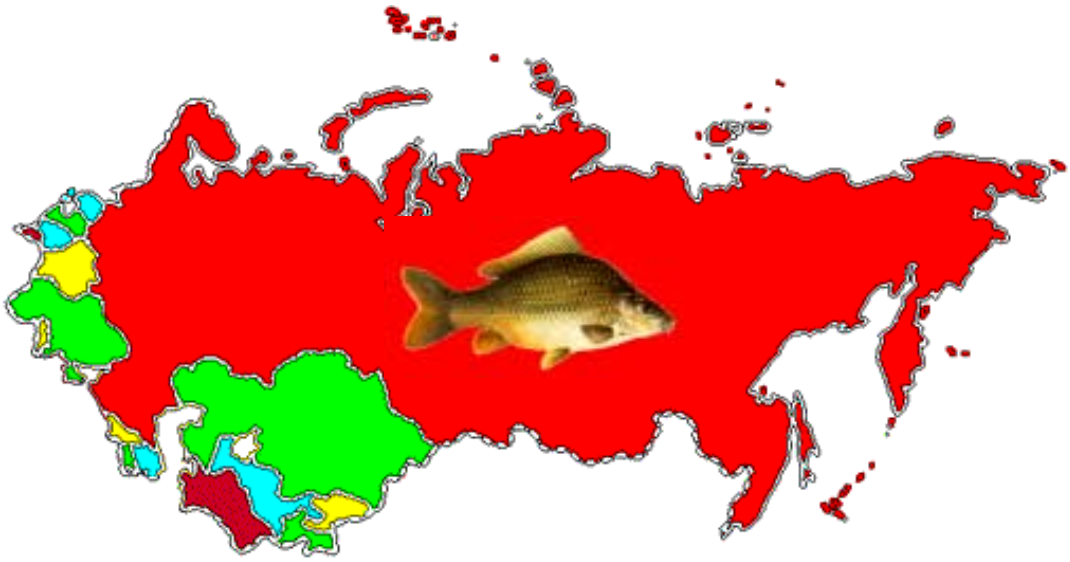
Regional Review on
Trends of Aquaculture Development
in the Former USSR countries



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Szarvas, Hungary

Contents

Background

An international conference on 'Aquaculture in the Third Millennium' was organised by FAO and the Network of Aquaculture Centers in Asia and the Pacific (NACA) in Bangkok, Thailand, between 20-25 February 2000. The presentation of regional reviews and a global synthesis was a basic part of the program of the conference. The Fish Culture Research Institute (HAKI) in Szarvas, Hungary, was engaged in the preparation of a regional review of aquaculture development trends in Europe with special emphasis on Central and Eastern European Countries. Based on a request by FAO, HAKI has expressed an interest to carry out also a regional review on the countries of the former USSR [1], taking into account the geographical overlap between Eastern Europe and the former USSR region. There are also a great deal of similarities in the changing socio-economic conditions in these countries, which affects the aquaculture development in this region. EASTFISH has agreed to support HAKI in the preparation of this additional review considering that nine countries of the former USSR are members of the EASTFISH project.

The structure of the review follows those principles, which were agreed during an FAO Expert Consultation on Trends in Aquaculture Development, held in Bangkok from 25-28 October 1999 prior to the Aquamillenium Conference. The data and information have been collected from various official and unofficial sources, and there may be some conflicts and inconsistencies among the information on production and trade. However, FAO FishStat data were used as a basic information on production, and these data were complemented with additional information, wherever it was possible. The availability ad reliability of basic information on aquaculture production and trade are greatly varying in the various regions, taking also into account the economical instability in many of the former USSR countries, and the significant diversity in socio-economic conditions.

[1] ***Armenia***, *Azerbaijan,* ***Belarus***, ***Estonia***, ***Georgia***, *Kazakstan, Kyrgyzstan,* ***Latvia***, ***Lithuania***, ***Republic of Moldova***, ***Russian Federation***, *Tajikistan, Turkmenistan,* ***Ukraine*** *and Uzbekistan. Countries in bold are EASTFISH member countries.*

1. General characteristics of aquaculture in the former USSR countries in 1990

The former USSR, which covers part of the European and Asian continents, comprises 15 countries. The area extends from the Baltic Sea in the west to the Pacific Ocean in the east and from the Arctic Ocean in the north to the Black Sea and the Caspian Sea in the south. The total area of the former USSR is about 22.3 million km2, which is almost 17% of the total area of the world. The Russian Federation alone covers 17.1 million km2, which is almost 13% of the total area of the world. Kazakhstan, with an area of 2.7 million km2, covers 2% of the total area of the world, while the remaining 13 countries combined also cover 2% of the total area of the world.

The total population of the former USSR was about 293 million in 1996, which represents 5% of the world population. About 32% of the total population of the countries of the former USSR is rural population, compared with 54% for the whole world, varying from 24% in the Russian Federation to 54% in Central Asia. About 17% of the economically active population is engaged in agriculture, compared with 47% for the whole world, varying from 12% in the Russian Federation to 30% in Central Asia. This reflects the importance of agriculture in Central Asia, while industry is largely predominant in the northern regions of the former USSR. The average population density is 13 inhabitants/km2, compared with 43 inhabitants/km2 for the whole world, varying from 9 inhabitants/km2 in the Russian Federation to 90 inhabitants/km2 in the Caucasus. The population growth between 1995 and 1996 was less than 0.06%, compared with a world average of 1.4%. While in the 1980s the annual demographic growth rate was still positive, many countries of the former USSR have shown a negative growth rate since independence in 1991. The main reason for this has been the difficult economic situation prevailing since independence, which has led to lower birth rates, and the migration of part of the population to other countries.

Aquaculture production in the former USSR countries possesses many unique characteristics and numerous similarities at the same time. The development in the field is still heavily influenced by post-effects of the system in which all producers were operating during the previous period. Thus, the first step of analysis of situation in aquaculture in the former USSR countries should comprise the detailed consideration of the "starting point of independence", i.e. situation in 1990. The data of that period can demonstrate the proportional involvement of different republics in aquaculture production, the level of output, which can be in general considered to be reached again in the future, and scope of species/farming technologies employed.

Aquaculture production in this region showed significant increases from 1984 to 1990, when total aquaculture production reached its peak at 420,000 metric tons, which was 55 % higher than in 1984. In 1990, this region contributed 2.6% in terms of production and 3.2% in terms of value to world aquaculture production.

The Table 1 is showing the aquaculture production output in 1990 in the former USSR by the republics and all-union entities, distributed also according to the production technologies. The share of aquaculture production by republics is also shown at the Figure 1.

Table 1.

Aquaculture production in former USSR (1990), thousand tonnes

Republics, organisations	Total aquaculture production	Culture patterns				By-production at agriculture farms
		Pond culture	Industrial culture	Lake ranching	Reservoir ranching, herbivorous only	
Republics:						
Russia	165.9	119.1	16.6	9.6		20.6
Ukraine	108.2	78.1	11.2		0.9	18
Belarus	18.4	15.4	1.4	0.7		0.9
Uzbekistan	24.3	20.6		3.5		0.2
Kazakhstan	10.2	7.3	0.2	2.3	0.1	0.3
Georgia	0.6			0.1		0.5
Azerbaijan	1.2	1.0		0.1		0.1
Lithuania	6.3	5.9		0.4	0	
Moldova	9.3	8.9			0.4	
Latvia	3.1	3.1				
Kyrgyztan	1.0	1.0				
Tadjikistan	3.6	3.5			0.1	
Armenia	5.6	5.6				
Turkmenistan	2.4	1.9			0.5	
Estonia	0.1					0.1
all republics in total:	**360.2**	**271.4**	**29.4**	**16.7**	**2**	**40.7**
All-union industry:						
Ministry of Fisheries	23.3	16.2	2.4	2.0	2.7	
Ministry of Energetics	8.4		8.4			
Ministry of Metal Industry	1.3	0.1	1.2			
Ministry of Nuclear Energetics	1.0		1.0			
Other ministries	2.8	1.3	1.1	0.4		
all-union industry in total:	**36.8**	**17.6**	**14.1**	**2.4**	**2.7**	
Total production:	**397**	**289**	**43.5**	**19.1**	**4.7**	**40.7**

Russia and Ukraine were the two major aquaculture producing countries in 1990, providing 76 % of the total production. Pond culture was the dominant form of aquaculture, having a share of about 73 % from the total production. Special characteristics of aquaculture in the state owned system was, that some ministries and agricultural farms had their own fish production units using those resources, which were under their control. Nine percent of the total aquaculture production came for example from those farms, which were under the supervision of various ministries. The contribution of agricultural farms to the total aquaculture production of the republics was about 11 percent.

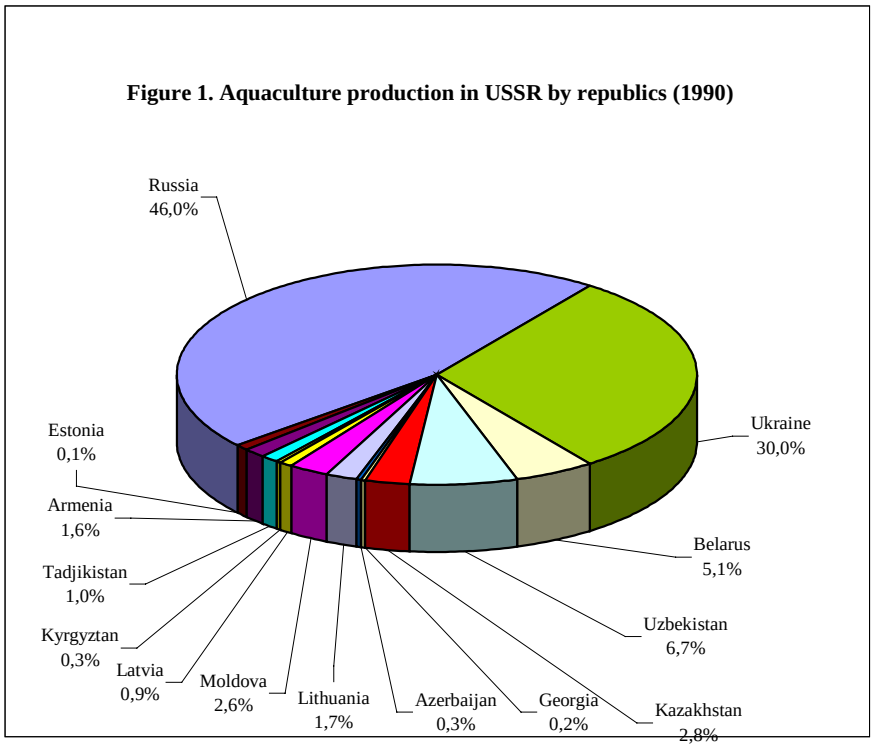
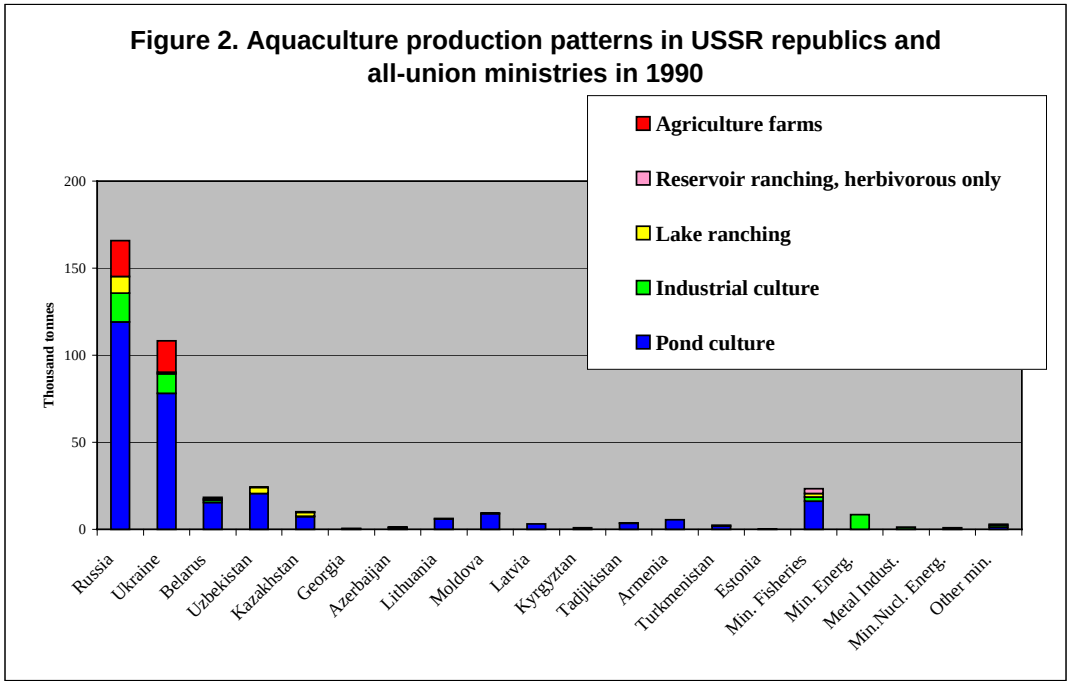
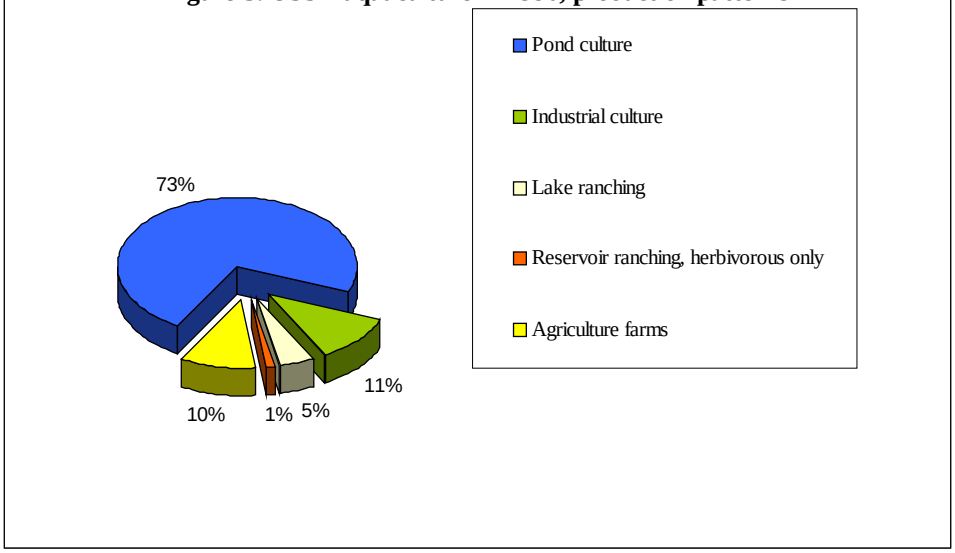


Figure 1 and 2 clearly show the dominant role of Russia and Ukraine in aquaculture production in the former USSR countries. Most of the production came from pond fish farms, however the contribution of agricultural farms to the total aquaculture production was also significant in the two major aquaculture production republics, Russia and Ukraine as shown in Figure 2.



The aquaculture production pattern by various methods in the USSR is shown at the Figure 3. Additional information on inland and marine aquaculture is also provided in Annexes 1 and 2.

Figure 3. USSR aquaculture in 1990, production patterns

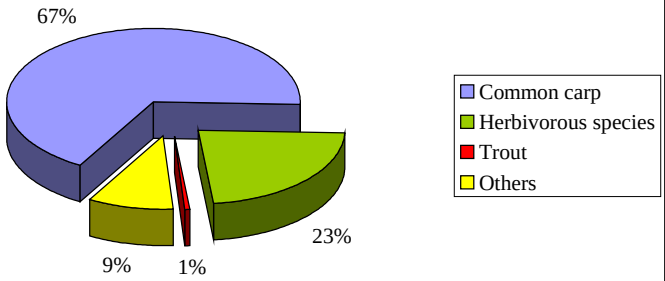


The scope of fish species farmed in the former USSR countries is rather wide, but in case of analysing from the point of view of production, the major place is occupied by carp, followed by herbivorous species. Summarised data on farmed species is shown in the Table 2 and at the Figure 4.

Table 2. Share of the total production by fish species in USSR (1990)

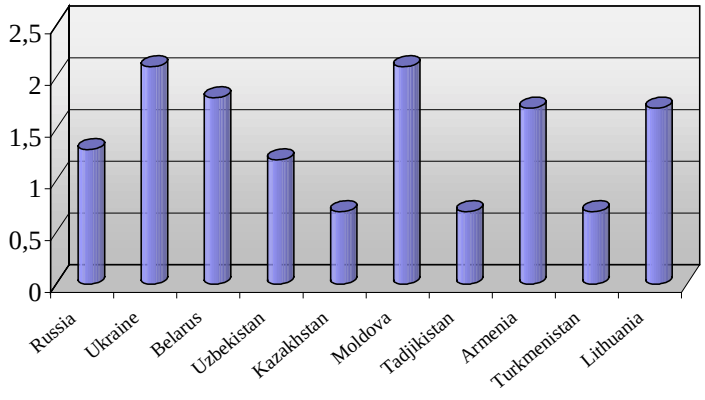
Species	**1000 tons**	**%**
Common carp	259.6	67,7
Herbivorous species	87.71	22,8
Trout	3.1	0,8
Channel catfish	1.65	0,4
Sturgeons	0.24	0,06
Whitefish	1.2	0,3
Others	29.8	7,8

Figure 4. Aquacculture production by fish species in USSR (1990)



Fish was always one of the main sources of valuable nutrient protein in the former USSR. However, the consumption patterns differs significantly from country to country. The total volume of consumption can be considered as relatively low, but it is necessary to take into account that these data related to aquaculture production only while the main source of consumed fish in former USSR countries is represented by sea catch. Figure 5 shows specific consumption of domestic aquaculture product in former USSR countries in 1990.

Figure 5. Consumption of fish, produced by domestic aquaculture in 1990 (kg per capita per annum)



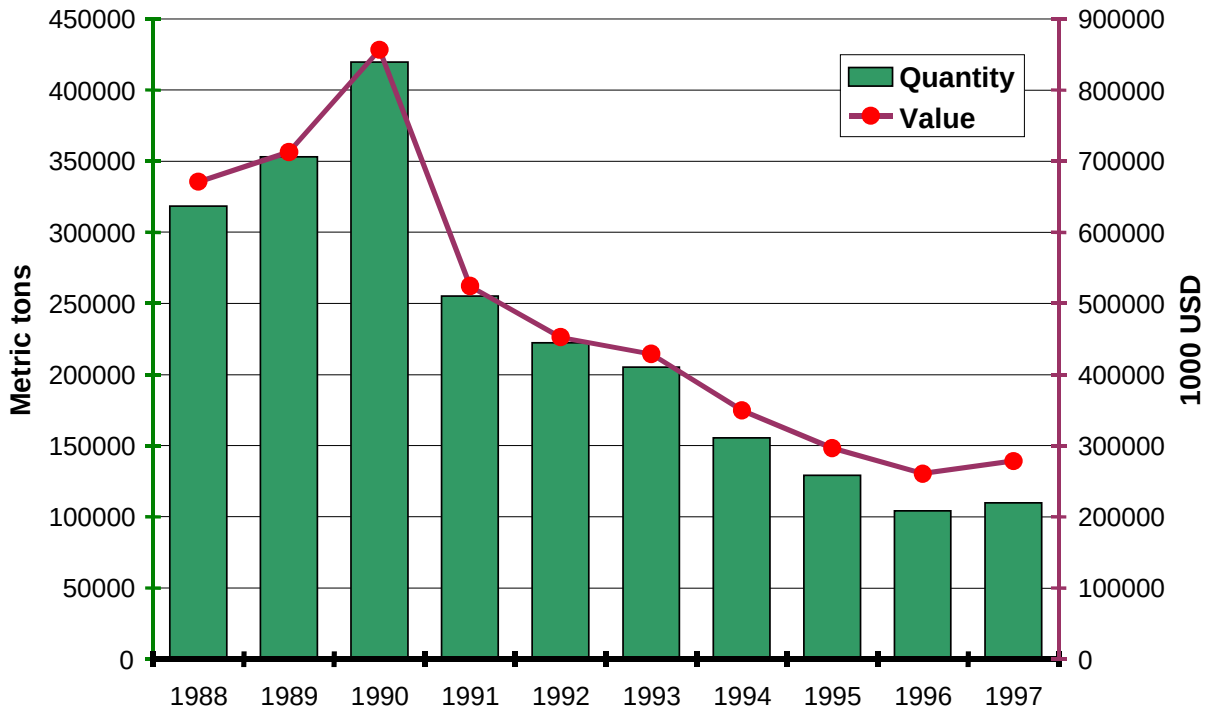
In addition to conventional aquaculture, lake and reservoir ranching, sea ranching of valuable species is performed in significant scope (mainly in Russia). The range of output can be characterised by 1 billion of smolts of Pacific salmons and 60 millions of sturgeon fingerling, released annually. This activity is greatly supported by the network of state hatcheries, which are shown at the Figure 6.

Figure 6. Major seed production sites for aquaculture and ranching in the territory of the former USSR

2. Aquaculture production in the former USSR countries between 1990-1997

After 1990 a dramatic decrease was observed both in volume and value of aquaculture production. From 1990 to 1991, the production volume and value dropped to 258,000 mt (-38.6%) and to 531 million US dollars (-38%), respectively. Between 1991 and 1996, the total production volume and value have continued to decrease to the lowest production (104,000 mt) and value 261 million US dollars in 1996. There was a slight increase, however, from 1996 to 1997 (+5.8% for production and +6.9% for value). While the rate of decrease was fast in the period between 1990 and 1994 (-21.0% and -19.1% average annual percent rates, respectively), the decrease in production for the 1994-1996 period indicated a slower rate of decline in production volume (-18.4%) and value (-13.5%). The changes in aquaculture production between 1988 and 1990 are shown in Figure 7. By 1997 the contribution of this region to world total aquaculture production volume and value decreased to 0.3% and 0.4%, respectively.

Figure 7. Aquaculture production in the countries of the former USSR, 1988-1997



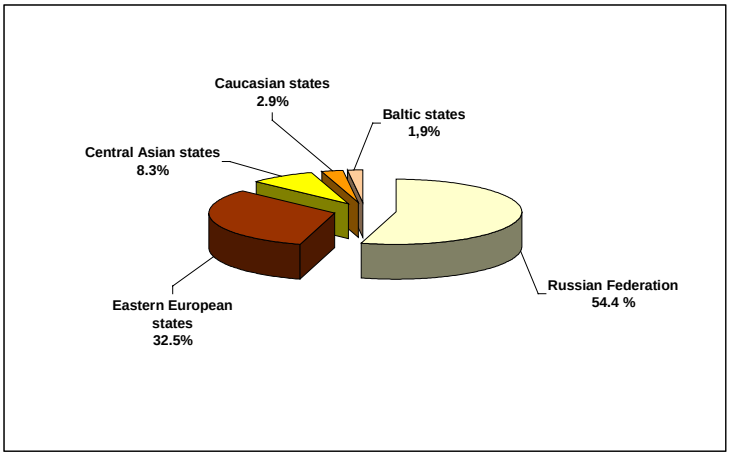
For the purpose of this study, 15 countries have been grouped into five regions, based primarily on their geographic conditions and, as far as possible, on hydro-climatic homogeneity, although the Russian Federation is, due to its size, subject to a wide variation of geographic and hydro-climatic conditions. The regions were referred as follows: **Russian Federation**: Russian Federation; **Eastern Europe**: Belarus, Moldova, and Ukraine; **Baltic States**: Estonia, Latvia, and Lithuania; **Caucasus**: Armenia, Azerbaijan, and Georgia; and **Central Asia**: Kazakhstan, Kyrgyz Republic, Tajikistan, Turkmenistan, and Uzbekistan.

The five sub-regions within the territory of the former USSR are shown at the Figure 8.

Figure 8. Sub-regions within the territory of the former USSR

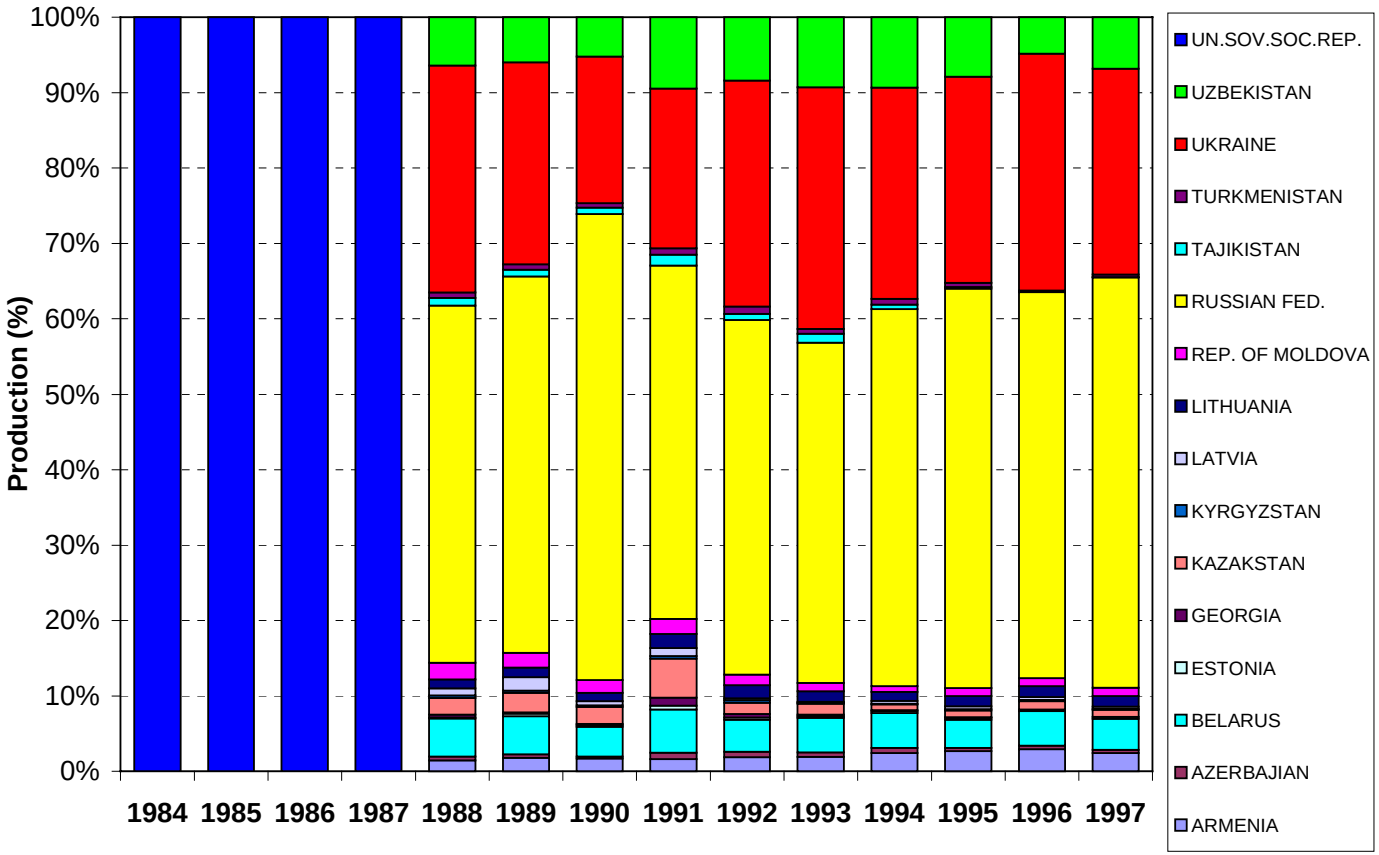
The aquaculture production by sub-regions was the following in 1997: Russian Federation (54.4%), "Eastern European" states (32.5%), Central-Asian states (8.3%), Caucasian states (2.9%) and Baltic states (1.9%). The share of aquaculture production by sub-regions and countries are shown at the Figures 9 and 10.

Figure 9. Aquaculture production by sub-regions



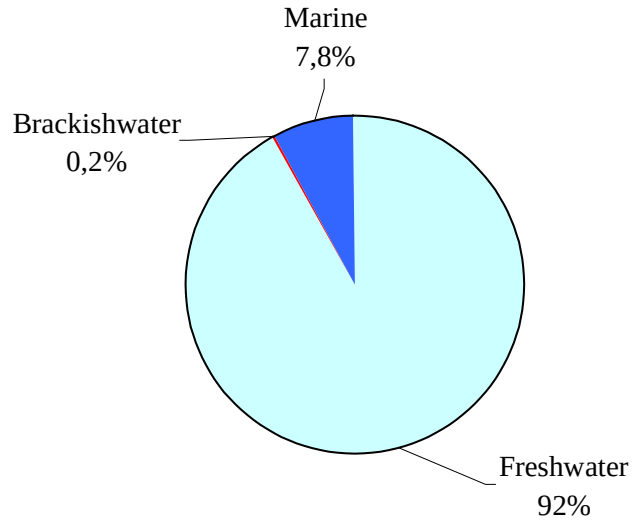
The most important producing countries in the region in 1990 were the Russian Federation (46%), Ukraine (30%), Uzbekistan (6.7%) and Belarus (5.1%). Along with the drastic decreases of aquaculture production all over the region, only the Russian Federation (54%) and Ukraine (27%) remained significant producers by 1997. The group of the other countries all together produced only 19 % of the total regional output in 1997.

