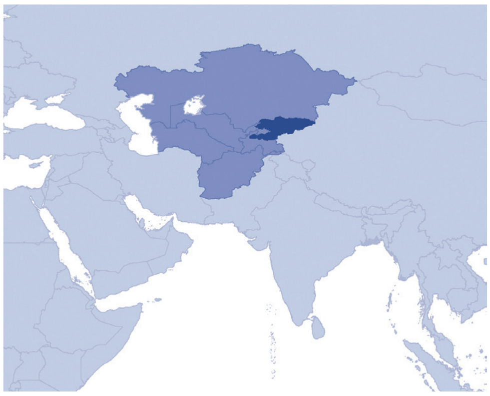
Kyrgyzstan



GEOGRAPHY, CLIMATE AND POPULATION

Geography

Kyrgyzstan is a landlocked country in Central Asia with a total area of 199 949 km^2. It is bordered in the north by Kazakhstan, in the east and southeast by China, in the southwest by Tajikistan and in the west by Uzbekistan. It became independent from the Former Soviet Union in August 1991. The country is divided into seven provinces (*oblasts*), which are Batken, Chu, Djalal-Abad, Issyk-Kul, Naryn, Osh and Talas.

Largely mountainous, the country is dominated by the western reaches of the Tien Shan range in the northeast and the Pamir-Alay in the southwest. The highest mountain is Victory Peak (Tomur Feng, 7 439 m above sea level) at the eastern tip of the country, on the border with China. The mountain stands in the Mustag massif, one of the world's largest glaciers. About 94 percent of the country rises over 1 000 m, and 40 percent at more than 3 000 m above sea level. Much of the mountain region is permanently covered with ice and snow and there are many glaciers, covering about 4 percent of the territory. The Fergana mountain range, running from the northwest across the country to the central-southern border region, separates the eastern and central mountain areas from the Fergana valley in the west and southwest. Other lowland areas include the Chu and Talas valleys near the northern border with Kazakhstan. The world's second largest crater-lake, is Issyk-Kul, in the northeast with a surface area of 6 236 km^2.

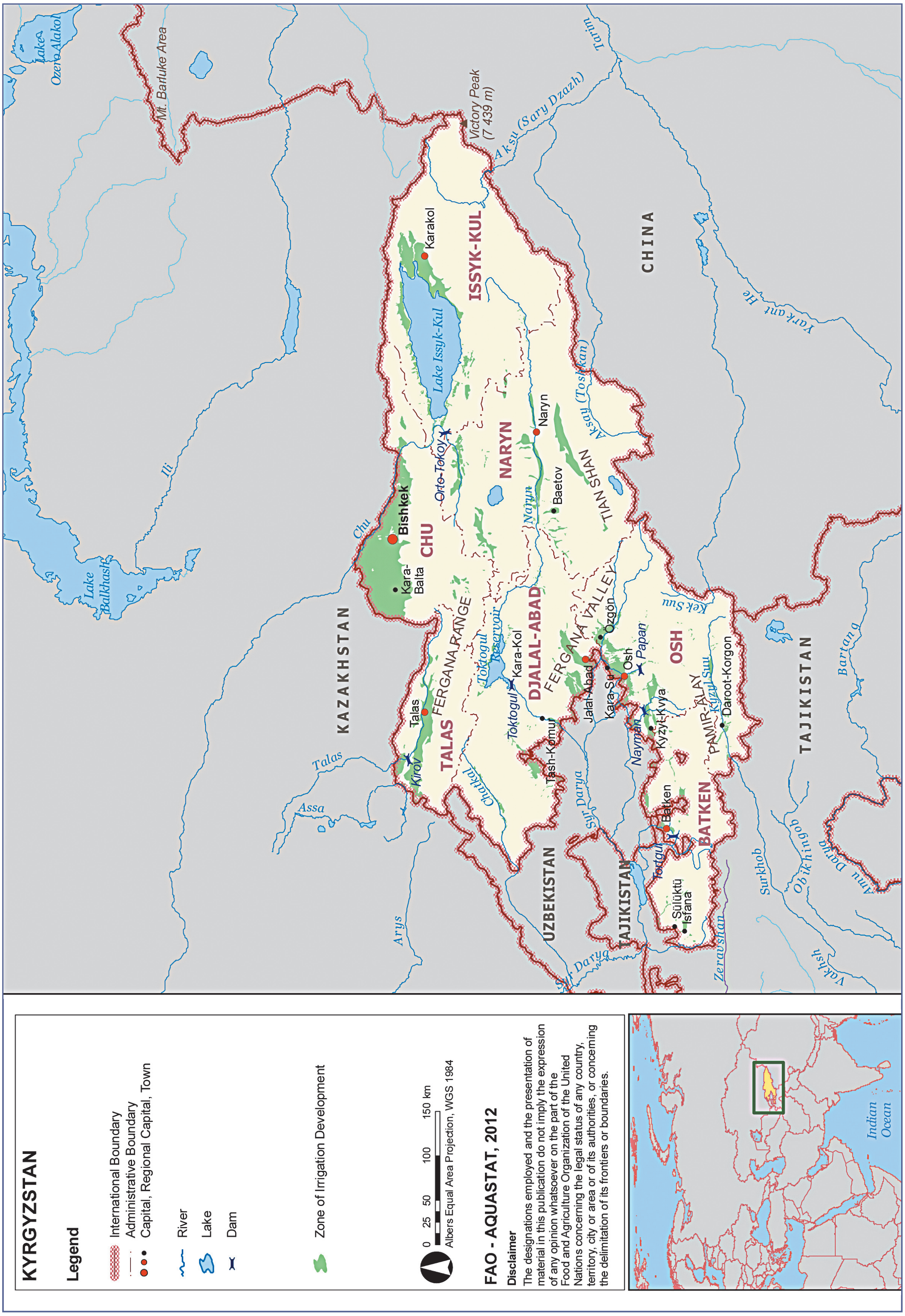
The cultivable area is an estimated 10 670 000 ha, or 53 percent of the total area, including 9 179 000 ha of permanent pasture. In 2009, the cultivated area was 1 351 000 ha, of which 1 276 000 ha temporary crops and 75 000 ha permanent (Table 1). In 1995 and 2000 the cultivated area was an estimated 1 326 000 ha and 1 423 000 ha respectively.

Climate

The climate is continental with hot summers and cold winters, during which frost occurs throughout the country. There is a frost-free period of 185 days per year in the Chu valley, 120–140 days per year in the Naryn valley and 240 days per year in the Fergana valley. Double cropping is therefore limited to a few vegetables. Average temperatures in the valleys vary from minus18 °C in January to 28 °C in July. Absolute temperatures vary from minus 54 °C in winter to 43 °C in summer. Average annual precipitation is an estimated 533 mm, varying from 150 mm on the plains (Fergana valley) to over 1 000 mm in the mountains. Precipitation occurs during the winter, mainly between October and April, when temperatures are low. Rainfed agriculture is therefore limited. Snowfall forms an important part of total precipitation. About 10 percent of the territory, at the lowest altitude, is classed as arid.

