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Fish species introductions in the Kyrgyz Republic

Cover photographs:

Cover photographs: Images of the main fish species introduced in Lake Issyk Kul. Sevan and rainbow trout captured by anglers (top centre). Pikeperch and oriental bream in confiscated gillnets (top left). Common carp and grass carp captured in Lake Issyk Kul (bottom right). (Courtesy of Azat Alamanov and András Woynárovich).

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Preparation of this document

The objectives for the design and implementation of FAO projects GCP/GLO/162/EC[1] and GCP/KYR/003/FIN[2] were to support the development of appropriate fisheries strategies and to ensure the sustainable development of the fisheries sector in the Kyrgyz Republic (Kyrgyzstan). Prior to and since independence in 1991, the introduction of non-native species for fishery and aquaculture activity in Kyrgyzstan has increased the pressure on endemic resources. Therefore, it was necessary to conduct an analysis of these introductions, to consider how they may affect the future development of fisheries and aquaculture, and to lay the foundation for more sustainable development.

The present document is the outcome of this analysis. It also includes an updated inventory of water, fisheries and aquaculture resources. In addition, it presents an overview of past and present management practices and provides feasible and practical solutions to develop sustainable fisheries and aquaculture into the future. Hence, it is envisaged that this publication will serve to rehabilitate and develop an ecologically sound fisheries and aquaculture sector. Its aim is also to find sustainable solutions for increasing the production from natural waters, reservoirs and fish farms of Kyrgyzstan.

The review has been endorsed by the Ministry of Agriculture and Melioration of the Kyrgyz Republic, which is the ministry responsible for fisheries and aquaculture in the country.

[1] GCP/GLO/162/EC – Kyrgyzstan: Development of Inland Fisheries and Aquaculture in the Kyrgyz Republic to Reduce Rural Food Insecurity.
[2] GCP/KYR/003/FIN: Support to Fishery and Aquaculture Management in the Kyrgyz Republic.

Abstract

Although Kyrgyzstan is rich in water resources, the productivity of its waters is low and its indigenous fish fauna is relatively poor, with only a limited number of commercially valuable species. However, as the waters are suitable for growing valuable cold-water fish species, several fish species were introduced and regularly stocked when Kyrgyzstan was part of the Soviet bloc. As a consequence of these introductions, both the number and proportion of indigenous fish species gradually declined. After Kyrgyzstan became an independent State, seed and fingerling production from hatcheries first fell significantly and then stopped completely, while illegal and unregulated fishing increased. This combination led to the collapse of both the fisheries and aquaculture sectors. Currently, national and foreign investors are increasingly interested in investing in the potentially lucrative cage farming of exotic rainbow trout, particularly in the unspoilt waters of Lake Issyk Kul, which may further endanger the efforts to restore and maintain the original fish fauna of the lake.

The objective of this document is to analyse the available information on historic practices, experiences and lessons learned on species introductions so that more suitable and improved practices can be used in future stocking programmes in Kyrgyzstan and elsewhere in the Central Asian region. Information is provided to support the management of exotic and indigenous species in Kyrgyz fisheries and aquaculture activity. It includes an analysis of the long-term consequences of possible stocking programmes for exotic and native species and the use of cages in natural waters.

The information presented in this document includes a detailed inventory of all waterbodies, fishery and fish culture resources in Kyrgyzstan. It will also serve the rehabilitation and sustainable development of both the fishery and aquaculture sectors in Kyrgyzstan in an ecologically sound manner. The document also recommends feasible solutions for the sustainable utilization of natural waters, reservoirs and fish farms in Kyrgyzstan.

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Abbreviations and acronyms

DOF	Department of Fisheries
EIA	environmental impact assessment
GEF	Global Environment Facility
HFU	Hunting and Fishing Union
MAWRPI	Ministry of Agriculture, Water Resources and Processing Industry
NGO	non-governmental organization
SAEPF	State Agency on Environment Protection and Forestry
SIETS	State Inspection of Ecological and Technical Security
SPNT	Specially Protected Natural Territory
SSR	Soviet Socialist Republic
UNDP	United Nations Development Programme

1. Introduction

The dissolution of the Union of Soviet Socialist Republics (the Soviet Union) in the early 1990s led to a significant reduction in fish production in all the former Soviet republics of Central Asia. One of the most dramatic declines occurred in Kyrgyzstan, where catches in 2005 fell to just 3 percent of the levels recorded in the late 1980s (Sarieva *et al*., 2008).

Kyrgyzstan is rich in water resources, but the development of fisheries is severely constrained by the oligotrophic nature of rivers and most lakes. These lakes have a low primary productivity and a relatively small number of commercially valuable native species. Despite this, water in Kyrgyzstan is abundant and its physical and chemical qualities are suitable for growing many very valuable cold-water fish species. For this reason, a large number of lakes and reservoirs were stocked with exotic fish species when Kyrgyzstan was part of the Soviet Union. These fish species were introduced from watersheds elsewhere in other parts of Central Asia and what is now the Russian Federation.

In Soviet times, large-scale stocking programmes ensured continued availability of fish. However, as early as the 1930s, and more intensively from the 1950s onwards, increasing quantities of a range of exotic species were introduced, including several predators, and in fishery catches the exotic species gradually replaced indigenous ones. After independence, the fisheries sector was privatized, and subsidized stocking programmes were almost completely discontinued. As a result, fisheries in the different natural and artificial waterbodies collapsed and some of the indigenous species almost disappeared. The situation became so serious that the Government implemented a five-year long moratoria on fishing in Lakes Issyk Kul and Son Kul in 2008 (Sarieva *et al*., 2008).

In order to understand how the situation became so critical it is necessary to consider the social context. Before 1991, agriculture was the main source of employment in Kyrgyzstan. These opportunities disappeared, as did state farms and cooperatives,[1] which were privatized, and the majority of rural peoples became unemployed. Only a smaller number of families were able to adjust and find other sources of income. The collapse of the huge Soviet market and the limited purchasing power of local markets further increased unemployment and reduced the prospect of being able to start permanent income-generating activities. By tradition, alongside agriculture, the fish stocks in Kyrgyz waters provided food security for local people. Although one single state-owned company, the Issyk Kul Fish Processing Factory, controlled fishing in the different waterbodies in Soviet times, local people had access to fish through informal channels. With the increasing poverty from the beginning of the 1990s, fisheries became an important provider of food and income at the same time as the capacity to monitor fisheries and to enforce legislation deteriorated, and the fisheries in effect became open-access resources.

The current ban on fishing (2008–2013) in the largest lakes seems to imply that overfishing was to blame for the dire situation in the fishery. However, no historical data were collected or analysed to support this conclusion, and the current capacity within the country to gather and analyse fisheries data is extremely low. Opinions about the reasons for the collapse, and whether or not the moratorium will have any positive impact on fish stocks, differ. It is probable that the current state of fisheries in

[1] Called sovkhozes and kolkhozes, respectively.

the country is the result of many different factors, which will include overfishing, but also non-native species introductions, among others (Sarieva *et al*., 2008).

The very low supply of fish and fish products in Kyrgyzstan has caught the attention of both Kyrgyz and foreign investors, interested in the potential for profit from investments in the sector. One of the subsectors that have received most attention is the lucrative farming of exotic rainbow trout, conducted through cage culture in the unspoilt waters of Lake Issyk Kul. Rainbow trout farming has expanded relatively quickly, and at present at least four companies grow rainbow trout in 21 cages in the lake. The total volume of these cages is about 52 500 m^3, and their reported production was 155.6 tonnes in 2010. In addition, it is understood that many foreign investors have significant plans to invest in and expand this activity. However, this is in the context of the current fishing moratorium and despite the fact that the lake is part of Issyk Kul Biosphere, which needs protection. Currently, the country does not have the legislative framework or the technical capacity in place to evaluate the environmental impacts of current and future production, to regulate the activity, or to monitor environmental impacts.

Currently, two FAO projects supporting the Kyrgyz Republic Fisheries and Aquaculture Management Strategy 2008–2010 are operational: (i) GCP/GLO/162/EC Kyrgyzstan: Development of Inland Fisheries and Aquaculture in the Kyrgyz Republic to Reduce Rural Food Insecurity; and (ii) GCP/KYR/003/FIN Support to Fishery and Aquaculture Management in the Kyrgyz Republic. Their objective is to ensure sustainable development of the fisheries and aquaculture sector, including improved legislation and compliance monitoring by providing capacity building and technical assistance.

It is against this backdrop that the present report was commissioned, with the following objectives:

- to analyse and provide information that will form the basis of the management of exotic and native species in fisheries and aquaculture in Kyrgyzstan;
- to develop responsible stocking practices;
- to gather experiences and lessons learned about positive and negative impacts of species introductions that can be used in Kyrgyzstan and regionally.

To support the above objectives, the report includes an updated inventory of the water, fisheries and aquaculture resources of the country, including information on the present state and production capacities of fish farms.

It is envisaged that the information presented in the report will serve the rehabilitation and sustainable and ecologically sound development of fisheries and aquaculture sector in Kyrgyzstan, through sound solutions for the optimal utilization of natural waters, reservoirs and fish farms.

GEOGRAPHY AND CLIMATE

Kyrgyzstan is a mountainous country in Central Asia, which is located on the northwestern slopes of the Himalayas. The area of the country is 199 820.7 km^2, of which 8 150 km^2 (4 percent) is covered with water (CIA, 2011). More than 90 percent of the country is occupied by the mountain ranges of the Tien Shan and Pamir-Alai. Elevation varies across the country, with the lowest point being the village of Kulundy in Batken Province (401 m above mean sea level) and highest point being the Jengish Chokusu (Pik Pobedy, 7 439 m above mean sea level), while the average elevation of the country is 2 750 m.

The neighbouring countries are Kazakhstan (to the north and northwest), Uzbekistan (to the west), Tajikistan (to the southwest) and China (to the south and southeast) (Figure 1).

Kyrgyzstan is divided into seven provinces and two city regions. The provinces are subdivided into a total of 40 districts (Figure 1, Table 1 and Table A2.1). The current

FIGURE 1
Map of Kyrgyzstan and its provinces

Notes: 1. City of Bishkek, 2. Batken Province (capital: Batken), 3. Chuy Province (capital: Bishkek), 4. Jalal-Abad Province (capital: Jalal-Abad), 5. Naryn Province (capital: Naryn), 6. Osh Province (capital: Osh), 7. Talas Province (capital: Talas), 8. Issyk Kul Province (capital: Karakol), 9. City Osh.

Source: Image from Geology.com (2011).

population of Kyrgyzstan is slightly more than four million people, but in addition almost one million people have temporarily left in search of work in other parts of the region and elsewhere.

The climate of the country is continental, but different regions have specific characteristics. There are seven regions with three in the south having a warmer and milder climate (Batken, Jalal-Abad and Osh), while the climate in the other four regions in the north is colder. They have a sharp continental climate with the exception of the Issyk Kul, which has a mountain–sea climate owing to the size of the lake (the tenth-largest in the world).

TABLE 1
Provinces and population of Kyrgyzstan

Provinces	Population		Area	
	Number	%	km^2	%
Batken Province	382 400	9.4	17 023.9	8.5
Chuy Province	770 800	19.0	18 684.4	9.4
Jalal-Abad Province	869 300	21.4	33 647.5	16.8
Naryn Province	249 100	6.1	46 706.9	23.4
Osh Province	1 176 000	29.0	29 165.1	14.6
Talas Province	199 100	4.9	11 445.9	5.7
Issyk Kul Province	413 100	10.2	43 147.0	21.6
Total	**4 059 800**	**100.0**	**199 820.7**	**100.0**

Source: National Statistical Committee of the Kyrgyz Republic (2010).

TABLE 2
Precipitation and air temperature in the regions of Kyrgyzstan

Region*		Precipitation (mm)	Temperature (°C)				Observation
			January		July		
			Min.	Max.	Min.	Max.	
Naryn		200 – 300	-27	-10	9	21	
Talas		300 – 500	-6.6		21		Continental climate
Chui		500 – 600	-17	6	20	25	Continental climate
Issyk Kul basin	West	100 – 200	-5.7	-2	17 – 17.5		Mountain-sea climate
	East	400 – 500					
Issyk Kul mountainous region		300	-15 – -16		11 – 12		Continental climate
Batken, Osh, Jalal-Abad		500	-3		24	27	Mild continental
Average for the Kyrgyzstan		533**	-27 -1	-1 8	5 20	20 27	In highlands In valleys

* Maximum elevation in Talas is 4 482 m above sea level. The elevation in Chu ranges from 800 to 3 900 m above sea level. In the Issyk Kul region, the highest peaks are Victory (7 439 m) and Khan Tengri (6 995 m). The climates of Batken, Osh and Jalal-Abad are almost identical.

** Equivalent to 106.6 km^3/year.

Source: Hydrometeorological Centre of the Kyrgyz Republic , Bishkek, Kyrgyzstan, personal communication (2011).

The geographical and seasonal distribution of rainfall in Kyrgyzstan varies considerably by region. In the northeast, it is 180–250 mm/year, and in the southwest it is between 900 and 1 000 mm/year. In January, the temperature varies from –1 to 8 °C in the valleys, and from –1 to –27 °C in the highlands (Table 2). In July, the temperature is between 20 and 27 °C in the valleys, and between 5 and 20 °C in the highlands.

The combination of high mountains, valleys and depressions has led to a high species diversity of terrestrial flora and fauna. In order to preserve the natural state of its unique ecosystems and landscapes, there is a network of protected areas in the country including eight national parks, six state national parks (state reserves) and two biosphere reserves recognized by UNESCO. One of particular relevance to this report is the Issyk Kul region, including the lake. In addition, there are 67 nature reserves, which are forest, botanical, geological and hunting preserves. Any human activities that may endanger the unique ecosystems and landscapes in these areas are restricted or prohibited (Box 1).

BOX 1
Protected territories in Kyrgyzstan

Kyrgyzstan has a total of 83 Specially Protected Natural Territories (SPNTs) with a total area of about 800 000 ha (about 4 percent of Kyrgyzstan's total land area). The critical characteristics of SPNTs are:

- In state reserves only, specifically identified types of economic activities are prohibited or limited.
- One of the main tasks of the national parks is to encourage and organize tourism that is not harmful to nature.
- Nature reserves were formed to preserve the natural environment of the area while making it available for recreational activities.
- Biosphere reserves are part of an international network and include many of the most important conservation areas, ecological research sites, and environmental education areas located all over the world. The biosphere reserves and the State can become full partners in the process of integrating conservation and sustainable development locally, and in sharing information and experience to help address regional and global problems.

Source: Biosphere Reserve Directorate (1994); Kyrgyzjer (2011).

Kyrgyzstan contains a number of rivers and wetlands of national and international importance. Under the UN Convention on Wetlands of International Importance especially as Waterfowl Habitat (the Ramsar Convention), Government Decision No. 310 declared Chatyr-Kul a wetland of international importance on 25 July 2005. Nationally, there are wetlands in isolated passages, such as Tyup Balykchi, and some of the bays of Lake Issyk Kul, which are both part of the Issyk Kul Nature Reserve. Sary-Chelek Reserve is located in Jalal-Abad Province and comprises of all of Lake Sary-Chelek. Rivers with the status of wetlands also flow through specially protected natural areas. In Talas Province, a tributary of the Talas River called the Besh-Tash River flows through the Besh Tashskogo Reserve. In Chui Province, the Ala-Archa and Chon-Kemin Rivers flow through the Ala-Archa and the Chon-Kemin national parks.

The Environmental Law of the Kyrgyz Republic strictly prohibits any agricultural activities, including fisheries, in core protected areas and in the surrounding buffer zones.

WATER RESOURCES

Kyrgyzstan is rich in both surface and underground water resources. The long-term annual precipitation is 106.6 km^3/year and the long-term total renewable water resources are 23 km^3/year. According to FAO (2011), Kyrgyzstan ranks fourth in terms of total renewable water resources per capita (4 263 m^3/year) and third in terms of total dam capacity (21.5 km^3) within the countries of the Caucasus and Central Asia (Tables A2.2 and A2.3).

Surface waters

The total area of natural water resources is about 701 100 ha.

Rivers

No river flows into Kyrgyzstan from other territories. The rivers of the country are glacial-snowfed, and there is therefore a significant seasonal change in their water flow. Some 80–90 percent of the yearly flow passes in the flood period between April and July, although the volume of water can increase by 10–15 times in summer flooding in June and August.

There are eight main water basins in the country named after their principal river or lake (Figure 2). The rivers of each water basin, listed in Table A2.4 and summarized in Table 3, form a grid of rivers with a total length of 3 399 km, with a total surface area of 5 807 ha on average. The total average annual flow of rivers is about 46 km^3.

Lakes

The total number of lakes in Kyrgyzstan is 1 923 with a total area of 6 800 km^2 (FAO, 2011), although according to national sources this area is 7 011 km^2. The nine largest lakes (Annex 1) represent 98.5 percent of the total area of all natural lakes (Tables 4 and A2.5). The remaining 1 914 lakes are small with an average water surface area of 5.4 ha.

Reservoirs

The total dam capacity Kyrgyzstan is 21.5 km^3, distributed among almost 60 reservoirs with a total area of about 47 311 km^2. Most of them are small and only 36 percent are larger than 100 ha (Tables 5 and A2.5.1). Water levels in reservoirs fluctuate considerably, on a daily basis and seasonally, owing to their use for irrigation and generation of electricity (details in Annex 1).

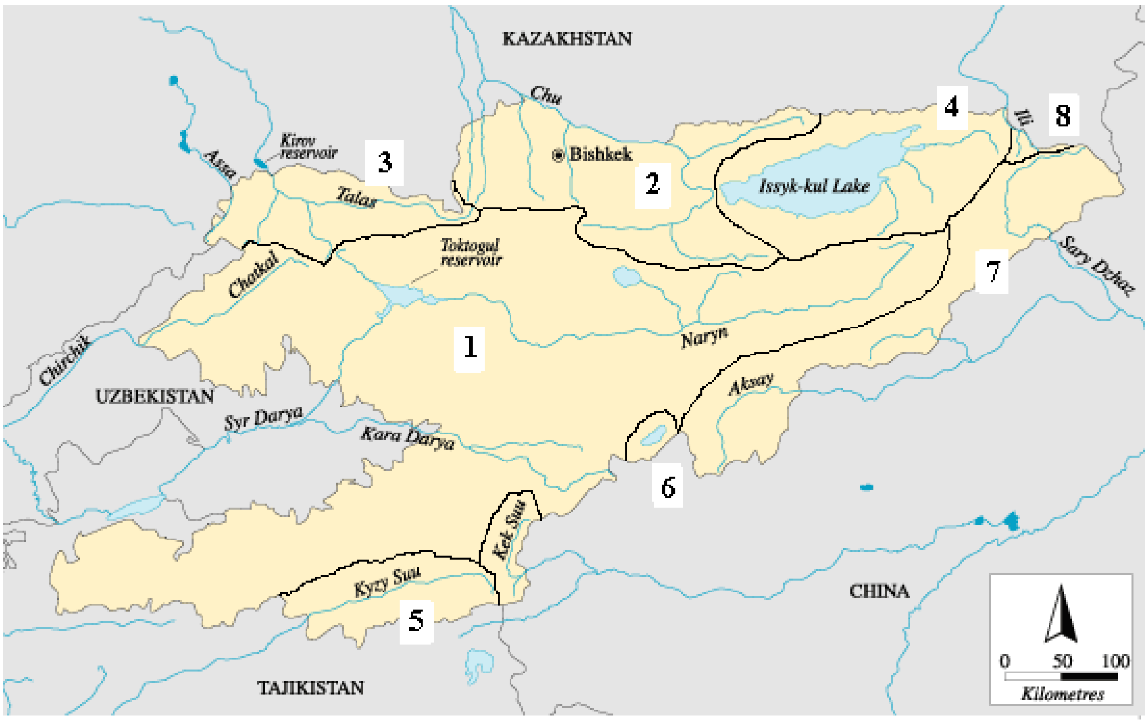
The network of irrigation systems is 795 km long. The principal irrigation canals are built out of concrete, and their water level varies depending on the end use. The longest

TABLE 3
Main rivers and corresponding basins in Kyrgyzstan

Name	River basin	Length (km)	Basin area (km^2)	Water (m^3/sec)		
				Min.	Average	Max.
Kyzyl-Suu	Amudarya	89	9 000	-	56.0	-
Ala-Archa	Chu	78	270	0.8	4.2	50.0
Chon-Kemin	Chu	116	1 890	7.2	21.7	83.7
Chu	Chu	221	22 600	4.3	91.0	267.0
Kichi-Kemin	Chu	81	614	0.9	2.1	4.0
Kochkor	Chu	45	2590	9.1	12.3	20.3
Ysyk-Ata	Chu	81	558	-	7.06	45.8
Chatkal	Syrdarya	217	7110	7.0	122.0	920.0
Djergalan	Issyk Kul lake	97	2100	7.1	22.5	104.0
Tyup	Issyk Kul lake	120	1180	1.4	10.6	123.0
Ak-Buura	Kara-Darya	136	2540	6.2	21.4	331.0
Kurshab	Kara-Darya	157	3750	10.9	24.6	58.6
Tar	Kara-Darya	142	4120	8.9	45.7	214.0
Kara Darya	Kara-Darya	180	30 100	-	121.0	-
Kogart	Kara-Darya	52	1010	5.4	18.3	58.8
Alabuga	Naryn	180	5880	9.7	26.5	124.0
At-Bkmashi	Naryn	180	5540	23.9	33.1	47.6
Koko-Meren	Naryn	199	10 400	29.7	80.3	215.0
Isfara	Syrdarya	130	3240	4.2	10.4	48.1
Naryn	Syrdarya	534	50 100	161.0	432.0	963.0
Soh	Syrdarya	124	3510	28.0	42.1	58.9
Talas	Talas	294	10 800	8.9	32.7	130.0
Sary-Djaz	Tarim	197	12 900	-	137.0	1000.0
Total		**3 650**	**191 802**	-	-	-

Source: Sarieva *et.al.* (2008).

FIGURE 2
River and lake basins of Kyrgyzstan



Notes: 1. Syr Darya river basin (61.9 percent); 2. and 3. Chui and Talas river basins (15.5 percent); 4. Lake Issyk Kul basin (3.4 percent); 5. Amu Darya river basin (4.4 percent); 6. and 7. Lake Chatyr Kol and Tarim (Sary Djaz) river basins (14.0 percent); 8. Lake Balkhash (Karkyra river) basin (0.8 percent).

Source: After Konurbaev and Timirkhanov (2003); Sarieva *et al.* (2008); and data available at FAO (2011).

and largest channel is the Big Chu Canal, which is used for irrigation of farmlands in the Chu valley and is the source of water for a large number of small reservoirs built for irrigation purposes. Owing to water diversion for irrigation, the depth of water in the canals falls to a low level in the summers and hence they are not considered suitable for raising fish.

TABLE 4
Largest lakes of Kyrgyzstan

Name	Province	Water basin	Altitude (m)	Area		Depth (m)		Length (km)	Width (km)
				km^2	%	Avg.	Max.		
Ala-Kul	Issyk Kul	Issyk Kul	3 532	1.6	0.02		4.5	2.3	0.7
Issyk Kul	Issyk Kul	Issyk Kul	1 609	6236.0	93.13	280.0	668.0	178.0	60.0
Merzbacher	Issyk Kul	Sary-Jaz	3 500	4.5	0.07		70.0	4.0	1.0
Kapka Tash	Jalalabad	Kara-Suu	2 303	1.0	0.01	21.0		15.0	0.7
Sary-Chelek	Jalalabad	Kojoo-Ata	1 925	3.9	0.06	98.0	234.0	5.9	1.8
Kara-Suu	Jalalabad	Naryn	1 998	3.8	0.06	55.7	147.0	5.8	1.3
Chatyr-Kul	Naryn	Naryn	3 530	170.6	2.55	3.8	16.6	23.0	11.0
Kel-Ukok	Naryn	Naryn	3 048	1.6	0.02	5.0	17.0	3.0	0.7
Son-Kul	Naryn	Naryn	3 016	273.0	4.08	9.2	22.0	28.5	18.0
Total/Average			**2 718**	**6 696.0**	**100.00**	**–**	**–**	**–**	**–**

TABLE 5
Summary list of reservoirs of Kyrgyzstan

Province	District	Quantity		Area	
		No.	%	ha	%
Batken	Batken	1	2	267.0	1
	Total	**1**	**2**	**267.0**	**1**
Chuy	Alamüdün	9	15	1719.0	4
	Chuy	2	3	3.0	0
	Jaiyl	6	10	318.0	1
	Kemin	1	2	3.0	0
	Moskva	3	5	751.0	2
	Panfilov	6	10	424.0	1
	Sokuluk	7	12	434.0	1
	Ysyk-Ata	2	3	98.0	0
	Total	**36**	**61**	**3750.0**	**8**
Issyk Kul	Jet-Ögüz	1	2	4.8	0
	Tyup	8	14	262.8	1
	Total	**9**	**15**	**267.6**	**1**
Jalal-Abad	Aksy	1	2	400.0	1
	Ala-Buka	1	2	480.0	1
	Bazar-Korgon	1	2	231.0	0
	Nooken	3	5	3240.0	7
	Toktogul	1	2	26 500.0	56
	Total	**7**	**12**	**30 851.0**	**65**
Naryn	Kochkor	1	2	2550.0	5
	Total	**1**	**2**	**2550.0**	**5**
Osh	Kara-Suu	1	2	710.0	2
	Nookat	1	2	450.0	1
	Uzgen	1	2	5400.0	11
	Total	**3**	**5**	**6560.0**	**14**
Talas	Talas	2	3	3065.0	6
	Total	**2**	**3**	**3065.0**	**6**
Grand Total		**59**	**100**	**47 311.0**	**100**

Fish ponds

The majority of fish ponds and small reservoirs in Issyk Kul Province are barrage ponds (Plate 3). They are located in cascades and receive continuously flowing water input from underground sources and springs, which then flow out through pond outlet structures[2] resulting in a constant exchange of water. Despite the tendency of nutrient levels in groundwater to be on low side, Ryspaev and Woynárovich (2008) reported that intensive development of algae and dense cover of waterweeds, mainly milfoil (*Myriophyllum* spp.), in the ponds and reservoirs indicate that the underground/spring waters are fertile. However, it is not clear whether the algal growth in pond water is caused by the nutrient load in underground/spring water or by farmers adding nutrients into pond water to stimulate algal growth. The total area of fish ponds is about 1 533.5 ha; the pond belong to many different fish farms (listed in Tables 7, A2.5, A2.12 and A2.26).

Underground waters

Groundwater is of great importance for the water supply to settlements, and for irrigation, agricultural, subsistence and other industrial needs in Kyrgyzstan. The country has more than 250 springs and wells composed of mineral and thermal waters of all types and varieties, used widely for drinking and medicinal purposes. The temperatures of warm and hot thermal waters range from 20 to 100 °C, and they are mainly distributed in the South, Mid- and North Tenir in Issyk-Ata, Alamudun, Ak-Suu (Teploklyuchenka), Jalal-Abad, Altyn-Arashan Gull, and other similar areas.

About 5 600 underground wells have been drilled to provide 4.9 million m^3 of water on a daily basis, 1.7 million m^3 in the south of the country and 3.2 million m^3 in the north.

Artesian pools are repositories of groundwater in the upper and middle structural and hydrological floors and are also a significant resource of freshwater. In Kyrgyzstan,

PLATE 1
Fish ponds around Lake Issyk Kul

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[2] These are either sluice or monk outlets (FAO, 1994, Figure 73).

there are about 50 artesian basins, with a total flow of 330 m^3/s; 30 of them are classified as large or medium. Large and medium-sized repositories are located in Chui, Talas, Issyk Kul, At-Bashy, Caravan Kokzharsky, Nookat, Alay and Fergana Ortoalyshsky. Smaller reserves are in Alabuga-Naryn, Susamir, Zhumgalskom, Toktogul and Chatkal. The total operational artisanal groundwater is equal to 5.2 million m^3 per day with 38.5 percent supplied to households for drinking and other uses, 44.3 percent used for irrigation and 0.8 percent used by industry.

Fresh groundwater is abundant in Kyrgyzstan. Most of it is discharged into river beds, representing about 30–70 percent of the average annual runoff despite the fact that the discharge of rivers from groundwater only occurs between November and March. This is because of the high degree of relief dissection (a dense network of cracks and fractures in the upper crust layer). The presence of thick deposits of unconsolidated sediments in the valleys and foothills (alluvial fans of rivers) result in the blowout of springs. Therefore, springs are found everywhere – in the plains, in riverine parts of the river valleys and on steep slopes. Depending on the hydrogeological conditions of groundwater, it tapers in the form of single spring, or comes to the surface as a linear flow, creating large waterlogged swampy areas.

According to estimates by the Kyrgyz Geological Service, large underground freshwater reserves are concentrated in the Chui (300 km^3), Talas (75 km^3) and Issyk Kul (58 km^3) valleys and this fact explains the abundance of springs in these regions.

In Chui Province, the survey conducted by Kyrgyz Geological Service selected and studied 27 springs, recording elevation and measuring salinity, flow rate, temperature, hardness and chemical composition. The middle and high parts of the region are mainly characterized by bicarbonate-calcium-rich waters with a salinity of 0.1–0.5 g/litre and flow rates of 0.5–1.5 litres/s. The exception is the spring with a wedging at lower Serafimovka, on the right bank of the Noorus River, where the flow is higher.

Chui springs occur at altitudes of 2 000–3 000 m in the mountainous parts of the Jardine-Kaindy, Karabalta, Aksu, Sokuluk, Ala-Archa, Alamedin Issyk-Ata and Kegety basins. In certain basins, such as Kichi-Kemin and Chon-Kemin, springs have a higher flow rate, reaching as much as 4–10 litres/s. Water temperature is between 3 and 11 °C.

A significant part of Chu valley groundwater is discharged into gullies carved in the ground surface to a depth of 5–10 m. They form streams and rivers with a constant flow called "Kara-Suu". The water flow volume can range between 100 and 1 000 litres/s, and, where landforms block this flow, wetlands or lakes are formed. Groundwater-associated wetlands are present in Tokmak, Bishkek and Kara-Balta, supported by a constant flow of 10–100 litres.

PLATE 2

Some of the springs around Lake Issyk Kul. Artesian water with a constant temperature of 13–14 °C (left); hot water used in public bath (centre); flow without use (right)



Source: Ryspaev and Woynarovich (2008).

In Talas Province, 19 springs were surveyed for salinity, flow rate, temperature, hardness and chemical composition. On the basis of the lithological composition of rocks, the springs can be divided into two groups:

- Those formed in the non-metamorphosed rocks, such as granite and porphyrite. They are characterized by relatively low flow rates, 1.5–6.0 litres/s, and are generally confined to the middle and upper, steep-slope parts of the river valleys of the Uch-Koshoy, Jong-Koshoy, Karakol, Beshtash and Keksu Rivers.
- Those formed in marble, limestone and memorized limestone, with flow rates of 30–100 litres/s, which then taper in the ravines of the southern slope of the ridge of Kyrgyzskogo valley, Sugata on the west to the valley, and Kenkol to east of Talas valley.

A major source of water with an output of 100 litres consists of wedges of boulder-pebble deposits with a high content of clay loam, which covers the bottom and the sides of the lower parts of the Karakol valley. Almost all the springs in Talas are the bicarbonate-calcium type, have a low salinity (0.02–0.50 g/litre) and their temperature varies between 3 and 10 °C.

In the Issyk Kul region, 30 springs have been surveyed and measures recorded (Plate 2). Of these, 11 are located within the valley of Lake Issyk Kul and the rest are scattered across the mountainous areas of the Tien Shan. Their composition is calcium bicarbonate, with mineralization in the range 0.1–0.7 g/litre. The discharge rates of these springs vary from 0.5 to 23 litres/s.

Springs emerge in the river valley in the east basin of Issyk Kul. They are also located north of Bosteri to Bokonbaevo, which is on the south shore. In the valleys (Sasykbulak, Karagaybulak, Chon-Aksu, Kichi-Aqsa, Baysoorun, Kuturgu, Tyup, Jergalan, Karakol, Jong-Kyzylsuu, Jeti-Oguz Zhuuku, Barskoon and Akterek), there are upwellings of springs with flow rates of 10–15 litres/s.

Along the perimeter of Lake Issyk Kul, where the coastal ground is thinner, accumulated water creates a piedmont plain of unconsolidated sediments. They form a multikilometre strip of wetlands. By creating a network of channels with a concentrated runoff, this water could be used for commercial purposes.

FISH FAUNA

The rivers of Kyrgyzstan are typically mountainous and remote, characterized by high flow rate and low nutrient composition. Therefore, all of the river systems are exclusively inhabited by small indigenous species such as loaches, river and mountain marinka and osman; species that have no or little commercial value (Tables A2.7, A2.7.1, A2.7.2, A2.7.3, A2.7.4, A2.7.5, A2.7.6 and A2.7.7).

The lakes of the country are oligotrophic. Many of them have no fish fauna or their natural fish production capacities remain below 1 kg/ha. Most waterbodies in Kyrgyzstan are characterized by good-water quality, are unpolluted and have a high oxygen content; and this is favourable for the development and culture of many valuable cold-water fish species. For these reasons, commercial fish species were introduced into the country.

A total number of 73 fish species belonging to 15 families are present in Kyrgyz waters (summarized in Table 6 and detailed in Table A2.7). Of these, 49 species are indigenous and 24 species have been introduced, either deliberately or accidently. Out of the 49 indigenous fishes, 6 species are endemic to the water systems of Lake Issyk Kul (Box 2). These are chebachok (*Leuciscus bergi* [Kashkarov, 1925]), chebak (*Leuciscus schmidti* [Herzenstein, 1896]), Issyk Kul naked osman (*Diptychus dybowskii lansdelli* [Gunther, 1889]), Issyk Kul marinka (*Schizothorax issykkuli* [Berg, 1907]), Issyk Kul gudgeon (*Gobio gobio latus* [Anikin, 1905]) and Issyk Kul minnow (*Phoxinus issykkulensis* [Berg, 1912]).

TABLE 6

Summary of indigenous and introduced fish species in Kyrgyzstan

Order, family and species	Indigenous	Introduced	Total
Acipenseriformes		**1**	**1**
Acipenseridae		**1**	**1**
Acipenser baerii (Brandt, 1869)		1	1
Salmoniformes	**1**	**5**	**6**
Coregonidae		**3**	**3**
Coregonus lavaretus Ludoga (Poljakov, 1874)		1	1
Coregonus migratorius (Georgi, 1775)		1	1
Coregonus peled (Gmelin, 1789)		1	1
Salmonidae	**1**	**2**	**3**
Oncorhynchus mykiss (Walbaum, 1792)		1	1
Salmo ischchan Issykogegarkuni (Lushin, 1932) (Lushin, 1932)		1	1
Salmo trutta oxianus (Kessler, 1874)	1		1
Esociformes	**1**		**1**
Esocidae	**1**		**1**
Esox lucius (Linnaeus, 1758)	1		1
Cypriniformes	**42**	**11**	**53**
Balitoridae	**3**		**3**
Nemachilus kuschakewitschi (Herzenstein, 1890)	1		1
Nemachilus oxianus (Kessler, 1877)	1		1
Nemachilus paradoxus (Turdakov, 1955)	1		1
Cobitidae	**6**		**6**
Cobitis aurata aralensis (Kessler, 1877)	1		1
Nemachilus dorsalis (Kessler, 1872*)* [synonym of *Triplophysa dorsalis* (Kessler, 1872)]	1		1
Nemachilus stoliczkai (Steindachner, 1866) (synonym of *Triplophysa stoliczkai* Steindachner, 1866)	1		1
Nemachilus stoliczkai (Steindachner, 1866)	1		1
Nemachilus strauchi (Kessler, 1874)	1		1
Nemachilus strauchi ulacholicus (Anikin, 1905)	1		1
Cyprinidae	**33**	**11**	**44**
Abramis brama orientalis (Berg,1949) (synonym of *Abramis brama* (Linnaeus, 1758)		1	1
Alburnoides taeniatus (Kessler, 1874)	1		1
Aristichthys nobilis (Richardson, 1845)		1	1
Aspiolucius esocinus (Kessler, 1874)		1	1
Aspius aspius (Linnaeus, 1758)	1		1
Barbus brachycephalus (Kessler, 1872)	1		1
Aspius aspius iblioides (Kessler, 1872)		1	1
Barbus capito conocephalus (Kessler, 1872)	1		1
Capoetobrama kuschakewitschi (Kessler, 1872)	1		1
Capoetobrama kuschakewitschi orientalis (Nikolskii, 1934)	1		1
Carassius auratus gibelio (Bloch, 1783)		1	1
Ctenopharyngodon idella (Valenciennes, 1844)		1	1
Cyprinus carpio (Linnaeus, 1758)	1		1
Diptychus dybovskii bergianus (Turdakov, 1952)	1		1
Diptychus dybovskii (Kessler, 1874)	1		1
Diptychus dybowskii kessleri Russky, 1888	1		1
Diptychus dybowskii lansdelli (Gunther, 1889)	1		1
Diptychus gymnogaster (Kessler, 1879)	1		1
Diptychus gymnogaster micromakulatus (Imanov, 1950)	1		1
Diptychus gymnogaster oschanihi (Berg, 1914)	1		1
Diptychus micromaculatus (Turdakov, 1955)	1		1
Diptychus sewerzovi (Kessler, 1872)	1		1
Gobio gobio latus (Anikin, 1905) [synonym of Gobio Gobio (Linnaeus, 1758)]	1		1
Gobio gobio lepidolaemus (Kesssler, 1872) [synonym of Gobio Gobio (Linnaeus, 1758)]	1		1
Hemiculter leucisculus (Basilewski, 1855)		1	1
Hypophthalmichthys molitrix (Valenciennes, 1844)		1	1

TABLE 6 (CONTINUED)

Order, family and species	Indigenous	Introduced	Total
Leuciscus bergi (Kashkarov, 1925)	1		1
Leuciscus leuciscus kirgisorum (Berg 1912) [synonym of Leuciscus leuciscus (Linnaeus, 1758)]	1		1
Leuciscus lindbergi (Zanin & Eremejew, 1934)	1		1
Leuciscus schmidti (Herzenstein, 1896)	1		1
Leuciscus squaliusculus (Kessler, 1872)	1		1
Phoxinus dementjevi (Turdakov & Piskarjov, 1954)	1		1
Phoxinus issykkulensis (Berg, 1912)	1		1
Pseudorasbora parva (Temminck & Schlegel, 1846)		1	1
Rhodeus sericeus (Pallas, 1776)		1	1
Rutilus rutilus aralensis (Berg, 1916)	1		1
Scardinius erythrophthalmus (Linnaeus, 1758)	1		1
Schizothorax issykkuli (Berg, 1907) [synonym of Schizothorax pseudoaksaiensis issykkuli (Berg, 1907)]	1		1
Schizothorax tschuensis (Pivnev, 1985)	1		1
Schizothorax intermedius eurycephalus (Berg, 1932)	1		1
Schizothorax intermedius intermedius (McClelland, 1842)	1		1
Schizothorax intermedius talassi (Turdakov, 1955)	1		1
Schizothorax pseudaksaiensis (Herzenstein, 1889)	1		1
Tinca tinca (Linnaeus, 1758)		1	1
Siluriformes	**2**		**2**
Sisoridae	**1**		**1**
Glyptosternon reticulatum (McClelland, 1842)	1		1
Siluridae	**1**		**1**
Silurus glanis (Linnaeus, 1758)	1		1
Cyprinodontiformes		**1**	**1**
Poeciliidae		**1**	**1**
Gambusia affinis holbrookii (Baird & Girard, 1853)		1	1
Gasterosteiformes	**1**		**1**
Gasterosteidae	**1**		**1**
Pungitius platygaster (Kessler, 1859)	1		1
Perciformes	**1**	**5**	**6**
Channidae		**1**	**1**
Channa argus warpachowskii (Berg, 1909)		1	1
Eleotridae		**1**	**1**
Perccottus glenii (Dybowski, 1877)		1	1
Gobidae		**1**	**1**
Rhinogobius similis (Gill, 1859)		1	1
Percidae	1	2	3
Lucioperca lucioperca (Linnaeus, 1758) [synonym of Sander lucioperca (Linnaeus, 1758)]		1	1
Perca fluviatilis (Linnaeus, 1758)	1		1
Perca schrenkii (Kessler, 1874)		1	1
Scorpaeniformes	**2**		**2**
Cottidae	**2**		**2**
Cottus jaxartensis (Berg, 1916)	1		1
Cottus spinolosus (Kessler, 1872)	1		1
Total	**49**	**24**	**73**

BOX 2

Mobile fish hatchery

In 2008, the United Nations Development Programme / Global Environment Facility (UNDP/GEF) project Strengthening Policy and Regulatory Framework for Mainstreaming Biodiversity into Fishery Sector started the programme of artificial propagation of the most vulnerable endemic species (naked osman and marinka) of Lake Issyk Kul. To propagate these fish two mobile hatcheries were designed and built.