Figure 10. Aquaculture production by countries of the former USSR between 1984-1997



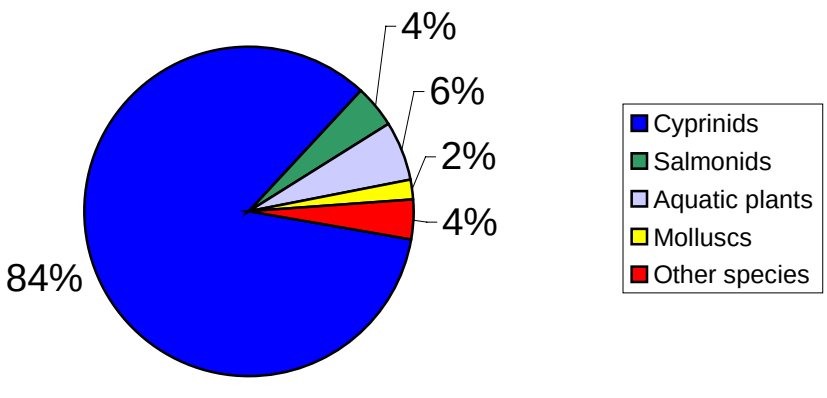
The vast majority of aquaculture production in this region is originated from freshwater aquaculture. In 1997, freshwater aquaculture produced 101,074 mt (92%), marine aquaculture 8,569 mt (7.8%) and brackish water aquaculture contributed only 0.2% (220 mt) to the total aquaculture production of the region (Figure 11.).

Figure 11. Contribution of freshwater, brackishwater and marine aquaculture to the total production in the former USSR countries in 1997



Aquaculture production is primarily based on the culture of cyprinids (84%) with a minor role of other species groups such as other freshwater fishes (6.1%), whitefishes (1.9%), molluscs (1.8%), seaweeds (6.0%) and other species (0.2%). The two dominant species cultured in the region are common carp (53%) and silver carp (25%). Other cultured fish species are trout, sturgeon, catfish, pikeperch, mullet and eel (3.1%). The remained 13% is derived mainly from the culture of seaweeds, mussels and other minor species (Figure 12).

Figure 12. Species composition of aquaculture in the former USSR countries in 1997



Summary

Total aquaculture production was amounted to 109,863 tons in volume and 278,6 million USD in value in 1997. The contribution of this region to world total was 0.3% and 0.6% respectively. The major part (92%) of the total production is originated from freshwater environment, and the main species is common carp (84% of the total production). The two dominant aquaculture production countries are the Russian Federation and Ukraine with share from the total production of 54% and 27% respectively. The aquaculture production in the countries of the former USSR is well below the peak production of 420,000 tons in 1990, when the contribution of this region to global aquaculture production was 2.6% in volume, and 3.2% in value. There was a dramatic decrease in aquaculture production in this region after the disintegration of the Soviet Union, and the break up of the state structure. The total aquaculture production in 1997 was only 26 % of the production in 1990. Even if there are great uncertainties in data supply on aquaculture production in this region, and can well be assumed that the actual production is higher than the reported one, the considerable drop in aquaculture production is evident.

If the situation in aquaculture production is compared between the EU- and the former USSR countries, it could be seen that the specific aquaculture production is about 3 kg/capita in the EU, while it is only around 0.4 kg/capita in the countries of the former USSR. A major difference in the structure of aquaculture production between the EU and the former USSR countries is, that about 75% of the production comes from marine environment in EU countries, while only 8% in the former USSR region. This may indicate the potential in the development of marine aquaculture in the former USSR region, although conditions are somehow less favourable here. If freshwater aquaculture production is compared between the two regions, its value is 0.73 kg/capita in the EU countries, and 0.34 kg/capita in the former USSR region as an average. This difference is definitely less than that of total aquaculture, however, tremendous freshwater resources are available in the territory of the former USSR, which would allow much higher production here than in the populous Western European region. The value of the total annual renewable freshwater resources (ARFR) is about 5306 cubic km in the territory of the former USSR, while it is only 1395 cubic km in the EU countries. If specific freshwater aquaculture production is calculated on the basis of the ARFR, it amounts 21 t/km^3 in the former USSR countries and 195 t/km^3 in the EU countries in 1997, which almost ten times higher. This also indicates the potential for the development of freshwater aquaculture in the countries of the former USSR, even if it is assumed that considerable freshwater resources are located in the permafrost area.

Aquaculture production is only around 2% of the total production of capture fisheries in the former USSR countries, which figure is well below the world average. This fact also indicates the potential for future aquaculture development in this region. Although the share of aquaculture in the total aquatic production shows a gradual increase globally year by year, there has been an opposite tendency in this region in the recent years. The contribution of aquaculture to the total aquatic production in the former USSR countries was 4.2% in 1993, which decreased to 2.2% in 1997. Although fisheries production also decreased after 1990 in this region, it was not as dramatic as in aquaculture. The decrease in fisheries production between 1992 and 1997 was about 17%, which was 51% in aquaculture.

General characteristics on the former USSR countries, together with the data on specific aquaculture production for the year 1997 are summarised in the Table 3.

Table 3. Major characteristics , with specific aquaculture production data of the former USSR countries in 1997

Country	Area (km2)	Population (million)	Total annual renewable freshwater resources (km3)	Total aquaculture production (metric tons)	Freshwater aquaculture production (metric tons)	Total production per area (kg/km2)	Total Production per population (tons/mil.cap.)	Production per freshwater resources (tons/km3)
Armenia	29 800	3,7	10,5	2 650	2 650	88,93	716	252,4
Azerbaijan	86 600	7,7	34,6	488	488	5,64	63	14,1
Belarus	207 500	10,4	76,0	4 505	4 505	21,71	433	59,3
Estonia	45 226	1,5	16,4	260	260	5,75	174	15,9
Georgia	70 000	5,0	63,3	0	0	0	0	0,0
Kazakhstan	2 717 300	16,9	109,6	1 044	1 044	0,38	62	9,5
Kyrgyztan	198 500	4,5	20,6	150	150	0,76	33	7,3
Latvia	64 100	2,5	37,4	345	345	5,38	138	9,2
Lithuania	65 200	3,7	25,9	1 516	1 516	23,25	410	58,5
Moldova	33 700	4,5	12,1	1 222	1 222	36,26	272	101,4
Russia	17 000 000	147,5	5010,0	59 766	51 110	3,52	405	10,2
Tadjikistan	143 100	5,9	16,0	85	85	0,59	14	5,3
Turkmenistan	488 100	4,1	24,7	342	342	0,70	83	13,8
Ukraine	603 700	50,8	156,5	30 000	29 814	49,69	591	190,5
Uzbekistan	447 400	23,4	50,4	7 490	7 490	16,74	320	148,6

Sources: FISHSTAT, 1999; AQUASTAT, 1998

3. Regional reviews

3.1 Eastern European States of the former USSR

3.1.1 General characteristics

The countries referred to as Eastern Europe (Belarus, Moldova and Ukraine) are located in the west of the former Soviet Union to the north of the Black Sea (Figure 13). Their total area is 845 000 km^2, which represents 3.8% of the total area of the former Soviet Union. Ukraine (603,700 km^2) occupies 70% of the territory of this region, while Belarus (207,600 km^2) and Moldova (33,700 km^2) 20% and 10% respectively. The total population was 64.5 million in the Eastern European states in 1996, about 22% of the total population of the countries of the former USSR. The most populous country in this region is Ukraine (49.8 million), followed be Belarus (10.3 million) and Moldova (4.4 million). The population density was 78 inhabitants/–km^2 in the region, six times more than the average population density for the former USSR countries. There was a slight decrease in population in Belarus (-0.09% in 1999) and Ukraine, while the change in population was positive in Moldova in 1999 (0.1%). Ukraine is the largest and economically most significant country in the region.

Figure 13. Eastern European States of the former USSR

There are significant similarities in the economical development in the three countries of the region, which are in transition from centrally planned to market economy. The GDP per capita (on purchasing power parity) however indicates the differences among the individual countries. The GDP per capita in 1998 was 5,200 USD in Belarus, and 2,200 USD in Ukraine, and Moldova. The contribution of agriculture to the GDP is the highest in Moldova (30%), while it is less in Belarus (20%) and Ukraine (14%). Due to the market-oriented transformation of the economy, agricultural land ownership is undergoing many changes as land privatisation progresses, though various degrees in the different countries. In Ukraine,

the previously dominant collective sector is shrinking, giving way to the development of the private sector. A few months after the announcement of the land privatisation decree, the private sector, consisting of individual farms, agricultural companies and agricultural cooperatives, owned 5.5 million ha, or about 12% of the total cultivable area. The public sector kolkhoz (collective farms) and sovkhoz (state farms) occupied 29.2 million ha and 10.1 million ha respectively. In spite of initial positive development in the restructuring of the economy, the progress of reforms slowed down recently, and financial crisis in the Russian Federation in 1998 had a negative effect on the economic growth. In Moldova, nearly 70% of the enterprises in the industrial sector (including food processing) have already been transferred to the private sector, however, privatisation in the agricultural sector is slow, and large agricultural areas are still occupied by kolkhoz and sovkhoz. In 1992, the number of registered private farms was 13 660 with an average area of 2.8 ha. The Moldavian government has recently been making progress on an ambitious economic reform agenda. As a part of its reform efforts, Moldova introduced a stabile convertible currency, freed all prices, stopped issuing preferential credits to state enterprises and backed steady land privatisation, removed export controls, and freed interest rates. Belarus retained closer political and economic ties to Russia than any of the other former Soviet republics. Little structural reform has taken place since 1995. Prices and currency exchange rates are controlled by the government, and the state interventions in the management of private enterprises create unfavourable environment for domestic and foreign investment. A further economic problem is the sizable trade deficit. Agriculture is almost exclusively in the hands of the sovkhoz and kolkhoz. In 1995, there were 3 000 private farms in Belarus, owning a total of 62, 100 ha of land.

3.1.2 Natural resources and climate

The region is rich in natural resources, thus agriculture plays an important role in the economy of all three countries in this region. The cultivable area as the percentage of the total area of the country amounts 76% in Moldova, 74% in Ukraine, and 57% in Belarus. After the Russian Federation, the Ukrainian Republic was far the most important economic component of the former Soviet Union, producing about four times the output of the next ranking republic. Its fertile black soil generated more than one-fourth of Soviet agricultural output, and its farms provided substantial quantities of agricultural products to other republics. Black soil also covers about 75% of Moldova's arable land. In the former USSR, Moldova, representing only 0.15% of the total area of the Soviet Union, produced 40% of the Soviet Union's tobacco, 10% of its fruits and 5% of its vegetables. Valuable freshwater aquatic resources are also available in the region. The main river basins are the Dnepr, Dnestr, Danube, Donets , Dvina, Neman and Bug basins. The total Annual Renewable Surface Water Resources (ARSWR) are estimated at about 244.55 km^3/year for the whole region, of which about 43% are generated within the region. In Ukraine alone, there are more than 22,000 rivers with a total length of over 170,000 km. The region is also rich in natural lakes, reservoirs and numerous smaller water bodies. There are about 3000 natural lakes in Ukraine with a total area of about 2000 km^2. Twenty two thousand dams have been constructed in Ukraine mainly for flow regulation, hydropower, irrigation and fisheries purposes. The largest water reservoirs, with a total capacity of 18.5 km^3 and a total surface water area of 6,888 km^2, are located along the Dnepr. These are the Kreminchugske (2,252 km^2), the Kahovske (2,155 km^2), the Kyivske (922 km^2), the Dniprodzerzhinske (567 km^2), the Zaporizske (410 km^2) and the Kanivske (582 km^2). It should also be mentioned, that the construction of the "Dnepr cascade" has been considered by experts as ecologically disastrous intervention into the ecosystem. Therefore, the ecological rehabilitation of the Dnepr basin is proposed through

cooperative international program, in which fisheries component may be an important element. There are 1,074 natural lakes and 115 water reservoirs in Belarus, with a total area of 116,000 ha. In Moldova, there are only few natural lakes. The largest one is the Lake Beleu in the Prut valley with a surface area of 6,300 ha.

In the north of this region, the climate is continental, with average temperatures of 19°C in summer and -5°C in winter. In the south, the climate is temperate and very favourable for agriculture with long, warm summers and relatively mild winters. Average temperatures are around 21°C in summer and -5°C in winter. The average annual precipitation is 547 mm, varying from 360 mm in the central part of Crimean peninsula, where irrigation is necessary to satisfy the summer crop water requirements, to 1 600 mm in the Carpathian mountains at north-west. Droughts are frequent in the southern areas.

3.1.3 Fisheries and aquaculture in the economy

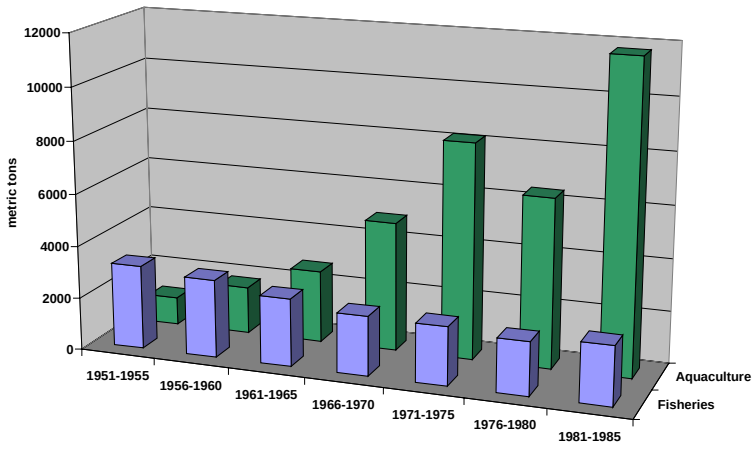
Among the three Eastern European states of the former USSR region, fisheries and aquaculture constitutes an important part of the national economy in Ukraine, while it has less significance is Belarus and Moldova.

Besides the abundant freshwater resources, Ukraine also has a 1,278 km coastline on the Black sea. The Ukrainian fisheries industry represents an integrated industrial complex of organisations of oceanic fisheries, powerful enterprises for processing and the sale of fish products, pond fish farms, fisheries cooperatives, scientific and educational institutions, research, design and construction organisations, as well as bodies for fish stock protection and restoration, where more than 60,000 people are employed. Fishing companies under the umbrella of the State Committee of Fisheries possess more than 120 large and medium size fishing vessels, about 160 small fishing vessels, about 50 fish transporting and processing vessels. The fishing fleet of the Ukrainian fisheries industry are in operation in the Atlantic, Antarctic, Indian and Western Pacific Oceans, as well as in the Black and Azov seas. The fishing industry of Ukraine is one of the few industries in the country which, after the sharp slump of 1990-1994, began to increase production considerably. From 1994 to 1996 the total volume of fish from harvesting and husbandry grew from 311,000 to 454,000 tons. This is still below the potential of the fisheries industry, capacity of which is estimated to be as high as 800,000 tons of fish, with an output of food fish products from vessels and coastal enterprises of more than 600,000 tons annually. The abundant freshwater resources provide good opportunities for inland fisheries in Ukraine. The total catch of inland fisheries was 71,800 tons in 1997. The majority of the fish (80% of the total catch or about 60,000 tons) were caught in reservoirs, in particular the Dnepr cascade, which has a total area of 6600 km^2. The main species in the catch were roach, silver carp, and bream. Fish catch in rivers is about 10% of the total amount caught in inland waters and the catch in lakes is approximately the same. The catch from rivers and lakes was about 7500 tons in 1997, mostly crucian carp (*Carassius* spp.), silver carp, roach, bream, pike-perch and common carp (Grynzhesky, 1998). At present ongoing economical reforms are taking place within the fishery industry. Of 288 enterprises and organisations under the authority of State Committee of Fisheries, 46 have changed ownership, 22 are at the stage of undergoing privatisation, and 92 are collective property.

Fisheries sector, employing about 4,000 people currently is relatively small but particular sector in the landlocked Belarus, taking also into account that fish is one of the safer fish products available on the food market. As a consequence of the Chernobyl disaster more than

30% of the territory of Belarus is still contaminated by radionuclides. Fish has lower levels of iodine, fluoride, and selenium compared to many other agricultural products. Main part of the fisheries production came from lakes (about 77%) in 1994, while the share of catches from rivers, reservoirs and semi-intensively managed water areas were 17.2%, 8.6% and 2% respectively. The average fisheries production between 1951 and 1955 was 3,190 t, which then decreased to 2,250 t between 1981-1985. There was a further decrease in fisheries production after the political and economical changes in the country, and the total catch amounted only about 557 t in 1995. The two main species in the total catch in 1995 were roach (44%) and bream (32%). The majority of the total fish production however comes from aquaculture, as illustrated in Figure 14. Aquaculture means almost exclusively pond fish production in Belarus. There were 27 state owned fish farm in 1995 with a total area of about 21,000 ha (Golubev and Kulesh, 1995).

Figure 14. Aquaculture and fisheries production in Belarus between 1950-1985
(Golubev and Kulesh, 1995)



The total fish production is well below the demand of the population, and about 92% of the overall fish supply are imported products. The government is making efforts to assist the industry in providing access to fishery agreements within the EEZs, increasing the import of pelagic fish via collaboration with enterprises in Russia and other states, increasing of inland water catches, and developing the processing industry. In order to reach these goals, the state is carrying out a restructuring program in the state hatchery system, provides financial support through investments, grants, custom and tax privileges, and optional market regulations.

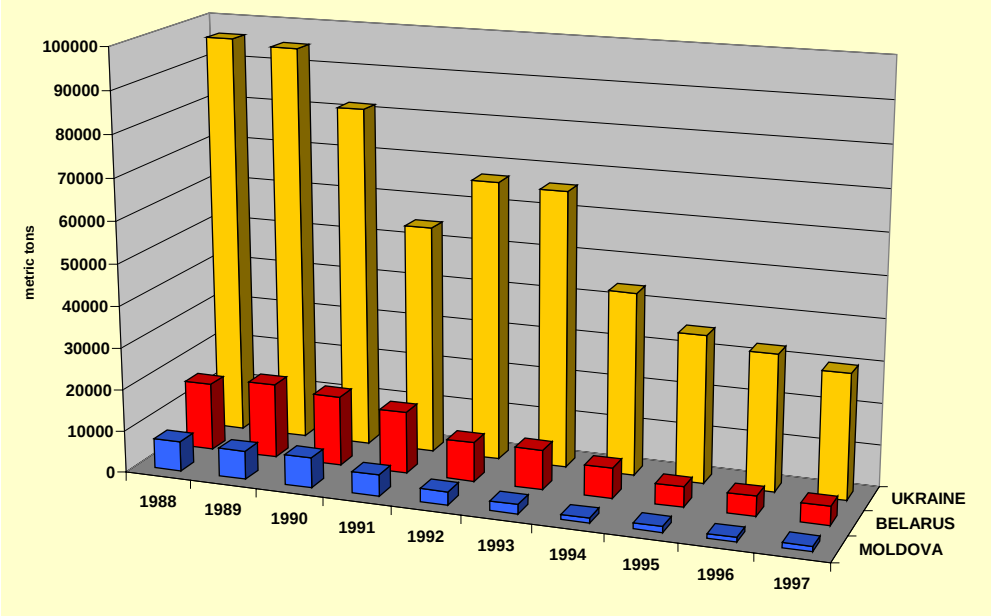
Fisheries and aquaculture doesn't play significant role in the national economy of the landlocked Moldova. In spite of previous efforts to develop culture based fisheries in the reservoirs, total freshwater catch remained below 100 tons in 1995. The major species of the planned stock enhancement program were pike-perch, *Vimba vimba*, *Barbus sp.*, *Abramis brama* and roach (Toderash et al, 1996). Fish has once been an important food item in Moldova. In the late nineties the fish consumption was 13.2 kg/cap/year. The demand was met mainly by import (40-42,000 t/year fresh and frozen, and 32 million cans of fish products), since local production was not higher than 9,500 tons. Between 1991-1997 there was a significant reduction both in production and import. In 1996, only 3,750 tons of frozen and fresh, and 3 million canned fish product were imported, and aquaculture production was also dropped to around 1200 tons. This has resulted in a lowering of fish consumption to 1 kg/cap/year (Borta, 1998). Although investment environment is the most favourable in

Moldova among the three Eastern European states of the former USSR, aquaculture has not seen as a prioritised area for investors.

3.1.4 Aquaculture production

There has been a significant drop in aquaculture production in all three countries of the Eastern European region as a consequence of the economical difficulties after the disintegration of the Soviet Union as illustrated at the Figure 15.

Figure 15. Aquaculture production in the Eastern European states of the former USSR
(Source: FAO FishStat, 1999)



In Ukraine, aquaculture production was close to 100,000 tons in 1988, which then dropped to 30,000 tons by 1997. Most of the fish are produced in earthen ponds operated by cooperatives and state owned fish farms. Leading enterprises in inland aquaculture and fisheries are the “Ukrrybhoz”, “Ukrrybprom”, and “Rybakkolhozobyedinenie”. Besides producing food fish in ponds, these enterprises also have the capacity to produce stocking material for natural waters and to develop culture based fisheries, mostly in reservoirs and smaller extent in coastal waters. In 1994 natural waters were stocked with 50 million of fingerlings of herbivorous fish, 1.5 million of sturgeon fingerlings, 3.0 million of grey mullet, and 3.2 million of flat fish. However, due to the prolonging economical recession in the country the production of both inland aquaculture and fisheries are far below the optimal level. The marine aquaculture production has also reached an extreme low level in 1997, when only 187 tons of production (mullets and Mediterranean mussels) was reported.

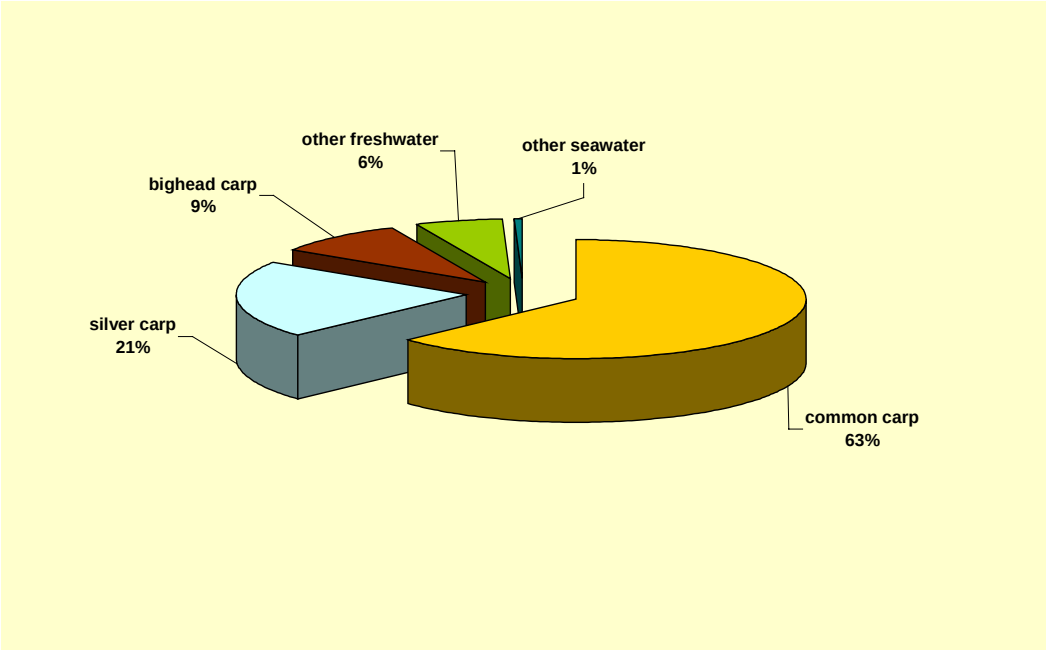
Based on FAO statistics, the aquaculture production in Belarus in 1997 was only one fourth of the production in 1989, exceeding slightly 4500 tons as seen at the Figure 15. These production data are lower than that of from Golubev and Kulesh (1995), who reported 7000 t in 1995 against the FAO data for this year, which was 4,844 t. The decline in aquaculture

production however is a clear tendency after the disintegration of the Soviet Union. There have been an increase in aquaculture production between 1950 and 1985, as shown at the Figure 14, while fisheries production were practically stagnating in the same period. The increase in aquaculture production continued until 1989, but started to fall after that year. There have been 27 state owned fish farms in Belarus in 1995, which were producing mainly common carp on a total fish pond area of about 21 000 ha. Other species, which have definite economical importance are crucian carp, pike, and rainbow trout. Heated effluents from power stations have also been used for the cultivation of grass carp, silver carp, bighead carp, and channel catfish. There have been promising experiments with the production of crayfish (mainly *Astacus astacus* and *Astacus leptodactylus*) in Belarus, however the economic difficulties in the country retarded all developments in aquaculture.

The peak aquaculture production period in Moldova was between 1986-1989, when annual production reached 9,500 tonnes (Borta, 1998). After the breaking up from the Soviet Union, the aquaculture production in Moldova started to decrease, and dropped to 1,222 tons by 1997 as reported by FAO. Fish are produced mainly in earthen fishponds, although cage culture of common carp was also applied in cooling water reservoir. The total area of fish ponds in Moldova is about 7,300 ha (Borta, 1998).

The number of cultivated species is very limited in this region and practically common carp is the only dominant species in aquaculture (Figure 16).

Figure 16. Species composition in the total aquaculture production in the Eastern European states of the former USSR (Source: FAO FishStat, 1999)

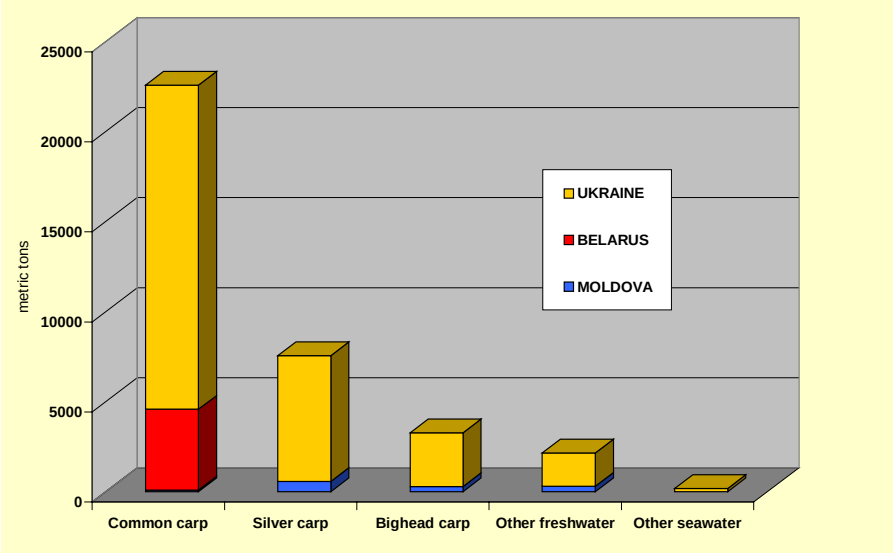


The figure evidently demonstrates, that species diversity is significantly restricted in the aquaculture production of the region. About 93% of the total production are represented by cyprinids, among which common carp has the highest share, while the volume of marine aquaculture represents only 1% in the total production. Marine aquaculture in Ukraine is

limited to the production of mullets and Mediterranean mussels, of which production were 150 and 30 tons respectively in 1997 according to the FAO statistics.

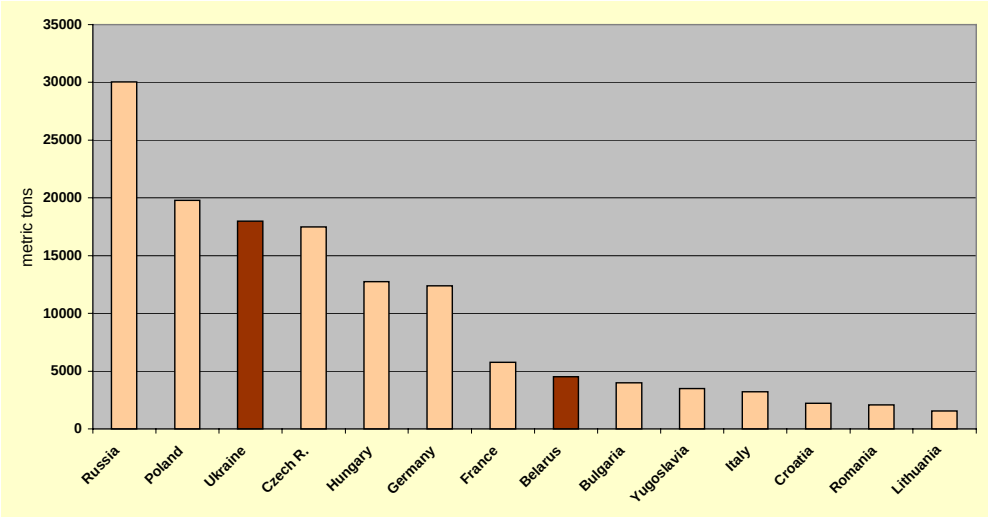
The share of the considered countries in the total aquaculture production is shown at the Figure 17, which indicates the dominance of Ukraine and Belarus in common carp production. In Moldova however, common carp production was the lowest in 1997 (79 tons), although the production of the top ranking silver carp was also not very high, amounting 560 tons.

