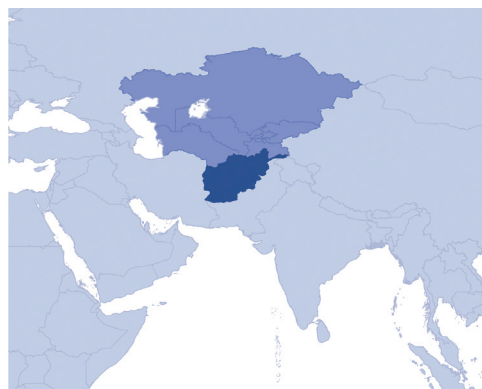


Afghanistan



GEOGRAPHY, CLIMATE AND POPULATION

Geography

Afghanistan is a landlocked country in Central Asia with a total area of about 652 000 km² (Table 1). It is bordered by Turkmenistan, Uzbekistan and Tajikistan to the north, China to the northeast, Pakistan to the east and south and the Islamic Republic of Iran to the west. It is characterized by its rugged terrain and an average elevation of 1 100 m above sea level, ranging from 150 to 8 000 m. One-quarter of the country's land lies at more than 2 500 m above sea level.

About three-quarters of the territory is comprised of mountains and hills, while lowlands include river valleys in the north and desert regions in the south and southeast. The Hindu Kush range, the westernmost extension of the Himalaya-Pamir mountain range, divides the country from west to east, while the Suleiman and Karakoram mountains flank the southern border with Pakistan. Major river valleys radiate from these mountains to the north, west and south, creating fertile valleys along which most agricultural and irrigation development occurs (Rout, 2008).

Administratively, the country is divided into 34 provinces (*welayat*): Badakhshan, Badghis, Baghlan, Balkh, Bamyán, Daykundi, Farah, Faryab, Ghazni, Ghor, Helmand, Herat, Jawzjan, Kabul, Kandahar, Kapisa, Khost, Kunar, Kunduz, Laghman, Logar, Nangarhar, Nimroz, Nuristan, Paktika, Paktya, Panjshir, Parwan, Samangan, Sari Pul, Takhar, Uruzgan, Wardak and Zabul.

In 2009, cultivated area was an estimated 7.91 million ha, of which 7.79 million were under temporary crops and 0.12 million ha under permanent. The major cultivated area is located in the north and west of the country.

Climate

Afghanistan is characterized by a dry continental climate, though the mountains cause many local variations. Temperatures vary from minus 10 °C in winter to 34 °C in summer. Annual distribution of rainfall is that of an essentially arid country, more than 50 percent of the territory receives less than 300 mm of rain. The eastern border regions are an exception, as they lie at the limit of monsoon influence. About 50 percent of precipitation occurs in winter (January to March), much of which falls as snow in the central mountainous regions. A further 30 percent falls in spring (April to June). Runoff from snowmelt in the spring and summer months, when day temperatures are high, is the lifeblood of Afghan agriculture.

Population

In 2011, total population was an estimated 32.3 million inhabitants, of which 77 percent rural (80 percent in 1999). The population density is about 50 inhabitants/km². During the period 2001–2011 annual population growth rate was an estimated 3.2 percent.

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TABLE 1
Basic statistics and population

Physical areas			
Area of the country	2009	65 223 000	ha
Cultivated area (arable land and area under permanent crops)	2009	7 910 000	ha
• as % of the total area of the country	2009	12	%
• arable land (annual crops + temp fallow + temp meadows)	2009	7 793 000	ha
• area under permanent crops	2009	117 000	ha
Population			
Total population	2011	32 358 000	inhabitants
• of which rural	2011	77	%
Population density	2011	50	inhabitants/km ²
Economically active population	2011	10 474 000	inhabitants
• as % of total population	2011	32	%
• female	2011	24	%
• male	2011	76	%
Population economically active in agriculture	2011	6 217 000	inhabitants
• as % of total economically active population	2011	59	%
• female	2011	32	%
• male	2011	68	%
Economy and development			
Gross Domestic Product (GDP) (current US\$)	2010	17 243	million US\$/yr
• value added in agriculture (% of GDP)	2010	30	%
• GDP per capita	2010	549	US\$/yr
Human Development Index (highest = 1)	2011	0.398	
Access to improved drinking water sources			
Total population	2010	50	%
Urban population	2010	78	%
Rural population	2010	42	%

In 2010, half the population had access to improved water sources (78 and 42 percent in urban and rural areas respectively). Sanitation coverage accounted for 37 percent (60 and 30 percent in urban and rural areas respectively).

ECONOMY, AGRICULTURE AND FOOD SECURITY

In 2010, Afghanistan's gross domestic product (GDP) was US\$17 243 million of which the agricultural sector accounted for 30 percent (Table 1).

In 2011, total economically active population was 10.5 million, or 32 percent of total population. Economically active agricultural population is an estimated 6.2 million, or 59 percent of total economically active population, of which 32 percent are female.

Water is the lifeblood of the people of Afghanistan, not just for living but also for the economy, which has traditionally been dominated by agriculture. Decades of war have destroyed much of Afghanistan's irrigation and other water supply systems, which are vital for the agricultural economy. In recent years the situation has been complicated by the drought. As an arid and semi-arid country, irrigation is essential for food production and there can be no food security without water security. The major staple crop is wheat, of which 80 percent is sown as a winter crop.

WATER RESOURCES AND USE

Water resources

Although Afghanistan is located in a semi-arid environment, it is still rich in water resources mainly because of the high mountain ranges such as Hindu Kush and Baba, which are covered with snow. Over 80 percent of the country's water resources originate in the Hindu Kush mountain ranges at altitudes of over 2 000 m. The mountains function as natural water storage, with snow during the winter and snowmelt in the summer that supports perennial flow in all the major rivers (ICARDA, 2002).

