0.2 euros for sea bream to 0.4 euros for the meagre. Of these, almost 97% represents the production of sea bream of sea bream and sea bass fry and 3% represents the production of fry for all other Mediterranean species (sharp snout seabream, pagrus, meagre). In 2019, it is estimated that the production of sea bream and sea bass fry will decrease by 2.08% and a total of 423 million fish will be produced. 245 million sea bream and 178 million sea bass fish will be produced, expecting a reduction of 2% and 2.2%, respectively, compared to 2018 (*ΣΕΘ, 2019*).

Since 2008, the industry has been facing an exogenous financial crisis in conditions of even more intense international competition and especially in conditions of suffocating liquidity due to the accumulated borrowing created by the previous crisis and the lack of access to borrowing money. This crisis is expected to lead to consolidation and even greater concentration of the industry (*ΣΕΘ, 2015*).

The industry's growth goal is inextricably linked to investment in research and innovation that will lead to new diversified products, improved production, packaging, distribution or consumption processes. These products must be even more competitive, i.e. of high nutritional value and low cost. The four main areas in which research must focus are:

- Improving the production process of existing species to reduce production costs.

- Diversification - Breeding of new species in order to take into account the trends and needs of the modern market.
- Sustainable production of fish feed, aiming to utilize alternative sources of high-quality protein and lipids such as marine plants and microorganisms.
- Manufacturing – processing, development of more effective raw material processing technologies, advances in maintenance, and traceability of products (*ΣΕΘ, 2015*).

1.6. Proposals for the promotion of fishing in the Region of Eastern Macedonia and Thrace

Targeted actions in REMTH are proposed in order to promote fisheries, strengthen competitiveness of aquaculture companies, and develop the sector in the region. In this regard, the actions are aimed at ensuring the quality of aquaculture products, enhancing diversification, promotion, and competitiveness of businesses. The proposed actions aspire to strengthen the competitiveness of the industry, the exports of fish, the legalization of the movement of shellfish from neighboring countries in the Region, and increase the added value of fish produced (e.g. by selectively promoting certain products such as mullet roe). The afore mentioned actions will in turn increase production and reduce production costs for businesses.

1.6.1. Promotion of a regional brand name for aquaculture

Like every product, each Region has its own identity. However, in the context of international competition to attract economic activity, a Region should acquire a distinct, attractive identity. This can be achieved by creating a peripheral brand name for aquaculture, the so-called place branding or regional brand name.

Each Region as a non-tangible, diverse and complex "product" is difficult to assess. Therefore, it is necessary to implement a brand name policy in order for aquaculture in the Region of Eastern Macedonia and Thrace:

- to become "visible" to target groups, identifiable recognizable and distinct from other Regions,
- to be presented as a "quality product",
- to convince target groups that it meets their requirements,
- to build a positive image, trust and respect.

The brand name of an area is crucial for promotion to target groups. It is important to identify with the area, to make a positive impression and to be imprinted in memory. It can be verbal, visual, or a combination. The distribution of the regional brand name can be done through souvenirs, stickers, videos, DVDs, Internet, leaflets, hotels, clothes, etc. It can be an umbrella brand name or a group brand name.

1.6.2. Promotion of the Region

Promotion of the Region's fish can be displayed with all modern means such as by participating in specialized exhibitions, by creating special investment guides, by sending delegations, by connecting chambers, by special conferences and workshops, by more straight forward means such as contact

with specific groups or companies of potential investors, etc. In modern times the cheapest and most direct means of promotion is the internet.

Creating a website and at the same time an electronic tool for attracting demand is a practice followed by many countries and regions in Europe.

The main purpose of the website will be to provide with accuracy, speed, attractiveness and reliability, data that will arouse the initial interest of prospective fishermen buyers from the Region of Eastern Macedonia and Thrace. The fragmentation of information and its lack in some cases requires the implementation of a comprehensive gateway for the Region's fish, which will be the starting point for product search routes from the region. It should have a spatial and thematic division and a hierarchical structure in order to ensure the valid information for the supply of fish from the Region.

The portal can be extended mainly to demand attraction issues. However, in order to achieve this, it will have to use all available scattered information at a regional level in order to search for information based on organizations, agencies and businesses.

1.6.3. General organization

Regions mainly offer services (e.g. information, advice, funding, tourism and cultural offers) and for this reason marketing is similar to marketing of services. Regional actors belong to the field of economics (e.g. chambers, businesses, hotels, traders, transporters), administration (regional self-government and administration, municipalities), media, science and research (e.g. universities and technical institutes, institutes), culture (e.g. museums, theaters) and leisure (e.g. sports), as well as citizens as consumers and producers of services.

For the creation and promotion of a regional marketing plan, it is required to create a regional network with the participation of all regional actors (e.g. Region, regional association of municipalities, public administration, associations and Chambers, universities, citizens), for the creation of a virtual regional enterprise aimed at creating the profile and attractiveness of the area. In particular, the promotion of REMTH fish and the support of competitiveness and entrepreneurship, require the creation of an institution capable of guiding, specializing and envisioning development strategies, adapted to local conditions and effective in the international economic system.

Therefore, it is proposed to establish a Regional Marketing Forum with the participation of representatives of regional and local government, business associations, businesses and civil society. The Forum will be responsible for drafting an overall regional marketing plan, which will include the analysis and configuration of the "product", the selection of the strategy and the means of promotion as well as its evaluation. The Forum will be invited to help create a competitive environment that will accelerate the networking of businesses with consumers.

1.7. Conclusions

The marketing strategy of the aquaculture sector in Greece takes into account that prices of products are stable and therefore there is no intense competition, the increase of exports to

European Union countries, merging of companies that have taken place in the sector so far, companies do not use advertising to a large extent, several large companies are certified according to ISO/ HACCP/ AGRO 1-2/ AGRO 4-2, and the growing consumption of fish in Europe and Greece. Large companies in the industry use slogans in order to communicate their Unique Selling Proposition either through the home page of its website or in the packaging they use. The largest companies in the sector have organized distribution networks through subsidiaries that promote them mainly abroad. In addition, these companies also sell fish on behalf of smaller companies in the industry that do not have their own distribution network. Fish markets and fishmongers are the most important network of aquaculture in retail.

There are coordinated efforts to develop a national brand name, which connects the quality aspects of seafood with their origin. As the creation of a global brand is complex, aquaculture companies plan to set up a producer organization that focuses specifically on promoting already established markets and exploring new opportunities for expanding distribution channels and market destinations. It is proposed to promote a Regional brand name for REMTH fish, the promotion of the Region and the organization of the bodies of the area for the creation and successful implementation of a complete marketing plan of fish. Greek aquaculture produces fish according to EU guidelines and standards for environmental protection, health and well-being and consumer protection, which add to the collective costs of their products.

2. ROMANIA

2.1. Characteristics, Structure and Resources of the sector

The inland waters of Romania represent 3 percent of the total surface of the country. There are 400.000 ha of natural lakes and ponds, manmade reservoirs, including the Danube Delta; 84 500 ha of fish farms; 15.000 ha of fish nursery areas; 66.000 km of rivers of which 18.200 km are in the mountain area; 1.075 km are located in the lower part of the Danube. At the same time, Romania has a 250 km coastline along the Black Sea, while the exclusive economic zone covers 25.000 km^2. Currently, over 70.000 ha are used in Romania as fish ponds and represent a great advantage for the development of aquaculture in the Country.
The fisheries sector includes aquaculture, marine and inland fishing activities, Romania's main fishery production component is represented by aquaculture, followed by the inland fisheries. The fisheries activities along the coastline of the Black Sea remain limited compared to inland fisheries.

According to the Aquaculture Units Registry (ARU), 518 units are registered in the aquaculture sector, which own 575 aquaculture farms (ponds, lakes, etc.). The 518 registered units are divided into: 19 nurseries (holding only a nursery license); 324 hatcheries (holding only a hatchery license); 175 nurseries and hatcheries (holding both nursery and hatchery license).

In Romania, the aquaculture activity consists mainly in freshwater crops, and the country's land resources and availability of inland waters provide excellent conditions for fish farming. In 2017, they were used the following main production methods: 82% of production: in fish ponds; 16% of production: in basins and canals; 2% of production: in floating cages. The most important cultured

fish species are members of the cyprinids, particularly common carp, followed by trout, zander and pike. In 2017 the aquaculture sector produced 12.209 tons of fish.

Within the aquaculture sector, the predominant activity is freshwater fish farming, while the cultivation of other freshwater aquatic organisms (crayfish, mussels, aquatic plants) or marine water is practically non-existent. Freshwater fish farming practiced in Romania is characterized from a technological point of view by two directions: intensive growth (especially salmonids) and extensive and semi-intensive growth of cyprinids in polyculture, in land basins (ponds, ponds and lakes).

Traditional cypriniculture in land basins is compatible with sensitive habitats and provides environmental benefits and services. In many of the NATURA 2000 sites in Romania, fish farming activities are carried out, these being fully compatible with the conservation of the natural values of the sites, the most eloquent proof being the very designation of the fish management area as a NATURA 2000 site. Extensive fish farms have become multifunctional farms where other social and environmental services are provided: recreation, maintaining biodiversity and improving water management.

2.2. Specific characteristics at the national level

The Romanian aquaculture sector produces mainly cyprinids, both of indigenous origin (carp, crucian carp) and of Asian origin (silver carp) that represents more than 75 percent of the total production. Until 2005, cyprinids dominated this industry, representing 85% of the total production, the remaining 15% being represented by trout, perch, pike, perch, catfish, sturgeon, etc. After the cyprinids, the second species produced is trout sharing 9%. In the following years this structure of the species has been largely preserved, still, there is a slight increasing towards cyprinids.

Even though sturgeons are not mentioned in this statistic, the caviar farms are currently starting out to develop and the population quotas of the Danube are given in different statistics. All reared species are freshwater species; marine aquaculture in Romania is at its initial stages, in spite of the 250 km long marine coast.

In 2016 there were registered 31 fish processing companies, and in 2017, 20.170 tons were produced of which prepared and frozen whole marine fish were the main product. Still, the Romanian market has a diversity of fishery products: live fish, full fish (fresh, refrigerated or frozen); primary processed fish (eviscerated, beheaded, filleted, cut); semi-prepared (marinated, pasted, fish roe, salted, smoked fish); canned fish (in oil, in tomato sauce, other types).

2.3. Management and promotion of the aquaculture sector

2.3.1. The Institutional Framework

In Romania National Agency for Fishing and Aquaculture (NAFA) has the responsibility for the design and for the development and implementation of the fisheries policy, which is a public institution entirely financed from the state budget. NAFA is the agency that draws-up the strategy and the legal framework for fisheries in Romania. And it is also responsible for the technical implementation of measures and for the control of regulations and activities in fisheries and aquaculture.

The proposal for the reform of the Common Fisheries Policy (CFP) aims to promote aquaculture through an open method of coordination: a voluntary cooperation process based on strategic guidelines and multi-annual national strategic plans that identify common objectives and, where possible, indicators to measure progress in this direction.

2.3.2. The Governing Regulations

The Law no. 192/2001 regulates the conservation, management and exploitation of living aquatic resources, aquaculture activity, as well as the processing and marketing of products obtained from fishing and aquaculture. Some of the objectives of this law are: pursuing a sustainable exploitation of living aquatic resources in natural fish basins, promoting sustainable development and taking the necessary measures to conserve and regenerate these aquatic resources and ecosystems; development of aquaculture sector; stimulating a responsible trade, which contributes to the conservation of living aquatic resources;
Order no. 171/2002 approves the norms for the marketing of fish and other aquatic animals, provided in the annex that is an integral part of this order.

2.3.3. Applied Research, Education and Training

The National Agency for Fishing and Aquaculture collaborates with research institutions in the field to meet the objectives set by the strategy and requires studies for the knowledge of the biology, ethology and structure diversity, functionality and productivity of aquatic ecosystems and their specific interactions. Some of the government aquaculture research institutions are: Institute of Research and Development for Aquatic Ecology, Fishing and Aquaculture, Galati, Romania; Fish Culture Research Center - Nucet, Dâmbovița County; National Institute for Environmental Protection, through the sub-units: National Institute for Marine Research and Development "Grigore Antipa" Constanța and National Institute for Research and Development "Danube Delta" Tulcea.

The Department of Fisheries and Aquaculture of the "Dunărea de Jos" University of Galati is the oldest and the most important provider of higher education and training in aquaculture and fisheries. At the same time, each of the domestic agricultural universities offers in their *curricula* training in fish breeding for day or regular students, but with varied emphasis and subject matter.

Training in aquaculture at undergraduate level is offered by the National Agency for Agriculture Consultancy, which is under the direct coordination of the Ministry of Agriculture and Rural Development. In addition, in Romania there are some training centers authorized to develop training courses for workers in aquaculture (especially for fish culture). In spite of the strong research sector, there is a gap between the sectors of education/training and the SMEs in terms of applicability of the results achieved by the education and research sectors in direct correlation with the SMEs needs.

2.4. Market research

Romania produces large quantities of crap, so it is naturally that on the Romanian market we find that the most fingerlings produced are those of cyprinids. In the country there are fish farms that are selling fingerlings, and many of these farms advertise on their website or buying-selling sites. Romania imported, in the period January -September 2017 a quantity of 56.021 tons of fish, crustacea and jellyfish, an increased value of 5.4% from 2016 – same period. The export values for the fish, registered in the same period are 20 times lower.