Population

The total population is about 5.4 million (2011), of which around 65 percent is rural (Table 1). The annual demographic growth rate was an estimated 0.8 percent during the period 2001–2011.


KYRGYZSTAN
Legend
International Boundary
Administrative Boundary
Capital, Regional Capital, Town
River
Lake
Dam
Zone of Irrigation Development
0 25 50 100 150 km
Albers Equal Area Projection, WGS 1984
FAO - AQUASTAT, 2012
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KAZAKHSTAN
CHINA
TAJIKISTAN
UZBEKISTAN
CHU
TALAS
ISSYK-KUL
NARYN
DJALAL-ABAD
OSH
BATKEN
Bishkek
Kara-Balta
Karakol
Naryn
Baetov
Talas
Kara-Kol
Tash-Kumyr
Jalal-Abad
Osh
Özgön
Kara-Suu
Kyzyl-Kyya
Daroot-Korgon
Batken
Sülüktü
Isfana
Lake Issyk-Kul
Lake Balkhash
Ozero Alakol
Toktogul Reservoir
Orto-Tokoy
Kirov
Papan
Toktogul
Tortgul
FERGANA RANGE
FERGANA VALLEY
TIAN SHAN
PAMIR-ALAY
Victory Peak (7 439 m)
Mt. Barluke Area
Chu
Ili
Talas
Assa
Arys
Naryn
Chatkal
Syr Darya
Naryn
Kek Suu
Kyzyl Suu
Aksay (Toshkan)
Aksu (Sary Dzazh)
Tarim
Yarkant He
Bartang
Surkhob
Obikhingob
Amu Darya
Vakhsh
Zeravshan
Indian Ocean

TABLE 1
Basic statistics and population

Physical areas			
Area of the country	2009	19 994 900	ha
Cultivated area (arable land and area under permanent crops)	2009	1 351 000	ha
• as % of the total area of the country	2009	6.8	%
• arable land (annual crops + temp fallow + temp meadows)	2009	1 276 000	ha
• area under permanent crops	2009	75 000	ha
Population			
Total population	2011	5 393 000	inhabitants
• of which rural	2011	65	%
Population density	2011	27	inhabitants/km^2
Economically active population	2011	2 491 000	inhabitants
• as % of total population	2011	46	%
• female	2011	43	%
• male	2011	57	%
Population economically active in agriculture	2011	507 000	inhabitants
• as % of total economically active population	2011	20	%
• female	2011	29	%
• male	2011	71	%
Economy and development			
Gross Domestic Product (GDP) (current US$)	2010	4 616	million US$/yr
• value added in agriculture (% of GDP)	2010	21	%
• GDP per capita	2010	865	US$/yr
Human Development Index (highest = 1)	2011	0.615	
Access to improved drinking water sources			
Total population	2010	90	%
Urban population	2010	99	%
Rural population	2010	85	%

Population density is 27 inhabitants/km^2. Average population density varies from six inhabitants/km^2 in the eastern mountainous zone to about 70 inhabitants/km^2 in the north.

In 2010, 90 percent of the total population had access to improved water sources (99 and 85 percent in urban and rural areas respectively) and 93 percent had access to improved sanitation (94 and 93 percent in urban and rural areas respectively).

ECONOMY, AGRICULTURE AND FOOD SECURITY

In 2010, the gross domestic product (GDP) was US$4 616 million and agriculture accounted for 21 percent of GDP (Table 1), while in 2000 it accounted for 37 percent. In 2011, the total economically active population was 2.49 million or just over 46 percent of the total population. The population economically active in agriculture is an estimated 507 000, or 20 percent of the total economically active population, while in 1996 it accounted for 30 percent. Of the total population economically active in agriculture 29 percent are female.

Agriculture is a significant part of the Kyrgyzstan's economy. There are 301 935 farms, grouped into six different categories (Table 2).

For most food products, actual consumption is far more than that produced. If no immediate measures are taken the gap between actual production and consumption may increase substantially.

TABLE 2
Number of farms by type (2005)

Type of farm	Number
State	111
Joint-stock company	51
Joint peasant economies	147
Agricultural cooperatives	926
Additional economies of state organizations and enterprises	538
Peasant farms	300 169
Total	**301 935**

WATER RESOURCES AND USE

Water resources

Water resources are formed by perennial and ephemeral rivers, brooks and springs, freshwater and brackish lakes, including the world's second largest high-mountain lake Issyk-Kul.

Kyrgyzstan may be divided into two hydrological zones: (i) the flow generation zone (mountains), covering 171 800 km^2, or 87 percent of the territory, (ii) the flow dissipation zone of 26 700 km^2, which is 13 percent of the territory. Most rivers are fed by glaciers and/or snow melt. Peak flows occur from April to July, with 80–90 percent of the flow in about 120–180 days extending into August or September.

There are six main river basin groups (Table 3). No rivers flow into Kyrgyzstan. The river basins, listing the largest first and progressing to the smallest area are:

1. Syr Darya river basin covers 55.3 percent of the country. In Kyrgyzstan the river is called the Naryn river before it reaches the Fergana valley. It then flows into Uzbekistan as the Syr Darya river, then into Tajikistan and then again into Uzbekistan where it receives the Chatkal river, a tributary that also rises in Kyrgyzstan. It then flows towards Kazakhstan.
2. Chu, Talas and Assa river basins, cover 21.1 percent of the country: All three rivers flow to Kazakhstan, where the portion that is not withdrawn is lost in the desert.
3. Southeastern river basins cover 12.9 percent of the country: These are different river basins that drain into the Tarim basin, China. The main rivers are the Aksu (Sary Dzhaz), Aksay (Toshkan) and Kek Suu, and are located at high elevations.
4. Lake Issyk-Kul internal and interior basin, cover 6.5 percent of the country: The lake has low salinity. The estimated flow from all rivers into the Issyk-Kul lake basin that does not evaporate is used for irrigation or municipalities. The lake and the surrounding rivers that drain into the lake are all within Kyrgyzstan.
5. Amu Darya river basin covers 3.9 percent of the country: The Amu Darya river rises mainly in Tajikistan, but receives a contribution from the Kyzyl Suu tributary, which originates in the southwest of Kyrgyzstan.
6. Lake Balkhash basin covers 0.3 percent of the country: The Karkyra river, which rises in Kyrgyzstan is a small tributary of the Ili river and flows to lake Balkhash in Kazakhstan.