In these hatcheries, which are stationed at the vicinity of the spawning sites of the targeted species, eggs, received through induced ovulation of sexually matured females, are fertilized, incubated and hatched. After hatching the developing fries are reared to an advanced size before they are stocked back into the lake (see plate).

Mobile fish hatchery for the propagation of endemic naked osman and marinka in 2011 (above). Broodfish of naked osman and larvae of marinka (below)

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Source: Alamanov (2008); Ryspaev and Woynárovich (2008), Alamanov and Mikkola (2011).

2. The fisheries in Kyrgyzstan

THE FISHERIES DURING THE SOVIET PERIOD

Between 1980 and 1990, fisheries were well-developed and profitable sectors of the Kyrgyz economy. The yearly average fish catch was more than 1 400 tonnes, and fish production in ponds exceeded 1 000 tonnes. The development of the fishing industry was achieved with the active participation of a number of stakeholders, including the fishing and aquaculture industries of Kyrgyzstan. The national fisheries organizations operated under the Ministry of Fisheries of the then Soviet Union and were divided into the following divisions/departments:

1. Office of Fisheries:
   - responsible for developing and improving fisheries management;
   - managed three commercial pond fish farms: Uzgen (290 ha), Talas (364 ha), Chu Regional Fish Hatchery[3] (370 ha) experimental zone hatcheries, Ton Fish Hatchery (15 ha) and Karakol Fish Hatchery (25 ha);
   - managed Issyk Kul fish processing plant;
   - coordinated the Central Laboratory for Control Fisheries and Production and its mobile unit.

2. Office of East-Central Asian Fishery Management:
   - responsible for the protection and reproduction of fish stocks and fisheries management in the waters of the Kirghiz Soviet Socialist Republic (SSR) and Tajik SSR;
   - this organization contained the Central Asian Production and Acclimatization Station, which itself had the following responsibilities:
     - stocking of lakes and reservoirs with salmon, whitefish, carp and other fish species and feed organisms to enhance commercial, sporting and recreational fisheries,
     - ichthyological expedition services, network control and monitoring stations and points,
     - district and divisional inspection of fisheries,
     - working with the Institute of Biology of the Academy of Sciences of the Kirghiz SSR, provided guidance for ichthyological, hydrobiological and fishery research and provided the scientific and biological basis of the development of the fishing industry. Fisheries related research was carried out by the Cholpon-Ata Bio-station which operated under the Institute of Biology of the National Academy of Sciences;
   - working with the management of Kyrgyz Fish Industrial Marketing, to ensure fish and high-protein fishery products for the population;
   - the Central Laboratory for Fisheries Production, in cooperation with scientists of the Academy of Sciences and the specialists of fish diseases at the Republican Veterinary Laboratory, were responsible for diagnosing and controlling fish diseases. The quality control of fish feeds were carried out by the veterinary and bacteriological laboratories;

[3] It is now managed by Balyk joint-stock company (Sarieva et al., 2008).

3. Issyk Kul Fishery Combinate:
   - state-owned, it was the only company responsible for the entire industrial fishing in three waterbodies, *viz*., Lakes Issyk Kul and Son-Kul and the Toktogul reservoir. In other smaller reservoirs, the requirements to accommodate fish fauna and the need for irrigation water were harmonized in order to ensure natural propagation of fishes;
   - commercial pond fish farming was practised at the Uzgen, Frunze (now Sturgeon JSC) and Talas fish farms, and the artificial propagation of commercial fish species in the Ton and Karakol (now Karakolbalygy LLC) hatcheries.

In many former socialist countries, sport fishing was considered one of the most important recreational opportunities people had, hence political and financial support was given to sport fishing. The Kyrgyz Hunting and Fishing Union (HFU) was established in 1959. It was well organized, with branches in all provinces. People paid a minimal daily fee of 50 kopeks, for which they were allowed to catch a maximum of five fish (Sarieva *et al*., 2008).

CURRENT STATE OF THE FISHERIES

Fishery administration

After independence, in the early 1990s, the responsibility for fisheries was given to the Republican Industrial Association of Fisheries under the Agro-industrial Committee. Later in 1994, the Republican Industrial Association of Fisheries was converted into a private stock corporation, Kyrgyzbalygy, and the Central Asian Production and Acclimatization Station became responsible for stocking and species introductions.

In 1997, the Department of Fisheries (DOF) was created, but it lasted only a short time and was abolished in July 2000. Its functions were handed over to the Ministry of Agriculture, Water Resources and Processing Industry (MAWRPI), and a new unit called the Sector of Fishery Industry was created in this ministry. Its main mandate was to improve fisheries management. The creation of the Sector of Fishery Industry improved the state of the fisheries through increased attention to research, reproduction, conservation and management. In 2001, the Sector of Fishery Industry was abolished, and its functions were turned over to the Fisheries Inspection Service. In 2003, this inspectorate introduced various measures to improve fisheries, *inter alia*, banning whitefish and trout fishing. However, weak enforcement of management measures resulted in an increase in poaching, and the ban on whitefish and trout did not result in any improvement in the fish stocks. Licences for catching fish were issued by the Fisheries Inspection Service of the MAWRPI from 2004 (Sarieva *et al*., 2008).

In order to organize further development and improved fisheries management in Kyrgyzstan, Government Decision No. 874 (November 2004) re-formed the DOF under the MAWRPI, where it remains today. At present, according to the "Law on Fishery", the DOF is specifically responsible for the fisheries development of seven waterbodies of national importance, *viz*., Lakes Issyk Kul, Son-Kul and Kara-Suu and the Ortho-Tokoi, Kirov, Toktogul and Bazar-Korgon reservoirs. In addition, the DOF manages:

- three state-owned enterprises (Ton Fish Hatchery, Uzgen Fish Farm and Talas Fish Farm);
- three State agencies (Son-Kul Fish Farm, Toktogul Fish Farm and Bazaar-Korgon Fish Farm).

The DOF is also responsible for the collection of yearly fish production data for all types of waterbodies. Data are collected quarterly in a standardized format (Form No. 28).

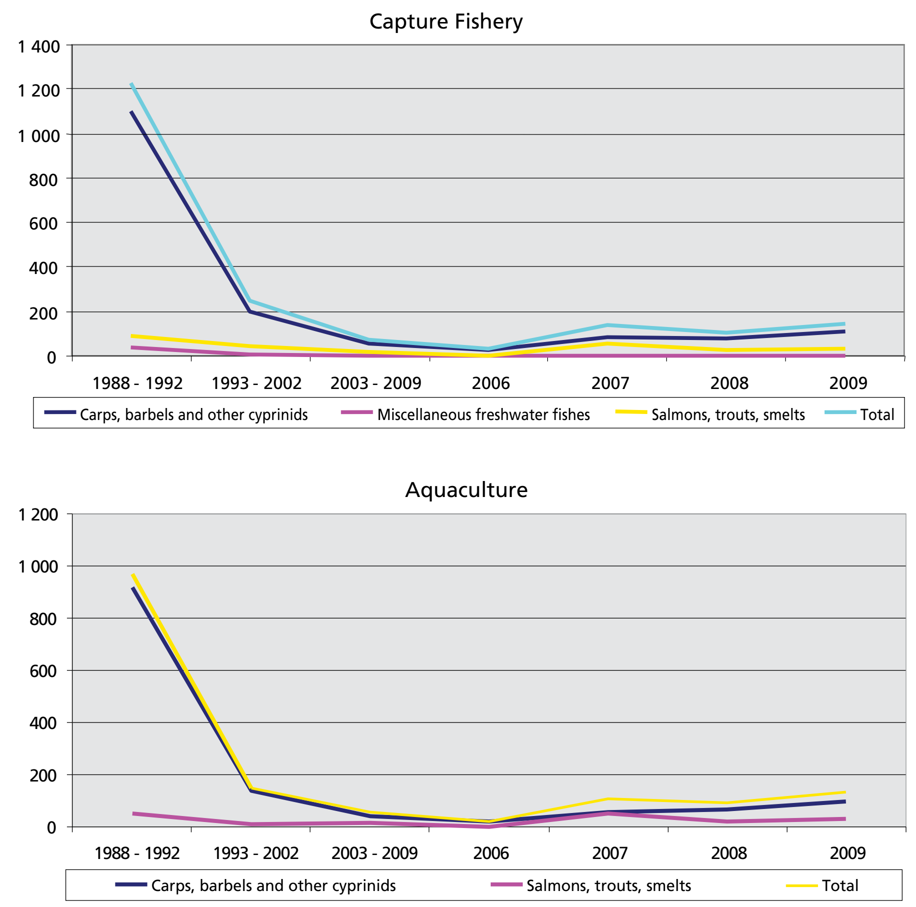
In addition to the state fishery institutions and enterprises, there is the HFU (or Kyrgyzohotrybolovsoyuz). It has responsibility for all rivers and reservoirs where fishing has no intrinsic commercial importance. In order to obtain a long-term or annual fishing licence, recreational fishers must be members of the HFU. As a general rule a recreational fisher is allowed to use up to five fishing rods and to catch up to 5 kg of fish per day. However, in order to catch certain native species (osman and river trout), it is necessary to buy an additional special three-day permit which allows five fish to be caught. The HFU issues licences for 10 000 river trout and 6 500 river osman annually. Only 100 permits are sold for each of the rivers that have been stocked for the purpose of recreational fishing (Table A2.8) (Sarieva *et al.*, 2008).

Changes in fisheries management that have occurred during the post-Soviet period do not favour the recreational and sport fishing, and little attention is paid to this subsector by government. The government provides access to a smaller number of the reservoirs and ponds, which had been managed by HFU in the past, although the pricing system for leases of reservoirs have changed with increasing lease fees for the HFU. In addition, many of the reservoirs offered for lease become practically empty during summers because water is allocated for irrigation purposes.

Fishery management of surface waters

The crisis in fisheries, with declining fish catches and lack of initiatives for further development of both the fishery and fish culture sectors, started during the transitional period. Capture and production levels achieved in the 1980s declined significantly, to about 3.3 percent by 2006, but have recovered slightly, up to 6.5 percent on the levels of the 1980s by 2009 and up to 15.8 percent by 2010 (Figure 3 and Tables A2.13, A2.14, A2.15, A2.16, A2.20, A2.21 and A2.22).

FIGURE 3
Output (in tonnes) of the capture fishery and aquaculture sectors in Kyrgyzstan, 1988–2009



The fishery in Lake Issyk Kul was depleted to a very low level by overfishing and mass poaching, added pressure from the previous addition of predatory fishes, inadequate financing of hatcheries and poor fish inspections, among others. As a result, the President of the Kyrgyz Republic declared a moratorium on artisanal and commercial fish catching in Lakes Issyk Kul and Son-Kul for 5 years for the period 2008–2013 (Alamanov and Mikkola, 2011).

In addition to the large lakes and reservoirs, there are 1 914 smaller lakes, but most of them cannot be exploited for fisheries purposes because they are located high in the mountains and the roads to them are not adequate. Often, these lakes are very small in size and could not support even moderate fish populations. They also remain cold during summers and freeze to the bottom in the winters, and this complicates continuous fisheries exploitation. Only fishes with a short growth period would be suitable. Moreover, most of them are located in protected national parks, which further restricts their potential use for fish culture. Therefore, it is not possible to consider stocking these waters with fish.

To provide fish for sport fishers, only Amu Darya trout is stocked in rivers. It is an omnivorous species that consumes both benthic organisms and non-target fish species, such as river osman and river loaches. Table A2.8 lists the rivers in which the stocking of Amu Darya trout and osman takes place where the stocked species has established itself.

In general, stocking of the main irrigation channels is not considered feasible. In summer, the water in the canals is almost entirely diverted for irrigation and they become very shallow. However, the integrated utilization of irrigation waters for fish culture could be feasible (Chapter 5).

Fish culture

Pond fish culture

The condition of pond structures, buildings and other infrastructure, machinery and equipment has deteriorated at state-owned pond farms. Deterioration commenced before privatization and has continued since, without specific plans for improvement. Similar to the collapse in capture fisheries, production at pond fish farms has also declined sharply (Tables 7, A2.13, A2.14, A2.15, A2.16, A2.20, A2.21, A2.22 and A2.26).

In the last 15 years, most of the fish ponds and reservoirs that could be used for fish culture have not been used for this at all, but instead used for watering livestock and for irrigation. In part, there has been a scarcity of suitable high-quality fish seed. At present, most of the fish ponds are leased from the government for 49 years, either by individual persons or enterprises. Leaseholders have then started to use these waters for both watering livestock and irrigation, but also increasingly for producing fish.

In recent years, surveys of small waterbodies around Lake Issyk Kul have identified those ponds suitable for pond culture, and communications with owners and leaseholders have shown that there is an increasing interest in resurrecting pond aquaculture. Between 2009 and 2011, government officers and fish farmers received technical training through the United Nations Development Programme/ Global Environment Facility (UNDP/GEF) and GCP/KYR/003/FIN projects in both Kyrgyzstan and abroad (Hungary and Finland). Therefore, while technical understanding has increased, the most acute problem remains having a continuous supply of good-quality fish seed for the fish farms and small waterbodies.

An accurate and up-to-date list of fish farms is summarized in Table 7 and may help the public state and private sectors to plan and develop their activities in both culture-based fisheries and aquaculture. Out of the many pond fish farms summarized in Table 7 and Table A2.12, Uzgen, Talas, Ton, Karakol, Chui and Uch-Terek are the largest and brief details on them are provided below.

TABLE 7
Summary list of pond fish farms in 2011

Province	Ownership	No. of farms	No. of ponds	Total area (ha)	Fish species	Production		
						Larvae (1000 pcs.)	Fry and fingerling (1000 pcs.)	Table fish (tonnes)
Issyk Kul	State	1	1	12.0	Common Carp			55.5
	Private	13	13	106.0	Silver Carp, Grass Carp			50.7
	Leased	39	61	213.0	Sevan Trout			6.5
	Total	**53**	**75**	**331.0**				**112.7**
Chuy	State	-	-	-	Common Carp			31.7
	Private	3	3	8.0	Silver Carp, Grass Carp			38.1
	Leased	23	64	655.0	Silver Carp, Grass Carp			
	Total	**26**	**67**	**663.0**				**69.9**
Talas	State	1	7	80.0	Common Carp			141.2
	Private	5	39	250.0	Silver Carp, Grass Carp			23.2
	Leased	3	2	16.0	Silver Carp, Grass Carp			
	Total	**9**	**48**	**346.0**				**164.4**
Osh	State	1	41	172.0	Common Carp			14.1
	Private	5	34	11.5	Silver Carp, Grass Carp			8.4
	Leased	2	4	2.5	Silver Carp, Grass Carp			
	Total	**8**	**79**	**186.0**				**22.5**
Jalal-Abad	State	1	1	0.5	Common Carp			2.6
	Private	9	10	5.5	Silver Carp, Grass Carp			1.6
	Leased	1	15	1.5	Rainbow Trout			10.5
	Total	**11**	**26**	**7.5**				**14.7**
Naryn	State	1	1	-	Peled, Whitefish			0.5
	Private	-	-	-				-
	Leased	-	-	-				-
	Total	**1**	**1**	**-**				**0.5**
Total – state		**5.0**	**51**	**264.5**				**245.6**
Total – private		**35.0**	**99**	**381**				**122.0**
Total – leased		**68.0**	**146**	**888**				**17.0**
Total		**108.0**	**296**	**1533.5**				**384.6**

Source: Sunil Siriwradena, International Team Leader, FAO Project Support to Fishery and Aquaculture Management in the Kyrgyz Republic (GCP/KYR/003/FIN), personal communication, 2011.

Talas Fish Farm was constructed in 1975. It is located in Bakai-Ata District of Talas Province. It was designed for an annual production of 600 tonnes of table fish. Its total area is 364 ha, of which 296 ha for table fish production, 68 ha for nursery rearing of fish fry and 0.2 ha for over-wintering. The main fish species produced are common carp, grass carp and silver carp.

Uch-Terek Fish Farm was established in 2001 in the Toktogul District of Jalal-Abad Province. Previously, the farm had been a site for the reproduction of fish (including common carp, grass carp, silver carp and Sevan trout) and for fishing (in that part of the Toktogul reservoir belonging to the Uch-Terek Rural Administration). This fish farm rents an area of 10 165 ha. Sites are located in the south and southeast of the reservoir and are characterized by strong current and depth – located in the former bed of the Naryn River, which is a favourable site for the cage culture of trout. At present, the farm's functions are limited to issuing permits to fishers to fish in the reservoir.

Toktogulsky Fish Farm was founded in 1990, also in the Toktogul District. Its activities include reproduction of common carp, grass carp, silver carp and Sevan trout, as well as fishing in the Toktogul reservoir in the part belonging to the Toktogul Rural Administration. It rents an area of 16 335 ha from the government. The fishing sites are located in the north and northwest of the reservoir and are characterized by greater uniformity in shape, less depth and richness of natural fish food supply for Chinese major carps. This area is also favourable for cage fish culture.

There are two state-owned fish farms (Uzgen Fish Farm and Ton Fish Hatchery) and one private fish farm (Karakol Fish Hatchery) that deal with the propagation of cultured fish species. Their total production in 2010 was 6.5 million common carp, 10.2 million Chinese major carps, 0.9 million Sevan trout and 1.9 million whitefish (Tables A2.24 and A2.25).

Uzgen Fish Farm is located in Osh Province and was built in 1968. At the time, the ponds were built to high fish-breeding and biological standards. The farm covers 290 ha, with 224.3 ha occupied by ponds to produce table fish, at an annual capacity of 500 tonnes. In addition, 47.1 ha are for nursery rearing of fish fry, 9.7 ha for broodfish development and quarantine, 4.6 ha for wintering, 3.6 ha for spawning, and the hatchery covers 0.6 ha. The fish farm is located in a mild continental zone and therefore offers favourable conditions to grow common carp, grass carp and silver carp over a high number of productive months.

Ton Fish Hatchery is a state-owned fish farm specializing in the artificial propagation of Sevan trout. It was built in 1964 and is located in the Ton District of Issyk Kul province. Until 2011, Sevan trout were trapped on the Ton River during their annual migration to spawn, using a specially designed trap (Plate 3), but in 2011 it was destroyed during river floods. Captured fish were kept in brood tanks and fry propagated (up to 10 million) for distribution to the farm ponds (Plate 4). Originally, there were ten large fish ponds, although the ones farthest away from the farm were privatized in 2000.

In addition to Sevan trout, the farm also supplies about 2 million common carp fingerlings. At 15–17 °C, the temperature of the hatchery water is below the optimum required to incubate common carp eggs and rear larvae. Therefore, heaters were installed in 2008, but these proved too expensive to operate. Currently, a less-expensive technique is used, whereby one of the fish ponds in the farm supplies water for the incubators, which are placed below the base of a dyke through which water is allowed to flow by gravity, and during the process the flowing water increases in temperature (Plate 4).

Karakol Fish Hatchery (or LLC Karakolbalygy) is privately owned and located in the Ak-Suu District of Issyk Kul Province. It specializes in the artificial propagation of valuable fish species, such as Sevan trout (2.0 million larvae/year) and common whitefish (15 million larvae/year). It was once a well-equipped hatchery but its condition deteriorated during the transition period, and the remaining hatchery equipment is now in a generally poor state (Plate 4). As at other private fish farms, the most acute problem is a lack of funds to upgrade the worn-out production equipment in the hatcheries and fish ponds.

PLATE 3

Sevan trout broodfish were previously captured in the Ton River, but today (2011) the facility is no longer functional. Captured Sevan trout broodfish (right)

Source: Ryspaev and Woynarovich (2008).

PLATE 4

Provisional pipe supplying water for incubation of carp eggs (top left) and tanks for rearing trout fry and fingerling in Ton fish Hatchery (top right). Zuger jars and larvae rearing tanks in Karakol Fish Hatchery (bottom)

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Tank fish culture

Although suitable cold-water resources are in large supply in Kyrgyzstan that could be used to grow market sized trout for example, there are currently no intensive fish tank farms in the country that do so.

The tank farms that do exist produce only fry and fingerlings (Plate 5) that are then supplied to larger pond farms and to cage culture. In the Ton hatchery, fingerlings

PLATE 5

Tanks used for rearing trout fry and fingerlings

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of Sevan trout are produced in different concrete, fibreglass and plastic-membrane tanks. Elsewhere, there is an increasing number of small tank farms within the Lake Issyk Kul area that are taking imported eyed eggs of rainbow trout, which are then incubated and developed into fry. Rainbow trout fry are then delivered to cage farms in Lake Issyk Kul.

Cage fish culture

Lake Issyk Kul has a number of characteristics that make it an attractive investment proposition for cage culture. It is large, has a large water volume, has good-quality water that is cool and importantly it does not freeze in winter despite its elevation. The cage farming of rainbow trout (Plate 6), a cold-water species native to the Americas and which is exotic to the lake, has expanded significantly. According to DOF statistics, there are four different companies growing rainbow trout in 21 growout and 8 fry-rearing cages in the lake (Table 8) producing 155.6 tonnes of fish annually, from a peak of 8 companies producing 300 tonnes in 26 cages in 2009 (Alamanov and Mikkola, 2011). It is understood that many foreign investors are planning to invest in expanding this cage culture activity, although there are issues with this.

Lake Issyk Kul is part of an internationally renowned biosphere reserve, designated in 2001 by UNESCO, and is itself a Wetland of International Importance (Ramsar), designated in 1976 – both factors entailing some responsibility to manage it well. Rainbow trout are thought to have escaped from these cage farms (Plate 71), and, as a predatory species, they can have a negative impact on the indigenous population. Moreover, as the country does not have the right legislative framework or the capacity in place to monitor, evaluate and regulate cage culture, expansion is questionable at present.

PLATE 6
Cage fish farms on Lake Issyk Kul

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TABLE 8
Rainbow trout cage culture operations on Lake Issyk Kul

Since (year)	Company	Location	Cages for fingerling		Cages for growout		Production in 2011 (tonnes)
			No.	Total Volume (m^3)	No.	Total Volume (m^3)	
2006	Aquafund (ОсОО «Аквафонд»)	Issik-Kul Lake (9 fishing section «Ak-Terek»).	4	72	7	17 500	96.4
2005	Eco-International (ОсОО РПО «Экос-Интернэшнл»)	Issik-Kul Lake (15 fishing section «Тон»).	2	36	10	25 000	57.0
2007	Aquada (ОсОО «АкваДа»)	Issik-Kul Lake (13 fishing section «Ak-Sai»).	0	0	2	5000	0.5
2007	Abyl (Крестьянское хозяйство «Абыл»)	Issik-Kul Lake (15 fishing section «Toni»).	2	36	2	5000	1.7
		Total	**8**	**144**	**21**	**52 500**	**155.6**

PLATE 7
Escaped rainbow trout captured in and around Lake Issyk Kul. Rainbow trout captured near a cage farm in Lake Issyk Kul (left). Rainbow trout captured by anglers on the Ton River (right)

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Illegal fishing

Until recently, the fish stocks in Lake Issyk Kul provided a means of food security for the local people. In the Soviet era, when a state company controlled the fishing in the lake, local people had access to fish in the lake through informal channels. However, from the beginning of 1990s, there was less control of both legal and illegal fishing and at the same time the financial conditions of families worsened, leading to poverty. Hence, illegal fishing became an important source of supplementary income, and, with many people doing it, had the potential to affect fish stocks overall. Since the moratorium was introduced in 2008, illegal fishing has continued. However, the real threats to the fish fauna of the lake are from people who poach fish and trade in large quantities (Ryspaev and Woynárovich, 2008; Alamanov and Mikkola, 2011).

Because of the availability of cheap monofilament gillnets (Figure 12) throughout the country, together with a lack of proper monitoring and surveillance, poaching of fish is a rather easy task in Kyrgyzstan. The practice of laying a few hundred metres of gillnets is widespread in Lake Issyk Kul. Many of the nets are lost or abandoned, and it has been estimated that there are several thousand ghost nets in the lake, which would require huge resources to recover.

Inspections on the lake are limited. The State Agency of Environmental Protection and Forestry employs 54 people and hires 18 inspectors, while the DOF has 7 inspectors on Lake Issyk Kul. The salary of all these inspectors is low (USD70–85

PLATE 8
Gill nets collected from Lake Issyk Kul

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PLATE 9
Typical pictures of anglers in Kyrgyzstan

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per month) and, according to sources at the State Agency of Environmental Protection and Forestry, there are no additional financial incentives involved in monitoring and surveillance operations. Their working conditions, including transport and communication facilities are very poor, resulting in low morale and motivation, which may open them to being vulnerable to corruption (Alamanov and Mikkola, 2011). Such conditions do not allow an effective monitoring and surveillance programme against amateur and professional poachers.

Today, angling is a widespread and popular activity in Kyrgyzstan (Plate 9), and unauthorized angling is common. Owing to the unorganized and uncontrolled angling, planned management of the fish fauna of Kyrgyz waters seems to be a very difficult task.

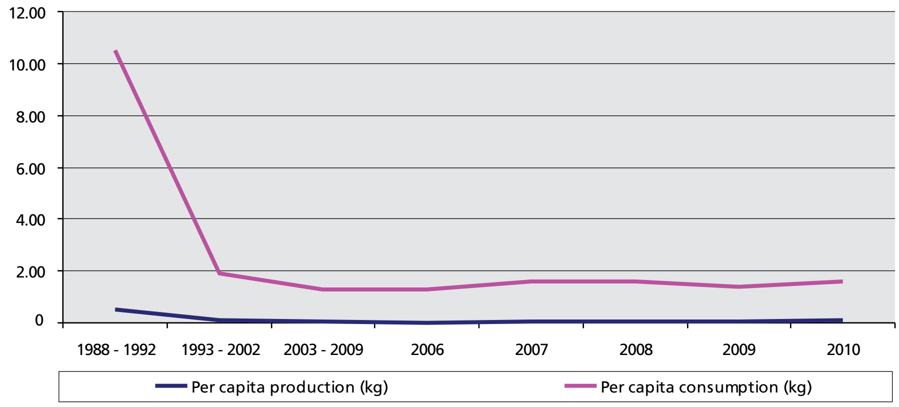
FISHERIES IN THE NATIONAL CONTEXT

In the Soviet period, fisheries were heavily subsidized. More than 1 000 people were employed in the sector, and their relative earnings were high. They were provided with means of transport (including several hundred boats) and fishing gear (Sarieva *et al.*, 2008). Following the decline in capture fisheries, prior to 2008, the number of people legally employed in the sector decreased from 1 000 to 70–75 people. Per capita fish consumption dropped between 1998 and 1991 and then remained low, but nonetheless was steady after independence (Figure 4, Plate 8 and Table A2.19) – generally maintained through increased importation of fish.

INTERNATIONAL SUPPORT TO THE FISHERIES OF KYRGYZSTAN

In February 2007, the Government of the Kyrgyz Republic, through the MAWRPI, requested FAO to provide technical assistance for the sustainable development and

FIGURE 4
Per capita production and consumption (in kilograms) of fish and fish products in Kyrgyzstan, 1988–2010



management of the fishery sector. FAO, through its European Community (EC/FAO) facility for consultancy services, approved Project GCP/GLO/162/EC – Kyrgyzstan – Development of Inland Fisheries and Aquaculture in the Kyrgyz Republic to Reduce Rural Food Insecurity. One of the results of this support was the elaboration of FAO Fisheries Circular No. 1030 (Sarieva *et al.*, 2008). This document had two main aims:

- First, it was intended to inform those interested in fisheries and aquaculture in Kyrgyzstan about the current situation with regard to fishery resources and their utilization in the country.
- Second, it attempted to provide an example of a consultative and participatory policy framework development process, and one that might also be useful for other countries in transition in the Central Asian region.

In addition to the above-mentioned points, the "Strategy for fisheries and aquaculture sector development and management in the Kyrgyz Republic (2008–2012)" was also prepared and presented to the Government of Kyrgyz Republic (Sarieva *et al.*, 2008).

By the second half of 2008 the UNDP/GEF project Strengthening Policy and Regulatory Framework for Mainstreaming Biodiversity into Fishery Sector (PIMS 3217) had been approved. The project was prepared because the native fish species had become seriously threatened by alien species and by overfishing. The primary root of the predicted loss of endemic species and the associated threat of extinction was summarized as follows:

- a massive increase in unregulated fishing in recent years;
- a virtual halt to the artificial restocking of the lake with juveniles of the four commercial endemic species;
- the introduction of several alien predatory species that were not being controlled.

The Government of the Kyrgyz Republic tried to provide a long-term scheme to promote the sustainable development of national resources, and fisheries development in particular. However, a number of barriers constrained the attention that could have been paid to integrating the requirements for endemic fish conservation into the fishery management regime.

The project strategy was designed to address the overall concerns relating to fisheries management in Kyrgyzstan by demonstrating a new fishery management regime within Lake Issyk Kul:

- by the conservation of the globally significant biodiversity (endemic fish species);
- within the context of socio-economic concerns, especially regarding poverty and livelihoods.

PLATE 10

Fish supply in the markets of Bishkek, imported fish in the summer market in 2010 (and some possibly produced in Kyrgyzstan)

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One of the key elements of the project is the Biodiversity Friendly Fisheries Management Regime, which was envisaged as being a package of national laws, by-laws and regulations developed and enforced with the objective of stabilizing the endemic fish species in the lake within the framework of a viable, sustainable and enforceable commercial fishery. The stabilization was planned to be achieved through limiting current fishing, controlling the size of introduced species, as well as restocking native species. The aim of this project is to create a mechanism that will ensure that the lessons learned in this project are captured and used in other large lakes that have the potential to generate high economic values through the fisheries of Kyrgyzstan (UNDP Project Document 2008).

The aim of the FAO/Government Cooperative Program (2009–2012) titled Support to Fishery and Aquaculture Management in the Kyrgyz Republic (GCP/KYR/003/FIN) is to support the implementation of the Strategy for Fisheries and Aquaculture Sector Development and Management in Kyrgyzstan (2008–2012). The development objective is to increase the capacity of the fisheries sector to generate food, employment and income for the rural population. This should be done in an environmentally sustainable manner through the introduction of improved aquaculture management, capture fisheries and modern fish processing and marketing. Due for completion in 2013, the main outcomes of the project are:

- a strengthened fisheries and aquaculture research system and well-trained personnel in Kyrgyzstan;
- a DOF capable of leading the management and development of the capture fisheries and aquaculture sector at the national level;
- a functional capture fisheries management system in place at the national and local levels;

availability of capable persons to lead new fish processing facilities and to promote improved fish utilization and marketing;

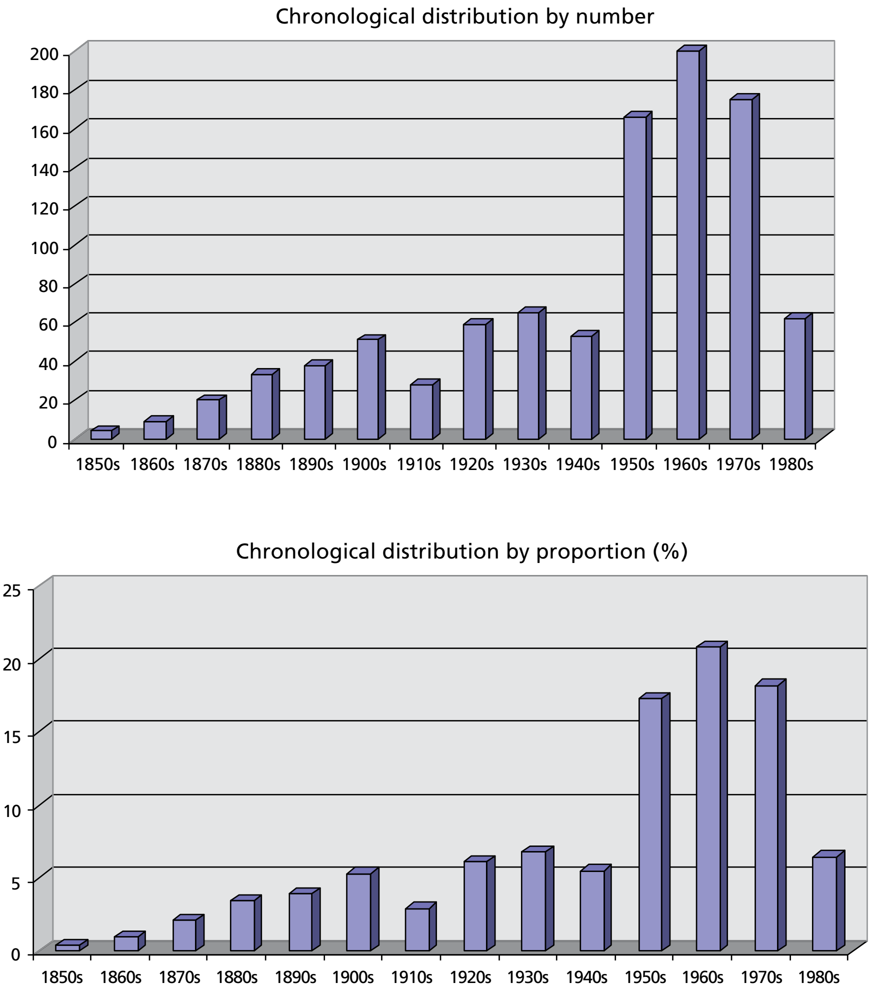
increased awareness in Central Asia of the opportunities provided by modern fisheries management to enhance sustainable production, to generate alternative rural employment, to increase rural food security and to improve the health of the population through higher fish consumption.

3. Introduced fish species in Kyrgyzstan

Although Kyrgyzstan belonged to a domain that was generally closed to the rest of the world, the introduction of new fishes into the country cannot be understood without a brief overview of the worldwide trends that characterized the different eras in which the transfers of major groups of fish species occurred.

According to the most concise document on international introduction of inland aquatic species (compiled by Welcomme [1988]), there had been 1 354 introductions of 237 species into 140 countries by the mid-1980s. Figure 5 shows that most transfers were completed between 1950 and the late 1970s. These figures do not include the transfers that happened within the then Soviet Union, which was considered one country at that time.

FIGURE 5
Chronological distribution of worldwide introductions of fish species between 1850 and 1985, by number and proportion



The reasons for about 21 percent of the international introductions of fish species into new aquatic environment until the early 1980s were unknown. The motives for the remaining introductions included aquaculture, improvement of wild stocks, ornamental purposes, control of unwanted organisms, and sport fishing (Figure 6). About 9 percent of species introductions happened accidently, transported together with other fish species that were introduced on purpose, or resulted from release from aquariums, fish farms or live transports for consumption (Welcomme, 1988).

Figure 7 demonstrates how the purposes for international introductions have changed. Since the 1920s, the proportion of fish species introduced for aquaculture has increased most dramatically, while those for introductions for other reasons have steadily declined. Rainbow trout, common carp, tilapia and Chinese major carps have

FIGURE 6
Purposes of worldwide introductions of fish species between 1850 and 1985

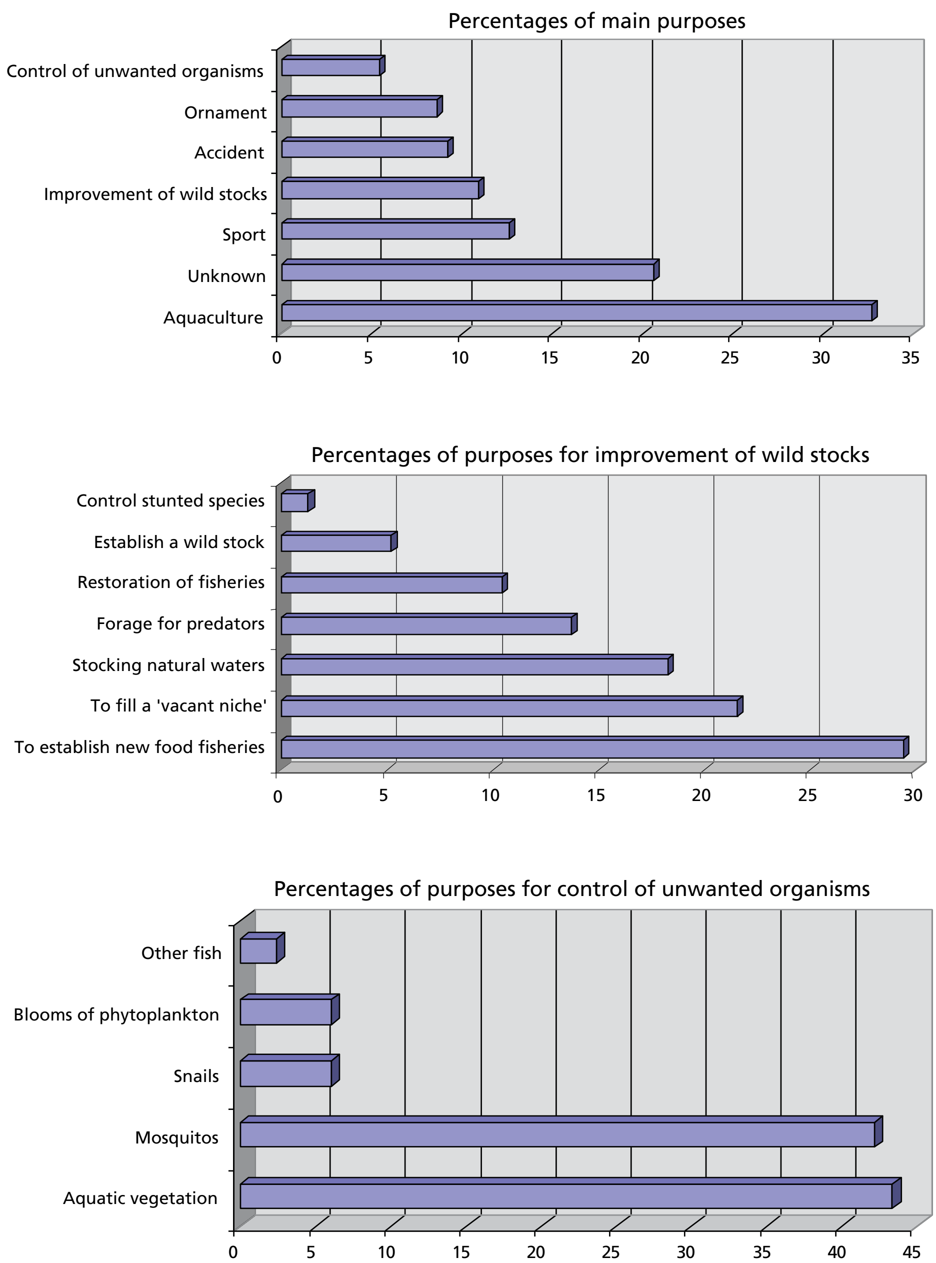


FIGURE 7
Main purposes of worldwide fish introductions between 1850 and 1985, in percentage terms

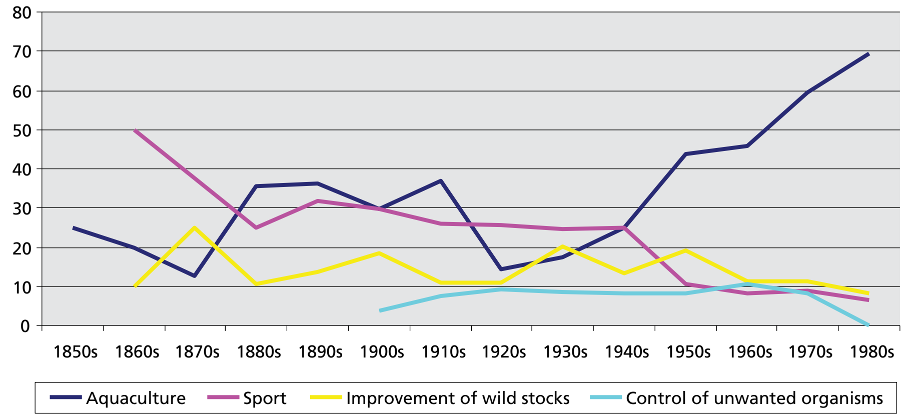
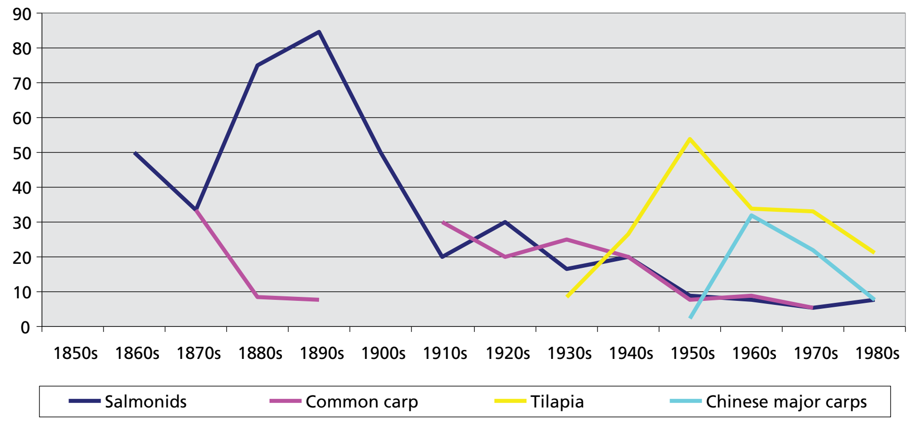


FIGURE 8
Major species groups of fishes introduced for aquaculture worldwide between 1850 and 1985, in percentage terms



been among the most frequently moved species among the many introductions for aquaculture (Figure 8).