Figure 17. The share of countries in total aquaculture production of various species groups in the Eastern European states of the former USSR
(Source: FAO FishStat, 1999)



The common carp production in Ukraine and Belarus has significance even on European level despite the significant drop in production since 1990. These two countries are among the leading carp producing countries in Europe as shown at the Figure 18.

Figure 18. Main carp producing countries in Europe (Source: FAO FishStat, 1999)



3.1.5 Main constraints and opportunities

Production

Although there has been a drastic drop in aquaculture production (70% in this region) within a 6-7 year period since the disintegration of the Soviet Union, that time, which is needed for the consolidation of the industry will much longer than the period of decline. The available abundant aquatic resources provide good basis for aquaculture development, and its increase up to the previous value of peak production in 1989 (117,288 tons) seems to be a realistic target. The present production in Ukraine is only 31% than in 1988, which fact itself indicates the potential of development, taking into account that the drop of production was coincided with the overall collapse of the economy and not caused by the internal problems within the sector. According to Borta (1998), the increase of the annual fish production up to 24,000 tonnes, which is almost 20 times higher than the present aquaculture production, and 5 times higher than the ever reached maximum, would be a realistic target in Moldova. (Borta, 1998). There is also a significant scope for aquaculture development in Belarus, where the production in 1997 was only 25% of the peak production (17,817 tons) in 1989. Even if production level is rather low in these countries currently, the specific production per available water resources is the highest among the countries of the former USSR, 129,1 tons/km^3 in Ukraine, 89,2 tons/km^3 in Moldova, and 61 tons/km^3 in Belarus (see Table 3). Although these figures have only indicative significance, the specific freshwater aquaculture production per available water resources are between 200-300 tons/km^3 in France and Germany, which may suggest that there is a scope for further aquaculture development in the Eastern European region of the former USSR. It is very difficult however to predict, how fast will be the recovery of aquaculture due to the prolonged economical crisis and other uncertainties in these countries, with special regard to Ukraine, which is the main aquaculture producing country in the region.

It is most probable however, that the structure of the aquaculture production will show considerable changes comparing to the previous situation before 1990, and the applied technologies and produced species will also show greater diversity in the future. It is a realistic expectation, that the currently extremely low level of marine aquaculture production will increase in Ukraine, initially based on the cultivation of the two traditional species, the mullets and the Mediterranean mussel. Traditional methods however, may require improvement, taking into account the new regulations, which will be applied in the future Code of Conduct for Responsible Fisheries, coastal zone management programmes, Environmental Impact Assessment etc.). Similarly to Western European countries, cage culture of marine species and sea ranching will also have a scope in marine aquaculture development on the Black Sea region.

Fish pond systems will remain major production bases in aquaculture in all three countries of the region, with special regard to Ukraine and Belarus. Well designed facilities are available in these countries, which, together with knowledge and experience of the farmers provides good basis for development. The diversification of applied production technologies –and species are expected however as a function of the changing environmental and marketing situations. The traditional species like common carp and herbivorous will continue to be the backbone species of aquaculture production, taking also into account the lack of inputs and low purchasing power of the population. The production of species, which are feeding low at the food chain however, may also be an important component of the development of sustainable aquaculture in the region. The main problem with the production of these species

is the comparatively week consumer's acceptance, which problem will be more pronounced in this region as well, parallel with the improving of living standards. This circumstance draws attention to the development of processing technique, through which these low value species could be transformed into marketable value added products. Processing background basically is available, however further R&D work is required to elaborate appropriate production and processing technology to make these pond-raised species competitive with cheap marine species. Semi-intensive pond fish production also offers good opportunities for integrated aquaculture, when organic wastes and agricultural by-products could efficiently been processed in fish ponds, and converted into valuable fish protein. The species diversity in polyculture should also be increased, with the involvement of carnivores (catfish, pike, pike-perch), and other non-conventional species. Where abundant water resources are available, and there are no environmental constraints, there is a scope for intensive production of high value species, with special regard to sturgeon and trout.

Even if abundant aquatic resources are available in this region, the environment "sensitiveness", and the increasing competition among water users are going to be important factors during future aquaculture development programs. Similarly to other regions in Europe, those fish ponds, which are located in environmentally sensitive areas, will be used as habitat for aquatic animals and plants. The recreational use (angling, eco-tourism, water sports) of some fish ponds will be another option during future development in aquaculture. These alternative uses however do not necessarily mean the complete withdrawal of aquaculture from these areas. The knowledge and experience of fish farmers could be utilised well during the operation and management of these areas, and fish farms could be potential partners and service providers for environment protection agencies, water authorities, municipalities and other organisations responsible for the management of certain water areas. The aquaculture sector however should be proactive, in order to be an equal right partner in integrated resources management programmes.

There is significant potential in the development of enhanced fisheries in this region. Culture based fisheries has long tradition in the Eastern European states of the former USSR region, both in inland and coastal areas in Ukraine. Valuable scientific results have been available on the fish fauna and aquatic environment for the most important water areas in the three countries of this region. Culture based fisheries could play a much more important role in the fresh fish supply to the population. Plans have been elaborated in Ukraine to stock reservoirs with two-year old herbivorous fish, and to develop an appropriate hatchery background. It is important to note however, that the propagation and stocking of indigenous species would get priority in the future stock enhancement programs.

Trade

Although no specific data are available for the trade of aquaculture products, and the information on the trade of fisheries products are also limited, it can be seen that the share of aquaculture products is only a small fragment of the overall fish supply in these countries. In Ukraine, the total output of fish products from fisheries and aquaculture for human consumption was 367,000 tons in 1996. The volume of fish import was 41,340 tons with a value of about 8.54 million USD in 1996 (EASTFISH, 1999). According to Grynzhesky (1998), the volume of imported fish products has reached 94,000 tons, and the products came mainly from Russia, the Baltic states, Poland, Denmark, Bulgaria, Morocco, UK, Norway, and Germany. The amount of fish, produced in aquaculture, is also far below the demand in Belarus. The country's fish consumption was 58,600 tons in 1998, when aquaculture

production could be around one tenth of this amount. It should also be mentioned that fish consumption was four times higher during 1986-87, when consumption per capita reached 21.4 kg/year. 93% of the fish consumed are imported pelagic species, mostly cheap fishes due to the limited purchasing power of the population. Belarus has a fish processing capacity of about 20,000 tons per year (mainly smoked and salted fish), and a freezing capacity of 32,000 tons as well. There is a very similar situation in Moldova, where the majority of the fish supply is ensured by import of fish products. About 3-4,000 tons of frozen and fresh fish and 4,000 tons of canned fish were imported to the country in 1996 (EASTFISH, 1999; Borta, 1998). Taking into account the large population (64.5 million), and the relatively high per capita fish consumption in the region, there is a huge domestic market for own aquaculture products, which potential is far from acceptable utilization. Carps are well accepted species in this region, therefore the development of carp production and trade is a realistic option to increase aquaculture business in these countries. The development of the production of cheap fish species may be an important aspects of aquaculture development, taking also into account the fact, that the increase of purchasing power can not be expected for some years.

No export data are available from these three countries, however based on the processing capacity, which is available in the region, mostly in Ukraine and Belarus, export volume could also be increased in the future, mainly towards other states of the former USSR. The technical upgrading of the existing facilities and the establishment of new ones, which meet the requirements of international quality standards are however, basic preconditions for the utilization of the export potential. The development of marketing infrastructure is also an indispensable condition for trade development in the region regarding the growing competition with frozen seafood products (traditionally popular in this region), and also with non-fish products. This should include the increase of species and product variety, and the availability of retail shops close to the consumers. An increasing segment of the population, and the growing tourism look for high quality products, which offers business opportunity for example in marine aquaculture in Ukraine, and may also provide basis for the establishment of intensive production facilities, where proper conditions are available. For this purpose, the abundant renewable groundwater resources could also be taken into account, in particular in Belarus, where large amount of subsurface water is available (18 km^3/year), but there are also valuable groundwater resources in Ukraine, which may be used for aquaculture. These potential developments however, are still largely hindered by economical difficulties in Belarus and Ukraine, where otherwise abundant resources and large domestic market are available.

Trade relations will probably show an increasing diversity in the future, however, the partnership with the Russian Federation and other former Soviet states will remain an important and strengthening component in aquaculture trade, despite the gradual approach of the Eastern European states to the European Union.

Policy and support

There has been a large and complex fisheries administration system in the former Soviet Union, which managed efficiently aquaculture and fisheries activities all over the country. This system stopped to operate after the disintegration of the Soviet Union, however former linkages, methods, knowledge and experiences regarding fisheries administration have been sustained, which have been incorporated in the new fisheries administration of the new independent countries. It proved to be however a long and difficult process to establish new and efficient government bodies to manage and coordinate fisheries activities in the new

socio-economic environment. The restructuring of the economy and the implementation of democratic reforms in the society have been progressing at different rates in the three countries of the Eastern European states, however, ten years after the disintegration of the Soviet Union, considerable changes are still taking place within the fisheries industry. In Ukraine, the Ministry of Fisheries was established in 1994, which has since been replaced by the State Committee of Fisheries (Goskomrybhoz). Of 288 enterprises and organisations under the authority of the State Committee of Fisheries, 46 have changed ownership, 22 are at the stage of undergoing privatisation, and 92 are collective property. Economic reforms are being implemented in the fishery sector, however the industry is facing serious difficulties, which have mainly financial origin. The fisheries industry is governed by Gosryboz in Belarus, which is a state association of the Ministry of Agriculture. The state program for the period of 1998-2005 for the assistance of the fisheries industry may have a positive impact on the sector, however there is a need for additional investments, especially for the rehabilitation of larger enterprises, which are still owned by the state. Legal frameworks related to fisheries have been largely in place in these countries, however, the implementation of the regulations constitutes the main problem.

Various internationally acknowledged R&D centres are available for the support of the fisheries industry. However, the scientific sphere was one of the great losers of the drastic changes during the transition into market economy, due to the sudden withdrawal of state support. Most of the research institutions have not been able to recover from the shock, and there is a fear that research values will start to erode. This is the area, where international collaboration could alleviate the situation considerably, however very little improvement could be seen at the moment. Further efforts are needed from international organisations, European institutions, but also from local institutions to intensify collaboration.

One of the key problems in aquaculture development is the lack of finance and investment, which constraints not only the operation of high input systems, but even low input systems suffer from the lack of money. The FAO EASTFISH Project has been established for the stimulation of fisheries business in the eastern part of Europe, but modest results have been reported from the Eastern European countries of the former USSR. At present investment environment is the most favourable in Moldova, among the three countries in the region, although the two other countries, Belarus and Ukraine, would offer greater opportunity for fisheries business supposedly. The large pond production sector however could not expect significant input from local and foreign investors, since semi-intensive pond fish production is not an attractive business area. The development of this sector is largely depending on the overall development of the national economy. EU provides financial assistance to the former Soviet states mainly through the TACIS project, however aquaculture has not been directly benefited from these projects yet.

Ukraine has bilateral fisheries agreements with Russia, France, Egypt and Georgia, which are related to industrial marine fisheries, but the international collaboration in inland fisheries and aquaculture is very limited. The reestablishment and activation of inter-regional collaboration between former USSR countries and other Eastern European countries in fisheries and aquaculture would be beneficial, and the existing informal and personal links could provide good basis for the development of that cooperation, however, the progress is slow. The organisation of regional workshops and conferences, and bilateral collaboration between institutions in the region would contribute to the improvement of the situation and may accelerate the wider scale inter-regional collaboration. There is a need however, for the assistance of international organisations with special regard to the EU and FAO.

3.2 Russian Federation

Russian Federation (Figure 19) is the biggest state of the former USSR, which also formally inherited the main part of the rights and obligations of the USSR within international community. In a number of areas the Russian Federation is occupying key position among the former USSR states and holding a leadership in the Commonwealth of the Independent States.

Figure 19. The Russian Federation

3.2.1 General characteristics

The territory of the Russian Federation covers area of 17,075,200 km^2 of Eastern Europe and Northern Asia (3/4 of the former USSR area, slightly more than 1.8 times the size of the US), bordering Arctic and Pacific Oceans. The land area within the territory is 16,995,800 km^2, total length of land boundaries comes to 19,917 km, and the coastline lasts 37,653 km. The Russian Federation constituted about 1/2 of the total population of the former USSR. In 1998 the population of the Russian Federation was 146.9 millions with average density of 8.6 inhabitants per 1 km^2 of the total land area. For the period of 1992-1998 the average annual population growth was negative and came to -0.2%. The administrative division includes 21 autonomous republics, 10 autonomous districts, 6 regions, 1 autonomous province, 49 provinces, and 2 federal cities.

Economical development in the Russian Federation after the disintegration of the USSR reflected profound processes aimed at gradual transformation to modern market economy and achieving of strong economic growth. After the initial period of stagnation, noticeable progress was attained by the end of 1997. However, in 1998 the economical development has experienced serious disturbances triggered by the Asian financial crisis. Russian GDP has contracted an estimated 43% since 1991, including a 5% drop in 1998. As purchasing power parity, GDP was evaluated as US$ 593.4 billion (US$ 4,000 per capita) in 1998, while GNP calculated by the Atlas method came to US$ 337.9 billion in total and US$ 2,300 per capita for the same year. Composition of GDP by sectors is presented by the following pattern: 7% - agriculture, 39% - industry, 54% - services (1997 data). Major part of enterprises has been transferred to private ownership in the course of the privatisation program. At the same time, legal and financial system still can be characterised as insufficiently developed from the point of view of market economy, despite number of important market-oriented laws were passed,

including a commercial code. Other important ongoing problem concerns persistence of significant budget deficits. To bridge over after-crisis difficulties and develop further the process of economical transformation, The Government of the Russian Federation has introduced specially elaborated Enhanced Economic Policy Package. It contains a number of up-front actions, which are targeted at correcting of the fiscal situation and accelerating of structural reforms, thus restoring financial market confidence and the prospects for sustained economic growth. The Enhanced Economic Policy Package is expected to support further the privatisation process, strengthen shareholder rights, improve transparency in the operations of infrastructure monopolies, and streamline the banking system.

The Russian Federation possesses diverse economical base formed by complete range of industries, which is at present noticeably dilapidated. However, the level of development and diversification of industry are definitely sufficient for the support of all kind of aquaculture activities.

3.2.2 Natural resources and climate

The country is reach in natural resources, but in average not favourable for agriculture production (either too cold or too dry). Major part of the country lacks proper soils; permafrost over much of Siberia is a serious obstacle for development. About 8% of the land territory are arable, while forests and woodland occupy 46%. However, water resources are abundant which provides a good basis for aquaculture development. Five largest rivers' systems (Ob' with Irtysh, Amur with Argun', Lena, Enisey, Volga) varies from 3,500 km to 5,400 km in length and from 1360 km^2 to 2990 km^2 in basins' territory. Number of all rivers that are over 10 km long exceeds 120,000. Total length of river system equals 2.3 million km, summarised annual discharge to the sea is estimated as 4,202 km^3 when discharge to other countries amounts 20.4 km^3 per year. The rivers of the Russian Federation freeze for from one month in the south-west up to 8 months and longer in the northern part of Siberia and Far East. On the largest rivers dams have been constructed. As a result, about 330 large reservoirs with total capacity of 360 km^3 and more than 3000 medium-sized reservoirs were created. Initially the program of rivers' flow regulation was targeted exclusively at hydroenergetics and irrigation, but created water reservoirs are also used for culture-based fisheries. At the same time, dam construction often cuts migration pathways of anadromous fish species, which negative effect was partially compensated by the establishing of large-scale state hatcheries. The irrigated land territory in the Russian Federation is about 40,000 km^2 (1993 estimation). Country possesses number of large lakes (lake Baikal is the world biggest fresh water lake according to the volume) and vast network of smaller fresh- and saltwater lakes which total number is about two millions.

The climate of the Russian Federation is varied from relatively dry (steppes) in the south through humid continental in much of the European part of the Russian Federation to the subarctic in Siberia and tundra climate in the polar north. The central western regions have climatic conditions, similar to the Central and Eastern Europe but in a more extreme form. The temperature differences between summer and winter are wide; snow in winter is considerable. In the Moscow region the average temperature is 19°C in summer and -9°C in winter. More temperate climate is observed in south, along the Black Sea cost. In most part of Siberia and in the northern areas the climate is severe, with long arctic winters and short, but hot summers. Average summer temperatures in Siberia are about -18°C, while average winter

temperatures vary from -18°C in the middle part up to -47°C in the far north. The climate of Far East region combines extreme temperatures of Siberia with monsoon-type conditions.

The average annual precipitation is about 590 mm in the Russian Federation, but the variations cover a range from less than 200 mm at the mouth of the Volga river in the south-west part of the country to more than 1000 mm in the mountains of the Far East region. In the northern regions of the Russian Federation water is generally in excess and drainage is of much importance. In the southern regions irrigation is required during agriculture season because of the lack of water. Annual Renewable Surface Water Resources (ARSWR) are estimated at 4,222.24 km^3, the share of ARSWR, coming from the neighbouring countries, is only 4.4%.

Border seas of the Russian Federation provide conditions for mariculture activities only in the minor part of 37,653 km of the coastline, although this minor part can be considered as relatively significant. However, environmental considerations impose definite restrictions on development of mariculture production, especially in the areas, where the necessary infrastructure is available.

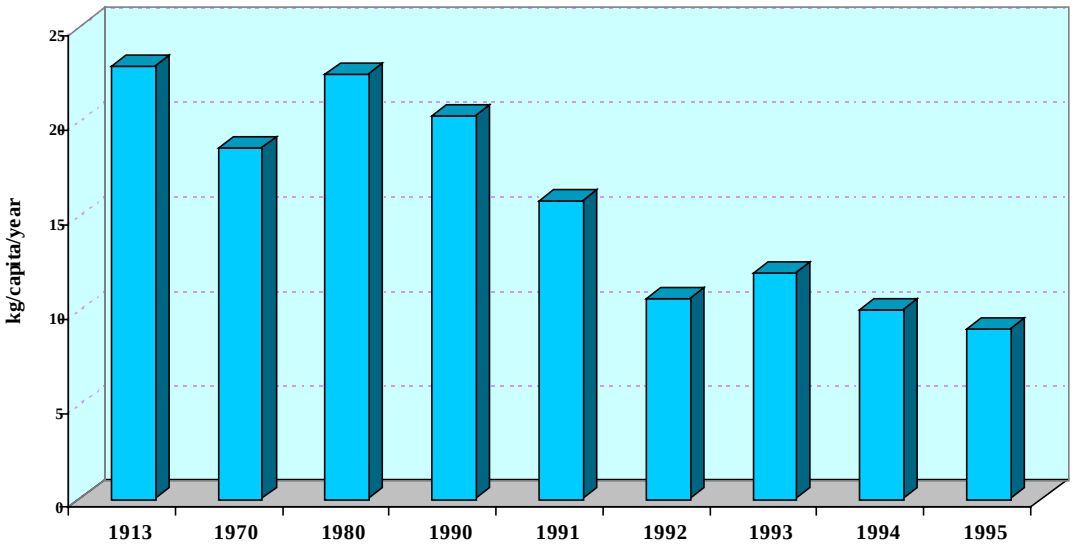
During the last decades environment was subjected to serious pollution, some sites were polluted by radionuclides. Aquaculture suffered mainly from the contamination of inland waterways and seacoasts both from industry and agriculture (in the last case often as the consequence of improper application of agricultural chemicals). With the beginning of overall transformation of the national economy conventional industrial pollution considerably decreased, but the risk of accidental pollution became even higher than before. Agricultural pollution of small lakes and rivers caused by animal farms activities has also increased. At the same time, the degree of contamination varies considerably, and there are significant territories and water stocks, which are still relatively or totally clean.

3.2.3 Fisheries and aquaculture in the economy

Production of fisheries industry was traditionally considered among the vital components of the national economy of the Russian Federation. Such significance is connected with the particular contribution of fisheries industry to ensure supplies of valuable animal protein for human consumption. Even after substantial decrease of production in the recent years, fishery products provide about 40% of protein in meat-and-fish diet subdivision of Russian consumers and 8% of the total animal dietary protein resources, which involves production from fish, meat, milk, and eggs (Mamontov J.P., 1998). The data on specific fish consumption in Russia both in 1913 and 1970-1995, shown at the Figure 20, demonstrate historically traditional importance of fish products for Russian consumers. There is well known consent, that high figure of specific fish consumption in 1970-1990 is to a great extent connected with deficit of meet products in the Soviet Union. Some analysts are inclined to consider a part of the decrease of specific fish consumption in 1991-1995 as associated with this phenomenon. However, for the long-term forecast of market demand for fisheries production in the Russian Federation, the figure of specific fish consumption in Russia in 1913 should be carefully considered as indicating the possibility of combination of relatively high consumption of fish and meet products. The major source of fish products on the Russian market was always presented by sea catches. However, the capacity of this market sector ensures the prospective for aquaculture development.

Figure 20. Specific fish consumption in Russia in 1913 - 1995, (kg per capita per year)

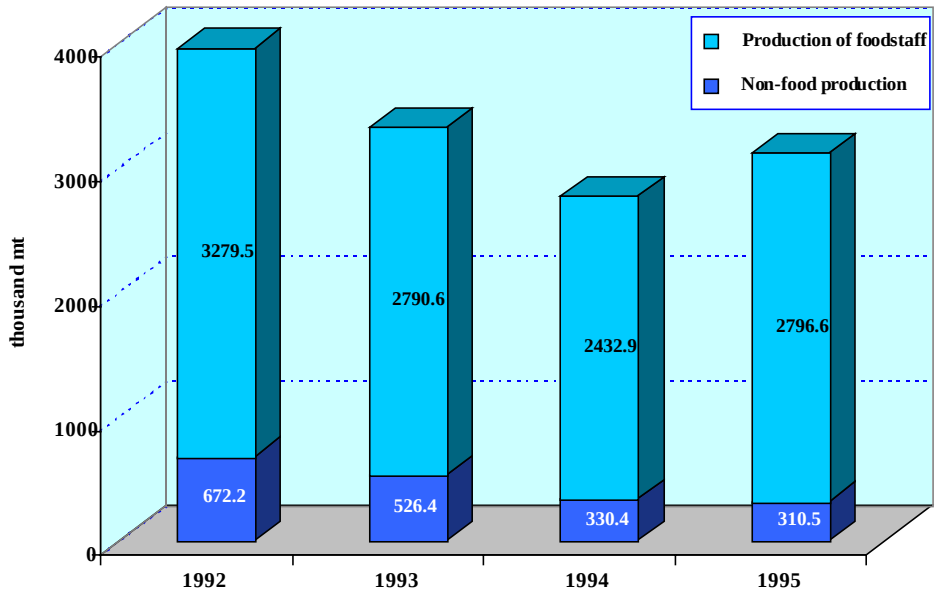
(Zilanov, V.K., Janovskaya, N. V. Russia at the world seafood market. Moscow, VNIRO, 1997)



The changes in the volume of production of fisheries industry of the Russian Federation in 1992-1995 are presented at the Figure 21. These data show that the drop in production reached the extreme in 1994, and the gradual increase has started from 1995.

Figure 21. Output of fisheries industry of the Russian Federation in 1992-1995

Zilanov, V.K., Janovskaya, N. V. Russia at the world seafood market. Moscow, VNIRO, 1997



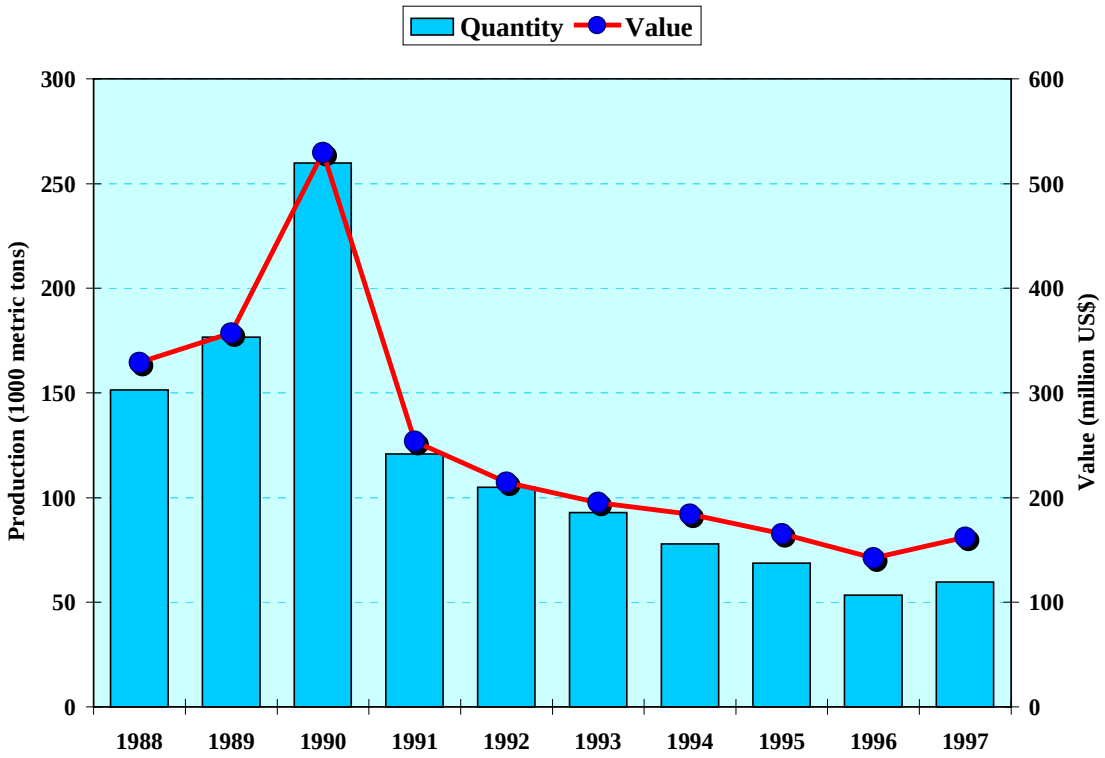
The explored fishery resources, for which the Russian Federation possesses nominal access, can ensure volume of catches about 9-11 million metric tons. This amount could be decreased up to 4.2-6.5 million metric tons after the exclusion of distant catching areas, where economical background of fisheries is questionable. The necessary volume of catch,

considered by the Government of the Russian Federation for the national fisheries policy, presently amounts 5 million metric tons.

3.2.4 Aquaculture production

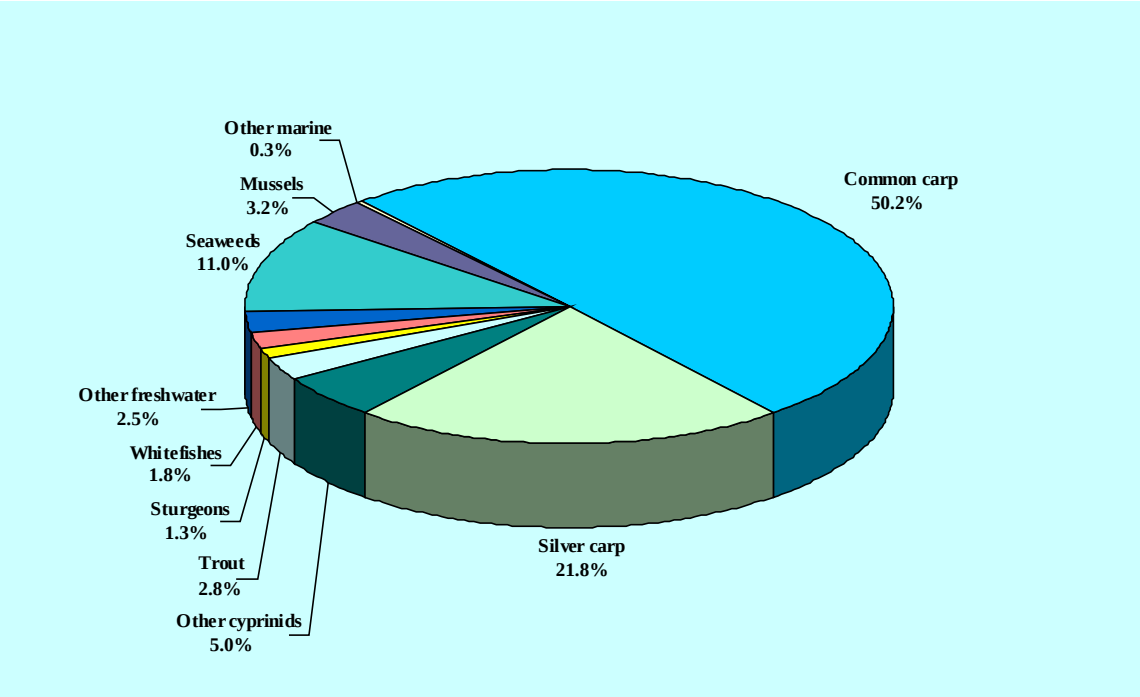
Aquaculture production in the Russian Federation (Figure 22-a) has dropped substantially in 1991-1996 during the first stage of overall restructuring of the national state system and economy. The decrease of production has been restrained in 1996 and in 1997 the aquaculture sector demonstrated certain increase. At the same time, the post-effects of 1998 economical crisis on aquaculture development could be observed within the subsequent years.