The average natural surface water flow is an estimated 46.46 km^3/year, all internally produced. The inflow from China from the rivers on the west slope of the Barluke mountain is an estimated 0.558 km^3/year. The Union of Soviet Socialist Republics (USSR) allocated a portion of these water resources to the Kirghiz Soviet Socialist Republic, with the rest going to the neighbouring Kazakh, Uzbek and Tajik Soviet Socialist Republics. This rule only referred to water flows within the USSR (36.09 km^3/year) and did not concern resources generated in the southeastern basins (5.36 km^3/year), since they flow towards China, lake Issyk-Kul basin

TABLE 3
Renewable surface water resources (RSWR) by major river basin

River basin	Region	Part of territory (%)	Internal RSWR (km^3/year)	Outflow to	Outflow secured through agreements (km^3/year)	Actual RSWR (km^3/year)
Syr Darya (Naryn, Chatkal)	West	55.3	27.42	Uzbekistan and Tajikistan	22.33	5.09
Chu, Talas and Assa	North	21.1	6.74	Kazakhstan	2.03	4.71
Southeastern (Tarim* basin)	Southeast	12.9	5.36	China	-	5.36
Rivers of the Lake Issyk-Kul **	Northeast	6.5	4.65	Endorheic and internal basin	-	4.65
Amu Darya (Kyzyl Suu)	Southwest	3.9	1.93	Tajikistan	1.51	0.42
Karkyra (Lake Balkhash*** basin)	Northeast	0.3	0.36	Kazakhstan	-	0.36
Inflow from west slopes of Barluke mountain						0.558
Total		**100**	**46.46**		**25.87**	**21.148**

* Tarim river is located in China
** This is an endorheic basin and all rivers flowing into it originate in the country, therefore outflow does not include this basin
*** Lake Balkhash is located in Kazakhstan

(4.65 km^3/year), which is an endorheic basin located entirely in Kyrgyzstan, and the very limited resources generated in the Balkhash lake basin (0.36 km^3/year). This allocation was re-endorsed by the five new states of Central Asia, until the Interstate Commission for Water Coordination can propose a new strategy for water sharing in the Aral Sea basin. Surface water resources allocated to Kyrgyzstan are calculated every year, depending on existing flows. On average, however, surface water represents a volume of 10.22 km^3/year out of the total 36.09 km^3/year. Adding the 5.36 km^3/year of the southeastern basin, the 4.65 km^3/year for lake Issyk-Kul basin and the 0.36 km^3/year of lake Balkhash basin area, and the inflow of the west slopes of Barluke mountain (0.558 km^3/year), gives a total of 21.148 km^3/year of actual renewable surface water resources (RSWR) (Table 3).

Annual renewable groundwater resources are an estimated 13.69 km^3/year, of which about 11.22 km^3/year is common to surface water resources (Table 4). In 1991, the groundwater resources, for which abstraction equipment existed, was an estimated 3.39 km^3/year, mainly in the Chu river basin (2.02 km^3/year), the Syr Darya river basin (0.73 km^3/year) and the lake Issyk-Kul basin (0.52 km^3/year).

Total internal renewable water resources are thus equal to 48.93 km^3/year (Table 4) and total actual renewable water resources equal to 23.62 km^3/year (Table 5), which is equal to actual renewable surface water resources (21.15) plus groundwater resources (13.69) minus the overlap between surface water and groundwater (11.22) (Table 3 and Table 4).

In 2005, produced and treated wastewater accounted for 144 and 142 million m^3 respectively.

In 1994, 1 720 million m^3/year of agricultural drainage water was collected in the collector-drainage canals, and about 380 million m^3/year of municipal and industrial untreated wastewater, for a total of 2 100 million m^3/year, of which 30 percent in the Chu river basin and 70 percent in the Syr Darya river basin. Of this total, about 1 800 million m^3/year returned to the rivers (300 million m^3/year in the Chu river and 1 500 million m^3/year in the Syr Darya river), which could be reused by downstream countries. Of the remaining 300 million m^3/year, direct use of treated wastewater accounted for 0.14 million m^3, while 299.86 million m^3/year was directly used for irrigation, after natural desalting treatment (phytomelioration).

TABLE 4
Internal renewable surface water resources (IRSWR) and internal renewable groundwater resources (IRGWR) by river basin (km^3/year)

River basin	IRSWR	IRGWR	Overlap	Total IRWR
Syr Darya	27.42	5.25	4.70	27.97
Southeastern (Tarim * basin)	5.36	1.76	1.76	5.36
Chu	5.00	3.60	2.56	6.04
Rivers of the Lake Issyk-Kul	4.65	2.02	1.61	5.06
Amu Darya	1.93	0.23	0.23	1.93
Talas and Assa	1.74	0.83	0.36	2.21
Karkyra (Lake Balkhash ** basin)	0.36	-	-	0.36
Total	**46.46**	**13.69**	**11.22**	**48.93**

* Tarim river is located in China
** Lake Balkhash is located in Kazakhstan

TABLE 5
Water: sources and use

Renewable freshwater resources			
Precipitation (long-term average)	-	533	mm/yr
	-	106 573	million m^3/yr
Internal renewable water resources (long-term average)	-	48 930	million m^3/yr
Total actual renewable water resources	-	23 618	million m^3/yr
Dependency ratio	-	1	%
Total actual renewable water resources per inhabitant	2011	4 379	m^3/yr
Total dam capacity	1995	23 500	million m^3
Water withdrawal			
Total water withdrawal by sector	2006	8 007	million m^3/yr
- agriculture	2006	7 447	million m^3/yr
- municipalities	2006	224	million m^3/yr
- industry	2006	336	million m3/yr
• per inhabitant	2006	1 575	m^3/yr
Surface water and groundwater withdrawal (primary and secondary)	2006	7 707	million m^3/yr
• as % of total actual renewable water resources	2006	33	%
Non-conventional sources of water			
Produced municipal wastewater	2005	144	million m^3/yr
Treated municipal wastewater	2005	142	million m^3/yr
Direct use of treated municipal wastewater	1994	0.14	million m^3/yr
Desalinated water produced		-	million m^3/yr
Direct use of agricultural drainage water	1994	299.86	million m^3/yr

Water in most rivers comes from glaciers and snow, and low and unreliable flows are often the rule in August and September, in the latter part of the growing season. Regulation of these flows is required to ensure adequate water supplies are available over the entire cropping period.

In 1995, total dam capacity was an estimated 23 500 million m^3. There were nine reservoirs in the Syr Darya river basin with a total capacity of 22 300 million m^3, six in the Chu river basin with a total capacity of 600 million m^3, and three in the Talas river basin with a total capacity of 600 million m^3. The Toktogul dam, with a reservoir capacity of 19 500 million m^3, is on the Naryn (Syr Darya) river. This multipurpose dam is used for irrigation, hydropower

production, flood protection and regulation. However, because of its location near the border with downstream Uzbekistan, it does not play an important role in the irrigation of areas within Kyrgyzstan. The same applies to the Kirov dam, which has a capacity of 550 million m^3 and is located on the Talas river near the border with downstream Kazakhstan. Twelve of the reservoirs are only used for irrigation, each of which has a capacity of more than 10 million m^3 (Table 6).