2.4.1. Street markets (legal standards on EU or national level)

Government Decision no. 348 of March 18, 2004 establishes the general rules for the exercise of specific forms of retail trade and the provision of services in some public areas, as well as the minimum equipment requirements necessary to carry out these activities. Retail in some public areas means the activity of marketing products and services, carried out permanently or seasonally in markets, fairs, public passages, public roads and streets or in any other area intended for public use, except those specially administered.

The purpose of regulating trade in public areas is to create a framework for the marketing of market products and services, which respects the principles of fair competition, protection of life, health, security and economic interests of consumers and the environment. Public areas may be managed directly by the local public administration or by private contractors under the conditions provided by law.

In public areas it can carry out its activity: any legal person engaged in the activity of retail sale of products; individual agricultural producers and their associations, which market their own agricultural and products.

2.4.2. Selling live or processed fish to restaurants

The Romanian market is supplied with fish coming from marine fishing, freshwater fisheries (catch or aquaculture) and from imports. The Romanian market offers the following forms of fishery products: live fish, full fish (fresh, refrigerated or frozen), primary processed fish (eviscerated, beheaded, filleted, cut), semi-prepared (marinated, pasted, fish roe, salted, smoked fish), canned fish (in oil, in tomato sauce, other types).

Still, the majority of restaurants from Romania use imported fish. But there are also businesses that have the of multifunctional fish farming. This involves the realization of the entire commercial chain: production of raw materials (fish farms) – production of finished products (fish processing section) – marketing and distribution of finished products (restaurant, own stores, traditional distribution networks).

Producer organizations are set up by fishermen or aqua culturists who associate freely for the purpose of implementing measures to ensure the best conditions for the marketing of their products. These measures aim to: encourage production planning and adaptation to demand, in particular through the implementation of catch plans; to promote the concentration of supply; to stabilize prices; encourage methods that promote sustainable fishing.

In order to help the restaurant and producers, the Tulcea Fish Exchange was created. It is an investment objective financed from the European Fisheries Fund. This investment comes in support of commercial fishermen, and has the role of facilitating the activity of fish collection centers and aquaculture farms in the Danube Delta on the distribution/sale segment, on safe marketing chains and as short as possible. The main purpose of the Fish Exchange is to strengthen the infrastructure for collecting and distributing fish caught or produced in aquaculture farms in the Danube Delta. The Romanian commercial provisions of fish are strangely coming from fish markets from Greece and Bulgaria and not from Danube Delta or Constanta County. The only operational fish stock in Romania is located in Tulcea (was reopened in 2019) but it is not used at the full capacity. Therefore, an amount of over 350 M.euro/year is spent by the Romanian commercial in their commercial relations with fish stocks from Greece and Bulgaria. Over 80% from the restaurants that are operational at the Black Sea area from Romania, are offering the fish dishes on regular bases. But the offer is covering fish from the Mediterranean Sea and not from the Black Sea. The reason is that the local fisheries are not equipped to offer a constant production flux. The owners of both restaurants and fish pond, have the opportunity to personalize their menu in direct correlation with the daily “pray”.

2.4.3. Groceries or live for pond stocking

The majority of fish products are distributed and sold through supermarket chains. Romanian’s household consumption is dominated by live/fresh fish, followed by frozen fish, and marinated and prepared products.

2.4.4. Food-size sport fish or ornamental fish using the following structure

Order no. 15/2011 regarding the conditions for recreational/sport fishing, the regulation for recreational/sport fishing, as well as the models of recreational/sport fishing permits. The attribution of the right of recreational/sport fishing is made by the administrators of the living aquatic resource, in all the natural fish habitats, in accordance with the law.
Recreational/sport fishing in natural fish habitats is based on permits issued by the administrator of living aquatic resources and issued by him or by sport fishermen's associations, as appropriate. Within the Ministry of Agriculture and Rural Development, through NAFA, operates the unique Register of records of sport fishermen's associations, legally constituted non-profit legal entities, as well as national representation forums, established on the principle of free association.
The association is ensuring fisheries management in the fishing areas that they have in custody and managing protected natural areas. Some of the fishing farm delivers to fish for sports fisheries after reaching a weight of two kilograms. At the same time there are also fish farms that offers arranged places for sport fishing, stating in their offer the kilograms and species of the fish.

2.4.5. Live and processed fish markets

In Romania we find many live and processed fish markets, still we encounter the same problem as restaurants, a large portion of the fish from the market comes from the import. Only in recent years a small number of Romanian companies have begun to offer competitive products from local production (especially semi-finished products). Most of the raw material is imported. Mackerel and

herring are the species that have a share in both imports and processing. Most of the total imports are represented by the import of frozen fish, in various forms of presentation.

2.4.6. Price formation

Emergency Ordinance 23/2008 on fishing and aquaculture states the the first sale represents sale which is made for the first time on the national territory and which establishes by documents the price of the product. The first price of fishery products is made in places established and authorized by the Ministry of Agriculture, Forests and Rural Development, at the proposal of the National Agency for Fisheries and Aquaculture.

Authorized persons and/or legal persons having production capacity for commercial fishing or aquaculture may, on their own initiative, set up producer organizations for the purpose of responsible fishing and improving the conditions for the sale of products made by their members. The members of the organizations must sell the product or products for which they are associated, in compliance with the legal provisions in force, in order to improve the quality of products, adapt the volume of supply to market requirements and improve the marketing process.

2.4.7. Market controls

The fish products may be sold or marketed only if they meet marketing standards for classification by quality, size or weight, packaging, presentation, and labeling. In Romania the National Authority for Consumer Protection is responsible for checking the quality, marketing and labeling of fish, prepackaged fish dishes and canned fish, while NAFA control the fish farms, the quality of the fish.

2.4.8. Cold chain

There are firms in Romania that specialized in this type of distribution, but the sector is still under development.

2.5. Marketing strategy

2.5.1. Product - variety, quality, design, features, brand name, packaging, services

As mentioned above, the majority of fish that Romania produces are cyprinids. The main cultured species in Romania are common carp, silver carp, bighead carp, grass carp, goldfish, rainbow trout, crucian carp and sea trout. These species account for 90 percent of the total production. In addition, northern pike, catfish and, more recently beluga and sturgeons are also reared. Currently, marine aquaculture in Romania is at its initial stages, a single mussel farm being registered farming Mediterranean mussel, despite the fact that certain studies suggest that there is interest and there are possibilities for developing this sub-sector.
The aim of the current aquaculture businesses is to ensure a higher level of quality of local products and services related to fishing and aquaculture. Belonging to the local standard will provide the consumer with a guarantee of the quality of the products and will provide information about their geographical origin. In this way it contributes to the development of local fishing brands. As mentioned above, the farm uses also offer different services, like sport fishing, for recreational purposes.

2.5.2. Price - list price, discounts, incentives, payment period, credit terms

The price reflects the quality of the product, and for the farm fish to prosper and profit, it must not be too low or too high. Many producers have a set price when they announce their offer, but the price is negotiable depending on the quantity the buyer wants. For crap the prices varies between 11-12 RON per kilogram, and the prices for trout are around 20 RON per kilogram. There is a financial instrument that are fostering support instruments for the Romanian fishery sector – the Operational Program for Fishery and maritime Affairs 2021-2027, the final version being adopted by the EC on 14.04.2020, the goal being the promotion of the sustainable fishery in regards of the environmental protection and efficiency of the resources used, innovation and competitiveness based on knowledge.
The facilities for both the Non-governmental and SMEs sectors that are active in the aquaculture areas are focused on:

- Modernization of the commercial fishery infrastructure: harbor and landing areas for fishery farms, setting up and modernization of the fishery arear inland water
- Enabling the fishery products increasing value in different stages: processing, commercial and selling (supporting the short supply chain from the fishermen to clients.
- Supporting innovation in the fishery area throughout the improvement of the operator's performance (creating the premises of building a constant flux of product both for the processors and restaurants owners)
- Supporting the breading process (interventions regarding the diversification of the production in different stages)
- Supporting initiatives from building networks and partnerships between the aquaculture stakeholders, hence creating the premises for a sustainable approach of the sector.

2.5.3. Place - channels, coverage, assortments, locations, inventory, transportation, logistics

Fish is an easily perishable product, and its preservation in food safety parameters from the time it is caught to the time of consumption or processing depends essentially on the time and conditions of transport. Also, the preservation of fish and fish products in good condition depends on the conditions of temporary storage within the marketing units.

So the aim is to give the buyer the product as fast as possible, to distribute it to the local shops or directly to the buyer.

2.5.4. Promotion - advertising, personal selling, sales promotion, public relations

The promotion for the products is made through every channel of advertisings and promotional activities carried out by the manufacturer to create demand for the product. The fish producer are advertising their products on social media pages, on their website or buying selling sites.

As mentioned above there are also association that helps the producer to sell and buy the products offered. According to the art 78 (1) (b) from the CE Regulation no 508/2014 regarding the European

Fund or Fishery and Maritime Affairs, every state will set up its national network that will comprise different actors from the aquaculture sector. The main objective of the network will be to support the Local Action Groups from the aquaculture area (FLAGs) in their effort to contribute to the sustainable development of the fishery areas that area included in the Local development strategies, that are previously approved by the Management Authority of the Operational Program for Fishery and Maritime Affairs 2014-2020. Within the activity of the network are included and financed throughout the program promotion activities for the network participants individual or as an interest group (for example a fish category that are bread or commercialized by more then 1 SMEs of NGO). The network is open for registration under the condition of meeting a set of conditions and the operational costs are usually financed by the program. The Romanian network (www.ampeste.ro) is also part of the European Network – FARNET https://webgate.ec.europa.eu.farnet

2.6. Marketing plan

2.6.1. Executive summary – resources existent (human, material so)

Fishing and aquaculture, along with fish processing and trade in fish and fish products, are activities present in all regions of the country. In some isolated areas, such as the Danube Delta and Meadow, fishing is one of the main activities, which provides jobs and sources of income for the local population.

Currently, the patrimony of fishery interest of Romania, consisting of surfaces permanently or temporarily covered with water, is estimated to have an area of almost 500.000 ha of stagnant water, 66.000 km of running water from the mountain, hilly and lowland area and 25.000 km of water from the Black Sea. The water surfaces in the public domain are represented by: 300.000 ha of natural lakes and ponds, 98.000 ha of accumulation and polder lakes, 47.000 km of rivers in the hilly and lowland area, 19.000 km of rivers in the mountain area, 1.075 km of the Danube river.

In February 2020 the unemployment rate was 3.9%, so by developing this sector we can create more jobs, helping the growth of the country's economy. In 2005, 2.781 people were employed in the aquaculture sector, representing over 40% of the total man power in the fisheries sector. The full time employees were 2.333, while 448 were part-time or occasionally recruited. People between 40-60 years of age were 601 (21.61 percent), 2 161 people were between 20-40 years of age (77.71 percent) and 19 people under 20 years of age (0.68 percent) were employed in aquaculture activities. Concerning the training level of people involved in the fisheries sector, the situation is as follows: higher education employees represent the 14.71 percent of the total, high school education employees 41.21 percent and elementary education employees, namely workers, 44.08 percent.

From a financial point of view, the European Union, through Operational Programmed for Fishing or European Maritime and Fisheries Fund offers financial opportunities to develop of modernize an aquaculture business. The fund also helps fishermen in the transition to sustainable fishing, supports coastal communities in diversifying their economies, finances projects that create new

jobs and improve quality of life along European coasts, supports sustainable aquaculture developments.

2.6.2. Target consumers

In the future there are signs of increased consumption of fish that will obviously affect the consumption of specialties. In recent years, a trend has emerged in terms of proper diet, and it is based on the appreciated fish meat because it improves the quality of life, reduces aging and helps maintain the figure.

Romanian consumers traditionally prefer meat products and the consumption of fisheries and aquaculture products is far below the EU average. However, the national average apparent consumption of fish and seafood has followed an upwards trend in recent years, reaching 6.2 kg per capita in 2015.

By creating a sustainable marketing plan, not only we meet meets the customer's requirements, we also attract new customers through the products offered by offering valuable and quality local products. So we can offer our customers local fresh fish. One of the preferred species are crap, and our hatcheries produces large quantity of cyprinids.

The appearance of imported species on the Romanian market has determined a diversification of the offer and a change of consumers' preference towards new fish species and forms of presentation (live, filleted, and portioned) as well as a demand for fish and fish products in increase until 2007.

The producers can also export fish, the Czech Republic is the largest producer and Poland the largest consumer, while Hungary has the highest consumption of carp per capita, with carp being the most consumed fish species in Hungary.

Romania produced in 2013, according to FAO data, over 3.500 tons of carp. However, Romania did not export any carp during this period, the entire production being used for domestic consumption. Also, we cannot forget about the export, our country export, in 2017, Romania exported 24.428 tons, (including 17 822 tons of fishmeal) of fisheries and aquaculture products worth €40 million. The ratio for import/export in Romania is 1:20.

2.6.3. Selling strategy – the concept of unique selling proposition- USP (how are we different from our competition)

Around 1440 products are listed in the register of protected designations of origin and Protected Geographical Indications (PGI) of the European Union, and Romania has seven products registered, witch 2 of them are fish, smoked mackerel from Romania's Danube, smoked bighead carp, from Ţara Bârsei.

PGI emphasizes the relationship between the specific geographic region and the name of the product, where a particular quality, reputation or other characteristic is essentially attributable to its geographical origin. It can apply to food, agricultural products and wines.