Figure 22-a. Aquaculture production in the Russian Federation
(Source: FAO FishStat, 1999)



In the species composition of aquaculture production of the Russian Federation cyprinids occupy the dominant position providing in 1997 about 77% of the total output. Two main species, common carp and silver carp, are giving respectively 50% and 22% of the total aquaculture production. Mariculture provided 14.5% in which about 3/4 referred to seaweed. Shellfish are produced exclusively in mariculture. The remaining 8.4% of the total production include substantial number of species, among which the share of freshwater species is prevalent. Crustaceans' farming is also performed only in freshwater environment. Noticeable number of species, which at present provides minor input into production figures, demonstrates substantial potential for development of aquaculture production, because farming technologies for these species are readily available.

Figure 22-b. Species composition in the total aquaculture production in the Russian Federation in 1997 (Source: FAO FishStat, 1999)



The structure of Russian aquaculture according to the affiliation of producers is rather complicated and currently undergoes gradual changes (Figure 23). Traditionally in the Russian Federation (and in the USSR before) farming of fish for the marked was affiliated mainly to the system of the Ministry of Agriculture. Special department of this ministry - Rosrybkhoz is engaged in coordination and support of commercial fish farming. Substantial scope of restocking activities, lakes and reservoirs ranching also belongs to this authority.

Figure 23. Structure of commercial aquaculture production in the Russian Federation in 1995-1997

(Mamontov J. P., Aquaculture in Russia: situation, priorities, and prospectives of development, St. Petersburg, 1998)

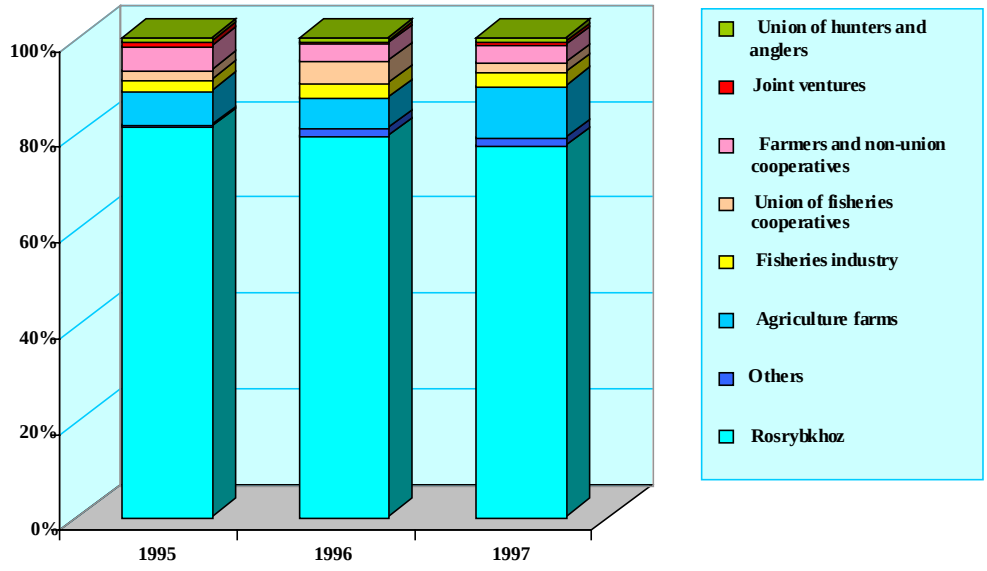
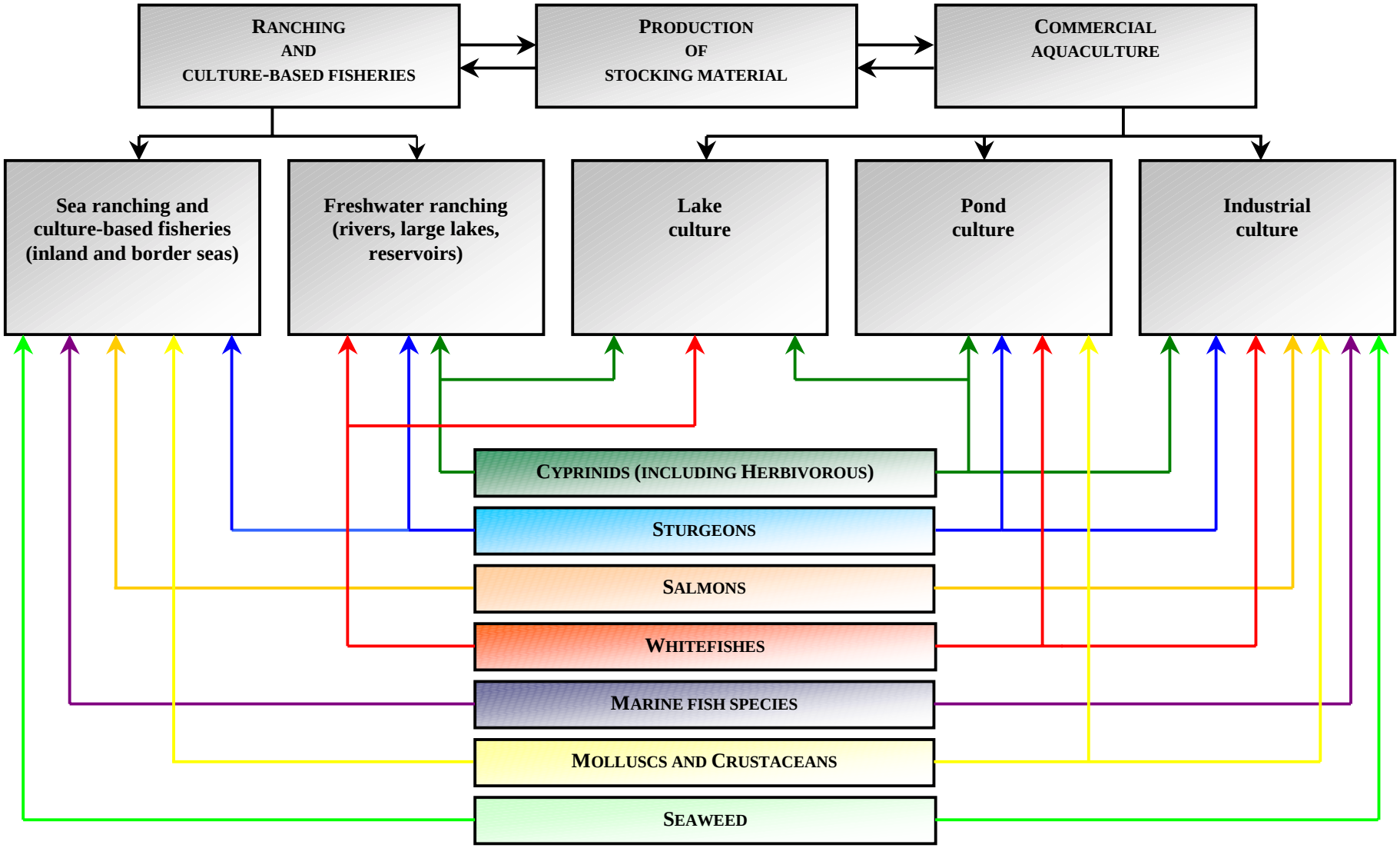


Figure 24. Structure of aquaculture activities in the Russian Federation
(Mamontov J. P., Aquaculture in Russia: situation, priorities, and prospectives of development, St. Petersburg, 1998)



Within the same ministry, fish farming is performed not only by specialised but also conventional agricultural farms - "kolkhoz" and "sovkhoz", nowadays often transformed into commercial companies. The Fisheries Committee (in the USSR - Ministry of Fisheries) is supervising the system of industrial state hatcheries for restocking activities of anadromous and other valuable fish species. This activity can be also considered as sea ranching. The Union of Fisheries Cooperatives also deals with fish farming, but the main lines of work of this system are related to the traditional and culture-based fisheries. Aquaculture activities of the Union of Hunters and Anglers are targeted mainly at stock enhancement. At the same time, in the current period of restructuring (which is at present far from completion), the individual fish farming enterprises could be state, cooperative or private property, independently to what system they formally belong.

The scheme at the Figure 24 demonstrates the structure of aquaculture activities in the Russian Federation according to the production methods and cultured species. As it can be seen, culture-based fisheries and ranching culture are of significant importance for Russian aquaculture. Such pattern also determines particular role of production of stocking material. This activity has long-term tradition and is performed by well-developed network of hatcheries. The support of culture-based fisheries is carried out according to scientifically based resource management doctrine. Resource evaluation, fishing regulation, and fishery enforcement implies in the Russian Federation the so-called "basin principle" according to which the territory of the country is divided into 27 regional fisheries administrations (Figure 25). This division follows the principles of biogeography and does not coincide with administrative regionalisation.

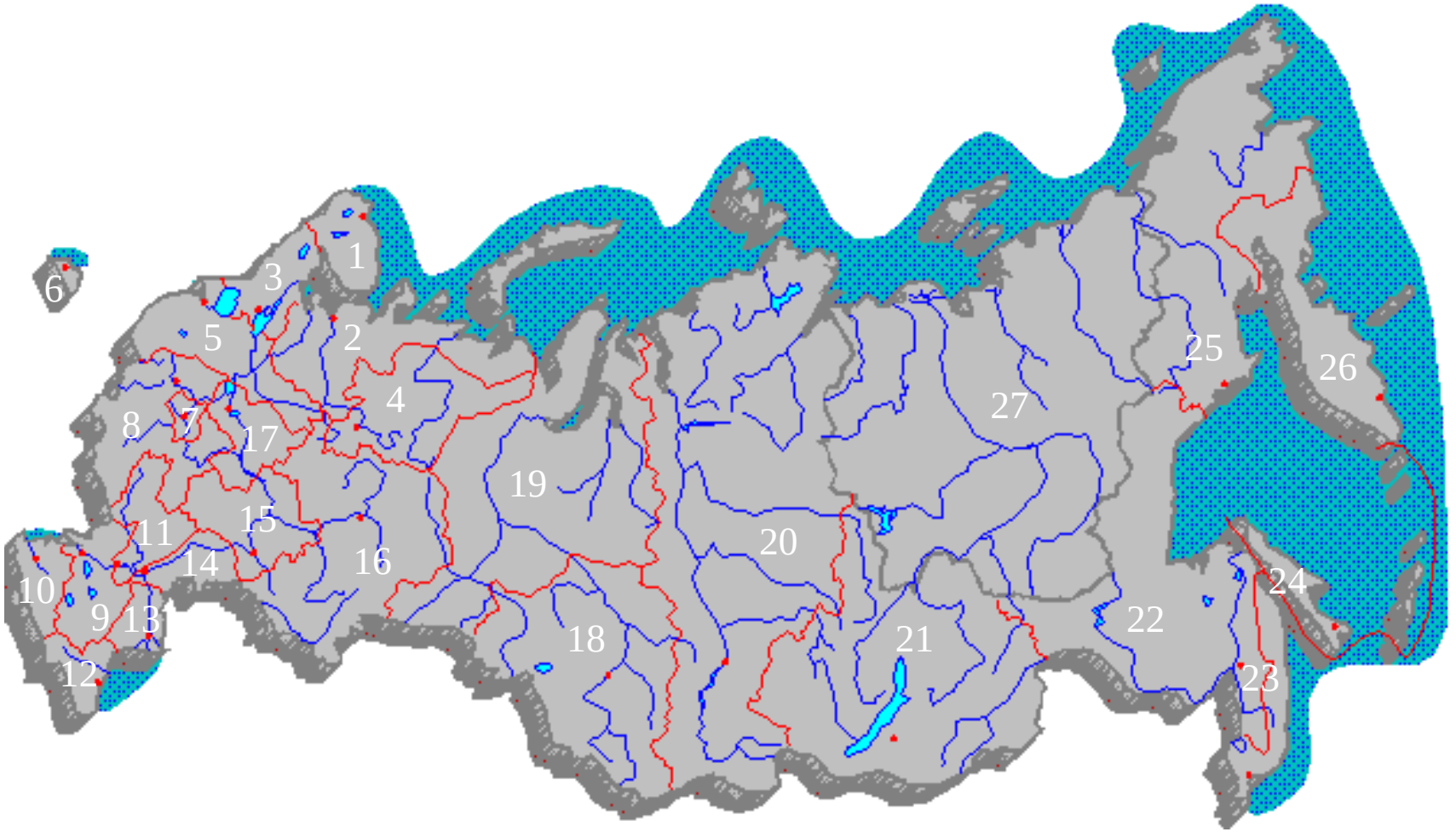
The scale of culture-based fisheries can be demonstrated by the number of viable juveniles released annually to the natural waters (Figures 26-a, 26-b, and Table 4).

Table 4. Restocking and mitigation in the Russian Federation in 1992-1997
(the data were provided by the Department of Restoration of Fish Resources, Fisheries Committee of the Russian Federation)

		1992	1993	1994	1995	1996	1997
Fisheries Committee							
	Sturgeons	76.577	63.061	67.178	55.183	52.226	57.73
	Salmons	664.15	512.133	447.086	499.2	602.1	617.19
	Whitefish	1.646	4.929	3.263	2.214	3	3.397
	Others*	2720.03	2569.9	2820.53	1902.2	1160.8	1223.6
	Herbivorous	22.218	22.9	23.581	23.5	23.13	22.5
	total:	3464.6	3172.9	3361.63	2482.4	1841.2	1924.4
Rosrybkhoz							
	Sturgeons	29	30.255	28.69	30.36	31.9	33
	Salmons	0.1	0.043	0.062	0.062	0.064	0.153
	Whitefish	39.1	79.71	51.83	41.6	27	62.7
	Others*	3631.8	3461.49	3390.5	3376.8	3300	3502.1
	Herbivorous	5.3	8.335	6.69	8.029	4.1	8.9
	total:	3705.3	3579.83	3477.77	3456.9	3363.1	3606.9
All Russia in total:		**7169.9**	**6752.73**	**6839.4**	**5939.3**	**5204.3**	**5531.3**

* - so-called "chastik", in general includes: wild carp, pike-perch, bream, vimba (zanthe), shemaya (*Chalcalburnus chalcoides*), Black sea roach (*Rutilus frisii*), and asp (sometimes other species).

Figure 25. Regional divisions of inland fish stocks management (so-called Basins' Administrations) in the Russian Federation



Basin Administrations:

1. Murmansk
2. Nothern
3. Karel
4. Komi
5. North-Western
6. West-Baltic
7. Moscow
8. Central
9. Azov
10. Kuban'
11. Tsiml'ansk
12. West-Caspian
13. North-Caspian
14. Lower Volga
15. Middle Volga
16. Kama-Ural
17. Upper Volga
18. Upper Ob'
19. Lower Ob'
20. Enisey
21. Baikal
22. Amur
23. Primorskiy
24. Sakhalin
25. Okhotsk
26. Kamchatka
27. Jakutia

Figure 26-a. Restocking activities in the Russian Federation in 1992-1997, all species

(data were provided by the Department of Restoration of Fish Resources, Fisheries Committee of the Russian Federation)

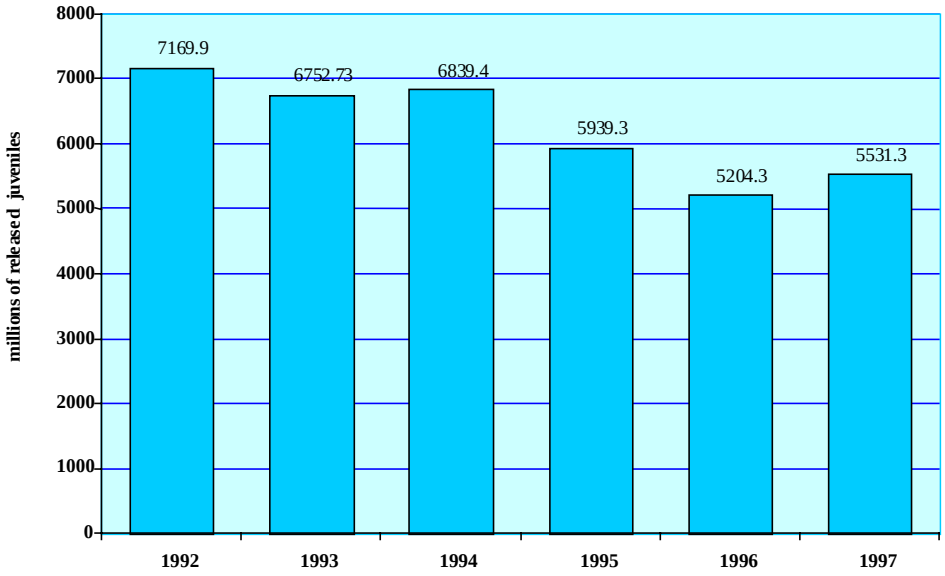
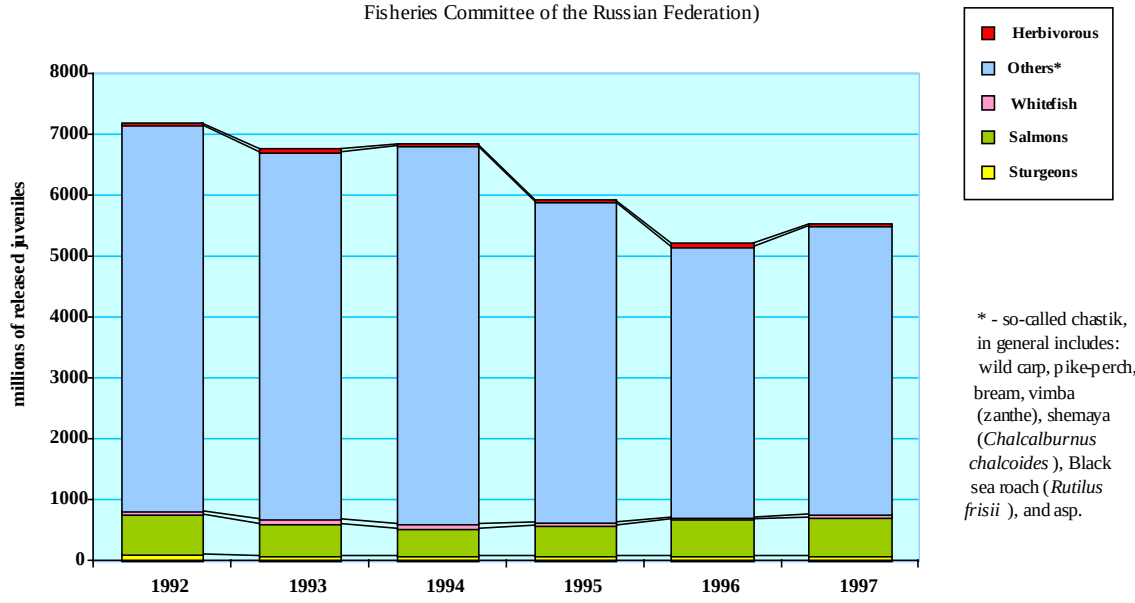


Figure 26-b. Restocking of different fish species in the Russian Federation in 1992-1997

(data were provided by the Department of Restoration of Fish Respources, Fisheries Committee of the Russian Federation)



The observed decline in production of juveniles for the restocking was not so deep as in commercial aquaculture production, which could be considered as a significant achievement of the sector. The effectiveness of restocking activities can be demonstrated by the share of hatchery-originated fish in sturgeon populations, which now amounts about 28% for Caspian Russian sturgeon population, 30% for Caspian stellate sturgeon population, and 90% for Caspian great white sturgeon population and all sturgeon species in the Sea of Azov.

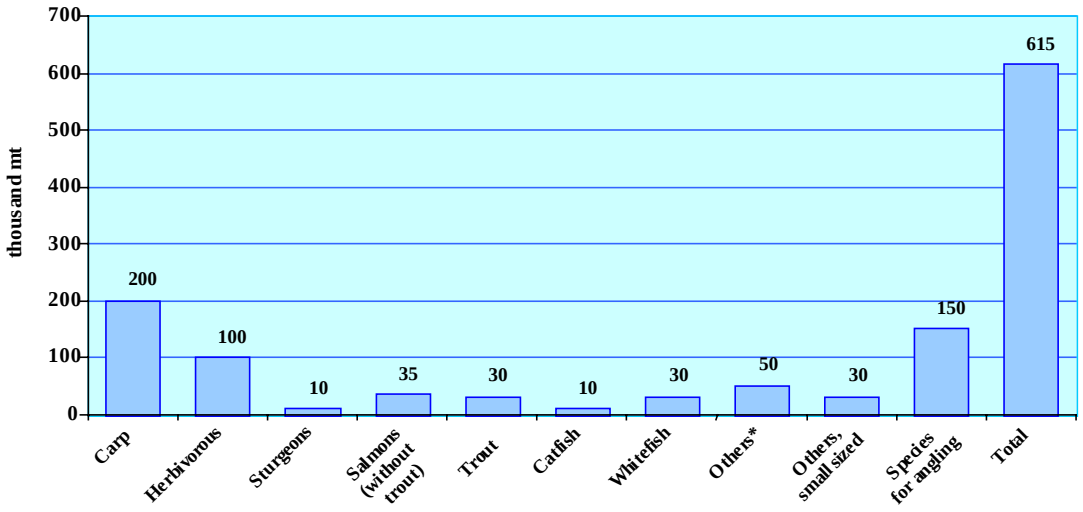
3.2.5 Main constraints and opportunities

Production

The comparison of the output of aquaculture production in the Russian Federation (not only now, but for the last two decades as well) and the volume of available water resources shows, that the level of resource utilisation is very low. Specific aquaculture production comes to 11.4 tons per 1 square km of internal renewable freshwater resources, 14.2 tons per 1 cubic km of ARSWR, 3.52 kg per 1 square km of land area, and 405 tons per 1 million of population. This situation is to a certain degree connected with traditional role of sea catches in the Russian economy. At present, when the principles of management in fisheries sector in the Russian Federation are based on the realities of market economy, production of aquaculture would gradually replace definite share of catch fisheries production at the market. The evaluation of principal production capabilities of aquaculture in the Russian Federation, ranges from 1 to 2.5-3 million tons depending on the involved analysts. Such estimations concern long-term prospective of development and assume overall stabilisation of the national economy, establishment of respective networks, and coming in force of new legislative base. However, even for the years of economical stagnation, the data on estimated consumer demand for aquaculture production in the Russian Federation (Figure 27) demonstrates that market capacity for these products is poorly filled.

Figure 27. Estimated consumer demand for main inland fish species in the Russian Federation

(Mamontov J. P., Aquaculture in Russia: situation, priorities, and prospectives of development, St. Petersburg, 1998)



* - so-called chastik, in general includes: wild carp, pike-perch, bream, vimba (zanthe), shemaya (*Chalcalburnus chalcoides*), Black sea roach (*Rutilus frisii*), and asp

The availability of necessary infrastructure is very significant for the substantiation of the balance of long-term and short-term progress patterns in the forecast of aquaculture development in the Russian Federation. Considerable part of water resources is unfavourably located. There is no properly developed transportation network at the significant part of the territory, numerous production sites are too distant from the market targets. The system of supplies also requires substantial improvement. At the same time, during previous development of this very large country, specific approaches to solve problems of e.g. big distances were already established. It can be foreseen in this connection, that future expansion of aquaculture activities will combine elements of compartmentalisation with centralised

networking. Other factor, which would effectively contribute to aquaculture development in the Russian Federation, is availability of valuable human resources in practical and academic spheres. Despite of definite deterioration, the network of academic, applied, and educational institutes is able to provide necessary support for implementation of new technologies and professional training.

Each direction of aquaculture activity in the Russian Federation is connected with specific set of constraints and opportunities for future development. Sea ranching would target new areas (e.g. in the north) and species, but the problems could be expected in connection with international disputes, enforcement issues, pollution, dilapidation and obsolescence of fishing fleet. Freshwater ranching in Russia could give in theory up to 1 million tons of catches, but main constants are related to poaching and water contamination. In addition, hatchery network for freshwater ranching is less developed and sometimes outdated. Lake culture would expand at north-west of the country and in Siberia, where traditionally cultured salmon and whitefish species could be supplemented by cyprinids and crustaceans. Fish production in lake culture could be constructively combined with recreational activities, but this pattern of aquaculture would also confront the same problems as ranching culture. Pond culture, which is forced to use extensive approach now, could gradually increase the specific production per area. Long-term prospective of pond culture in Russia seems to be encouraging, however, the development would be slow because the diversity of conditions in many cases will require elaboration of individual production strategy scheme for each farm. Intensity of growth of fresh- and saltwater industrial culture could depend mainly on general stabilisation of the national economy. The availability of quality fish feeds is strong restricting factor for aquaculture development in the Russian Federation, thus in short-term prospective fish production from ranching methods will grow more intensively, than in pond and industrial farming. In all the range of aquaculture activities, the progress could be enhanced by increasing of the number of reared species.

Figure 28. Analysis by activities and species of the prospective of development of aquaculture in Russian Federation in the coming decade

(Mamontov J. P., Aquaculture in Russia: situation, priorities, and prospectives of development, St. Petersburg, 1998)

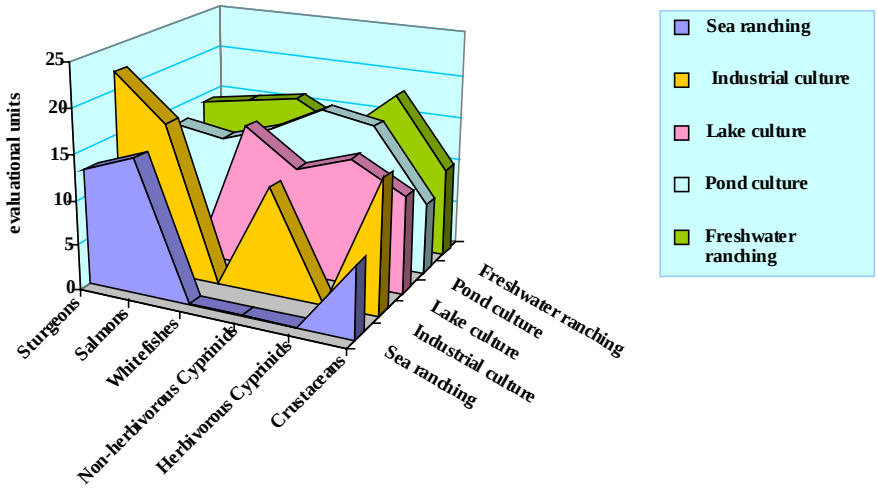


Table 5. Analysis of the prospective of development of different activities and the use of various species in Russian aquaculture in the coming decade
(Mamontov J. P., Aquaculture in Russia: situation, priorities, and prospective of development, St. Petersburg, 1998)

Scale: 1 - unreasonable; 2 - high risk; 3 - middle possibilities; 4 - reasonable; 5 - no risk

Activities	**Limiting factors**					
and species	market	investment	ecology	technology	assets	total
Sea ranching:						
Sturgeons	4	1	3	2	3	13
Salmons	4	2	3	3	3	15
Crustaceans	3	1	2	1	1	8
Freshwater ranching:						
Sturgeons	4	3	2	2	3	14
Salmons	4	3	2	3	3	15
Whitefishes	4	3	2	4	3	16
Non-herbivorous Cyprinids	4	2	3	2	2	13
Herbivorous Cyprinids	4	4	3	4	3	18
Crustaceans	5	1	2	1	1	10
Lake culture:						
Whitefishes	4	3	3	3	3	16
Non-herbivorous Cyprinids	4	1	4	2	1	12
Herbivorous Cyprinids	4	2	4	2	2	14
Crustaceans	5	2	2	1	1	11
Pond culture:						
Sturgeons	3	2	3	2	3	13
Salmons	3	2	2	3	2	12
Whitefishes	4	2	2	3	3	14
Non-herbivorous Cyprinids	4	3	3	4	3	17
Herbivorous Cyprinids	3	3	3	4	3	16
Crustaceans	3	1	2	1	1	8
Industrial culture:						
Sturgeons	4	5	5	5	3	22
Salmons	3	4	4	3	3	17
Non-herbivorous Cyprinids	2	1	4	2	3	12
Crustaceans	4	2	3	4	2	15

Figure 28 presents the results of expert evaluation of the potential of the development of different activities in Russian aquaculture and possible role of cultured species. Evaluation procedure has considered the following initial key points:

- consumer demand and its forecast;
- modern environmental restrictions;
- long-term economic expediency;
- credit availability and recoupment of capital investment;

– current state of production facilities and depreciation of assets;
– need for new technologies;
– availability of specialised feeds.

Individual inputs of these key points in the results are listed in the Table 5.