In 1985, gross theoretical hydropower potential was an estimated 162 500 GWh/year, and the economically feasible potential an estimated 55 000 GWh/year. Hydropower installed capacity is about 3 GW, a number of hydropower plants are part of the Naryn-Syr Darya cascade, controlled by the Toktogul dam. Hydropower plays a key role in Kyrgyzstan and is the country's main source of energy (about 90 percent of electricity generation in 1995), given its limited gas, oil and coal resources. However, hydropower production mainly releases water in winter, while downstream countries need water for the summer cropping season. At the regional level, competition between irrigation and hydropower appears to be a major issue. An agreement was reached with Uzbekistan and Kazakhstan in 1996. These two countries transfer energy, coal or gas to Kyrgyzstan in the period of power deficit, to compensate Kyrgyzstan for not releasing water for hydropower in winter.

International water issues

During the Soviet period, the sharing of water resources among the five Central Asian republics was based on the master plans for development of water resources in the Amu Darya (1987) and Syr Darya (1984) river basins.

The USSR allocated only part of the transboundary surface water flow of 36.09 km^3/year internally produced in the Kirghiz Soviet Socialist Republic to the Republic itself, the rest being allocated to the neighbouring states of Kazakh, Uzbek and Tajik Soviet Socialist Republics. This rule did not concern the resources generated in the southeastern basins (5.36 km^3/year), since they flow towards China, lake Issyk-Kul basin (4.65 km^3/year), which is an endorheic basin located entirely in Kyrgyzstan, and the very limited resources generated in the lake Balkhash basin (0.36 km^3/year).

In 1992, with the establishment of The Interstate Commission for Water Coordination (ICWC), the newly independent republics decided, with the Agreement of 18 February 1992, to prepare a regional water strategy and continue to respect existing principles until the proposal and adoption of a new ICWC water-sharing agreement. The new agreement was confirmed

TABLE 6
List of irrigation dams and their characteristics

Nr	Reservoir	Oblast	Date of completion	Volume (million m^3)	Height (m)	Irrigation area (ha)
1	Tortgul	Batken	1971	90	34	11 500
2	Stepninskoe	Chu	1935	0.8	3.5	1 880
3	Ala-Archa, off-channel	Chu	1966	51	24.5	17 500
4	Sokuluk	Chu	1968	11.5	28	4 000
5	Spartak	Chu	1978	23	15	3 000
6	Ala-Archa, in-channel basin	Chu	1986	90	35	20 000
7	Bazar-Kurgan	Djalal-Abad	1962	30	25	18 000
8	Orto-Tokoy	Naryn	1956	470	52	220 000
9	Nayman	Osh	1966	40	41	6 000
10	Papan	Osh	1981	260	120	45 000
11	Kirov	Talas	1975	550	86	142 000
12	Kara-Bura	Talas	Incomplete	27	58	7 915

as the 'Agreement on joint actions to address the problem of the Aral Sea and socio-economic development of the Aral Sea basin', which was signed by the Heads of the five states in 1996. The main achievement of the ICWC over the years has been the conflict-free supply of water to all water users, despite the complexities and variations of dry and wet years.

In 1993, with the development of the Aral Sea basin programme, two new organizations emerged: the Interstate Council for the Aral Sea (ICAS) to coordinate implementation of the programme and the International Fund for Saving the Aral Sea (IFAS) to raise and manage its funds. In 1997, the two organizations merged to create the IFAS (UNDP, 2004).

The most acute disagreement in the Syr Darya basin relates to the operation of the Toktogul reservoir in Kyrgyzstan, which leads to a conflict of interests between Kyrgyzstan, Uzbekistan and Kazakhstan. The two downstream countries are interested in maintaining storage in the Toktogul reservoir for summertime irrigation, whereas winter energy generation from the reservoir is beneficial to Kyrgyzstan (UNDP, 2004).

In 1998, an agreement was reached between Kazakhstan, Kyrgyzstan and Uzbekistan for the use of water and energy resources in the Syr Darya basin.

IFAS is under the authority of the deputy prime ministers of the Central Asian states, but excludes Afghanistan. The organization's task is to administer the Aral Sea Basin Programme, or more specifically, to prepare a general strategy for water distribution, rational water use, and protection of water resources in the Aral Sea Basin (SIWI, 2010).

In 2000 Kyrgyzstan and Kazakhstan signed an agreement regarding shared water resources of the Chu and Talas rivers. The parties agreed to share operational and maintenance (O&M) costs regarding transboundary infrastructure in proportion to received water amounts. The agreement is regarded a success and has been described as the 'way forward' for Central Asian water politics (SIWI, 2010).

In 2002, the Central Asian and Caucasus countries formed the CACENA Regional Water Partnership under the Global Water Partnership (GWP). Within this framework state departments; local, regional and professional organizations; scientific and research institutes; and the private sector and NGOs cooperate in the establishment of a common understanding concerning the critical issues threatening water security in the region (SIWI, 2010).

The partnership between the European Union Water Initiative (EUWI) and its Eastern Europe, Caucasus and Central Asia (EECCA) programme seeks to improve management of water resources in the EECCA region. This partnership was established at the World Summit for Sustainable Development in 2002. A significant component is 'Integrated water resources management, including transboundary river basin management and regional seas issues' (SIWI, 2010).

In 2004, experts from Kazakhstan, Kyrgyzstan, Tajikistan and Uzbekistan produced a regional water and energy strategy within the framework of the United Nations Special Programme for the Economies of Central Asia (UN-SPECA). In collaboration with EUWI and the United Nations Economic Commission for Europe (UNECE) is developing integrated water resources management in the Central Asian States. In cooperation with Germany and other countries of the European Union (EU), UNECE may play a role implementing the EU Strategy for Central Asia in the water and energy sectors (SIWI, 2010).

Tensions exist between Kyrgyzstan and Uzbekistan in the Fergana valley. The Andijan reservoir, lying in a border area and currently leased to Uzbekistan, increases tensions. Kyrgyzstan claims that it does not receive any compensation for the lease, while Uzbekistan has been reluctant to enter into negotiations (SIWI, 2010).

Water use

In 2006, water withdrawal was an estimated 8 007 million m^3, of which about 93 percent was withdrawn by agriculture, 3 percent by municipalities and 4 percent by industry (Table 5 and Figure 1). Primary and secondary surface water and groundwater account for 92.4 percent and 3.8 percent respectively of total water withdrawal. Direct use of irrigation drainage water represents 3.7 percent and direct use of treated wastewater 0.002 percent (Figure 2). In 1994, water withdrawal was an estimated 10 100 million m^3. In some basins (Syr Darya, Chu, Talas) there was a fairly severe water shortage, while in others (Amu Darya, Issyk-Kul, southeastern) there was a surplus. About 90 percent of all drinking water supplied by centralized systems is provided by groundwater.

Reduced water withdrawal from 1994 to 2006 may be explained by:

- reduced canal capacity because of lack of means for cleaning;
- acute recession in industrial production;
- insufficient means of peasant farmers who are unable to cultivate their irrigated land;
- incentive to use irrigation water economically with the introduction of payment for water use;
- changes in crops from cotton, sugar beet, tobacco, maize, grasses to those having a shorter vegetative period (grain crops).