The country has five major river basins (Table 2):

1. *Kabul river basin:* The Kabul river originates in the central region of the Hindu Kush, about 100 km west of Kabul, and has a drainage area of 54 000 km² in Afghanistan. It flows eastward through Kabul and, after entering Pakistan, joins the Indus river east of Peshawar. Its main tributaries include the Logar, Panjsher (with its own major tributary the Ghorband), Laghman-Alingar and Kunar rivers. Most of these rivers are perennial with peak flows during the spring months as their drainage area encompasses the snow-covered central and northeastern parts of the Hindu Kush. The Kabul river is the only river in Afghanistan that is tributary to a river system, the Indus river, which reaches the Indian Ocean. Other minor Indus tributaries, with a combined drainage area of 18 600 km², drain southeastern Afghanistan and all flow eastwards into Pakistan and eventually join the Indus river. The Kabul river, and other tributaries of the Indus together drain 11 percent of Afghanistan.
2. *Helmand river basin and western flowing rivers:* The 1 300 km long Helmand river rises out of the central Hindu Kush mountains, close to the headwaters of the Kabul river. The river flows in a southwesterly direction, then westwards to its terminus in the Sistan marsh or depression along the border with the Islamic Republic of Iran. The Helmand river flow is mostly supplied by the upper catchment areas that receive snowfall in the winter months. The river and its tributaries, such as the Arghandab and Ghazni rivers, drain about 29 percent of Afghanistan's area or about 190 000 km². The Adrascan or Harut Rud, the Farah Rud, and the Khask Rud rivers also drain into the Sistan marsh. These rivers drain the southwestern part of Afghanistan, which is 80 000 km² or 12 percent of Afghanistan's area.
3. *Hari Rod and Murghab river basins:* The Hari Rod river, which has a drainage area of about 40 000 km², or 6 percent of the area of Afghanistan, flows west from its source 250 km west of Kabul through the city of Herat and into the Islamic Republic of Iran. At the Iranian border, the river turns northwards and eventually empties into the Tejen Oasis in Turkmenistan. Because of the narrow and elongated configuration of this river basin, the Hari Rod does not have significant tributaries. Another river, the Murghab river, with a drainage area of 40 000 km², or 6 percent of the area of Afghanistan, also dies out in Turkmenistan.
4. *Northern flowing rivers:* These rivers originate on the northern slopes of the Hindu Kush and flow northwards towards the Amu Darya river. Most of these rivers die out on the Turkistan plains before reaching the Amu Darya. From west to east, the main rivers include the Shirin Tagab, the Sarepul, the Balkh and the Khulm rivers. These river basins cover 12 percent of Afghanistan, or about 75 000 km².
5. *Amu Darya river basin:* The Amu Darya river, also called the Oxus in Afghanistan, originates in the Afghanistan part of the Pamir river. Formerly called the Abi-Panja, it forms over 1 100 km of Afghanistan's northern border with Tajikistan and Turkmenistan. Two main tributaries drain Afghanistan, the Kunduz river (and its tributary the Khanabad) and the Kokcha river, both originate in northeastern Hindu Kush. The rivers are perennial with substantial flows from snowmelt in the spring

months. These two river basins, and the upper drainage area of the Amu Darya, cover 14 percent of Afghanistan or about 91 000 km².

Together the Kabul and Amu Darya river basins cover one-quarter of the country and contribute almost two-thirds of surface water resources generated within its borders; or the internal renewable surface water resources (IRSWR) (Table 2).

Total IRSWR is an estimated 37.5 km³/year and total internal renewable groundwater resources (IRGWR) an estimated 10.65 km³/year. Afghanistan being an arid country, the overlap is thought to be only 1 km³/year, or less than 10 percent of groundwater resources. This brings total internal renewable water resources (IRWR) to 47.15 km³/year.

The Amu Darya (Panj) river is the border river between Afghanistan and Tajikistan, then between Afghanistan and Uzbekistan and finally between Afghanistan and Turkmenistan before entering Turkmenistan. It never enters Afghanistan. The total flow of the river, where it flows from Tajikistan to the border, and where the border river is called the Panj river, is an estimated 33.4 km³/year. According to an agreement in 1946 with the Former Soviet Union, Afghanistan was entitled to use up to 9 km³ of water from the Panj river. The contribution of Afghanistan to the Amu Darya is 6 km³/year from the Kunduz tributary and 5.7 km³/year from the Kokcha tributary. The incoming flow of the Kunar river, from Pakistan to Afghanistan, is an estimated 10 km³/year.

The Kunar river joins the Kabul river at Jalalabad, about 180 km downstream of the border. The outflow of the Kabul river to Pakistan, which is 80 km further downstream, and of several other tributaries of the Indus that originate in Afghanistan is an estimated 21.5 km³/year. They all join the Indus river in Pakistan. The outflow of the Helmand river to the Islamic Republic of Iran is an estimated 6.7 km³/year. Other rivers originate in Afghanistan and cross its border, but most of these are ephemeral and, moreover, evaporate in depressions at or just over the border and are therefore not counted as outflow.

The outflow of the Hari-Rod river, which becomes the border between Afghanistan and the Islamic Republic of Iran is 1.07 km³/year. Based on the agreement between the Islamic Republic

TABLE 2
Renewable water resources by river basin (Adapted from: Favre and Kamal, 2004;
Rout, 2008; Uhl and Tahiri, 2003)

River basin	Area (km ²)	Part of total area %	IRSWR ^a (km ³ /year)	TARSWR ^b (km ³ /year)	Groundwater recharge (km ³ /year)
Kabul (Indus)	72 600	11	11.5 ^c	21.5 ^c	1.92
Helmand and Western	270 000	41	9.3 ^d	8.48 ^d	2.98 ^e
Hari Rod-Murghab	80 000	12	3.1	3.1	0.64 ^f
Northern	75 000	12	1.9	1.9	2.14 ^f
Amu Darya (Panj)	91 000	14	11.7 ^g	20.7 ^g	2.97
Other	63 400	10			
Total	652 000	100	37.5	55.68	10.65

a IRSWR = Internal Renewable Surface Water Resources

b TARSWR = Total Actual Renewable Surface Water Resources

c Flow of Kunar, entering from Pakistan into Afghanistan, is 10 km³

d 0.82 km³/year is to be reserved for the Islamic Republic of Iran from the Helmand river according to an agreement from 1972

e Groundwater recharge: Helmand 2.48 km³ and Western 0.5 km³

f Groundwater recharge: the figure for Northern (2.14 km³) includes Murghab, while the figure of Hari Rod-Murghab (0.64 km³) excludes Murghab (Source: Uhl and Tahiri, 2003).

g The flow of border river Panj where the Bartang enters is 33.4 km³. According to a treaty in 1946 with the Soviet Union 9 km³/year can be used by Afghanistan

of Iran and Turkmenistan regarding this flow, it is considered to enter the Islamic Republic of Iran. The outflow of the Murghab river to Turkmenistan is 1.25 km³/year. This brings the total natural inflow to 10 km³/year and the total natural outflow to 42.22 km³/year.

Afghanistan's water resources are still largely underused. It is not fully understood, however, how much of this 'potential' resource can be accessed without damage to livelihoods and ecosystem. For example, it is not fully known how much of the groundwater can be extracted without leading to an excessive decline in groundwater levels, which may result in a stage of 'water mining' (Qureshi, 2002). Problems may arise in the Kabul and Eastern Helmand river basins.

There are few environmentally important natural wetlands and lakes in Afghanistan (Favre and Kamal, 2004).

