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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).

Preparation of this document

The objectives for the design and implementation of FAO projects GCP/GLO/162/EC[1] and GCP/KYR/003/FIN2[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

Contents

Plates

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.

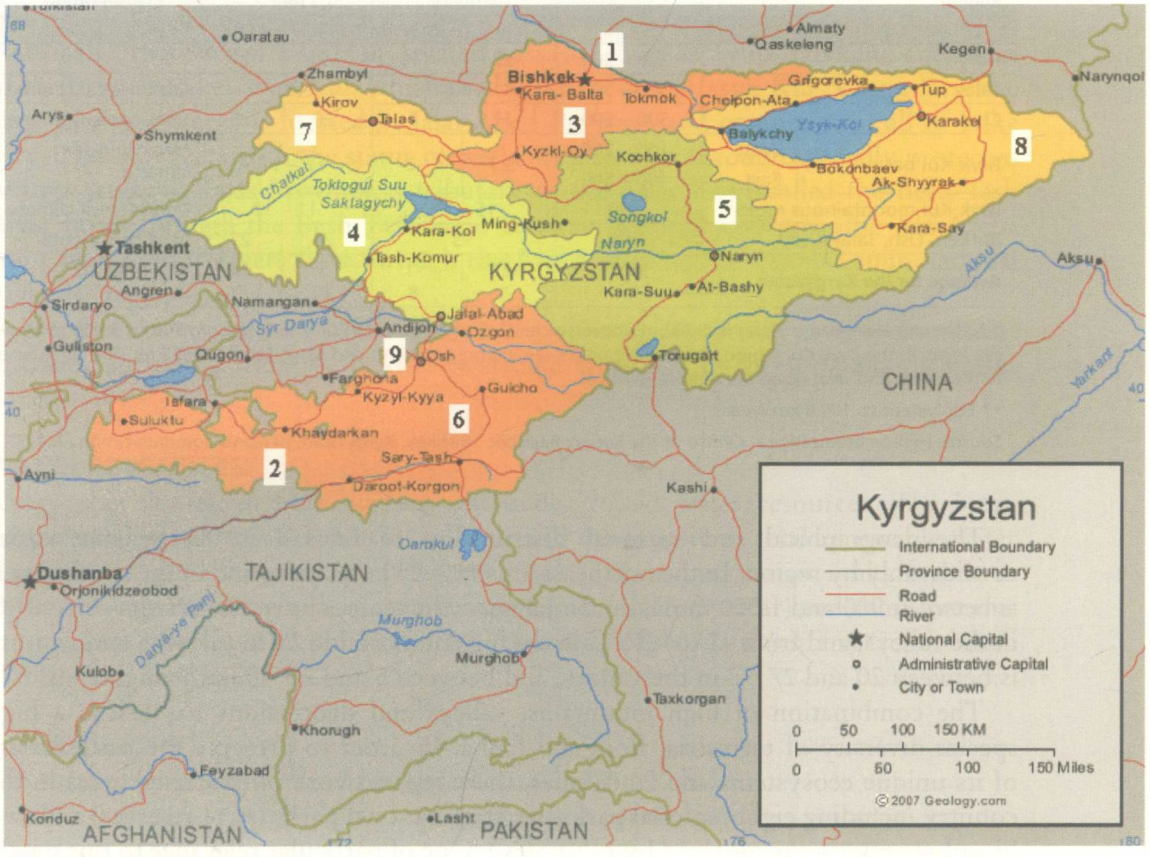
GEOGRAPHY AND CLIMATE

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	%	km²	%
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).