FIGURE 1
Water withdrawal by sector
Total 8 007 million m^3 in 2006

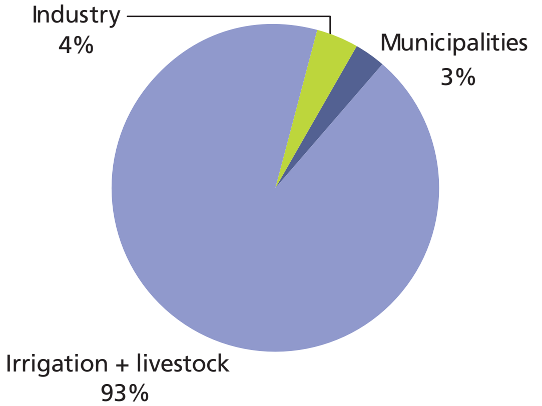
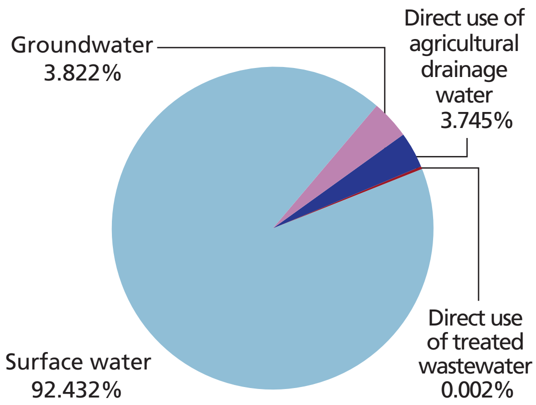


FIGURE 2
Water withdrawal by source
Total 8 007 km^3 in 2006



IRRIGATION AND DRAINAGE DEVELOPMENT

Evolution of irrigation development

Irrigation is of key importance to the agricultural sector. Irrigation potential is about 2.25 million ha. Compared with 0.43 million ha in 1943, irrigation covered an estimated 1 077 000 ha in 1994, developed mainly in the Syr Darya river basin (42 percent), the Talas and Chu river basins (41 percent), and around lake Issyk-Kul. In 2005, the area equipped for full control irrigation was an estimated 1 021 400 ha, three-quarters of the cultivated area. Irrigated area was reduced between 1994 and 2005 because most irrigation schemes constructed during the Soviet period, have become rainfed because of the high price of electricity and spare parts for irrigation equipment.

The main irrigation technique is surface irrigation (Figure 3). In 1990, sprinkler irrigation was practised on 141 000 ha and 12 ha of localized irrigation. Because of the lack of spare parts (all equipment was produced in the Russian Federation of the former Soviet Union, and because of the substantial increase in energy costs, sprinkler irrigation decreased during the 1990s. About 37 000 ha were in use in 1994, only 400 ha in 2005.

In 1994, water was mainly supplied from diverted rivers (80 percent). Only 13 percent relied on reservoir water, 6 percent on pumping from rivers and 1 percent on groundwater (Figure 4). The

FIGURE 3
Irrigation techniques on area equipped for full control irrigation
Total 1 021 400 ha in 2005

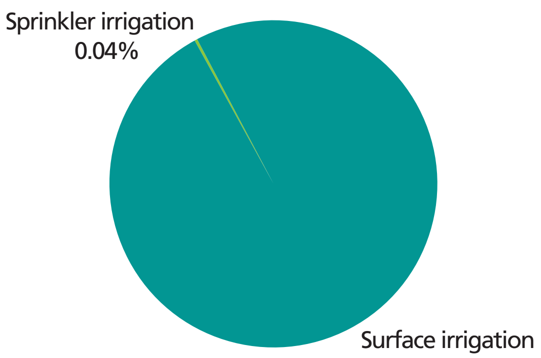
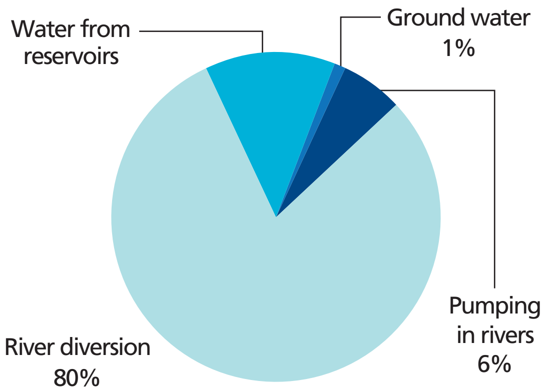


FIGURE 4
Source of irrigation water on area equipped for full control irrigation
Total 1 077 500 ha in 1994



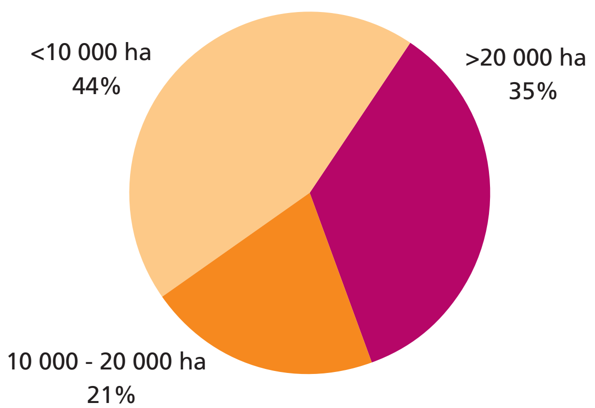
irrigation network comprises 12 835 km of canals, of which 82 percent are earthen, 17 percent concrete and 1 percent are pipes.

Irrigation schemes are subdivided according to their technical characteristics:

- Engineering irrigation schemes represent 40.2 percent of the area. They have water-inlet structures on rivers, which provide silt protection, are available for flash flood water flow and provide guaranteed off-take from irrigation sources. The canals are lined.
- Semi-engineering schemes have water-inlet structures, but canals are only partly lined and partly equipped with water distribution structures. The area served by such schemes represents 34.4 percent.
- Non-engineering schemes have no water-inlet structures; canals are not equipped with water distribution structures and are not lined. The area served by such schemes accounts for 25.4 percent.

In 1990, there were 1 346 irrigation schemes. Large schemes (>5 000 ha), mainly *kolkhoz* or *sovkhoz*, represented 60 percent of the irrigated area, medium schemes (1 000–5 000 ha) 21 percent, and small schemes (< 1 000 ha) 19 percent (Figure 5 and Table 7).

FIGURE 5
Type of full control irrigation schemes
Total 967 000 ha in 2002



The inter-farm irrigation network is generally well maintained, particularly the main canals downstream of the large storage dams. The distribution network within the *kolkhoz* and *sovkhoz* is generally poorly designed, built and maintained. Seepage and leakage losses in the distribution system are considerable, resulting in an estimated conveyance/distribution efficiency of 55 percent.