In 1992 the installed capacity of the major hydroelectric plants was 281 MW, about 70 percent of total installed capacity. Considerable potential exists for hydropower generation, both by large dams and micro-hydropower stations. Total large dam capacity is an estimated 3.658 km³. Information exists about the following dams:

- The Kajaki dam was constructed in the 1950s by an American construction company as part of the Helmand Arghandab Valley Authority Project. The project was an ambitious undertaking by the governments of Afghanistan and the United States and was designed to store water for downstream irrigation. In the 1970s, the United States Agency for International Development (USAID) funded hydropower plant construction at the dam, which included two 16.5 MW generators. Reservoir capacity was 1.2 km³. Years of neglect, however, have taken their toll on the dam and its ability to perform as designed. Work is ongoing to improve power generation and the dam's irrigation component.
- The Darunta dam is an hydroelectric dam on the Kabul river, approximately 7 km west of Jalalabad, the capital of Nangarhar province. Companies from the Former Soviet Union constructed the dam in the early 1960s. It contains three vertical Kaplan units with a rated output of 3.85 MW each. Originally, the dam supplied 40 to 45 MW of electrical power but silting and damage to the system during the Afghan civil war reduced its output to 11.5 MW. The plant is currently in poor condition and requires major rehabilitation, including possible replacement of all three turbines. USAID funded rehabilitation of the Darunta hydroelectric plant, completion was foreseen in January 2012.
- The Dahla dam is the largest dam in Kandahar province, and the second largest in Afghanistan. First built between 1950 and 1952, years of disrepair and war left it functioning at reduced capacity. One of Canada's projects in Afghanistan was to repair the dam and its irrigation system (2008–2011), with a budget of US\$50 million. As a result of this project, 80 percent of Kandaharis living along the Arghandab irrigation system have access to a secure water supply to stimulate agricultural production. It was anticipated that at project end irrigated land in the Arghandab river basin would double. For centuries, the Arghandab valley, where the dam is located, has been known as the breadbasket of Afghanistan. The region could become the most productive agricultural area in the country, the greatest scope being for the creation of food surpluses for processing and export (Government of Canada, 2011).
- The Naghlu dam on the Kabul river has a design capacity of 100 MW. It is the largest power plant in Afghanistan and generates most of Kabul's electricity. It is currently being rehabilitated and only three of the four generators are operational. Its reservoir has a storage capacity of 0.550 km³. Commissioned in 1968, the power station fell into disrepair, by the 2001 invasion of Afghanistan, only two generators were operational. In August 2006, Afghanistan's Ministry of Energy and a Russian company rehabilitated the two inoperable generators and replaced the transformers. The first of the two became operational in September 2010 and the transformers were replaced in early

2012. The World Bank is funding rehabilitation. The second unit was to be operational by the end of 2012.

- Several other dams, such as the Surubi dam, a hydropower dam, on the Kabul river in Kabul province; the Sardeh dam on the Gardeyz river in Ghazni province with a total capacity of 0.259 km³; the Band-e Amir dam on the Balkh river in Bamyan province; the Chak E Wardak dam on the Logar river in Wardak province; the Qargha dam in Kabul province.
- The Salma dam (an hydroelectric dam) is under construction. Originally constructed in 1976, on the Hari Rod river the dam was damaged early in the civil war. India committed to funding the completion of the Salma dam in 2006. Once completed, the hydroelectric plant could produce 42 MW, in addition to providing irrigation on 75 000 ha (stabilizing the existing irrigation on 35 000 ha and development of irrigation facilities on an additional 40 000 ha). Further, the Shah wa Arus dam is under construction on the Sharkardara river in Kabul province, estimated opening in 2016.

Another 11 hydropower projects are planned, total cost US\$6 405 million, with an output of 2 196 MW and reservoir capacity of 4.4 km³ (Khurshedi, 2011) (Table 3).

International water issues

All major rivers in Afghanistan originate in the central highlands region or the northeastern mountains. The only notable exception is the Kunar river, its source is in the Karakoram mountains across the border in Pakistan, and the Amu Darya river, which originates in Tajikistan and is only a border river for Afghanistan. Many rivers are shared with Afghanistan's neighbouring countries therefore use of water from rivers with their source in Afghanistan takes on a regional dimension. Most Afghan rivers drain into inland lakes or dry up in sandy deserts or irrigation canals. The only exception is the Kabul river itself, and other rivers in the Kabul river basin, which flow to Pakistan where they join the Indus river before flowing into the Indian Ocean.

In 1921, Afghanistan and the United Kingdom signed a treaty to establish relationships with neighbouring countries. The United Kingdom agreed to permit Afghanistan to draw water from a pipe for use by residents of Tor Kham. Afghanistan agreed to permit British officers and tribespeople on the British (now Pakistan) side of the border to use the Kabul river for navigation and to maintain existing irrigation rights (Favre and Kamal, 2004).

In 1950, Afghanistan and Iran created the Helmand River Delta Commission, which had the task of measuring and dividing river flows between the two countries. In 1972, a document was

TABLE 3
Planned hydropower projects in Kabul river basin (Source: Khurshedi, 2011)

Sub-basin	Name of project	Cost (million US\$)	Output (MW)	Reservoir capacity (km ³)
Punjshir	Totumdara	332	200	0.4
	Barak	1 174	100	0.5
	Punjshir	1 078	100	1.3
	Baghdara	607	210	0.4
Logur Upper Kabul	Haijana	72	72	0.2
	Kajab	207	15	0.4
	Tangi Wadag	356	56	0.4
	Gat	51	86	0.5
Lower Kabul	Laghman	1 434	1 251	0.3
	Konar (A)	1 094	95	
	Kama		11	
Total		6 405	2 196	4.4

signed between Afghanistan and Iran for the allocation of the discharge of 26 m³/s of Helmand river water to Iran year round, which is equal to about 0.82 km³/year.

International agreements on the use and quality of Amu Darya transboundary water between Afghanistan and the former Soviet Union were signed during the two different eras. The first being the Stalin era (mid-1920s ~1953) during which Afghanistan and the former Soviet Union signed the border agreement in 1946. Afghanistan gave Kuczka region back to the Former Soviet Union. This circumstance entailed closer relationship between both nations. An international water agreement was reached in 1946, under which entitled Afghanistan to use up to 9 km³ of water from the Panj river. The second Soviet era was the Khruchchyov-Daoud era (1953-1963).

The Former Soviet Union steadily promoted economic assistance and military aid. In 1954, the Soviet Union offered grants of US\$240 million to Afghanistan and built 100 km of pipeline from Termez, Uzbekistan. In 1955, the Soviet Union announced further assistance, such as agricultural development, hydroelectric generation and construction of irrigation infrastructure. In 1956, Afghanistan signed a contract accepting Russian supervisors for the construction of water facilities. At the beginning of 1958, Afghanistan and the former Soviet Union reconfirmed and signed the border agreement. The second international agreement on the use and quality of Amu Darya transboundary water was signed in 1958.