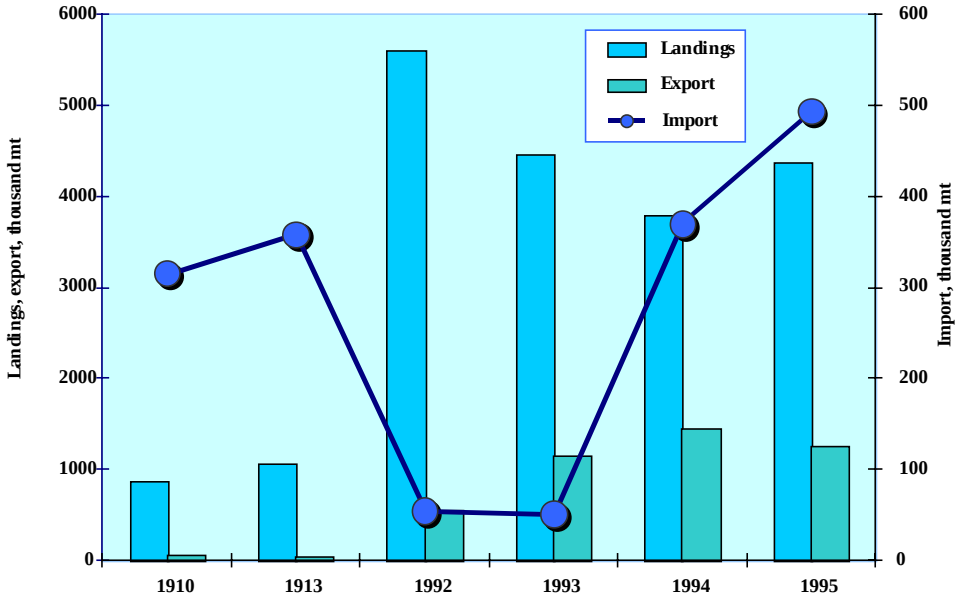
The evaluation indicated the most favourable prospective for industrial culture of salmons and sturgeons, pond culture of all cyprinids, lake culture of whitefishes, and freshwater ranching of whitefishes and herbivorous cyprinids. This group is followed by industrial culture of crustaceans, pond culture of whitefishes, lake culture of herbivorous cyprinids, freshwater ranching of salmons and sturgeons, and sea ranching of salmons.

Trade

It is impossible to outline separate trade patterns for aquaculture products basing on the statistics of fish products trade in the Russian Federation. However, the conclusions concerning the trade of fishery production are generally applicable for the evaluation of factors, influencing aquaculture trade.

Figure 29. Fish catch and trade in Russia in 1910, 1913 and 1992-1995

(Zilanov, V.K., Janovskaya, N. V. Russia at the world seafood market. Moscow, VNIRO, 1997)



The patterns in the trade of fish products in the Russian Federation experienced significant changes during the recent period (Figure 29). During 1992-1995 import of fish products has increased almost ten times, while landings have decreased only by 22%, and export has risen about two times. Figures of import of fish products almost coincided in 1994 and 1913, which indicates existence of long-term traditions in this trade. Relatively high figures of import could be connected to increased consumer demand for quality fish products. This market niche could be successfully filled by aquaculture. Currently only 4% of the total fish consumption in the Russian Federation are represented by live and fresh fish products, which creates promising sale possibilities for production from fish farms. At the same time, further

development of facilities and trade network is necessary to ensure the delivery of fresh products from farms to customers. Introduction of advanced processing technologies (e.g. bone removal), convenient portioning and packaging are the factors, which significance for the success of trade of aquaculture products cannot be overestimated.

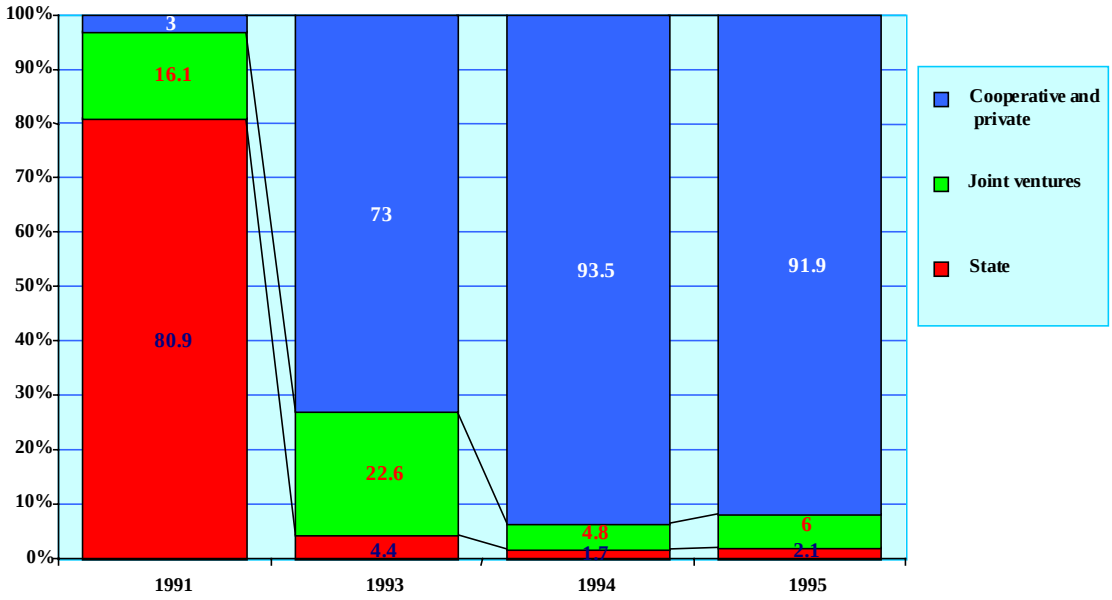
Policy and support

The policy provisions in fisheries sector always include participation of state and other centralised structures not only in post-socialistic countries, but also in the states with developed market economy. In the Russian Federation, the issues related to fisheries and aquaculture are regulated by the Fisheries Committee, Ministry of Agriculture, and Ministry of Environment Protection. Fishery enforcement within Russian Exclusive Economic Zone is performed by the State Department of Board Guard. The Interdepartmental Ichthyological Commission formed by Fisheries Committee, Ministry of Agriculture, Ministry of Environment Protection, and Academy of Sciences is coordinating research and development policies in fisheries and aquaculture and mitigation activities. The Commission has several Councils dealing with specialised issues. Several associations of producers were created for provision of centralised non-governmental support. Fish farmers are joined mainly within Rybkhozassociation, but they can also act, e.g. to protect their interests in foreign trade, via All-Russian Association of Fishery Industry, Entrepreneurs, and Exporters (VARPE).

Together with the overall restructuring of the state system and economy, property structure of fisheries enterprises has considerably changed (Figure30).

Figure 30. Affiliation of Russian fisheries enterprises (percentage, 1991-1995)

(Zilanov, V.K., Janovskaya, N. V. Russia at the world seafood market. Moscow, VNIRO, 1997)



In spite of the fact that overwhelming part of fishery enterprises were privatised, the successful work of the sector in general is dependent upon definite centralised support measures. In case of aquaculture, the poor condition of fish feed industry could greatly restrain the sector's development. However, reorganisation and speed-up of this industry

could not be achieved beyond an integrated program combining the efforts of policy makers, institutional system, investors, and entrepreneurs.

Credit availability is relatively optional for fish trade, but for the needs of aquaculture it is necessary to reach much wider involvement of local banks along with the change of general credit doctrine. Greater participation of financial institutions in aquaculture development cannot be attained without reliable insurance practice, which is not actually started by the present time.

Participation in the international programs could provide substantial assistance for elaboration of centralised policy to support aquaculture sector during the transitional period. One of the steps in this direction was joining by the Russian Federation of FAO EASTFISH project in February 2000.

3.3 Baltic States

3.3.1 General characteristics

The total area of the three Baltic states (Estonia, Latvia and Lithuania), located in the northwest part of the former USSR, is 174,900 km^2, which represents 0.8% of the total area of the former USSR (Figure 31). Estonia (45,100 km^2) occupies 26%, while both Latvia (64,600 km^2) and Lithuania (65,200 km^2) equally 37% of the territory of this region. Lithuania became independent from the Soviet Union in March 1990, Latvia in May 1990, while Estonia in August 1991.

Figure 31: The Baltic States of the former USSR

In 1996, the total population of Estonia, Latvia and Lithuania were 1.5, 2.5 and 3.7 million, respectively. Thus, the total population of the Baltic states was 7.7 million in 1996, which is 2.7% of the total population of the countries of the former USSR. The rural population was equally 27% in each of the three Baltic states. The average population density was 44 inhabitants/km^2, more than three times higher than that of the former USSR. The population density is varying according to the different sites, the most densely populated areas are the urban areas, especially those counties where the capitals are located. While the annual population growth rates in the Baltic states was slightly positive during the 1980's, it became negative in the 1990's. Estonia has had a negative population growth rate, about -1% per year recently, Latvia -0.7% in 1994, and Lithuania -1% in 1994 and 1995. These decreases are related, on the one hand, to a reduced natural population growth, and on the other, to the fact that some of the people with other nationalities (in particular Russians, but also people from Belarus and Ukraine) have been leaving the Baltic states.

In 1996, 13% of the economically active population was engaged in agriculture in Estonia, 14% in Latvia and 18% in Lithuania. In 1993, agriculture accounted for an estimated 10% of GDP in Estonia, almost 8% in Latvia, and 7% in Lithuania.

3.3.2 Natural resources and climate

The cultivable land area in Estonia is estimated at almost 1.4 million ha, which is 30% of the total area of the country. In 1995, the total cultivated area was 863 324 ha, of which 98.5% was covered by annual crops. Since independence, the agricultural sector has been going through a process of privatisation. Before the Second World War, Estonia had approximately 140 000 private farms, which were collectivised into 360 sovkhoz (state farms) during the Soviet era. After independence at the end of 1991, there were still 120 sovkhoz occupying about 30% of the agricultural land, 265 kolkhoz (collective farms) occupying 57% of the agricultural land, and 7 227 registered private farms occupying the remaining 13% of the agricultural land. Today, the agricultural sector is almost fully privatised. In Estonia, the sea has an impact on the climate throughout the country. Winters are mild, springs are short, summers are warm and sunny, and autumns are long and windy. The average precipitation is 632 mm/year, but is somewhat lower on the islands and in the coastal areas while being somewhat higher in the uplands. The climatic conditions allow the cultivation of one crop per year during summer with irrigation possibly needed in May and June. In dry years, it is necessary to irrigate in July and August as well. However, drainage is more important than irrigation. It is estimated that without drainage about two-thirds of the land for agricultural production would suffer from waterlogging.

In Latvia, the cultivable area is estimated at over 2.5 million ha, which is 39% of the total area of the country. In 1994, the cultivated land was estimated at 1.2 million ha, of which over 98% were covered by annual crops. The soils in Latvia are generally not very fertile. Around 230 000 ha are threatened by wind erosion and around 380 000 ha by water erosion. According to various estimates, marshes cover 5-10% of the total area of the country. Some swamps of peat ground reach a depth of 5 m. Until 1989, 60% of the area was cultivated by kolkhoz (collective farms) and 40% by sovkhoz (state farms). In 1989, as a result of the proclamation of the ‘Act on Land Reform in Rural Areas’, private farms started developing. In 1994, the private sector, including peasant farms, household plots, private auxiliary farms and private fruit gardens, cultivated over 1 million ha. The average size of private farms does not exceed 20 ha. In Latvia, the average annual precipitation, including snowfall, has been estimated at 743 mm. In the four climatic regions the annual precipitation is varying between 600 and 850 mm, winter (from -3 to -7°C) and summer (16.5-17°C) temperatures are slightly different, however, the differences in humidity are more pronounced. For agriculture, drainage is more important than irrigation. Over 90% of the agricultural land in Latvia can be intensively cultivated only if drained. Irrigation is generally supplementary irrigation.

Lithuania is part of the east European plain, and within the country, lowland plains alternate with hilly uplands. The cultivable area is estimated at about 3.9 million ha, which is 60% of the total area of the country. In 1994, the cultivated area was estimated at almost 2.6 million ha, of which 98% was covered by annual crops. The central and western parts of Lithuania are the best regions for crop production, especially the middle lowland. This region was almost entirely exploited before 1989-1991, in order to supply cities such as Moscow and Saint Petersburg with agricultural products. In the Soviet era, agriculture was collectivised and organized in large-scale farms. After independence, agriculture was restructured and the land returned to its former owners. The structure of Lithuanian agriculture is now characterised by three different types of farming. In 1995, private commercial farms occupied some 33% of the farmland. Collective commercial farms occupied some 20% of the farmland. Smallholdings, with an average size of 2 ha, occupied another 21%. The remaining 26% were under state ownership, rented out to various types of farms. The restructuring process has not yet been

completed and legal titles for most of the land are still not settled. Lithuania is a semi-humid country. The climate is transitional between maritime and continental. In the 12-15 km-wide coastal zone it is maritime, and in the east of the country it is continental. The average annual precipitation is 748 mm, ranging from less than 550 mm in the north to a maximum of more than 846 mm in the hilly areas. Over two-thirds of the precipitation occurs during the warm period, from April to October. The main issue in relation to agriculture is thus the removal of excess water to enable cropping.

The region is mainly flat along the coast and somewhat undulating farther inland. The highest elevation is 312 m above sea level. There is a dense network of waterways in this region and there are numerous lakes and marshes. The climate is influenced by the region's position between the Eurasian land mass and the Baltic Sea. Average temperatures are around 17°C in summer and -5°C in winter. The average annual precipitation is 716 mm, varying from 500 mm in parts of Lithuania to 850 mm in the uplands of Latvia. In this mainly low-lying, flat region, drainage is more important for agriculture than is irrigation. Large areas can only be cultivated intensively if drained. Irrigation is generally limited to supplementary irrigation.

3.3.3 Fisheries and aquaculture in the economy

The Baltic region is the smallest region of the former USSR territory (186,400 km^2 area; 16.4 million population). Aquaculture has a minor role in fish supply in these countries comparing to capture fisheries. The share of aquaculture was less than one percent from total fish production (both capture and culture) in 1997 in the three Baltic states. The limited aquaculture production focuses on common carp and trout. The share in the total aquaculture production of the former USSR by sub-regions was the smallest in the Baltic States, with only 1.9 % contribution. Economic reforms have been progressing well in this region, and economic assistance is also directed toward these countries from Scandinavia. There is a better entrepreneurial environment in this region due to these circumstances, which may have positive effect on future aquaculture development.

In Estonia the primary sectors of the whole fisheries industry are the marine fisheries (including distant water and Baltic Sea fisheries), the inland water fisheries and aquaculture. In 1996, the total volume of catches was 108,500 tonnes (34,700 t distant water, 71,400 t Baltic Sea and 2,360 t inland water catches), while the inland aquaculture amounted to 272 tons. Between 1994-1996 the Estonian fisheries sector contributed 2.6% to the total GDP of the country. There are some 20,000 people employed in fisheries, 2,000 in the capture fisheries and 2,000 in inland aquaculture, some 8,000 in the processing industry and some 8,000 in marketing and trade. In 1990, fish and fish products consumption was estimated at 23-27 kg per capita, while the most recent figure show a consumption value of 19-25 kg per capita.

Latvian fishery has a long history, the first fishermen's society was established in 1220. The intensive coastal and Baltic Sea fisheries, which based on historical traditions, had already developed before the Second World War. In the Soviet period, the fisheries were subjected to the planned economy and large-scale industry. There was also a large growth of the labour force in fisheries. After regaining independence in 1990, the fisheries industry was subjected to privatisation, and to facilitate the development of private fisheries. In this transition period, a deep economic crisis affected the fishery and fish processing enterprises. Since 1994, the general conditions have improved, and the situation has stabilised. However, the prospects for ocean fishery have been reduced to a minimum level. Presently the most important fishery

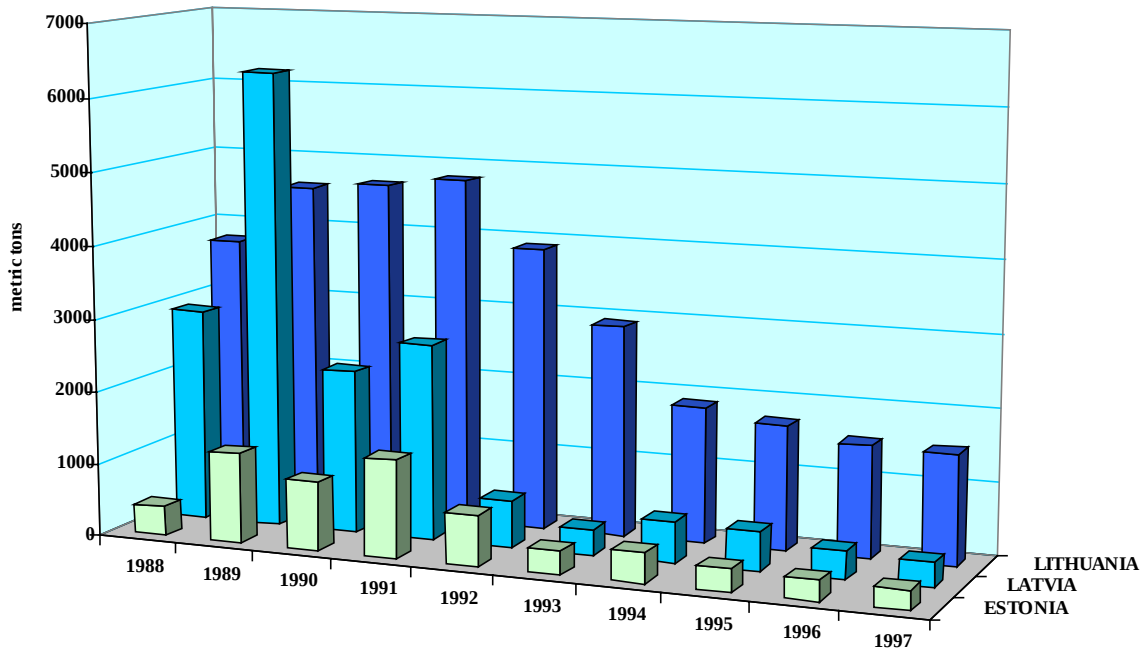
sectors are the Baltic Sea and coastal fisheries among the three other ones (distant water fishery, inland water fishery, and aquaculture). The consumption of fish products has decreased because of the rising prices. In 990, the annual consumption of fish products was 22.5 kg per capita, which has dropped to 8.9 kg per capita by 1995.

Despite of its small size and short coastline, Lithuania has a relatively large fishing and processing industry, as well as a developing aquaculture sector. Both fisheries and aquaculture have always been important sectors of the Lithuanian economy. There is a long tradition in deepsea fishing as well as the Baltic and inland fisheries. Aquaculture has developed despite of the unfavourable climatic conditions prevailing in the country for the production of commonly cultured fish species in other European countries. At the end of the Soviet period the total catch of the Lithuanian deepsea fleet reached nearly 400,000 tones, and the Baltic Sea catch 18,000 tons per year. Total catches from the inland fisheries and aquaculture production together amounted to nearly 19,000 tons per year (of which some 4,800 tons originated from aquaculture). At that time the whole fisheries sector employed more than 20,000 people. After the time of independence in 1990, Lithuania met serious difficulties in its transition to market economy. Total catches dropped dramatically due to the economic crisis and the loss of fishing rights in traditional fishing areas. In 1995, total deepsea catches were as low as 33,000 tons, and the Baltic Sea and inland water catches also decreased dramatically with some 70%. Local consumption of fish also declined significantly from 20 kg per capita in 1990 to 8 kg per capita in 1994.

3.3.4 Aquaculture production

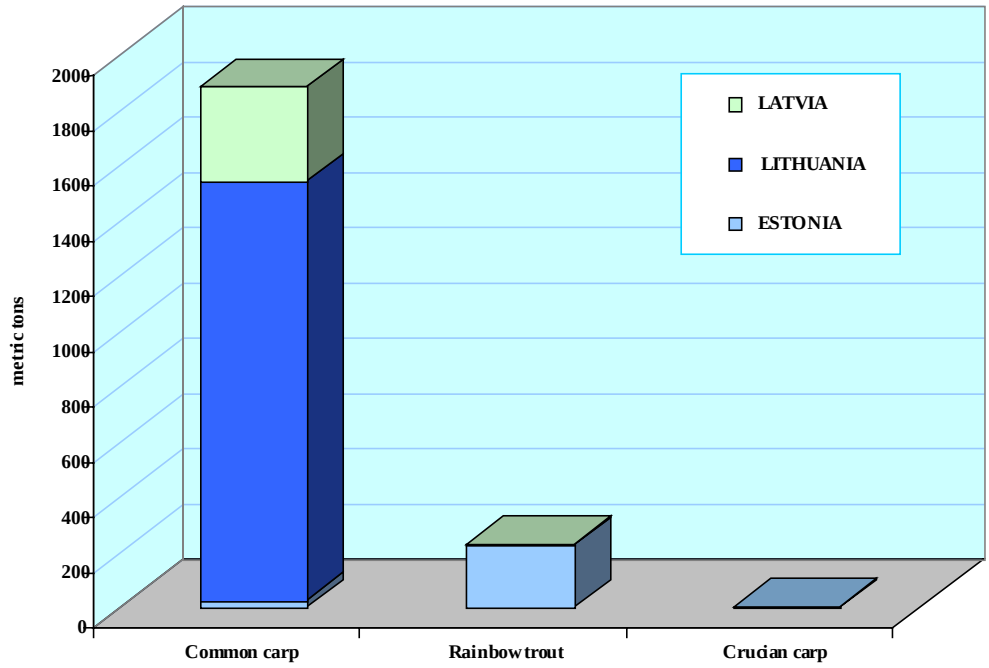
During the period between 1988 and 1997 aquaculture production in the Baltic states of the former USSR demonstrated growth before the disintegration of the Soviet Union and substantial decrease in the following years. The degree of augmenting or declining of production was different in each country, but the tendency in all three Baltic states is similar (Figure 32).

Figure 32. Aquaculture production in the Baltic states of the former USSR
(Source: FAO FishStat, 1999)



The composition of species, reared in aquaculture of the Baltic states of the former USSR can be characterised as rather limited, especially, if the production data for the years 1994-1997 are considered (Figure 33). Carp possesses the predominance, the remaining share of production formed mainly by the rainbow trout. Atlantic salmon, brook trout, whitefishes, and sturgeons are also farmed or introduced in aquaculture during the past decade. However, they were not reported within the aquaculture production during the second part of ninetieths.

Figure 33. Aquaculture production by species in the Baltic States in 1997 (Source: FAO FishStat, 1999)



Fish farming in Estonia originates from the Central European tradition of pond fish culture. Common carp and rainbow trout were introduced to the country at the end of the 19th century. The capacity of Estonian aquaculture facilities comprised 2,525 ha of fish ponds and tanks and 2,700 m^3 of cages in 1996. The total production of fish for consumption reached its peak of about 1,700 metric tons in 1989, and has decreased significantly since then. The total production in 1997 was only 260 tons (227 t rainbow trout, 28 t common carp and 5 t crucian carp. There are promising signs of recovery in Estonian fish farming now. Almost all former state owned fish farms have been privatised. Fish farms are using more modern technologies and have initiated business contacts with Western companies. New species like sturgeon and crayfish have been introduced into commercial culture.

In Latvia, carp is the major aquaculture species, but rainbow trout is also becoming popular. The freshwater crayfish with its good sales possibilities could be a prospective species for farming in the future. The peak in aquaculture production was attained in 1991, when 6,288 tons of fish was produced, which was exclusively common carp. During the 1990's aquaculture production decreased dramatically. By 1992 the total production dropped to 641 tons, and in 1991 the total production was only 345 tons. Carp farming and processing for consumption is basically organised by one state owned fish farm. Private fish farmers are few, but their numbers are steadily increasing. Most of them have one or more ponds for stocking

fry bought elsewhere. Due to the changes in property and market conditions, the further development of aquaculture is not advisable to follow previous experiences because of the high expenses in pond maintenance and cool water conditions.

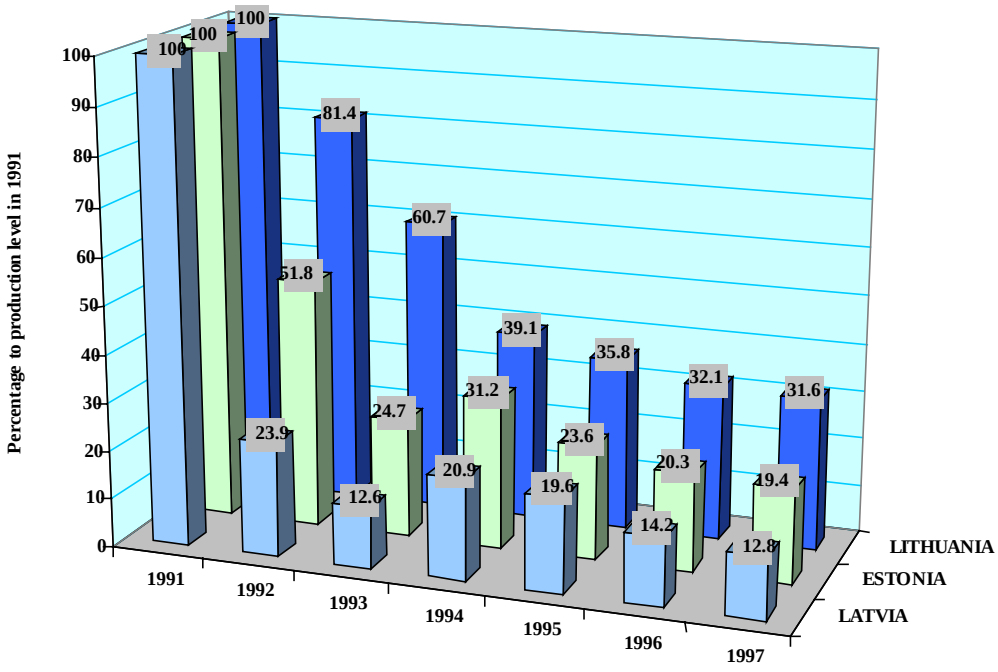
During the closing years of the Soviet period (1989-1991) the total aquaculture production in Lithuania reached its peak in 1991 with 4,792 tons per year quantity. However, in the following years production continuously decreased, especially until 1994. The lowest production volumes were experienced in 1996 and 1997 (1,537 and 1,516 tones, respectively). Common carp remained the major cultured fish species, but some pike, pike-perch and goldfish were also raised by the carp producers. Over the last few years carp raising in ponds has become more extensive, as it depends mainly on the cheaper corn feeding, rather than using the more expensive, imported combined feeds.

3.3.5 Main constraints and opportunities

Production

Aquaculture production in the Baltic states underwent substantial decrease after the disintegration of the Soviet Union. However, the drop in production (if compared to 1991) differs significantly depending on the country (Figure 34).

Figure 34. Aquaculture production in the Baltic states after the disintegration of the former USSR, percentage to 1991 (Source: FAO FishStat, 1999)



The further development patterns could be influenced by several groups of factors. Like in other states of the former USSR, the discontinuance of previously established connections and schemes has created certain difficulties for aquaculture sector. In the case of Baltic states these effects could be considered as relatively less potent and referred mainly to the contraction of the market for fresh and freshly processed fish. The total reorganization of the

aquaculture sector from the centrally planned to modern market economy may be reckoned as much serious obstacle for increase of aquaculture production. At the same time, overall direction of the development of national economies in the Baltic states towards balanced and constant economic growth with simultaneous ensuring of protection of environment should provide good prospective for aquaculture. The Baltic states succeeded to create attractive environment for entrepreneurial activities, which factor, together with constant growth of foreign investments, could also support the aquaculture development. It should be marked that fisheries sector is traditionally strong in the Baltic states, thus it will substantially influence further development of aquaculture production. Aquaculture will experience the pressure of competition because of relatively low prices for seafood, but on the other hand well-developed fish processing industry could provide services for aquaculture producers. The technical problems, which aquaculture in the Baltic states will have to overtake are connected with diagnostic and prophylactic of diseases, improvement of pond management, and protection of pond facilities from water birds.

Trade

Production of fisheries sector in the Baltic states has good export potential both to Eastern European and former USSR countries, while aquaculture production, with minor exceptions, is targeted for the domestic consumption. Problems of trade in aquaculture are mainly related to low prices for aquaculture products and small variety of cultured species. The significance of the adaptation of products to urban customer needs (fast food, etc) cannot be overestimated. Consumption of unprocessed fish is declining, products with a higher degree of processing and delicacies are expected to be in greater demand in future; differentiation in consumers needs and habits is also predicted. Such restructuring of the scope of aquaculture products is of particular importance in the view of future EU accession when custom barriers will be removed adding the pressure of imported aquaculture products.

Policy and support

Restructuring of administration system in the Baltic states which followed gaining of independence has the major impact on the support of aquaculture sector and development of the relevant policy. The key issues in this field are connected with the changes in ownership and legislation. In most cases the farms are privatised or considered for the privatisation. The lakes and some other water bodies are available for ranching fisheries through lease agreements. The regulatory legislation base, however, could undergo further development, which will influence the situation in aquaculture. In some cases strengthening of environmental regulations could substantially aggravate the position of fish farmers, if no respective support measures will be undertaken.