Role of irrigation in agricultural production, economy and society

In 2005, the harvested irrigated area was 1 021 400 ha. Temporary crops represent 82.3 percent of total harvested irrigated area.

Main irrigated crops are wheat (35.3 percent), temporary and permanent fodder (10.7 percent), barley (8.5 percent) and potatoes (7.4 percent) (Table 7 and Figure 6). Permanent meadows and pastures account for 106 900 ha. Although the yields for irrigated land are generally low by world standards, they are about two to five times higher than yields on non-irrigated areas. In 1997, the average yields for wheat, barley and rye were 2.2, 2.2 and 1.9 tonne/ha respectively on irrigated land and 1.1, 0.9 and 1 tonne/ha respectively on rainfed land.

In 1995, the average cost of surface irrigation development was US$5 800/ha, US$8 500/ha and US$11 600/ha for small, medium and large schemes respectively. The respective cost of sprinkler irrigation was US$6 900/ha, 10 400/ha and 14 200/ha. However, these costs varied substantially depending on physiographic conditions. In general, costs were lower in the Chu valley and the Issyk-Kul basin and higher in the Syr Darya valley, which is more mountainous. Rehabilitation costs varied between US$2 400/ha and 5 000/ha.

Status and evolution of drainage systems

It is estimated that 750 000 ha of irrigated land would need drainage. In 2000 only 144 910 ha were equipped for drainage, and 3 000 ha represented un-irrigated cultivated, drained area (Table 7). In 1994 surface and subsurface drainage accounted for 56 and 44 percent respectively. Mainly subsurface drainage was developed on newly reclaimed areas in the north and southwest. With the very restricted budget of the Ministry of Agriculture, Water Resources and Process Industry, it is unlikely that the government will be able to maintain, and effectively operate the existing drainage system or to undertake any improvement or extension. For this reason, salinity and drainage problems will most likely worsen.

The inter-farming collector and drainage network is about 646 km, out of which 619 km is surface and 27 km subsurface drainage, and 158 km is in unsatisfactory condition. The on-farm

FIGURE 6
Irrigated crops on area equipped for full control irrigation
Total harvested area 1 021 400 ha in 2005 (cropping intensity on actually irrigated area: 100%)

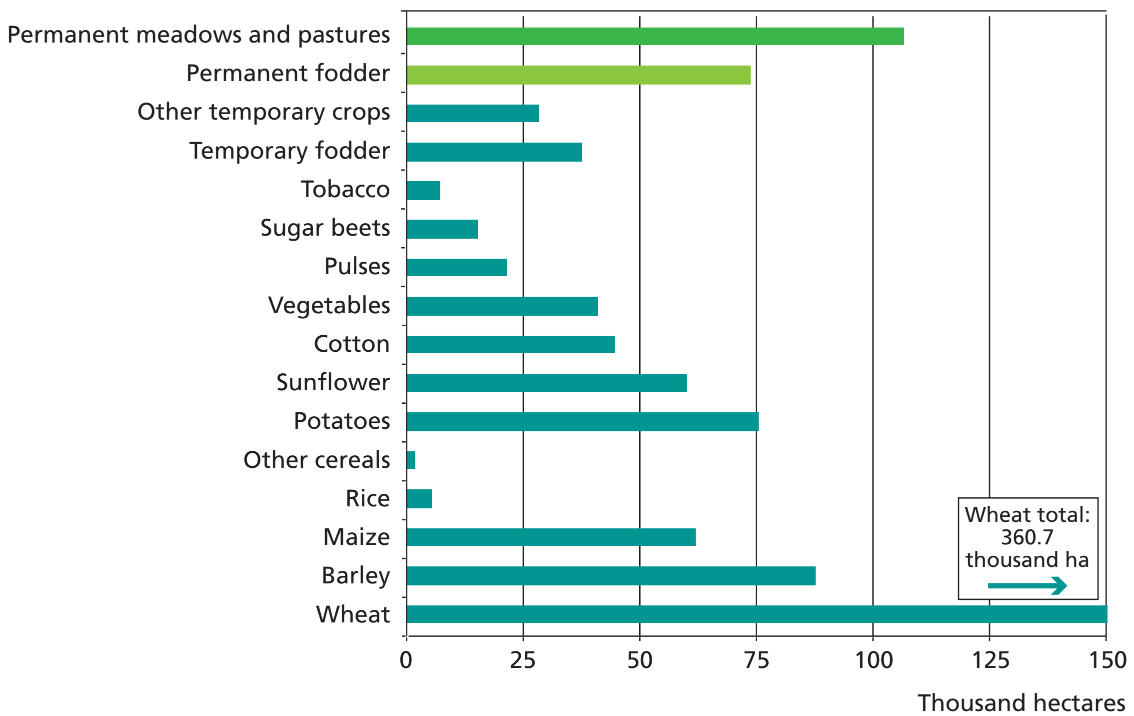


TABLE 7
Irrigation and drainage

Irrigation potential			2 247 000	ha
Irrigation				
1. Full control irrigation: equipped area		2005	1 021 400	ha
- surface irrigation		2005	1 021 000	ha
- sprinkler irrigation		2005	400	ha
- localized irrigation		2005	0	ha
• % of area irrigated from surface water		1994	99	%
• % of area irrigated from groundwater		1994	1	%
• % of area irrigated from mixed surface water and groundwater			-	%
• % of area irrigated from mixed non-conventional sources of water			-	%
• area equipped for full control irrigation actually irrigated		2005	1 021 400	ha
- as % of full control area equipped		2005	100	%
2. Equipped lowlands (wetland, ivb, flood plains, mangroves)			-	ha
3. Spate irrigation			-	ha
Total area equipped for irrigation (1+2+3)		**2005**	**1 021 400**	**ha**
• as % of cultivated area		2005	75.3	%
• % of total area equipped for irrigation actually irrigated		2005	100	%
• average increase per year over the last 11 years		1994 -2005	-0.5	%
• power irrigated area as % of total area equipped			5.2	%
4. Non-equipped cultivated wetlands and inland valley bottoms			-	ha
5. Non-equipped flood recession cropping area			-	ha
Total water-managed area (1+2+3+4+5)		**2005**	**1 021 400**	**ha**
• as % of cultivated area		2005	75.3	%
Full control irrigation schemes	**Criteria**			
Small-scale schemes	< 1 000 ha	1990	204 500	ha
Medium-scale schemes	> 1 000 ha and < 5 000 ha	1990	229 400	ha
Large-scale schemes	> 5 000 ha	1990	643 200	ha
Total number of households in irrigation		1990	705 825	
Irrigated crops in full control irrigation schemes				
Total irrigated grain production			-	metric tons
• as % of total grain production			-	%
Harvested crops				
Total harvested irrigated cropped area		2005	1 021 400	ha
• Temporary crops: total		2005	841 100	ha
- Wheat		2005	360 700	ha
- Barley		2005	86 600	ha
- Maize		2005	61 500	ha
- Rice		2005	5 000	ha
- Millet		2005	80	ha
- Sorghum		2005	4	ha
- Other cereals		2005	1 516	ha
- Potatoes		2005	76 000	ha
- Sugar beet		2005	14 500	ha
- Pulses		2005	20 800	ha
- Vegetables		2005	40 600	ha
- Tobacco		2005	5 600	ha
- Cotton		2005	45 500	ha
- Sunflower		2005	59 200	ha
- Fodder (temporary)		2005	35 800	ha
- Other temporary crops		2005	27 700	ha
• Permanent crops: total		2005	73 400	ha
- Fodder (permanent)		2005	73 400	ha
• Permanent meadows and pastures		2005	106 900	ha
Irrigated cropping intensity (on full control area equipped)		2005	100	%
Drainage - Environment				
Total drained area		2000	147 910	ha
- part of the area equipped for irrigation drained		2000	144 910	ha
- other drained area (cultivated non-irrigated)		2005	3 000	ha
• drained area as % of cultivated area		2000	10.4	%
Flood-protected areas			-	ha
Area salinized by irrigation		2005	49 503	ha
Population affected by water-related diseases		2005	122 800	inhabitants