Trout was among the first species to gain popularity and reached a peak in the last decades of the nineteenth century. In this period, trout were introduced practically everywhere within the range of their thermal tolerance. Among the other frequently introduced species were Chinese major carps, which boomed during the 1960s (Figure 8).

CHOICE OF FISH SPECIES IN KYRGYZSTAN

In the past, the main objective of fisheries management in Kyrgyzstan was to increase fish production in lakes, reservoirs and fish ponds. Similar to many other countries worldwide, this was achieved through the introduction of new fish species. Between 1930 and 1982, a total of 21 exotic fish species were introduced into the waters of the country (Tables 9 and 10).

TABLE 9
Summary chronological list of introduced fish species in Kyrgyzstan

Year of introduction	Family	Species	English name	Number	%
1930	Poeciliidae	*Gambusia affinis holbrookii* (Girard, 1859)	Mosquito fish	1	5
	Salmonidae	*Salmo ischchan Issykogegarkuni* (Lushin, 1932)	Sevan trout	1	5
			Total	**2**	**10**
1931	Cyprinidae	*Hemiculter leucisculus* (Basilewski, 1855)	Sharpbelly	1	5
1932	Cyprinidae	*Rhodeus sericeus* (Pallas, 1776)	Bitterling	1	5
1947	Cyprinidae	*Cyprinus carpio* (Linnaeus, 1758)	Common carp	-	-
1950	Cyprinidae	*Tinca tinca* (Linnaeus, 1917)	Tench	1	5
1954	Cyprinidae	*Abramis brama orientalis* (Berg, 1949)	Bream	1	5
		Carassius auratus auratus (Linnaeus, 1758)	Goldfish	1	5
			Total	**2**	**10**
1958	Cyprinidae	*Aspius aspius iblioides* (Kessler, 1872)	Aral asp	1	5
	Percidae	*Lucioperca lucioperca* (Linnaeus, 1758)	Pikeperch	1	5
			Total	**2**	**10**
1960	Percidae	*Perca schrenkii* (Kessler, 1874)	Balkhash perch	1	5
1965	Cyprinidae	*Aristichthys nobilis* (Richardson, 1845)	Bighead carp	1	5
		Ctenopharyngodon idella (Valenciennes, 1844)	Grass carp	1	5
		Hypophthalmichtys molitrix (Valenciennes, 1844)	Silver carp	1	5
	Eleotridae	*Perccottus glenii* (Dybowski, 1877)	Amur sleeper	1	5
	Gobidae	*Rhinogobius similis* (Gill, 1859)	Amur goby	1	5
	Channidae	*Channa argus warpachowskii* (Berg, 1909)	Snakehead	1	5
			Total	**6**	**29**
1966	Coregonidae	*Coregonus migratorius* (Georgi, 1775)	Baikal omul	1	5
		Coregonus lavaretus Ludoga (Poljakov, 1874)	Common whitefish	1	5
		Coregonus peled (Gmelin, 1789)	Peled	1	5
			Total	**3**	**14**
1970	Salmonidae	*Oncorhynchus mykiss* (Walbaum, 1792)	Rainbow trout	1	5
1978	Cyprinidae	*Pseudorasbora parva* (Temminck and Schlegel, 1846)	Topmouth gudgeon	1	5
1982	Acipenseridae	*Acipenser baerii* (Brindt, 1869)	Siberian sturgeon	1	5
			Grand Total	**22**	**100**

TABLE 10
Purposes and results of fish introductions into the waters of Kyrgyzstan

Mosquito fish – Gambusia affinis holbrookii (Baird and Girard, 1853)	
Year of introduction:	1930
Introduced from:	Central Asia
Introduced to:	Water bodies in Chui District
Purpose:	To control mosquito larvae.
Result:	Introduced to control malaria. Populations are established in Chui and Osh Districts (Pivnev, 1990)
Sevan trout – *Salmo ischchan Issykogegarkuni* (Lushin, 1932)	
Year of introduction:	1930
Introduced from:	Lake Sevan, Armenia
Introduced to:	Lake Issyk Kul
Purpose:	To fill the gap of missing predator fishes in the Lake Issyk Kul.
Result:	Introduced to Lake Issyk Kul in 1930 and 1936. It is found nearly at all of the inflowing rivers of the Lake Issyk Kul during the spawning season. Its natural propagation fails for different reasons, including man-made barriers built on inflowing rivers and poaching for brooder during the reproduction seasons. Therefore its stock has been maintained through artificial propagation (re-stocking) since 1964 (Ryspaev and Woynárovich, 2008).
Sharpbelly – *Hemiculter leucisculus* (Basilewski, 1855)	
Year of introduction:	Early 1931
Introduced from:	Uzbekistan
Introduced to:	Water bodies in Chui District
Purpose:	Accidentally introduced with grass carp and silver carp.
Result:	The populations are not well established and considered as miscellaneous fish (Pivnev, 1990)

TABLE 10 (CONTINUED)

Bitterling (*Rhodeus sericeus* (Pallas, 1776))	
Year of introduction:	1932
Introduced from:	Russia
Introduced to:	No information
Purpose:	It was introduced as a forage fish for predators.
Result:	No information
Common carp – *Cyprinus carpio* (Linnaeus, 1758)	
Year of introduction:	1947
Introduced from:	Rivers of Siberia
Introduced to:	Frunze Fish Farm
Purpose:	To replace the less productive native strains and stock them into the different waters.
Result:	Though common carp is indigenous in Lake Issyk Kul different improved strains were artificially propagated in order to produced fingerlings and stock them in large quantities into the lake (Ryspaev and Woynárovich, 2008).
Tench – *Tinca tinca* (Linnaeus, 1758)	
Year of introduction:	1950
Introduced from:	Russia
Introduced to:	Lake Issyk Kul
Purpose:	To enrich the stock composition of fish fauna in lakes and reservoirs.
Result:	It was introduced to Lake Issyk Kul in the 1950s and it has since established itself in all parts of the littoral zone of the lake (Ryspaev and Woynárovich, 2008).
Oriental bream – *Abramis brama orientalis* (Berg, 1949)	
Year of introduction:	1954
Introduced from:	Central Asia
Introduced to:	Lake Issyk Kul
Purpose:	To enrich the stock composition of fish fauna in lakes and reservoirs.
Result:	Introduced in 1954 and 1956. This species established well and became one of the most invasive species in Lake Issyk Kul- At present the largest its populations are found in the eastern part of the lake (Ryspaev and Woynárovich, 2008).
Goldfish – *Carassius auratus auratus* (Linnaeus, 1758)	
Year of introduction:	1954
Introduced from:	Fish farm at Alma Ata, Kazakhstan
Introduced to:	Frunze Fish Farm
Purpose:	It was introduced with common carp by accident.
Result:	Introduced in 1954 accidentally together with young carps to the Frunze Fish Farm. From Frunze it spread into the Chui Valley and in 1963 it was introduced also to Lake Issyk Kul (Ryspaev and Woynárovich, 2008).
Pikeperch – *Lucioperca lucioperca* (Linnaeus, 1758)	
Year of introduction:	1958
Introduced from:	Russia
Introduced to:	Lake Issyk Kul
Purpose:	To fill the gap of missing predator fishes in the Lake Issyk Kul.
Result:	This fish species propagates in the nature hence established very well and became the most dangerous invasive fish species in Lake Issyk Kul (Ryspaev and Woynárovich, 2008).
Aral asp (*Aspius aspius iblioides* (Kessler, 1872)	
Year of introduction:	1958
Introduced from:	Urals
Introduced to:	Lake Issyk Kul
Purpose:	To enrich the stock composition of fish fauna of Lake Issyk Kul.
Result:	It did not establish in the lake (Ryspaev and Woynárovich, 2008).
Balkhash perch (*Perca schrenkii* (Kessler, 1874))	
Year of introduction:	1960
Introduced from:	Kazakhstan
Introduced to:	Chui River basin, Nijny-Archinsky reservoir
Purpose:	To enrich the stock composition of fish fauna in lakes and reservoirs.
Result:	Not very well established. Populations are snmall. Used recreational fisheries (Pivnev, 1985)
Amur goby – *Rhinogobius similis* (Gill, 1859)	
Year of introduction:	1965
Introduced from:	Uzbekistan
Introduced to:	Accidentally introduced with grass car and silver carp
Purpose:	
Result:	Not well established. Small populations exist (Pivnev, 1985).

TABLE 10 (CONTINUED)

Amur sleeper – *Perccottus glenii* (Dybowski, 1877)	
Year of introduction:	1965
Introduced from:	Uzbekistan
Introduced to:	To ponds in Chui Districts and Issyk Kul lake
Purpose:	Accidentally introduced with grass carp and silver carp
Result:	Not well established. Small populations exist (Pivnev, 1985). It is a successful rival of young commercial species as it eats young larvae etc (UNDP Project Document 2008).
Bighead carp – *Aristichthys nobilis* (Richardson, 1845)	
Year of introduction:	1965
Introduced from:	Uzbekistan
Introduced to:	Frunze Fish Farm in order to distribute to other fish farms and reservoirs
Purpose:	To fill the vacant niche of zooplankton feeder in reservoirs and fish ponds.
Result:	
Grass carp – *Ctenopharyngodon idella* (Valenciennes, 1844)	
Year of introduction:	1965
Introduced from:	Uzbekistan
Introduced to:	Frunze Fish Farm in order to distribute to other fish farms and reservoirs
Purpose:	To fill the vacant niche of macro vegetation feeder in reservoirs and fish ponds.
Result:	There are no evidences that this fish reproduce naturally. It was also introduced in Lake Issyk Kul, but here it is extremely rare and difficult to find some of its specimens (Ryspaev and Woynárovich, 2008).
Silver carp – *Hypophthalmichtys molitrix* (Valenciennes, 1844)	
Year of introduction:	1965
Introduced from:	Uzbekistan
Introduced to:	Frunze Fish Farm in order to distribute to other fish farms and reservoirs
Purpose:	To fill the vacant niche of phytoplankton feeder in reservoirs and fish ponds.
Result:	It was also introduced in Lake Issyk Kul, but it has no trace in the lake (Ryspaev and Woynárovich, 2008).
Snakehead – *Channa argus warpachowskii* (Berg, 1909)	
Year of introduction:	1965
Introduced from:	Uzbekistan
Introduced to:	Reservoirs in Chui Districts
Purpose:	To enrich the stock composition of fish fauna in lakes and reservoirs.
Result:	No information
Baikal omul – *Coregonus migratorius* (Georgi, 1775)	
Year of introduction:	1966
Introduced from:	Lake Baikal, Russia
Introduced to:	Lake Issyk Kul
Purpose:	To fill the vacant niches in lakes and reservoirs.
Result:	It was introduced from Lake Baikal at the 1960s and at the beginning of the 1970s, but could not establish its population in Lake Issyk Kul (Ryspaev and Woynárovich, 2008).
Common whitefish – *Coregonus lavaretus Ludoga* (Poljakov, 1874)	
Year of introduction:	1966
Introduced from:	Russia
Introduced to:	Ton Fish Hatchery
Purpose:	To fill the vacant niches in lakes and reservoirs.
Result:	It was introduced in the 1960s and 1970s also from Sevan Lake. Now it is found in the lake everywhere, especially in Tjup and Jergalan bays. In the Soviet time it was propagated artificially in and regularly restocked from the nearby fish hatcheries (Ryspaev and Woynárovich, 2008).
Peled – *Coregonus peled* (Gmelin, 1789)	
Year of introduction:	1966
Introduced from:	Russia
Introduced to:	Frunze Fish Farm
Purpose:	To fill the vacant niches in lakes and reservoirs.
Result:	Introduced at the beginning of the 1960s and 1970s into the Kyrgyz Republic and it still can be found in Lake Son-Kul but it could not establish hence disappeared from Lake Issyk Kul (Ryspaev and Woynárovich, 2008).

TABLE 10 (CONTINUED)

Rainbow trout – *Oncorhynchus mykiss* (Walbaum, 1792)	
Year of introduction:	1970
Introduced from:	Several places
Introduced to:	Ton Fish Hatchery
Purpose:	For intensive cage culture in Lake Issyk Kul.
Result:	It was brought first in the 1970s later in the 1980s to Ton Fish Hatchery. During this period cages were set on the north side of the lake, but the production failed because of the poor quality of feeds. Since this time, still today new cages have been set on the lake. Apparently escaped specimens can be found at the inflowing rivers. It is possible that Rainbow trout does not establish in the lake because of all female stocks imported from abroad. However the escaped specimens feed on endemic species and the pollution caused by the cages deteriorate the water quality of Lake Issyk Kul (Ryspaev and Woynárovich, 2008).
Topmouth gudgeon – *Pseudorasbora parva* (Temminck and Schlegel, 1846)	
Year of introduction:	1978
Introduced from:	River Amur
Introduced to:	Fish ponds and Lake Issyk Kul
Purpose:	No purpose, introduced by accident
Result:	It was also accidentally introduced together with carps from River Amur. It is now a serious competitor with the young of native fishes as it quickly multiplies and displaces the majority of the indigenous species (Ryspaev and Woynárovich, 2008).
Siberian sturgeon – *Acipenser baerii* (Berg, 1869)	
Year of introduction:	1982
Introduced from:	Rivers of Siberia
Introduced to:	Toktogul reservoir. This species was brought to Lake Issyk Kul Biological Station from Russia in 1982, when fertile eggs were incubated and young fish were grown to 10 cm length. They were not stocked deliberately, but it is possible that some specimens escaped.
Purpose:	To enrich the stock composition of fish fauna in Toktogul reservoir.
Result:	It established in Toktogul reservoir.
Striped bystranka – *Alburnoides taeniatus* (Kessler, 1874)	
Year of introduction:	No information
Introduced from:	Central Asia
Introduced to:	Reservoirs in Chui District and Issyk Kul lake
Purpose:	No purpose, introduced by accident
Result:	It is an aquarium fish released into Issyk Kul lake by accident. According to Konurbaev and Timirkhanov (2003) this aquarium species has also found its way to the lake, but no further details are given (Ryspaev and Woynárovich, 2008).

Rationale behind choice of species and expected benefits

The purposes of the fish introductions summarized in Table 10 differed according to the type of water where they were stocked.

Lakes

Until the early 1960s, Lake Issyk Kul was the only natural lake with a commercial fishery (Tables A2.9, A2.10 and A2.11). Out of the country's many natural lakes (listed in Annex 1), only Lakes Issyk Kul and Son-Kul currently have established commercial fisheries. In Lake Issyk Kul, the purpose of fish introductions was to replace the native fish fauna with high-value exotic species (listed in Table A1.3). The newly introduced fish species were expected to prey on low-value native species and then be captured and sold as high-value items. Lake Son-Kul had no fish fauna until 1959 when four fish species (listed in Table A1.4) were stocked in order to utilize the natural productivity and capacity of the lake.

Rivers

In most of the rivers of Kyrgyzstan, valuable fish species, such as Amu Darya trout, osman and marinka, were introduced in the 1970s in order to establish and develop sport and recreational fishing.

Reservoirs and ponds

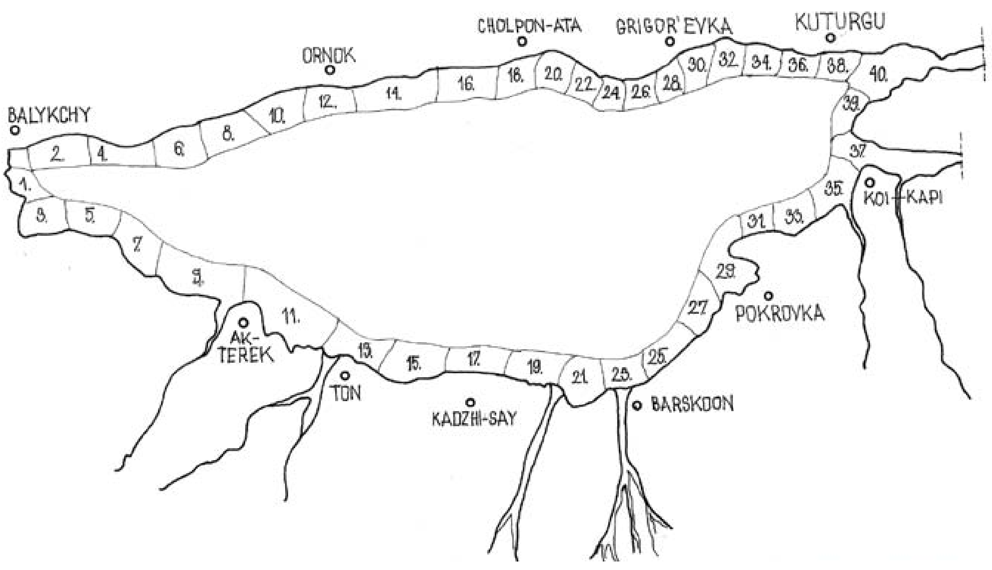
The reason for stocking reservoirs, which were constructed from the 1960s onwards (Annex 1), was to introduce commercially valuable species that would utilize vacant niches in the available water. The choice of species stocked depended on the physical and biological conditions of each reservoir. In waterbodies where the temperature of the surface water reached more than 20–22 °C, common carp, Chinese major carps or sturgeon were stocked. In other waterbodies, cold-water fish species, such as trout and whitefish, were regularly released (Annex 1).

In smaller and warmer reservoirs, where enough water remained at the end of the irrigation season, extensive practices prevailed (low stocking density, using natural productivity as the food source), while in fish ponds, more intense (seeding ponds, adding nutrients to increase productivity, and perhaps adding feed) polyculture of common carp and the introduced Chinese major carps was practised.

Precautionary mechanisms and impact assessments

In case of Lake Issyk Kul, ichthyologists had concluded previously that the natural primary and secondary production capacity of the lake was underutilized and, therefore, new fish species (listed in Table A1.3) were recommended for introduction into the lake. The decisions were based on theoretical considerations, guided by fishing records and the results of biological studies to determine which niches the new species would be able to occupy. However, a thorough analysis of the environmental impacts of the introduced fish species was not performed. In this period, the coastal zone of Issyk Kul was divided into 40 fishing sites as presented in Figure 9. The size of the fishing sites was calculated according to their production potentials in order to establish appropriate fish catch quotas (Ryspaev and Woynárovich, 2008). The peak in yearly catches of any particular species occurred during their spawning season, although the practice of catching during this season was modified at different points. In 1982, the fishing of chebachok in its spawning season became prohibited and later, in 1986, a total ban on fishing for naked osman was introduced (Sarieva *at al*., 2008; Ryspaev and Woynárovich, 2008).

FIGURE 9
Fishing sites on Lake Issyk Kul



Source: Ryspaev and Woynarovich (2008).

In Lake Son-Kul, a similar series of investigations of the physical, chemical and biological characteristics of the lake was carried out over several years before the choice of fish species to be stocked there was made.

IMPACTS OF INTRODUCTIONS

Experiences and mistakes

The establishment of the introduced fish species varied according to location, and whether they were introduced into Issyk Kul, Son-Kul or reservoirs and whether they could maintain their populations through natural reproduction.

Lakes

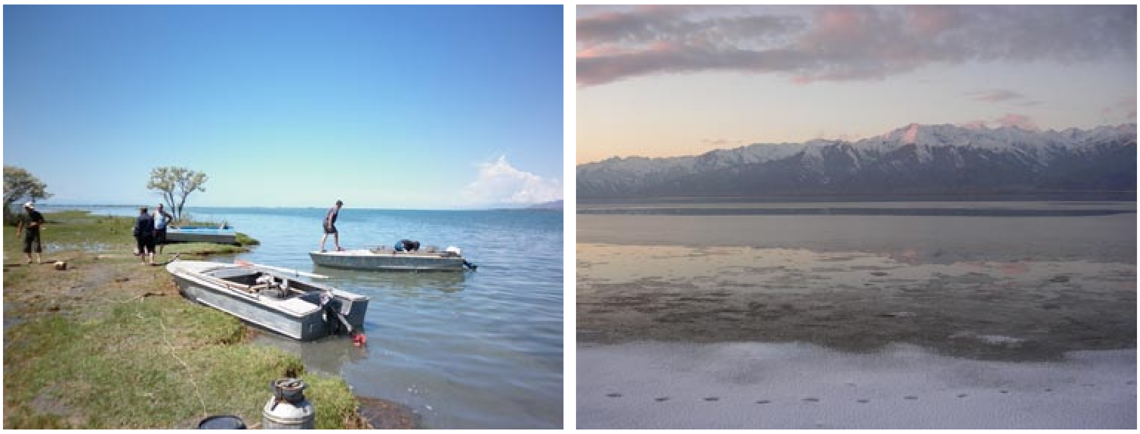
Some of the introduced species did not acclimatize or reproduce successfully and, therefore, disappeared. Examples introduced to Lake Issyk Kul were the Sevan whitefish, Baikal omul, peled, asp zberber (*Aspius aspius iblioides* [Kessler 1872]), Samarkand khramulya (*Varicorhynus capoeta heratensis natio steindachneri*), sturgeon[4] and silver carp. As might be expected the purely freshwater species such as whitefish and large peled did not reproduce successfully in the brackish water of Lake Issyk Kul.

Grass carp was introduced and grew rapidly, but owing to a lack of sufficient spawning grounds it never established a self-reproducing population. Today, it is very rare to find grass carp, and the ones found are most likely to have escaped from nearby reservoirs or fish ponds. Populations of introduced crucian carp, tench and other similar species can be found mainly in the bay of Tyup where the water is less saline.

The first commercial fish species stocked in Lake Issyk Kul was Sevan trout. Work started in 1930 and the release was completed in 1936. Sevan trout successfully acclimatized in the lake, but owing to a lack of spawning rivers its population increased only very slowly. Sevan trout are an anadromous species of fish and enter rivers to spawn. Although most of the hydrochemical parameters of rivers in the lake basin were suitable for the spawning of anadromous species, there were a number of barriers that limited suitable spawning sites. Rivers were regulated for irrigation purposes for example, and hence they lost value as a suitable habitat for spawning. Five kilometres from the mouth of the Jergalan River, a dam was built, to ensure water availability for a pumping station, and this structure prevented further upstream migration of fish, thereby limiting the available space for spawning. Moreover, owing to the constant lowering of lake's water level in the last 40 years (at a rate of about 8.5 cm/year) common carp too have lost suitable spawning grounds in the lake (Plate 11). Apart

PLATE 11

Typical dried-up former spawning grounds of common carp in Lake Issyk Kul



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4 This fish was not stocked on purpose: it is possible that some specimens escaped from the Lake Issyk Kul Biological Station.

from being used as spawning grounds, the shallow areas of the lake were also warmed by the sun and provided excellent feeding grounds for many fish species, including chebachok and chebak.

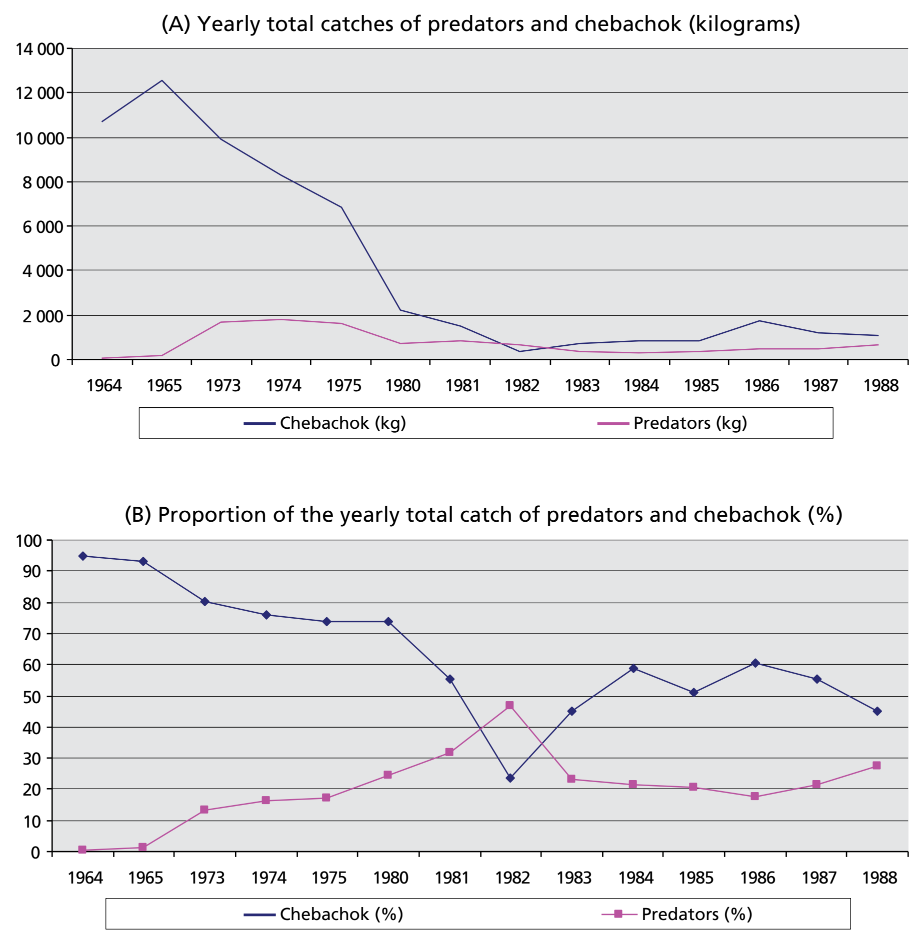
As a result of some of these restrictions and to ensure the availability of fingerlings of Sevan trout for stocking purposes, the Ton and Karakol hatcheries were built in 1964 and 1969, respectively. Collected brood stock was used for artificial propagation of fry and fingerlings, not only of Sevan trout, but also other valuable commercial fish species such as common whitefish and common carp.

Despite the small size of their original populations, other fish species adapted and established itself well in Issyk Kul. In 1956, oriental bream was introduced and established well. Not all introductions have been as positive.

In 1958, pikeperch was introduced with the aim of enriching species composition and increasing the catches of commercial fish species. This fish found favourable conditions both for feeding and reproduction. Catches of pikeperch (and other species – Figure 10) reached more than 160 tonnes (see Table A2.9). As had been planned, pikeperch successfully took the role of being a biological controller and consumer of numerous non-commercial non-target small species. However, when these species became depleted, pikeperch also preyed on endemic chebachok and other endemic species, affecting their numbers. As a result of the introduction of pikeperch, the previously very large population of chebachok at the bay of Tyup became fully depleted.

FIGURE 10

Yearly catches (kilograms) and catch proportions (percentage) of introduced predators (pikeperch and Sevan trout) and native chebachok in Lake Issyk Kul, 1965–1989



Also in Lake Issyk Kul, the introduction of Amur chebachok from the Frunze fish farm caused considerable damage because it carried fish parasites and infectious diseases, which resulted in a measles-like disease that caused considerable mortality in chebachok and a number of other fish species.

Although environmental conditions were favourable for fish, Lake Son-Kul had no fish in it until 1959. At the time, ichthyologists had a unique opportunity to shape the composition of fish fauna of this lake. The work started with the acclimatization of trout, osman, tench and other fish species. In 1968, 40 specimens of peled yearlings were released and they propagated after two years. In 1970, an additional 592 800 peled larvae were stocked and success for this species exceeded all expectations. Peled in the second year reached a good commercial weight of 2–3 kg. In 1976, Nikitin (1976) estimated that production of 140 tonnes/year of peled would be possible on the basis of the zooplankton (3.4 g/m^3) and zoobenthos (117 kg/ha) productivity of the lake. Together with peled, common whitefish was also introduced into the lake. It found the natural conditions favourable for reproduction and its population gradually increased in the lake. At the time, it was decided not to catch common whitefish in order to allow this increase in weight and number. Prior to 1991, catches were controlled but since 2000 the lake has been excessively (three-four-fold) overfished. As the result, both the stock and the individual size of peled and whitefish have declined drastically.

In addition to overfishing, another example of an unfortunate introduction was the grey loach (*Nemacheilus dorsalis* [Kessler, 1872]). Having been introduced into Lake Son-Kul, the grey loach established itself well in the lake, but unlike other species added at the time (e.g. whitefish and peled), in the end it was not regarded as a commercially valuable or preferred species for consumption. However, one of the preferred foods for grey loach are fish eggs, of such species as whitefish and others, which then affects their productivity. It also outcompetes other species for food and nutrients, which in combination with overfishing has resulted in low fish catches in Lake Son-Kul.

Reservoirs

Production for fisheries in the larger reservoirs has not been a great success. Introduced sturgeon, trout, whitefish, peled, common carp and Chinese major carps either did not establish themselves well or failed to establish themselves at all. With reservoir water being used for irrigation, these fish species were not able to reproduce successfully owing to the huge daily and season fluctuations in water levels.

Rivers

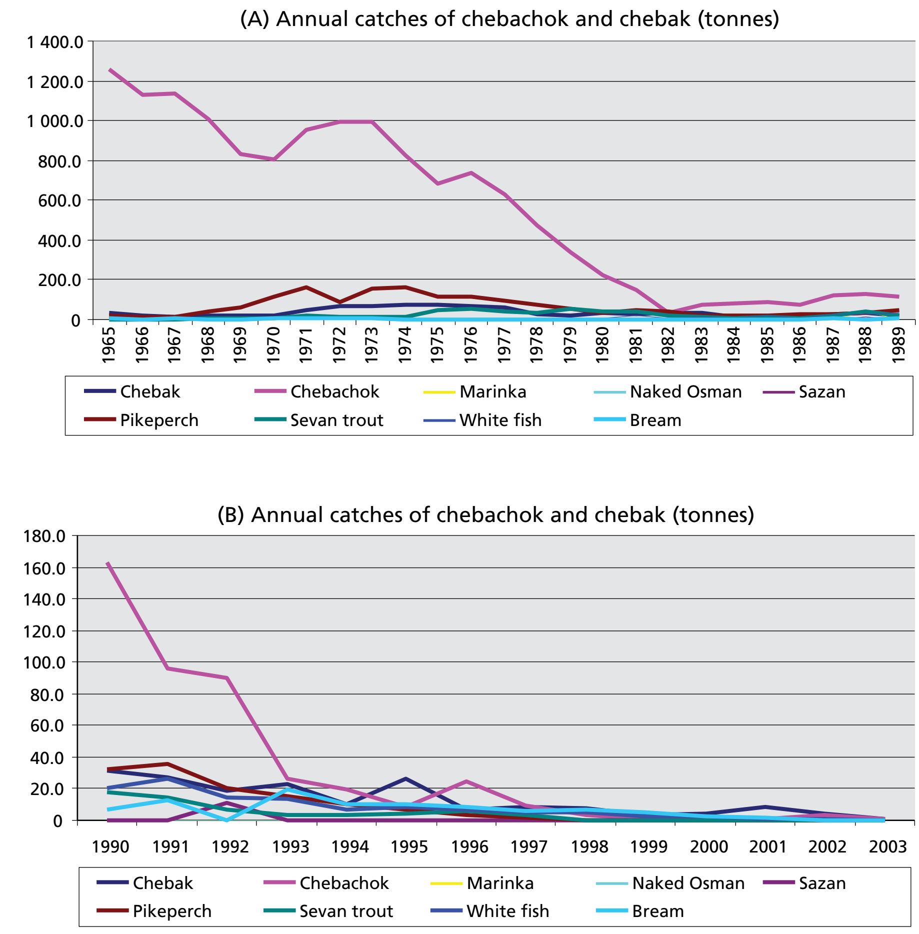
Owing to their low productivity, fish stocked in most mountain rivers did not establish viable populations. One exception is the Amu Darya trout, which did successfully reproduce, and became a favourite trophy for sport fishers. Fish introductions in rivers where sport and recreational fishing can be organized and practised have increased significantly in number. As a result of a decision by the Government, all rivers and other waterbodies that have no fishery, but on which sport and recreational fisheries can be organized, should be leased to the HFU, and this has happened in many cases.

General conclusions

The stocking of whitefish in Lake Son-Kul and Chinese major carps in the Toktogul reservoir can be considered successful examples of fish acclimatization in Kyrgyzstan.

The largest introductions and the most severe negative consequences took place in Lake Issyk Kul. Here, the 13 indigenous species, 6 of which are endemic (Chapter 1 and Table A1.2), were supplemented by 16 introduced fish species. Over time, the relative proportions of native to introduced fish species drastically changed in favour of the latter. Before the introductions, there were no obligate piscivorous fish species in Lake Issyk Kul, although marinka, osman and carp may occasionally feed on smaller

FIGURE 11
Annual catches of chebachok and chebak in Lake Issyk Kul, 1965–1989 and 1990–2003



Source: Ryspaev and Woynárovich (2008).

fish. After the introductions, potential prey species were affected by pikeperch in the shallower regions along the coast and by Sevan trout in the deeper open waters.

Change occurred gradually until the early 1990s, but during and after the period of transition from Soviet control to independence in the mid-1990s, the stock of endemic chebachok and chebak declined, and other species, such as naked osman and marinka, practically disappeared (Figure 11 and Tables A2.9, A2.10 and A2.11).

The introduction of pikeperch and bream, and their uncontrolled spread, in Lake Issyk Kul was a mistake, which together with the negative changes in the socio-economic conditions of many rural people during the early 1990s and unregulated fishing in the lake, resulted in an inevitable decline of the fisheries, of both natural lakes and reservoirs.

Rectification of mistakes

With the spread of pikeperch across Lake Issyk Kul, the number of endemic species declined drastically (Tables A2.9, A2.10 and A2.11). Specialists from the Institute of Biology and Pedology of the National Academy of Sciences, and international consultants, recommended that the pikeperch population needed to be reduced and that this could be done by interrupting their reproductive cycle. They recommended the use of artificial nests where pikeperch could spawn, which could then be removed from the lake (Ryspaev and Woynárovich, 2008).

PLATE 12
Selective fishing of alien and invasive fish species (pikeperch) on Lake Issyk Kul carried out under a UNDP/GEF project in late June 2011. Captured fish are accurately weighed and donated to local orphanages

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There were other actions that government authorities took when the deteriorated status of fish stocks in general and of the endemic fish species in particular was recognized in the largest lakes of the country. These included the ban on fishing during spawning seasons in 1982, a ban of year-round fishing of naked osman in 1986, and the fishing moratoria on Lakes Issyk Kul and Son-Kul in 2008. In 2004, the Parliament issued a decree that outlawed the introduction of exotic fish species into Lake Issyk Kul.

The problem was deemed to be so serious in Lake Issyk Kul that UNDP/GEF project Strengthening Policy and Regulatory Framework for Mainstreaming Biodiversity into Fishery Sector was established in 2008. The main aim of the project was to control introduced alien fish such as pikeperch and bream (Plate 12) and to restore the stocks of the endemic chebachok, chebak, marinka, and naked osman. As a result of the project, chebachok, which had completely disappeared from the bay Tyup, is now returning to this section of the lake.

4. Summary of the reasons for the present state of the fisheries and lessons learned from the Kyrgyz experience

There are some critical questions5 that need to be answered in order to determine the reasons for the present state of the fisheries in Kyrgyzstan and to learn from the experiences gained:

- Would a more appropriate choice of species for stocking have prevented the collapse in fisheries in Lakes Issyk Kul and Son-Kul?

In the years when exotic fish species were being introduced into the waters of Kyrgyzstan, this was done in the context of a world-wide trend of filling "vacant" niches of less-productive natural and artificial waterbodies. Although the fish species were well chosen (based on their potential productivity), the long-term consequences of the introduction were not considered in detail or foreseen.

- To what degree were the species introductions responsible for the disappearance of the endemic species and the collapse of the fisheries in Lake Issyk Kul?

After the introduction of Sevan trout, pikeperch and bream followed and accelerated the drastic reduction in the endemic chebachok (see Figure 11 and Tables 11, A2.9, A2.10 and A2.11). The recent increase in the number of rainbow trout cages in Lake Issyk Kul has increased the chances of unintentional release of this fish through escapes. As rainbow trout is an aggressive predator, its negative impact on the fish fauna of the lake can be predicted and there are warning signs of this already (Alamanov and Mikkola, 2011).

- What other reasons not related to fish species could explain the partial or total disappearance of the endemic species and the collapse in fisheries of Lake Issyk Kul?

Poverty has played a role in the reduction of endemic species in Lake Issyk Kul and the general collapse of the fishery. In the early 1990s, when state control was being introduced to replace central Soviet control, there was a large reduction in state funding, many people lost their jobs, the rural economy collapsed (as did fishing), and poverty prevailed.

- Are legal and illegal fishing and angling linked to the sharp decline in fisheries and fish culture results in the different waters of the country?

In the transition period, the protection of state and cooperative properties and the enforcement of law weakened, and, combined with high unemployment, this led to a large increase in illegal fishing. Not only were traditional fishers involved but an increasing number of non-fishers also fished Kyrgyz lakes in order to obtain food and income. The process was considerably increased when inexpensive small-mesh monofilament gillnets flooded the country.

It is unlikely that a single explicit reason was responsible for the collapse in fisheries and the disappearance of endemic species such as marinka and naked osman. A combination of overfishing, poor legislation and law enforcement, poor decision-

[5] Questions were phrased by Raymon van Anrooy, FAO Fisheries Officer (FAOSLC), and John Jorgensen, FAO Fisheries Officer (FAOSLM).

making on translocation of species including for fisheries and aquaculture, poverty, and perhaps even a changing climate may all have contributed to the present state of the fisheries in Kyrgyzstan.