At present the structural funds, related to fisheries sector, are not directly targeted at the needs of aquaculture development. Business environment in the Baltic states, which is generally helpful, includes optional credit doctrine, but aquaculture could face difficulties in access to financing because of relatively long pay-back period. Significant work is to be done to involve local funds in support of fish farming which will also contribute to the rural development.

At the international level relations of Baltic states are developing very intensively with EU and Scandinavian countries, which opens additional opportunities for the support. The Baltic states participate actively in a number of international organisations, they are signatory for wide scope of international agreements. All three Baltic states are the members of FAO EASTFISH project. However, prevalence of fisheries, if compared with aquaculture sector, can be often observed in all these activities. To bring aquaculture into equal position with fisheries in the Baltic states, involved parties (farmers, businessmen, politicians, etc.) should form an influential lobby which could keep the decision makers aware about the needs and advantages of this sector.

3.4 Caucasian states

3.4.1 General characteristics

The Caucasus includes Armenia, Azerbaijan and Georgia, and is located in the south-west of the Former USSR territory, between the Black Sea and the Caspian Sea (Figure 35). Its total area is 186,100 km^2, or 0.8 % of the total area of the former USSR, is only slightly larger than that of the Baltic states. The region is located at the southern foothills of the Greater Caucasus mountain range, which is considered as the boundary between Europe and Asia. The highest peak in the region stands at about 5,000 m above sea level. Large areas around the Black Sea, the Caspian Sea, and the river deltas are lowlands.

The climate varies from warm, humid, subtropical in the north-east near the Black Sea coast, with average temperature in summer of 22°C and in winter of 5°C, to typical dry continental, with average summer temperatures up to 27°C. The average annual precipitation is 735 mm, varying from 200 mm in the Ararat valley in central Armenia to 1,700 mm in western Georgia. In the southern and eastern parts of this region irrigation is necessary, but drainage is also required in large areas to reduce irrigation-induced salinization. In the high rainfall region of western Georgia drainage is important.

The population was 16.7 million in 1996, 5.7% of the total population of the countries of the former USSR. With 90 inhabitants/km^2, the population density in this region is the highest of the former Soviet Union.

Figure 35: The Caucasian states of the former USSR

3.4.2 Natural resources and climate

With a total area of 29,800 km^2, Armenia is the smallest country of the former USSR. It is a landlocked country, located south of the Caucasus Mountains. Agriculture is greatly influenced by the topography, most of the cultivated land lying within an altitude range of 600-2,500 m. The cultivable area is estimated at almost 1.4 million ha, which is 47% of the

total area of the country. In 1995, the cultivated area was estimated at 408,147 ha, of which 346,413 ha were occupied by annual crops and 61,734 ha by permanent crops. Official figures on the progress of privatisation indicate that by the end of 1993 about 87% of the land had already been privatised. Individual private farms have become the dominant forms of farming. At the end of 1994, there were nearly 300,000 private farms with holdings averaging less than 2 ha. The total population is about 3.64 million (1996), of which 31% is rural. The average population density is 122 inhabitants/km^2. In 1994, agriculture employed 15% of the economically active population and its contribution to GDP was 41%.

Depending on altitude, Armenia enjoys a variety of climatic conditions. The Ararat valley is characterised by hot dry summers and cold dry winters, with a total annual precipitation of 200-300 mm. Precipitation increases towards the mountains, up to 1,000 mm on Mount Ararat. It is highest from April to June and lowest from December to February. The average precipitation for the country is estimated at 526 mm/year.

Armenia lies wholly within the Kür (Kura) River basin. The basins of the tributaries flowing directly to the Kür River cover less than 25% of the country in the north-east. Here the outflow to Georgia through the Debet River is estimated at about 0.890 km^3/year and the outflow to Azerbaijan at about 0.555 km^3/year. The Araks River, which forms the border between Turkey and Armenia and further downstream between Iran and Armenia, flows into Azerbaijan where it joins the Kür River about 150 km before its mouth at the Caspian Sea. The total outflow to Azerbaijan through the tributaries of the Araks River (Arpa, Vorotan, and Vokhchi) is estimated at about 1.791 km^3/year.

The RSWR originating inside the country are estimated at 6.271 km^3/year and the internal renewable groundwater resources at 4.200 km^3/year. The overlap between surface water and groundwater is estimated at 1.400 km^3/year. This results in 9.071 km^3 of total annual IRWR. The border flow of the Araks River between Turkey and Armenia is estimated at 1.929 km^3/year; that of the Akhuryan River, also between Turkey and Armenia, at 0.986 km^3/year. Half of these flows, or 1.458 km^3/year, is accounted for in Armenia's water balance. The total ARWR are thus estimated at 10.529 km^3/year, of which 7.729 km^3 surface water, 4.200 km^3 groundwater and 1.400 km^3 overlap.

The largest lake in Armenia is Lake Sevan, located in the east of the country. It lies at 1,925 m above sea level, which makes it a strategic source of energy and irrigation water. The level of the lake, originally with a surface area of about 1,414 km^2 and 58 km^3 of stored water, has fallen since the 1930's due to the increasing use for irrigation, hydropower, and domestic water supply. By 1972, its level had fallen by almost 19 m and its surface area had been reduced to 1,250 km^2. Since 1972, unforeseen changes in the lake ecology (loss of fish population), water quality (entrance of sewage) and microclimate (freezing of the lake in winter) have occurred. The government attempted to raise the water level of the lake again through reduced water take-off. The measures met with initial success and the lake rose about 1 m between 1978 and 1990. However, demands on the water increased more rapidly at the beginning of the 1990's, when electricity was again generated during the winter. This resulted in the 1 m gained being lost again. Work has begun on the construction of more pumping stations and balancing reservoirs to raise the level of the lake.

In 1995, the total capacity of constructed reservoirs was estimated at 1,155 million m^3, of which 1,108 million m^3 was stored in reservoirs behind dams with a capacity of over 5 million m^3 each. Most water is used for irrigation. About 145 million cubic meters is used for

municipal and industrial purposes. The largest reservoir is on the Akhuryan River, which forms the border with Turkey. It has a storage capacity of 525 million m^3, is shared with Turkey, and provides water for the irrigation of about 30,000 ha in Armenia. New dams, under construction or identified, could store an additional almost 1000 million m^3 of water.

In 1994, the total water withdrawal for agricultural, domestic and industrial purposes was 2 925 million m^3, of which 66% for irrigation purposes. Since the mid-1980's, there has been a decrease in the total water withdrawal, mainly due to a decrease in agricultural and industrial water withdrawal. Around 200 million m^3 of water was estimated to be necessary for fisheries, recreation, and power generation.

Azerbaijan, located on the south-eastern slopes of the Caucasus mountains, has a total area of 86,600 km^2. About 43% of the area of Azerbaijan are situated 1000 m above the sea level. The cultivable area is estimated at about 4.32 million ha, which is 50% of the total area of the country. Almost all the land is shared between the *sovkhoz* (state farms) and the *kolkhoz* (collective farms). In 1993, the cultivated area was 1.80 million ha, or 42% of the cultivable area, of which 1.54 million ha were annual crops and 0.26 million ha permanent crops. The total population of the country is 7.6 million (1996), of which 44% is rural. The average population density is 88 inhabitants/km^2. In 1996, agriculture employed 30% of the economically active population. Women make up about 36% of the rural labour force. The rural female labour force accounts for 48.5% of the total female labour force. The share of agriculture in GDP dropped from 39% in 1990 to 31% in 1995, due to the prevailing situation in the rural areas.

The climate in Azerbaijan is continental. Arid weather with average summer temperatures above 22°C is observed in the lowlands. In the mountain regions, temperatures can be below 0°C in winter and in Nakhchivan severe frost may occur. Humid tropical weather is observed in the coastal zone near the Caspian Sea, mainly in the Lenkoran lowlands in the south-east. The average precipitation is estimated at 541 mm/year.

Four major river basins can be distinguished, two of which are international: the basin of the Kura and Araks rivers; the Samur River basin; the coastal river basins in the northeast between the Samur and Kura river basins; and the coastal river basins in the Lankaran region in the southeast, south of the Kura River basin. The internally generated surface water resources are estimated at 5.955 km^3/year. The total RSWR, including incoming and bordering flows, are estimated at 28.115 km^3/year. For the Kura and Araks rivers, which are shared between Turkey, Georgia, Armenia, Iran, and Azerbaijan, discussions are underway on water sharing between the countries. The internal renewable groundwater resources are estimated at 6.51 km^3/year, of which 4.35 km^3/year are common to surface water. The groundwater resources are famed for their quality as mineral drinking water and are also used for medical purposes. The Nakhchivan Autonomous Republic is especially rich in mineral groundwater. The total number of artesian wells is estimated at about 7,000 with a total discharge of about 2.1 million m^3/year.

The total reservoir capacity of large dams (larger than 100 million m^3 each) is estimated at 21.35 km^3. The four largest reservoirs are the Minghechauir and Shamkir on the Kura River, the Nakhchivan on the Araks River and the Sarsangh on the Terter River. The total capacity of smaller reservoirs for irrigation purposes is estimated at 100 million m^3.

In 1995, the total water withdrawal for agricultural, domestic and industrial purposes was 16.53 km^3, of which over 70% for agricultural uses and almost 25% for industrial purposes. On the Apsheron peninsula, where the capital Baku is located, the share of industrial water withdrawal is 70%. In 1975, the total water withdrawal was 12.14 km^3, of which 77% for agricultural uses and 19% for industrial purposes.

Georgia, with a total area of 69 700 km², is located in the Caucasus region in the south-east of Europe. It declared its independence from the Soviet Union in April 1991. The country can be divided into three physiographic regions: mountains covering about 54% of the total area, highlands about 33%, and valleys some 13%. The northern boundary consists of the Caucasus Mountains, whose highest peak stands at some 5000 m above sea level. About 70% of the territory lies below 1 700 m above sea level. Cropping is possible throughout the country up to 2000 m. At higher elevations, only pastures are reported. Since the end of the Soviet period, a process of land privatisation has been undertaken. Of the total agricultural land of 3 million ha, some 0.7 million ha are now owned and cultivated by private farmers; 0.3 million ha have been leased to farmers for short-term (3-5 years), medium-term (25 years) or long-term (49 years) periods; while 2 million ha are still owned by the state. Except for some seed-breeding farms, most of the state-owned land, which is no longer managed by *sovkhoz* (state farms) or *kolkhoz* (collective farms), is not cultivated. The total cultivable area, which according to Georgian statistics is equal to the agricultural area, was estimated in 1996 at some 3 million ha, or 43% of the territory. About 2.2 million ha are forest, which, under the Forest Code of 1978, cannot be transformed into agricultural cropped areas. The cultivated land is estimated at 1.06 million ha, of which 29% of permanent crops and 71% of annual crops. The total population is estimated at 5.4 million (1996), of which 41% is rural. The average population density is 78 inhabitants/km², but varies from 25 inhabitants/km² in the mountainous areas to 250 inhabitants/km² in the valleys. Before independence, the annual population growth was about 1% per year, but since 1991, the growth has been negative. In 1995, the population was estimated to be 1% less than in 1991. Agriculture employs some 25% of the economically active population. Due to the shrinking of the industrial sector since 1990, the contribution of agriculture to GDP reached 38% in 1995, a share much higher than in the 1980s.

Georgia, with an average rainfall of 1,065 mm/year, can be divided into two climatic regions:

- West Georgia, where the climate is subtropical humid. The average precipitation is estimated to vary between 1 100 and 1 700 mm/year. Drainage of excess water is one of the main problems for agriculture in this part of the country. Average temperatures vary between 5°C in January and 22°C in July.

- East Georgia, where the climate is subtropical dry. The average precipitation varies between 500 and 1 100 mm/year. About 80% of the rainfall occur from March to October, while the longest dry period is about 50-60 days. Drought years are common. Hail occurs in spring and autumn. There is a need for irrigation in the areas where precipitation is less than 800 mm/year. Average temperatures vary between -1°C in January and 22°C in July.

The country can be divided into two main river basin groups: the Black Sea basin, in the west of the country and the Caspian Sea basin, in the east of the country.

The renewable groundwater resources are estimated at 17.23 km³/year, of which, however, 16 km³/year are considered to be drained by the surface water network (overlap). In 1990, the

total water abstraction was estimated at 3 km³/year from some 1 700 tube-wells. A further 7 km³/year could be abstracted in the future according to a recent assessment. Groundwater use was not greatly developed during the Soviet period, due to the emphasis on large-scale state-run surface irrigation schemes. The IRWR are estimated at 58.13 km³/year and the ARWR at 63.33 km³/year.

There are about 43 dams in Georgia, and their total reservoir capacity is estimated at about 3.2 km³. The largest dam, for hydropower, is the Inguri dam, with a reservoir capacity of 1.092 km³. In 1995, hydropower supplied 89% of electricity. For irrigation purposes, some 31 dams have been built, with a total reservoir capacity of 1 km³, of which 782 million m³ is active. The three largest irrigation reservoirs are all on the Iori River: the Sioni reservoir upstream (325 million m³), the Tbilisi reservoir (308 million m³) and the Dalimta reservoir downstream (180 million m³).

The total water withdrawal was estimated at 3.5 km³/year in 1990, less than in 1985 (4.6 km³). The main reason for this decrease has been the industrial decline since the end of the Soviet Union. This decline resulted in a 50% reduction in industrial water withdrawal between 1985 and 1990.

3.4.3 Fisheries and aquaculture in the economy

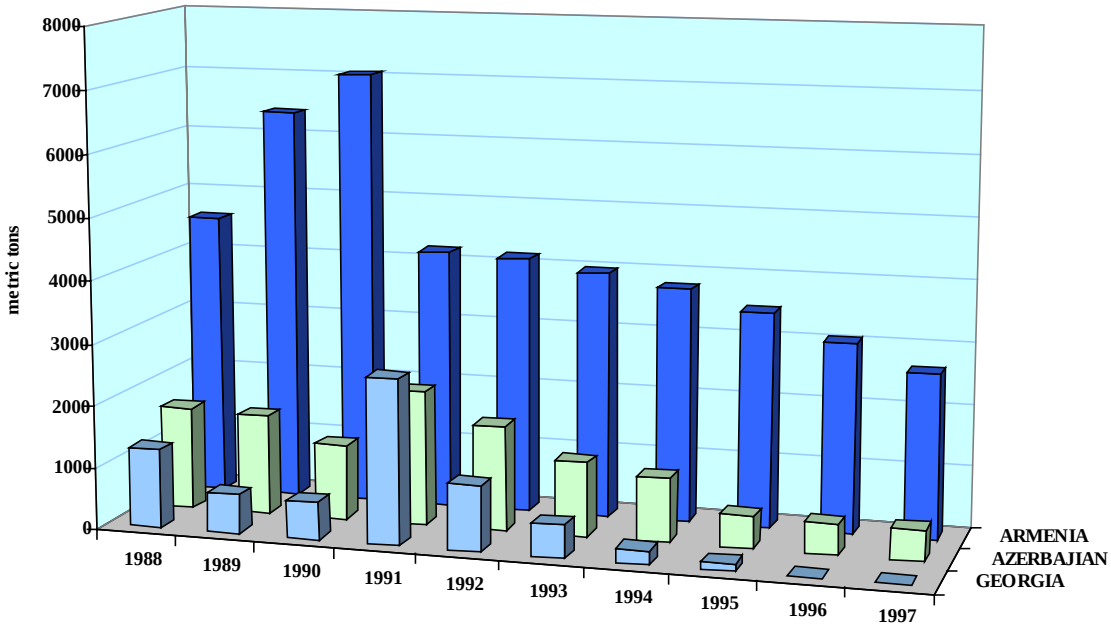
The role of fisheries and aquaculture varies within the former USSR region. The political and economical changes in the region resulted in dramatic drop in agriculture and aquaculture production, and sharp decrease in the supply of fisheries products as well. The supply of frozen marine products from Russia decreased considerably due to new borders, prices, regulations etc. Some countries like Azerbaijan, Georgia and Turkmenistan practically lost their fishing fleet or their access to seashore. Local wars in Armenia, Azerbaijan, Georgia, and Tajikistan, and partial return to feudalism in the Asian republics caused further difficulties in these countries. After 1990, food security became a major problem in most states of the Caucasian and Central Asian regions. Seven countries in these two regions of the former USSR have been classified as low-income food deficit (LIFD) countries: Armenia, Azerbaijan, Georgia in the Caucasian region, and Kyrghyzstan, Tajikistan, Turkmenistan, Uzbekistan in the Central Asian region, with a combined population of 54 million people. The annual per capita GDP in these countries is below 1,500 USD. Although many of these countries are experiencing growth in GDP, and various humanitarian aids also alleviate the food supply problems, fight against poverty will remain an important issue in these regions in the future.

Aquaculture doesn’t play significant role in the economy of these countries, but the contribution of aquaculture to poverty alleviation should get more attention in the future regarding the available water resources, especially in Uzbekistan and Georgia. Aquaculture production dropped to practically zero in Georgia, which is the third most populous country (5 million) among the seven LIFD countries. The value of the total annual renewable water resources is the sixth highest (63.3 km3) among the 15 countries of the former USSR, which could be considered as a good basis for future aquaculture development. Aquaculture could also be taken into account as a method for poverty alleviation in the two other Caucasian countries: Armenia and Azerbaijan.

3.4.4 Aquaculture production

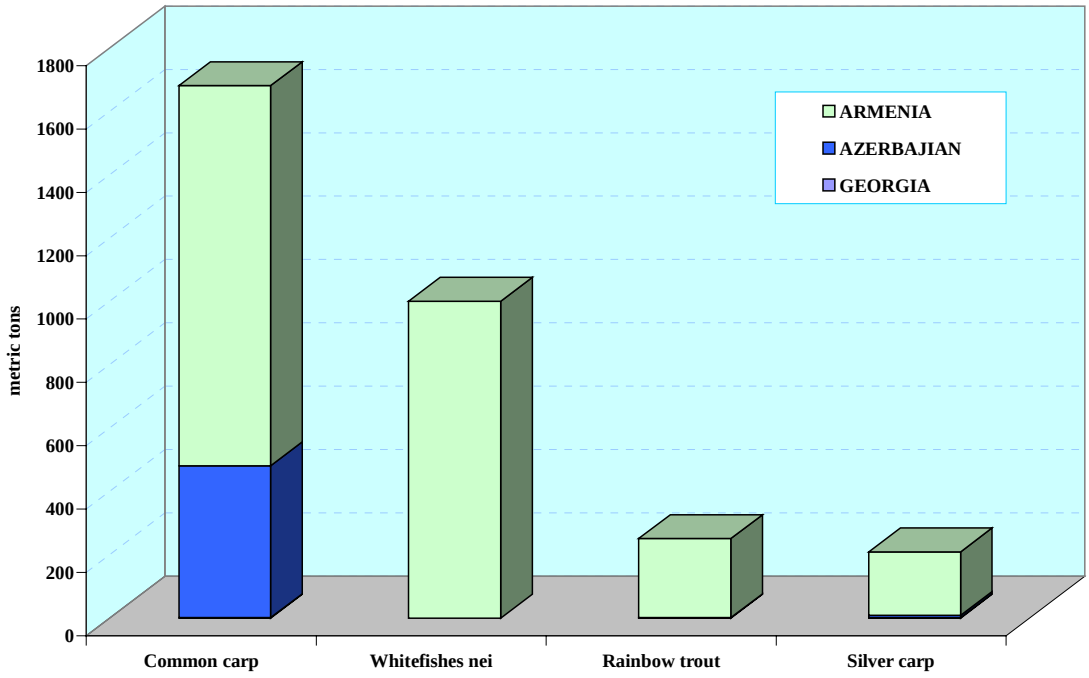
There has also been a dramatic decrease in fish production in the three countries of the Caucasian region after the disintegration of the Soviet Union, although the decline was the lowest in this region with 65%, comparing to Russia or the Central Asian region (77%). Aquaculture production in the Caucasian states (Figure 36) was reported to be only 3,138 tons in 1997, which mainly came from Armenia (2,650 t or 84%). However, the aquaculture production decreased significantly from 1991 to 1997 in Armenia as well (from 7,041 tons to 2,650 tons). In Azerbaijan, the highest production with 2,176 tons was observed in 1991, and it dropped to 488 tons by 1996. In Georgia, the reported aquaculture production dropped from 2,600 tons in 1991 to practically zero by 1997. In 1997, the whole Caucasian region contributed only 2.9% to the similarly decreased total aquaculture production of the whole former USSR region. Armenia, which is the smallest country in the former USSR region, has the highest specific aquaculture production per area, population, and renewable water resources.

Figure 36. Aquaculture production in the Caucasian states of the former USSR
(Source: FAO FishStat, 1999)



Main cultivated species in 1997 (Figure 37) were cyprinids, which mostly produced in small private farms in Armenia, and in sovkhoz (state farms) and kolkhoz (collective farms) in Azerbaijan. Rainbow trout was also cultured in lower quantities in Armenia and Georgia. The collapse of the state-owned farms, slow restructuring process, and continued military actions were the main reasons for the practical cease of the aquaculture production in Georgia. All of the three countries of the region are classified as low-income food deficit countries, which face serious difficulties especially in the North Caucasus. There is a need for humanitarian aid in these countries, but low input aquaculture could also contribute to the improvement of the rural life.

Figure 37. Aquaculture production by species in the Caucasian states in 1997
(Source: FAO FishStat, 1999)



3.4.5 Main constraints and opportunities

Production

Production of aquaculture in the Caucasian states of the former USSR dropped significantly during the recent years. The main reasons are the same, as in other states of the former Soviet Union: restructuring of the economy, disruption of cooperative connections, unsettled property rights, instability, etc. It should be noted, that practically all these impediments are not connected to aquaculture sector itself, and thus not indicate its poor developmental potential. The achievements in aquaculture technology in the region are underexploited at present but could serve as the basis for acceleration of future development. Trout culture at small and medium size farms could be substantially extended, especially in mountain areas, which at the same time will contribute to the rural development. There is a good prospective for mariculture practices in several coastal locations, however eutrophication of the Black Sea and pollution of the Caspian impose definite restrictions. Reservoir and lake ranching also have potential to expand.

Trade

Marketing potential for aquaculture products in the Caucasian states of the former USSR can be estimated as relatively high. At the same time, consumer preferences differ significantly in urban and rural areas, coastal and mountain zones, ethnic sub-regions, etc. Fish from aquaculture is sold mainly fresh (often alive) and sometimes smocked. With the development of processing in aquaculture sector the production can be marketed also in frozen and canned forms, because at present seafood in such forms is welcomed by the customers. In the recent

years, fresh-frozen and boiled-frozen mussels became popular, especially in recreational areas. Currently the Caucasian states are importing most part of marketed fish products, which is in general helpful for wider market penetration of domestic aquaculture production.

Policy and support

In the Caucasian states of the former USSR the reorganisation of the economical system was substantially complicated by a number of issues. One of the serious difficulties is related to multifaceted character of the economy of mountain areas, where the changes are more painful and development is usually slower. In addition, movement towards self-governing in one of the Georgian provinces and territorial dispute between Armenia and Azerbaijan grew into military conflicts. Among the issues of policy, which influence aquaculture development, substantial progress was attained mainly in privatisation, while regulatory framework (e.g. related to water use, land lease, etc.) still needs to be improved. Overall economical difficulties are not allowing the governments to establish credit doctrine, optional for the sectors with relatively long production cycle, such as aquaculture. Average credit availability is also low in these countries, however the lines established within programs of World Bank and EBRD could serve as supportive tools for aquaculture development. National financial institutions possess very limited experience in substantiation of aquaculture crediting, thus participation in the international programmes, targeted at aquaculture development, is of high significance for this region. Georgia and Armenia are the members of FAO EASTFISH project.

3.5 Central Asian states

3.5.1 General characteristics

The Central Asian states include Kazakhstan, Kyrgyzstan, Tajikistan, Turkmenistan, and Uzbekistan. They are located at the central southern part of the former USSR territory, bordering Iran, Afghanistan, and China (Figure 38). Kazakhstan and Turkmenistan border east part of the Caspian Sea, Aral Sea is divided between Kazakhstan and Uzbekistan.

Figure 38: The Central Asian states of the former USSR

The total area of the five Central Asian countries is almost 4 million km^2, which represents almost 18% of the area of the former USSR. Kazakhstan alone covers 68% of this area. The relief in this region is extremely varied. In the east are the Tien Shan and Pamir mountain ranges. The highest mountain of the former USSR, Qullai (Peak of Communism) at 7 495 m above sea level, is located in the northern Pamir in Tajikistan. Much of the mountain region is permanently covered with ice and snow and there are many glaciers. Mountain ranges in the south of the region include the earthquake prone Kopetdag range along the border with Afghanistan. In the north-east of the region in Kyrgyzstan lies the second largest crater lake in the world, the Issyk-Kul. On the border between Kyrgyzstan, Tajikistan, and Uzbekistan the Fergana valley is located, which is the major agricultural area in this region. In the south-west lies the Kara-Kum or Black Sand desert, which is one of the largest sand deserts in the world and covers over 80% of the territory of Turkmenistan. Another large desert, the Kyzyl-Kum or Red Sand desert, extends over Kazakhstan and the north of Uzbekistan. The west of the region is dominated by the depressions of the Caspian Sea. The Aral Sea, in the central western part, is located on the border between Kazakhstan and Uzbekistan. It is known to have become one of the world's most serious environmental disaster areas, because the two main rivers which flowed into the Aral Sea have been diverted for irrigation, drying up and leaving behind a harmful layer of chemical pesticides and natural salts.

The total population was almost 54.6 million in 1996, 18.6% of the total population of the countries of the former USSR. The population density in this region was 14 inhabitants/km^2,

with a minimum of 6 inhabitants/km^2 in Kazakhstan, which is less than half the population density of the former USSR.

According to the classification of economies, performed by the World Bank, Kazakhstan and Uzbekistan referred to the Lower-Middle Income Economies, while Kyrgyzstan, Tajikistan, and Turkmenistan are considered as Low-Income Economies. The GDP per capita, according to 1998 estimations, is the highest in Kazakhstan (US$ 3,100) and the lowest in Tajikistan (US$ 990). The GDP composition by sectors is also different. Agriculture forms form 11.5% in Kazakhstan up to 47% in Kyrgyzstan, industry provides from 12% (Kyrgyzstan) to 50% (Turkmenistan).

3.5.2 Natural resources and climate

The climate in the region is continental, but varies considerably according to altitude. Average winter temperatures vary between -3°C and -20°C, but can fall below -45°C in the mountain regions in Tajikistan. Average summer temperatures vary between 19°C and 32°C, but often reach 50°C in the south-eastern Kara-Kum in Turkmenistan.

The average annual precipitation in this region is 338 mm, varying from less than 70 mm in the plains and deserts to 2 400 mm in the mountains of central Tajikistan. One half of the total irrigated area of the former USSR is located in the Central Asia. The two major land quality problems related to irrigation in the region are the interrelated issues of salinity and waterlogging caused by high groundwater levels. This makes drainage important in this region.

In Kazakhstan four major hydrologic regions can be distinguished, depending on the final destination of water: the Arctic Ocean through the Ob River, the Caspian Sea, the Aral Sea and internal lakes, depressions or deserts. The total IRSWR of Kazakhstan are thus estimated at 69.32 km³/year, while the total incoming flow from the neighbouring countries is estimated at 34.19 km³/year. The outflow to the Russian Federation is estimated at 38.8 km³/year, while the total outflow to the Aral and Caspian seas is estimated at 1.5 and 5 km³/year respectively. The main rivers at the territory of Kazakhstan are Syr Darya, Chu, Talas, and Assa. The Caspian Sea is the largest lake in the world. Its level is presently subject to important variations. In the last decade, the Caspian Sea level has risen by about 2 m, which has resulted in waterlogging in towns and villages, and the loss of agricultural land. On the other hand, the Aral Sea has been affected by a dramatic decrease in its level and volume, mainly due to irrigation development upstream. There are more than 17 000 natural lakes in Kazakhstan, with total area of about 45 000 km² and total volume of water estimated at about 190 km³. Salinity varies from 0.12 g/litre in east Kazakhstan to 2.7 g/litre in the central part of the country. More than 4 000 lakes are inventoried as saline. The largest lakes are: Lake Balkhash, with an area of 18 000 km² and a volume of 112 km³; Lake Zaisan, with an area of about 5 500 km²; and Lake Tengiz, with an area of 1 590 km². More than 180 water reservoirs have been constructed in Kazakhstan, for a total capacity of 88.75 km³. There are 19 large ones, with a capacity higher than 0.1 km³ each, accounting for 95% of the total capacity. Most of them are multipurpose: hydropower production, irrigation, and flood control.