These agreements founded an international commission to cope with the uses and quality of transboundary water resources. After the second era, however, the relationship between the two nations deteriorated. The Soviet invasion disrupted Afghanistan from 1979 to 1989. After withdrawal in 1989, the Soviet Union collapsed in 1991. Formal frameworks for international coordination in the Amu Darya river basin between Afghanistan and the new (former Soviet Union) countries in Central Asia no longer existed after the second era (Fuchinoue, Tsukatani and Toderich, 2002; Favre and Kamal, 2004).

The environmental problems of the Aral Sea basin are among the worst in the world. Water diversions, farming methods and industrial waste resulted in the Sea disappearing, salinization and organic and inorganic pollution. The problems of the Aral Sea basin, which previously had been an internal issue for the Soviet Union, became internationalized after its demise in 1991. In 1992, five major riparian (former Soviet Union) countries – Kazakhstan, Kyrgyzstan, Tajikistan, Turkmenistan, and Uzbekistan – signed an agreement to coordinate policies concerning their transboundary waters and established the Interstate Commission for Water Management Coordination to manage, monitor and facilitate the agreement (Favre and Kamal, 2004). Two international freshwater agreements were signed by the Central Asian Republics covering the Amu Darya river.

The first agreement was the 'Agreement on joint activities in addressing the Aral Sea crises and the zone around the Sea, improving the environment, and enduring the social and economic development of the Aral Sea region', signed in 1993. The second agreement was the 'Resolution of the Heads of States of Central Asia on work of the Economic Commission of the Interstate Council for the Aral Sea (ICAS) on implementation of an Action Plan on improvement of the ecological situation in the Aral Sea Basin for the 3–5 years to come with consideration of social and economic development of the region', signed in 1995 (Fuchinoue, Tsukatani and Toderich, 2002). As a result of conflicts Afghanistan, which is a critical partner to any future transboundary water management agreement, has so far been unable to participate in any discussions or agreements (Favre and Kamal, 2004).

Afghanistan uses only about 2 km³/year of the 9 km³/year of water from the Panj river that it is entitled to use under the 1946 treaty with the Former Soviet Union. The Panj river has

an annual flow of 19 km³, if Afghanistan develops agriculture in the north, this will radically change the flow of the Amu Darya (Favre and Kamal, 2004).

Once Afghanistan implements plans for the construction of dams and facilities on its rivers for flood control, electricity generation and irrigation expansion (Table 3), this will impact the amount of water and timing of peak runoff to the Islamic Republic of Iran, Pakistan, Uzbekistan and Turkmenistan (Khurshedi, 2011).

Water use

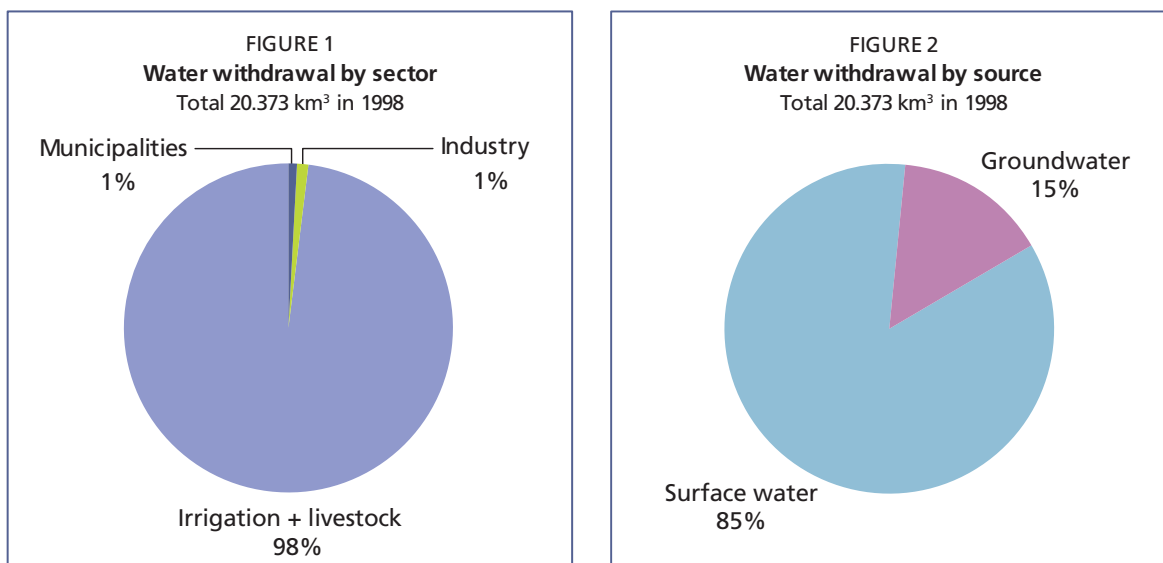
In 1998, total water withdrawal was estimated at 20.373 km³, of which 20.0 km³ or 98 percent was for agriculture, 1 percent for municipal and 1 percent for industrial purposes (Table 4 and Figure 1). Of total water withdrawal 17.317 km³ or 85 percent was from surface water sources and the remainder 3.056 km³ or 15 percent from groundwater (Figure 2) (Rout, 2008). In 1987, total water withdrawal was an estimated 26.11 km³ of which 25.8 km³ or 99 percent for agricultural purposes.

Referring to the Government of Afghanistan's 1980s yearbook statistics, the total annual groundwater extraction amounted to some 3 km³ (Favre and Kamal, 2004). Uhl and Tahiri (2003) estimated groundwater withdrawal for irrigation to be 2.8 km³/year.

Historically, groundwater withdrawal has been largely limited to water from shallow unconfined aquifers abstracted using *karez* and traditional wells from which water is drawn using animal power (*arhad*). More recently, deeper confined aquifers are being developed for domestic and municipal water supply using modern well-drilling techniques (Rout, 2008).