5. Conclusions and recommendations

SECTOR MANAGEMENT

It is important to build up stable cooperation between the various stakeholders in the fisheries sector including fish hatcheries, fish farmers and fisheries companies, leaseholders of waterbodies, governmental organizations and non-governmental organizations (NGOs). From the Government, this cooperation should be based on correct and transparent administration of the sector.

The DOF was re-established in 2006 under the then MAWRPI to develop and manage the fishery sector in accordance with the 1997 Law on Fish Industry. In addition to the Law on Fish Industry, there exists a Strategy for Fisheries and Aquaculture Sector Development and Management in the Kyrgyz Republic (2008–2012) and a draft Strategy for Aquaculture Development in the Kyrgyz Republic (2012–2020), which is pending approval from the Government. Despite these, the overall legal framework in Kyrgyzstan is currently inadequate to handle the task of developing, managing and sustaining modern fisheries and aquaculture activities.

There are overlapping and conflicting legal instruments in the three laws that affect fishery activity (namely, the Law on Fish Industry, Law on Wildlife and Flora, and Law on Environment) that need to be addressed in order to define clear functions and responsibilities of the respective state agencies. Critical amendments to these laws, in the areas of introduction of new species and protection of native species, as well as in enabling fisheries comanagement, require the marginalized DOF to build broad support with a view to the future introduction of a more comprehensive and modern Fisheries and Aquaculture Law. Each step along the way in this process enables the DOF to build consensus and capacity and ensures that its legislative activities will be implemented sustainably.

Priority amendments to existing legislation may resolve urgent issues. However, institutional and policy conflicts stemming from existing legislation will continue to impede technical activities until a broadly-based consultative process addresses and harmonizes the actions of stakeholders, both governmental and non-governmental. It is recommended that an interdepartmental working group should be established under the leadership of the DOF, but with a broadly representative membership. The Government should establish this working group to ensure that representatives of other ministries and state bodies are authorized and able to participate, and if necessary compelled to participate. The initial terms of reference for this working group would be to:

- review the three pieces of legislation;
- review the draft legislation related to fisheries in the field of environmental impact assessment (EIA) and regulatory impact assessment;
- consider environmental financing proposed by the State Agency on Environment Protection and Forestry (SAEPF);
- provide comments on new proposed legislation and legal instruments that take these reviews into account.

Through a roundtable discussion at the end of this legal activity programme, the DOF would initiate a consultative process that could be used to propose and draft new fisheries and aquaculture legislation and to modify other applicable legal instruments.

Moreover, as is the case for many other countries, aquaculture in Kyrgyzstan tends to be considered as part of national fisheries legislation. When a legal definition of aquaculture has been prepared, the collateral issues relating to aquaculture facilities and aquaculture products will be taken into account and covered by the appropriate legislation (Siriwardena, 2007). Therefore, a legal definition for aquaculture should be included in the above review process in order to facilitate regulation of the aquaculture industry.

According to the Law on Fish Industry, the DOF establishes the rules under which fish are caught, bred and stocked (Sarieva *et al.*, 2008). Management is the responsibility of three units: Fishery and Aquaculture, Ichthyology, and Operational Control and Fishery Regulation. However, the licences for and collection of fees for commercial fishing in the major reservoirs and lakes are issued by the State Agency on Environment Protection and Forestry (SAEPF). In licensing, the DOF has only an approving/rejecting role. The DOF has the mandate for inspection of fisheries, but the effectiveness of this activity is severely hampered by its limited human and financial resources and by clashes in this activity with other departments. In addition to the DOF, the SAEPF used to have responsibility for control and surveillance over fishing activities until this responsibility was transferred to the newly established State Inspection of Ecological and Technical Security (SIETS) in 2012. However, according to the observations of ichthyologists of the National Academy of Sciences, the bans on fishing in Lakes Issyk Kul and Son-Kul are not effectively enforced and illegal fishing has not been stopped. This stems from the inability of the DOF, SAEPF and SIETS to recognize the overlaps, to maintain tight control, and to carry out law enforcement, all in the context of an underlying lack of financial resources.

In order to improve the enforcement of fishery laws and regulation, the fishery inspections currently carried out by both the DOF and SIETS should be transferred entirely to the SIETS. This will help to remove overlapping responsibilities between the agencies as well as allocate required funding to one agency for the control and surveillance purpose. The few officers attached to the inspection service of the DOF could be better utilized if they liaised with SIETS counterparts and concerned NGOs, as well as with governmental organizations responsible for the maintenance of fishery laws in the country.

Motivation of the fishery inspectors and the officers and specialists of the DOF and in the government-run fish farms is important. Motivation would be increased if good and reliable vehicles and equipment were available. In addition, and incentives such as competitive salaries and some form of bonus after nets are confiscated (in the case of inspectors) and if production targets are reached (in the case of fish culturists on state fish farms) should be essential parts of the overall reform.

Clearly defined roles and functions of the key stakeholders are urgently needed for effective management of the main waterbodies of national importance. Accordingly, each main waterbody of national importance should have one single managing body. This body could be public, private or a public–private partnership, and would receive an overall management concession for a certain period (e.g. 10–20 years). The overall supervision of the waterbody and the management body should be the responsibility of a Fishery Scientific Council comprising staff from three departments – the SAEPF, National Academy of Sciences and DOF. The SAEPF should have the overall environmental protection role, while the DOF should oversee licensing, allocation of fishing sites and monitoring of fisheries management activities. The National Academy of Sciences should provide the underlying scientific and research inputs to management (Alamanov and Mikkola, 2011). In addition to enforcement of laws and regulations, and management of specific waterbodies, transparent and reliable statistics are a prerequisite for improved management of the fish stocks in Kyrgyzstan.

MANAGEMENT OF FISH FAUNA AND FISHERY MANAGEMENT OF SURFACE WATERS

The fish production capacity of waterbodies intrinsically depends on the qualitative and quantitative composition of natural fish food. Therefore, the restoration of commercial catches to an optimal and sustainable level must be based on the actual fish production capacity of lakes and reservoirs. In addition, there should be restrictions regarding the minimum size of the fish allowed to be caught and the quantity of fish allowed to be captured for each fish species.

There are no systematic studies assessing annual sustainable fishery yields for the main lakes and reservoirs in Kyrgyzstan. However, according to estimations made by local specialists, the optimal annual fish production would be 600–800 tonnes in Lake Issyk Kul and 200–250 tonnes in Lake Son-Kul. These estimations are based on previous annual fish production in Lake Issyk Kul, with yields of 1.5–2.0 kg/ha (Knourbaev *et al.*, 2005), and reflect the nutrient-poor status of the lake. Lake Son-Kul previously produced from 108.2 tonnes to 600 tonnes of peled (21.9 kg/ha) and whitefish (3.96 kg/ha) (Sarieva *et al.*, 2008), but the declared production is currently 2.2 tonnes/year because broodfish used for propagation is the only allowable catch (DOF, Bishkek, Kyrgyzstan, personal communication, 2011).).

The DOF carries out ad hoc stock enhancement in Lake Issyk Kul with Sevan trout added, and with Chinese major carps and common carp added to some reservoirs, such as Toktogul. According to Konurbaev *et al.* (2005), rainbow trout, Sevan trout and pikeperch endanger endemic species by predating on them. Two dace species, Issyk Kul marinka and naked osman, are the endemic species that are most seriously affected and endangered (Alamanov and Mikkola (2011). These species, and Schmidt's dace, are species that once contributed to a lucrative fishery in Lake Issyk Kul. Although initiatives to revive them are under way, there is currently increasing concern regarding the predatory pressure. Despite this concern, the DOF and private hatcheries around Lake Issyk Kul, at the request of DOF, continue to stock Sevan trout into the lake. No attempts have been made to restock dace species in order to restore their severely depleted spawning biomass to a level where it can once again provide regular and substantial yields. Lessons learned from other Asian countries indicate that the fisheries of large lacustrine waterbodies, with proper management, rely on naturally recruited stocks, perhaps with occasional replenishment of broodstock. Therefore, the most sustainable way to enhance fish production will be a revival of the dace fish populations.

For sustainable development of the fisheries, the following activities are essential:

- monitoring and protection of natural spawning grounds;
- well-planned and steady annual supply of quality fish seed of species of commercial importance;
- protection of rare and endangered native and endemic fish species.

Commercial fisheries

Transparent management and consistent supervision together with realistic, well-elaborated and implemented physical and financial plans for sustainable fishery management of each waterbody could improve the situation considerably. Having one single state, public or private organization (as a leaseholder) responsible for the fisheries management of the different natural and artificial waterbodies could be very advantageous.

The current moratorium on commercial fishing was aimed at reviving dwindling endemic Schmidt dace species in Lake Issyk Kul. However, as government agencies are unable to implement an effective surveillance and monitoring programme owing to a lack of resources, the fishing moratorium has become ineffective and does not serve its purpose. Moreover, continuation of the moratorium will not help in reducing the predatory pressure from the well-established alien fish populations of pikeperch, common bream and rainbow trout in the lake. In order to reduce and/or control predatory pressure, it would be beneficial to allow fishing of such predatory species using selective fishing gear. It is also recommended that the government should support the ongoing fisheries comanagement activities in Lake Issyk Kul to implement restricted fishing with selective fishing gear. Fishing with nets should be prohibited on the entire lake unless it is carried out to control the populations of the different alien species and only then when it is well planned and with selective gear (Alamanov and Mikkola, 2011). Such fishery management is practised on many large European and North American lakes and reservoirs, and the necessary techniques have already been studied by Kyrgyz professionals, in Hungary, for example. A re-assessment of the role of commercial fishing would be timely and advantageous.

The above could be implemented alongside an enhancement of controlled sport fishing on Lake Issyk Kul. As sport fishing specifically targets pikeperch, rainbow and Sevan trout, as well as bream, an increase in such activity may partly replace the use of selective netting.

Artificial propagation of native fish species, including the endemic naked osman and marinka, has already started and reintroductions have taken place in Lake Issyk Kul through the UNDP/GEF project (Plate 4). Similar activities should be further encouraged by the Government. The production of larvae of native species could increase to commercial levels if families around the lake were financially encouraged to become interested in fry rearing and restocking (Ryspaev and Woynárovich, 2008).

In the original analysis of “potential”, using reservoirs for fisheries was not planned and, therefore, no assessment was made of the physical or biological status or the social-fishery situation. Nor were any initiatives planned to improve conditions for local-reservoir fisheries. For this reason, an objective assessment of the fisheries in each reservoir should be completed in order to determine potential production and to implement necessary management measures, measures to combat poaching and enforcement of the established fishing regulations. The seasonal reduction in the water level in most of the reservoirs is generally predictable because water is used for controlled irrigation. By introducing more fish-friendly water management measures, significant improvements could be achieved in fish production.

Recreational fisheries

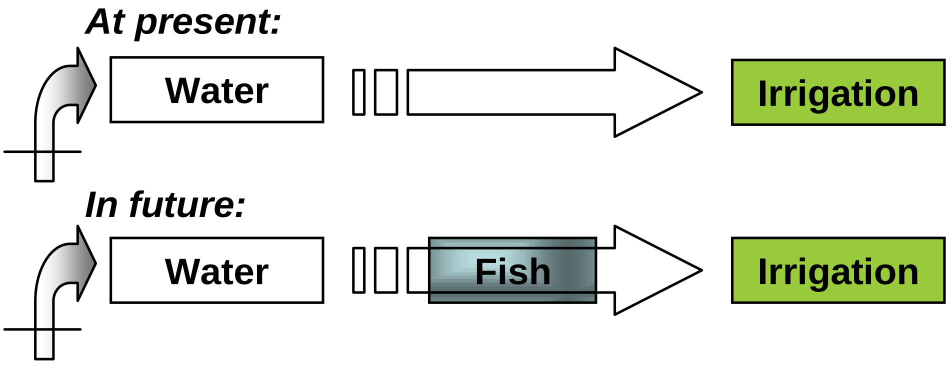
The Government should collaborate with the HFU in the development of a suitable management system for recreational fisheries. This new management system, agreed by Government but implemented by the HFU, should include a proposal for reducing the costs of leasing waterbodies. The HFU should also draw up a business plan for the implementation of a development scheme for recreational fisheries in each waterbody leased by it.

FISH CULTURE

Without a prospering fish culture sector, the rehabilitation of fisheries in the lakes and reservoirs of Kyrgyzstan would be very difficult. Therefore, professional attention and government support should be given to this subsector. Development of fish culture in small reservoirs, ponds, and cages in suitable waterbodies and in land-based intensive farms could successfully contribute to the reduction of fishing pressure on endangered species.

Accordingly, the total production potential of all fish ponds and small reservoirs around Lake Issyk Kul could vary between 190 and 600 tonnes/year. These results would be between 40 and 125 percent of the average of the annual catches registered at the lake between 1965 and 2003 (Ryspaev and Woynárovich, 2008). Model calculations for Issyk Kul Province may be considered and adapted throughout the country.

FIGURE 12
Irrigation integrated with fish production



Sources: Ryspaev and Woynárovich (2008); Khavtasi *et al.* (2010).

Fish production can be increased by integrating fish culture with irrigation where irrigation water is of sufficient quality to be channelled through a suitable fish production unit (Figure 12), before being returned for use in irrigation.

Protecting rare and endangered native and endemic fish species should be done through planned artificial reproduction, because these species need an intervention to maintain their populations. Therefore, financial and technical support should be provided in the form of supporting mobile hatcheries (Box 2) and on-farm training for fish hatchery staff. However, this is not a long-term sustainable solution. It remains important to assess and evaluate systematically the reasons why these species have disappeared and to begin rectify the problem only when the identified bottleneck has been removed or mitigated.

In order to ensure a consistent supply of quality fish seed, it is timely to develop a decentralized system of seed production and to develop networks for seed supply in order to reach more remote areas; both to be done through support from the government and local administrative institutions. Farmers having access to high quality fish seed, available at the appropriate time for stocking, will ensure the smooth flow of products along the entire aquaculture value chain (Siriwardena, 2007). Support and supervision by the government to develop privatized extension services of fish seed producers and technically sound professionals could be the feasible and a sustainable practical solution.

A shift in the government's role from being a fish seed supplier competing with the private sector to one of collaboration would be more beneficial to the long-term viability of the fish seed industry, to genetic conservation and to quality control (Siriwardena, 2007). Therefore, government hatcheries, with some backup by private hatcheries (and vice versa), should focus on maintaining genetic stocks and broodstock of species in order to overcome certain constraints related to genetic quality, such as inbreeding problems and difficulties in breeding some species. Small-scale hatcheries face problems in sourcing and maintaining the supply of their own quality broodstock owing to a lack of pond space and broodstock management capacity. A possible solution would be the development of small-scale carp hatcheries to meet the local demand for fish seed for aquaculture and fisheries (Box 3).

Inbreeding is widely believed to be a factor causing poor quality seed. However, in most cases, poor husbandry management and environmental factors are more likely to be responsible for any poor quality of fish seed. This indicates the need for adequate extension services for the dissemination of applicable production technologies together with support for improving production infrastructure. Preconditions for sustainable results are different in government and private fish hatcheries:

BOX 3

Characteristics of small-scale hatcheries to be developed in Kyrgyzstan

Fish farms should rear a wide range of different fish species to stock selected natural waters, reservoirs and fish ponds. For this purpose, the best solution is to use multispecies carp hatcheries, where pike, pikeperch, wels, tench, common and Chinese major carps can be propagated artificially.

These hatcheries should be an integral part of a 1.0–1.5 ha fish farm that consists of smaller (0.01–0.02 ha) and larger (about 0.1–0.5 ha) ponds where broodfish can be prepared and kept during the propagation season.

Out of the total area, 0.8–1.0 ha is needed for about 200–300 broodfish of the different carps and 0.05 – 0.1 ha for 60–100 broodfish of wels (Horvath, Tamás and Tölg, 1984). These stocks of broodfish are sufficient to produce at least 25 million and 5 million feeding larvae of carps and wels respectively.

The hatcheries should be gravity-supplied with good-quality pond water. One of the smaller ponds can serve well this purpose.

The following devices should be installed in the hatcheries:

- 2 smaller broodfish manipulation tanks (1 m × 2 m × 1 m);
- 2 larger broodfish manipulation tanks (1.5 m × 3 m × 1 m);
- 20 Zuger glasses (8 litres/glass) or 10 small-sized incubation jar (20 litres/jar);
- 10 medium-sized incubation jars (60 litres/jar);
- 4 large incubation jars (200 litres/jar);
- 10 small fry rearing troughs (100 litres/trough).

The listed hatchery devices are suitable for incubating the eggs and rear the larvae of not only all of the fish species listed above. They are also suitable for the experimental and commercial propagation of indigenous fish species.

If it is planned to produce advanced fry on the farm, additional ponds will be needed.

- In government hatcheries, competitive salaries and result oriented bonuses should be given to the staff.
- For private hatcheries, funds, in the form of soft loans from the State, should be allocated to ensure rehabilitation and upgrading of their production facilities (Plate 13). The reason for the poor state of the production infrastructure in newly privatized fish farms is that during the transition period there was a gap in ownership and working morale also declined. This had the consequence that most of the premises and production infrastructure of state and cooperative farms and agricultural companies became dysfunctional. By the time they were privatized, not only their value had declined but so had their usability. This is why such farms and companies should be supported with attractive financing. In return, these hatcheries could provide extension services together with the supplied fish seed.

With a view to stabilizing and increasing table fish production, the following should be considered.

- The optimum use of fish ponds and small reservoirs. Statistics show that fresh fish supply from national production is very low at present (Table A2.19) at less than one kilogram per capita. Because of this, the demand for cheap fish, such as carps, significantly exceeds the supply from the country’s own waters and farms. Consequently, there is a gap that is filled with fish imports from Kazakhstan. However, recommendations from the World Health Organization suggest the annual per capita consumption of fish and fish products should be at least 12 kg (equivalent to a total of about 48 000 tonnes/year for Kyrgyzstan). However, attaining only the fish consumption of the late 1980s and fulfilling this demand (about 10 kg per capita) from national production could significantly increase fish production in Kyrgyzstan. Without proper fishery management of both natural and artificial waterbodies, side by side with the development of the culture of suitable fish species, a significant rise in fish consumption in Kyrgyzstan cannot be expected.

- Construction of intensive production units for trout. At present, the rivers in Kyrgyzstan are of no specific commercial importance, but in the long run they have enormous potential both for supplying water for highly profitable trout farms and for the development of angling tourism. Their parallel sustainable development needs coordinated planning. In the foothills where the water quality of streams and many rivers is ideal, trout farms could be constructed. This would require substantial financial investment for building and equipping trout hatcheries and farms, as well facilities for a steady supply of production materials (fish seed, feeds, etc.). In this sector, family and community enterprises could have an important role.
- Utilization of underground cold and warm water resources. Studies focused on the physical character and geography of springs have already been conducted. They have also been examined by the Institute of Geology of the Academy of Sciences and by the Office of Geology in other studies to provide supporting information for hydrology, hydrogeology and water resources. However, conducted between 1960 and 1990, they involved only about 2–3 percent of all springs. Therefore, further research is needed in order to assess the current state of water resources from springs in the country. After an accurate survey of the availability and sustainable use of wells, established proportions of both artesian and thermal water resources could support intensive production units for trout, and other suitable fish species identified and selected after careful research (Plate 2).

Development of fish culture in ponds, reservoirs and land-based intensive fish farms could reduce the fishing pressure on the natural lakes. As soon as artesian or springwater-based trout farming proves its many advantages over the cages in Lake Issyk Kul, including more rapid[6] and more controlled production, entrepreneurs will turn away from the lake.

Furthermore, processing plants should be part of the development procedure so that produced fish can be processed into saleable value-added products. An associated marketing infrastructure should also be developed to ensure full added value is attained.

PLATE 13

Fish propagation facilities ready for rehabilitation and upgrading at the Karakol fish hatchery

COURTESY OF ANDRÁS WOYNAROVICH

[6] Spring and artesian waters have a year-round constant temperature of about 10–15 °C, unlike Lake Issyk Kul where the trout growth slows considerably in the winter months.

FUTURE RESEARCH NEEDS

FAO project GCP/KYR/003/FIN and UNDP/GEF projects have already initiated the elaboration of an EIA for aquaculture in Kyrgyzstan (Corner, 2011; Corner, Siriwardena and Fersoy, forthcoming), including for rainbow-trout cages on Lake Issyk Kul, which will be a milestone in the development of aquaculture generally and protection of the fragile ecosystem of the lake. Box 4 summarizes the scope of the EIA.

National professionals advocate the establishment of cage fish farms on suitable waters other than Lake Issyk Kul. It is estimated that several tens to several hundreds of rainbow trout cages could be set on the suitable and vast area of the Naryn cascade reservoirs. These waters could provide feasible options for compensating cage fish farm owners whose licences might be revoked from Lake Issyk Kul. In addition, involvement of family enterprises in cage culture of rainbow trout on these reservoirs could also ensure considerable income generation. Therefore, the suitability of the Naryn reservoirs for cage culture of rainbow trout should be surveyed and relevant applicable production technologies researched.

The number of fingerlings used in current stock enhancement practices in Kyrgyzstan appears to have been rather arbitrarily determined, mainly governed by the availability of fry and fingerlings of specific species for stocking purposes, and not based on any scientific rationale.

BOX 4

Environmental impact assessment of cage culture of rainbow trout on Lake Issyk Kul

The objective of an environmental impact assessment (EIA) of rainbow-trout cage culture on Lake Issyk Kul would be to provide decision-makers with information about whether to issue new licences for cages. Such an EIA should contain the following chapters (at least):

1. Overview of precedents of and still practised cage trout farming in cold freshwater lakes in environment-sensitive countries
   - Technical aspects
   - Environmental aspects, including both positive and negative impacts
   - Related policy, regulatory and management frameworks
   - Preconditions of establishment and conditions of operating such cage farms (regulations)
   - Mitigation of environmental impacts
     - Impact of fingerling-rearing fish farms around the lake
     - Impacts of cages
     - Impacts of feeding of fish
     - Impacts of fish escaped from the cages
   - Lessons learned
2. Cage culture of trout in Lake Issyk Kul
   - Technical and environmental aspects
     - Year of establishment, location and number of cages and their yearly production
     - Estimated past, present and future impact of the cage
     - Applicable mitigative measures
   - Applied policy, regulatory and management frameworks
3. Recommendations
   - Technical and environmental issues
   - Policy, regulatory and management related issues
   - Awareness-raising programmes and way forward

Sources: After Corner (2011) and Corner, Siriwardena and Fersoy (forthcoming).

According to De Silva and Funge-Smith (2005), for a carefully planned stock enhancement programme in a large waterbody such as Lake Issyk Kul, the following issues need to be understood through research:

- Does the waterbody need a stock enhancement strategy? As part of this evaluation, a number of questions must be addressed:
  - What are the current yields and the species composition of the fishery?
  - Is the fishery primarily dependent on indigenous and/or exotic species?
  - Are the main constituent species of the fishery self-recruiting, and does spawning occur in the waterbody or not?
  - What is consumer acceptance of the main constituent species?

Having clear answers to these questions will indicate whether the waterbody needs regular stock enhancement. The issues are then:

- What form should the enhancement take?
  - Should the fishery be sustained through a regular stocking programme of non-self-recruiting but desirable species with ready consumer acceptability?
  - Is it more appropriate to "re-seed" depleted spawning populations of major species of the fishery (to sustain the existing self-recruiting fishery of either indigenous or exotic species)?
  - Will the activity be financially sustainable?
- How to decide what to stock?
  - Determine the potential fishery yield of the waterbody using an appropriate yield-predictive model. If the actual fish yield is close to the predictive value, then stocking will not be effective and therefore it should not be undertaken. If there is a significant gap between the actual and predicted yield, then enhancing fish stocks may be justified.

Therefore, a developed research programme should include responses to such issues in order to develop a suitable stock enhancement programme to support food security and livelihood enhancement in fishing communities.

If stocking activities are seeking to fill apparently vacant ecological niches, particularly in large waterbodies, this should be done on the basis of a sound understanding of trophic relationships in the waterbody concerned. A stocking strategy based on experiences from aquaculture ponds, in accordance with the polyculture principle in which a species is selected to fill a food niche, may not necessarily be the most suitable approach for open waterbodies as trophic relationships, particularly in large waterbodies, can be extremely complex (De Silva and Funge-Smith, 2005).

In order to ensure an optimal stocking strategy, the potential productivity of the waterbody must be determined. There are a number of tools available to fishery management to predict the total yield from a waterbody, including the morpho-edaphic index, which is one of the simpler tools available for such productivity assessments. There are other fish-yield prediction indices such as chlorophyll *a*, shoreline development and indices based on catchment land-use patterns. The Institute of Biology and Pedology of the National Academy of Sciences should undertake studies to test which tools are most applicable in the context of Kyrgyzstan to design more meaningful stock enhancement programmes for lakes and reservoirs.

As part of their formal training, university students could regularly monitor changes in the fish fauna of the different waters of Kyrgyzstan. Supervised by senior scientists and professionals, these students could greatly contribute to a better understanding of the management of fishery resources of the country and develop their own skills and expertise in the process.

Elaboration of all details of the technology of artificial propagation and mass production of the fry and fingerlings of marinka and naked osman should continue.

Optimal fisheries utilization of irrigation reservoirs would become possible if the management of these waterbodies could:

- avoid reducing the water level during the spawning season of affected fish species;
- limit short-term fluctuations of water levels;
- avoid draining the water too quickly and to too low a depth.

To determine whether the above-listed actions are feasible, specific research on the fish production capacities and the related technical solutions for fish production in such waterbodies should be completed.

With respect to aquaculture research, agendas should be discussed and developed jointly with farmers so that their needs are addressed appropriately through "institute–industry research partnerships" (Siriwardena, 2007). This approach will ensure research support is channelled to meet the needs of farmers and industry development as a whole, while preserving environmental sustainability in the long term. Some of the urgent research topics are:

- tools for decision-making concerning broodstock and seed quality, breeding and culture environment and risk-reduction measures against diseases;
- indigenous broodstock management, breeding, genetics and fry-nursing practices;
- suitable farm-made feeds where appropriate, or cheap and sustainable locally sourced feeds.

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Annex 1 – Lakes and reservoirs of Kyrgyzstan

This annex aims to contribute to a better understanding of past and present fisheries in all the key larger lakes and reservoirs in Kyrgyzstan and to provide information to advise and help prepare for future decisions on fisheries management. Key characteristics of the larger lakes and reservoirs of Kyrgyzstan are listed in Table A1.1. Descriptions are presented in the following sections.

TABLE A1.1
Summary list of waterbodies described in Annex 1

Province	District	Name of waterbody	Type of water		Total
			Lake	Reservoir	
Batken	Batken	Tort-Kul reservoir		267	267
		Total		**267**	**267**
Chuy	Alamüdün	Ala-Archa (Lower-Ala-Archinskoye riverbed)		1 000	1 000
		Ala-Archinsk (Lower-Ala-Archinskoye tanker)		625	625
	Jaiyl	Kara-Balta reservoir		149	149
	Moskva	Ak-Suu reservoir		136	136
		Spartac reservoir		590	590
	Panfilov	Agermen reservoir		34	34
		Kara-Tuma reservoir		220	220
	Sokuluk	Sokuluk reservoir		180	180
		Total		**2 934**	**2 934**
Issyk Kul	Ak-Suu	Merzbacher	450		450
	Several	Issyk Kul	623 600		623 600
		Total	**624 050**		**624 050**
Jalal-Abad	Aksy	Uch-Korgon reservoir		400	400
	Bazar-Korgon	Bazar-Korgon reservoir		231	231
	Nooken	Kurpsay reservoir		1 200	1 200
		Shamaldysai reservoir		240	240
		Tash-Kumir		1 800	1 800
	Toktogul	Kara-Suu	383		383
		Toktogul reservoir		26 500	26 500
		Total	**383**	**30 371**	**30 754**
Naryn	At-Bashy	Chatyr-Kul	17 060		17 060
	Kochkor	Kel-Ukok	160		160
		Ortho-Tokoi reservoir		2 550	2 550
	Several	Son-Kul	27 300		27 300
		Total	**44 520**	**2 550**	**47 070**
Osh	Kara-Suu	Papan reservoir		710	710
	Nookat	Naiman reservoir		450	450
	Uzgen	Kampyravat reservoir		5 400	5 400
		Total		**6 560**	**6 560**
Talas	Talas	Kara Buurin reservoir		265	265
		Kirov reservoir		2 800	2 800
		Total		**3 065**	**3 065**
Grand total of described lakes and reservoirs			**668 953**	**45 747**	**714 700**
Area of not described lakes and reservoirs			**3 390**	**1 564**	**4 954**

LARGER LAKES

Lake Issyk Kul

Lake Issyk Kul is located in the northeast of the country at an altitude of 1 609 m above sea level. The lake occupies a significant portion of the Issyk Kul depression, which is tectonic in origin. The basin lies between two mountain ranges: the Kungei Ala-Too in the north and the Terksy Ala-Too in the south. The lake lies within the Issyk Kul Biosphere Reserve and was designated a Ramsar Wetland in 2001.

Lake Issyk Kul is the second-largest high-altitude waterbody in the world. It is also one of the deepest lakes, with a wide range of unique physical and chemical characteristics. The lake is fed by about 80 rivers and streams, which have a rain–snow–glacial basis. The water quality of the lake is driven by an underlying chloride–sulphate–sodium–magnesium character, which has a pH value of 8.7–8.9. Its average salinity varies from 5.9 to 6.1 g/litre, but in the bays where large rivers enter, the water is diluted and salinity varies between 2.0 and 3.1 g/litre.

The surface area of Lake Issyk Kul is 6 236 km^2. It is 178 km long and 60 km wide. Its maximum depth is 668 m, while the average depth is 280 m. More than 63 percent of the lake is deeper than 100 m. The water of the lake Kul is oligotrophic. It is rich in phytoplankton (299 identified taxa). There are 117 taxa of zooplankton, of which 98 are rotifers, 11 are cladocerans and 8 are copepods. The bays and shallow waters are richer in phytoplankton and zooplankton than are the open waters. *Arctodiaptomus salinus* (Calanoida, Copepoda) is present everywhere in the lake. In a year, it may represent 75–95 percent of the total number, and 95–99 percent of the biomass within zooplankton. At night, this species migrates to the surface water, where its concentration may reach up to 35 000 individuals/m^3. Consequently, *Arctodiaptomus salinus* is an important food source for some of the fish species across their various age groups. The zoobenthos comprises 224 taxa and their mean annual biomass is 8–10 g/m^2 down to a depth of 40 m. Chrinomids, molluscs, gammarids and mysids[1] constitute 6–8 g/m^2 of the total biomass. In the deeper zones, down to about 70 m, the biomass varies between 2.5 and 3.5 g/m^2. It is dominated by chironomids and the mollusc *Radix auricularia*.

Factors combine to give a natural fish productivity of 1.5–2 kg/ha or less. Before the Soviet era, there was no fishing on the lake at all. Its natural productivity was less than 1 kg/ha. At that time, the small chebachok was the dominant species.

According to different sources, out of the 29 fish species present in the lake, only 13 are indigenous to Lake Issyk Kul. Of the 13 indigenous species, 6 are endemic (Tables A1.2 and A1.3). Among the listed endemic species only four (chebak, chebachok, marinka and naked osman) have commercial value.

TABLE A1.2
Fish species indigenous and endemic in Lake Issyk Kul

Order – family – species	English name	Local name
Indigenous species in the river system		
	Cypriniformes – Cyprinidae	
Cyprinus carpio (Linnaeus, 1758)	Common carp	Сазан
	Cobitidae	
Nemachilus stoliczkai (Steindachner, 1866)	Stone loach	Тянь-Шанский голец
Nemachilus stoliczkai (Steindachner, 1866)	Tibetan stone loach	Тибетский голец
Nemachilus strauchi ulacholicus (Anikin, 1905)	Spotted thick-lip loach	Иссык-Кульский губач
Nemachilus strauchi (Kessler, 1874)	Spotted thick-lip loach	Губач
Nemachilus dorsalis (Kessler, 1872)	Gray loach	Серый голец
Endemic species		
	Cypriniformes – Cyprinidae	
Gobio gobio latus (Anikin, 1905)	Issyk Kul gudgeon	Иссык-Кульский пескарь
Leuciscus bergi (Kashkarov, 1925)	Issyk Kul dace, chebachok	Иссык-Кульский чебачок
Leuciscus schmidti (Herzenstein, 1896)	Schmidt's dace, chebak	Иссык-Кульский чебак
Phoxinus issykkulensis (Berg, 1912)	Issyk Kul minnow	Иссык-кульский гольян
Diptychus dybowskii lansdelli (Gunther, 1889)	Issyk Kul naked osman	Иссык–Кульский голый осман
Schizothorax issykkuli (Berg, 1907)	Issyk Kul marinka	Иссык-Кульская Маринка

Sources: UNDP Project Document (2008); Ryspaev and Woynárovich (2008).

[1] Three mysid species were introduced from Lake Balkhash between 1965 and 1968. Now, they are permanently established at a depth of 1.5–1.8 m. Their biomass may reach 1.5–2.5 g/m^2 (Savvaitova and Petr, 1999).

TABLE A1.3
Fish species introduced into Lake Issyk Kul

Order – family – species	English name	Local name	Introduction
	Salmoniformes – Coregonidae		
Coregonus migratorius (Georgi, 1775)	Baikal omul	Байкальская омуль	1966
Coregonus lavaretus Ludoga (Poljakov, 1874)	Common whitefish	Сиг-лудога	Years of 1960s
Coregonus peled (Gmelin, 1789)	Peled	Пелядь	Years of 1970s
	Salmoniformes – Salmonidae		
Oncorhynchus mykiss (Walbaum, 1792)	Rainbow trout	Радужная форель	Years of 1980s
Salmo ischchan Issykogegarkuni (Lushin, 1932)	Sevan trout	Иссык-Кульская форель	1930
	Cypriniformes – Cyprinidae		
Abramis brama (Linnaeus, 1758)	Oriental bream	Аральский лещ	1956
Alburnoides taeniatus (Kessler, 1874)	Striped bystranka	Полосатая быстрянка	1970
Carassius auratus auratus (Linnaeus, 1758)	Goldfish	Серебряный карась	1954*
Ctenopharyngodon idella (Valenciennes, 1844)	Grass carp	Белый Амур	1965
Hypophthalmichtys molitrix (Valenciennes, 1844)	Silver carp	Толстолобик	1965
Pseudorasbora parva (Temminck and Schlegel, 1846)	Topmouth gudgeon	Амурский чебачок	When grass carp*
Tinca tinca (Linnaeus, 1758)	Tench	Линь	Years of 1950s
	Perciformes – Eleotridae		
Perccottus glenii (Dybowski, 1877)	Amur sleeper	Головешка или ротан	No information*
	Perciformes – Percidae		
Lucioperca lucioperca (Linnaeus, 1758)	Pike-perch	Судак	1958

* Introduced by accident.

Sources: UNDP Project Document (2008); Ryspaev and Woynárovich (2008).

Before the introduction of exotic fish species, the proportion of the low-value endemic chebachok was the highest (Tables A2.10 and A2.11).

Despite the significant costs of the introduction of commercial fish species, the introduced predator species Sevan trout and pikeperch directly reduced the number of chebak and chebachok, while oriental bream and those introduced accidently (*Eleotris* or Amur chebachok) destroyed a significant portion of eggs laid by the endemic species. This was one of the reasons why the fish production of the lake declined (Table A2.9).

In Lake Issyk Kul, the spawning seasons of the different fishes produced the peak of the yearly catches. This was modified when fishing for chebachok in its spawning season was prohibited in 1982. Later, in 1986, a total ban on naked osman fishing was introduced (Sarieva *at al*., 2008).

Between 1965 and 1990, the yearly average quantity of captured fish was 681.6 tonnes. Within the same period, the maximum and minimum yearly catches were 1 350 tonnes and 142.4 tonnes, respectively. In this period, a total of 16 586.9 tonnes of fish was captured in Lake Issyk Kul.

After 1991, the state fishery company closed and fishing activities were privatized with strictly set quotas, but these were largely ignored. In the period 1991–2003, the total catches were 765.6 tonnes, while the yearly average registered catch remained about 58.9 tonnes. This was less than 10 percent of the average yearly catches between 1965 and 1990.

By 2008, the combination of legal, illegal, unreported and unregulated fishing had reached such an extent that a five-year-long fishing moratorium had to be imposed on Lake Issyk Kul. However, with this moratorium being introduced, the government authorities lost the chance to evaluate and officially receive reliable information on the fish fauna of the lake. This is because the most economic and efficient samplings of the fish stock is done through evaluation of the commercial catches, and these were banned in 2008 (Ryspaev and Woynárovich, 2008).

One consequence of the collapse of the fisheries was that the number of endemic fish species also fell dramatically in Lake Issyk Kul, at a time when they would have been expected to recover. Two species, naked osman and marinka, became so endangered that action had to be taken, and so in order to understand the serious problems a project of the United Nations Development Programme / Global Environment Facility (UNDP/GEF) was started, titled Strengthening Policy and Regulatory Framework for Mainstreaming Biodiversity into Fishery Sector.

Lake Son-Kul

Highland Lake Son-Kul is the largest freshwater lake of Kyrgyzstan. It is located in the Naryn region at 3 016 m above sea level. The lake is situated in a small valley of the Tien Shan mountains between the ridges of Son-Kul-Too in the north and the Moldo-Too and spurs of the mountains Boor-Albas in the south.

The lake is 28.5 km long, has a maximum width of 18 km and covers an area of 273 km^2. The maximum depth of the lake is 22 m. Several small rivers drain into the lake. The waters of the rivers that flow into the lake are clean and free of human contamination. In winter, the lake is completely covered with ice, and this period lasts from late November to June.

There were no fish in the lake until 1959, when the introduction of valuable fish species started. A batch of 40 peled yearlings (32–47.5 g/fish) was introduced on 30 July 1968, brought from Lake Mid-Pokrovskoy (within the Issyk Kul basin). Subsequently, further larvae of peled were introduced in 1971, and the larvae of chira were released twice, in 1971 and 1972. At first, both species grew well, but later the chira did not find the conditions favourable for natural reproduction, and hence it gradually disappeared as the stockings were discontinued.

Since 1975, catches of common whitefish have been observed as isolated cases. This species was introduced accidentally together with peled. In 1978, the lake produced 108.2 tonnes (3.96 kg/ha) of peled and whitefish. After this, when fishing laws were better observed, landing of whitefish and peled were 140–330 tonnes/year (5–12 kg/ha). Later, the average yearly landings increased to 600 tonnes (21.9 kg/ha), but this was not sustainable (Sarieva *et al*, 2008) and, owing to uncontrolled over-fishing, a five-year fishing moratorium was also imposed on Son-Kul in 2008.

TABLE A1.4
Fish species introduced into Lake Son-Kul

Order – family – species	English name	Local name	Introduction
	Salmoniformes – Salmonidae		
Coregonus lavaretus Ludoga (Poljakov, 1874)	Common whitefish	Сиг-лудога	1975
Coregonus peled (Gmelin, 1789)	Peled	Пелядь	1968
	Cypriniformes – Cyprinidae		
Diptychus dybovskii (Kessler, 1874)	Naked osman	Иссык–кульский голый осман	1960*
	Cobitidae		
Nemachilus stoliczkai (Steindachner, 1866)	Stone Loach	Тянь-Шанский голец	
Nemachilus dorsalis (Kessler, 1936)	Grey Loach	Серый голец	

* *Sources:* Pivnev (1990); Ryspaev and Woynárovich (2008).