From this date we see that Romania has unique products and it also shows our potential to deliver quality products. The producers communicate with the consumers, for example social media to explain how are the fishes raised, what kind of they eat, if it is ecological or not. There is not yet a consolidated strategy approach regarding the selling of the local fish, although in the Romanian network there are efforts in this regard.

2.6.4. Pricing and positioning strategy (position on the market in direct correlation with the price offer)

As mentioned above, the price reflects the quality of the product, and for the farm fish to prosper and profit, it must not be too low or too high. The price is competitive (market-oriented), meaning that means that e-commerce retailers set their prices according to those of competition and market trends, not according to customer demand or costs. Still the price also fluctuates when there is an economic crisis. Although there are differences regarding the supply chain (the fluctuance and the inconsistence registered at the level of Romanian producers), the prices are comparable (Romania, Greece and Bulgaria).

2.6.5. Distribution plan

The costumers have to possibility to buy directly from the producers through the ads placed by the producers on different sites. The means of transport is established between the two parties. Many of these advertisement offers free transport, other offers free transport if a certain quantity is purchased. The supply chain is unstable. Therefore, the distribution plan is usually daily generated. There are all in business (producing and delivering) that are including their own fishing pound, this being the solution adopted for providing a constant offer to the consumers.

2.6.6. Offers building

The offers include the fish species and the kilograms for different uses, fish for consumption or for sport fishing. These offers also include the possibility of free transport to attract the costumers.

The offers for sport fishing often include the pictures of fishes, showing the potential costumers what they can capture, inviting all people, of all ages to participate in this sport. Often, the offers are discussed and negotiated directly with the supermarkets – as final sellers.

2.6.7. Marketing materials

For the marketing materials there are needed catalogues or flyers.

2.6.8. Promotions strategies (online promotion, offline promotion, TV, specific events etc.)

A significant part of the promotion is made online, on the social media platform, association sites or profile sites. They also communicate with their customers through social media platforms, they show photographs of their product to attract the costumers, or show the fishes that are for sport fishing, the kilogram of fishes differs depending on what they are used for.

2.6.9. Financial projection

From 2013 to 2012, total income decreased by 16%, while the operational cost decreased by 15%. The total income is dominated by the turnover from the sale of fish from the farms, which contributes 65% of total income, leaving only 33% to other income and only 2% for subsidies. In 2017, Romania exported 24.428 tons, (including 17.822 tons of fishmeal) of fisheries and aquaculture products worth €40 million.

Having this date, we expect that this sector will grow and develop by attracting different forms of financing.

2.7. Marketing strategies

The present situation, pandemic COVID 19, created a supplementary pressure on the aquaculture field. The Romanian POPAM amended its support with a enabled a set of mitigation measures for the pandemic situation, that included the following:

- compensation amounts for the fishermen – temporary suspension of the commercial fishery in the period 01.02.2020-31.12.2020
- compensation amounts for the aquaculture representatives in the case of temporary suspension of the production and selling activities or additional costs correlated with the pandemic situation, for the period 01.02.2020-31.12.2020
- compensation amounts for the processors in the case of temporary reduction of production and selling in the case of supplementary costs regarding the production storage correlated with the pandemic situation, for the period 01.02.2020-31.12.2020.

The measured above mentioned are tackling the financial challenges faced by the sector, in the same time enabling the possibility of accessing the support in a strategic manner, enforcing the existent networks and its efforts of increasing its presence on the Romanian consumption market. There is a compulsory need for an integrated approach in terms of developing the marketing strategy at the national level, that are tackling the specificity of both industrial and domestic production in direct correlation with the national consumption.

3. TURKEY

Turkey is very big country by its area, length of the coasts, fishery production provided four seas and rich inland waters, and aquaculture production carried out both in marine, brackish and inland waters. Therefore there should be intelligent marketing strategies to increase revenues of the fishers and farmers as well as supply healthy fish and fish products to the consumers with considerable prices.

3.1. Characteristics and structure of the sector

3.1.1. State of aquaculture production

Aquaculture has rather short historical background in Turkey comparing with other countries. It started with eel culture in 1960's in the western part of Turkey (Aegean Region). Then rainbow trout

culture has started in 1970's and spread all over the country. The capacities were kept small at the beginning due to high costs of feed, energy and staff which cause expensive market value comparing with the fish captured from the sea and the inland waters. Therefore farmers having small capacities used to run small restaurants to market their production by adding value, and used to find good prices when the fishing season closed from April to September. Another common belief was the "artificiality" of the fish which all requirements need to be covered by unnatural ways. The most successful farms operators were the ones who feed fish with poultry and butcher wastes as wet meal which create skin colour as same as the fish in wild environment, energetic and good meat quality. Such products could be able to have good prices in the farm and market. During these periods and even now, consumers have preferred to eat wild fish for its price, natural taste and abundant supply. When catch and landings started to decrease due to unfavourable conditions (pollution, invasive species, climate change, overfishing, etc) affecting fish stocks, farm produced fish became attractive due to its continuous supply, species and product diversity, and high export potential.

3.1.2. Specific characteristics

Despite of the stagnation in capture fisheries production, farmed products is increasing in Turkey. Total number of fish farms in Turkey is 2100 with the total capacity 486786 tons per year. Number of farms producing marine fish species are 426 with the capacity of 254430 tons while there are 1860 farms in inland waters with the total annual capacity of 232356 tons (BSGM, 2018). According to the 2018 data, total aquaculture production is 314537 tons of which 209370 tons from marine and 105167 tons from inland aquaculture.

Total of 29586 tons were produced in the Black Sea (9.41%); of which 13257 tons in marine and 11018 tons in inland farms.

There are 20 marine fish hatcheries with an annual capacity of 815 million juveniles and 55 inland water hatcheries with a capacity of 541 million juveniles in Turkey. According to the records of the General Directorate of Fisheries and Aquaculture (GDFA), 5 of the 20 marine fish hatcheries run by private sector and produce only sea bream and/or sea bass. Other marine hatcheries produce fish species such as meagre (*Argyrosomus regius*), common dentex (*Dentex dentex*), turbot (*Psetta maxima*), red porgy (*Pagrus pagrus*), sharpsnout seabream (*Diplodus puntazzo*), brown meagre (*Sciaena umbra*), shi drum (*Umbrina cirrosa*), pink dentex (*Dentex gibbosus*), Red banded sea bream (*Pagrus auriga*), sand steenbras (*Lithognathus mormyrus*), red porgy (*Pagellus acerne*), horse mackerel (*Trachurus trachurus*), grey mullet (*Mugil cephalus*) (BSGM, 2018).

Aquaculture is one of the main social and economic drivers in the Black Sea due to lack of industry, employment and commerce possibilities. Rivers discharging to the Black Sea and spring waters encouraged local citizens to be interested in trout farming since 1960's. Due to climate and topography of the region, entrepreneurs started trout farming even in small capacities up to 5 tons per year. Rivers born from highlands host endemic brown trout (*Salmo trutta*) and sea trout (*Salmo*

labrax), which are popular in the region. When aquaculture develops in other regions of Turkey, the share of the Black Sea started to decrease due to small capacities and lower production even the number of farms higher.

In 2000, the share of the aquaculture production was 15% and gradually decreased to 9% though the improvement of the aquaculture by cage culture in dams and sea. There is a higer increase in the production of farmed species all over the country.

Trabzon is one of the most important provinces by means of total aquaculture production as 5541 tons of which 5155 tons comes from marine and 386 tons from inland farms. With such marine production, Trabzon is the top producer in the Black Sea. Production capacities in marine and dam cages is continuously increasing by extension of the current farm capacities and allocation of new farming sites for entrepreneurs in 2020 and 2021 onwards.

According to the data of The MoAF, the production from aquaculture in Trabzon has increased 8.5% in Trabzon (9538 tons in 2014; 10352 tons in 2019), 96% in Ordu (1591 tons in 2014; 3115 tons in 2009), 3579% in Sinop (42 tons in 2014; 1545 tons in 2019). Aquaculture production has reduced 51% in Samsun city from 5741 tons in 2014 to 2830 tons in 2019. As in the region, total production in Turkey has increased 59% from 2014 to 2019, 235133 tons and 373356 tons, respectively.

This volume of production requires good strategies for marketing on these fields:

- Sufficient egg and juvenile supply in time,
- Supply of feed in good quality for each growth cycle of fish
- Fish transportation capacities form farm to farm
- Qualified staff working each of the production cycles
- Marketing of fish in different production steps (egg, fry, fingerlings, portion size, adult, big sized fish)
- Sufficient processing, freezing and cold storage,
- Looking for new international markets to export
- Advertising and promotion

One of the main problems of the industry is the juvenile supply. In case of sea bass and sea bream, companies have their own hatcheries to cover their needs. Some part is also exported. Trout culture has very serious lack of sufficient juvenile supply. Big companies are obliged to import eggs in order to overcome this problem. It is one of the new markets in the region to deliver these eggs to the hatcheries contracted. Until reaching the size of transfer, nursery and on growing period are completed in those hatcheries under their responsibility.

There is no problem to supply fish feed. There are many companies produce fish feed for various growth stages as well as imports. Some of them are not in good quality due to insufficient fish meal ingredient; some others are very expensive which creates high costs to the farmers. But any case there is no supply problem in the market.

There is fish transportation vehicles commonly used in all farms to transfer fish to/from farms when and where is needed. It is very easy to upload and download fish to trucks and their new environment.

Specification of all these processes needs qualified staffs which are obtained from the graduates of Faculties of Fisheries (Istanbul, Rize, Sinop), Faculty of Marine Sciences- Department of Fisheries Technology (Trabzon, and Ordu), plus from the other universities having fisheries education in other cities. Divers are another group of qualified staff needed at many stages of culture in cage farming. Universities and diving schools are in charge of their trainings.

There are also sufficient fish processing, cold storage and freezing plants in the region which are essential in marketing. Local demands are covered directly from the farms for fresh consumption. After June trout are all harvested from the cages in sea due reduced oxygen levels. Farms in dams in high elevations and small farms located nearby rivers fed by stream waters may continue keeping trout in all season and market fresh.

3.2. Market research

Marketing is the final but the most important step to reach targeted levels for the aquaculture business investments to make fastest turnovers and provide sustainability for the company.

Literally, marketing strategy is a part of any business plan that outlines any overall advertising plan on how to find and attract customers or customers with the business. Marketing strategy focuses on what it is desired to achieve for the business and marketing efforts. As a following step, a marketing plan is needed to explain how a company will achieve these goals.

The main deficiencies are these two concepts on marketing of fish and fish products of Turkey. Obviously there are rather minor problems in internal marketing. Producer-wholesaler-retailer links are well established and packing, processing, cold chain, transportation to other markets provided efficiently. There are rules regulating markets and sanitary issues, standards, etc.

The most important problem is not to be a brand name in international markets. At present majority of fish and fish products exported as raw material to be sold under buyer's brand in European and Asian markets though exporter companies and deliver the products with cold chain.

3.2.1. Juvenile supply

As far as aquaculture production has increased, the demand for juveniles has also increased. At present, there are no sufficient hatchery capacities for trout farming in the region and Turkey. Therefore there is great competition to provide juveniles from hatcheries in different locations of Turkey which let high costs of the final product. This is the common problem for rainbow trout ranching in net cages established in dam reservoirs and sea. In case of Black Sea salmon "Salmo labrax" and sea bass, there is no problem for juvenile supply. After transferring juveniles from their origin by trucks inside the aerated tanks, they reached their final destination with 2-3% mortality for further growth and fattening.

During this competitive period, preliminary agreements from company to company by paying certain level of advance could be sufficient. The more early agreement provides priority for the allocation and delivery of the juveniles from producers. Buyer is responsible for the delivery.

Information about 6 hatcheries marketing juveniles are given below:

FIRAT ALABALIK (2 hatcheries) 1-20 g juveniles Saha Mahallesi Halfeti Yolu Üzeri 5.Km Birecik Şanlıurfa/ TÜRKİYE Phone: +90 414 652 38 41_ -Gürçay Köyü Mevki Birecik Karkamış 19.km de Karkamış \Gaziantep e mail: info@firatbalik.com.tr, ala_firat@hotmail.com **GERMANY BRANCH:** HC Fırat Gıda GmbH, Alfred Nobel-Str. 22 59423 Unna http://www.euphrat-food.de/Startseite/ **Phone:** 02303/98 323 20 **Fax:** 02303/98 323 21 **E-mail:** info@euphrat-food.de HC Euphrat Food GmbH Dürerstraße 3 95129 Schwarzenbach an der Saale http://firatbalik.com.tr/	**AKDERE LTD** Juvenile capacity: 2 mil/year -Akdere Fish Farm, Akdere Köyü, Gürün / Sivas -Hurman Kalesi Premises: Hurman Kalesi Yanı, Dağlıca - Afşin / Kahramanmaraş Tel: 0346 734 10 13, Fax: 0346 734 11 12 GSM: 0532 413 36 56 Email: akderealabalik@gmail.com Skype: hamit.akdere, Twitter: akderealabalik http://www.akdereltd.com/index.html
YILMAZ ALABALIK Juvenile capacity: 10 mil/year Işıtan Mahallesi AG Mevkii Gürün / SİVAS info@yilmazalabalik.com Phone: +90 (346) 715 10 07 Necdet Yılmaz: +90 (532) 515 02 81 Tolga Yılmaz: +90 (505) 702 05 87 http://yilmazalabalik.com/	**ÖNDER ALABALIK** Babataşı Mh. Muhammer Aksoy Blv. No:2 Fethiye - MUĞLA Phone: +90 252 - 614 69 49 Fax: +90 252 612 72 32 E mail: info@onderalabalik.com.tr http://www.onderalabalik.com.tr/contact_us.aspx
KEBAN ALABALIK A.Ş. 150 juveniles per year Çırçır Mevkii Keban/ ELAZIĞ Phone:+90 424 571 23 23 - +90 424 571 22 01 Fax: +90 571 32 70 Email: info@kebanalabalik.com.tr http://www.kebanalabalik.com.tr/	**ÖZPEKLER SU ÜRÜNLERI LTD.** Bozburun Mahallesi A.Nazif Zorlu Sanayi Sitesi 7152 Sokak No.4 Merkezefendi / DENİZLİ Phone: +90 258 3722566 Fax: +90 258 3717421 https://www.ozpekler.com.tr/ozpekler/

There is no problem to find juveniles of *Salmo labrax* and Sea bass in the region due to pre-orders and availability on demand.