TABLE 4
Water: sources and use

Renewable freshwater resources			
Precipitation (long-term average)	-	327	mm/yr
	-	213 300	million m ³ /yr
Internal renewable water resources (long-term average)	-	47 150	million m ³ /yr
Total actual renewable water resources	-	65 330	million m ³ /yr
Dependency ratio	-	29	%
Total actual renewable water resources per inhabitant	2011	2 019	m ³ /yr
Total dam capacity	2009	3 658	million m ³
Water withdrawal			
Total water withdrawal by sector	1998	20 373	million m ³ /yr
- agriculture	1998	20 000	million m ³ /yr
- municipalities	2005	203	million m ³ /yr
- industry	2005	170	million m ³ /yr
• per inhabitant	1998	937	m ³ /yr
Surface water and groundwater withdrawal (primary and secondary)	1998	20 373	million m ³ /yr
• as % of total actual renewable water resources	2000	31	%
Non-conventional sources of water			
Produced municipal wastewater	-	-	million m ³ /yr
Treated municipal wastewater	-	-	million m ³ /yr
Direct use of treated municipal wastewater	-	-	million m ³ /yr
Desalinated water produced	-	0	million m ³ /yr
Direct use of agricultural drainage water	-	-	million m ³ /yr



IRRIGATION AND DRAINAGE DEVELOPMENT

Evolution of irrigation development

The history of irrigated agriculture in Afghanistan goes back more than 4 500 years to an ancient settlement near Kandahar (ICARDA, 2002).

By 1978, the surface water potential was more or less fully exploited by existing irrigation systems, if no further regulation works were constructed, although the efficiency of exploitation left room for considerable improvement. Irrigated areas could have been expanded by building major dams and other water regulation structures, all of which required major capital investment. There is no estimate, even rough, of irrigation potential.

For the past 30 years, the rural sector has been severely impacted by war and civil unrest. Irrigation system structures have been damaged, sometimes deliberately. While many rehabilitation efforts have necessarily been emergency assistance, long-term strategies to improve the performance and reliability of irrigation systems are also required (Rout, 2008). An estimated 27 to 36 percent of all irrigation systems were directly affected by war before 2000. These figures do not take into account the indirect effects of neglect and abandonment.

Irrigated land is usually located in the river basins of the north, west and southwest (ICARDA, 2002). Almost 75 percent is located in the northern and Helmand river basins. A FAO satellite survey, conducted in 1993, Table 5 lists irrigated land cover by river basin. It shows total irrigated area as 3.21 million ha, of which 48 percent is intensively cultivated and 52 percent intermittently with one or more crops each year. It is assumed that the survey covers both informal and formal irrigation systems (Table 6).

Not listed, however, is the area used for private gardens, vineyards and fruit trees, which could be over 90 000 ha and could receive some form of irrigation (Rout, 2008). It is estimated that in 2002 the area was the same, area actually irrigated was 1.73 million ha, or 54 percent of the area equipped for irrigation. In 2011, the area actually irrigated was an estimated 1 896 000 ha.

In 1967, a survey estimated the total irrigation area to be 2.72 million ha. The survey shows the existence of nearly 29 000 systems, of which 27 percent drew from surface water sources (rivers and streams), and the remainder from groundwater sources (springs, *karez* and wells) (Rout, 2008). While surface water systems made up less than one-third of the total number, they covered 86.5 percent of the irrigated area, confirming the importance of surface water as the

TABLE 5
Area equipped for irrigation (Source: Rout, 2008)

Water basin	Irrigation areas (ha)			Total	Total (%)
	Intensively cultivated (2 crops/year)	Intensively cultivated (1 crops/year)	Intermittently cultivated		
Kabul	62 000	244 000	178 100	484 100	15
Helmand	95 000	380 800	900 200	1 376 000	43
Hari Rod-Murghab	34 500	138 000	128 400	300 900	9
Northern	40 000	197 800	387 000	624 800	19
Amu Darya	106 200	247 800	48 100	402 100	13
Non-drainage area	3 880	10 000	6 700	20 580	1
Total	341 580	1 218 400	1 648 500	3 208 480	100

main irrigation water source. Springs account for 6.9 percent of the area, karezes for 6.2 percent and shallow and deep wells for 0.4 percent (Favre and Kamal, 2004). In 2002 it was estimated that 18 percent of the total area equipped for irrigation on 3.21 million ha and 16 percent of actually irrigated area on 1.73 million ha were irrigated using groundwater (Figure 3).

In 1963, some 114 000 ha were reported to be equipped for sprinkler irrigation.

Irrigation systems can be divided into two main categories: informal irrigation systems (surface water systems, karez, springs and wells) and formal irrigation systems.

Informal systems are centuries-old and traditionally developed and managed by local communities within the constraints of local resources. They have undergone social and physical changes, and expand or contract based on water availability or challenges arising from years of conflict. Informal systems account for 88 percent of the country's irrigated area (Rout, 2008). They are divided into four categories:

- *Informal surface water systems:* They make up 75 percent of the irrigated area. Their prevalence largely results from widespread availability of both water resources from rivers and streams as well as adjacent land suitable for development, usually along river terraces and alluvial plains. The key infrastructure typically found in surface water systems includes: diversion structures (*sarband*); main, secondary and tertiary canals (predominantly made of unlined earth); control structures (weirs, *sehdarak* bifurcators, offtakes and spillways); conveyance structures (siphons, aqueducts, super-passages and culverts); protection structures (embankments as well as gabion and retaining walls); and access and ancillary structures (water mills, bridges and access points). Some schemes include small retention dams and water-harvesting structures (Rout, 2008). Small-scale informal surface water systems are the traditional irrigation systems, many of which have been established for centuries. Large-scale informal surface water systems are located mainly on

FIGURE 3
Source of irrigation water on area
equipped for full control irrigation
Total 3 208 480 ha in 2002