Lake Chatyr-Kul

Lake Chatyr-Kul is the third-largest lake in Kyrgyzstan. It is located in the border zone of the Naryn region in the south of the Tien Shan mountains at an altitude of 3 530 m above sea level. The clay–salt–marsh basin is surrounded by the mountain ranges At-Bashi in the north and Torugart in the south. With a length and width of 23 and 11 km, respectively, the area of the lake is 170.6 km^2. According to the Biology and Soil Institute of the National Academy of Sciences, the depth in the eastern part varies between 1.5 and 8 m, while in the western parts it can be as deep as 19 m.

Fifty-two seasonal rivers and creeks drain into the lake but they are only present in the summer. The water that flows into the lake from the rivers is clean and not contaminated. The water of Chatyr-Kul is slightly saline at a concentration of about

2 g/litre, particularly in the northwestern part of the lake. This is because here the water is in contact with limestone, which has a high calcium-carbonate content. In winter, the lake is completely covered with ice with a thickness between 1.25 and 1.5 m. The lake freezes in late October and remains covered with ice for about 7–8 months, with melting starting in early May. By late June, the lake is completely free of ice.

The estimated average biomass of zooplankton, mainly gammarids, varies from 4.7 g/m^2 to 7.1 g/m^2 (ww) at a density of 80 000–100 000 specimens/m^2 in the summer. This biomass would be ideal for whitefish growth and development.

Today, the lake is without fish, and it was declared a Ramsar site in 2005, where currently the introduction of fish would be illegal (Sarieva *et al.*, 2008). Should conditions change, a precondition of introducing fish into the lake would be to carry out an environmental impact assessment (EIA) supported by a set of complex year-round surveys of the physical, chemical and biological conditions and characteristics of the lake.

Lake Sary-Chelek

The lake is located in Jalal-Abad Province in the western Tien Shan at an altitude of 1 925 m above sea level. This is the largest of the six lakes located in the territory. It is part of the Sary-Chelek Biosphere Reserve, designated in 1979.

With a length of 5.94 km and a maximum width of 1.8 km, the lake covers an area of 3.88 km^2. Its maximum depth is 234 m. Most local researchers believe that the lake originated through landslide activity.

The lake is oligotrophic. Its water is fresh, and the nature of mineralization is of the hydro–carbonate–sulphate–calcium type. In summer, the oxygen content in the surface water is high (7.3–9.5 mg/litre). The lake is highly stratified, and the oxygen content gradually reduces with increasing depth. At a depth of 55 m, oxygen disappears completely and a hydrogen sulphide zone begins.

The quality and quantity of the zooplankton biomass fully satisfies the sole representative of the fish fauna, marinka. Fisheries exploitation of the lake is prohibited because it is in a specially protected area.

Lake Kara-Suu

This is a small lake in Jalal-Abad Province in the Naryn River basin. It is situated in the valley of the Kara-Suu River at an altitude of 1 998 m above sea level. It has a landslide origin and has several small rivers and streams that drain into it.

The lake is 3.82 km^2 (length 5.8 km, average width 0.26 km and maximum width 1.28 km). Its average depth is 55.7 m, while the maximum depth is 147 m. The water level fluctuates by as much as 15 m according to the season. The water level begins to increase in late April and early May, but it gradually drops from September to April.

The temperature of the surface water in summers is 11.5 °C on average. The pH of the water is 7.31. The oxygen content of the surface water is about 6.2 mg/litre, reducing with depth to 2.09 mg/l at a depth of 143 m. In winter, from November the lake freezes and the ice persists until April.

It is a typical cold-water lake in which the fish food production is low. Zooplankton is represented mainly by rotifers, copepods and cladocerans. The total average biomass of plankton is 404 mg/m^2. Zoobenthos is also poorly developed (146.8–221.8 mg/m^2) being mainly oligochaetes and chironomid larvae. The larvae of stoneflies, mayflies and caddis flies can also be found in the lake and its tributaries.

The fish fauna is represented by ordinary marinka, Severtsov's osman, and Tibetan and grey loaches. Although there are more Severtsov's osman than marinka, it is not considered to be of a good quality to catch, because almost all the adult fish have ligulosis, a common disease in Cyprinids.

In 1988, about 510 000 peled larvae were incubated in the Karakol Fish Hatchery and then released in the lake. Although peled breeds naturally, the survival rate is low. At present, about 12 tonnes (31.4 kg/ha) of fish is harvested annually. Out of this, 10 tonnes (26.2 kg/ha) is peled and 2 tonnes is (5 kg/ha) marinka. With an annual stocking of peled fry, the productivity of the lake could be increased by 1.5–2 times.

Lake Kel-Ukok

Lake Kel-Ukok is located in the Naryn region, at an altitude of 3 048 m above sea level in a gorge, about 20 km above the village of Kochkor. The lake covers 1.6 km^2, being 3 km long and 0.69 km wide, with a maximum depth of 55 m. The bottom is littered with ancient moraine.[2] There is no road to the lake. It can be approached only on foot or horseback.

The water runoff from the lake is the result of seepage through a dam built from large rocks. The edge of the dam is 20–30 m above lake level. Three rivers and numerous streams flow into the lake, with a maximum flow between June and August. The temperature of the water does not rise above 12–14 °C in summer. The lake freezes in November and remains frozen until June.

The oxygen content of the water is 6.5 mg/litre and the pH is exactly 7. Zooplankton is represented mainly by rotifers, copepods and cladocerans. Their average biomass is about 977 mg/m^3. The zoobenthos is dominated by gammarids.

Owing to the favourable physical, chemical and biological characteristics of the lake, peled was stocked in the 1980s to acclimatize and establish brood stock, but information about the result of this introduction and current information is missing.

There is no commercial fishing on the lake, mainly because access to the lake by vehicle is impossible and there are no financial resources for road construction.

Lake Merzbacher

This lake is an example of an ice-dammed lake. It is located at an altitude of 3 016 m between two branches of the Engilchek Glacier in the Tien Shan mountains. The lake is on the upper section of the Engilchek River at the end of the North Engilchek Glacier behind an ice dam formed by the body of the South Engilchek Glacier. The lake is the result of glacial meltwater. Every summer, between July and September, the lake partly drains, with the lower part draining into the Engilchek River. The upper part remains full of water. The lake reaches its maximum size by the middle of summer, when it breaks through the glacier. Drainage is completed within 6–8 days and is accompanied by a shattering flood during which water passes out of the lake at a rate of about 1 000 m^3/s. At the maximum water level, the area of the lake is 4.5 km^2 (4 km long and 1 km wide on average) and its depth is 130 m. Its water volume is about 0.15 km^3. About 50–80 percent of the lake is full of icebergs. After the breakout of the lake, they sink to the bottom where they create a huge pile of ice. For obvious reasons, there are no fish in the lake and it cannot be used for fishing.

LARGER RESERVOIRS

Cascade of Naryn reservoirs

Along the River Naryn, there are five reservoirs with a total area of 291.2 km^2. These are the Toktogul (265 km^2), Kurpsay (12 km^2), Tash-Kumyr (7.8 km^2), Shamaldysai (2.4 km^2) and Uch-Korgon (4 km^2) reservoirs.

Toktogul reservoir

This reservoir is formed by the dam of the Toktogul hydroelectric power plant on the Naryn River in Osh Province. It is located in Jalal-Abad Province in the Aba Ketmen-

[2] Rocks and sediments carried by glaciers.

Tube Basin, which is the lowest lying basin of the Tien Shan Mountains. It was built to supply water for irrigation and to generate power. After completion of the dam, filling of the reservoir began in 1973.

The water surface area is 265 km^2 and, at its maximum water level, the reservoir holds about 19.5 km^3 of water. It is 65 km long and 12 km wide at its widest point. Its average depth is 69 m with a maximum depth of 180 m. The level of the reservoir fluctuates by as much as 63 m during the course of a season.

About ten rivers feed the reservoir, including the Chichkan, Uzun Ahmet, Torkent and Uch-Terek Rivers. The Naryn River has very muddy water and its temperature is low – even in summer, it is about 15 °C.

The mineral content of the water is 200–250 mg/litre. The oxygen content in the surface water varies from 98.2 percent in early spring to 78.3 percent in autumn and winter. The water temperature varies seasonally and in different parts of the lake. The highest temperature of the surface water in the pelagic zone is about 23–24 °C. In shallow areas, the temperature is somewhat higher. In estuarine areas of the major rivers, the water temperature remains low in summer, and it varies between 13 and 15 °C. The reservoir does not freeze in winter.

Phytoplankton is represented by 47 species and is widespread throughout the reservoir. The dominant species are small forms – those which are important in the diet of zooplankton and juvenile fish. The zooplankton includes 13 common species. The zoobenthos formed in the flood-water zone consists of chironomid larvae, oligochaetes, caddis flies, mayflies, gammarids and mysids.

The fish fauna of the Toktogul reservoir consists of 18 species, as listed in Table A1.5. As the native fish species had no commercial value, other more-valuable species were introduced on the recommendation of the Academy of Sciences in the 1970s and 1980s. Of these, Sevan trout stocked from Lake Issyk Kul found favourable conditions for

TABLE A1.5
Indigenous and introduced fish species in Toktogul reservoir

Order – family – species	English name	Local name	Introduction
Indigenous species of the river system			
Cypriniformes – Cyprinidae			
Schizothorax intermedius intermedius (McClelland, 1842)	Common marinka	Обыкновенная маринка	-
Leuciscus squaliusculus (Kessler, 1872)	Syrdarya dace	Сырдарьинский елец	-
Diptychus micromaculatus (Turdakov, 1955)	Scaled osman	Чешуйчатый осман	-
Diptychus sewerzovi (Kessler, 1872)	Severtzov osman	Осман Северцова	-
Aspiolucius esocinus (Kessler, 1874)	Pike asp	Щуковидный жерех	-
Nemachilus kuschakewitschi (Herzenstein, 1890)	Kushakewitsch loach	Голец Кушакевича	-
Nemacheilus dorsalis (Kessler, 1872)	Gray loach	Серый голец	-
Nemacheilus stoliczka (Steindachner, 1866)	Tibetan stone loach	Тибетский голец	-
Glyptosternon reticulatum (McClelland, 1842)	Turkestan catfish	Туркестанский сомик	-
Salmoniformes – Salmonidae			
Salmo trutta oxianus (Kessler, 1874)	Amurdaya trout	Амударьинская форель	-
Introduced species			
Acipenseriformes – Acipenseridae			
Acipenser baerii (Brandt, 1869)	Siberian sturgeon	Сибирский осетр	1982
Salmoniformes – Salmonidae			
Salmo ischchan Issykogegarkuni (Lushin, 1932)	Sevan trout	Иссык-Кульская форель	1970s
Cypriniformes – Cyprinidae			
Cyprinus carpio (Linnaeus, 1758)	Common carp	Сазан, карп	1970s
Carassius auratus auratus (Linnaeus, 1758)	Goldfish	Серебряный карась	1970s
Ctenopharyngodon idella (Valenciennes, 1844)	Grass carp	Белый Амур	1970s
Hypophthalmichtys molitrix (Valenciennes, 1844)	Silver carp	Толстолобик	1970s
Pseudorasbora parva (Temminck and Schlegel, 1846)	Topmouth gudgeon*	Амурский чебачок	1970s
Perciformes – Eleotridae			
Rhinogobius similis (Gill, 1859)	Amur goby	Амурский бычок	1970s

* Introduced by accident.

spawning in the tributaries of the Chichkan and Uzunahmet Rivers, and the numerous minnows present in the lake form the basis of its natural food.

In the early years of filling the reservoir, the population of marinka exploded. However, at present it is small. Pike live in the Naryn River. In the early years of the reservoir, pike were plentiful but later their number dropped dramatically. In recent years, there has been no catch of this fish.

The growth of Sevan trout and common carp in the reservoir is good. Conditions for natural reproduction are still satisfactory. Intensive poaching during their propagation period and the huge fluctuation in the water level limit the development of their naturally established populations. Although they grow well and readily spawn in the reservoir, their natural stocks are therefore in a depressed state. For this reason, further artificial propagation and regular re-stocking would be necessary to maintain a sustainable fishery.

Sevan trout is a commercial fish in the reservoir. Fishing for this species began in the 1980s and is carried out mainly in the estuary of the Usunahmat River, although it is known that the fish go into the mouth of almost all the rivers that enter the reservoir.

Fisheries of Chinese major carps (grass, silver and bighead carp) are in a normal state. According to unconfirmed information, these fish spawn in the Naryn River and enter the reservoir, which has formed self-reproducing populations. These data requires scientific confirmation.

Siberian sturgeon was introduced in 1982. In the following years, it was captured in isolated cases when high growth rates were reported. At present, there is no trace of this fish. It is thought that it was probably wiped out by poaching.

Originally, there were no plans for the Toktogul reservoir to be exploited as a fishery. For this reason, neither the physical nor the social conditions necessary for such a fishery were developed or assessed. An objective assessment of the conditions for fisheries should be completed in order to determine catch limits and quotas so that sustainable results can be achieved. In order to increase the production of fish in the reservoir, effective measures should be taken against poaching and violations of the established fishing rules.

The reservoir has a unique role in influencing the water and fishery management of the downstream reservoirs.

Kurpsay reservoir

This reservoir is located in Jalal-Abad Province on the Naryn River, just downstream of the Toktogul reservoir. It was finished in 1981. Prior to the regulation of the Naryn River, the river was 40–50 m wide at this section. The surface area of the reservoir is 12 km^2. It is 40 km long and 0.3–0.4 km wide on average, with a maximum width of 1 km. The maximum depth is 95 m and the total capacity is 354 million m^3. The water in the reservoir does not freeze in winter.

The increase in water level in the reservoir begins in late May and goes on until the end of July, with significant fluctuations. The decrease in water is smooth and predictable and lasts until October. The actual fluctuation and decrease in the water depth depend on irrigation and hydropower needs, as well as on the water release programme of the upstream Toktogul reservoir. For example, a water level change of 10–15 cm/hour in the upstream reservoir results in a 2–4 cm/hour change at the downstream reservoir. Diurnal variation and the runoff to the subsequent dams may be as much as 1 000 m^3/sec.

Natural fish food production of the reservoir can be described as good. The biomass of zoobenthos is about 5.7 g/m^2 (about 20 tonnes), the average biomass of zooplankton varies between 3.5 and 4 g/m^2(about 300 tonnes), while the biomass of fish can be as much as 7 tonnes. The indigenous fish fauna is similar to that in the Toktogul reservoir (Table A1.5).

The reservoir has no fishery status. It is difficult to access because the reservoir is a canyon-type reservoir and there is only one place through which a section of its bank can be reached.

Tash-Kumyr reservoir

The Tash-Kumyr reservoir is also located in Jalal-Abad Province and is the third reservoir on the Naryn cascade, immediately downstream of the Kurpsay reservoir. It is used for irrigation and energy generation purposes. It was commissioned in 1988, has a surface area of 7.8 km^2 with a length of 18.8 km and width of between 100 and 850 m. The maximum and average depths of its water are 65 and 18.5 m, respectively. The reservoir can hold 144 million m^3 of water. The water only freezes in very severe winters.

During the year, there are sharp fluctuations of the water level, caused by water released from the two upstream reservoirs and release from it. The daily and hourly maximum amplitude of water level changes are 2.56 and 1.89 m, respectively. The quantity of water released hourly through the hydroelectric dam on Kurpsay is about 150 m^3/s, which means a complete water exchange in the reservoir takes about 11 days.

In the reservoir, the quantity of zoobenthos and zooplankton can be estimated on the basis of the water volume removed from Kurpsay. These can be as much as 12 and 200 tonnes, respectively. On this basis, the fish fauna present is estimated to be about 4.5 tonnes. The reservoir has no fishery status and the fish fauna is similar to the reservoirs upstream (Table A1.5).

Shamaldysai reservoir

The fourth reservoir in the Naryn cascade is also located in Jalal-Abad Province, on the route of the Naryn River. Its total area is 2.4 km^2. The lake's water level is exposed to considerable diurnal fluctuations, which depend on the water released from the upstream reservoirs.

The fish fauna mainly contains the same species as present in the upstream reservoirs (Table A1.5). The reservoir has no fishery status.

Uch-Korgon reservoir

The Uch-Korgon reservoir is located in Jalal-Abad Province and was built in 1962 for storing water for irrigation. It covers an area of 4.0 km^2. The water level fluctuates considerably (no data), release being diurnal and dependent on the release of water from the upstream reservoirs.

In contrast to other reservoirs of the Naryn cascade, it is characterized by a rapid growth of algae and higher aquatic plants, which are a favourable food supply for herbivorous fish. The fish fauna is represented by those fish listed in Table A1.5. The reservoir has no fishery status.

Other reservoirs

Bazar-Korgon reservoir

This reservoir is located in Jalal-Abad Province and was built in the river valley of the Kara-Unguri-Say (Karadarya river basin within Syr Darya) in 1962 for storing irrigation water.

At its highest water level, it covers an area of 2.7 km^2 (containing 23 million m^3). However, because of the water withdrawals in the summer months, its surface shrinks to 22.2 percent of its original size (or 0.6 km^2).

The most widespread species are the common marinka, and the Tibetan and grey loaches (Table A1.6); native fish fauna that has no commercial value, but the reservoir holds a fishery status and is currently also used for sport/recreational fishing.

TABLE A1.6
Indigenous and introduced fish species in Bazar-Korgon reservoir

Order – family – species	English name	Local name	introduction
Indigenous species in the river system			
	Cypriniformes – Cyprinidae		
Schizothorax intermedius intermedius (McCleeland, 1842)	Common marinka	Обыкновенная маринка	-
Diptychus sewerzovi (Kessler, 1872)	Scaled osman*	Чешуйчатый осман	-
Nemacheilus dorsalis (Kessler, 1872)	Gray loach	Серый голец	-
Nemacheilus stoliczka (Steindachner, 1866)	Tibetan stone loach	Тибетский голец	-
Glyptosternon reticulatum (McClelland, 1842)	Turkestan catfish*	Туркестанский сомик	-
Introduced species			
	Cypriniformes – Cyprinidae		
Cyprinus carpio (Linnaeus, 1758)	Common carp	Сазан, карп	In the 1970s
Ctenopharyngodon idella (Valenciennes, 1844)	Grass carp	Белый Амур	In the 1970s
Hypophthalmichtys molitrix (Valenciennes, 1844)	Silver carp	Толстолобик	In the 1970s

* Rare species.

Ortho-Tokoi reservoir

The reservoir was built for irrigation purposes in 1956. It is located in the Naryn region, built across the headwaters of the Chu River at 1 700 m above sea level, and therefore its water freezes in winter. The level and the surface area of the water change significantly during the year. These severely affect the natural reproduction of fishes. The maximum area of the reservoir is 23.2 km^2 when the volume of water is about 470 million m^3. From spring to autumn, the water level drops and the water surface reduces to 4.0 km^2 (17.2 percent) and during this period only about 20 million m^3 of water (4.3 percent) remains in the reservoir (Plates A1.1 and A1.2).

PLATE A1.1
View of the Ortho-Tokoi reservoir in July 2010. At this time, the water level in the reservoir has dropped by more than 20 m

COURTESY OF ANDRÁS WOYNAROVICH

PLATE A1.2
View of the Chui River below the Ortho-Tokoi reservoir in 2010

COURTESY OF ANDRÁS WOYNAROVICH

Indigenous fish species have no commercial value, but they can serve as food fish for species of commercial values. With this purpose, several times in 1961 and 1962, sexually matured Sevan trout was stocked in the Chu River (located above the reservoir). Attempts were also made to establish a population of common carp, but owing to unfavourable spawning conditions this attempt failed. In more recent years, larvae of common whitefish from Lake Son-Kul were stocked (Table 1.7), which resulted in catches of about 1.0 tonne in 2009. According to Sarieva *et al.* (2008), the reservoir could produce much more, about 1.9 tonnes/year (0.8 kg/ha per year).

Another limitation of this reservoir, for proper exploitation as a fishery, is that a considerable part of the fish stock is drained with the water (Plate A1.3).

Kirov reservoir

The reservoir is located in Talas Province. It was built on the Talas River for irrigation purposes in 1975. At its full capacity, the water surface of the reservoir is 28 km^2. As with other similar reservoirs, all built in the foothills of mountain ranges, its productivity is low and its water freezes in winter.

TABLE A1.7
Indigenous and introduced fish species in Orto-Tokoi reservoir

Order – family – species	English name	Local name	Introduction
Indigenous species in the river system			
	Cypriniformes – Cyprinidae		
Diptychus micromaculatus (Turdakov, 1955)	Scaled osman	Чешуйчатый осман	-
Nemachilus stoliczkai (Steindachner, 1866)	Stone loach	Тянь-Шанский голец	-
Nemacheilus dorsalis (Kessler, 1872)	Gray loach	Серый голец	-
Introduced species			
	Salmonifirmes – Coregonidae		
Coregonus lavaretus Ludoga (Poljakov, 1874)	Common whitefish	Сиг-лудога	Years of 2000s
	Cypriniformes – Cyprinidae		
Schizothorax issykkuli (Berg, 1907)	Issyk Kul marinkia	Иссык-Кульская Маринка	1961, 1962
Salmo ischchan Issykogegarkuni (Lushin, 1932)	Sevan trout	Иссык-Кульская форель	
Cyprinus carpio (Linnaeus, 1758)	Common carp	Сазан, карп	

PLATE A1.3
Catching fish at the draining slide of the Ortho-Tokoi reservoir. Youngsters positioned on the draining canal capture fish with scoop nets

COURTESY OF ANDRÁS WOYNAROVICH

TABLE A1.8
Indigenous and introduced fish species in Kirov reservoir

Order – family – species	English name	Local name	Introduction
Indigenous species in the river system			
	Cypriniformes – Cyprinidae		
Schizothorax intermedius talassi (Turdokov, 1955)	Talas marinka	Талас маринка	-
Diptychus micromaculatus (Turdakov, 1955)	Scaled osman	Чешуйчатый осман	-
Leuciscus lindbergi (Zanin and Eremeiew, 1934)	Talas dace	Таласский елец	-
Nemacheilus dorsalis (Kessler, 1872)	Gray loach	Серый голец	-
Introduced species			
	Cypriniformes – Cyprinidae		
Cyprinus carpio (Linnaeus, 1758)	Common carp	Сазан, карп	
Tinca tinca (Linnaeus, 1758)	Tench	Линь	
Aspius aspius iblioides (Kessler, 1872)	Caspian or Aral asp	Обыкновенный жерех	
Carassius auratus auratus (Linnaeus, 1758)	Goldfish	Серебряный карась	
Ctenopharyngodon idella (Valenciennes, 1844)	Grass carp	Белый Амур	
Hypophthalmichtys molitrix (Valenciennes, 1844)	Silver carp	Толстолобик	
	Perciformes – Percidae		
Lucioperca lucioperca (Linnaeus, 1758)	Pike-perch	Судак	

The fish fauna consists of both native and introduced fish species as listed in Table A1.8. However, as neither the productivity nor the water temperature is optimal for carps, the production of the reservoir is low at about 0.5 tonnes of common carp and 0.2 tonnes of Chinese major carps. According to Sarieva *et al*. (2008), the reservoir could produce much more, perhaps 16–17 tonnes/year (5.7–6.1 kg/ha per year). At present, the reservoir is used for both commercial and recreational fishing.

Papan reservoir

The Papan reservoir is located in Osh Province. It was built on the Ak-Buura River in 1987 in order to supply the region with irrigation water. At peak water level, its surface area is 7.1 km^2 and holds 260 million m^3 of water. Similar to the Kirov reservoir, its fish food production capacity is low. The lake freezes in winter. At present, the reservoir is used for recreational fishing only.

The fish fauna of the reservoir is poor (Table A1.9), with a yearly fish production of about 2.1 tonnes (3 kg/ha per year) (Sarieva *et al*., 2008).

Tort-Kul reservoir

This reservoir is located in Batken Province. It was built on the Isfara River in 1977 in order to accumulate a supply of irrigation water. At its highest water level, it holds about 9 million m^3 of water and has a surface area of 6.6 km^2. Its water freezes in winter.

The fish production capacity of the reservoir is low and its fish fauna is poor (Table A1.8). According to Sarieva *et al*. (2008), the reservoir could produce about 8 tonnes of fish per year (12 kg/ha per year).

TABLE A1.9
Indigenous and introduced fish species in Papan and Tort-Kul reservoirs

Order – family – species	English name	Local name	Introduction
Indigenous species in the river system			
	Cypriniformes – Cyprinidae		
Schizothorax intermedius intermedius (McCleeland, 1842)	Common marinka	Обыкновенная маринка	-
Diptychus micromaculatus (Turdakov, 1955)	Scaled osman	Чешуйчатый осман	-
Nemacheilus stoliczka (Steindachner, 1866)	Tibetan stone loach	Тибетский голец	-
Glyptosternon reticulatum (McClelland, 1842)	Turkestan catfish	Туркестанский сомик	-
Introduced species			
	Cypriniformes – Cyprinidae		
Cyprinus carpio (Linnaeus, 1758)	Common carp	Сазан, карп	

Naiman reservoir

The Naiman reservoir is located in the Batken region and was built on the Abshir-Sai River for irrigation purposes. At maximum water level, it covers an area of 3.2 km^2 and holds 40 million m^3 of water. Its productivity is low and the indigenous fish fauna is very similar to that in the Papas and Tort-Kul reservoirs (Table A1.9). Its water freezes in winter and there is no commercial fishery on the reservoir, only recreational fishing.

Ala-Archinsk and Ala-Archa reservoirs

These two reservoirs were built in Chui Province on the Ala-Archa River (Plate A1.4).

Also called the Ala-Archinsk – tanker reservoir, the Ala-Archinsk reservoir was built in 1989 in order to supply irrigation water. At its maximum water level, it covers an area of 6.3 km^2, being 3.5 km long and 1 km wide. The average water depth is 6 m and the reservoir holds 39 million m^3 of water and at low water level the reservoir is only 1.5 km^2 (Plate A1.5).

The reservoir's water belongs to the hydrocarbonate class and calcium group, with a mineral content of 215–289 mg/litre. The oxygen regime of the water is satisfactory.

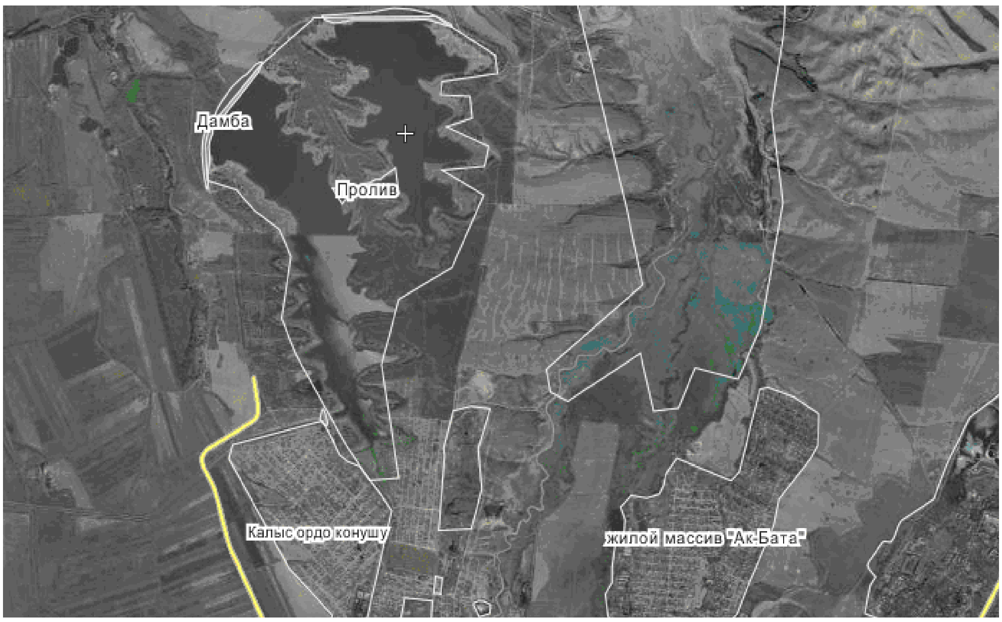
The fish fauna consist of 16 indigenous and introduced species (Table A1.10). The water from the Ala-Archa River enters the reservoir after passing through the city of Bishkek, hence it is rather polluted.

At present, the reservoir is leased and managed by the Kyrgyz Hunting and Fishing Union (HFU) and used for sport and recreational fishing. Considering the ever-increasing leasing fees, there are no financial resources to maintain a proper environment, for fish stocking and for enforcement of fishing conditions. The common opinion is that it is a citizen's right to conduct angling on the reservoir and is consequently free of charge. Without income generation, re-stocking of the reservoir is financially unfeasible.

The Ala-Archa reservoir is also called the Ala-Achinsk – river bed reservoir. This shallow reservoir was built in 1989 to supply water for irrigation. When it is full, the

PLATE A1.4

Satellite view of the Ala-Archinsk (left) and Ala-Archa (right) reservoirs, located to the north of Bishkek



COURTESY OF ANDRÁS WOYNAROVICH

TABLE A1.10
Indigenous and introduced fish species in Ala-Archinsk and Ala-Archa reservoirs

Order – family – species	English name	Local name	introduction
Indigenous species in the river system			
Cypriniformes – Cyprinidae			
Schizothorax pseudoaksaiensis (Herzenstein, 1889)	Chui marinka	Чуйская маринка	-
Esociformes – Esocidae			
Esox lucius (Linnaeus, 1758)	Pike	Щука	
Introduced species			
Cypriniformes – Cyprinidae			
Cyprinus carpio (Linnaeus, 1758)	Common carp	Сазан, карп	
Rutilus rutilus aralensis (Berg, 1916)	Aral loach	Аральская плотва	
Leuciscus leuciscus kirgisorum (Berg, 1912)	Kyrgyz dice	Елец киргизский	
Abramis brama orientalis (Berg, 1949)	Oriental bream	Аральский лещ	
Alburnoides taeniatus (Kessler, 1874)	Striped bystranka	Полосатая быстрянка	
Hemiculter leucisculus (Basilewski, 1855)	Sharpbelly	Корейская востробрюшка	
Pseudorasbora parva (Temminck and Schlegel, 1846)	Topmouth gudgeon	Амурский чебачок	
Carassius auratus auratus (Linnaeus, 1758)	Goldfish	Серебряный карась	
Ctenopharyngodon idella (Valenciennes, 1844)	Grass carp	Белый Амур	
Hypophthalmichtys molitrix (Valenciennes, 1844)	Silver carp	Толстолобик	
Cypriniformes – Poeciliidae			
Gambusia affinis holbrookii (Baird and Girard, 1853)	Mosquitofish	Гамбузия	
Perciformes – Percidae			
Perca schrenkii (Kessler, 1874)	Balkhash perch	Окунь балхашский	
Perciformes – Cannidae			
Channa argus warpachowskii (Berg, 1909)	Snakehead	Змееголов	
Perciformes – Eleotridae			
Perccottus glenii (Dybowski 1877)	Amur sleeper	Головешка или ротан	

water surface is about 10 km^2 and its volume is 16.7 million m^3. Similarly to the Ala-Archinsk reservoir, its water is polluted because of its flow through Bishkek prior to entering the reservoir. This lake also freezes in winter.

There are 16 species in the fish fauna (Table A1.10). Currently, the reservoir is used for sports and recreational fishing.

Spartacus reservoir

The Spartacus reservoir is located in Chui Province. It was built on the Ak-Suu River in order to supply irrigation water. The water of the Ak-Suu River is sulphate-based and mineralization varies between 481 and 756 mg/litre. The area of the reservoir is 5.9 km^2 and it holds 22.1 million m^3 of water, which is considered slightly polluted. The reservoir freezes in winters. The fish species of the reservoir are listed in Table A1.11. There is only sport and recreational fishing on the reservoir.

PLATE A1.5
Reduced water level in the Ala-Archinsk reservoir July 2011. None of the anglers had a fishing licence

COURTESY OF ANDRÁS WOYNAROVICH

TABLE A1.11
Indigenous and introduced fish species in Spartacus reservoir

Order – family – species	English name	Local name	Introduction
Indigenous species in the river system			
Cyprinidae			
Leuciscus leuciscus kirgisorum (Berg, 1913)	Kyrgyz dice	Елец киргизский	
Schizothorax pseudoaksaiensis (Herzenstein, 1889)	Chui marinka	Чуйская маринка	
Rutilus rutilus aralensis (Berg, 1916)	Aral loach	Аральская плотва	
Esociformes – Esocidae			
Esox lucius (Linnaeus, 1758)	Pike	Щука	
Introduced species			
Cypriniformes – Cyprinidae			
Cyprinus carpio (Linnaeus, 1758)	Common carp	Сазан, карп	
Abramis brama orientalis (Berg, 1949)	Oriental bream	Аральский лещ	
Alburnoides taeniatus (Kessler, 1874)	Striped bystranka	Полосатая быстрянка	
Hemiculter leucisculus (Basilewski, 1855)	Shapbelly	Корейская востробрюшка	
Pseudorasbora parva (Temminck and Schlegel, 1846)	Topmouth gudgeon	Амурский чебачок	
Carassius auratus auratus (Linnaeus, 1758)	Goldfish	Серебряный карась	
Ctenopharyngodon idella (Valenciennes, 1844)	Grass carp	Белый амур	
Hypophthalmichtys molitrix (Valenciennes, 1844)	Silver carp	Толстолобик	
Siluriformes – Siluridae			
Silurus glanis (Linnaeus, 1758)	Wels, European catfish	Сом	
Perciformes – Cannidae			
Channa argus warpachowskii (Berg, 1909)	Snakehead	Змееголов	
Perciformes – Eleotridae			
Perccottus glenii (Dybowski 1877)	Amur sleeper	Головешка или ротан	

Sokuluk reservoir

The reservoir is located in Chui Province. It was built on the Sokuluk River in 1978 to store and supply irrigation water. At its highest water level, its surface area is 1.8 km^2 (3.61 km long and 1 km wide), when its capacity is about 11.7 million m^3. Its maximum depth is 20 m. The reservoir freezes in winter. The species of its fish fauna are listed in Table A1.12. The reservoir is used by anglers.

TABLE A1.12
Indigenous and introduced fish species in Sokuluk reservoir

Order – family – species	English name	Local name	Introduction
Indigenous species in the river system			
Cyprinidae			
Leuciscus leuciscus kirgisorum (Berg, 1913)	Kyrgyz dice	Елец киргизский	
Schizothorax pseudoaksaiensis (Herzenstein, 1917)	Chui marinka	Чуйская маринка	
Rutilus rutilus aralensis (Berg, 1907)	Aral loach	Аральская плотва	
Esociformes – Esocidae			
Esox lucius (Linnaeus, 1758)	Pike	Щука	
Introduced species			
Cypriniformes – Cyprinidae			
Cyprinus carpio (Linnaeus, 1852)	Common carp	Сазан, карп	
Abramis brama orientalis (Berg, 1872)	Oriental bream	Аральский лещ	
Alburnoides taeniatus (Kessler, 1874)	Striped bystranka	Полосатая быстрянка	
Hemiculter leucisculus (Bleeker, 1982)	Sharpbelly	Корейская востробрюшка	
Pseudorasbora parva (Temminck and Schlegel, 1846)	Topmouth gudgeon	Амурский чебачок	
Carassius auratus gibellio (Linnaeus, 1758)	Goldfish	Серебряный карась	
Ctenopharyngodon idella (Valenciennes, 1844)	Grass carp	Белый амур	
Hypophthalmichtys molitrix (Valenciennes, 1844)	Silver carp	Толстолобик	
Perciformes – Cannidae			
Channa argus warpachowskii (Berg, 1909)	Snakehead	Змееголов	
Perciformes – Eleotridae			
Perccottus glenii Dybowski	Amur sleeper	Головешка или ротан	

Kara-Tuma reservoir

The reservoir is located in Chui Province. It was built in 1987 to accumulate and supply irrigation water. It covers 2.2 km^2. Its water freezes in winter. The species of its fish fauna are listed in Table A1.13. At present, the reservoir is used only by anglers.

TABLE A1.13
Indigenous and introduced fish species in Kara-Tuma reservoir

Order – family – species	English name	Local name	Introduction
Indigenous species in the river system			
Cyprinidae			
Leuciscus leuciscus kirgisorum (Berg, 1912)	Kyrgyz dice	Елец киргизский	
Schizothorax pseudoaksaiensis (Herzenstein, 1889)	Chui marinka	Чуйская маринка	
Cyprinus carpio (Linnaeus, 1758)	Common carp	Сазан, карп	
Scardinius erythrophthalmus (Linnaeus, 1758)	Rudd	Красноперка	
Rutilus rutilus aralensis (Berg, 1916)	Aral loach	Аральская плотва	
Esociformes – Esocidae			
Esox lucius (Linnaeus, 1758)	Pike	Щука	
Introduced species			
Cypriniformes – Cyprinidae			
Abramis brama orientalis (Berg, 1949)	Oriental bream	Аральский лещ	
Alburnoides taeniatus (Kessler, 1874)	Striped bystranka	Полосатая быстрянка	
Hemiculter leucisculus (Bleeker, 1982)	Sharpbelly	Корейская востробрюшка	
Pseudorasbora parva (Temminck and Schlegel, 1846)	Topmouth gudgeon	Амурский чебачок	
Carassius auratus auratus (Linnaeus, 1758)	Goldfish	Серебряный карась	
Ctenopharyngodon idella (Valenciennes, 1844)	Grass carp	Белый амур	
Hypophthalmichtys molitrix (Valenciennes, 1844)	Silver carp	Толстолобик	
Perciformes – Cannidae			
Channa argus warpachowskii (Berg, 1909)	Snakehead	Змееголов	
Perciformes – Eleotridae			
Perccottus glenii (Dybowski 1877)	Amur sleeper	Головешка или ротан	

Kara-Balta reservoir

This reservoir is located in Chui Province. It was built on the Kara-Balta River in 1964 to accumulate and supply irrigation water. It is 1.49 km^2 and its water freezes in winter. The fish fauna of the reservoir is represented by native and introduced species as listed in Table A1.14. At present, the reservoir is used only by anglers.

TABLE A1.14
Indigenous and introduced fish species in Kara-Balta reservoir

Order – family – species	English name	Local name	Introduction
Indigenous species in the river system			
Cyprinidae			
Leuciscus leuciscus kirgisorum (Berg, 1912)	Kyrgyz dice	Елец киргизский	
Schizothorax pseudoaksaiensis (Herzenstein, 1889)	Chui marinka	Чуйская маринка	
Rutilus rutilus aralensis (Berg, 1916)	Aral loach	Аральская плотва	
Introduced species			
Esociformes – Esocidae			
Esox lucius (Linnaeus, 1758)	Pike	Щука	
Cypriniformes – Cyprinidae			
Cyprinus carpio (Linnaeus, 1758)	Common carp	Сазан, карп	
Abramis brama orientalis (Berg, 1949)	Oriental bream	Аральский лещ	
Alburnoides taeniatus (Kessler, 1874)	Striped bystranka	Полосатая быстрянка	
Hemiculter leucisculus (Basilewski, 1855)	Sharpbelly	Корейская востробрюшка	
Pseudorasbora parva (Temminck and Schlegel, 1846)	Topmouth gudgeon	Амурский чебачок	
Carassius auratus auratus (Linnaeus, 1758)	Goldfish	Серебряный карась	
Ctenopharyngodon idella (Valenciennes, 1844)	Grass carp	Белый амур	
Hypophthalmichtys molitrix (Valenciennes, 1844)	Silver carp	Толстолобик	
Perciformes – Cannidae			
Channa argus warpachowskii (Berg, 1909)	Snakehead	Змееголов	

Ak-Suu reservoir

The reservoir is located in Chui Province. It was built on the Ak-Suu River in 1982 for storing and supplying irrigation water. Its surface is 1.36 km^2. The reservoir freezes in winter. The species of its fish fauna are listed in Table A1.15. At present, the reservoir is used by anglers.