drainage network is about 4 893 km, which is managed by rural local governance, water user associations, peasant farms and others. About 1 936 km is in unsatisfactory condition, of which 1 112 km is surface and 824 km is subsurface drainage (Table 8).

In 2005, land reclamation was carried out to improve conditions on irrigated land, with the financial support of the Water Resources Department, the state register and regional budgets. This resulted in the cleaning of 127 km surface drainage and the washing out of 39 km of subsurface drainage networks. Furthermore, 55 hydraulic engineering constructions, 133 hydro stations, 920 observation wells and five vertical drainage systems were repaired, and 3.3 km of surface drainage network was cut along collectors to address flash flooding.

WATER MANAGEMENT, POLICIES AND LEGISLATION RELATED TO WATER USE IN AGRICULTURE

Institutions

The following institutions are responsible for water resources management:

The National Parliament, Jogorku Kenesh, is responsible for: water regulation legislation, exercising state ownership rights for water resources, developing the water code and water-protection legislation, developing a state policy on the use and protection of the water fund, legislative regulation of paid water use, international contracts and agreements for water problems.

The government is responsible for: state water-economic programmes and their investment, coordination of activities between institutions and scientific-research, adoption of basic rates of payments for water use, regulation of water use and water protection, external affairs concerning water relations and water pollution.

Until 2010, the basic water management functions were concentrated in three administrative bodies: the Ministry of Agriculture, Water Resources and Process Industry (MAWR&PI), the Emergency Ministry (EM) and the Agency for Geology and Mineral Resources.

MAWR&PI was the central state body for water management with the following functions: regulation of the use of the water fund; management of state-owned hydro-economic capital assets; meeting the water requirements of the population and agricultural producers; development of irrigation infrastructure; conducting state accounting of water use; administrating the state water cadastre on water use section and control of state water use. The national-level Water Resources

TABLE 8
Technical condition of collector and drainage systems (2005)

Oblast	Availability of drainage network (km)		Availability of on-farm drainage network (km)	
	Total	Unsatisfactory condition	Total	Unsatisfactory condition
Batken	22.8	12.1	268.2	88.3
Djalal-Abad			254.57	73.7
Issyk-Kul	23.88	16.46	206.262	169.87
Naryn			120.24	69.84
Osh	19.2	12.1	354.7	242.13
Talas	4	-	270.44	134.5
Chu	575.6	125.1	3 418.3	1 201.1
Total	**646.45**	**158.36**	**4 892.7**	**1 938.28**

Department (WRD) of MAWR&PI was the basic state executing body for management of water resources for irrigation. Each *oblast* has a basin water resources department (BWRD); each *rayon* (second order administrative division) has a *rayon* water resources department (RWRD). In 2010, the State Committee on Water and Land Reclamation was established and entrusted with water resources management, state irrigation and land reclamation.

The Emergency Ministry is responsible for prevention of accidents and natural disasters; management of water protection; legislation of environmental protection, including water fund protection; control of sewerage disposal in water bodies, sewage treatment norms and sewage use; state water cadastre on 'surface waters' and 'water quality' sections; and monitoring of surface water bodies.

The Agency for Geology and Mineral Resources carries out the following functions: state accounting of groundwater storage; monitoring of groundwater deposits; licenses for groundwater use and the protection of groundwater.

Oblasts and *rayon* water resources departments are the lowest-level territorial government agencies for water management implemented by WRD. They carry out the state policy for O&M of water bodies, and regulate distribution and use of water resources, water supply to agricultural water users, water use control.

The State Water Inspection, established in 1999, is responsible for monitoring the use of water bodies, water facilities and irrigation infrastructure. It supervises the observance of legislative and statutory acts on the use of the state water fund; prevents infringement of use of water resources; conducts the state inventory on use of water resources; and promotes the rational use of irrigation water and irrigated land to prevent desertification, soil erosion, salinization and waterlogging.

Local state administration bodies (municipal bodies) participate in the management of the water fund. They are responsible for protection of the rights of water users and the allotment of land for the water fund.

Water management

Kyrgyzstan has sufficient quantities of water of excellent quality for municipal and industrial use for the foreseeable future. Because of commitments to downstream countries, water availability may become a constraint to expanding irrigation, extending land reclamation, and improving the productivity of irrigated areas, unless water use efficiency is significantly improved, and a major effort made to conserve water.

Currently, a multistage branch management system for water resources is used in Kyrgyzstan, meaning that functions and responsibilities are distributed between the various ministries and departments. These are the National Parliament, the Government, MAWR&PI (with the specialized WRD), EM, the Agency of Geology and Mineral Resources, other water use ministries and departments, local governance bodies, unions and water user associations (WUA).

The WUAs carry out the following functions with voluntary cooperation:

- operation of irrigation, water supply and drainage networks, waste network and ponds, reservoirs, pumping stations, sprinkler machines, water-outlets and other hydraulic engineering constructions and devices;
- water distribution among WUA members according to license conditions;
- construction, modernization, repair, cleaning and other actions to support the proper condition for WUAs' irrigation network and its development;
- prevention of water pollution;
- organization to improve the professional skills of members for irrigated agriculture.

The following projects are being completed, or have already been completed, to improve the quality of water supply and water distribution:

- Irrigation schemes rehabilitation project (World Bank credit), 1998–2006: 31 water-economy entities have been rehabilitated, including 27 linear irrigation schemes and four reservoirs have been constructed. Rehabilitation covers an irrigation area of 120 400 ha. The total project cost: US$43.8 million.
- Water management improvement project, started in 2006, assisted rehabilitation of 20 irrigation schemes with 84 000 ha abolished irrigated land. Total project cost: US$28 million.