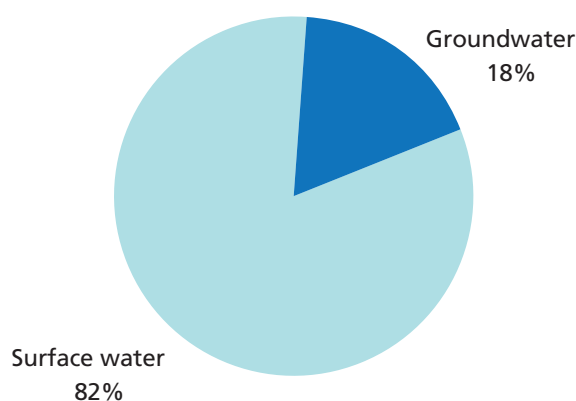


TABLE 6
Irrigation and drainage

Irrigation potential			ha
Irrigation			
1. Full control irrigation: equipped area	2002	3 208 480	ha
- surface irrigation		-	ha
- sprinkler irrigation	1967	114 000	ha
- localized irrigation		-	ha
• % of area irrigated from surface water	2002	82	%
• % of area irrigated from groundwater	2002	18	%
• % 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	2011	1 896 000	ha
- as % of full control area equipped	2002	59	%
2. Equipped lowlands (wetland, ivb, flood plains, mangroves)		-	ha
3. Spate irrigation		-	ha
Total area equipped for irrigation (1+2+3)	2002	3 208 480	ha
• as % of cultivated area	2002	42	%
• % of total area equipped for irrigation actually irrigated	2002	59	%
• average increase per year over 10 years	1993-2002	0	%
• power irrigated area as % of total area equipped			%
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)	2002	3 208 480	ha
• as % of cultivated area	2002	42	%
Full control irrigation schemes		Criteria	
Small-scale schemes		< ha	- ha
Medium-scale schemes		> ha and < ha	- ha
Large-scale schemes		> ha	- ha
Total number of households in irrigation		-	
Irrigated crops in full control irrigation schemes			
Total irrigated grain production (wheat and barley)		-	metric tons
• as % of total grain production		-	%
Harvested crops			
Total harvested irrigated cropped area	2011	2 176 000	ha
• Temporary crops: total	2011	1 978 000	ha
- Wheat	2011	1 303 000	ha
- Rice	2011	208 000	ha
- Barley	2011	116 000	ha
- Maize	2011	183 000	ha
- Potatoes	2006	15 000	ha
- Sugar beet	2006	2 000	ha
- Pulses	2006	27 000	ha
- Vegetables	2011	69 000	ha
- Cotton	2011	33 000	ha
- Sesame	2006	10 000	ha
- Sunflower	2006	10 000	ha
- Sugarcane	2006	2 000	ha
• Permanent crops: total	2011	198 000	ha
Grapes	2011	61 000	ha
Fruit trees	2011	137 000	ha
Irrigated cropping intensity (on full control actually irrigated area)	2011	115	%
Drainage - Environment			
Total drained area	-	-	ha
- part of the area equipped for irrigation drained		-	ha
- other drained area (non-irrigated)		-	ha
• drained area as % of cultivated area		-	%
Flood-protected areas		-	ha
Area salinized by irrigation		-	ha
Population affected by water-related diseases		-	inhabitants

the plains and along the main valleys. Although called informal, their operation and maintenance was highly structured. Large parts of these schemes were abandoned because land became infertile because of waterlogging and salinization, particularly in the Hari Rod, Farah Rud and Helmand valleys.

- *Karez (qanat)*: These date back several millennia. They comprise an unlined underground gallery in the hillside that brings water by free flow from underground aquifers to be used for surface irrigation. Dug by local craftspeople from shafts at close intervals, they are small but may be many kilometres long. Although most are shorter than 5 km, the length of the karez can run up to 16 km; it is said the longest Afghanistani karez is 70 km long. It is estimated that 6 740 kareze still supply water to 168 000 ha, as in 1967, the date of the last inventory. Average irrigated area per karez is 25 ha, but ranges from less than 10 ha to more than 200 ha. It should be noted that kareze are often used for domestic water supply. Karez irrigation is common in the south and southwest of the country and less in the north. Most karez systems are located within the Helmand river basin (Rout, 2008). One of the disadvantages of the karezes is that there is no mechanism to stop water flowing during winter, or when there is no need for irrigation. In each karez about 25 percent of total annual volume of water is wasted (ICARDA, 2002). The karez provides sustained perennial flow and good quality water and has the advantage of being relatively immune to natural disasters (such as earthquakes and floods) and human destruction in war (Tamuri, 2007). However, these systems may commonly face problems such as vulnerability to collapse of subsurface infrastructure, water losses in canals, flood damage and groundwater depletion. Karez are organized and operated by local communities, traditionally under a karezkan specialist responsible for construction and maintenance of subsurface sections; a *mirab* (water master) oversees surface distribution operations. Water allocations, similar to surface water systems, are based on water entitlements and rotations (Rout, 2008). Most karez are no longer in use (World Bank, 2009).
- *Springs*: Many rural communities depend on the nearly 5 558 spring-fed systems estimated to irrigate approximately 187 000 ha. The relatively low flow rate of springs means that the systems are often supplemented by diverted surface water flows when available. The systems are commonly found in upper and tributary catchments and are concentrated in the more mountainous central and southeastern provinces (Rout, 2008). When the groundwater level falls such as during drought years, the result is reduced outflow from springs. This is why some of the worst drought-stricken areas of the country are located in regions where farmers depend heavily on spring water for irrigation (ICARDA, 2002).
- *Wells*: Estimates from the late 1960s indicated that less than 1 percent of the total irrigated area is supplied by water from wells. Groundwater is lifted from large diameter shallow wells with the help of a wheel (*arhad*), animal power supplies irrigation water to an individual farmer's fields. The irrigated land does not exceed 3 ha. The total number of shallow wells in Afghanistan is 8 595, which irrigate around 12 000 ha of land. In recent years, however, the use of modern well-drilling and pumping technology has been more widespread, considerably increasing the number of wells and their capacity (ICARDA, 2002; Rout, 2008) (Table 7).

Formal systems are large-scale irrigation schemes that have been developed with central government assistance, financing, management, operation and maintenance. With additional support from bilateral and multilateral donors, most of these schemes were developed between the late 1940s and the 1970s. Afghanistan has ten formal schemes totalling nearly 333 000 ha. The largest is the Helmand-Arghandab scheme (Helmand province). The other systems are: Sardeh (Ghazni), Parwan (Parwan and Kabul), Nangarhar (Nangarhar), Sang-i-Mehr (Badakhshan), Kunduz-Khanabad (Kunduz), Shahrawan (Takhar), Gawargan (Baghlan), Kelagay (Baghlan) and Nahr-i-Shahi (Balkh) (Table 8) (Rout, 2008; Favre and Kamal, 2004).

TABLE 7

Irrigation area by origin of water in the late 1960s (Source: Favre and Kamal, 2004)

System and area	Rivers and streams	Springs	Karez	Wells (arhad)	Total
Systems (number)	7 822	5 558	6 741	8 595	28 716
Systems (%)	27.2	19.4	23.5	29.9	
Area (ha)	2 348 000	187 000	168 000	12 000	2 715 000
Area (%)	86.5	6.9	6.2	0.4	

TABLE 8

Formal irrigation schemes built by the government of Afghanistan (Source: Favre and Kamal, 2004)