MoAF DG Wildlife has conducted a project to produce juveniles or brown trout for the enhancement of rivers that the adults taken from the same river. In the last 11 years, total of 11,491,500 juvenile trout have been released from Altındere Trout Breeding and Production Station in Maçka district of Trabzon to streams and lakes in different provinces of Turkey. In 2017, it was stated that 3,042,000 more natural trout fry released into the streams in 16 provinces, while the amount of juvenile trout released into streams and lakes in 12 years will reach 14 million 533 thousand 500 in total.

Regional Directorate of Nature Conservation and National Parks of the Ministry of Agriculture and Forestry has initiated the project “Natural Trout Breeding and Fishing of In-Forest Waters” in 2005

to increase destructed trout populations due to illegal and overfishing. Project aims to produce natural (red spotted) trout and additional 4 more subspecies to release in their natural habitats, to develop sportive fishing and support local people by social and economic aspects. There is no sale to the commercial producers. However station works like an inventory to keep adults and juveniles of trout species representing the natural sub-species of many regions of the country.

3.2.2. Street markets/ local fish shops/ wholesale markets

According to the latest statistics majority of the fishery products are marketed fresh across the country; especially the fish from capture fisheries. Fishing season in the Black Sea starts in mid-autumn and continues till April. During this period there are intensive marketing efforts and bulk of fish are loaded to trucks from fishing ports to the wholesale markets of big metropolitan cities (Ankara, İzmir, Bursa and Istanbul). Small vehicles deliver fish for the needs of local markets and neighbouring cities. In late autumn and winter time, anchovy, bonito, blue fish and horse mackerel are transported in Styrofoam boxes with ice. Refrigerated trucks are used for longer distances. Cold chain is well established in Turkey, vehicles used to carry fish from local wholesale markets or directly from purse seine vessels in fishing ports to targeted cities to be recorded wholesale markets in final destination. When they turn back, bring usually imported fish from Istanbul or fish feed and other supplies for the market and fish farms. Main legal document is the certificate of origin at the transportation phase.

Main actors in the marketing process are the wholesalers who have offices in the whole sale markets in each of the Black Sea coastal cities and targeted markets. Fish either are sold in Trabzon Wholesale Fish Market or Wholesale Market in the targeted city after transferring fish in cold chain over auctions which is rather different than in EU countries. Price of the fish is very depended to quantity of fish landed and arrived to the market, its freshness, size of the fish and the demand from retailers. Every skipper or industrial fishing vessel has an agreement with one of the wholesaler and their fish are sold via contracted wholesaler with a commission up to 18%. This high commission covers all the economic losses and cost of transportation, staff coasts to upload and download the trucks.

If the supply is more than demand or size of the catch is so small than the allowable minimum landing size, prices goes down and fish consumption increases. If it remains unsold, it is forwarded to fish processing plants for fish meal and oil with cheaper prices (1/5 to 1/10 of the market price). On the other hand capture fishery has the seasonality, out of the fishing season, fresh fish consumption rate decreases due to higher prices. In coastal cities, citizens used to process fish as keeping in brine solution or in salt; especially bonito and anchovy. Some of fish shops and retailers prepare these products to sell their customers in no fishing season. Some part of the anchovy are shocked and marketed in local supermarkets throughout the year and exported to EU markets especially where Turkish workers lived in.

Farm products have different marketing structure. Due to fixed costs; mainly fish feed, energy and staff costs, producers determines the basic price. Some markets and restaurants demand fresh fish, then, harvesting from ponds and cages is carried out upon request. Some others may want chilled

and frozen in larger quantities. There is constant supply of farmed fish to the wholesale markets over determined prices by the fish farm. All fish and fish products are kept and carried Styrofoam boxes either fresh with ice or frozen. Majority of farmed fish is deep frozen for the export. Expert import companies or the agents of international companies are always involved in exporting process at the beginning of the production cycle by negotiating/pre-contracting of the producer companies. At the end of the growing season fish harvested from cages/ponds are transferred to the processing plants for cleaning, filleting, gutting and/or freezing. Export process is completed either from Trabzon Airport but mostly from Istanbul after transferring fish by trucks under cold chain. Processing plants prepare fish in different styles according to the demand of the market in different types and volumes.

The minimum standards are determined with legal measures and street markets, local fish shops and wholesale markets are expected to apply all standards described in the regulations.

Officially wholesale markets are under the responsibility of Municipalities from arrival of fish, keeping records, health control and hygienic controls of the market. Unfortunately system doesn't work very well; sales and recordings are carried out by the wholesalers and they report to the market administration. Point controls are done by Provincial Directorate of MoAF or together with Municipality polices.

Main wholesale markets in the region are Trabzon and Samsun Metropolitan cities, Ordu, Giresun, and Rize. None of them have institutional capacities like the ones in EU countries. Main and common problems of the wholesale markets are:

- Lack of any kind of institutional information in the website of the municipalities,
- No contact addresses,
- No website,
- No transparency,
- No official identity,
- Ineffective management system,
- Lack of effective legal supportive measures for the operation of wholesale markets
- No relationship about the functions of fish markets in the fishing and aquaculture industry and management authorities.
- Not open for the view of the public for the ones who want to know landings in time by species, prices, quality standards, monitoring, share of each wholesaler in marketing, etc.

As conclusion, wholesale markets are not transparent and not functioning very well in Turkey. In order to benefits of the fishermen, fish farmers and consumers, wholesale market regulation need to be aligned according to the modern effective concept requirements including market administration, duties and responsibilities, human resources, transparent (electronic) auction system, storage units and reporting services. Wholesale markets should be put in the required palace for better fisheries management, and need to be useful institution for fisheries economy.

3.2.3. Selling live or processed fish to restaurants

Sale of live fish to the restaurants is very rare. Restaurants usually prefer to buy frozen fish as whole and fillets in some cases. Customers used to eat whole fish cooked in different ways. On the other hand, in case of big trout, they serve fish slices prepared in the restaurant. Main origin of fish for restaurants is the wholesale markets. If any farm located close to the restaurant and farm is in the harvesting period or trout reach the market size orders can be done directly from the farm. These types of sale is not easy for the companies farming fish in sea cages due to difficulty to catch, transfer, box, ice and deliver. Small trout farms producing fish in ponds prefer this type of marketing due to benefit higher price than in the wholesale market and escape from commission costs born in the wholesale market.

3.2.4. Groceries or live for pond stocking

Big supermarkets have fish corners selling variety of fish and fish products of different companies. Out of fishing season, majority of the fish are farmed species from Turkey and imported ones (Table 3). Main species and product types are; sea bass, sea bream and trout as farmed fish. The others are the wild fish caught from the sea or inland waters and imported fish (Norwegian salmon, frozen shrimp, octopus, calamari, etc. Customers used to buy fish from supermarkets due to feeling safety from their veterinary controls, traceability processes, cold chain from farm to shelf, cleaning and gutting services.

Fish corners/supermarkets are also obliged to work on Fish sales regulation of MoAL .

As it is described before MoAF carried our breeding projects to enhance fish stocks in new build dams, natural lakes and other inland water reservoirs where fish stocks collapsed or destructed. Trout subspecies were farmed by providing adults in forest areas and their juveniles are released to the same rivers and small lakes to increase their population abundance. Mirror carp is another species widely used for the enhancement of lateral lakes, dams and small irrigation lakes for socio-economic purposes for the benefit of local citizens.

3.2.5 Sports (amateur) fishing

Amateur fishing activity is carried on only for sports or recreation, not for financial and commercial gain. Therefore fish caught with permitted fishing gear cannot be sold. “Communique 4/2, Regulating the Fishing for Amateur (Sports) Purposes”, No: 2016/36[195].

3.3. Marketing channels of fish and fishery products in Turkey

There is high correlation between production, trade and consumption rates. Turkey has considerable high rate of capture fisheries and aquaculture production however consumption per capita is still remains lower than EU and global level, which is 5-6 kg per capita (Table 1). The reason is the nutrition habits and consumption culture of the citizens; majority of the consumers prefer to

[195]https://www.tarimorman.gov.tr/BSGM/Lists/Duyuru/Attachments/65/4-2-Numaral%c4%b1-Amat%c3%b6r-Ama%c3%a7l%c4%b1-Su-%c3%9cr%c3%bcnleri-Avc%c4%b1l%c4%b1%c4%9f%c4%b1n%c4%b1n-D%c3%bczenlenmesi-Hakk%c4%b1nda-Tebli%c4%9f.pdf

eat fish within the catch season as fresh and low demand for processed seafood and other marine organisms like crustaceans and molluscs.

Two other important and interrelated factors that affect consumption is the amount of production and price. If the production of migratory fish species such as anchovy, sardine, bluefish, bonito and horse mackerel decrease, naturally consumption amounts also decrease. Especially since September, when fishing season starts the abundant catch of these species may also affect the market price of other fish species and fish prices remain at a low level during this period till December.

Fish consumption rate is also related with the locality of the people are living in. Consumption per capita is over 30 kg in coastal settlements but less than a kg in distant locations to the coasts and highlands.

Turkey is exporter and importer country. Imports have reached to 40 – 45 % of the quantity exported. Though the production in 2019 has increased 33% than 2018, majority of increased quantity were used for fish meal and oil due to abundant catch of undersized anchovy in the Black Sea. Fish meal and oil plants are beneficiaries of the catch of undersized fish due to use of unselective purse seines for pelagic migratory species.

Fish meal and oil exports of Turkey has increased by 57% in the January-October (2020) period according to the same period in previous year to 32 countries, with 26109 tons by issuing 45.4 million US $.

Table 1. Fisheries production, export, import and consumption in Turkey

Years	Production (tons)	Export (ton)	Import (ton)	Consumption (ton)		Unevaluated	Consumption per capita (kg)
				Domestic consumption	Fish meal & oil		
2000	582376	14533	44230	538764	71000	2309	8
2005	544773	37655	47676	520985	30000	3809	7.2
2010	653080	55109	80726	505059	168073	5565	6.9
2015	672241	121053	110761	479741	176138	6070	6.1
2016	588715	145469	82074	426085	93096	6139	5.4
2017	630820	156681	100444	441573	130917	2093	5.5
2018	628631	177500	98315	499461	47276	3115	6.1
2019	836524	200226	90684	624182	209109	3233	6.3

In the first four months of 2020, with the value of 10.8 million US$ of fish oil and 9.8 million US$ of fish meal were exported from Trabzon, and total of 20.6 million $ income was obtained.

In line with the increasing trend in aquaculture, Turkey needs more fish meal than exports; in 2018 6030 tons of fish meal exported while 132763 tons imported; equivalent to 9.5 million $ and 179 million $, respectively. In case of fish oil exports was 10238 tons (22 million $) and import was 56762 tons (82 million $). Not only feed industry for aquaculture essentially uses fish meal but also poultry and animal husbandry industry as the vital ingredient of animal feeds.

Comparing with 2018 data, aquaculture production has increased from 314537 tons to 373356 tons in 2019 (Table 2) of which 68.8 % provided from marine and 31.2 % from inland aquaculture. Sea bass is the leading species by 137419 tons, followed by rainbow trout with 123573 tons (116053 tons in inland and 9692 tons in marine aquaculture) and sea bream with 99730 tons.

Table 2. Fish production and value by years

Years	Capture fisheries		Aquaculture	
	Quantity (tons)	Value (million TL)	Quantity (tons)	Value (million TL)
2000	503345	368	79031	140
2005	426496	1575	118277	704
2010	485939	1079	167141	1067
2015	431907	1245	240334	2569
2019	463168	2380	373356	7694

Increasing trend of the value of production from aquaculture with the less quantity than capture fisheries, made aquaculture sector more attractive for the investors. Real value is coming from the export value which is always more for the farmed species. Practically it can be interpreted that capture fish production is more suitable for the consumption of Turkish citizens in the fishing season. Then, farmed species is preferred in no fishing season. But majority of farmed fish have chance to introduce international markets.

Turkey exported 200226 tons of fish with the value of 1026 million $ and imported 90684 tons by paying 189 million $ with wide range of species from various countries. Scomber and salmon from Norway are the most important species in the import list (about 50%).

Turkey exports to 80 countries; of which 70.4% are European countries, 26.5% are Asian countries and a small amount to the others. Most exported countries are Italy, the Netherlands, Germany, Russia and England.