TABLE A1.15
Indigenous and introduced fish species in Ak -Suu reservoir

Order – family – species	English name	Local name	Introduction
Indigenous species in the river system			
	Cyprinidae		
Leuciscus leuciscus kirgisorum (Berg, 1912)	Kyrgyz dice	Елец киргизский	
Cyprinus carpio (Linnaeus, 1758)	Common carp	Сазан, карп	
	Esociformes – Esocidae		
Esox lucius (Linnaeus, 1758)	Pike	Щука	
Introduced species			
	Cypriniformes – Cyprinidae		
Rutilus rutilus aralensis (Berg, 1916)	Aral loach	Аральская плотва	
Abramis brama orientalis (Berg, 1949)	Oriental bream	Аральский лещ	
Alburnoides taeniatus (Kessler, 1874)	Striped bystranka	Полосатая быстрянка	
Hemiculter leucisculus (Basilewski, 1855)	Sharpbelly	Корейская востробрюшка	
Pseudorasbora parva (Temminck and Schlegel, 1846)	Topmouth gudgeon	Амурский чебачок	
Carassius auratus auratus (Linnaeus, 1758)	Goldfish	Серебряный карась	
Ctenopharyngodon idella (Valenciennes, 1844)	Grass carp	Белый амур	
Hypophthalmichtys molitrix (Valenciennes, 1844)	Silver carp	Толстолобик	
	Perciformes – Cannidae		
Channa argus warpachowskii (Berg, 1909)	Snakehead	Змееголов	
	Perciformes – Eleotridae		
Perccottus glenii (Dybowski 1877)	Amur sleeper	Головешка или ротан	

Kampravat reservoir

The reservoir is located on the border with Uzbekistan. There are no fisheries activities in this waterbody because its registration is disputed at present.

Agermen reservoir

This reservoir is located in the Chui region and is used for irrigation. The maximum water surface area is 0.34 km^2. The water level in the reservoir is closely related to the use of the water, and hence its fluctuation is significant. Currently, this waterbody is used for both fish culture and recreational fishing. The local fish fauna is represented by those species listed in Table A1.16.

TABLE A1.16
Indigenous and introduced fish species in Agermen reservoir

Order – family – species	English name	Local name	Years of first introduction
Indigenous species in the river system			
	Cyprinidae		
Leuciscus leuciscus kirgisorum (Berg, 1912)	Kyrgyz dice	Елец киргизский	
Cyprinus carpio (Linnaeus, 1758)	Common carp	Сазан, карп	
	Esociformes – Esocidae		
Esox lucius (Linnaeus, 1758)	Pike	Щука	
Introduced species			
	Cypriniformes – Cyprinidae		
Alburnoides taeniatus (Kessler, 1874)	Striped bystranka	Полосатая быстрянка	
Hemiculter leucisculus (Basilewski, 1855)	Sharpbelly	Корейская востробрюшка	
Pseudorasbora parva (Temminck and Schlegel, 1846)	Topmouth gudgeon	Амурский чебачок	
Schizothorax pseudoaksaiensis (Herzenstein, 1889)	Chui marinka	Чуйская маринка	
Carassius auratus auratus (Linnaeus, 1758)	Goldfish	Серебряный карась	

Kara Buurin reservoir

The reservoir is located in the Talas region, on the route of the Kara-Buur River, and it is used for irrigation purposes. Its surface area is 2.65 km^2. During the irrigation season, the daily fluctuation of the water level is very high, which adversely affects both the natural reproduction of fish and the natural fish production of water. At present this water is controlled by the Department of Fisheries and used for fish production by the Talas State Fish Farm.

The local fish fauna is represented by the fish species listed in Table A1.17.

TABLE A1.17
Indigenous and introduced fish species in Kara Buura reservoir

Order – family – species	English name	Local name	Introduction
Indigenous species in the river system			
Cypriniformes – Cyprinidae			
Schizothorax intermedius talassi (Turdokov, 1955)	Talas marinka	Таласская маринка	
Leuciscus lindbergi (Zanin and Eremeiew, 1934)	Talas dace	Таласский елец	
Nemachilus dorsalis (Kessler, 1872)	Gray loach	Серый голец	
Introduced species			
Cypriniformes – Cyprinidae			
Cyprinus carpio (Linnaeus, 1758)	Common carp	Сазан, карп	
Carassius auratus auratus (Linnaeus, 1758)	Goldfish	Серебряный карась	
Ctenopharyngodon idella (Valenciennes, 1844)	Grass carp	Белый Амур	
Salmoniformes – Salmonidae			
Salmo trutta oxianus (Kessler, 1874)	Amurdaya trout	Амударьинская форель	

Annex 2 – The fisheries and aquaculture sector of Kyrgyzstan – tables

TABLE A2.1
Provinces districts and towns of Kyrgyzstan

Admionistrative units			Type and number of the administrative units		
Province	**District**	**Center of district**	**District**	**Town**	**Grand total**
Batken	Batken	Batken	1		1
	Kadamjay	Pulgon	1		1
	Lailak	Isfana	1		1
	Sülüktü	Sülüktü		1	1
		Total	**3**	**1**	**4**
Biskek	Biљkek	Biљkek		1	1
		Total	**0**	**1**	**1**
Chuy	Alamüdün	Lebedevka	1		1
	Chuy	Chüy	1		1
	Jaiyl	Kara-Balta	1		1
	Kemin	Kemin	1		1
	Moskva	Belovodskoe	1		1
	Panfilov	Kayyngdy	1		1
	Sokuluk	Sokuluk	1		1
	Tokmok	Tokmok		1	1
	Ysyk-Ata	Kant	1		1
		Total	**8**	**1**	**9**
Issyk Kul	Ak-Suu	Karakol	1		1
	Balykcy	Balykcy		1	1
	Issyk Kul	Cholpon-Ata	1		1
	Jeti-Ögüz	Kyzyl-Suu	1		1
	Karakol	Karakol		1	1
	Ton	Bökönbaev	1		1
	Tüp	Tüp	1		1
		Total	**5**	**2**	**7**
Jalal-Abad	Aksy	Kerben	1		1
	Ala-Buka	Ala-Buka	1		1
	Bazar-Korgon	Bazar-Korgon	1		1
	Chatkal	Kanysh-Kyya	1		1
	Kara-Köl	Kara-Köl		1	1
	Kök-Žaŋgak	Kök-Žaŋgak		1	1
	Majluu-Suu	Majluu-Suu		1	1
	Nooken	Massy	1		1
	Suzak	Suzak	1		1
	Taš-Kömür	Taš-Kömür		1	1
	Togus-Toro	Kazarman	1		1
	Toktogul	Toktogul	1		1
	Žalal-Abad	Žalal-Abad		1	1
		Total	**8**	**5**	**13**
Naryn	Ak-Talaa	Baetov	1		1
	At-Bashy	At-Bashy	1		1
	Jumgal	Chaek	1		1
	Kochkor	Kochkor	1		1
	Naryn	Naryn		1	1
	Tien-Shan	Naryn	1		1
		Total	**5**	**1**	**6**

TABLE A2.1 (CONTINUED)

Admionistrative units			Type and number of the administrative units		
Province	**District**	**Center of district**	**District**	**Town**	**Grand total**
Osh	Alay	Gülchö	1		1
	Aravan	Aravan	1		1
	Chong-Alay	Daroot-Korgon	1		1
	Kara-Kulja	Kara-Kulja	1		1
	Kara-Suu	Kara-Suu	1		1
	Kyzyl-Kyja	Kyzyl-Kyja		1	1
	Nookat	Eski-Nookat	1		1
	Osh	Osh		1	1
	Uzgen	Uzgen	1		1
		Total	**7**	**2**	**9**
Talas	Bakay-Ata	Leninpol	1		1
	Kara-Buura	Kyzyl-Adyr	1		1
	Manas	Pokrovka	1		1
	Talas	Talas	1	1	2
		Total	**4**	**1**	**5**
		Grand Total	**40**	**14**	**54**

Source: Statoids (1999).

TABLE A2.2
Total renewable water resources per capita (actual) in CCA* countries

Sl#	Country	1988-1992	1993-1997	1998-2002	2003-2007	2008-2012
		m³/inhab/yr.				
1	Georgia	11 846	12 859	13 690	14 341	14 479
2	Kazakhstan	6 670	7 078	7 355	7 082	6 919
3	Turkmenistan	6 368	5 701	5 374	5 087	4 964
4	**Kyrgyzstan**	**5 156**	**4 870**	**4 613**	**4 491**	**4 379**
5	Azerbaijan	4 658	4 382	4 188	3 932	3 825
6	Tajikistan	2 895	2 688	2 542	2 420	2 356
7	Armenia	2 252	2 478	2 538	2 527	2 518
8	Uzbekistan	2 345	2 122	1 994	1 902	1 858

* CCA: Caucasus and Central Asia.

Source: FAO (2011).

TABLE A2.3
Total dam capacities in CCA* countries

Sl#	Country	1988-1992	1993-1997	1998-2002	2003-2007	2008-2012
		km³				
1	Kazakhstan	NA	90.3	90.3	90.3	90.3
2	Tajikistan	NA	29.0			
3	**Kyrgyzstan**	**NA**	**21.5**			
4	Azerbaijan	NA	21.4	21.5	21.5	21.5
5	Uzbekistan	NA	19.0			
6	Turkmenistan	NA	4.0	4.0	4.0	4.0
7	Georgia	NA	3.4	3.4	3.4	3.4
8	Armenia	NA	1.4	1.4	1.4	

* CCA: Caucasus and Central Asia. NA: Data not available.

Source: FAO (2011).

TABLE A2.4

List of the rivers in Kyrgyzstan

Sl#	River basin (Russian)	River basin (Englsih)	Name of river (Russian)	Name of river (English)	Name of river (English)	Deatails
1	Бассейн реки Аму-Дарья	Amudarya	река Аксу	Aksu River	Aksu	No
2	Бассейн реки Аму-Дарья	Amudarya	река Чон-Аксу	Chon-Aksu river	Chon-Aksu	No
3	Бассейн реки Аму-Дарья	Amudarya	река Карасу (Западная)	Karasu River (West)	Karasu (West)	No
4	Бассейн реки Аму-Дарья	Amudarya	река Бозучук	River Bozuchuk	Bozuchuk	No
5	Бассейн реки Аму-Дарья	Amudarya	река Чон-Джергес	River Chon-Dzherges	Chon-Dzherges	No
6	Бассейн реки Аму-Дарья	Amudarya	река Чон-Куочи	River Chon-Kuochi	Chon-Kuochi	No
7	Бассейн реки Аму-Дарья	Amudarya	река Чон-Сарыбулак	River Chon-Sarybulak	Chon-Sarybulak	No
8	Бассейн реки Аму-Дарья	Amudarya	река Чонташ	River Chontash	Chontash	No
9	Бассейн реки Аму-Дарья	Amudarya	река Джыргалан	River Dzhyrgalan	Djergalan	Yes
10	Бассейн реки Аму-Дарья	Amudarya	река Восточный Кенсу	River East Kensu	East Kensu	No
11	Бассейн реки Аму-Дарья	Amudarya	река Ичке-Джергес	River Ichke-Dzherges	Ichke-Dzherges	No
12	Бассейн реки Аму-Дарья	Amudarya	река Ичкесу	River Ichkesu	Ichkesu	No
13	Бассейн реки Аму-Дарья	Amudarya	река Ичкетор (Чон-Тор)	River Ichketor (Chon-Tor)	Ichketor (Chon-Tor)	No
14	Бассейн реки Аму-Дарья	Amudarya	река Кичи-Сарыбулак	River Kichi-Sarybulak	Kichi-Sarybulak	No
15	Бассейн реки Аму-Дарья	Amudarya	река Кызылсу	River Kizilsu	Kizilsu	No
16	Бассейн реки Аму-Дарья	Amudarya	река Конурулен	River Konurulen	Konurulen	No
17	Бассейн реки Аму-Дарья	Amudarya	река Курчак-Арал	River Kurchak-Aral	Kurchak-Aral	No
18	Бассейн реки Аму-Дарья	Amudarya	Река Кызыл-суу	River Kyzyl-Suu	Kyzyl-Suu (Allay valley)	Yes
19	Бассейн реки Аму-Дарья	Amudarya	река Мамбеттор	River Mambettor	Mambettor	No
20	Бассейн реки Аму-Дарья	Amudarya	река Шаты	River Shaty	Shaty	No
21	Бассейн реки Аму-Дарья	Amudarya	река Табылгаты	River Tabylgaty	Tabylgaty	No
22	Бассейн реки Аму-Дарья	Amudarya	река Талдысу	River Taldysu	Taldysu	No
23	Бассейн реки Аму-Дарья	Amudarya	река Кичи-Куочи	River the Kichi-Kuochi	Kichi-Kuochi	No
24	Бассейн реки Аму-Дарья	Amudarya	река Тюп	River Tup	Tjup	Yes
25	Бассейн реки Аму-Дарья	Amudarya	река Турасу (Улахол)	River turas (Ulahol)	Turas (Ulahol)	No
26	Бассейн реки Аму-Дарья	Amudarya	река Тургеньаксу	River Turgenaksu	Turgenaksu	No
27	Бассейн реки Аму-Дарья	Amudarya	река ВосточныйКорумды	River Vostochnyy Korumdy	Vostochnyy Korumdy	No
28	Бассейн реки Аму-Дарья	Amudarya	река Западный Кенсу	River West Kensu	West Kensu	No
29	Бассейн реки Аму-Дарья	Amudarya	река ЗападныйКорумды	River Zapadnyy Korumdy	Zapadnyy Korumdy	No
30	Бассейн реки Чу	Chu	река Аксу	Aksu River	Aksu	No
31	Бассейн реки Чу	Chu	река Ала-Арча	Ala-Archa river	Ala-Archa	Yes
32	Бассейн реки Чу	Chu	река Чим-Булак	Chim-Bulak river	Chim-Bulak	No
33	Бассейн реки Чу	Chu	река Чолок-Каинды	Choloki river-Kaindy	Choloki-Kaindi	No
34	Бассейн реки Чу	Chu	река Чон-Кемин	Chon-Kemin river	Chon-Kemin	Yes
35	Бассейн реки Чу	Chu	река Кичи-Кемин	River Kichi-Kemir	Kichi-Kemir	Yes
36	Бассейн реки Чу	Chu	Река Иссык-Ата	River Ysyk-Ata	Ysyk-Ata	Yes
37	Бассейн реки Чу	Chu	река Аламедин	River Alamedin	Alamedin	No
38	Бассейн реки Чу	Chu	Река Коко-Мерен	River Chu	Keke-Meren	Yes

TABLE A2.4 (CONTINUED)

Sl#	River basin (Russian)	River basin (Englsih)	Name of river (Russian)	Name of river (English)	Name of river (English)	Deatails
39	Бассейн реки Чу	Chu	река Чу с притоками	River Chui and its tributaries	Chui	Yes
40	Бассейн реки Чу	Chu	река Восточный Каракол	River East of Karakol	East of Karakol	No
41	Бассейн реки Чу	Chu	река Восточный Суек	River East Suyek	East Suyek	No
42	Бассейн реки Чу	Chu	река Иссык-Ата	River Issyk-Ata	Issyk-Ata	No
43	Бассейн реки Чу	Chu	река Калмаксуу	River Kalmaksuu	Kalmaksuu	No
44	Бассейн реки Чу	Chu	река Кара-Балта	River Kara-Balta	Kara-Balta	No
45	Бассейн реки Чу	Chu	река Каракуджур	River Karakudzhur	Karakudzhur	No
46	Бассейн реки Чу	Chu	река Кегеты	River Kegety	Kegety	No
47	Бассейн реки Чу	Chu	река Кокомерен	River Kokomeren	Kökömeren	Yes
48	Бассейн реки Чу	Chu	река Орто-Каинды	River Ortho-Kaindy	Ortho-Kaindy	No
49	Бассейн реки Чу	Chu	река Тегерментысу	River Tegermentysu	Tegermentysu	No
50	Бассейн реки Чу	Chu	река Торсуу	River Torsuu	Torsuu	No
51	Бассейн реки Чу	Chu	река Тюлек	River Tyulek	Tyulek	No
52	Бассейн реки Чу	Chu	река Жаламыш	River Zhalamysh	Zhalamysh	No
53	Бассейн реки Чу	Chu	река Шамси	Shamsi River	Shamsi	No
54	Бассейн реки Кара-Дарья	Kara-Darya	река Абшир-Сай	Abshir-Sai River	Abshir-Sai	No
55	Бассейн реки Кара-Дарья	Kara-Darya	река Ак-Бура	Ak-Bura River	Ak-Buura	Yes
56	Бассейн реки Кара-Дарья	Kara-Darya	река Аксай	Aksai river	Aksai	No
57	Бассейн реки Кара-Дарья	Kara-Darya	река Аксу	Aksu River	Aksu	No
58	Бассейн реки Кара-Дарья	Kara-Darya	река Араван-Сай	Aravane river-Say	Aravane-Say	No
59	Бассейн реки Кара-Дарья	Kara-Darya	река Чили-Сай	Chile-Sai River	Chile-Sai	No
60	Бассейн реки Кара-Дарья	Kara-Darya	река Кара-Дарья	Kara-Darya river	Kara-Darya	Yes
61	Бассейн реки Кара-Дарья	Kara-Darya	река Майли-Сай	Miley-Sai River	Miley-Sai	No
62	Бассейн реки Кара-Дарья	Kara-Darya	река Ойтал	Oita River	Oita	No
63	Бассейн реки Кара-Дарья	Kara-Darya	река Актерек	River Akterek	Akterek	No
64	Бассейн реки Кара-Дарья	Kara-Darya	река Атымкул (Ачык-Таш)	River Atymkul (Achyk Tash)	Atymkul (Achyk Tash)	No
65	Бассейн реки Кара-Дарья	Kara-Darya	река Чет-Байсаур	River Chet-Baysaur	Chet-Baysaur	No
66	Бассейн реки Кара-Дарья	Kara-Darya	река Четинди	River Chetindi	Chetindi	No
67	Бассейн реки Кара-Дарья	Kara-Darya	река Чолпон-Ата	River Cholpon-Ata	Cholpon-Ata	No
68	Бассейн реки Кара-Дарья	Kara-Darya	река Чон-Койсу	river Chon-Koisu	Chon-Koisu	No
69	Бассейн реки Кара-Дарья	Kara-Darya	река Чон-Сугеты	river Chon-Suget	Chon-Suget	No
70	Бассейн реки Кара-Дарья	Kara-Darya	река Чон-Урюкты	river Chon-Uryukty	Chon-Uryukty	No
71	Бассейн реки Кара-Дарья	Kara-Darya	река Яссы	River Iasi	Iasi	No
72	Бассейн реки Кара-Дарья	Kara-Darya	река Джеруй	River Jerooy	Jerooy	No
73	Бассейн реки Кара-Дарья	Kara-Darya	река Караганды (Дол-Булак)	River Karaganda (Dol-Bulak)	Karaganda (Dol-Bulak)	No
74	Бассейн реки Кара-Дарья	Kara-Darya	река Каракульджа	River Karakuldzha	Karakuldzha	No
75	Бассейн реки Кара-Дарья	Kara-Darya	река Кара-Унгур (-Сай)	River Kara-Unguri	Kara-Unguri	No
76	Бассейн реки Кара-Дарья	Kara-Darya	Река Кокарт	River Kegart	Kegart	Yes

TABLE A2.4 (CONTINUED)

Sl#	River basin (Russian)	River basin (Englsih)	Name of river (Russian)	Name of river (English)	Name of river (English)	Deatails
77	Бассейн реки Кара-Дарья	Kara-Darya	река Кичи-Урюкты	River Kichi-Uryukty	Kichi-Uryukty	No
78	Бассейн реки Кара-Дарья	Kara-Darya	река Кырк-Кичик	River Kirk Kichik	Kirk Kichik	No
79	Бассейн реки Кара-Дарья	Kara-Darya	река Кызыл-Унгур	River Kizil-Unguri	Kizil-Unguri	No
80	Бассейн реки Кара-Дарья	Kara-Darya	река Коксай	River Koksai	Koksai	No
81	Бассейн реки Кара-Дарья	Kara-Darya	река Корумды	River Korumdy	Korumdy	No
82	Бассейн реки Кара-Дарья	Kara-Darya	река Котчан	River Kotchan	Kotchan	No
83	Бассейн реки Кара-Дарья	Kara-Darya	река Культор	River Kultor	Kultor	No
84	Бассейн реки Кара-Дарья	Kara-Darya	река Кумбель	River Kumbel	Kumbel	No
85	Бассейн реки Кара-Дарья	Kara-Darya	река Курменты	River Kurmenty	Kurmenty	No
86	Бассейн реки Кара-Дарья	Kara-Darya	река Куршаб (Гульча)	River Kurshab (Gulcha)	Kurshab (Gulcha)	Yes
87	Бассейн реки Кара-Дарья	Kara-Darya	река Кутурга	River Kuturga	Kuturga	No
88	Бассейн реки Кара-Дарья	Kara-Darya	река Кыргызата	River Kyrgyzata	Kyrgyzata	No
89	Бассейн реки Кара-Дарья	Kara-Darya	река Орто-Байсаур	River Ortho-Baysaur	Ortho-Baysaur	No
90	Бассейн реки Кара-Дарья	Kara-Darya	река Орто-Долонаты	River Ortho-Dolonaty	Ortho-Dolonaty	No
91	Бассейн реки Кара-Дарья	Kara-Darya	река Орто-Урюкты	River Ortho-Uryukty	Ortho-Uryukty	No
92	Бассейн реки Кара-Дарья	Kara-Darya	река Шинаты	River Shinaty	Shinaty	No
93	Бассейн реки Кара-Дарья	Kara-Darya	река Каменная (Чон-Байсаур)	River Stone (Chon-Baysaur)	Stone (Chon-Baysaur)	No
94	Бассейн реки Кара-Дарья	Kara-Darya	река Сугетты	River Sugetty	Sugetty	No
95	Бассейн реки Кара-Дарья	Kara-Darya	река Тегерменты	River Tegermenty	Tegermenty	No
96	Бассейн реки Кара-Дарья	Kara-Darya	родник Арсланбоб	spring Arslanbob	Arslanbob	No
97	Бассейн реки Кара-Дарья	Kara-Darya	река Тар	Tar River	Tar	Yes
98	Бассейн реки Нарын	Naryn	река Тегерек-Булак	Bulak river Tegerek	Bulak Tegerek	No
99	Бассейн реки Нарын	Naryn	Карасу	Karasu	Karasu	No
100	Бассейн реки Нарын	Naryn	река Атбаши-Карасу	Karasu River Atbashy	Karasu Atbashy	No
101	Бассейн реки Нарын	Naryn	река Нарын с притоками	Naryn River and its tributaries	Naryn	Yes
102	Бассейн реки Нарын	Naryn	река Ничке	Nitschke river	Nitschke	No
103	Бассейн реки Нарын	Naryn	река Алабуга	River Alabuga	Alabuga	Yes
104	Бассейн реки Нарын	Naryn	река Атбаши	River Atbashy	At-Bashi	Yes
105	Бассейн реки Нарын	Naryn	река Бала-Чичкан	River Bala Chichkan	Bala Chichkan	No
106	Бассейн реки Нарын	Naryn	река Болгарт	River Bolgart	Bolgart	No
107	Бассейн реки Нарын	Naryn	река Чичкан	River Chichkan	Chichkan	No
108	Бассейн реки Нарын	Naryn	река Джергетал	River Dzhergetal	Dzhergetal	No
109	Бассейн реки Нарын	Naryn	река Ичкебаш	River Ichkebash	Ichkebash	No
110	Бассейн реки Нарын	Naryn	река Каракоин	River Karakoin	Karakoin	No
111	Бассейн реки Нарын	Naryn	река Кочкор	River Kochkor	Kochkor	Yes
112	Бассейн реки Нарын	Naryn	река Кодуль (Кашкасу)	River Kodul (Kashkasu)	Kodul (Kashkasu)	No
113	Бассейн реки Нарын	Naryn	река Кокомерен	River Kokomeren	Kökömeren	Yes

TABLE A2.4 (CONTINUED)

Sl#	River basin (Russian)	River basin (Englsih)	Name of river (Russian)	Name of river (English)	Name of river (English)	Deatails
114	Бассейн реки Нарын	Naryn	река Онарча	River Onarcha	Onarcha	No
115	Бассейн реки Нарын	Naryn	река Оттук	River Ottuk	Ottuk	No
116	Бассейн реки Нарын	Naryn	река Сарытал	River Sarytau	Sarytau	No
117	Бассейн реки Нарын	Naryn	река Торкент	River Torkent	Torkent	No
118	Бассейн реки Нарын	Naryn	река Узунахмат	River Uzunahmat	Uzunahmat	No
119	Бассейн реки Нарын	Naryn	Суусамыр	Suusamyr	Suusamyr	No
120	Бассейн реки Нарын	Naryn	Западный Каракол	Western Karakol	Western Karakol	No
121	Бассейн реки Сыр-Дарья	Syrdarya	река Ак-Суу	Ak-Suu River	Ak-Suu	No
122	Бассейн реки Сыр-Дарья	Syrdarya	река Сох	Cox River	Cox	No
123	Бассейн реки Сыр-Дарья	Syrdarya	река Ходжа-Бакирган	Hodge-river Bakirgan	Hodge-Bakirgan	No
124	Бассейн реки Сыр-Дарья	Syrdarya	река Исфара	Isfara river	Isfara	Yes
125	Бассейн реки Сыр-Дарья	Syrdarya	река Актерек	River Akterek	Akterek	No
126	Бассейн реки Сыр-Дарья	Syrdarya	река Бар-Булак	River Bar Bulak	Bar Bulak	No
127	Бассейн реки Сыр-Дарья	Syrdarya	река Босого	River barefoot	Barefoot	No
128	Бассейн реки Сыр-Дарья	Syrdarya	река Барскаун	River Barskaun	Barskaun	No
129	Бассейн реки Сыр-Дарья	Syrdarya	река Чаткал	River Chatkal	Chatkal	Yes
130	Бассейн реки Сыр-Дарья	Syrdarya	река Челпек	River Chelpek	Chelpek	No
131	Бассейн реки Сыр-Дарья	Syrdarya	река Чет-Койсу	River Chet-Koisu	Chet-Koisu	No
132	Бассейн реки Сыр-Дарья	Syrdarya	река Чок-Тал	River Chok-Tal	Chok-Tal	No
133	Бассейн реки Сыр-Дарья	Syrdarya	река Чон-Джаргылчак	River Chon-Dzhargylchak	Chon-Dzhargylchak	No
134	Бассейн реки Сыр-Дарья	Syrdarya	река Чон-Кызылсу	River Chon-Kizilsu	Chon-Kizilsu	No
135	Бассейн реки Сыр-Дарья	Syrdarya	река Чычкан	River Chychkan	Chychkan	No
136	Бассейн реки Сыр-Дарья	Syrdarya	река Дюресу (Чырпыкты)	River Dyuresu (Chyrpykty)	Dyuresu (Chyrpykty)	No
137	Бассейн реки Сыр-Дарья	Syrdarya	река Джуука (Заука)	River Dzhuuka (Zauka)	Dzhuuka (Zauka)	No
138	Бассейн реки Сыр-Дарья	Syrdarya	река Гавасай	River Gavasay	Gavasay	No
139	Бассейн реки Сыр-Дарья	Syrdarya	река Ирдык	River Irdyk	Irdyk	No
140	Бассейн реки Сыр-Дарья	Syrdarya	река Исфана	River Isfana	Isfana	No
141	Бассейн реки Сыр-Дарья	Syrdarya	река Исфайрамсай	River Isfayramsay	Isfayramsay	No
142	Бассейн реки Сыр-Дарья	Syrdarya	река Джети-Огуз	River Jeti-Oguz	Jeti-Oguz	No
143	Бассейн реки Сыр-Дарья	Syrdarya	река Кара-Кол	River Kara-Kol	Kara-Kol	No
144	Бассейн реки Сыр-Дарья	Syrdarya	река Кардалы	River Kardaly	Kardaly	No
145	Бассейн реки Сыр-Дарья	Syrdarya	река Кашкасу	River Kashkasu	Kashkasu	No
146	Бассейн реки Сыр-Дарья	Syrdarya	река Кассансай	River Kassansay	Kassansay	No
147	Бассейн реки Сыр-Дарья	Syrdarya	река Кажи (Кадрен-Сай)	River kazhi (Frame-Say)	kazhi (Frame-Say)	No
148	Бассейн реки Сыр-Дарья	Syrdarya	река Кичине-Кызылсу	River Kichin-Kizilsu	Kichin-Kizilsu	No
149	Бассейн реки Сыр-Дарья	Syrdarya	река Корумду	River Korumdu	Korumdu	No
150	Бассейн реки Сыр-Дарья	Syrdarya	река Орто-Койсу	River Ortho-Koisu	Ortho-Koisu	No
151	Бассейн реки Сыр-Дарья	Syrdarya	река Падыш-Ата	River Padysha-Ata	Padysha-Ata	No

TABLE A2.4 (CONTINUED)

Sl#	River basin (Russian)	River basin (Englsih)	Name of river (Russian)	Name of river (English)	Name of river (English)	Deatails
152	Бассейн реки Сыр-Дарья	Syrdarya	река Сандалаш	River Sandalash	Sandalash	No
153	Бассейн реки Сыр-Дарья	Syrdarya	река Сарыбулак	River Sarybulak	Sarybulak	No
154	Бассейн реки Сыр-Дарья	Syrdarya	река Шахимардан	River Shakhimardan	Shakhimardan	No
155	Бассейн реки Сыр-Дарья	Syrdarya	Река Сох	River Soh	Soh	Yes
156	Бассейн реки Сыр-Дарья	Syrdarya	река Сумсар	River Sumsar	Sumsar	No
157	Бассейн реки Сыр-Дарья	Syrdarya	река Тамга	River Tamga	Tamga	No
158	Бассейн реки Сыр-Дарья	Syrdarya	река Таралган	River Taralgan	Taralgan	No
159	Бассейн реки Сыр-Дарья	Syrdarya	река Терек-Сай	River Terek-Say	Terek-Say	No
160	Бассейн реки Сыр-Дарья	Syrdarya	река Кичи-Джаргылчак	River the Kichi-Dzhargylchak	Kichi-Dzhargylchak	No
161	Бассейн реки Сыр-Дарья	Syrdarya	река Кичи-Сарыбулак	River the Kichi-Sarybulak	Kichi-Sarybulak	No
162	Бассейн реки Сыр-Дарья	Syrdarya	река Тон	River Tone	Tone	No
163	Бассейн реки Сыр-Дарья	Syrdarya	река Тоссор	River Tossor	Tossor	No
164	Бассейн реки Сыр-Дарья	Syrdarya	река Шор-Булак	Shor-Bulak river	Shor-Bulak	No
165	Бассейн реки Талас	Talas	река Асса	Assa river	Assa	No
166	Бассейн реки Талас	Talas	река Бешташ	River Beshtash	Beshtash	No
167	Бассейн реки Талас	Talas	река Карабура	River Karabura	Karabura	No
168	Бассейн реки Талас	Talas	река Кумуштак	River Kumushtak	Kumushtak	No
169	Бассейн реки Талас	Talas	река Куркуреусу	River Kurkureusu	Kurkureusu	No
170	Бассейн реки Талас	Talas	река Урмарал	River Urmaral	Urmaral	No
171	Бассейн реки Талас	Talas	река Талас	Talas river	Talas	Yes
172	Басейн реки Тарим	Tarim	Река Сары-Джаз	River Sary-Djaz	Sary-Djaz	Yes

TABLE A2.5.1
Database of still waters

Sl#	Province	District	Name of waterbody	Type of waterbody	Used for	Area (ha)	Category	Details
142	Batken	Batken	Tort-Kul reservoir	W.Res	Irrigation	267.0	5) 100 - 500 ha	in Annex 1
70	Chuy	Alamüdün	Ala-Archa (Lower-Ala-Archinskoye riverbed)	W.Res	Irrigation	1 000.0	6) 500 - 1000 ha	in Annex 1
69	Chuy	Alamüdün	Ala-Archinsk (Lower-Ala-Archinskoye tanker)	W.Res	Irrigation	625.0	6) 500 - 1000 ha	in Annex 1
75	Chuy	Alamüdün	BSR “Alamedin-Norus”	W.Res	Irrigation	4.0	1) Less than 5 ha	No
73	Chuy	Alamüdün	BSR “Karagoo”	W.Res	Irrigation	5.0	2) 5 - 25 ha	No
74	Chuy	Alamüdün	BSR “Tatinsky”	W.Res	Irrigation	5.0	2) 5 - 25 ha	No
76	Chuy	Alamüdün	BSR (at.Grozd)	W.Res	Irrigation	5.0	2) 5 - 25 ha	No
77	Chuy	Alamüdün	BSR (at.Konstantinovka)	W.Res	Irrigation	4.0	1) Less than 5 ha	No
71	Chuy	Alamüdün	Chumysh reservoir	W.Res	Irrigation	56.0	4) 50 - 100 ha	No
72	Chuy	Alamüdün	Hydropower reservoir-5	W.Res	Irrigation	15.0	2) 5 - 25 ha	No
79	Chuy	Alamüdün	Marble Pond	Pond	Natural	30.0	3) 25 - 50 ha	No
81	Chuy	Alamüdün	Pond	Pond	Natural	3.5	1) Less than 5 ha	No
85	Chuy	Alamüdün	Pond (at.Sadovoe)	Pond	Natural	2.5	1) Less than 5 ha	No
86	Chuy	Alamüdün	Pond (Meat and Bone Works)	Pond	Natural	1.5	1) Less than 5 ha	No
82	Chuy	Alamüdün	Pond (MTF-2)	Pond	Natural	7.0	2) 5 - 25 ha	No
78	Chuy	Alamüdün	Pond HPP-6	Pond	Irrigation	3.0	1) Less than 5 ha	No
83	Chuy	Alamüdün	Pond No. 1 (at.Leninskoe)	Pond	Natural	5.0	2) 5 - 25 ha	No
84	Chuy	Alamüdün	Pond No. 2 (at.Leninskoe)	Pond	Natural	4.0	1) Less than 5 ha	No
80	Chuy	Alamüdün	Pond No. 3 (at May Day)	Pond	Natural	3.0	1) Less than 5 ha	No
93	Chuy	Chuy	BSR No. 1 K-1	W.Res	Irrigation	2.0	1) Less than 5 ha	No
94	Chuy	Chuy	BSR No. 13	W.Res	Irrigation	1.0	1) Less than 5 ha	No
90	Chuy	Chuy	Pond Tokmakskiy sahzavoda	Pond	Natural	20.0	2) 5 - 25 ha	No
91	Chuy	Chuy	Pond Tokmakskiy-1	Pond	Natural	14.0	2) 5 - 25 ha	No
92	Chuy	Chuy	Pond Tokmakskiy-2	Pond	Natural	12.0	2) 5 - 25 ha	No
119	Chuy	Jaiyl	Akbashat-5 reservoir	W.Res	Irrigation	40.0	3) 25 - 50 ha	No
121	Chuy	Jaiyl	Eriktuu reservoir	W.Res	Irrigation	20.0	2) 5 - 25 ha	No
116	Chuy	Jaiyl	Kara-Balta reservoir	W.Res	Irrigation	149.0	5) 100 - 500 ha	in Annex 1
117	Chuy	Jaiyl	Mechanical reservoir	W.Res	Irrigation	42.0	3) 25 - 50 ha	No
120	Chuy	Jaiyl	Stepninskoe reservoir	W.Res	Irrigation	34.0	3) 25 - 50 ha	No
118	Chuy	Jaiyl	Zheken-2 reservoir	W.Res	Irrigation	33.0	3) 25 - 50 ha	No
98	Chuy	Kemin	BSR “Sarbos”	W.Res	Irrigation	3.0	1) Less than 5 ha	No
96	Chuy	Kemin	Chelek lake	Lake	Natural	1.2	1) Less than 5 ha	No
97	Chuy	Kemin	Kol-Tor lake	Lake	Natural	1.6	1) Less than 5 ha	No
95	Chuy	Kemin	Zhashyl-Kul lake	Lake	Natural	1.4	1) Less than 5 ha	No
113	Chuy	Moskva	Ak-Suu pond	Pond	Natural	21.0	2) 5 - 25 ha	No
110	Chuy	Moskva	Ak-Suu reservoir	W.Res	Irrigation	136.0	5) 100 - 500 ha	in Annex 1
112	Chuy	Moskva	Makachi reservoir	W.Res	Irrigation	25.0	2) 5 - 25 ha	No

TABLE A2.5.1 (CONTINUED)

Sl#	Province	District	Name of waterbody	Type of waterbody	Used for	Area (ha)	Category	Details
114	Chuy	Moskva	Moscow pond	Pond	Natural	14.0	2) 5 - 25 ha	No
115	Chuy	Moskva	Path of Lenin pond	Pond	Natural	24.0	2) 5 - 25 ha	No
111	Chuy	Moskva	Spartac reservoir	W.Res	Irrigation	590.0	6) 500 - 1000 ha	in Annex 1
126	Chuy	Panfilov	Agermen reservoir	W.Res	Irrigation	34.0	3) 25 - 50 ha	in Annex 1
128	Chuy	Panfilov	Chaldovar pond	Pond	Natural	25.0	2) 5 - 25 ha	No
129	Chuy	Panfilov	Field pond	Pond	Natural	3.0	1) Less than 5 ha	No
122	Chuy	Panfilov	Kara-Tuma reservoir	W.Res	Irrigation	220.0	5) 100 - 500 ha	in Annex 1
127	Chuy	Panfilov	Ladybansky reservoir	W.Res	Irrigation	8.0	2) 5 - 25 ha	No
125	Chuy	Panfilov	Puchuk reservoir	W.Res	Irrigation	60.0	4) 50 - 100 ha	No
123	Chuy	Panfilov	Reservoir. “Panfilov-1 reservoir	W.Res	Irrigation	40.0	3) 25 - 50 ha	No
124	Chuy	Panfilov	Reservoir. “Panfilov-2 reservoir	W.Res	Irrigation	62.0	4) 50 - 100 ha	No
106	Chuy	Sokuluk	BDR “Sharga”	W.Res	Irrigation	130.0	5) 100 - 500 ha	No
101	Chuy	Sokuluk	Chat-Kul reservoir	W.Res	Irrigation	13.0	2) 5 - 25 ha	No
100	Chuy	Sokuluk	Dzhalgach reservoir	W.Res	Irrigation	44.0	3) 25 - 50 ha	No
102	Chuy	Sokuluk	Kara-Kul reservoir	W.Res	Irrigation	10.0	2) 5 - 25 ha	No
109	Chuy	Sokuluk	Kyrgyz lake	Lake	Natural	5.0	2) 5 - 25 ha	No
105	Chuy	Sokuluk	Long lake	Lake	Irrigation	37.0	3) 25 - 50 ha	No
108	Chuy	Sokuluk	Red Dawn pond	Pond	Natural	15.0	2) 5 - 25 ha	No
103	Chuy	Sokuluk	Reservoir No. 1	W.Res	Irrigation	30.0	3) 25 - 50 ha	No
104	Chuy	Sokuluk	Reservoir No. 2	W.Res	Irrigation	27.0	3) 25 - 50 ha	No
107	Chuy	Sokuluk	Rotten beam pond	Pond	Natural	10.0	2) 5 - 25 ha	No
99	Chuy	Sokuluk	Sokuluk reservoir	W.Res	Irrigation	180.0	5) 100 - 500 ha	in Annex 1
88	Chuy	Ysyk-Ata	BDR “Bos-Barmak.” VBCHK	W.Res	Natural	38.0	3) 25 - 50 ha	No
87	Chuy	Ysyk-Ata	BDR Art. Ivanovka VBCHK	W.Res	Irrigation	60.0	4) 50 - 100 ha	No
89	Chuy	Ysyk-Ata	Old channel BCHK pond	Pond	Natural	10.0	2) 5 - 25 ha	No
5	Issyk Kul	Ak-Suu	Ala-Kul	Lake	Natural	160.0	5) 100 - 500 ha	No
36	Issyk Kul	Ak-Suu	Fur farms lake	Lake	Natural	10.0	2) 5 - 25 ha	No
31	Issyk Kul	Ak-Suu	Lake (at Karazhal)	Lake	Natural	3.3	1) Less than 5 ha	No
32	Issyk Kul	Ak-Suu	Lake (at.Teploklyuchenka)	Lake	Natural	1.5	1) Less than 5 ha	No
33	Issyk Kul	Ak-Suu	Lake (at.Teploklyuchenka)	Lake	Natural	2.4	1) Less than 5 ha	No
34	Issyk Kul	Ak-Suu	Lake (at.Teploklyuchenka)	Lake	Natural	2.5	1) Less than 5 ha	No
35	Issyk Kul	Ak-Suu	Lake (at.Teploklyuchenka)	Lake	Natural	2.7	1) Less than 5 ha	No
8	Issyk Kul	Ak-Suu	Merzbacher	Lake	No fishery	450.0	5) 100 - 500 ha	in Annex 1
29	Issyk Kul	Issyk Kul	Aksu lake	Lake	Natural	1.3	1) Less than 5 ha	No
28	Issyk Kul	Issyk Kul	Baysorun lake (at.Ananevo)	Lake	Natural	1.0	1) Less than 5 ha	No
30	Issyk Kul	Issyk Kul	Lighthouse pond (at Assoc)	Pond	Natural	3.2	1) Less than 5 ha	No
39	Issyk Kul	Jet-Ögüz	Black Lake (at Lipenka)	Lake	Natural	4.7	1) Less than 5 ha	No