Two hydrological zones can be distinguished in Kyrgyzstan: the flow generation zone (mountains), covering 171 800 km^2, or 87% of the territory; and the flow dissipation zone of 26 700 km^2, which is 13% of the territory. Most of the rivers are fed by glaciers and/or snow

melt. Peak flows occur from April to July, with 80-90% of the flow in the period of about 120-180 days extending to August or September. There are six main river basin groups in the country. No rivers flow into the Kyrgyz Republic. The river basins are, from the largest to the smallest: Syr Darya River basin, Chu, Talas and Assa river basin, south-eastern river basins (main rivers are the Aksay, Sary Dzhaz, and Kek Suu), Lake Issyk-Kul interior basin, Amu Darya River basin, and Lake Balkhash basin. The average natural surface water flow is estimated at 44.05 km^3/year, all internally produced. The total number of natural lakes in the Kyrgyz Republic is 1 923, with a total surface area of 6 800 km^2. The largest lake is Lake Issyk-Kul with a total area of 6 236 km^2. Due to the glacier and snow origin of most of the rivers, low and unreliable flows are often the rule in the months of August and September, which correspond to the latter part of the growing season. Regulation of these flows is thus needed to ensure that adequate water supplies are available over the whole cropping period. In 1995, the total capacity of reservoirs was estimated at 23.5 km^3. There were 18 reservoirs: 6 in the Chu River basin, with a total capacity of 0.6 km^3; 3 in the Talas River basin, with a total capacity of 0.6 km^3; and 9 in the Syr Darya River basin, with a total capacity of 22.3 km^3. The Toktogul dam, with a reservoir capacity of 19.5 km^3, is situated on the Naryn River, a northern tributary of the Syr Darya.

Tajikistan can be divided into four major river basins. The Syr Darya basin in the north-west of the country forms part of the total Syr Darya basin, about 78% of the flow of the Syr Darya River is generated on the territory of the Kyrgyz Republic. In the Amu Darya basin 82.5% of the flow of the Amu Darya River is generated on the territory of Tajikistan by the Vakhsh, Pyandzh and Kafirnigan rivers. The Zeravshan basin is formed by Zeravshan River, rising in Tajikistan, was once the largest tributary of the Amu Darya River. At present its flow is almost fully used, mainly for irrigation. In the extreme north-east of the country, a small area drains towards China. The total IRSWR of Tajikistan are estimated at 63.3 km^3/year. There are 1 300 natural lakes in Tajikistan with a total water surface area of 705 km^2 and a total capacity of about 50 km^3. About 78% of the lakes are situated in the mountain zone above 3 500 m above sea level. The largest lake in the country is Lake Karakul in the north-east at an altitude of 3 914 m, with a surface area of 380 km^2 and a capacity of 26.5 km^3. In 1994, there were 19 dams in Tajikistan: 5 in the Syr Darya River basin and 14 in the Amu Darya River basin (7 on the Vakhsh River, 4 on the Pyandzh River and 3 on the Kafirnigan River). Their total reservoir capacity is about 29 km^3 and the reservoir area 934 km^2. There are nine large reservoirs (capacity more than 500 million m^3 each) with a total capacity of 25.34 km^3 and an area of 690 km^2. The largest reservoirs are the Nurek on the Vakhsh River (10.5 km^3), the Kayrakkum on the Syr Darya River (4.16 km^3), and the Lower Kafirnigan on the Kafirnigan River (0.9 km^3). The main purposes of the reservoirs are hydropower production and irrigation.

The river runoff originating in Turkmenistan is estimated at 1.0 km^3/year. Several rivers are found in Turkmenistan, most of them flowing into the country from its neighbours. The part of the Amu Darya flow allocated to Turkmenistan is 50% of the actual river flow at the Kerki gauging station, the other 50% being allocated to Uzbekistan. The largest and most important waterway in Turkmenistan is the Kara Kum canal. This canal was constructed in the 1950s and is, with its some 1 300 km, the longest canal in the world. The canal capacity is estimated at 630 m^3/s. Its inlet at the Amu Darya River is located just after the river enters Turkmenistan from Uzbekistan. It brings water to Ashkhabad and to the oases in the south. There are 18 artificial reservoirs with a total capacity of about 2.89 km^3: 8 on the Murghab River, 3 on the Tedzhen River, 3 on the Atrek River and 4 on the Kara Kum canal. The largest reservoir is the Hauz-Khan reservoir on the Kara Kum canal with a total capacity of 0.875 km^3. All the

reservoirs were designed and constructed mainly for irrigation purposes, and are affected by heavy siltation. The total IRWR are thus estimated at 1.36 km³/year, and the total ARWR at 24.72 km³/year.

Two river basins are found in Uzbekistan. These basins form the Aral Sea basin: the Amu Darya basin in the south, covering 86.5% of Uzbekistan, and the Syr Darya basin in the north, covering 13.5% of the territory. The ARWR (together with groundwater resources) can be estimated at 50.41 km³/year. The collector-drainage water outflow has led to the creation of artificial lakes in natural depressions. The largest lakes are: Lake Aydarkul, in the Arnasay depression in the middle reach of Syr Darya, storing about 30 km^3 in 1995; the Sarykamish and Sudochie lakes, both located in the lower reach of the Amu Darya, storing 8 and 2 km^3 respectively. Several lakes have also been formed in the central part of the country in the Amu Darya basin, the largest being Lake Parsankul storing about 2 km^3, close to the Zeravshan River. There are 50 reservoirs in Uzbekistan with a total capacity of about 19 km^3; 21 of them with a total capacity of 5 km^3 in the Syr Darya basin, and 29 with a total capacity of 14 km^3 in the Amu Darya basin. The largest reservoirs are multipurpose dams, used for irrigation, flood control, and hydropower production. In the Syr Darya basin, the largest reservoirs are the Charvak reservoir, with a capacity of 1.99 km^3, on the Chirchik River near the capital Tashkent, and the Andijan reservoir, with a capacity of 1.9 km^3, on the Karadarya River in the Fergana valley. In the Amu Darya basin, the largest reservoir is the Tuaymuyun, in the Khorezm vilayat, with a storage capacity of 7.8 km^3, consisting of four separate reservoirs.

The sharing of water resources among the five Central Asian states of the former USSR is of primary importance for the region. Scarcity of water in the central part of the region seriously affects aquaculture development because of competition with irrigation for agriculture. The possibilities of the development of integrated aquaculture is also doubtful in connection with high level of chemical pollution of water, used for irrigation.

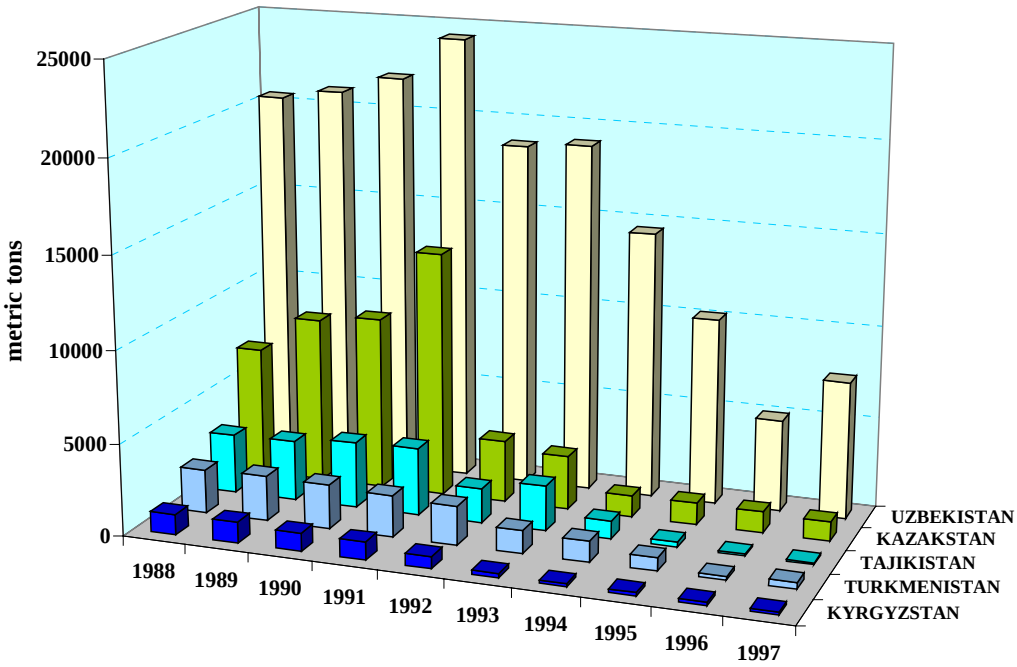
3.5.3 Fisheries and aquaculture in the economy

The involvement of fisheries and aquaculture in the economy of Central Asian states of the former USSR differs from country to country, It has experienced substantial changes during the recent period. Sea fishery in Aral Sea has been stopped before the disintegration of the USSR. Among the five considered countries, Kazakhstan was previously most active in marine fishery in the Caspian Sea. Despite of the difficulties of restructuring period, fisheries industry of Kazakhstan continues to develop. Tangible foreign investment was allocated in Atyrau (Gur'ev) - the main fish port of this country. Turkmenistan is also undertaking efforts to expand fishery industry, based mainly on catches of mackerel from the Caspian. Kazakhstan and Turkmenistan possess regular quota in sturgeon catches in the Caspian. Inland fishery is important in Kazakhstan, Kyrgyzstan, and Turkmenistan, and has local significance in Tajikistan and Uzbekistan. Aquaculture and culture-based fisheries have old traditions in all Central Asian states of the former USSR, but current problems of water deficit and environment pollution seriously endanger the prospective of the sector.

3.5.4 Aquaculture production

Aquaculture production in Central Asian states significantly decreased after the disintegration of the USSR (Figure 39).

Figure 39. Aquaculture production in the Central Asian states of the former USSR (Source: FAO FishStat, 1999)

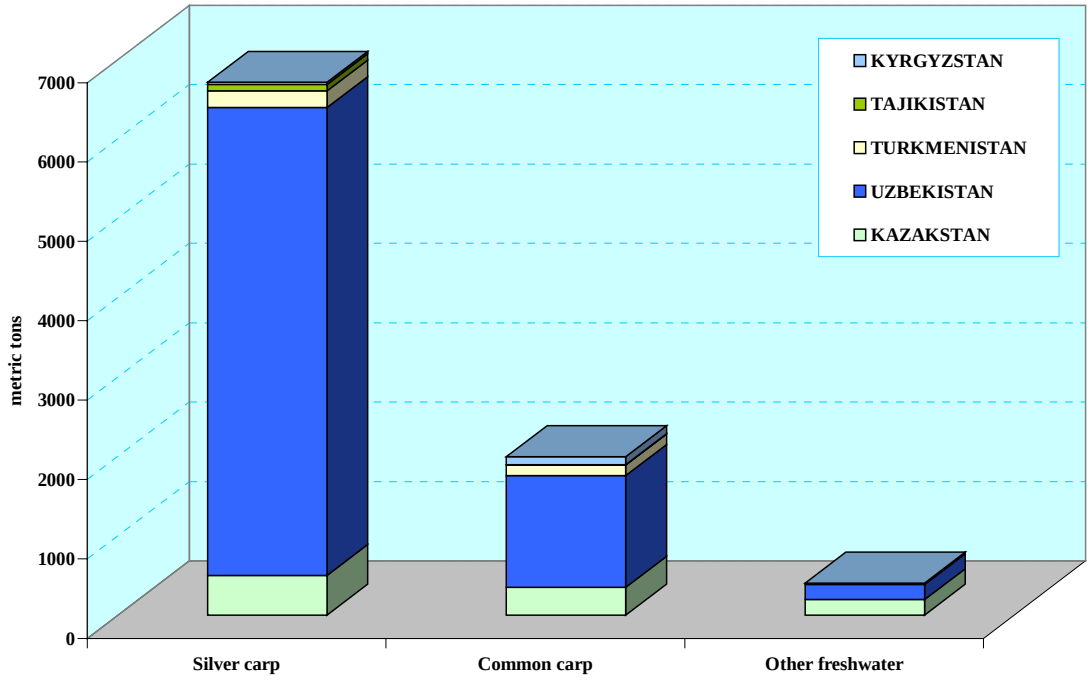


The drop in production was most sharp in Kazakhstan, where the output of aquaculture in 1992 equals only 25.3% of the 1991 figure. In comparison with 1991, aquaculture production in 1997 came to 30.8% in Uzbekistan, 15.4% in Kyrgyzstan, 15.2% in Turkmenistan, 7.8% in Kazakhstan, and only 2.3% in Tajikistan. During 1995-1996, the decrease was slowed in Kazakhstan, Kyrgyzstan, and Tajikistan. In 1997 certain increase of aquaculture production was observed in Uzbekistan and Turkmenistan.

The main contributor to aquaculture output of the whole region is Uzbekistan, which in 1997 has provided about 82% of the regional production. The inputs of Kazakhstan, Turkmenistan, Kyrgyzstan, and Tajikistan were 11%, 4%, 2%, and 1%, correspondingly.

From the point of view of the volume of production, the species composition in the aquaculture of the Central Asian states of the former USSR is comparatively poor (Figure 40). Two cyprinid species, silver carp and common carp, give 74% and 22% of the total output, respectively. The remaining 4% are composed by different sets of species depending on the country. In Kazakhstan these are pike-perch, bream, snakeheads, asp, catfish, and grass carp. Grass carp is also reared in Kyrgyzstan and Tajikistan. Crusian carp is an additional species in aquaculture of Uzbekistan. Several trout and whitefish species are farmed in mountain areas of Kyrgyzstan. Numerous local species do not give tangible input in the production figures, but aquaculture is supporting their populations mainly for recreational fishery.

Figure 40. Aquaculture production by species in the Central Asian states of the former USSR in 1997 (Source: FAO FishStat, 1999)



3.5.5 Main constraints and opportunities

Production

In addition to the necessary restructuring after the disintegration of the USSR and re-orientation to the market economy, each Central Asian state has its specific problems, which could influence further development of aquaculture sector. Most serious limitations could be connected with deficit of fresh water, pollution, and international regulation of the water use in the area. The problem of delivery of fresh aquaculture production is actual for all region, but it will require more efforts from Kazakhstan with its vast territory and uneven distribution of population. Difficult access to the facilities in mountain areas is adding to this problem. Coastal mariculture could be developed in Kazakhstan and Turkmenistan along the Caspian shore, however its fate is strongly dependent upon the expansion of oil industry and its environmental impact.

Trade

Low income of significant part of the population is restraining quick growth of trade of aquaculture products, especially of value-added. At the same time, during the soviet period fish products from sea catches were the main source of dietary protein, which inevitably changed the preferences of customers. Trade patterns would be substantially influenced by the development of fish processing industry, which is presently at very low level. In connection with hot climate and considerable distances, significant part of aquaculture production can be distributed in canned form.

Policy and support

The privatisation process, which could change the structure, ownership, and management of aquaculture industry in the Central Asian states of the former USSR, has passes only the first stages. Immediate financial needs of the national economy in these countries make difficult the implementation of support programs for aquaculture development. However, input of the governmental structures can be realised via the measures, which contribute to the attraction of foreign investment. Alongside with the stabilisation of the economy, establishment of respective legislative environment would support entrepreneurial activity in the Central Asian states thus benefiting also aquaculture sector. Fish farming has long tradition in the region, some farming techniques, which are now in wide use, were developed there. At the same time, new economic and social conditions in this countries and international milieu require new approaches and solutions. Advantageous possibilities for gaining of necessary experience and familiarisation with successful practices are provided by participation in the international programs, such as FAO-EASTFISH project.

4. Synthesis

4.1 Analysis of demand, production, and consumption trends

- **Analysis and comparison of trends in fish consumption**

Based on data, which came from various sources, it seems that there has been an unfortunate decrease in fish consumption in the past years in the former USSR countries. The fish consumption was the highest in the middle eighties (around 30 kg/cap/year), and shows a gradual decrease since that time. The five year average for the period of 1991-1995 was 33 % lower than that of for the period between 1986-1990. Meat consumption also decreased in this period, however it was only 8 % if the five year averages for the periods of 1991-1995 and 1986-1990 are compared. Based on recent statistical data, it seems that the negative tendency has been stopped, and some increase in fish consumption could be observed in the past three years. According to FAO statistics the average fish consumption (both freshwater and marine species and products) in the fifteen countries of the former USSR was 13.25 kg/cap/year. Although fish consumption shows great variety in different countries from 0.1 kg/cap/year in Tajikistan to 36.7 kg/cap/year in Estonia, it is still below the world average (15.9 kg/cap/year). The four main fish consuming countries are Estonia, Lithuania, Russia and Latvia, with an average of about 23,2 kg/cap/year, while the average fish consumption in the other eleven countries is only 3,1 kg/cap/year. The consumption of freshwater species is especially low, 2,0 kg/cap/year as an average of the fifteen countries. The main freshwater fish consuming countries are Russia (3.1 kg/cap/year), Estonia (2.7 kg/cap/year), Kazakhstan (and Turkmenistan (2.1 kg/cap/year). The average freshwater fish consumption in the other countries is only 0,65 kg/cap/year. The slight increase in fish consumption will likely to continue in the coming years. It is assumed that the actual fish consumption is higher than in the statistics, but that amount of fish, which is consumed directly by small scale producers, or sold in the localities, is not always appearing in the statistics. Based on the availability of the aquatic resources in many countries, the traditions in fish production and consumption, it can be possibly stated, that fish production and consumption will increase parallel with the consolidation of the overall economic situation in the region. It is expected that the consumption of the low and medium value species and products will increase first, but there is also a scope for the increase of the consumption of quality or premium fish products on longer term.

- **Aquaculture as a source of food and contribution of aquaculture for human nutrition**

Fish has always been a major source of animal protein in the former USSR, however, the consumption is varying significantly from country to country as described above. The majority of food fish supply is originated from marine catch, which also decreased dramatically in the past period. Seven countries of the former USSR (Armenia, Azerbaijan, Georgia Kyrghyzstan, Tajikistan, Turkmenistan, and Uzbekistan) have been classified as low income food deficit countries. There has been dramatic decrease in fish production in these countries, especially in Georgia, where fish production dropped from 2600 tons in 1991 to practically zero by 1997. It is not only a coincidence that the fish production per capita in five of these countries (Azerbaijan, Georgia Kyrghyzstan, Tajikistan and Turkmenistan) are the lowest in the region of the former USSR, not exceeding 40 grams per person per year as an average. Significant freshwater and marine aquatic resources, available for fish production

have not been exploited or remained greatly underused. The development of aquaculture could play an important role in the improvement of nutrition and rural life in these countries. Although the ratio of the rural population is the highest in these LIFD countries (around 50 % as an average) there are also large rural areas in other countries (Moldova, Ukraine, Belarus and Russia), where aquaculture could play a more important role in the improvement of rural life in the future.

- **Analysis of regional production statistics**

Total aquaculture production was amounted to 109,863 tons in volume and 278,6 million USD in value in 1997. The contribution of this region to world total was 0.3% and 0.6% respectively. 92% of the total production is originated from freshwater environment, and the main species is common carp (84% of the total production). The two dominant aquaculture production countries are the Russian Federation and Ukraine with a share from the total production of 54% and 27% respectively. The aquaculture production in the countries of the former USSR is well below the peak production of 420,000 tons in 1990, when the contribution of this region to global aquaculture production was 2.6% in volume, and 3.2% in value. There was a dramatic decrease in aquaculture production in this region after the collapse of the Soviet Union, and the break up of the state structure. The total aquaculture production in 1997 was only 26 % of the production in 1990. The extreme present situation should not be considered as appropriate basis for insightful quantitative analysis. Officially reported aquaculture production in Georgia for example dropped to practically zero, but it is extremely low in some other countries as well (e.g. 85 tons in Tajikistan, or 260 t in Estonia). Such amount of fish could be easily produced by one single farm. Even if there are great uncertainties in data supply on aquaculture production in this region, and can well be assumed that the actual production is higher than the reported one, the considerable drop in aquaculture production is evident.

If the situation of aquaculture production is compared between the EU- and the former USSR countries, it could be seen that the specific aquaculture production per capita is about 3 kg/capita in the EU, while it is only around 0.4 kg/capita in the countries of the former USSR. A major difference in the production structure between the EU and the former USSR countries is, that about 75% of the production comes from marine environment in EU countries, while only 8% in the former USSR region. This may indicate the potential in the development of marine aquaculture in the former USSR region, although conditions are somehow less favourable here. If the specific freshwater aquaculture production per capita is compared between the two regions, its value is 0.73 kg/capita in the EU countries, and 0.34 in the former USSR region as an average. This difference is definitely less than that of total aquaculture, however, tremendous freshwater resources are available in the territory of the former USSR, which would allow much higher production here than in the populous Western European region. The value of the total annual renewable freshwater resources (ARFR) is about 5306 cubic km in the territory of the former USSR, while it is only 1395 cubic km in the EU countries. If specific freshwater aquaculture production is calculated on the basis of the ARFR, it amounts 21 t/km3 in the former USSR countries and 195 t/km3 in the EU countries in 1997, which almost ten times higher. This also indicates the potential in freshwater aquaculture development in the countries of the former USSR, even if it is assumed, that considerable freshwater resources are located in the permafrost area.

Aquaculture production is only around 2% of the total production of capture fisheries in the former USSR countries, which is well below the world average, and this fact also indicates

the future potential of aquaculture development in this region. Although the share of aquaculture from total aquatic production shows a gradual increase globally year by year, there has been an opposite tendency in this region in recent years. The contribution of aquaculture to the total aquatic production in the former USSR countries was 4.2% in 1993, which decreased to 2.2% in 1997. Although fisheries production also decreased after 1990 in this region, it was not as dramatic as in aquaculture. The decrease in fisheries production between 1992 and 1997 was about 17%, which was 51% in aquaculture.

- **Comparison of regional production trends**

The 15 countries of the former USSR could be grouped in five regions, based primarily on geographic conditions and on hydro-climatic homogeneity, although the Russian Federation is, due to its size, subject to a wide variation of geographic and hydro-climatic conditions. The regions referred to as: *Russian Federation*; *Baltic States*: Estonia, Latvia and Lithuania;; *Eastern Europe*: Belarus, Moldova, Ukraine; *Caucasus*: Armenia, Azerbaijan, Georgia; and. *Central Asia*: Kazakhstan, Kyrghyzstan, Tajikistan, Turkmenistan, and Uzbekistan. The aquaculture production by sub-regions was the following in 1997: Russian Federation (54.4%), "Eastern European" states (32.5%), Central-Asian states (8.3%), Caucasian states (2.9%) and Baltic states (1.9%).

The share of aquaculture production by regions shows a close connection with the share of the population by the specific regions from the total population of the former USSR region, which is 50.5%, 22.5%, 2.6%, 5.6% and 18.8% respectively. The connection between the aquaculture production and the size of the population is more pronounced than that of between aquaculture production and the annual internal renewable water resources.

The tendency in dramatic decline of aquaculture production is very similar in all regions. The drop in aquaculture production between 1990 and 1997 was 73 percent in the former USSR region as an average. It was highest in Russia and Central Asia (77%) and lowest in the Caucasian states (65%), although the aquaculture production of the Caucasian states Georgia fell from 607 t to zero by 1997. Some recovery in aquaculture production could be observed since 1996 in Russia and Uzbekistan, where aquaculture production was higher in 1997 with 29 % and 38% respectively. The increase in these two countries resulted in 5% increase in aquaculture production for the whole former USSR region. This development also indicates that aquaculture industry is over the shock and will gradually increase production depending on the changing in the economic environment. That can be foreseen however, that the full recovery of the aquaculture industry, when the production will reach the level of the late eighties, will take a long time.

- **Population growth (regional and global) and projection/s up to 2020**

The total population of the former USSR states was 291,659,000 in 1998. 50.5% of the population leaves in the Russian Federation, 22.5% in the Eastern European states, 18.8% in the Central Asian states, 5.6% in the Caucasian states, and 2.6% in the Baltic states. Prefigure of population growth in the former USSR countries seems to reflect the global patterns. Although the population increase for the whole region is expected to be about 1 percent (294,950,000 by the year 2020), there are significant differences by regions. The most manifested rise of population can be expected in the Central Asian states, where population may increase by 28% in the period of 1998 and 2020, reaching 70.2 million. The second highest population increase is expected in the Caucasian states by 10% for the same period.

The UN projection for Baltic states indicates 14 % decrease in the population by 2020. In previous decade Russia possessed intermediate position but the recent data show evident turn toward the slowing of population augmentation. According to UN projection, the population in the Russian Federation will be about 5 % less than in 1998. A decline of about 4% in the population of the Eastern European states can also be expected.

- **Quantitative or semi-quantitative (as possible) projection of aquaculture demand, production, and per kaput consumption**

The statistical data shows that, the share of marine species and products is 85 percent of the total fish consumption in the countries of the former USSR. The vast majority of the consumed marine species and products are from capture fisheries, taking into account that marine aquaculture amounts only 8 percent of the total aquaculture production in this region. The fish consumption is the highest in the three Baltic countries and in the Russian Federation as described in previous chapters. In Azerbaijan and Turkmenistan the consumption of marine fish and products is only 0.1 kg/cap/year, while the consumption of freshwater fish and products is 1.2 and 2.1 kg/cap/year respectively. There is a similar situation in Kazakhstan, where consumption of marine species and products is 0.9 kg/cap/year, while that of freshwater fish and products is 2.1 kg/cap/year. These data suggest, that freshwater aquaculture will play an important role in the future to satisfy the demand of the population.

The peak consumption of fishes and fisheries products was around 30 kg/cap/year in the former USSR in 1986. It took 25 years to reach this level, from about 14 kg/cap/year in 1961, which represents an increasing rate of 0.64 kg/cap/year or 4.56 %/year. This increase was well over the world average, which was 1.8 %/year over this period. There has been a significant development in aquaculture production during this period in the Soviet Union, which enjoyed considerable amount of state support directly through subsides and indirectly through research and development. Fish consumption started to decline even before the disintegration of the Soviet Union since 1987. Then the average fish consumption reached a low level of 13.25 kg/cap/year in 1997, which is less than the 1961 average. No doubt that fish consumption will increase in the future, as some signs already indicate that, however, it is difficult and risky to estimate the rate of increase taking into account the new and complex situation in the region. If fish consumption will increase with an average rate of 4% until 2020 (slower at the beginning and faster in a later stage), then the average consumption of aquaculture species and products will be around 25.5 kg/cap/year in 2020, which is still lower than the peak consumption in 1986. The share of aquacultured species in the total consumption is around 10-15 percent presently, which may change in the future for the favour of aquacultured products and could increase up to 20 % until 2020. Thus, the average consumption of aquacultured species and products could reach about 5 kg/cap/year by 2020. Calculating with a total population of 295.4 million in the former USSR countries, the total demand for aquaculture species and products could be 1.48 million tons in this region. This simplified calculation doesn’t take into account the expected regional differences. For example, there will be a higher rate of population increase in Central Asia, where fish consumption is lower than the average. Even if the demand will not reach that volume of around 1.5 million tons by 2020, there is a significant scope for aquaculture development in order to satisfy the demand of the population with locally produced fish and products, not to mention export possibilities. The 1997 aquaculture production in the countries of the former USSR (around 110,000 t) is less than one tenth of the estimated consumption of aquaculture products in these countries in the year 2020.

- **Aquaculture as method of poverty alleviation**

The role of aquaculture varies within the region. The political and economical changes in the region resulted in dramatic drop in agriculture and aquaculture production, and sharp decrease in the supply of fisheries products as well. The supply of frozen marine products from Russia decreased considerably due to new borders, prices, regulations etc. Some countries like Azerbaijan, Georgia and Turmenistan practically lost their fishing fleet or their access to seashore. Local wars in Armenia, Azerbaijan, Georgia, and Tajikistan, and partial return to feudalism in the Asian republics caused further difficulties in these countries. After 1990, food security became a major problem in most states of the Caucasian and Central Asian regions. Seven countries in these two regions of the former USSR have been classified as low-income food deficit (LIFD) countries: Armenia, Azerbaijan, Georgia in the Caucasian region, and Kyrghyzstan, Tajikistan, Turkmenistan, Uzbekistan in the Central Asian region, with a combined population of 54 million people. The annual per capita GDP in these countries is below 1,500 USD, which for example was only 111 USD in Kyrghyzstan and 240 USD in Tajikistan in 1997. Although many of these countries are experiencing growth in GDP, and various humanitarian aids also alleviate the food supply problems, fight against poverty will remain an important issue in these regions in the future.

Aquaculture doesn't play significant role in the economy of these countries, but the contribution of aquaculture to poverty alleviation should get more attention in the future regarding the available water resources, especially in Uzbekistan and Georgia. Uzbekistan is the third largest aquaculture production country after Russia and Ukraine, where the increase of the production level from the present 7490 t up to about 20,000 t would be an important contribution to the improvement of food supply and employment situation. Aquaculture production dropped to practically zero in Georgia, which is the third most populous country (5 million) among the seven LIFD countries. The value of the total annual renewable water resources is the sixth highest (63.3 km3) among the 15 countries of the former USSR, which could be considered as a good basis for future aquaculture development. Aquaculture could also be taken into account as a method for poverty alleviation in the two other Caucasian countries: Armenia and Azerbaijan. However, there is a limited scope for aquaculture development in Kyrghizstan and Tajikistan, where aquatic resources are scarce, and the combined aquaculture production of the two countries has never been higher than about 4500 tons.