Fresh-cooled fish constitute the largest portion of the exported fishery products, and its share increased from 46% to 62% in recent years. The share of frozen fish decreased from 22% to 13%, while the proportion of fish fillets varied between 14-17%.

Farm prices may vary according to the quantity ordered; from 15 to 25 TL as small quantities takes higher prices. According to the changes of Turkish Lira against US $ and €, prices can be adjusted which has more impact on domestic markets. In average farm prices for export may vary between € 3-5 per kg of big trout, sea bream and sea bass while their prices are € 6-12 in EU markets. It is believed that the real value can only be reached by creation of the brand/label names under the names of exporter/producer Turkish companies.

There are 180 certified fish processing plants in Turkey; 10 are processing bivalve molluscs, 15 are processing frog legs and snails. As of 2017, number of processing plants has reached to 210 facilities; of which 9 plants process bivalve molluscs, 17 plant process frog legs and snails. It is estimated that 6-7 thousand people are employed in these establishments.

3.3.1. Markets and price

There are variety of fish markets taking place between the ports/farms where fish landed/produced and sale units to the consumers. Figure 14 shows the marketing channels of fish and fish products in Turkey.

If the capacity of the farm located on river sides is small, usually they directly reach consumers by selling in farm, or over small fish shops. As the production increases, farmers intend to open small fish restaurants to sell value added products to increase their earnings.

Farmer producing larger quantities in dam and sea cages, they have more options in marketing; selling to the wholesalers as big quantities, or deserve fish especially for export after processing as frozen, filleted and packed in different types. For big demands they supply frozen whole fish to main wholesale markets in big cities after transporting them in cold chain.

At present more than 75% of big trout or Black Sea salmon are exported either via the exporter company of the producer or other exporter companies by paying commission or other means of payments upon agreement.

In domestic markets price of capture fish production is formed in big wholesale markets by auction (Table 3, Figure 15) and price of farmed fish is determined according to the production cost. Therefore the price of wild fish may show great variation within the year due to quantity of the catch, level of demand, season (fishing or no-fishing period), time of the day of marketing (early or late hours), freshness (time of capture and transportation to the market); while price of farmed fish have rather stable prices.

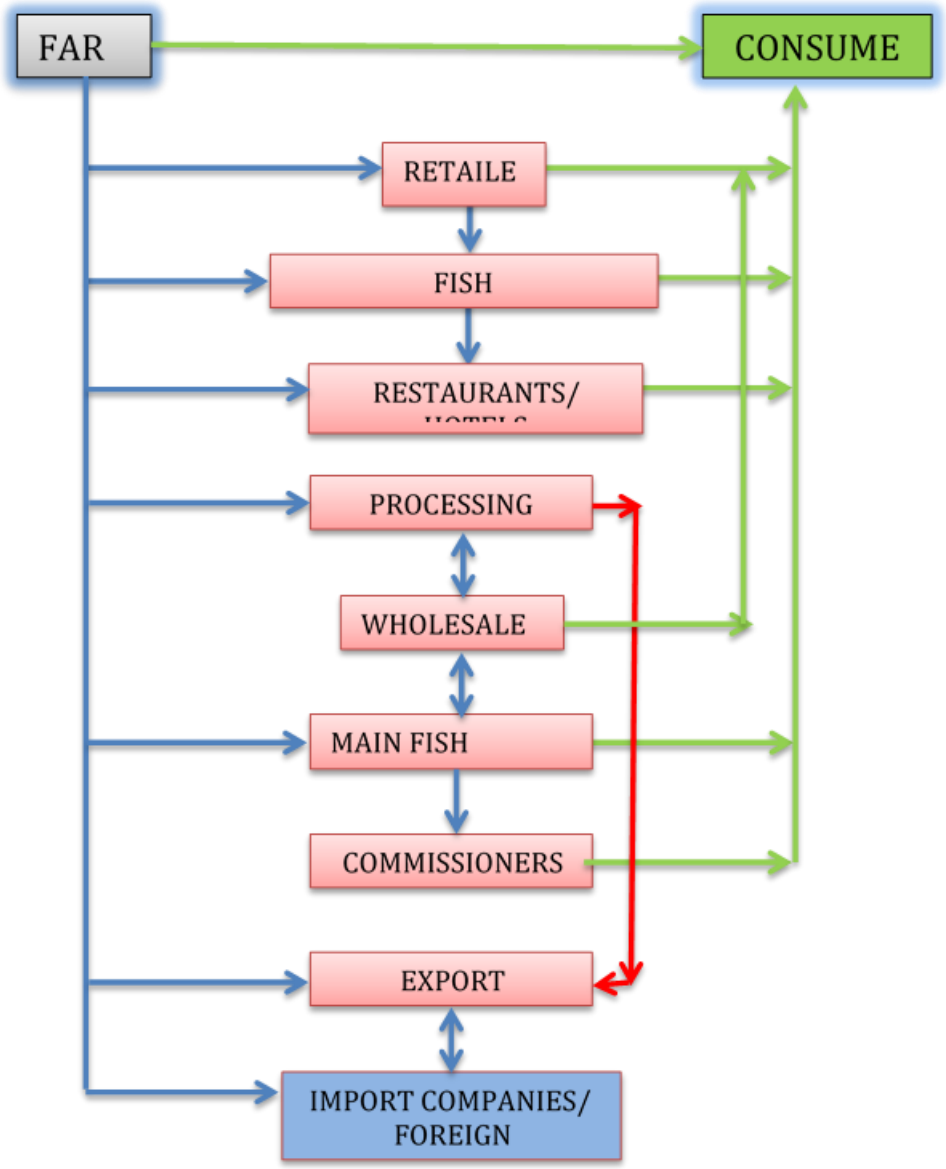

Figure 14. Marketing channels of aquaculture products in Trabzon and Turkey

3.3.2. Product types in markets

There are several types of products delivered to the markets according to the demand from consumers and marketing/export companies (Table 4). Local consumers prefer to buy farmed fish as fresh, but in some cases due to weather and sea conditions frozen products are wanted in the market. Chilling the products with ice is obligatory to keep fish in healthy condition in boxes during marketing. Fresh marketing covers mainly alive fish harvested from the ponds to send restaurants which exhibit trout sp alive in aquariums for the selection of the customers. All of the frozen products are prepared in fish processing plants.

Table 3. Price of farmed fish in various markets on certain dates

Species	*Market*	*Price TL per kg* (Min-Max)*	*Date*
Trout (inland)	Farm/fish shops	20-25	Year average
Trout (marine)	Istanbul Wholesale fish Market	17	07/12/2020
	Bursa Wholesale fish market	20-25	
	Ankara Wholesale Fish Market	17.5-30	
	Trabzon wholesale Fish Market	30-35	11/12/2020
	CarrefourSA	40	14/12/2020
	Migros	80 (Fillet), 75 (slice)	
Sea bream	Istanbul Wholesale fish Market	30	07/12/2020
	Bursa Wholesale fish market	40-60	
	Ankara Wholesale Fish Market	35-45	
	İzmir Wholesale Fish Market	10-60	28/11/2020
	CarrefourSA	40	14/12/2020
	Migros	35-55	
Sea bass	Istanbul Wholesale fish Market	38	07/12/2020
	Bursa Wholesale fish market	40-60	
	Ankara Wholesale Fish Market	37.5-47.5	
	İzmir Wholesale Fish Market	26-55	28/11/2020
	CarrefourSA	47-60	14/12/2020
	Migros	50-60	

*Exchange rate: € 1 = 9.3 TL (28.11.2020); 9.5 TL (07.12.2020); 9.6 TL (14.12.2020)

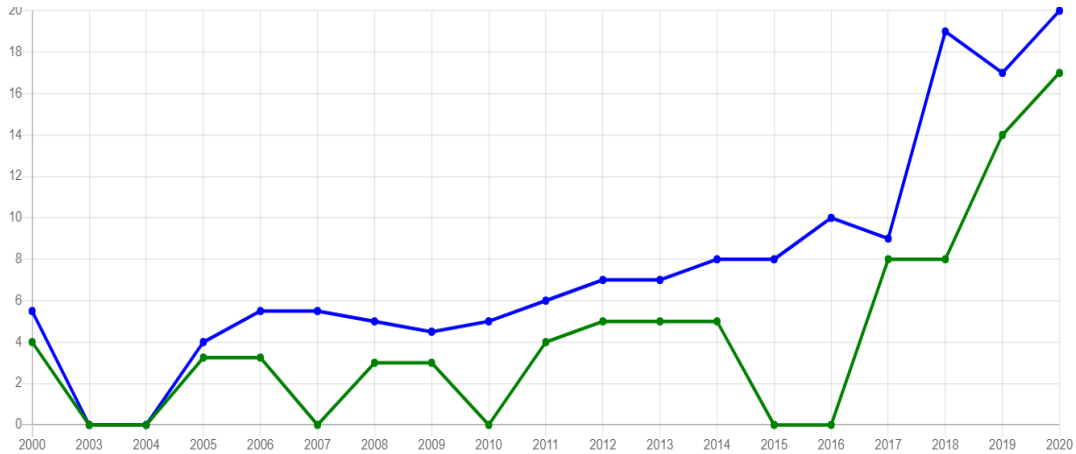

Figure 15. Price of big rainbow trout reared in marine cages by years (upper line: max, lower line min price-TL)

Table 4. Types of fish and fish products in marketing process

Product type	Species	Unit weight of fish	Volume of final pack
Fresh	Trout sp, Sea bream, Sea bass	150-250 g	Undefined
Fresh-chilled & fresh cleaned	Sea bass	0.2 to 1.5 kg	In EPS boxes as 5,10 & 25 kg
	Sea bream		
Fresh chilled	Trout	0.4-6.0 kg per fish	
Fresh gutted & chilled	Trout	0.4-4.5 kg per fish	
Fresh-chilled fillets	Sea bass	100-600 g	
	Sea bream		
	Trout	0.2-3.0 kg	
Frozen whole & frozen cleaned	Sea bass	0.2-1.5 kg per fish, glazed, In printed bags of 500, 750 & 1000g	In 10 &15 kg boxes
	Sea bream		
Frozen whole	Trout	0.4-6.0 kg in printed bags of 0.75- 1kg	In boxes of 10, 15 & 25 kg
Frozen gutted/cleaned		0.4-4.5 kg per fish, glazed, In printed bags of 750 & 1000g	
Frozen fillet with skin or skinless	Sea bass	100-600 g per fish, glazed, In printed bags of 500, 750 & 1000g	In 10 &15 kg boxes
	Sea bream		
	Trout	0.2-3.0 kg per fish, glazed, In printed bags of 500, 750 & 1000g	

3.3.3. Prices of fish for farming

Aquaculture investments are increasing in the region and Turkey. Progresses in the aquaculture are not the same in each level of breeding. The capacities in ranching/fattening farms increase faster than juvenile production. Therefore cost of juveniles may increase when the demand is high. Trout juvenile supply has become a real problem threatening aquaculture industry in the region. Table 5 shows the cost of trout at different life stages for further farming.

3.4. Research and Innovation

There are huge efforts to develop new meals to supply to the market as new products made from fish which are carried out by the Universities (Faculty of Fisheries, Departments of Fish Processing of Faculty of Marine Sciences, and Departments of Food Technologies of Engineering Faculties. Besides the Universities, research studies also carried out under the supervision and coordination of the General Directorate of Agricultural Research (TAGEM) of MoAF by four fisheries research institutes and a fisheries department.

Such research studies cover to develop technics to extend shelf life of the products, new packaging materials and packing systems, converting traditional processing systems to industrial level, new methods to reduce or minimise chemical and biological contaminations, development of new products as instant fish soups from local fish species, fish doner kebap.

Table 5. Prices of trout from egg to big sizes

Type	Price
Imported triploid eyed egg	0.25-0.45 TL per egg based to the quantity (average 0.30 TL per egg)
Eyed egg (piece)	0.10-0.15 TL (summer egg) 0.20-0.27 TL triploid summer egg
Eyed egg (piece)	0.08-0.10 TL per diploid egg in normal spawning season
Fry (2-3 g)	0.40-0.50 TL per juvenile
Juvenile (5 g)	0.80-1.20 TL for each piece (varies with time and place)
Juvenile (10 g)	1.5 -2.5 TL each (varies with time and place)
Juvenile (40-50 g)	>50 TL per kg (varies with time and place)
Young (80-120 g)	>50 TL per kg (varies with time and place)
Trout (200-250 g)	20-25 TL per kg (wholesale market)
Trout (200-250 g)	3.0-3.5 US$ per kg (live sale to net cages)
Trout (> 500 g)	3.0-3.5 US$ per kg (live sale to net cages)
Trout (> 1000 g)	3.5 -4.0 US$ per kg (live sale to net cages)

Research studies on fish breeding and aquaculture is very important in order to rational use of resources, to increase production, meeting the increasing demand for fishery products, supporting natural stocks, create new employment opportunities and increase of the exports. Therefore research on aquaculture has been adopted as a general policy in the development plans.

At present, training and awareness-raising activities are carried out to improve the interaction between aquaculture studies and the environment. On the other hand, special care is given to the training of the staff working in the aquaculture and processing industry according to the new technical developments, legal requirements of certification procedures. Life-long learning programs are getting more importance according to the fast developments in the industry.