TABLE A2.5.1 (CONTINUED)

Sl#	Province	District	Name of waterbody	Type of waterbody	Used for	Area (ha)	Category	Details
44	Issyk Kul	Jet-Ögüz	Bugor-1 pond (at Lipenka)	Pond	Natural	1.4	1) Less than 5 ha	No
49	Issyk Kul	Jet-Ögüz	Dalnij lake (at Lipenka)	Lake	Irrigation	25.9	3) 25 - 50 ha	No
43	Issyk Kul	Jet-Ögüz	Hydropower reservoir (at Lipenka)	W.Res	Irrigation	4.8	1) Less than 5 ha	No
53	Issyk Kul	Jet-Ögüz	Kara-Kol lake (at Ak-Dube)	Lake	Natural	36.5	3) 25 - 50 ha	No
52	Issyk Kul	Jet-Ögüz	Kokui-Kol lake (at Ak-Dube)	Lake	Natural	32.0	3) 25 - 50 ha	No
55	Issyk Kul	Jet-Ögüz	Lake Ala-Kol lake	Lake	Natural	680.0	6) 500 - 1000 ha	No
54	Issyk Kul	Jet-Ögüz	Lake Jdashil-Kol lake	Lake	Natural	480.0	5) 100 - 500 ha	No
50	Issyk Kul	Jet-Ögüz	Nalij lake (at Kyzyl-Su)	Lake	Natural	4.9	1) Less than 5 ha	No
40	Issyk Kul	Jet-Ögüz	Pond No. 1 (at Lipenka)	Pond	Natural	3.1	1) Less than 5 ha	No
41	Issyk Kul	Jet-Ögüz	Pond No. 2 (at Lipenka)	Pond	Natural	3.2	1) Less than 5 ha	No
42	Issyk Kul	Jet-Ögüz	Pond No. 3 (page Lipenka)	Pond	Natural	3.9	1) Less than 5 ha	No
46	Issyk Kul	Jet-Ögüz	Pond No. 4 (at Lipenka)	Pond	Natural	3.3	1) Less than 5 ha	No
47	Issyk Kul	Jet-Ögüz	Sibenko lake (at Lipenka)	Lake	Natural	3.4	1) Less than 5 ha	No
51	Issyk Kul	Jet-Ögüz	Srednij lake (at Kyzyl-Su)	Lake	Natural	8.9	2) 5 - 25 ha	No
45	Issyk Kul	Jet-Ögüz	Tegirmen pond (at Lipenka)	Pond	Natural	3.2	1) Less than 5 ha	No
38	Issyk Kul	Jet-Ögüz	Tsikolka lake (at Lipenka)	Lake	Natural	1.8	1) Less than 5 ha	No
57	Issyk Kul	Jet-Ögüz	Unnamed No. 1 (at Jeti-Oguz)	Lake	Natural	5.0	2) 5 - 25 ha	No
58	Issyk Kul	Jet-Ögüz	Unnamed No. 2 (at Jeti-Oguz)	Lake	Natural	6.2	2) 5 - 25 ha	No
59	Issyk Kul	Jet-Ögüz	Unnamed No. 3 (at Jeti-Oguz)	Lake	Natural	4.0	1) Less than 5 ha	No
60	Issyk Kul	Jet-Ögüz	Unnamed No. 4 (at Jeti-Oguz)	Lake	Natural	5.2	2) 5 - 25 ha	No
37	Issyk Kul	Jet-Ögüz	Zelenij gaj lake (at Lipenka)	Lake	Natural	16.0	2) 5 - 25 ha	No
56	Issyk Kul	Jet-Ögüz	Zhydyk-Kol lake (at Jeti-Oguz)	Lake	Natural	25.6	3) 25 - 50 ha	No
48	Issyk Kul	Jet-Ögüz	Zhydyk-Kol lake (at Lipenka)	Lake	Natural	6.3	2) 5 - 25 ha	No
1	Issyk Kul	Several	Issyk Kul	Lake	Fishery	623 600.0	9) Above 50000 ha	in Annex 1
63	Issyk Kul	Ton	Ace-Max lake	Lake	Natural	8.6	2) 5 - 25 ha	No
61	Issyk Kul	Ton	Aydin-Kul lake	Lake	Natural	3.0	1) Less than 5 ha	No
67	Issyk Kul	Ton	Kennels. Olen-1 lake (high-altitude zone)	Lake	Natural	2.0	1) Less than 5 ha	No
68	Issyk Kul	Ton	Kennels. Olen-2 lake (high-altitude zone)	Lake	Natural	26.0	3) 25 - 50 ha	No
64	Issyk Kul	Ton	Kosh-Kara-Kol lake	Lake	Natural	1.2	1) Less than 5 ha	No
62	Issyk Kul	Ton	Sasyk-Kul lake	Lake	Natural	1.6	1) Less than 5 ha	No
66	Issyk Kul	Ton	Teshik-Kul lake (alpine zone)	Lake	Natural	20.0	2) 5 - 25 ha	No
65	Issyk Kul	Ton	Unnamed lake (at Tort Kul)	Lake	Natural	5.0	2) 5 - 25 ha	No
19	Issyk Kul	Tyup	Black lake	Lake	Irrigation	46.0	3) 25 - 50 ha	No
11	Issyk Kul	Tyup	BSR “Big Dam” (at.Dolon)	W.Res	Irrigation	85.0	4) 50 - 100 ha	No
14	Issyk Kul	Tyup	BSR “Gosspetshoz” (at.Nikolaevka)	W.Res	Irrigation	18.0	2) 5 - 25 ha	No
15	Issyk Kul	Tyup	BSR “Kosh-Dube-1”	W.Res	Irrigation	57.0	4) 50 - 100 ha	No
16	Issyk Kul	Tyup	BSR “Kosh-Dube-2-Chyrgoy”	W.Res	Irrigation	56.0	4) 50 - 100 ha	No
13	Issyk Kul	Tyup	BSR “Lighthouse”	W.Res	Irrigation	13.0	2) 5 - 25 ha	No

TABLE A2.5.1 (CONTINUED)

Sl#	Province	District	Name of waterbody	Type of waterbody	Used for	Area (ha)	Category	Details
18	Issyk Kul	Tyup	BSR “Shaty”	W.Res	Irrigation	3.8	1) Less than 5 ha	No
12	Issyk Kul	Tyup	BSR “Small dam”	W.Res	Irrigation	26.0	3) 25 - 50 ha	No
17	Issyk Kul	Tyup	BSR “Victory” (at.Mihaylovka)	W.Res	Irrigation	4.0	1) Less than 5 ha	No
10	Issyk Kul	Tyup	Kara-Kol lake	Lake	Fishery	46.0	3) 25 - 50 ha	No
23	Issyk Kul	Tyup	Kolotilin lake	Lake	Natural	1.2	1) Less than 5 ha	No
22	Issyk Kul	Tyup	Kuturginskoe lake	Lake	Natural	1.2	1) Less than 5 ha	No
20	Issyk Kul	Tyup	Oh-Tal lake	Lake	Natural	4.0	1) Less than 5 ha	No
21	Issyk Kul	Tyup	Osipov lake	Lake	Natural	1.3	1) Less than 5 ha	No
27	Issyk Kul	Tyup	Pond (at Ak-Bulun)	Pond	Natural	3.0	1) Less than 5 ha	No
26	Issyk Kul	Tyup	Pond (at.Kuturgu)	Pond	Natural	4.0	1) Less than 5 ha	No
25	Issyk Kul	Tyup	Pond (at.Tyup)	Pond	Natural	16.5	2) 5 - 25 ha	No
24	Issyk Kul	Tyup	Shuvaeva lake	Lake	Natural	1.1	1) Less than 5 ha	No
9	Jalal-Abad	Aksy	Sary-Chelek	Lake	Natural-reserve	388.0	5) 100 - 500 ha	No
134	Jalal-Abad	Aksy	Uch-Korgon reservoir	W.Res	Irrigation	400.0	5) 100 - 500 ha	in Annex 1
135	Jalal-Abad	Ala-Buka	Kassan-Sayskoe reservoir	W.Res	Irrigation	480.0	5) 100 - 500 ha	No
136	Jalal-Abad	Bazar-Korgon	Ala-Kol lake	Lake	Natural	410.0	5) 100 - 500 ha	No
131	Jalal-Abad	Bazar-Korgon	Bazar-Korgon reservoir	W.Res	Fishery	231.0	5) 100 - 500 ha	in Annex 1
132	Jalal-Abad	Nooken	Kurpsay reservoir	W.Res	Irrigation	1 200.0	7) 1000 - 10000 ha	in Annex 1
133	Jalal-Abad	Nooken	Shamaldysai reservoir	W.Res	Irrigation	240.0	5) 100 - 500 ha	in Annex 1
147	Jalal-Abad	Nooken	Tash-Kumir	W.Res	Irrigation	1 800.0	7) 1000 - 10000 ha	in Annex 1
7	Jalal-Abad	Toktogul	Kapka Tash	Lake	Natural	100.0	4) 50 - 100 ha	No
3	Jalal-Abad	Toktogul	Kara-Suu	Lake	Fishery	383.0	5) 100 - 500 ha	in Annex 1
130	Jalal-Abad	Toktogul	Toktogul reservoir	W.Res	Fishery	26 500.0	8) 10000 - 50000 ha	in Annex 1
6	Naryn	At-Bashy	Chatyr-Kul	Lake	Natural-reserve	17 060.0	8) 10000 - 50000 ha	in Annex 1
147	Naryn	Kochkor	Ak-Kol lake	Lake	Natural	7.0	2) 5 - 25 ha	No
146	Naryn	Kochkor	Aragol lake	Lake	Natural	10.0	2) 5 - 25 ha	No
4	Naryn	Kochkor	Kel-Ukok	Lake	Fishery	160.0	5) 100 - 500 ha	in Annex 1
145	Naryn	Kochkor	Ortho-Tokoi reservoir	W.Res	Fishery	2 550.0	7) 1000 - 10000 ha	in Annex 1
2	Naryn	Several	Son-Kul	Lake	Fishery	27 300.0	8) 10000 - 50000 ha	in Annex 1
141	Osh	Kara-Suu	Kulun lake	Lake	Natural	730.0	6) 500 - 1000 ha	No
138	Osh	Kara-Suu	Papan reservoir	W.Res	Irrigation	710.0	6) 500 - 1000 ha	in Annex 1
137	Osh	Nookat	Naiman reservoir	W.Res	Irrigation	450.0	5) 100 - 500 ha	in Annex 1
140	Osh	Uzgen	Kampyravat reservoir	W.Res	Irrrigation/energy	5 400.0	7) 1000 - 10000 ha	in Annex 1
144	Talas	Talas	Kara Buurin reservoir	W.Res	Irrigation	265.0	5) 100 - 500 ha	in Annex 1
143	Talas	Talas	Kirov reservoir	W.Res	Fishery	2 800.0	7) 1000 - 10000 ha	in Annex 1

TABLE A2.5.2
Summary table of still waters (according to size)

Type of waterbody	Category	Number of waterbodies			Area of waterbodies		
		No.	%	%	ha	%	%
Lake	1) Less than 5 ha	24	16	41	54.2	0.01	0.01
	2) 5 - 25 ha	13	9	22	113.2	0.02	0.02
	3) 25 - 50 ha	8	5	14	275.0	0.04	0.04
	4) 50 - 100 ha	1	1	2	100.0	0.01	0.01
	5) 100 - 500 ha	7	5	12	2 431.0	0.34	0.36
	6) 500 - 1000 ha	2	1	3	1 410.0	0.20	0.21
	8) 10000 - 50000 ha	2	1	3	44 360.0	6.16	6.60
	9) Above 50000 ha	1	1	2	623 600.0	86.62	92.75
	Total	**58**	**39**	**100**	**672 343.4**	**93.39**	**100.00**
Pond	1) Less than 5 ha	16	11	53	48.8	0.01	17.92
	2) 5 - 25 ha	13	9	43	193.5	0.03	71.06
	3) 25 - 50 ha	1	1	3	30.0	0.00	11.02
	Total	**30**	**20**	**100**	**272.3**	**0.04**	**100.00**
Water reservoir	1) Less than 5 ha	8	5	14	26.6	0.00	0.06
	2) 5 - 25 ha	11	7	19	137.0	0.02	0.29
	3) 25 - 50 ha	11	7	19	388.0	0.05	0.82
	4) 50 - 100 ha	7	5	12	436.0	0.06	0.92
	5) 100 - 500 ha	12	8	20	3 148.0	0.44	6.65
	6) 500 - 1000 ha	4	3	7	2 925.0	0.41	6.18
	7) 1000 - 10000 ha	5	3	8	13 750.0	1.91	29.06
	8) 10000 - 50000 ha	1	1	2	26 500.0	3.68	56.01
	Total	**59**	**40**	**100**	**47 310.6**	**6.57**	**100.00**
	Grand total	**147**	**100**	**-**	**719 926.3**	**100.00**	**-**

TABLE A2.6
Area equipped for irrigated in Kyrgyzstan in 1994

Province	District	Irrigated area (ha)
Batken	Batken	14 846
	Kadamjai	26 997
	Lailak	13 639
	Total	55 482
Chui	Alamüdün	34 618
	Chui	33 769
	Jaiy	42 658
	Kemin	28 438
	Moskovsky	44 426
	Panfilov	31 731
	Sokuluk	59 906
	Ysyk-Ata	55 589
	Total	331 135
Jalal-Abad	Aksyi	12 357
	Ala-Buka	16 218
	Bazar-Korgon	18 652
	Chatkal	8 765
	Nooken	22 868
	Suzak	45 001
	Togus-Toro	4 072
	Toktogul	14 013
	Total	141 946
Naryn	Ak-Talaa	15 962
	At-Bashi	32 330
	Jumgal	19 223
	Kochkor	24 785
	Tien-Shan	27 505
	Total	119 805
Osh	Alai	6 755
	Aravan	22 517
	Chong-Alay	14 179
	Kara-Kuldja	7 275
	Kara-Suu	42 930
	Nookat	26 328
	Uzgen	22 181
	Total	142 165
Talas	Bakai-Ata	27 690
	Kara-Buura	30 468
	Manas	18 214
	Talas	38 743
	Total	115 115
Issyk Kul	Ak-Suu	41 342
	Djety-Oguz	42 956
	Ton	25 937
	Tyup	24 826
	Ysyk-Köl	34 331
	Total	**169 392**
	Grand Total	**1 075 040**

Source: FAO (2011).

TABLE A2.7
Database of fish species in Kyrgyzstan

Order	Family	Species	Status	Issyk Kul	Son-Kul	Kara Su	Narin RB	Chu RB	Talas RB	Kara-Darya RB	Year of introduction	Englsih name	Local name
Acipenseriformes	Acipenseridae	*Acipenser baerii* (Brandt, 1869)	Introduced	0	0	0	1	0	0	0	1982	Siberian sturgeon	Сибирский осетр
Salmoniformes	Coregonidae	*Coregonus lavaretus Ludoga* (Poljakov, 1874)	Introduced	1	1	0	0	0	0	0	1966	Common whitefish	Сиг-лудога
Salmoniformes	Coregonidae	*Coregonus migratorius* (Georgi, 1775)	Introduced	0	0	0	0	0	0	0	1966	Baikal Omul. Artic cisco	Байкальская омуль
Salmoniformes	Coregonidae	*Coregonus peled* (Gmelin, 1789)	Introduced	0	1	1	1	0	0	0	1966	Peled	Пелядь
Salmoniformes	Salmonidae	*Oncorhynchus mykiss* (Walbaum, 1792)	Introduced	1	0	0	0	0	0	0	1970	Rainbow trout	Радужная форель
Salmoniformes	Salmonidae	*Salmo ischchan Issykogegarkuni* (Lushin, 1932)	Introduced	1	0	0	1	0	0	0	1930	Sevan/Issyk Kul trout	Иссык-Кульская форель
Salmoniformes	Salmonidae	*Salmo trutta oxianus* (Kessler. 1874)	Indigenous	0	0	0	1	1	1	1		Amu-Darya trout	Амударьинская форель
Esociformes	Esocidae	*Esox lucius* (Linnaeus, 1758)	Indigenous	0	0	0	0	1	0	0		Northern pike	Щука
Cypriniformes	Balitoridae	*Nemachilus kuschakewitschi* (Herzenstein, 1890)	Indigenous	0	0	0	1	0	0	1		Kushakewitsch loach	Голец Кушакевича
Cypriniformes	Balitoridae	*Nemachilus oxianus* (Kessler, 1877)	Indigenous	0	0	0	1	0	0	1		Amu-Darya stone loach	Амударьинский голец
Cypriniformes	Balitoridae	*Nemachilus paradoxus* (Turdakov, 1955)	Indigenous	0	0	0	1	0	1	0		Talas stoneloach	Таласский голец
Cypriniformes	Cobitidae	*Cobitis aurata aralensis* (Kessler, 1877)	Indigenous	0	0	0	1	1	0	1		Golden spine loach	Аральская щиповка
Cypriniformes	Cobitidae	*Nemachilus dorsalis* (Kessler, 1872)	Indigenous	1	1	1	1	1	1	1		Grey loach	Серый голец
Cypriniformes	Cobitidae	*Nemachilus stoliczkai* (Steindachner, 1866)	Indigenous	1	0	0	1	1	0	1		Tibetan stone loach	Тибетский голец
Cypriniformes	Cobitidae	*Nemachilus strauchi* (Kessler, 1874)	Indigenous	1	0	0	0	0	0	0		Spotted tick lip loach	Губач
Cypriniformes	Cobitidae	*Nemachilus strauchi ulacholicus* (Anikin, 1905)	Indigenous	1	0	0	0	0	0	0		Spotted tick lip loach	Иссык-Кульский губач
Cypriniformes	Cyprinidae	*Abramis brama orientalis* (Berg, 1849)	Introduced	1	0	0	0	1	1	0	1954	Bream	Аральский лещ
Cypriniformes	Cyprinidae	*Alburnoides taeniatus* (Kessler, 1874)	Indigenous	1	0	0	1	1	1	1		Striped bystranka	Полосатая быстрянка
Cypriniformes	Cyprinidae	*Aristichthys nobilis* (Richardson, 1845)	Introduced	0	0	0	1	1	1	0	1965	Bighead carp	Пестрый толстолобик
Cypriniformes	Cyprinidae	*Aspiolucius esocinus* (Kessler, 1874)	Introduced	0	0	0	1	0	0	0		Pike asp	Щуковидный жерех
Cypriniformes	Cyprinidae	*Aspius aspius iblioides* (Kessler, 1872)	Indigenous	0	0	0	0	1	0	0		Asp	Аральский жерех
Cypriniformes	Cyprinidae	*Barbus brachycephalus* (Kessler, 1872)	Indigenous	0	0	0	0	1	0	0		Aral barbel	Аральский усач
Cypriniformes	Cyprinidae	*Barbus capito conocephalus* (Kessler, 1872)	Indigenous	0	0	0	0	1	0	0		Turkestan barbel	Туркестанский усач
Cypriniformes	Cyprinidae	*Capoetobrama kuschakewitschi* (Kessler, 1872)	Indigenous	0	0	0	0	1	0	0		Sharpray	Остролучка
Cypriniformes	Cyprinidae	*Capoetobrama kuschakewitschi orientalis* (Nikolskii, 1934)	Indigenous	0	0	0	0	1	1	0		Chui sharpray	Чуйская остролучка. чебачок
Cypriniformes	Cyprinidae	*Carassius auratus auratus* (Linnaeus, 1758)	Introduced	0	0	0	1	1	1	1	1954	Goldfish. Prussian carp	Серебряный карась
Cypriniformes	Cyprinidae	*Ctenopharyngodon idella* (Valenciennes, 1844)	Introduced	0	0	0	1	1	1	0	1965	Grass carp	Белый амур

TABLE A2.7 (CONTINUED)

Order	Family	Species	Status	Issyk Kul	Son-Kul	Kara Su	Narin RB	Chu RB	Talas RB	Kara-Darya RB	Year of introduction	Englsih name	Local name
Cypriniformes	Cyprinidae	*Cyprinus carpio* (Linnaeus, 1758)	Indigenous	1	0	0	1	1	1	1		Common carp	Сазан. карп
Cypriniformes	Cyprinidae	*Diptychus dybovskii bergianus* (Turdakov 1952)	Indigenous	0	0	0	0	1	0	0		Chui osman	Чуйский осман
Cypriniformes	Cyprinidae	*Diptychus dybovskii* (Kessler, 1874)	Indigenous	1	0	1	1	1	1	1		Naked osman	Голый осман
Cypriniformes	Cyprinidae	*Diptychus dybowskii kessleri* (Russky, 1888)	Indigenous	0	0	0	0	0	0	0		Chyrchyk osman	Чирчикский голый осман
Cypriniformes	Cyprinidae	*Diptychus dybowskii lansdelli* (Gunther, 1889)	Indigenous	1	0	0	0	0	0	0		Issyk Kul naked osman	Иссык–Кульский голый осман
Cypriniformes	Cyprinidae	*Diptychus gymnogaster* (Kessler, 1879)	Indigenous	0	0	0	1	0	0	0		Tian-Shan scaled osman	Тянь-Шанский чешуйчатый осман
Cypriniformes	Cyprinidae	*Diptychus gymnogaster micromakulatus* (Imanov, 1950)	Indigenous	0	0	1	0	0	0	0		Issyk Kul scaled osman	Иссык–Кульский чешуйчатый осман
Cypriniformes	Cyprinidae	*Diptychus gymnogaster oschanihi* (Berg, 1914)	Indigenous	0	0	0	1	0	0	0		Suusamyr scaled osman	Суусамырский чешуйчатый осман
Cypriniformes	Cyprinidae	*Diptychus micromaculatus* (Turdakov, 1955)	Indigenous	0	0	0	1	1	0	0		Talas naked osman	Таласский голый осман
Cypriniformes	Cyprinidae	*Diptychus sewerzovi* (Kessler, 1872)	Indigenous	1	0	0	1	0	0	0		Severtzov osman	Осман Северцова
Cypriniformes	Cyprinidae	*Gobio gobio latus* (Anikin, 1905)	Indigenous	1	0	0	1	1	1	1		Issyk Kul gudgeon	Иссык-Кульский пескарь
Cypriniformes	Cyprinidae	*Gobio gobio lepidolaemus* (Kesssler, 1872)	Indigenous	0	0	0	0	1	0	1		Turkestan gudgeon	Туркестанский пескарь
Cypriniformes	Cyprinidae	*Hemiculter leucisculus* (Basilewski, 1855)	Introduced	0	0	0	1	1	0	0	1931	Sharpbelly	Корейская востробрюшка
Cypriniformes	Cyprinidae	*Hypophthalmichthys molitrix* (Valenciennes, 1844)	Introduced	0	0	0	1	1	1	0	1965	Silver carp	Толстолобик
Cypriniformes	Cyprinidae	*Leuciscus bergi* (Kashkarov, 1925)	Indigenous	1	0	0	0	0	0	0		Issyk Kul Dace	Иссык-Кульский чебачек
Cypriniformes	Cyprinidae	*Leuciscus leuciscus kirgisorum* (Berg, 1912)	Indigenous	0	0	0	0	1	0	0		Kyrgyz dace	Киргизский елец
Cypriniformes	Cyprinidae	*Leuciscus lindbergi* (Zanin and Eremeiew, 1934)	Indigenous	0	0	0	0	0	1	0		Talas dace	Таласский елец
Cypriniformes	Cyprinidae	*Leuciscus schmidti* (Herzenstein, 1896)	Indigenous	1	0	0	0	0	0	0		Schmidt's dace	Иссык-Кульский чебак
Cypriniformes	Cyprinidae	*Leuciscus squaliusculus* (Kessler, 1872)	Indigenous	0	0	0	0	0	0	1		Syr Darya dace	Сырдарьинский елец
Cypriniformes	Cyprinidae	*Phoxinus dementjevi* (Turdakov and Piskarjov, 1954)	Indigenous	0	0	0	0	1	0	0		Dementjev minnow	Чуйский гольян
Cypriniformes	Cyprinidae	*Phoxinus issykkulensis* (Berg, 1912)	Indigenous	1	0	0	0	0	0	0		Issyk Kul minnow	Иссык-Кульский гольян
Cypriniformes	Cyprinidae	*Pseudorasbora parva* (Temminck and Schlegel, 1846)	Introduced	1	0	0	1	1	1	1	1978	Stone moroko/False harlequin	Амурский чебачок

TABLE A2.7 (CONTINUED)

Order	Family	Species	Status	Issyk Kul	Son-Kul	Kara Su	Narin RB	Chu RB	Talas RB	Kara-Darya RB	Year of introduction	Englsih name	Local name
Cypriniformes	Cyprinidae	*Rhodeus sericeus* (Pallas, 1776)	Introduced	0	0	0	0	1	0	0	1932	Bitterling	Обыкновеный горчак
Cypriniformes	Cyprinidae	*Rutilus rutilus aralensis* (Berg, 1916)	Indigenous	0	0	0	0	1	0	0		Aral roach	Аральская плотва
Cypriniformes	Cyprinidae	*Scardinius erythrophthalmus* (Linnaeus, 1758)	Indigenous	0	0	0	0	1	0	0		Rudd	Красноперка
Cypriniformes	Cyprinidae	*Schizothorax issykkuli* (Berg, 1907)	Indigenous	1	0	0	0	0	0	0		Issyk Kul marinkia	Иссык-Кульская маринка
Cypriniformes	Cyprinidae	*Schizothorax tschuensis* (Pivnev 1985)	Indigenous	0	0	0	0	1	0	0		Chui marinka	Чуйская маринка
Cypriniformes	Cyprinidae	*Schizothorax intermedius eurycephalus* (Berg, 1932)	Indigenous	0	0	0	0	0	0	1		Marinka	Сарычелекская маринка
Cypriniformes	Cyprinidae	*Schizothorax intermedius intermedius* (McClelland, 1842)	Indigenous	0	0	0	1	1	0	1		Common marinka	Обыкновенная маринка
Cypriniformes	Cyprinidae	*Schizothorax intermedius talassi* (Turdakov, 1955)	Indigenous	0	0	0	0	0	1	0		Talas marinka	Таласская маринка
Cypriniformes	Cyprinidae	*Schizothorax pseudaksaiensis* (Herzenstein, 1889)	Indigenous	0	0	0	0	1	0	0		Ili marinka	Илийская маринка
Cypriniformes	Cyprinidae	*Tinca tinca* (Linnaeus, 1758)	Introduced	1	0	0	0	1	1	0	1950	Tench	Линь
Siluriformes	Sisoridae	*Glyptosternon reticulatum* (McClelland, 1842)	Indigenous	0	0	0	1	0	0	1		Turkestan catfish	Туркестанский сомик
Siluriformes	Sisoridae	*Silurus glanis* (Linnaeus, 1758)	Indigenous	0	0	0	0	1	0	1		European catfish	Сом
Gasterosteiformes	Gasterosteidae	*Pungitius platygaster* (Kessler, 1859)	Indigenous	0	0	0	0	1	0	0		Southern ninespine stickleback	Чуйская колюшка
Perciformes	Channidae	*Channa argus warpachowskii* (Berg, 1909)	Introduced	0	0	0	0	1	0	0	1965	Amur snakehead	Змееголов
Perciformes	Eleotridae	*Hypseleotris swinhonis* (Gunther, 1873)	Introduced	1	0	0	0	1	0	0	1965	Eleotris	Элеотрис (головешка)
Perciformes	Gobidae	*Rhinogobius similis* (Gill, 1859)	Introduced	0	0	0	0	1	0	0	1965	Amur goby	Амурский бычок
Perciformes	Percidae	*Lucioperca Lucioperca* (Linneaus, 1758)	Introduced	1	0	0	0	0	0	0	1958	Pikeperch	Судак
Perciformes	Percidae	*Perca fluviatilis* (Linnaeus, 1758)	Indigenous	0	0	0	0	1	0	0	1960	River perch	Обыкновенный окунь
Perciformes	Percidae	*Perca schrenkii* (Kessler, 1874)	Introduced	0	0	0	0	1	0	0	1960	Balkash perch	Балхашский окунь
Scorpaeniformes	Cottidae	*Cottus jaxartensis* (Berg, 1916)	Indigenous	0	0	0	1	0	0	1		Chatkal sculpin	Чаткальский подкаменщик
Scorpaeniformes	Cottidae	*Cottus spinolosus* (Kessler, 1872)	Indigenous	0	0	0	1	0	1	1		Turkestan sculpin	Туркестанский подкаменщик

TABLE A2.7.1
Fish species in the water basin of Lake Issyk Kul

Order	Family	Species	Number of species
		Indigenous	
Cypriniformes	**Cobitidae**	*Nemachilus dorsalis* (Kessler, 1872)	1
		Nemachilus stoliczkai (Steindachner, 1866)	1
		Nemachilus strauchi (Kessler, 1874)	1
		Nemachilus strauchi ulacholicus (Anikin, 1905)	1
		Total	**5**
	Cyprinidae	*Alburnoides taeniatus* (Kessler, 1874)	1
		Cyprinus carpio (Linnaeus, 1758)	1
		Diptychus dybovskii (Kessler, 1874)	1
		Diptychus dybowskii lansdelli (Gunther, 1889)	1
		Diptychus sewerzovi (Kessler, 1872)	1
		Gobio gobio latus (Anikin, 1905)	1
		Leuciscus bergi (Kashkarov, 1925)	1
		Leuciscus schmidti (Herzenstein, 1896)	1
		Phoxinus issykkulensis (Berg, 1912)	1
		Schizothorax issykkuli (Berg, 1907)	1
		Total	**10**
		Cypriniformes Total	**15**
		Indigenous Total	**15**
		Introduced	
Salmoniformes	**Coregonidae**	*Coregonus lavaretus Ludoga* (Poljakov, 1874)	1
		Total	**1**
	Salmonidae	*Oncorhynchus mykiss* (Walbaum, 1792)	1
		Salmo ischchan Issykogegarkuni (Lushin, 1932)	1
		Total	**2**
		Salmoniformes Total	**3**
Cypriniformes	**Cyprinidae**	*Abramis brama orientalis* (Berg, 1949)	1
		Pseudorasbora parva (Temminck and Schlegel, 1846)	1
		Tinca tinca (Linnaeus, 1758)	1
		Total	**3**
		Cypriniformes Total	**3**
Perciformes	**Eleotridae**	*Hypseleotris swinhonis* (Gunther, 1873)	**1**
		Total	**1**
	Percidae	*Lucioperca Lucioperca* (Linnaeus, 1758)	1
		Total	**1**
		Perciformes Total	**2**
		Introduced Total	**8**
		Grand Total	**23**

TABLE A2.7.2
Fish species in the water basin of Lake Son-Kul

Order	Family	Species	Number of species
		Indigenous	
Cypriniformes	**Cobitidae**	*Nemachilus dorsalis* (Kessler, 1872)	1
		Total	**1**
		Cypriniformes Total	**1**
		Indigenous Total	**1**
		Introduced	
Salmoniformes	**Coregonidae**	*Coregonus lavaretus Ludoga* (Poljakov, 1874)	1
		Coregonus peled (Gmelin, 1789)	1
		Total	**2**
		Salmoniformes Total	**2**
		Introduced Total	**2**
		Grand Total	**3**

TABLE A2.7.3
Fish species in the water basin of Lake Kara Su

Order	Family	Species	Number of species
Indigenous			
Cypriniformes	**Cobitidae**	*Nemachilus dorsalis* (Kessler, 1872)	1
		Total	**1**
	Cyprinidae	*Diptychus dybovskii* (Kessler, 1874)	1
		Diptychus gymnogaster micromakulatus (Imanov, 1950)	1
		Total	**2**
	Cypriniformes Total		**3**
Indigenous Total			**3**
Introduced			
Salmoniformes	**Coregonidae**	*Coregonus peled* (Gmelin, 1789)	1
		Total	**1**
	Salmoniformes Total		**1**
Introduced Total			**1**
Grand Total			**4**

TABLE A2.7.4
Fish species in the water basin of Naryn River Basin

Order	Family	Species	Number of species
		Indigenous	
Salmoniformes	**Salmonidae**	*Salmo trutta oxianus* (Kessler, 1874)	1
		Total	**1**
		Salmoniformes Total	**1**
Cypriniformes	**Balitoridae**	*Nemachilus kuschakewitschi* (Herzenstein, 1890)	1
		Nemachilus oxianus (Kessler, 1877)	1
		Nemachilus paradoxus (Turdakov, 1955)	1
		Total	**3**
	Cobitidae	*Cobitis aurata aralensis* (Kessler, 1877)	1
		Nemachilus dorsalis (Kessler, 1872)	1
		Nemachilus stoliczkai (Steindachner, 1866)	1
		Total	**4**
	Cyprinidae	Alburnoides *taeniatus* (Kessler, 1874)	1
		Cyprinus carpio (Linnaeus, 1758)	1
		Diptychus dybovskii (Kessler, 1874)	1
		Diptychus gymnogaster (Kessler, 1879)	1
		Diptychus gymnogaster oschanihi (Berg, 1914)	1
		Diptychus micromaculatus (Turdakov 1955)	1
		Diptychus sewerzovi (Kessler, 1872)	1
		Gobio gobio latus (Anikin, 1905)	1
		Schizothorax intermedius intermedius (McClelland, 1842)	1
		Total	**9**
		Cypriniformes Total	**16**
Siluriformes	**Sisoridae**	*Glyptosternon reticulatum* (McClelland, 1842)	1
		Total	**1**
		Siluriformes Total	**1**
Scorpaeniformes	**Cottidae**	*Cottus jaxartensis* (Berg, 1916)	1
		Cottus spinolosus (Kessler, 1872)	1
		Total	**2**
		Scorpaeniformes Total	**2**
		Indigenous Total	**20**
		Introduced	
Acipenseriformes	**Acipenseridae**	*Acipenser baerii* (Brandt, 1869)	1
		Total	**1**
		Acipenseriformes Total	**1**
Salmoniformes	**Coregonidae**	*Coregonus peled* (Gmelin, 1789)	1
		Total	**1**
	Salmonidae	*Salmo ischchan Issykogegarkuni* (Lushin, 1932)	1
		Total	**1**
		Salmoniformes Total	**2**
Cypriniformes	**Cyprinidae**	*Aristichthys nobilis* (Richardson, 1845)	1
		Aspiolucius esocinus (Kessler, 1874)	1
		Carassius auratus gibelio (Linnaeus, 1758)	1
		Ctenopharyngodon idella (Valenciennes, 1844)	1
		Hemiculter leucisculus (Basilewski, 1855)	1
		Hypophthalmichthys molitrix (Valenciennes, 1844)	1
		Pseudorasbora parva (Temminck and Schlegel, 1846)	1
		Total	**7**
		Cypriniformes Total	**7**
		Introduced Total	**10**
		Grand Total	**30**

TABLE A2.7.5
Fish species in the water basin of the Chu River Basin

Order	Family	Species	Number of species
		Indigenous	
Salmoniformes	**Salmonidae**	*Salmo trutta oxianus* (Kessler, 1874)	1
		Total	**1**
		Salmoniformes Total	**1**
Esociformes	**Esocidae**	*Esox lucius* (Linnaeus, 1758)	1
		Total	**1**
		Esociformes Total	**1**
Cypriniformes	**Cobitidae**	*Cobitis aurata aralensis* (Kessler, 1877)	1
		Nemachilus dorsalis (Kessler, 1872)	1
		Nemachilus stoliczkai (Kessler, 1866)	1
		Total	**4**
	Cyprinidae	*Alburnoides taeniatus* (Kessler, 1874)	1
		Aspius aspius iblioides (Kessler, 1872)	1
		Barbus brachycephalus (Kessler, 1872)	1
		Barbus capito conocephalus (Kessler, 1872)	1
		Capoetobrama kuschakewitschi (Kessler, 1872)	1
		Capoetobrama kuschakewitschi orientalis (Nikolskii, 1934)	1
		Cyprinus carpio (Linnaeus, 1758)	1
		Diptychus dybovskii bergianus (Turdakov 1952)	1
		Diptychus dybovskii (Kessler, 1874)	1
		Diptychus micromaculatus (Turdakov, 1955)	1
		Gobio gobio latus (Anikin, 1905)	1
		Gobio gobio lepidolaemus (Kesssler, 1872)	1
		Leuciscus leuciscus kirgisorum (Berg, 1912)	1
		Phoxinus dementjevi (Turdakov and Piskarjov, 1954)	1
		Rutilus rutilus aralensis (Berg, 1916)	1
		Scardinius erythrophthalmus (Linnaeus, 1758)	1
		Schizothorax tschuensis (Pivnev, 1985)	1
		Schizothorax intermedius intermedius (McClelland, 1842)	1
		Schizothorax pseudaksaiensis (Herzenstein, 1889)	1
		Total	**19**
		Cypriniformes Total	**23**
Siluriformes	**Sisoridae**	*Silurus glanis* (Linnaeus, 1758)	1
		Total	**1**
		Siluriformes Total	**1**
Gasterosteiformes	**Gasterosteidae**	*Pungitius platygaster* (Kessler, 1859)	1
		Total	**1**
		Gasterosteiformes Total	**1**
Perciformes	**Percidae**	*Perca fluviatilis* (Linnaeus, 1758)	1
		Total	**1**
		Perciformes Total	**1**
		Indigenous Total	**28**
		Introduced	
Cypriniformes	**Cyprinidae**	*Abramis brama orientalis* (Berg, 1949)	1
		Aristichthys nobilis (Richardson, 1845)	1
		Carassius auratus auratus (Linnaeus, 1758)	1
		Ctenopharyngodon idella (Valenciennes, 1844)	1
		Hemiculter leucisculus (Basilewski, 1855)	1
		Hypophthalmichthys molitrix (Valenciennes, 1844)	1
		Pseudorasbora parva (Temminck and Schlegel, 1846)	1
		Rhodeus sericeus (Pallas, 1776)	1
		Tinca tinca (Linnaeus, 1758)	1
		Total	**9**
		Cypriniformes Total	**9**

TABLE A2.7.5 (CONTINUED)