No	Name of scheme	Province	Area under irrigation (ha)	Main structures	Remarks
1	Helmand-Arghandab project	Helmand and Kandahar	103 000	Kajaki and Dhala Dams, Diversion of Boghra, Main canal of Boghra, Shahrawan, Shamalan, Darweshan and Baba Walee	Water flow managed by government, maintenance by NGOs
2	Sardeh	Ghazni	15 000	Reservoir (capacity 164 million m ³). Left and right canal	Water flow managed by government, maintenance by NGOs
3	Parwan	Parwan and Kabul	24 800	Diversion, Main canal. Eastern and Southern canal. Pumping station. Power house	Water flow managed by government, maintenance by NGOs
4	Nangarhar irrigation system	Nangarhar	39 000	Darunta dam and power station, Main canal, pumping station, state farms	Water flow managed by government, maintenance by NGOs
5	Sang-i-Mehr	Badakhshan	3 000	Intake and main canal	Run by community, maintenance by NGOs
6	Kunduz-Khanabad	Kunduz	30 000	Diversion, left and right canal, regulator	Not completed, not operational
7	Shahrawan	Takhar	40 000	Intake, main canal	Water flow managed by government, maintenance by NGOs
8	Gawargan	Baghlan	8 000	Intake, main canal	8 000 out of 20 000 ha currently cultivated, water flow managed by government, Maintenance by NGOs
9	Kelagay	Baghlan	20 000	Intake, main canal	Water flow managed by government, maintenance by NGOs
10	Nahr-i-Shahi	Balkh	50 000	Diversion, main canal and division structures	Run by government and community
Total			332 800		

Most of these schemes are supplied by surface water, and very little is known about the formal irrigation schemes supplied by groundwater from deep and shallow wells. In Khost/Paktia province, surface water irrigation schemes were supplied by some 100 deep wells until the late 1980s (ICARDA, 2002). Several of the schemes have storage dams and capacity to generate hydropower. Over the past 30 years, the schemes have become heavily degraded because of lack of funding and loss of technical and institutional capacity to support operation and maintenance (Rout, 2008). By 1993, only a small part of these schemes was operational. Land tenure was different than most traditional systems in that ownership of land was registered.

Some schemes were operated under private land ownership agreements, while others were operated as state farms where land ownership was deeded to the State. Since 2003, a number of ongoing rehabilitation initiatives have been launched (Rout, 2008).

There have been no concerted efforts to exploit water using modern technology, mainly because of the high initial and maintenance costs (ICARDA, 2002).

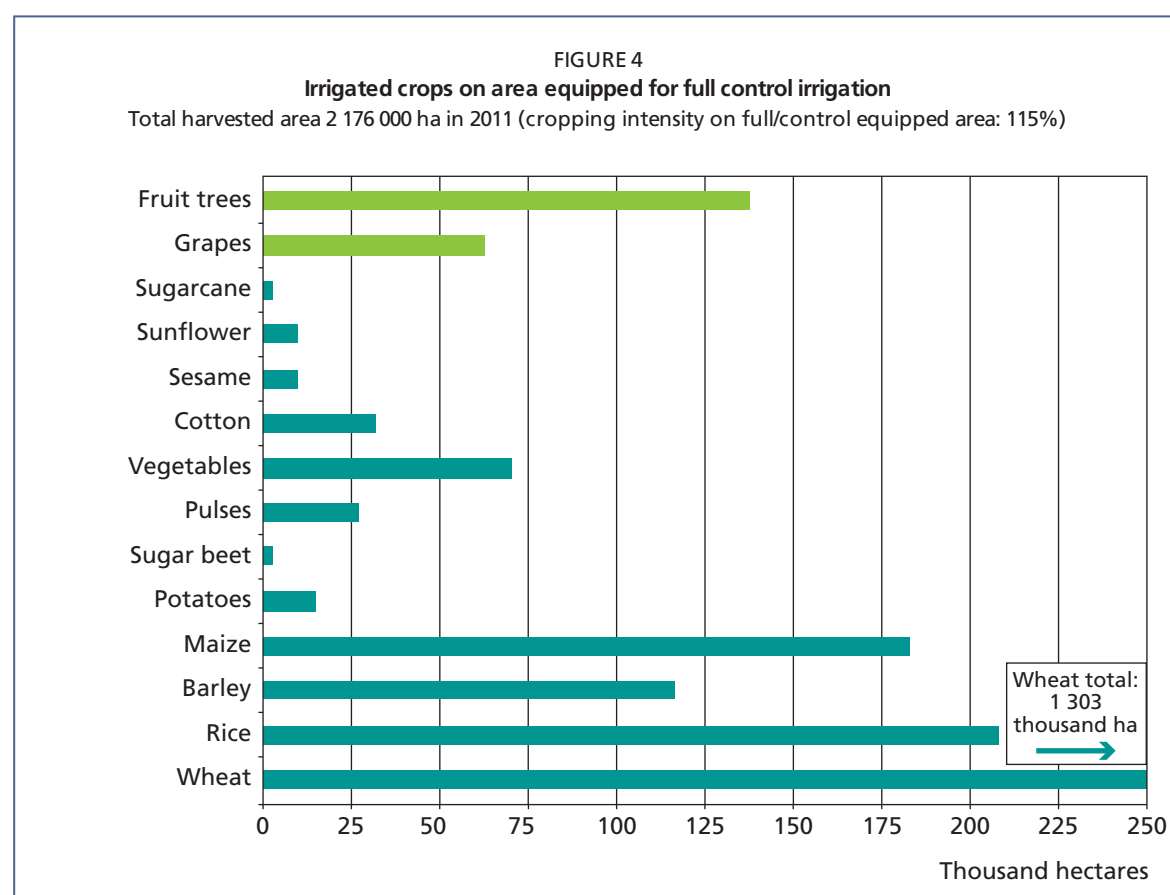
Small-scale schemes (< 3 ha) account for 83 percent of irrigated farms and 8 percent of rainfed, medium-scale schemes (3-6 ha) account for 14 percent of irrigated farms and 8 percent of rainfed, while large-scale schemes (> 6 ha) account for 3 percent of irrigated farms and 84 percent of rainfed (Qureshi, 2002). The average irrigated farm is 1.4 ha, while the average rainfed farm is 6–7 ha.

Role of irrigation in agricultural production, economy and society

In 2011, total harvested irrigated cropped area was an estimated 2 176 000 ha. Wheat accounts for 1 303 000 ha, or 59.9 percent of the harvested irrigated cropped area, followed by rice 208 000 ha (9.6 percent), maize 183 000 ha (8.4 percent), fruit trees (including grapes) 198 000 ha (9.1 percent), barley 116 000 ha (5.3 percent), vegetables 69 000 ha (3.2 percent), cotton 33 000 ha (1.5 percent) and other crops on 99 000 ha (4.5 percent) (Table 6 and Figure 4).

Sustaining and increasing productivity on irrigated land is essential for the overall food security of Afghanistan.

Cropping intensity varies widely from system-to-system according to the relative scarcity of water in relation to land. It may achieve 200 percent in large, formal systems with full water control (upstream of the river systems, when climatic conditions allow an early wheat crop), while in other systems up to two-thirds of the equipped area are kept fallow each year on a rotation basis.



Per capita wheat consumption in Afghanistan is one of the highest in the world. Pre-war, irrigated land produced 77 percent of all wheat and 85 percent of all food and agricultural crops. Irrigated yields are estimated to be three times that of rainfed yields.