Fish diseases are very serious threats limiting the development of aquaculture today by causing high mortalities. Therefore providing healthy environment with the minimum stressors is very important to reduce losses and obtain healthy products both at enterprise and national level. Therefore, in terms of fisheries health, research studies are important and the results obtained from these studies can be widely used in disease control and help for the protection of natural stocks. In addition, providing healthy, reliable and high quality products may contribute to the public consumption and meet international standards on fish welfare. Monitoring from farm to fork in parallel with EU practices and control systems should be developed.

3.5. Regulations for fish markets and farmed products

3.5.1. Regulation on Wholesale and Retail Fish Sales

The main legislation is the “Regulation on Fisheries Wholesale and Retail Sales” dated 19.06.2002(Official Journal No: 24790), based on Fisheries Law, 1380 and amended Law, 3288; articles 23 and 29.

This Regulation has been prepared in order to ensure that fishery products are offered to consumers in a fast and safe manner in accordance with hygiene, quality and standards, within free competition conditions.

It aims to set up the minimum general, technical, hygienic, physical and infrastructural conditions that must be complied with in fisheries wholesale places established or to be established by municipalities and/or real and legal persons, and the establishment, operation, management and operation of these places, retail sale of fishery products and the procedures and principles regarding the conditions that employees should have at the sales points, and the matters related to control and inspection.

Ministry of Agriculture and provincial directorates are authorized to implement this regulation across country.

First chapter defines the terms of the regulation; wholesale markets wholesale centres, retail markets and fish shops which all work in accordance with the conditions set forth in this Regulation. The roles, duties and responsibilities were explained according to the different actors taking part in the operation of markets, i.e. operators, arbitration board, operation manager, responsible manager, controller, audits, producers as fishers and fish farmers, brokers and fish traders. Additional definitions were also made for physical capacities as auction area, cold stores, handling and packaging units. There are articles about whole sales and retail sales, and fees to be paid to the municipality or to the operator company.

Second chapter concerns with the establishment of wholesale fish markets within the borders of the province for marketing seafood. Retailers and fish shops are obliged to have sales document from wholesale market in order to sustain their business. Retail sales are forbidden in wholesale markets.

Regulation describes the locations where the markets can be established, legal and physical requirements, permissions from health, environment and other relevant public administrations, application procedures for the market construction and establishment, and the need for water and electricity supply, water analyses reports, discharging and getting rid of waste water plans and EIA reports (Chapter 3).

Next chapter describes essential infrastructures and their technical features to provide hygienic conditions for different types of markets in various capacities starting from the inlet ramps for the fish entry to the exit of fish boxes sold to the buyers. In this context there are standards to adjust physical conditions of the market building, sanitary and hygienic rules for fish keeping and storage units, exhibition areas and their properties, auction procedures, offices and meeting rooms for different role players, ice making cooling and freezing units, social spaces and their hygiene conditions, registry and data collection/recording systems, pack and packing areas and waste management systems.

Special attention are given to the operation process of the markets regarding coming fish, weighing, counting boxes, recording, keeping as for the type of the product, quality control, label checks, preparation of receipts and transfer documents, inspection and control and auditing mechanisms.

3.5.2. Communication for supporting processed fishery products (No: 2020/17, dated 12.06.2020)

The Communiqué regulates the procedures and principles regarding the support of processed fishery products to be given to those engaged in aquaculture[196]. For 2020, it is determined as to give governmental support 2 TL per kg of processed fish with the upper limit 100 tons.

3.5.3. Instructions for permit of export to fishery business enterprises and issuing a health certificate for the products[197]

With this Instruction prepared within the scope of the Veterinary Services, Plant Health, Food and Feed Law numbered 5996, fishing products from our country, live bivalve molluscs, frog legs, processed land snails, live frogs and land snails, and the products of these enterprises and livestock for aquaculture fish, ornamental fish, etc. Rules for issuing health certificates for the export of products are determined.

Businesses wishing to export to European Union (EU) member countries and other countries and operating in the subjects specified in the "Part I" of this instruction must comply with the provisions of this instruction.

In accordance with the "Regulation on Registration and Approval Procedures of Food Businesses", the products produced in food establishments having Business Approval Certificate and Business Approval Number can only be supplied to the market for human consumption.

Enterprises wishing to export are required to obtain an Export Permit from our Ministry within the scope of this Instruction, in addition to the Business Approval Certificate and Business Approval Number received within the scope of the Regulation.

In addition, businesses that want to export primary products such as live frogs, live land snails, juvenile fish for aquaculture and aquarium ornamental fish are required to obtain a Business Registration Certificate and a Business Registration Number covered by the same Regulation.

However, for the export of aquaculture products such as juvenile fish and aquarium ornamental fish for aquaculture, the business license will be valid instead of the Business Registration Certificate.

Businesses that have already obtained export permission before the publication of Law No. permitted business will continue to be included in the lists.

Businesses wishing to export to European Union (EU) member countries and other countries and operating in the subjects specified in the "Part I" of this instruction must comply with the provisions of this instruction.

In accordance with the "Regulation on Registration and Approval Procedures of Food Businesses", the products produced in food establishments having Business Approval Certificate and Business Approval Number can only be supplied to the market for human consumption.

[196] https://kms.kaysis.gov.tr/Home/Goster/163221
[197] https://kms.kaysis.gov.tr/Home/Goster/24875

Enterprises wishing to export are required to obtain an Export Permit from our Ministry within the scope of this Instruction, in addition to the Business Approval Certificate and Business Approval Number received within the scope of the Regulation. In addition, businesses that want to export primary products such as live frogs, live land snails, juvenile fish for aquaculture and aquarium ornamental fish are required to obtain a Business Registration Certificate and a Business Registration Number covered by the same Regulation. However, aquaculture such as juvenile fish and goldfish for aquaculture

In the exportation of products, the business breeding license will be valid instead of the Business Registration Certificate.

Businesses that have already obtained export permission before the publication of Law No. permitted business will continue to be included in the lists.

Document regulates authorised profession groups as inspectors; export permissions and its procedures (application and supporting documents as water analyses used in production, updated HACCP plan copy, company registry certificate); in-situ inspections in line with templates of Inspection Form, HACCP System Inspection Form which are prepared by the Ministry of Agriculture and Forestry. Evaluation report will be submitted in 16 days after the inspection process in the Ministry has been completed in 30 days (45 days in total).

According to the supply to be exported, export permission number should be used as 11 for fish, 12 for shrimp, 20 for fresh, chilled, frozen, deep frozen, filleted etc prepared from fish, crayfish, shrimp, etc captured from nature; 30 processed products as smoked, cured, dried marinated, fish oil, by indicating (F) for captured products, (A) for Aquaculture products, etc.

3.5.4. Live, fresh, cooled and frozen products import instructions[198]

This instruction determines the controls to be carried out at customs by the authorized officers of Ministry of Agriculture and Forestry at the time of actual import, and the procedures and principles to be applied in these transactions. Main documents to be issued and attached are The Control Certificate, Proforma Invoice or Invoice, health certificate, Fresh, chilled and frozen products to be used as food is the document showing that these products are obtained under appropriate technical and hygienic conditions and that they are in accordance with the national legislation, certificate of origin.

3.6. Administrative bodies and supportive organizations in marketing

- Ministry of Agriculture and Forestry- DG Fisheries and Aquaculture, veterinary and food control services
- Ministry of Health,
- Ministry of Trade, Under Secretariat of Foreign Trade,
- Ministry of Environment and Urbanization,
- Municipalities,

[198] https://kms.kaysis.gov.tr/Home/Goster/23574

- Chambers of Trade and Industry,
- Union of Exporters
- Seafood Promotion Group

3.7. Certificates in farming, processing and marketing

Companies having production in global scale and export potential own various types of certificates regarding their product and processing qualities which are desired in international trade. Important ones can be listed as:

- ISO 9001, HACCP 130001 and ISO 22000 Quality and Food Management Systems and GLOBAL GAP standards for fish feed production,
- ISO 9001, ISO 22000, BRC (British Retail Consortium) and IFS (International Food Standart) Certificates, GLOBAL GAP standards for fish farming units,
- ISO 9001:2000 HACCP 130001 for processing and packaging companies
- Turkish Food Codex Regulation and Codex Alimentaris Commission for all processing plants, pursuant to the national and international food safety criteria () and have the health approval number issued by the EU.
- ISO 9001 Quality, ISO 14001 Environmental Management System, HACCP and ISO 22000 Food Safety Management System, IFS and BRC, and Integrated Global G.A.P standards for fish processing and cold chain.
- ASC (Aquaculture Stewardship Council) Certificate for the safety criteria of fish from net to plate.

3.8. A business plan for marketing in aquaculture industry

According to the existing state of aquaculture, such a business system can be applied to solve existent problems and increase production and exports from the Black sea (Fig. 15). In order to provide more progress in the field of aquaculture, weaknesses and threats should be converted strengths and opportunities by rational methods. Level of success will be closely related to positive motivation of all stakeholders to reach short, mid and long term targets determined by the common understanding.

According to the reports on the Black Sea region, climate change will have an impact as the floods. Therefore essential measures should be taken in short and midterm to get rid of threat of flood (by fostering the farm borders, changing locations, renewal of water intake and discharge systems).

Efficient lobbying activities needed to reduce pollution risks in river basins and impact of hydroelectric power plants on fish farms.

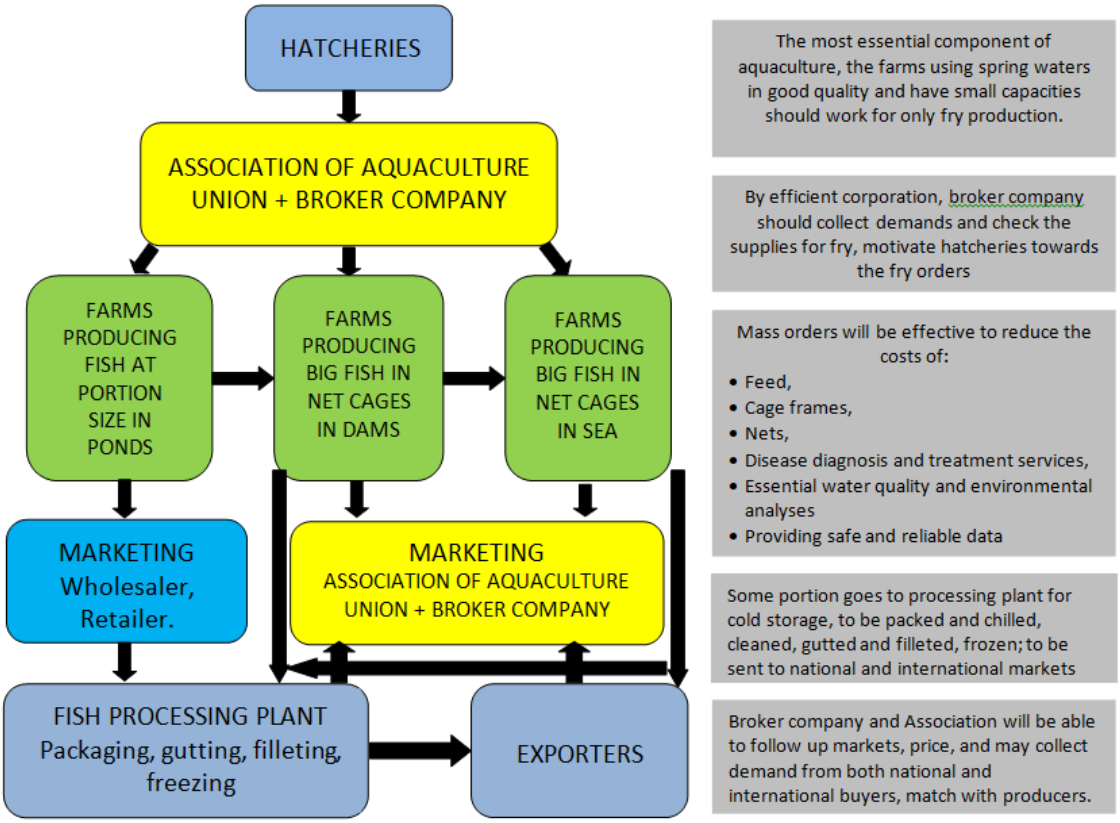

Figure 15. An aquaculture business model for the Black Sea of Turkey

In order to solve such problems, Union of Aquaculture Producers in provinces and top organization Association of Aquaculture Producer Unions (AAPU) need to be more active to communicate with the Ministry of Agriculture and Forestry (MoAF) and other public stakeholders. On the other hand AAPU must change organizational structure from bottom up instead of vice versa. If there is need any legal support, a binding regulation should be drafted and proposed to the MAF.

Main problem in the sector is smooth marketing with good price, high costs of feed and insufficient fry supply. At present majority of the investors are hardly find fry from the hatcheries across country. If AAPU is able to organize such common action to organize suppliers and buyers to determine juvenile need, hatcheries may have chance to produce sufficient amount of fish to cover the need of the industry. Small fish farms can be reorganized as hatcheries only produce fish juveniles intensively. Brokerage system could be established on digital platform to bring producers and buyers together for an active service benefit of the all parties. Same type of role can be acted for the feed, material and equipment supply necessary for production with sufficient quantity, in time with lower costs. On the other hand veterinary services, consultancies and training needs may also be provided under this collective system. Actually it will be a typical platform which can act like a producer organization for the benefits of members.

Recently, big trout producers have formed a media group to discuss the future of big trout production in the Black Sea Region with the participation of academia, producers, administrative staff, exporters, etc. Their main target is the sustainable production of big trout by creating a brand name (i.e Turkish Salmon, Black Sea Salmon), increasing the attraction in international markets, organization of awareness campaigns to increase domestic consumption as well.