Order	Family	Species	Number of species
Indigenous			
Perciformes	Channidae	*Channa argus warpachowskii* (Berg, 1909)	1
		Total	**1**
	Eleotridae	*Hypseleotris swinhonis* (Gunther, 1873)	1
		Total	**1**
	Gobidae	*Rhinogobius similis* (Gill, 1859)	1
		Total	**1**
	Percidae	*Perca schrenkii* (Kessler, 1874)	1
		Total	**1**
		Perciformes Total	**4**
		Introduced Total	**13**
		Grand Total	**41**

TABLE A2.7.6
Fish species in the water basin of Talas River Basin

Order	Family	Species	Number of species
Indigenous			
Salmoniformes	Salmonidae	*Salmo trutta oxianus* (Kessler, 1874)	1
		Total	**1**
		Salmoniformes Total	**1**
Cypriniformes	Balitoridae	*Nemachilus paradoxus* (Turdakov, 1955)	1
		Total	**1**
	Cobitidae	*Nemachilus dorsalis* (Kessler, 1872)	1
		Total	**1**
	Cyprinidae	*Alburnoides taeniatus* (Kessler, 1874)	1
		Capoetobrama kuschakewitschi orientalis (Nikolskii, 1934)	1
		Cyprinus carpio (Linnaeus, 1758)	1
		Diptychus dybovskii (Kessler, 1874)	1
		Gobio gobio latus (Anikin, 1905)	1
		Leuciscus lindbergi (Zanin and Eremeiew, 1934)	1
		Schizothorax intermedius talassi (Turdakov, 1955)	1
		Total	**7**
		Cypriniformes Total	**9**
Scorpaeniformes	Cottidae	*Cottus spinolosus* (Kessler, 1872)	1
		Total	**1**
		Scorpaeniformes Total	**1**
		Indigenous Total	**11**
Introduced			
Cypriniformes	Cyprinidae	*Abramis brama orientalis* (Berg, 1949)	1
		Aristichthys nobilis (Richardson, 1845)	1
		Carassius auratus auratus (Linnaeus, 1758)	1
		Ctenopharyngodon idella (Valenciennes, 1844)	1
		Hypophthalmichthys molitrix (Valenciennes, 1844)	1
		Pseudorasbora parva (Temminck and Schlegel, 1846)	1
		Tinca tinca (Linnaeus, 1758)	1
		Total	**7**
		Cypriniformes Total	**7**
		Introduced Total	**7**
		Grand Total	**18**

TABLE A2.7.7
Fish species in the water basin of Kara-Darya River Basin

Order	Family	Species	Number of species
		Indigenous	
Salmoniformes	**Salmonidae**	*Salmo trutta oxianus* (Kessler, 1874)	1
		Total	**1**
		Salmoniformes Total	**1**
Cypriniformes	**Balitoridae**	*Nemachilus kuschakewitschi* (Herzenstein, 1890)	1
		Nemachilus oxianus (Kessler, 1877)	1
		Total	**2**
	Cobitidae	*Cobitis aurata aralensis* (Kessler, 1877)	1
		Nemachilus dorsalis (Kessler, 1872)	1
		Nemachilus stoliczkai (Steindachner, 1866)	1
		Total	**4**
	Cyprinidae	*Alburnoides taeniatus* (Kessler, 1874)	1
		Cyprinus carpio (Linnaeus, 1758)	1
		Diptychus dybovskii (Kessler, 1874)	1
		Gobio gobio latus (Anikin, 1905)	1
		Gobio gobio lepidolaemus (Kesssler, 1872)	1
		Leuciscus squaliusculus (Kessler, 1872)	1
		Schizothorax intermedius eurycephalus (Berg, 1932)	1
		Schizothorax intermedius intermedius (McClelland, 1842)	1
		Total	**8**
		Cypriniformes Total	**14**
Siluriformes	**Sisoridae**	*Glyptosternon reticulatum* (McClelland, 1842)	1
		Silurus glanis (Linnaeus, 1758)	1
		Total	**2**
		Siluriformes Total	**2**
Scorpaeniformes	**Cottidae**	*Cottus jaxartensis* (Berg, 1916)	1
		Cottus spinolosus (Kessler, 1872)	1
		Total	**2**
		Scorpaeniformes Total	**2**
		Indigenous Total	**19**
		Introduced	
Cypriniformes	**Cyprinidae**	*Carassius auratus auratus* (Linnaeus, 1758)	1
		Pseudorasbora parva (Temminck and Schlegel, 1846)	1
		Total	**2**
		Cypriniformes Total	**2**
		Introduced Total	**2**
		Grand Total	**21**

TABLE A2.8
Limits for catching trout and osman in Kyrgyz rivers, 2009–2011

Sl No.	River (Englsih name)	Amu Darya trout (pcs.)	River osman (pcs.)
1	Alamedin	500	-
2	Ala-Archa (to the border of the Natural Park)	500	-
3	Suusamyr	-	500
4	Western Karakol	-	500
5	Kokomeren	-	500
6	Kara-Balta	500	-
7	Kegety	500	-
8	Shamsi	500	-
9	Issyk-Ata and its tributaries	500	-
10	Chon-Kemin with tributaries	-	500
11	Zhylamysh	-	500
12	Chu in the Naryn and Issyk Kul	-	500
13	Rivers of Lake Issyk Kul basin	-	500
14	Suyek	500	-
15	Naryn and its tributaries	-	500
16	He Peka-Archa	500	-
17	Besh-Tash and its tributaries	500	-
18	Urmaral tributaries	500	-
19	Kara-Bura	500	-
20	Kumushtag	500	-
21	Peka-Suu Kurkureu	500	-
22	Chychkan tributaries	500	-
23	Ahmet Uzun	500	-
24	Karakuldzha	500	-
25	Kara-Suu and its tributaries	500	-
26	Kyzyl Unguri tributaries	500	-
27	Kara and its tributaries	-	500
28	Ak-Buura tributaries	500	-
29	Kyzyl-Suu and its tributaries	500	-
30	Abshir-Sai	-	500
31	Chile-Say	-	500
32	Kyr-Ata	-	500
33	Kotchan	-	500
	Total	**10 000**	**6 500**

TABLE A2.9

Yearly catches on Lake Issyk Kul, 1965–2003

Year	Min. Avg. Max.	Tons										Min.	Avg.	Max.
		Chebak	Chebachok	Marinka	Naked Osman	Common carp	Pike-perch	Sevan trout	White fish	Bream	Common minnow	Total			
1965		32.0	1 257.0	6.0	2.0	23.6	20.0	0.3	-	9.1	-	**1 350.0**	-	135.0	1 257.0
1966		23.0	1 132.2	4.5	0.3	2.0	13.6	2.0	-	2.4	-	**1 180.0**	-	118.0	1 132.2
1967		13.4	1 138.3	4.0	0.2	2.0	14.0	3.0	-	9.1	-	**1 184.0**	-	118.4	1 138.3
1968		23.0	1 009.5	3.0	2.0	8.0	38.0	4.5	-	2.0	-	**1 090.0**	-	109.0	1 009.5
1969		21.0	833.3	2.0	0.4	7.0	58.0	5.3	-	2.0	-	**929.0**	-	92.9	833.3
1970		18.9	803.2	0.5	0.8	6.0	116.3	5.0	-	5.5	-	**956.2**	-	95.6	803.2
1971		44.9	956.0	0.5	1.1	3.4	160.9	17.6	-	9.6	-	**1 194.0**	-	119.4	956.0
1972		64.9	994.9	2.0	1.0	2.0	86.5	14.3	-	3.6	-	**1 169.2**	-	116.9	994.9
1973		69.2	993.2	2.3	2.6	2.3	152.8	12.9	-	4.0	-	**1 239.3**	-	123.9	993.2
1974		74.8	826.2	2.7	1.0	1.0	165.4	11.9	0.5	3.0	-	**1 086.5**	-	108.7	826.2
1975		77.1	685.6	0.3	1.2	1.1	112.4	47.2	0.3	3.0	-	**928.1**	-	92.8	685.6
1976		67.0	740.4	0.4	1.2	0.3	111.8	51.6	3.6	1.8	-	**978.1**	-	97.8	740.4
1977		58.6	627.7	0.2	1.8	0.6	97.7	40.7	5.0	1.4	-	**833.7**	-	83.4	627.7
1978		26.1	473.7	0.1	2.4	0.3	72.6	35.4	4.4	0.7	-	**615.7**	-	61.6	473.7
1979		19.0	340.8	0.4	1.8	0.2	52.8	53.8	4.3	0.5	-	**473.6**	-	47.4	340.8
1980		35.6	223.8	1.9	1.3	3.2	36.2	38.3	5.2	2.3	-	**347.8**	-	34.8	223.8
1981		30.1	150.0	-	1.4	0.1	49.2	37.7	17.8	0.6	-	**286.9**	-	28.7	150.0
1982		31.5	33.6	0.4	0.8	0.3	43.0	23.3	7.8	1.7	-	**142.4**	-	14.2	43.0
1983		34.2	71.3	4.2	0.9	0.4	20.3	16.4	13.0	0.6	-	**161.3**	-	16.1	71.3
1984		14.6	81.4	10.5	0.8	0.6	21.5	6.2	9.1	1.2	-	**146.0**	-	14.6	81.4
1985		13.4	86.0	14.6	0.4	2.2	22.0	12.9	23.5	1.7	-	**176.7**	-	17.7	86.0
1986		20.0	75.0	10.0	-	5.0	30.0	10.0	10.0	-	-	**160.0**	-	16.0	75.0
1987		30.1	123.0	2.2	0.3	1.7	27.1	20.2	30.0	5.5	1.8	**241.9**	0.3	24.2	123.0
1988		34.2	131.1	42.0	-	15.8	34.1	41.4	25.1	-	-	**323.6**	-	32.4	131.1
1989		22.6	117.2	0.4	-	0.2	46.5	18.6	35.2	8.1	2.2	**250.9**	-	25.1	117.2
1990		31.7	162.7	0.2	-	0.0	32.0	17.7	20.6	6.6	4.2	**275.7**	-	27.6	162.7
1991		27.4	96.0	0.0	-	-	35.8	14.6	25.9	13.0	3.6	**216.3**	-	21.6	96.0
1992		18.9	90.3	0.3	-	10.7	20.7	6.9	14.7	-	1.8	**164.3**	-	16.4	90.3
1993		22.6	26.3	-	-	-	15.1	3.2	13.6	19.5	-	**100.3**	-	10.0	26.3
1994		10.6	19.6	-	-	-	9.8	3.2	6.6	10.2	-	**60.0**	-	6.0	19.6
1995		26.1	8.7	-	-	-	6.6	4.6	8.7	10.2	-	**64.9**	-	6.5	26.1
1996		6.8	24.9	-	-	-	3.4	6.1	7.0	8.2	-	**56.4**	-	5.6	24.9
1997		8.1	9.3	-	-	-	2.1	3.5	4.9	6.2	-	**34.1**	-	3.4	9.3
1998		8.0	3.6	-	-	-	0.2	0.2	5.0	7.0	-	**24.0**	-	2.4	8.0
1999		3.7	0.6	-	-	-	0.2	0.2	2.9	5.3	-	**12.9**	-	1.3	5.3
2000		4.2	0.2	-	-	-	0.1	0.1	2.8	2.8	-	**10.2**	-	1.0	4.2
2001		8.6	0.8	-	-	-	0.3	0.1	1.0	1.8	-	**12.6**	-	1.3	8.6
2002		3.9	3.2	-	-	-	0.1	0.2	0.6	0.2	-	**8.2**	-	0.8	3.9
2003		0.8	0.5	-	-	-	-	0.3	-	-	-	**1.6**	-	0.2	0.8

TABLE A2.9 (CONTINUED)

Year	Min. Avg. Max.	Tonnes										Min.	Avg.	Max.
		Chebak	Chebachok	Marinka	Naked Osman	Common carp	Pike-perch	Sevan trout	White fish	Bream	Common minnow	Total			
1965-90	Min.	13.4	33.6	-	-	0.0	13.6	0.3	-	-	-	**142.4**	-	6.1	33.6
1965-90	Avg.	35.8	541.0	4.4	1.0	3.4	62.9	21.1	8.3	3.3	0.3	**681.6**	0.3	68.2	541.0
1965-90	Max.	77.1	1 257.0	42.0	2.6	23.6	165.4	53.8	35.2	9.6	4.2	**1 350.0**	2.6	167.0	1 257.0
1965-90	**Total**	**926.3**	**12 906.0**	**109.4**	**23.7**	**65.6**	**1 650.5**	**562.6**	**241.2**	**89.8**	**11.8**	**16 586.9**	**11.8**	**1 658.7**	**12 906.0**
1991-03	Min.	0.8	0.2	-	-	-	-	0.1	-	-	-	**1.6**	-	0.1	0.8
1991-03	Avg.	11.5	21.8	0.0	-	0.8	7.3	3.3	7.2	6.5	0.4	**58.9**	-	5.9	21.8
1991-03	Max.	27.4	96.0	0.3	-	10.7	35.8	14.6	25.9	19.5	3.6	**216.3**	-	23.4	96.0
1991-03	**Total**	**149.8**	**283.9**	**0.3**	**-**	**10.7**	**94.4**	**43.1**	**93.8**	**84.4**	**5.3**	**765.6**	**-**	**76.6**	**283.9**
1965-69	Min.	13.4	833.3	2.0	0.2	2.0	13.6	0.3	-	2.0	-	**929.0**	**-**	86.7	833.3
1965-69	Avg.	22.5	1 074.1	3.9	1.0	8.5	28.7	3.0	-	4.9	-	**1 146.6**	-	114.7	1 074.1
1965-69	Max.	32.0	1 257.0	6.0	2.0	23.6	58.0	5.3	-	9.1	-	**1 350.0**	-	139.3	1 257.0
1965-69	**Total**	**112.4**	**5 370.3**	**19.5**	**4.9**	**42.6**	**143.6**	**15.1**	**-**	**24.6**	**-**	**5 733.0**	**-**	**573.3**	**5 370.3**
1970-79	Min.	18.9	340.8	0.1	0.8	0.2	52.8	5.0	-	0.5	-	**473.6**	-	41.9	340.8
1970-79	Avg.	52.0	744.2	0.9	1.5	1.7	112.9	29.0	1.8	3.3	-	**947.4**	-	94.7	744.2
1970-79	Max.	77.1	994.9	2.7	2.6	6.0	165.4	53.8	5.0	9.6	-	**1 239.3**	-	131.7	994.9
1970-79	**Total**	**520.5**	**7 441.7**	**9.4**	**14.9**	**17.2**	**1 129.2**	**290.4**	**18.1**	**33.1**	**-**	**9 474.4**	**-**	**947.4**	**7 441.7**
1980-89	Min.	13.4	33.6	-	-	0.1	20.3	6.2	5.2	-	-	**142.4**	-	7.9	33.6
1980-89	Avg.	26.6	109.2	8.6	0.6	2.9	33.0	22.5	17.7	2.2	0.4	**223.8**	0.4	22.4	109.2
1980-89	Max.	35.6	223.8	42.0	1.4	15.8	49.2	41.4	35.2	8.1	2.2	**347.8**	1.4	45.5	223.8
1980-89	**Total**	**266.3**	**1 092.3**	**86.3**	**5.9**	**29.4**	**330.0**	**225.0**	**176.7**	**21.7**	**4.0**	**2 237.5**	**4.0**	**223.8**	**1 092.3**
1990-99	Min.	3.7	0.6	-	-	-	0.2	0.2	2.9	-	-	**12.9**	-	0.8	3.7
1990-99	Avg.	16.4	44.2	0.0	-	1.1	12.6	6.0	11.0	8.6	1.0	**100.9**	-	10.1	44.2
1990-99	Max.	31.7	162.7	0.3	-	10.7	35.8	17.7	25.9	19.5	4.2	**275.7**	-	30.9	162.7
1990-99	**Total**	**164.0**	**441.9**	**0.4**	**-**	**10.7**	**125.9**	**60.3**	**109.9**	**86.2**	**9.6**	**1 008.8**	**-**	**100.9**	**441.9**
2000-03	Min.	0.8	0.2	-	-	-	-	0.1	-	-	-	**1.6**	-	0.1	0.8
2000-03	Avg.	4.4	1.2	-	-	-	0.1	0.1	1.1	1.2	-	**8.1**	-	0.8	4.4
2000-03	Max.	8.6	3.2	-	-	-	0.3	0.3	2.8	2.8	-	**12.6**	-	1.8	8.6
2000-03	**Total**	**17.5**	**4.7**	**-**	**-**	**-**	**0.5**	**0.5**	**4.4**	**4.8**	**-**	**32.4**	**-**	**3.2**	**17.5**
All Years	Min.	0.8	0.2	-	-	-	-	0.1	-	-	-	**1.6**	-	0.1	0.8
All Years	Avg.	27.7	368.0	3.0	0.7	2.6	44.3	15.2	7.9	4.4	0.3	**474.0**	0.3	47.4	368.0
All Years	Max.	77.1	1 257.0	42.0	2.6	23.6	165.4	53.8	35.2	19.5	4.2	**1 350.0**	2.6	168.0	1 257.0
All Years	**Total**	**1 080.6**	**14 351.0**	**115.6**	**25.7**	**99.9**	**1 729.1**	**591.3**	**309.1**	**170.3**	**13.6**	**18 486.2**	**13.6**	**1 848.6**	**14 351.0**

TABLE A2.9 (CONTINUED)

Year	Min. Avg. Max.	Tonnes											Min.	Avg.	Max.
		Chebak	Chebachok	Marinka	Naked Osman	Common carp	Pike-perch	Sevan trout	White fish	Bream	Common minnow	Total			
1965-90	Min. %	9.4	23.6	-	-	0.0	9.6	0.2	-	-	-	**100.0**	-	4.3	23.6
1965-90	Avg. %	5.3	79.4	0.7	0.1	0.5	9.2	3.1	1.2	0.5	0.0	**100.0**	0.0	10.0	79.4
1965-90	Max. %	5.7	93.1	3.1	0.2	1.7	12.3	4.0	2.6	0.7	0.3	**100.0**	0.2	12.4	93.1
1965-90	**Total %**	**5.6**	**77.8**	**0.7**	**0.1**	**0.4**	**10.0**	**3.4**	**1.5**	**0.5**	**0.1**	**100.0**	**0.1**	**10.0**	**77.8**
1991-03	Min. %	51.3	12.8	-	-	-	-	3.2	-	-	-	**100.0**	-	6.7	51.3
1991-03	Avg. %	19.6	37.1	0.0	-	1.4	12.3	5.6	12.2	11.0	0.7	**100.0**	-	10.0	37.1
1991-03	Max. %	12.7	44.4	0.1	-	5.0	16.5	6.8	12.0	9.0	1.7	**100.0**	-	10.8	44.4
1991-03	**Total %**	**19.6**	**37.1**	**0.0**	**-**	**1.4**	**12.3**	**5.6**	**12.2**	**11.0**	**0.7**	**100.0**	**-**	**10.0**	**37.1**
1965-69	Min. %	1.4	89.7	0.2	0.0	0.2	1.5	0.0	-	0.2	-	**100.0**	-	9.3	89.7
1965-69	Avg. %	2.0	93.7	0.3	0.1	0.7	2.5	0.3	-	0.4	-	**100.0**	-	10.0	93.7
1965-69	Max. %	2.4	93.1	0.4	0.1	1.7	4.3	0.4	-	0.7	-	**100.0**	-	10.3	93.1
1965-69	**Total %**	**2.0**	**93.7**	**0.3**	**0.1**	**0.7**	**2.5**	**0.3**	**-**	**0.4**	**-**	**100.0**	**-**	**10.0**	**93.7**
1970-79	Min. %	4.0	72.0	0.0	0.2	0.0	11.1	1.1	-	0.1	-	**100.0**	-	8.8	72.0
1970-79	Avg. %	5.5	78.5	0.1	0.2	0.2	11.9	3.1	0.2	0.3	-	**100.0**	-	10.0	78.5
1970-79	Max. %	6.2	80.3	0.2	0.2	0.5	13.3	4.3	0.4	0.8	-	**100.0**	-	10.6	80.3
1970-79	**Total %**	**5.5**	**78.5**	**0.1**	**0.2**	**0.2**	**11.9**	**3.1**	**0.2**	**0.3**	**-**	**100.0**	**-**	**10.0**	**78.5**
1980-89	Min. %	9.4	23.6	-	-	0.1	14.3	4.4	3.7	-	-	**100.0**	-	5.5	23.6
1980-89	Avg. %	11.9	48.8	3.9	0.3	1.3	14.7	10.1	7.9	1.0	0.2	**100.0**	0.2	10.0	48.8
1980-89	Max. %	10.2	64.3	12.1	0.4	4.5	14.1	11.9	10.1	2.3	0.6	**100.0**	0.4	13.1	64.3
1980-89	**Total %**	**11.9**	**48.8**	**3.9**	**0.3**	**1.3**	**14.7**	**10.1**	**7.9**	**1.0**	**0.2**	**100.0**	**0.2**	**10.0**	**48.8**
1990-99	Min. %	28.7	4.7	-	-	-	1.6	1.6	22.5	-	-	**100.0**	-	5.9	28.7
1990-99	Avg. %	16.3	43.8	0.0	-	1.1	12.5	6.0	10.9	8.5	0.9	**100.0**	-	10.0	43.8
1990-99	Max. %	11.5	59.0	0.1	-	3.9	13.0	6.4	9.4	7.1	1.5	**100.0**	-	11.2	59.0
1990-99	**Total %**	**16.3**	**43.8**	**0.0**	**-**	**1.1**	**12.5**	**6.0**	**10.9**	**8.5**	**0.9**	**100.0**	**-**	**10.0**	**43.8**
2000-03	Min. %	51.3	12.8	-	-	-	-	3.2	-	-	-	**100.0**	-	6.7	51.3
2000-03	Avg. %	53.9	14.5	-	-	-	1.5	1.7	13.6	14.8	-	**100.0**	-	10.0	53.9
2000-03	Max. %	68.5	25.5	-	-	-	2.4	2.1	22.3	22.3	-	**100.0**	-	14.3	68.5
2000-03	**Total %**	**53.9**	**14.5**	**-**	**-**	**-**	**1.5**	**1.7**	**13.6**	**14.8**	**-**	**100.0**	**-**	**10.0**	**53.9**
All Years	Min. %	51.3	12.8	-	-	-	-	3.2	-	-	-	**100.0**	-	6.7	51.3
All Years	Avg. %	5.8	77.6	0.6	0.1	0.5	9.4	3.2	1.7	0.9	0.1	**100.0**	0.1	10.0	77.6
All Years	Max. %	5.7	93.1	3.1	0.2	1.7	12.3	4.0	2.6	1.4	0.3	**100.0**	0.2	12.4	93.1
All Years	**Total %**	**5.8**	**77.6**	**0.6**	**0.1**	**0.5**	**9.4**	**3.2**	**1.7**	**0.9**	**0.1**	**100.0**	**0.1**	**10.0**	**77.6**

Source: Ryspaev and Woynárovich (2008).

TABLE A2.10
Proportion of the different species in the total catch in Issyk Kul, 1965–2003

Year	%										
	Chebak	Chebachok	Marinka	Naked Osman	Common carp	Pike-perch	Sevan trout	White fish	Bream	Common minnow	Total
1965	2	93	0	0	2	1	0	-	1	-	**100**
1966	2	84	0	0	0	1	0	-	0	-	**87**
1967	1	84	0	0	0	1	0	-	1	-	**88**
1968	2	75	0	0	1	3	0	-	0	-	**81**
1969	2	62	0	0	1	4	0	-	0	-	**69**
1970	1	59	0	0	0	9	0	-	0	-	**71**
1971	3	71	0	0	0	12	1	-	1	-	**88**
1972	5	74	0	0	0	6	1	-	0	-	**87**
1973	5	74	0	0	0	11	1	-	0	-	**92**
1974	6	61	0	0	0	12	1	0	0	-	**80**
1975	6	51	0	0	0	8	3	0	0	-	**69**
1976	5	55	0	0	0	8	4	0	0	-	**72**
1977	4	46	0	0	0	7	3	0	0	-	**62**
1978	2	35	0	0	0	5	3	0	0	-	**46**
1979	1	25	0	0	0	4	4	0	0	-	**35**
1980	3	17	0	0	0	3	3	0	0	-	**26**
1981	2	11	-	0	0	4	3	1	0	-	**21**
1982	2	2	0	0	0	3	2	1	0	-	**11**
1983	3	5	0	0	0	2	1	1	0	-	**12**
1984	1	6	1	0	0	2	0	1	0	-	**11**
1985	1	6	1	0	0	2	1	2	0	-	**13**
1986	1	6	1	-	0	2	1	1	-	-	**12**
1987	2	9	0	0	0	2	1	2	0	0	**18**
1988	3	10	3	-	1	3	3	2	-	-	**24**
1989	2	9	0	-	0	3	1	3	1	0	**19**
1990	2	12	0	-	0	2	1	2	0	0	**20**
1991	2	7	0	-	-	3	1	2	1	0	**16**
1992	1	7	0	-	1	2	1	1	-	0	**12**
1993	2	2	-	-	-	1	0	1	1	-	**7**
1994	1	1	-	-	-	1	0	0	1	-	**4**
1995	2	1	-	-	-	0	0	1	1	-	**5**
1996	1	2	-	-	-	0	0	1	1	-	**4**
1997	1	1	-	-	-	0	0	0	0	-	**3**
1998	1	0	-	-	-	0	0	0	1	-	**2**
1999	0	0	-	-	-	0	0	0	0	-	**1**
2000	0	0	-	-	-	0	0	0	0	-	**1**
2001	1	0	-	-	-	0	0	0	0	-	**1**
2002	0	0	-	-	-	0	0	0	0	-	**1**
2003	0	0	-	-	-	-	0	-	-	-	**0**
2004											
2005											
2006											
2007											

Source: Ryspaev and Woynárovich (2008).

TABLE A2.11
Proportion of the different species within the yearly catches in Lake Issyk Kul, 1965–2003

Year	%											Groups of Species			
	1. Chebak	2. Chebachok	3. Marinka	4. Naked Osman	5. Common carp	6. Pike-perch	7. Sevan trout	8. White fish	9. Bream	10. Common minnow	Total	1 + 2 + 10	1 + 2 + 9 + 10	6 + 7	All of Groups
1965	2	93	0	0	2	1	0	-	1	-	**100**	95	96	2	**98**
1966	2	96	0	0	0	1	0	-	0	-	**100**	98	98	1	**99**
1967	1	96	0	0	0	1	0	-	1	-	**100**	97	98	1	**99**
1968	2	93	0	0	1	3	0	-	0	-	**100**	95	95	4	**99**
1969	2	90	0	0	1	6	1	-	0	-	**100**	92	92	7	**99**
1970	2	84	0	0	1	12	1	-	1	-	**100**	86	87	13	**99**
1971	4	80	0	0	0	13	1	-	1	-	**100**	84	85	15	**100**
1972	6	85	0	0	0	7	1	-	0	-	**100**	91	91	9	**100**
1973	6	80	0	0	0	12	1	-	0	-	**100**	86	86	13	**99**
1974	7	76	0	0	0	15	1	0	0	-	**100**	83	83	16	**100**
1975	8	74	0	0	0	12	5	0	0	-	**100**	82	82	17	**100**
1976	7	76	0	0	0	11	5	0	0	-	**100**	83	83	17	**99**
1977	7	75	0	0	0	12	5	1	0	-	**100**	82	82	17	**99**
1978	4	77	0	0	0	12	6	1	0	-	**100**	81	81	18	**99**
1979	4	72	0	0	0	11	11	1	0	-	**100**	76	76	23	**99**
1980	10	64	1	0	1	10	11	1	1	-	**100**	75	75	21	**97**
1981	10	52	-	0	0	17	13	6	0	-	**100**	63	63	30	**93**
1982	22	24	0	1	0	30	16	5	1	-	**100**	46	47	47	**94**
1983	21	44	3	1	0	13	10	8	0	-	**100**	65	66	23	**89**
1984	10	56	7	1	0	15	4	6	1	-	**100**	66	67	19	**86**
1985	8	49	8	0	1	12	7	13	1	-	**100**	56	57	20	**77**
1986	13	47	6	-	3	19	6	6	-	-	**100**	59	59	25	**84**
1987	12	51	1	0	1	11	8	12	2	1	**100**	64	66	20	**86**
1988	11	40	13	-	5	11	13	8	-	-	**100**	51	51	23	**74**
1989	9	47	0	-	0	19	7	14	3	1	**100**	57	60	26	**86**
1990	12	59	0	-	0	12	6	7	2	2	**100**	72	74	18	**92**
1991	13	44	0	-	-	17	7	12	6	2	**100**	59	65	23	**88**
1992	12	55	0	-	7	13	4	9	-	1	**100**	68	68	17	**84**
1993	23	26	-	-	-	15	3	14	19	-	**100**	49	68	18	**86**
1994	18	33	-	-	-	16	5	11	17	-	**100**	50	67	22	**89**
1995	40	13	-	-	-	10	7	13	16	-	**100**	54	69	17	**87**
1996	12	44	-	-	-	6	11	12	15	-	**100**	56	71	17	**88**
1997	24	27	-	-	-	6	10	14	18	-	**100**	51	69	16	**86**
1998	33	15	-	-	-	1	1	21	29	-	**100**	48	78	2	**79**
1999	29	5	-	-	-	2	2	22	41	-	**100**	33	74	3	**78**
2000	41	2	-	-	-	1	0	28	28	-	**100**	43	71	1	**72**
2001	68	6	-	-	-	2	0	8	14	-	**100**	75	89	3	**92**
2002	48	39	-	-	-	1	2	7	2	-	**100**	87	89	3	**93**
2003	51	32	-	-	-	-	17	-	-	-	**100**	83	83	17	**100**

Source: Ryspaev and Woynárovich (2008).

TABLE A2.12
List of selected fish farms

Name	Location		Number of ponds	Area (ha)			Capacity			Species	Owned by
	Province	District		Nursery	Table fish	Total	Fish larvae (1000 pcs.)	Fry and fingerling (1000 pcs.)	Table fish (tonnes)		
Uzgen Fish Farm	Osh	Uzgen	65	65.7	224.3	290.0		2 000 000	500	Carps*	State
Talas Fish Farm	Talas	Bakai-Ata	45	68.0	296.0	364.0		3 000 000	600	Carps*	State
JSC "Balykchy"	Chui	Alamedin	21	38	198	236		15 000 000	300	Carps*	Joint-stock company
Ton Fish Hatchery	Issyk Kul	Ton	6	-	-	7.7		12 000 000		Common carp, sevan trout	State
LTD "Karakolbalygy"	Issyk Kul	Ak-Suu	16	2.0	20.0	25.0		15 000 000			Private

* Common carp, silver carp, bighead carp and grass carp.

Sources: Department of Fisheries and its departments.

TABLE A2.13
Fish production in fisheries and aquaculture in Kyrgyzstan, 2006–2010

Type of fish production	2006	2007	2008	2009	2010
	Tonnes				
Fishery	34.1	33.6	7.8	24.2	55.7
Aquaculture	37.3	105.0	91.6	119.2	290.6
Total	**71.4**	**138.6**	**99.4**	**143.4**	**346.3**

TABLE A2.14
Fish production in Kyrgyzstan, 2005–2010

Type of fish production	2005	2006	2007	2008	2009	2010
	Tonnes					
Lakes	13.5	5.0	11.0	-	2.0	3.3
Aquaculture	16.5	37.3	105.0	91.6	119.2	290.6
Reservoir	12.7	29.1	22.6	7.8	22.2	52.4
Pond	16.5	34.2	52.0	69.0	85.7	135.0
Cage		3.1	53.0	22.6	33.5	155.6
Total	**42.7**	**71.4**	**138.6**	**99.4**	**143.4**	**346.3**

TABLE A2.15
Fish production of fisheries and aquaculture subsectors in 2010

Species		Fish production (Kg)
Fishery		
Common carp. Chinese major carps		52 400
Whitefish. peled. Sevan trout		3 346
	Subtotal	**55 746**
Aquaculture		
Rainbow torut		155 600
Common carp. Chinese major carps		135 000
	Subtotal	**290 600**
	Grand total	**346 346**

TABLE A2.16
Fish production of fisheries and aquaculture subsectors, 1988–2010

	Tonnes							
Species	**Avg 1988–1992**	**Avg. 1993–2002**	**Avg. 2003– 2009**	**2006**	**2007**	**2008**	**2009**	**2010**
Aquaculture								
Carps and other cyprinids	916.2	139.5	41.4	34.2	52.0	69.0	85.7	135.0
Salmons. trouts	52.0	8.0	28.1	3.1	53.0	22.6	33.5	155.6
Total	**968.2**	**147.5**	**69.5**	**37.3**	**105.0**	**91.6**	**119.2**	**290.6**
Fisheries								
Carps and other cyprinids	1 097.8	200.6	17.0	29.1	22.6	7.8	22.2	52.4
Miscellaneous freshwater fishes	35.8	6.0	19.7	5.0	11.0	-	2.0	-
Salmons. trouts	90.0	41.7						3.3
Total	**1 223.6**	**248.3**	**36.7**	**34.1**	**33.6**	**7.8**	**24.2**	**55.7**
Grand total	**2 191.8**	**395.8**	**106.2**	**71.4**	**138.6**	**99.4**	**143.4**	**346.3**

Source: FAO (2011).

TABLE A2.17
Frozen fish imports by Kyrgyzstan, 2011

Species	Origin	Quantity (tonnes)	Price (KGS/tonnes)	Price (USD/tonnes)
Salmon, herring, sardines, mackerel, forel kambala	Russia	2 813.2	114 466.50	2 488.40
Salmon, flounder, herring, trout, mackerel	Norway	3 626.9	190 939.33	4 150.86
Sardines, trout	Estonia	1 405.7	109 445.49	2 379.25
Sardines	Latvia	0.1	844.18	18.35
	Total	**7 845.9**	**415 695.50**	**9 036.86**

TABLE A2.18
Availability of fish for consumption in Kyrgyzstan

Origin	Quantity (Tonnes)
Fisheries	55.7
Aquaculture	290.6
Import	7 845.9
Total	**8 192.2**

TABLE A2.19
Per capita production and consumption of fish and fish products in Kyrgyzstan

Categories	Avg. 1988–1992	Avg. 1993–2002	Avg. 2003–2009	2006	2007	2008	2009	2010
Per capita production (kg)	0.54	0.10	0.03	0.01	0.06	0.05	0.07	0.08
Per capita consumption (kg)	10.50	1.90	1.30	1.30	1.60	1.60	1.40	1.60

Observation: Per capita consumption was estimated for the period 1988–1992.

Sources: National Statistical Committee of the Kyrgyz Republic (2011); adapted from FAO (2011).

TABLE A2.20
Still-water resources suitable for commercial fisheries in 2010

Name of waterbody	Area (ha)	Million m^3	Fish production (tonnes)	
			2005	2010
Lakes				
Issyk Kul	623 600		-	-
Son-Kul	27 300		1.0	1.0
Kara-Suu	382		-	-
Chatyr-Kul	17 060		-	-
Total of lakes	**668 342**	**-**	**1.0**	**1.0**
Main water reservoirs				
Toktogul	26 500		132.0	-
Orto-Tokoi	2 500	450	1.9	1.5
Kirov	2 800	540	168.0	0.5
Bazar-Korgon	231	20	1.0	-
Niznee Ala-Archa	130		100.0	-
Kurpsay	370		4.5	-
Shamaldysai	240		0.9	-
Other types of water bodies*	-		-	-
Total of reservoirs	**32 771**	**1 010**	**408.3**	**2.0**
Total	**701 113**	**1 010**	**409.3**	**3.0**

* Low-lying land and abandoned waters, which can be converted into fish producing areas.

TABLE A2.21
Fish species produced in the different waters of Kyrgyzstan in 2010

Fish species	Waterbodies (tonnes)			
	Ponds	Lakes	Reservoirs	Total
Silver carp	46.5	-	2.4	**48.9**
Grass carp	3.5	-	-	**3.5**
Common carp	133.0	-	2.0	**135.0**
Rainbow trout	-	155.6	-	**155.6**
Peled	-	1.8	-	**1.8**
Whitefish	-	0.5	1.5	**1.5**
Total	**183.0**	**157.9**	**5.9**	**346.3**

TABLE A2.22
Area and results of fish production systems in 2010

Species	Pond culture		Cage culture		Tank culture	
	Area (ha)	Fish (tonnes)	Volume (m^3)	Fish (tonnes)	Volume (m^3)	Fish (tonnes)
Silver carp	1 860	40	-	-	-	-
Grass carp	1 860	12	-	-	-	-
Common carp	1 860	132	-	-	-	-
Rainbow trout			22 000	153		15
Peled	1					
Whitefish	2					
Total	**1 863**	**184**	**22 000**	**153**	**-**	**15**

TABLE A2.23
Potential fish species suitable for aquaculture

Introduced species	Location
Peled	Ponds
Whitefish	Reservoirs
Rainbow trout	Tanks
Sevan trout	Tanks
Sturgeon	Tanks
Warm water fishes	Tanks

TABLE A2.24
Fish larvae production in the public sector in 2010

Species	Uzgen Fish Farm (pcs.)	Ton Fish Hatchery (pcs.)
Silver carp	100 000	
Grass carp	100 000	
Common carp	300 000	230 000
Sevan trout		886 000
Total	**500 000**	**1 116 000**

TABLE A2.25
Fish larvae production in the private sector in 2010

Species	LTD Karakolbalygy (pcs.)	Price of yearling (KG/kg)	Price of yearling (USD/kg)
Silver carp	5 000 000	180	3.91
Grass carp	5 000 000	180	3.91
Common carp	6 000 000	180	3.91
Whitefish	1 870 000	-	-

TABLE A2.26
Yearly production of selected pond fish farms, 1985–2010

Year	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	
	Tonnes													
Chui Fish Farm	241	274	200	415	390	316	545	326	250	54	67	22	28	
Uzgen Fish Farm	271	411	408	431	497	380	270	200	31	-	6	5	5	
Talas Fish Farm	27	120	132	152	270	274	154	66	74	16	-	-	-	
Year	**1998**	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**
	Tonnes													
Chui Fish Farm	21	29	30	38	32	39	44	40	35	3	-	-	40	-
Uzgen Fish Farm	-	-	0	12	24	19	13	6	13	23	18	35	25	10
Talas Fish Farm	-	-	-	-	-	-	-	11	21	30	45	36	30	21

Note: Fish catches in the Talas fish farm absent owing to the fact that the ponds were idle from 1995 to 2004; since 2005, pond area leased to private entrepreneurs under a contract with the Department of Fisheries..

The present technical paper analyses the available information on historic fish species introductions in the Kyrgyz Republic and investigates and evaluates experiences, lessons learned and its consequences on the biodiversity of inland waters, inland fisheries and aquaculture production. This technical paper also discusses more suitable and improved practices that can be developed in future fish stocking programmes and to support the management of exotic and indigenous species in inland fisheries and aquaculture. The stocking of whitefish in Lake Son-Kul and Chinese major carps in the Toktogul reservoir can be considered successful examples of fish introductions in the Kyrgyz Republic. The largest introductions and the most severe negative consequences took place in Lake Issyk Kul. Here, 13 indigenous species, six of which are endemic species, were supplemented by 16 introduced fish species which overtime led to a drastic change of the relative proportions of native to introduced fish species in favour of the latter causing a decline in the ecosystem service of fisheries, affecting livelihoods of many rural poor. Considering the past experiences and lessons learned, this study also outlines a summary of reasons for the present state of fisheries in the Kyrgyz Republic and recommendations for the sector management including management of fish fauna and fishery including commercial and recreational fisheries and aquaculture and research needs. An updated detailed inventory of the water, fisheries and aquaculture resources in the Kyrgyz Republic, including information on the present state and production capacities of fish farming activities and historic fish introductions by water resource is given. It is also intended to provide a method for similar analyses elsewhere.