In some sub-regions the change of political system was accompanied by ruining of large collective agriculture farms which caused high local unemployment and also added to the reducing of local availability of animal protein resources. At the same time, the pond farms, previously the parts of such collective farms, in many cases served as the basis for successful launching of aquaculture enterprises, which contribute in re-establishment of protein supply.

- **Role of aquaculture from a development context**

Aquaculture has an important role in certain regions and localities, however its general weight in the overall economy is relatively low comparing to other agricultural sectors. The role of aquaculture can be not evident at the scene of restructuring of economically unbalanced industrial hyper-complexes. Aquaculture can be taken into account as a method of poverty alleviation in some LIFD countries, where adequate aquatic resources are available, as discussed above, and also in Chapter 6. Aquaculture can also be integrated into rural development programmes in some countries, where aquaculture (especially pond fish

production) has long tradition. Modern form of aquaculture (intensive cage culture and recycling systems) could also be applied in certain coastal and inland areas, where infrastructure and inputs are available. Main obstacles of aquaculture development however, are the lack of financial resources due to the internal economical problems of the individual countries, and the loss of confidence among foreign investors.

The European Union is the largest donor to the New Independent States (NIS) in the former USSR region, which excludes the Baltic states. Funds are provided mainly through TACIS program, which ensured about 3,800 million euro between 1991 and 1998 to the region, including Mongolia. About 50 % of TACIS support has been allocated for nuclear safety and environment, restructuring state enterprises and private sector development, public administration reform, social services and education. Agriculture and food component is about 9% of the total support, but the share of aquaculture is minimal. The other main donors to the region are the USAID, World Bank, EBRD, IMF and Japan, with similar pattern of fund allocation. Development assistance programmes in aquaculture have been focusing mainly on the rehabilitation of sturgeon stocks in the Caspian region.

4.2 Capacity of aquaculture to achieve the projected targets, based on recent/current trends and outlook

Aquaculture sector in the region previously was relatively strong and well organised. Production development was supported by effective, diversified and well-integrated research and development activities; advanced regulatory framework was also present. In spite of partial fragmenting due to the disintegration of the Soviet Union and lowered efficiency caused by serious financial constraints, valuable personal resources, knowledge and experience are still available. The region possesses great aquatic resources both in inland and coastal areas, which could be fruitfully exploited for aquaculture production without the deterioration of the environment. Technological enhancement of aquaculture sector could be effectively supported by highly developed industry, which is undergoing reorganisation and seeking for new tasks and customers in the future. Regulatory framework is experiencing substantial changes and this process could continue for relatively prolonged period, nevertheless previous progress is giving a constructive basis for management of aquaculture development.

Thus, it seems to be evident that aquaculture sector of the region possesses basic capacity for significant increase of aquaculture production through application of effective and sustainable technologies and more precise matching of market requirements. However, it should be taken into account, that future development of aquaculture in the considered region is highly dependent on the overall economic development in the countries of the former USSR and their success in the elaboration and implementation of development-supportive regulatory framework.

4.3 Principle realistic methods of achieving the projected target

- **Recognition of aquaculture as a preferred user of resources**

Aquaculture had good public perception in the past, so it is possible to expect that traditionally welcoming approach both from public and institutional environment would

continue. However, further efforts will be necessary to maintain positive and affirmative public acceptance. If competition for the resources itself could be considered in the region as the secondary factor, there could be a significant scope of contradictions connected with the competition for infrastructure, necessary for the exploitation of the resources. Culture-based fisheries presents significant share of aquaculture activities in the region, in this connection the issues related to natural populations management should be of particular attention of the aquaculturists. At the same time, even aquaculture has never been considered as tangible source of pollution in the region, it could happen that environmental problems could be wrongly associated with aquaculture activities in the future. Aquaculture producers may not be enough powerful to form an influential lobby in the turbulent socio-economic environment in the region, thus international collaboration takes special significance.

- **Efficient use of primary resources**

Aquaculture has outstanding possibilities to be efficient user of primary resources through the revitalising and modernisation of the aquaculture sector. Pond aquaculture has a long tradition in this region, which has been always based on the utilisation of primary resources. There is a great potential for the development of pond aquaculture in the region, based on the prevailing conditions and wide acceptance of those species, which are feeding low on the food chain. Through with the application of appropriate polyculture technologies not only the primary resources could be utilised efficiently, but fish ponds could also play an important role in the recycling of organic wastes. Culture-based fisheries could provide the most efficient utilisation of primary resources and can be implemented at the water stocks unsuitable for conventional aquaculture. However, the degree of efficiency of utilisation of primary resources will be critically dependent from numerous factors such as pollution of watersheds or, from other hand, stability of legislation related to the reservation of land rights.

- **Expansion; increasing area; available water resources**

The available water resources make possible to extend the area for aquaculture production first of all in the Russian Federation, but also in Kazakhstan, Ukraine, and Belarus. The annual renewable freshwater resources of these three countries amount 93% of the total of the region (Russia 88%, Ukraine 3%, Kazakhstan 2%). The low aquaculture production per annual renewable freshwater resources in Russia (10.2 t/km^3), and in Kazakhstan (9.5 t/km^3) indicate the possibility of expansion of aquaculture in these two countries, taking into account that this value is reported as 190.5 t/km^3 in Ukraine. The expansion would not necessarily mean the construction of new ponds or other aquaculture facilities, but the revitalising the existing systems, and further development of culture based fisheries. The area of reservoirs and lakes used for fisheries production could be significantly increased by improved stocking and integrated resource management. In the Russian Federation and Belarus a number of new type so-called "commercial lake farms" could be established, which would also add to the aquaculture expansion. Recreational fishery is already playing significant role, especially in the Russian Federation, Ukraine, Belarus, Moldova, and the Baltic states. It can be expected that significance of recreational fishery would increase with overall economic stabilisation, therefore additional water area would be involved in aquaculture-related activities.

- **Diversification**

The previously rather homogeneous production pattern (semi-intensive pond culture) and species composition (common carp dominance) should be diversified in the future in order to meet market requirements, and to use the resources in a sustainable way. At the present low level of aquaculture production, the main goal of most of the farms is to increase production volume, taking also into account the needs of the traditional markets and the purchasing power of the population. However, in those fish production regions, which are close to urban areas, where local products should compete with high quality import products, aquaculture production will be likely to diversify into culture of higher value species like e.g. salmon, whitefish or sturgeon. Relatively limited number of cultivated species can be recognised from statistical figures of commercial aquaculture production. At the same time, numerous other species of fish, molluscs and crustaceans (both freshwater and marine) are grown at different small-scale farms within the former USSR area, and wide scope of applied research was performed to develop farming technologies for new indigenous and non-indigenous species. This potential provides a good possibility for wide-scale introduction of different underused species into the aquaculture practice. At the same time, additional research work would be needed to update previously developed farming technologies or create the new ones, which would better match current economic environment.

- **Intensification: increased unit area production from existing ponds**

Intensification is an important option for aquaculture development in the region, however its extent would greatly vary within the region. Significant potential is connected with wide introduction of modern fish feeds, greatly underused in the past. The intensity level in most of the farms is very low presently, due to the unavailability and high price of feed and other input materials. The restructuring and re-vitalisation of the local fish feed producing industry (with special regard to high quality fishmeal production) would play a critical role. At the same time, output of aquaculture farms per area of existing facilities could be increased by wider implementation of highly productive stock lines. Additional potential is related to the improvement of hydrochemical environment at the farms, and, in some cases, veterinary issues. Parallel with the consolidation of the economic situation in the region, the increase of the intensity level in fish production can be expected, similarly to pond fish production in Central and Eastern European countries. However, because of differences in climatic conditions, more diverse technological approach would be necessary. For instance, at the North of the Temperate Zone, application patterns of fertilisers in pond management will be dissimilar with ones in use in e.g. Asian States.

- **Increased culture based fisheries**

There is significant potential in the development of culture based fisheries, especially in the view of presence of numerous water reservoirs. Culture based fisheries also has a long tradition in the region, which is a good basis for future development. Important area of culture based fisheries is the Caspian region, where several international projects assist the rehabilitation of sturgeon stocks. A number of sturgeon hatcheries have been set up or modernised in this region. Salmon production through culture based fisheries and marine ranching at the Russian Far East can be considered as an example of sustainable population management. The augmentation of production of juveniles here could be expected as 5-7 percent per year. It should be also taken into account that in this area development could

concern mainly transformation of small ichthyological stations (located directly at the spawning sites) into full-scale hatcheries-nurseries, as it was already done at number of sites at Sakhalin. At Russian Pacific coast, especially in Southern area, the efforts could continue to increase production of seaweed, molluscs (first of all scallops) and a number of other species in the prospective. In the Baltic states and Russian North restocking of salmon population would continue, however, the future development could be influenced by the commercial salmon farming. Countries around Black Sea possess tangible prospective for intensive development of culture of mussels and lagoon ranching of mullets. At the Russian North, in Estonia, and in mounting areas of other countries, lake ranching of several species of whitefish could be continued, but increase of production seems not to be very significant because of lack of environmentally suitable lakes. In Russian Federation, Ukraine, Belarus, Moldova, and in smaller scale in the Caucasian and Asian states further expansion of culture based fisheries at big lakes and water reservoirs can be foreseeing. The capacity of inland culture-based fisheries for fish species, excluding so-called valuable species (salmons, whitefish, and sturgeons), only in the Russian Federation was estimated by leading national fisheries research institutes as at least 1 million tons. However, intensification of culture-based fisheries in inland waters should be supported by wide introduction of specialised fishing gears and development of small-tonnage fishing fleet. Increasing importance of recreational fisheries around major towns and in tourist areas could create additional demand for culture-based fish population management. Such demand would give the aquaculture sector additional possibility for the development of new facilities for production of stocking material.

- **Increase in integrated aquaculture**

There is a theoretical scope and also long-term traditions in some sub-regions for integration of pond aquaculture with other sectors. Although the state owned farms, where good conditions were available for integration between aquaculture and agriculture activities within the same farm, in some cases collapsed, the advantages of the integration have been recognised, and technologies are known. There are about 1 million ha of water stocks in conventional use by agriculture producers only in the Russian Federation. At present only 1/10 of these waters is used for the purposes of integrated aquaculture, but this share could be significantly extended. Integration of aquaculture with rice production and irrigation is very common in the Asian states, however, relatively high level of pollution would restrain further development of these production schemes, at least within the nearest years. It could be also a problem for all countries of the region, how small-size individual farms would be able to integrate aquaculture and non-aquaculture activities, taking into account the needs for integrated resource management. Associations of farmers could be effective gears in this connection, but not a short time is required for the development of such associations in the region. Finally, the great potential, which is available in this region for integration, could be utilised efficiently only if adequate institutional and legal framework will provide satisfactory conditions for the development of integrated aquaculture.

- **Increasing technical efficiency**

This is one of the key elements of future aquaculture development in the considered region. The network of research and development institutes, engaged in fisheries and aquaculture, together with highly developed industry, which currently undergoes restructuring, create a good basis for increasing technical efficiency. The aquaculture sector has sizeable capacity to adapt new technologies, however the rate and extent of the development would largely depend on the stabilisation and development of the overall economy in the region. At the same time, taking into account substantial investment costs, required in most cases for technical improvements, comparatively durable production cycle in aquaculture, and, respectively, prolonged credit pay-back period, it should be considered that state-supported aquaculture development programs could be inevitable for the increase of technical efficiency of the sector.

- **Getting more people involved in aquaculture; reduction of barriers to entry into aquaculture**

Since there have been significant changes in the employment patterns in these countries, and such changes are still going on, it is difficult to predict the future employment possibilities in aquaculture. There is a high probability however, that the number of new entrants would increase in the future, parallel with the socio-economic changes. Aquaculture enterprises usually provide relatively limited employment possibilities, but growing number of new enterprises should be connected with number of entrepreneurs, changing their occupation to aquaculture business. It is expected however, that new aquaculture entrepreneurs could face problems caused by unsettled property and tenure rights and administrative procedures, which would in certain degree limit the possibilities for newcomers to start the career in aquaculture entrepreneurship. In addition, newcomers would face problems related to the availability and quality of special education, essential for the work in aquaculture. The EASTFISH project is addressing some of the last problems, however, more international comprehensive activities seems to be necessarily undertaken.

- **Community involvement**

Despite of existing positive public attitude to fish farming in the countries of the region, significant community involvement in aquaculture concerns could not be evidently anticipated because of “shadowing” by numerous other issues. At the same time, more investigations are needed taking into account the considerable changes in these countries. It is nevertheless clear, that associations of aquafarmers should devote special attention to widening of public relations and building up an "attractive" image of aquaculture. Attentive consideration of these tasks would be expected from the side of policy makers as well.

4.4 Key issues and constraints

- **Technological**

Valuable human resources are readily available for assisting the necessary technological development in aquaculture, however the main issue is how to mobilise these resources, and how to provide the required technical and financial conditions. Pond fish production technologies would continue to be dominant in freshwater aquaculture, but the gradual development of culture-based fisheries and sea ranching is also expected within the next decades. Marine aquaculture has a scope to develop as well. Cage culture (both freshwater and marine) could be predicted as technological scheme of growing popularity because of increased flexibility in farm management and business planning. In the coming period industrial aquaculture would not have significant share in the overall statistical figures, however, taking into account the size of the region, its output could be substantial and its role in definite localities could be considerable. In general, technological richness of aquaculture could increase much faster with the overcoming of the post-effects of previous system of planned economy and politically based restrictions.

- **Institutional**

Substantial changes are taking place in the institutional system in the region. However, relatively long time is required until the efficient operation of the new institutions. The differences between countries within the region are sometimes considerable, which concerns not only the current progress, but also previous advancements and traditions. The external assistance aimed at the development of the institutional system should continue and even intensify in the future. At the same time, there is an evident need for thorough consideration of pre-history, local specificity, and socio-political factors in such programs. Therefore, any assistance or collaborative programs would be effective only if the level and approach of involved national teams are satisfactory and work of such program teams would obtain proper recognition by the national governments and lawmakers.

- **Socio-economical**

The problems of the aquaculture industry in the region are direct consequences of the socio-economical changes in these countries during the transition from centrally planned to market economy. Aquaculture development therefore is highly depending on the consolidation of the socio-economic environment, and socio-economic aspects should get high priority during the planning of aquaculture development programs. Socio-economic issues vary according to the particular region. In the LIFD countries poverty alleviation would get the first priority, while in other regions aquaculture development could provide good business opportunities. Aquaculture, which activity has long tradition in many countries of the region, could contribute well to maintain the rural population, to improve their life quality, and to preserve cultural values. Other input of aquaculture into transformation of socio-economic patterns would be related to the augmenting of overall number of independent small-scale producers and thus changing of social patterns.

- **Environmental**

Environmental aspects have not been considered properly in the past, and there have been significant environment degradations in the region. The dominating fish pond production however has not been responsible for the deterioration of the environment. Environmental problems should rather be addressed to other industries (pollution from heavy industry in Volgo-Caspian region, chemical and forestry-related pollution in Siberia, forestry-related pollution in Far East, pollution from agriculture in Central Russia). The cases of overfishing cannot be linked to environmental issues, moreover, the compensation activities were always undertaken. Sustainable development is also overriding strategic issue in this region, especially in the Russian Federation, Belarus, Ukraine and the Baltic states. Nonetheless, it can be expected that sometimes expansion of commercial aquaculture could face an obstructive feed back from the side of environmentalists dabbled in politics. From the other hand, environmental disorders could hamper aquaculture development, especially related to culture-based fisheries. Finally, in some situations like establishing of new "park-styled" facilities for recreational fishery aquaculture could substantially and directly contribute to the environmental management. In many cases environment rehabilitation of border or multi-border watersheds, necessary for the development of aquaculture, could be achieved only on the ways of intensive international collaboration. Governments need to create an “enabling” environment and accelerate the re-establishing of respective frame of intergovernmental agreements. The application of the principles of the FAO Code of Conduct for Responsible Fisheries should be encouraged.

- **Financial and economic**

There has been an elongated economical recession in the considered region, which has affected aquaculture development significantly. Moreover, for number of countries of the region political stability can be regarded as the precondition for further economical development. General credit availability in these countries can be characterised as relatively high, and as in all emerging economies, significant volume of venture capital is present within the region. However, in case of aquaculture the obstacles for getting financial input are represented by unsettled property rights, necessity of relatively long-term credits, and lack of experience of work with aquaculture sector in financial institutions. In the Russian Federation, Ukraine, and the Baltic states aquaculture entrepreneurs have to compete for the investment with fishing industry. In addition, insurance is practically unavailable for aquaculture business, except several trial cases in salmon culture, which were undertaken by single foreign company as an experiment. Similarly with agriculture, financial conditions for intensive development of aquaculture include state support in form of tax benefits, state loans, and optional credit availability doctrine. In many countries definite taxation concessions are established for fish producers, but often the benefits are collected mostly by the traders. With minor exceptions state loans system seems to be an issue of the future development. In many countries within the region the credit lines from international developmental and donating agencies are instituted through the number of national banks, but only few examples of aquaculture-related landings can be observed. From the other hand, there is often no “bridges” between the farmers and financial entrepreneurs, and sometimes they are speaking on different languages. In this view the activities aimed at financial and economic education of aquafarmers, including international training programs, cannot be overestimated.

- **Market and trade**

Huge volume of the domestic market in this area represents good marketing potential for aquaculture production, not only for fresh but also for frozen and canned products. The estimated demand is considerably higher than the present aquaculture production. There are substantial variations of the consumers' preferences between the countries of the region. Thus carp and herbivorous species are popular practically everywhere, sturgeon and salmon species can be easily sold in most of the countries, while eel could find buyers mainly at the north-west and whitefish at the northern area of the region. Production of aquaculture could face growing competition from the side of frozen seafood, traditionally popular in most part of the region. In this connection, significant work should be done to improve the retail patterns to bring fresh or freshly processed fish closer to consumer, to diversify the assortment, and propose wider scale of portioning. There would be an option for the development of specialised aquaculture facilities near big cities, which will supply restaurants with live fish, crustaceans, and products of marine aquaculture, especially in the recreational seashore areas.

- **Development and research**

There is a need for new, demand-led multidisciplinary research programs, which are aiming at specific issues, related to the planned technology developments in the industry, with special regard to the environment and socio-economy. However, research funds have been cut back dramatically, and research infrastructure has also been deteriorated. Further international support and more importantly, collaboration are needed to revitalise scientific resources here for the benefit of the region, as well as for solving of global problems. In the judgement procedures, related to the distribution of both national and international support, the well-established approaches elaborated by the international bodies (European Commission, World Bank, FAO) would be fruitfully employed.

4.5 Issues and constraints common to all regions

Aquaculture production expanded dynamically all over the world during the past decade, but there was one sub-region where it contracted dramatically: the ex-socialist countries of Central and Eastern Europe and the former USSR. The decline was similar in all the countries, despite considerable variations in their national economies. This indicates that the root causes of the process were general problems of the transition from centrally planned to market economy, which are indeed the problems that are not related specifically to aquaculture sector. This leads to the conclusion that the solutions could not be found within the aquaculture sector either, the more so as aquaculture is a relatively insignificant and weak part of the national economies in the ex-socialist countries of Eastern Europe and the former USSR.

The transition from centrally planned to market economy proved to be painful and relatively prolonged process especially in the former USSR countries. Local and border conflicts as well as the problems related to organised crime have deepened the crisis after the disintegration of the Soviet Union as the political entity in 1991. Despite the macroeconomic stabilisation until 1996, the investment climate has not improved, and other social conditions, including social security, education and poverty, have deteriorated. The market reform and the growth of the private sector also resulted in a growing income disparity in many countries. Since August

1998, the Russian Federation has been in a serious financial crisis, which also affected other former USSR countries, which have remained closely inter-linked economically with Russia. There is substantial unemployment rate in most of the countries of the former USSR, and even if food is available on the market, the price is not affordable for significant segment of the population. The problems indicate the inefficiencies in the production, processing, marketing, transportation, banking and legal systems, which would take years to address. Many countries are now experiencing growth in GDP, albeit from the levels less than half that prior to the transition to market economy.

The region possesses valuable assets that include not only significant land, water and labour resources but also traditions and appropriate technologies in aquaculture, considerable research and development capacities and, on the long run, immense market potential. Proper utilisation of these assets is matching the common interests of the world community, however wasting them would create problems that could reach a global dimension.

4.6 Issues and constraints specific to the region

There are significant differences between the sub-regions at the territory of the former USSR, therefore major specific issues and constraints are discussed by sub-regions.

The **Russian Federation** is the largest country of the world, which have tremendous and diverse aquatic resources (38.8 thousand km marine boundary and 4,312 km^3 annual internal renewable water resources). The present low level of aquaculture production is in a sharp contrast to the available natural resources and the valuable professional and scientific knowledge. The once well-developed aquaculture sector has been facing serious difficulties since the disintegration of the Soviet Union. Those issues and constraints, which are discussed in the previous chapter, are in most cases also relevant to the Russian Federation. There may be some development in aquaculture production at certain localities and in individual farms, however the overall situation of aquaculture development is highly depending on the consolidation of the economy of the country, which presumably could take relatively long time. It should be also considered that traditionally significant role of capture fisheries could in some areas influence the development of commercial aquaculture. At the same time, the specificity of aquaculture in the Russian Federation is that activities related to restocking and mitigation of aquatic resources is very significant and such pattern could be expected to continue.

The **Baltic region**, (Estonia, Latvia and Lithuania) is the smallest region of the former USSR territory (186,400 km^2 area; 16.4 million population). Aquaculture has a minor role in fish supply in these countries comparing to capture fisheries. The share of aquaculture was less than one percent from total fish production (both capture and culture) in 1997 in the three Baltic states. The limited aquaculture production focuses on common carp and trout. Economic reforms have been progressing well in this region, and economic assistance is also directed toward these countries from Scandinavia. There is a better entrepreneurial environment in this region due to these circumstances, which may have positive effect on future aquaculture development.

The **Eastern European region** is a major agricultural region, where the ratio of the cultivated area is about 70% of the total area. The value of the annual renewable freshwater resources is also high (318.5 km^3/year) in this region, which offers good conditions for aquaculture, in

which pond fish culture is dominant. Ukraine is the second largest aquaculture producer in the whole former Soviet region after the Russian Federation. The specific aquaculture production in the Eastern European region per area, population and renewable aquatic resources are also higher than the average of the whole former USSR region by 8.5, 1.5 and 8.1 times respectively. Pond fish culture would remain major aquaculture activity in this region, which situation is very similar to that of aquaculture in the Russian Federation. There is also some scope to increase marine aquaculture in Ukraine, which has 2,766 km of shoreline on the Black Sea. Only about 1 t of marine aquaculture was reported in 1997, which is negligible comparing to the 352.000 tons marine catch in the same year.

The **Caucasian region** (Armenia, Azerbaijan and Georgia) is a mountainous region between the Black and Caspian Sea, which has a slightly bigger area than that of the Baltic states, although the population here about two times more. Aquaculture production was reported as only 3,138 tons in 1997, which mainly came from Armenia (2,650 t or 84%), while reported aquaculture production dropped to zero in Georgia. Armenia, which is the smallest country in the former USSR region, has the highest specific aquaculture production per area, population and renewable water resources. Main cultivated species in 1997 were cyprinids, which mostly produced in small private farms in Armenia, and in sovkhoz (state farm) and kolhhoz (collective farm) in Azerbaijan. The collapse of the state-owned farms, slow restructuring process, and continued military actions were the main reasons for the practical cease of the aquaculture production in Georgia. All three countries of the region are classified as low income food deficit countries, which face serious difficulties especially in the North Caucasus. There is a need for humanitarian aid in these countries, but low input aquaculture could also contribute to the improvement of the rural life.

The **Central Asian region** (Kazakhstan, Kyrghyzstan, Tajikistan, Turkmenistan and Uzbekistan) occupies 18% of the area of the former USSR. Four countries of the region, with the exception of Kazakhstan, are classified as low income food deficit countries. Kazakhstan is the second largest country of the former USSR region, where deserts and steppes account for more than 80% of the total area. During the land reform since 1994 most of the land have been transferred to farmers or companies through private ownership or long term leases (99 years). There is similar trend in land ownership in the other Central Asian countries as well, although land privatisation and diversification of agricultural production still remain priority issues in the policy actions within this region. The two main aquaculture production countries in Central Asia are Uzbekistan and Kazakhstan, however production dropped from 37,698 tons in 1990 to 8,534 t in 1997. The value of the renewable freshwater aquatic resources (160 km^3/year) indicates the aquaculture potential of these two countries, but no quick development could be expected due to the economic constraints.

There is no significant aquaculture activity in the three other Central Asian countries (Kyrghyzstan, Tajikistan and Turkmenistan), where aquaculture production is limited by the available water resources. Aquaculture production was reported as only 577 tons in 1997 in these three countries, which is about 8% of the peak production of the Central Asian region (6,995 t) in 1990. Even if there is limited scope for aquaculture development in this region, the increase of fish production (mostly low value fish for rural population) to the level prior to the disintegration of the USSR, would be a significant contribution to the food supply of the population in this poor region.

4.7 Approaches and strategies for overcoming the constraints and addressing opportunities

The two main directions of aquaculture development in the large part of the territory of the former USSR could be the revitalising and development of the existing, formerly prosperous, inland aquaculture sector (mainly pond fish farm complexes), and the development of culture based fisheries.

The share of coastal and marine aquaculture may be increased in the future from the present 8% in terms of volume through aquaculture development, however freshwater aquaculture would remain dominant in this region, taking into account the tremendous freshwater resources. It is doubtful that freshwater aquaculture sector will regain the previous unity and power, which it had during the Soviet era, but there is a need for coordinated efforts of all players from aquaculture in the region in order to be competitive with other resource users and to meet the new challenges. The possibility of integration with other resource users (agriculture, industry, tourism, water supply, environment protection, etc.) should be considered as much as possible during the future development of aquaculture. The multi-faceted nature of pond aquaculture and the possible multi-purpose utilisation of the earthen ponds offer unique opportunities for aquaculturists to make viable business not only through fish production, but also by providing services for other sectors (stocking material for recreational fisheries, operation of angling ponds etc.). Pond aquaculture however would remain a major producer of those species feeding low on the food chain, which is important aspect in rural areas of the region. Scientists and aquaculturists in this region could play a leading role even on global scale in the development of “new-type” fish pond technologies, in which wastes recycling, appropriate polyculture and “organic production” would be the major elements.

However, as the time is passing after the disintegration of the Soviet Union, there is an urging need for the acceleration and completion of the establishment of appropriate legislative and institutional framework, the restructuring of the aquaculture sector, stabilising of the ownership rights, and the improvement of marketing infrastructure.

4.8 Opportunities for inter-regional co-operation

Inter-regional co-operation is one of the key issues in this region, where former links have been broken, or became inefficient after the disintegration of the USSR. However, the reestablishment of formerly prosperous collaboration, and the establishment of new cooperative pathways seems to be a rather slow process mainly due to the structural and financial problems. Only very few professionals and scientists can afford to attend international aquaculture conferences and other events abroad, and the participation in various international aquaculture organisations and networks is also very weak. That would be the interest both of the aquaculture sector in the former USSR region and the international aquaculture community to intensify the collaboration, however this would require substantially more external support in the future. That would also be useful to improve cooperation in aquaculture development among transition countries, in order to exchange information, and learn from each other’s experiences. In spite of some sporadic efforts by few development organisations, very limited support has been given to stimulate cooperation in aquaculture among the transition countries, much less than in other regions of the world. These countries have very limited own resources to develop collaboration in aquaculture

development, and few local initiatives of limited scope had very little effect on the improvement of the situation.

The remained professional and personal linkages between the Russian Federation and the new independent states even after the disintegration of the USSR, provide a good basis for future regional collaboration, even if their content and extent is rather limited presently. The establishment of several producer's associations, in particular the Association of Inland Aquaculture Enterprises (Rybkhozassociation) is a recent positive development, which improve the exchange of information among aquaculture enterprises in the former USSR countries. In the latest period organisation of regional and international aquaculture conferences became regular in Russia, Ukraine and Belarus. Other former USSR countries could also be involved in the work of regional meetings and conferences focusing on selected topics, having high priority in the region. The establishment of databases including directories of institutions and enterprises is of great importance in regards to the new and complex situation in this region. The first steps in this field were done within the frame of several international projects (e.g. Sea-World); national fishery databases are under development in the Russian Federation, Belarus and the Baltic states. Twinning of institutions (within the region and in Europe), would provide an excellent basis for long-term collaboration, which should be encouraged and promoted in the future. In 1997 several aquaculture enterprises, regulatory bodies and research institutions from Ukraine, Russian Federation, Poland, Belarus and Moldova were joined to establish International Council for Research and Development Cooperation in Water Bioresources Research and Aquaculture. The Council meetings, which are held annually, devoted to the problems of development of inland fisheries and aquaculture during the restructuring period and transition to the market economy.

Although the Russian Federation, and the majority of the other countries of the region, have joined to the main international treaties and actively participate in the work of various international organisations, many countries of the region are not adequately represented in international aquaculture organisations (WAS, EAS, EIFAC, etc.). This situation should be improved for the benefit of both the individual countries and the organisations. The assistance of FAO-EASTFISH, which has been established for stimulating of aquaculture business in the region, could also be better utilised in the future.

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