Covid-19 outbreak has worldwide impact on international markets. Fortunately, aquaculture industry has managed overcome of this impact by intelligent approach. When fish sales were decreased, MoAF organized sales campaign with supermarket chains by fixed, reduced price for marketing farm products. International demands cancelled at the beginning, prices went down. Fish farmers stored their products after freezing. When demands started they import this bulk of fish with higher price than the time of strict pandemic closures. Another important result is that farmers did not stop their production and no one lost their job in the Black Sea region.

3.9. Further developments in aquaculture for production and marketing

According to the decisions taken in the last aquaculture summit, The Ministry of Agriculture and Forestry decided to prepare some action plans and implement on certain issues in order to support aquaculture and marketing in Turkey.

- Increasing aquaculture production by increasing productivity with sustainability rules, and promotes farming of alternative species. Target is to produce 600 thousand tons of fish by 2023, and export fish at 2 billion $,
- New fish farming sites will be allocated, closed intensive farming systems will be promoted,
- Improving licensed cold storage, spreading electronic products trading. Products will be stored in an insured and healthy manner with modern infrastructure. Thus, product losses will be prevented, trade will be recorded, transportation costs will be reduced and market price stability will be ensured.
- Ensuring the sustainability of family business - supporting entrepreneurship in youth, positive discrimination will continue in the projects to be implemented for women and youth. Supports will continue in this period as well in order to economically develop rural citizens.
- Promoting farming in foreign countries, food safety in all conditions, with bilateral collaborations to be made with other countries, it is planned to increase cooperation in the agricultural field (brooder extent), to guarantee the supply of raw materials with the agriculture-based industry, to increase the production area and to expand the trade network.
- Branding in agricultural and forestry products. Creating a Global Scale Brand is one of the main goals of the Ministry. It is planned to determine target markets, to collaborate with ministries on branding and to increase production of value added products.

3.10. Conclusion

Fish production from aquaculture of Turkey is the only export item in animal food products to EU countries. Annual sales have exceeded 800 million US dollars. According to the plans, 2023 target was 1 billion dollars, but the aquaculture industry upgraded 2023 target to 1.5 billion dollars. Annual fish production in sea farms has reached to 253 395 tons. Farmed fish are exported to 59 countries, and 70% of the exports go to the EU countries. Sea bass and sea bream are the main species in production and exports. The share of sea bass and sea bream in the exports is 60%. Almost all of the trout production from the marine cages is exported to Japan. Recently, the USA and Russia are the new promising countries for the export of aquaculture.

This large production capacity made Turkey the world leader in juvenile fish production.

While EU countries, the USA and other developed countries are more in demand for the consumption of cultured fish, the situation is different in Turkey. Fish from aquaculture has difficulty to enter the kitchen of consumers comparing with the other cultured products; meat, milk, vegetables and fruits are at the forefront. There is strong need to promotion campaigns and public awareness activities on the quality of the farmed fish and importance of fish in nutrition.

4. UKRAINE

4.1. Production and consumption

In 2016, the total consumption of fish and seafood in Ukraine amounted to 432 thousand tons (Fig. 16).

The consistently low demand for fish and seafood is the result of the unstable economic and political situation in the country. The most important factors affecting the consumption of fish and seafood in Ukraine are:

- 5% increase in total inland fishing and a 25% increase in imports in 2008 led to a 20% increase in fish and seafood consumption compared to 2007.

- The financial crisis (2008-2009) caused a drop in fish and seafood consumption of 17% in 2009 compared to 2008 due to a decrease in consumer purchasing power, rising prices for imported goods due to the fall of the national currency and other internal and external factors (Ukrainians were forced replace the fish protein diet with a cheaper one).

- The annexation of the Crimean peninsula and problems with the delivery of fish to the militarized regions caused a decrease in consumption in 2014 compared to 2013.

Nevertheless, 2016 saw a slight improvement in the overall level of consumption of fish and seafood, which could stop the decline of the previous two years.

Statistics of the State Service of Statistics confirm that the share of imports in monetary terms consumed is much higher than the share of exports (Fig. 16). This can be explained by the fact that national production provides only 20% of domestic demand, the rest is imported.

Changes in fish and seafood exports are due to economic, political and regulatory factors. The largest decline (after 2013) was due to the loss of the Russian market, which made up on average 80-85% of all Ukrainian exports. At the same time, 63% of fish were caught after annexation of the Crimean peninsula.

Imports of fishery products in the amount of 320 000 tons and own fish in the amount of 180 000 tons (officially 90 000 tons) the total volume of the fish market of Ukraine is about 500 000 tons.

Accordingly, with a population of 35 million people in Ukraine, about 14 kg of fish per year.

It should be borne in mind that, according to the United Nations Food and Agriculture Organization (FAO), the recommended rate of fish consumption is 20 kg per person per year. In this case, marine fish should be 75% of the stated norm.

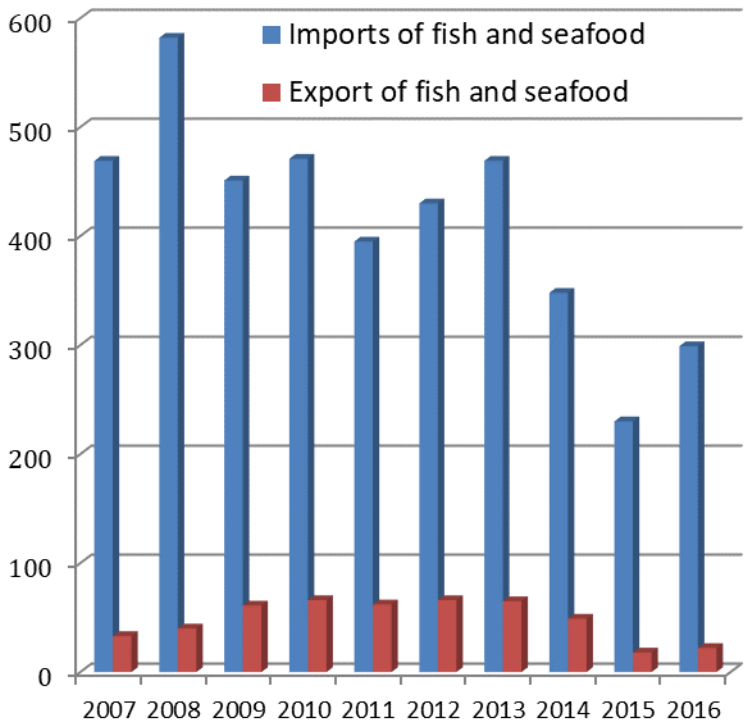

Fig. 16. Exports and imports of fish and seafood in Ukraine during 2011-2016 (USD million).

4.2. Development of aquaculture industry

An analysis of Porter's five forces was used to determine the level of competition in the industry and to show the aquaculture development strategy. The methodology identifies five forces that evaluate the attractiveness of doing business in the industry.

Analysis includes an analysis of the three parts of "horizontal" competition:

- the threat of the appearance of substitutes,
- the threat of new players and
- competition

and the two forces of "vertical" competition:

- an analysis of the market power of suppliers and
- consumers.

Two industries were compared: aquaculture and poultry as the main competing industries.

Comparative analysis of poultry and aquaculture[199]:

- The purchasing power of aquaculture consumers is higher than that of poultry
  - high elasticity of demand, so consumers can use less expensive products, in this case - poultry products
  - lack of differentiation in the aquaculture products market compared to the poultry market
  - the absence of some unique substitutes
- Aquaculture suppliers' purchasing power is higher than the poultry market:
  - low level of competition among suppliers in the aquaculture industry compared to the poultry industry
  - high costs associated with changing suppliers due to high dependence on imported feed and other products
- The risks of emerging aquaculture players are higher than in the poultry market:
  - low level of consolidation of aquaculture companies;
  - lower differentiation of products and strength of existing brands in aquaculture compared to poultry industry, respectively barriers to access to this industry are lower;
  - low level of development of aquaculture distribution channels (especially the absence of cold logistics), which reduces the attractiveness of the industry;
  - a high level of regulation of the aquaculture industry (a large number of permits at the entrance to the industry; high requirements from the state: 30 kg of 100 kg to submit to the state expertise of fish quality;
  - long payback period for certain aquaculture species (for caviar business, the average fish ripening period is 6-10 years, and only after that time can the final product be obtained);

[199] https://www.slideshare.net/Easy_Business/ss-83657232

- The level of competition in aquaculture is much lower than in poultry;
- low concentration of companies;
- high barriers to entry (over-regulation);
- low growth rate of the industry;
- low product differentiation and standardization in the aquaculture industry creates an infinite number of alternatives for the consumer, leading to a constant change in his choice. Because of this, there is a high level of future income volatility in the industry.

- The threat of aquaculture substitute products is lower than in poultry:
  - limited volume of direct substitutes in the market (high price, mainly because they are all imported)
  - the high cost of replacing the product in the aquaculture industry (mainly because they are all imported).

To sum up, the aquaculture industry in Ukraine is characterized by low levels of competition, especially when compared to poultry. Among the main advantages and prospects for the growth of the aquaculture industry in Ukraine are the low level of market consolidation, the limited number of direct substitutes available in the market, the high price of direct substitutes in the aquaculture industry and the high market power of buyers.

4.3. Aquaculture business development

The main constraints for aquaculture business development are low differentiation and standardization of products, lack of quality logistics, over-regulation of aquaculture production, relatively low profitability of the industry and low market growth.

Successful aquaculture businesses rely upon effective marketing strategies developed as a result of comprehensive market planning. Market plans begin with a thorough assessment of the current market situation based on secondary data. Additional direct observations or sometimes market research supplement the broader trends found in secondary data. The market plan then carefully analyzes the strengths and weaknesses of the business, including external threats and opportunities and internal strengths and weaknesses. Careful consideration should be given to whether the market can be segmented and whether the company should focus on one single product or various products and product lines. Examining the product's life cycle and development of a price-quality matrix and a product-space map will help to clarify optimal product positioning strategies. Once the key parts of the marketing strategy are defined (target markets, how to position the product(s), how to price the product, and distribution channels), a financial analysis of the marketing plan needs to be developed as well as a methodology for monitoring and evaluating the company's marketing performance[200].

Fee fishing is an attractive marketing alternative for many small-scale producers. The increased demand for fishing opportunities and per capita consumption of fisheries products have led to rapid

[200] https://onlinelibrary.wiley.com/doi/abs/10.1002/9781118859223.ch9

expansion and development in this market. A major benefit is the premium price paid for fish. The price per pound may be as much as double that paid by large processing plants[201].

The initial step in establishing a fee fishing operation is determining what the customer wants. Fishermen's preferences vary from one geographic area to another. This determination should include not only the species and size of fish to use, but also conveniences such as concessions, bait, tackle, restrooms, shaded areas, benches, etc.

Additionally, the potential fee fishing operator must determine where, how and when to sell. Location is an important consideration in determining if fee fishing is a viable marketing alternative. Ideally, fee fishing ponds should be easily accessible from a heavily traveled road near an urban center. Fee fishing customers appreciate convenient parking areas and easy access to ponds. The site should be identified with large signs on the nearest major road, and additional signs on secondary roads. Most fee fishing operations depend on word-of-mouth advertising to attract customers. It is essential that potential customers be able to locate the fee fishing operation.

Marketing through fee fishing requires a willingness to deal with the public and to work long hours, often seven days a week. Considerable management ability is required to provide maximum returns. The primary advantage is the premium price received by the operator.

Small-scale producers may sell fishes to live haulers. Live haulers usually buy fishes at the pond bank, then transport and sell them at other outlets such as processing plants, pay lakes, recreational lakes, or retail outlets. Small-scale producers often have difficulty working with live haulers because the producers lack proper equipment and experience. Live haulers need to know exactly how many pounds, what size, and when fishes will be available. Live haulers prefer not to handle small quantities of fish, less than 1,000 to 2,000 pounds, and in some areas not less than 5,000 to 10,000 pounds. Some live haulers may use small trucks to transport fishes within restricted geographic areas, providing an outlet for 500 to 1,000 pounds of fish at a time. They prefer that fish be of a consistent size.

Another marketing alternative is direct sales of live, whole or processed fish. This option requires a holding facility but offers the advantage of a premium price with a minimum amount of dealing with the public. Specific hours of operation can be established. Small producers may be open only a few hours one day per week. This allows efficient scheduling of time and reduces time lost waiting for a customer. Orders for fish can be taken prior to pick up with all customers required to pick up fish during a specified time.

If processed fish are sold directly to the public, sanitary processing facilities are required. Local public health officials should be contacted concerning regulations for processing and selling aquaculture products.

Direct Sales to Restaurants, Grocery Stores, and Other Retail Outlets. Direct sales to restaurants, grocery stores, or other retail outlets often appear to be a viable marketing alternative for small producers. In most cases they are not. Although there may be many retail outlets in the vicinity,

[201] https://thefishsite.com/articles/smallscale-marketing-of-aquaculture-products

they require a constant supply and consistent size product. A small producer probably will have fish available for only a very short time. Even though the producer might be able to deliver a quality product at a reasonable price, the retail outlet manager will usually choose an established distributor or large producer for convenience and dependability.

V. Database with good practices in aquaculture in partner countries

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 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 (Κ. Σωφρονίδης, Α.Κ. 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 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 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"[202].