The following investment projects have been prepared:

- Irrigation scheme rehabilitation project, Phase II, 2007–2012: Primary activity is restoration of design parameters, modernization of inter-economic irrigation schemes and dam safety on an irrigated area of about 106 222 ha. Estimated cost US$46 million. An additional US$3 million is reserved for organizational aspects.
- New land development project, Phase I, 2007–2010: Primary activity is the restoration of design parameters, modernization of inter-economic irrigation schemes and dam safety on an irrigated area of about 28 000 ha. Estimated cost US$55 million.

In 2007 the MAWR&PI published the Agricultural Development Strategy in collaboration with numerous government agencies, donors, private sector organizations and civil society representatives. The three-year process was facilitated and funded by the Asian Development Bank (ADB) at a cost of US$600 000. Since there is limited scope for expansion of the agricultural area, the principal source of growth must be through increasing agricultural productivity. The strategy focuses on ensuring continuous flows of knowledge and innovations to private production entities and government administration agencies.

In 2010, a new Agricultural Development Strategy (2011–2020) was formulated by the new government, which requested assistance from FAO to support the strategy. Eight priority sectors were selected: public sector services; agro-processing and marketing; land market development; water resources management; training, research and development; trade and tax policy; rural credit and rural development. The anticipated impact of the strategy will be to reduce rural poverty and food insecurity through providing a more stable agricultural policy.

Finances

The WRD and BWRDs are financed by the state budget through MAWR&PI. The RWRDs are financed from the state budget and water users funds received for water delivery services. Agreements have been concluded between the RWRDs and each water user in the *rayon* concerning water delivery services. Bills for payment are delivered monthly. The government authorizes the text of the contract. Payment rates for water delivery are established by Parliament. Approximately 50 percent of actual expenditure for O&M is covered by the state budget and 50 percent by payment for water delivery service.

Water use is chargeable according to the 'Water Act' currently in force in Kyrgyzstan. The payment is collected from all water users irrespective of the department they belong, their citizenship, kinds and patterns of ownership, except for cases established by special legislation of Kyrgyzstan (public health services, recreation, sports, rest, etc.). The order, conditions and amount paid for use of water bodies and water resources vary for different users and are determined by specific legislation. However, these amounts are still largely inadequate to cover actual O&M needs.

In 1997, the annual O&M cost of full cost recovery was an estimated US$350/ha, but the actual operational costs did not exceed US$60/ha in the four years prior to 1997. In the past, farmers

were not charged for water, although the land tax was two or three times higher on irrigated land than on non-irrigated land of similar quality. In 1992–1993, a water fee was imposed on the *kolkhoz* and *sovkhoz*.

In 1995, MAWR&PI proposed a water charge equivalent to US$0.6/1 000 m^3, to cover O&M costs. Parliament approved the equivalent of US$0.1/1 000 m^3, this amount was divided by three for supplementary irrigation during autumn and winter. In 1995, only 29 percent of the charges due were collected.

Policies and legislation

In 2005, the Water Code was based on the concept of integrated water resources management (IWRM). The Code covers the fundamental principles of recognition of the economic value of water resources, consolidation of controlling functions over water resources within the framework of a newly established specific state authority, organization of water resources management based on hydrographic (basin) and the participation of water users in planning and management. The Water Code promotes transparent legal relations between state authorities for the management of irrigation infrastructure and the newly established and growing group of cooperative users of irrigation water (UNDP, 2010).

ENVIRONMENT AND HEALTH

Water quality in rivers is good. Rivers are fed by glacial melt, which has a low salt concentration (0.04–0.15 g/litre) and low pollution level. Observations in all basins show a low concentration of nitrates, organic matter and nutrients (less then 1 mg/litre). There are cases of wastewater pollution; the reasons are:

- incorrect storage and use of fertilizers, chemicals, industrial waste;
- non-observance of the sanitary code;
- improper technical conditions for sewerage systems, ineffective cleaning of agriculture, cattle-breeding and industrial effluent.

About 90 percent of all drinking water supplied by centralized systems is groundwater, which mostly meets standards for drinking water quality.

Nuclear tailing dump is a very serious problem in Kyrgyzstan not fully solved yet and threatening the whole region.

In 2005, irrigation caused salinization of an estimated 49 503 ha. In 1994, about 60 000 ha were considered saline by Central Asia standards (toxic ions exceeded 0.5 percent of total soil weight). In addition there were 60 000 ha, divided into 34 200 ha moderately saline and 25 800 ha highly saline, a further 63 400 ha were slightly saline. In the Chu river basin, about 15 percent of the irrigated area is considered saline, while this figure falls to 5 percent in the Syr Darya river basin. In 2005, irrigation caused waterlogging on 35 399 ha.

In 2006, according to the Land Reclamation Cadastre 85 percent of the total irrigated area is in good condition, 6 percent in satisfactory condition and 9 percent in unsatisfactory condition. Unsatisfactory condition is caused by high groundwater level (37 percent), soil salinity (52 percent) and a combination of the two (11 percent). Poorly functioning vertical drainage systems have caused land deterioration on reclaimed land.

Harvest losses are as follows: 13–17 percent on low saline land, 32–37 percent on medium saline land and 60–64 percent on highly saline land. On average, around 27 percent of harvest is lost on saline land and up to 38 percent on land where the groundwater level is high.

Land is removed from agricultural rotation also because of the high level of soil pollution, caused by toxic waste from the mineral resource industry. Mercury, antimony, mining and smelting industries pollute the surrounding territories with heavy metals. The pollution level from heavy metals near mining and smelting enterprises exceeds by 3 to 10 times the maximum permissible concentration. High-level pollution may be controlled in the largest plants, along traffic lines and near waste disposal.

In 2005, 122 800 inhabitants were affected by water-related diseases.

PROSPECTS FOR AGRICULTURAL WATER MANAGEMENT

Extension of irrigation land could be implemented on dry land, pastures and hayfields. This refers to about 1 200 000 ha, including 632 000 ha of land in good condition; 517 000 ha where a drainage system could be constructed; 28 000 ha requiring leaching; 1 168 000 ha needing investment; 208 000 ha where gypsum needs to be applied; 519 000 ha requiring stone collection; 1 173 000 ha requiring erosion prevention measures, 50 000 ha needing terracing. Development cost per hectare: US$2 630–US$26 320.

Assuming a 1 percent annual population growth rate, population will be 5 6 million in 2015 and 6 million in 2025. Feeding a larger population can be achieved by increasing the arable land area or by intensifying crop production and yield, or a combination of the above. Basic measures to increase food production are:

- increasing productivity of available agricultural land by taking the necessary steps to increase land and crop productivity;
- training agriculturists and introducing agricultural techniques: soil tillage, crop selection, crop rotation and fertilizers, and techniques for land reclamation including irrigation, drainage, leaching;
- evaluating current use of agricultural land to ensure productive use;
- preventing status change from agricultural land to industrial or other construction;
- adopting appropriate measures to develop additional land and water resources.

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