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,

[202] https://fishfromgreece.com/

- 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 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"(ΣΕΘ, 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 production[203].

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.

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.

[203] https://www.organiclife.gr/

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 chain[204].

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 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 entities[205].

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).

[204] https://www.asc-aqua.org/what-you-can-do/take-action/find-a-supplier/
[205] https://inale.gr/en/home_inale_en/

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, e.tc.). 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.

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 Health[206].

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

[206] https://www.pamth.gov.gr/index.php/en/enimerosi/diafaneia/deltia-typou-anakoinoseis/pamth/item/33190-853-2004

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 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 Development[207].

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, Perka fluviatilis, Leuciscus*

[207] (http://www.caviargr.com/home.html, Ευρωπαϊκή Επιτροπή, Wikipedia, Huffington Post, Kathimerini, Voria)

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 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 potential[208].

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

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

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 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)[209].

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 are[210]:

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 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.

[209] https://thefishsite.com/articles/production-methods-for-the-common-carp
[210] https://www.scribd.com/doc/78307950/57668826-Cresterea-Intensiva-a-Crapului

3.1.1.4. Super-intensive productions

This type of production can be achieved only in systems with recirculation and water thermostatization. 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 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 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 Kingdom[211].

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.

[211] Fisheries and aquaculture in Europe, No 56, June, 2012

The most popular species from Romanian farms are *Acipenser stellatus, Acipenser gueldenstaedtii, Huso huso* and *Acipense 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 10-12º, reaching its peak at the end of April when the water temperature rises to 15º ÷ 18º C, and gradually decreases towards the beginning of May.

The eggs hatch at a period of 110º days, which means that at a water temperature of 10ºC 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 systems[212].

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 Factory	19.07.2017-19.07.2019	7,310,724.47	3,648,051.51

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

[212] *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.

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.

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.

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 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

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. Zatun Pond Recreational Base (www.spjadppgalati.ro)

Zatun 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), 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-peste-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

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 Gümüshane, 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 Limited[213]

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 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).

[213] Sancak Mah. No 25/A Yomra, Trabzon, 61250 Turkey, Phone: +90 462 3413646, www.yomrasuurunleri.com Director: Ilker Yildrim, ilkery.61@gmail.com

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.

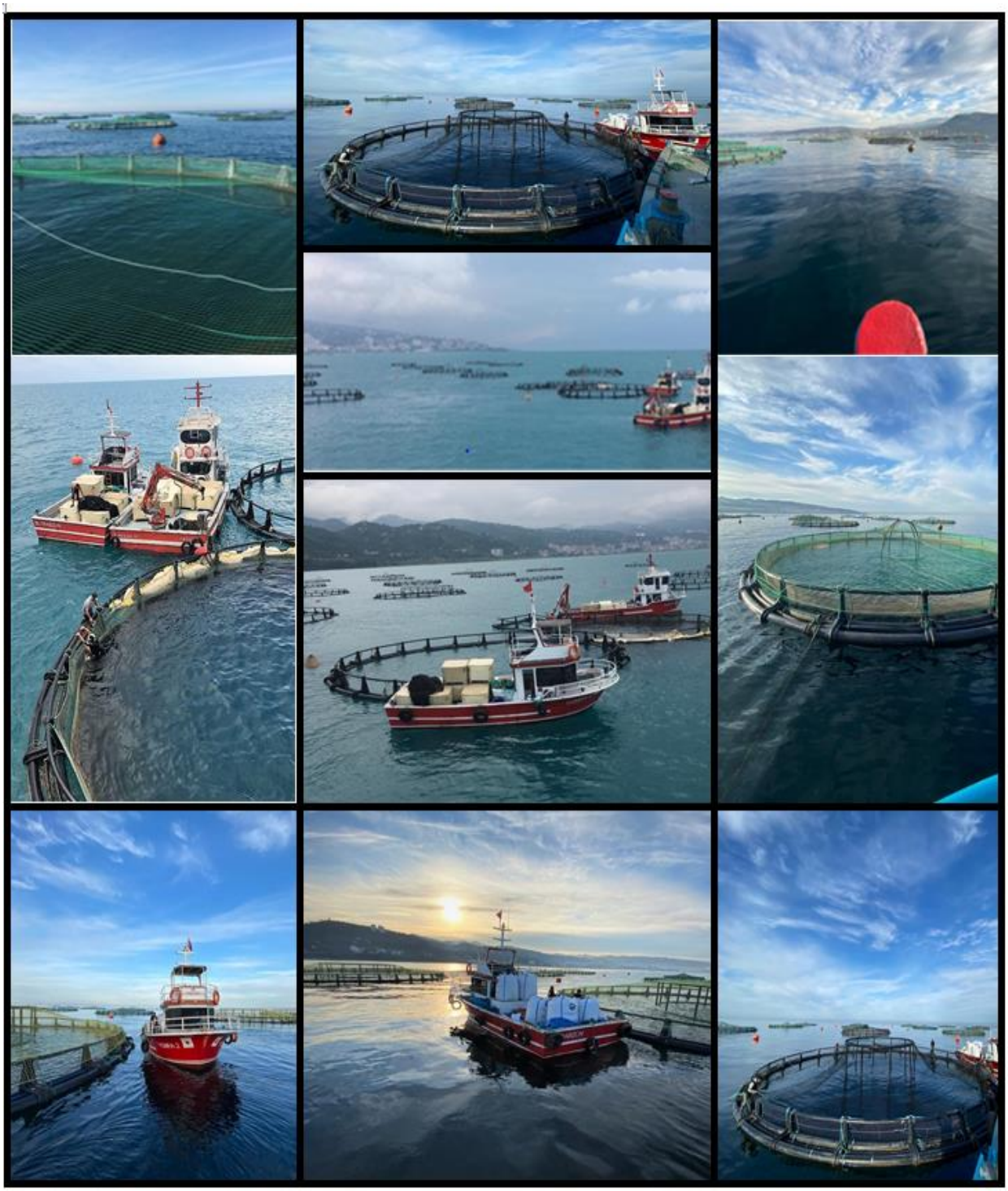

Figure 1. Views from Yomra Aquaculture marine cage system

4.1.2. Polifish/Politek Inc[214].

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.

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.

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 HACCP[215] 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	100-200, 200-300, 300-400, 400-600g per fish	In EPS boxes as 5 & 10 kg

[214] 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

[215] Hazard Analysis and Critical Control Point

Sea bass	fillets		
	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	
	Frozen cleaned	500-750, 750-1000 g per fish	In boxes of 10 & 15 kg blocks
	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%

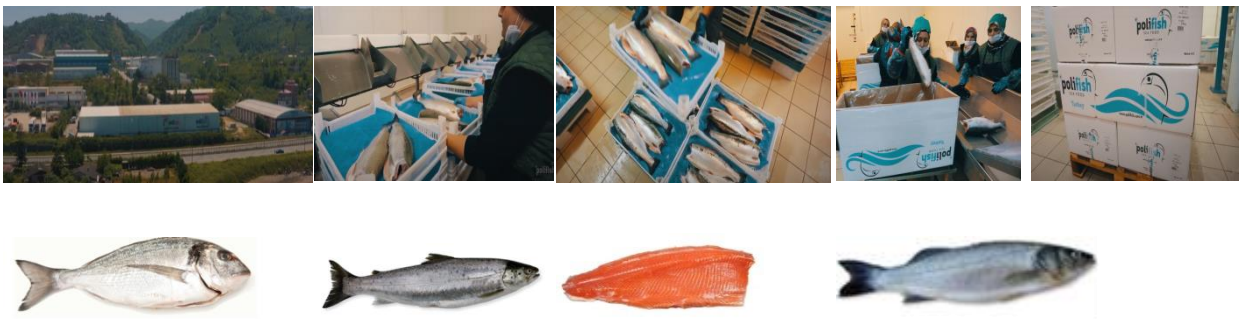

Figure 2. Polifish Inc and some of the products

4.1.3. Northern (Kuzey) Fisheries Industry and Trade Limited[216]

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 m^2. 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.

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

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

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		Yakakent Town	Net cages	4000
	Sinop	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.

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.

Small trout

Big trout

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 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 emmission 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.

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 m^3 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.

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 Kilic 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 Kılıc Ersen 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	Reseach 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.
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. Kilic Deniz and Metro Cash and Carry has started new Project "Metrochef" together. Kilic 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

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

Rainbow Trout 	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. Weight On demand Shelf life 7 days (0; +4 C) Nutritional Facts (for 100g) Energy: 549 kJ (130 kcal) Fat: 5,01 Carbohydrate: < 1 g, Sugar: < 1 g, Protein: 21 g Packaging Styrofoam box
Bluefin Tuna 	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.
Salmon Trout 	Salmon Trout origined 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. 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 fis in our country. Very rich in protein and Omega 3. Preferred size of Salmon Trout is between 1000 gand 3000 g. It is especially preferred beacuse of bright, reddish meat color and has a less bony structure. Tout has a wide range of consumption, from grilling to baking, from casserole to preparation of pita. Easily accessible and tasty in whole seasons.
Olive Flounder (Hirame) 	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.

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.

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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https://www.youtube.com/channel/UCAQbsEM7ttGO_CeJJdXdjUA/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 m^2 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, Ida Food developers took necessary steps related to further increase in the quality and investing.

Ida 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 IDA Food & Foreign Trade Limited

As quality and food policy, company targeted:

- 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

  - 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

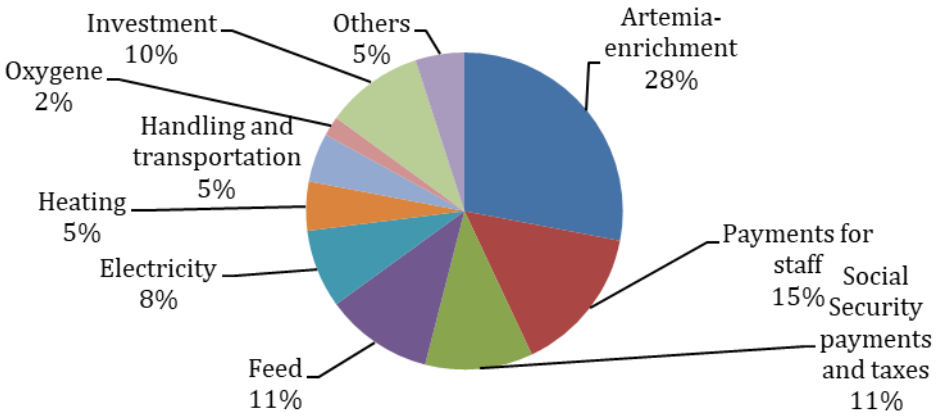
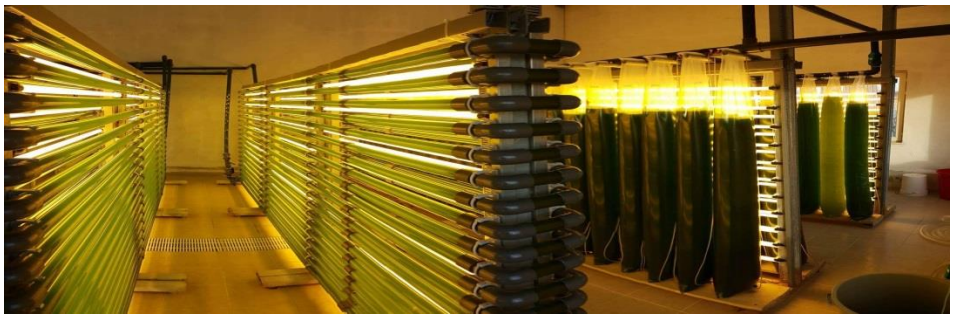
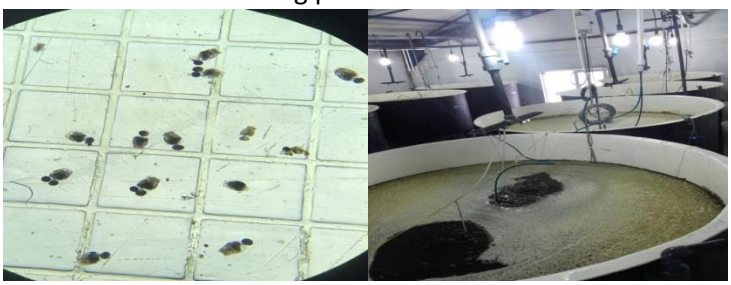


Figure 5. Main costs in production



Alg production



Rotifer production

Figure 6. Live food production unit

Total water volume used in production cycle is 4130 m^3. 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)	Total 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

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

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).

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, IDA GIDA has started meagre production in the farm.

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http://idagida.com.tr/index.php/en/company/

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 billion[217] 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.

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)[218] . 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.

[217] http://www.ribaki.org.ua/docs/darg/koncepcia_fond.pdf
[218]https://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

- 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.

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 highquality 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"[219]

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 m^3 ;

- amount of feed per year t - 10 000 kg;

- water flow rate - 15 m^3 / h;

- the cost of growing 1 kg of catfish - 1.5-1.8 euros;

- maintenance staff - 1 person.

[219] http://vismar-aqua.com/proekt-klarievyj-som-10.html

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 Shrimp[220]

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.

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;

[220] http://vismar-aqua.com/proekt-krevetka-5.html

- 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.

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 presented . 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 Khmelnitsky Industrial Agricultural and Fish Farming Company, Irklievsky 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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