In 1993, the average cost of irrigation scheme rehabilitation was an estimated US\$200/ha for small schemes. Rehabilitation costs for large, modern schemes, including main structures, are considerably higher.

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

Institutions

The Ministry of Water and Energy (MWE) is responsible for mapping, monitoring and management of surface water and groundwater resources. Following the United States invasion of Afghanistan the Ministry had the task of coordinating an effort to reintroduce power to areas of Afghanistan that had been cut off.

The Ministry of Agriculture, Irrigation and Livestock (MAIL) has the mission to restore Afghanistan's licit agricultural economy through increasing production and productivity, natural resources management, improved physical infrastructure and market development (MAIL, 2011).

Urban water supply is the responsibility of the Ministry of Public Works. Water supply and sewerage disposal in the Microrayon area of Kabul is the duty of the Microrayon Maintenance Department.

The mandate of the Central Authority for Water and Sanitation is urban water supply within the areal limits of the Master Plan of the city.

The Ministry of Mines is responsible for groundwater investigation and survey, especially for 'deep' hydrogeological mapping of strategic plans for optimal exploitation of resources.

The municipalities are responsible for surface water drainage and solid waste disposal.

The Ministry of Rural Development is active in designing deep wells and networks for parts of Kabul City outside the Master Plan, where shallow groundwater is salty.

Water management and finances

As described in Rout (2008), overall system management is led by a senior representative called *wakil* (Herat) or *mirab bashi* (Kunduz and Balkh). This person is usually a well-respected community member and landowner with experience and knowledge of the system as well as influence with the local government. In addition to system management, the representative also has the broader responsibility of liaising with adjacent irrigation communities, particularly over customary rights on the location and operation of the *sarband*. In some locations, a main canal committee supports the *wakil* or *mirab bashi*, while in others by a *mirab* or *chak bashi*. In both cases, the supporting role represents the different upper, middle and lower sections of a system. In larger systems, a *badwan* is responsible for operation and maintenance of the *sarband* because of its importance and high maintenance requirements.

Through a *mirab* (water master) (Herat) or *chak bashi* (Kunduz and Balkh) or a village committee, the recipient community is usually responsible for the management of operation and maintenance of all canals and structures downstream of the secondary canals to farm turnouts. The *mirab* or *chak mirab* is typically a well-respected landless sharecropper with a

working knowledge of system operation and maintenance. This official, may have one or two assistants, and is usually elected by water rights holders (landowners), or their sharecropping representatives, and serves as a link between the government water authority personnel and farmers. *Mirabs* generally receive some compensation in the form of farm products, such as wheat, for performance of their duties (ICARDA, 2002). Payment for the services of system representatives is traditionally set as a unit weight of crop (e.g. wheat). The amount of payment received depends on the level of the official.

Surface water systems are largely managed as autonomous units. While there are variations in structure, they essentially follow similar principles regarding election of representatives, payment for services, and contributions to maintenance and capital works. These organizations follow many of the concepts behind water user associations: stakeholder participation, community-based representation, financial independence and hydraulic integrity. Government involvement is generally minimal and largely confined to provision of emergency rehabilitation, dispute resolution and, in some instances, holding the register of water rights.

System maintenance generally takes place in early spring to coincide with low or no-flow, when labour is readily available.

Three decades of conflict have adversely affected the performance of irrigation systems and the ability of communities to sustain them. Since 2001, several initiatives have been launched to develop the irrigation sector and to better manage water resources. MWE, the lead government institution for revitalizing the irrigation system sector, receives support from international and bilateral donors. The major programmes are:

- Emergency irrigation and rehabilitation project (EIRP), financed by the World Bank, in all the basins (budget: US\$75 million);
- Emergency infrastructure, rehabilitation and reconstruction project, financed by the Asian Development Bank (ADB), Japan Fund for Poverty Reduction (JFPR), in the northern river basin (budget: US\$15 million);
- Balkh basin integrated water resources management project, financed by the JFPR (budget: US\$10 million);
- Kunduz river basin project, financed by the European Commission (EC) (budget: US\$15 million);
- Western Basins Project, financed by the ADB, Canadian International Development Agency (CIDA) and Abu Dhabi Fund (budget: US\$ 90 million), in the Hari Rod-Murghab basin;
- Amu Darya river basin management programme, financed by the EC (budget: US\$5 million).

Numerous other agencies have contributed to rehabilitating irrigation systems, among them: the Ministry of Rehabilitation and Rural Development; the Danish Committee for Aid to Afghan Refugees; German Agro-Action, Urgence Réhabilitation Développement, World Vision and USAID (Rout, 2008).

Since 1990, FAO has actively been involved in irrigation rehabilitation and development activities (FAO, 2008). The nationwide Emergency Irrigation Rehabilitation Project (EIRP) financed by the World Bank, started in June 2004, implemented by the MWE with support from FAO. With this project farmers and their families will benefit from improved, reliable and equitably distributed irrigation water, which leads to increased agricultural productivity, better income, improved food security and reduces the farmers' vulnerability to drought. As of May 2008, 495 299 ha of agricultural land had been rehabilitated, of which about 80 000 ha was brought back under irrigation.

Project monitoring and evaluation recorded that satisfactory changes have been achieved by the project, for instance the average yield in irrigated areas has increased by 24 percent. Significantly increased wheat yield has improved rural household income, farm employment and poverty alleviation. The provision of irrigation water has contributed to increased production of high-value crops including barley, maize, rice, vegetables, cotton, orchards and horticulture, which could potentially earn foreign exchange (FAO-Water, 2011).

Maloma canal, in the Karokh district of Herat province, is one scheme that has been recently rehabilitated under the EIRP, with a capacity of 2 m³/s. Dawandar Wash feeds this canal. During the period of conflict this irrigation scheme suffered from the direct and indirect impacts of the war such as bombing, lack of proper maintenance because of farmers' displacement or migration, erosion, river regime change, etc. This canal is the only source of water for irrigation as well as drinking for four main villages with 1 330 households. Since 1990, FAO has rehabilitated more than 1 200 similar schemes. More than 700 schemes at an approximate cost of US\$460 million were ready for implementation on availability of funding (FAO, 2008).

In the north of Afghanistan, at Kokcha river in Kunduz and Takhar provinces, EIRP is completing a feasibility study for a Lower Kokcha Irrigation and Hydropower Project. Once completed, this project will supply water to a further 132 000 ha of agricultural land (FAO-Water, 2011).

In light of the success of EIRP, the World Bank has agreed to allocate a further US\$28 million with additional scope of work for the next two years in addition to the US\$75 million originally allocated. During the period, preparations for a follow-up phase will be launched to target up-scaled irrigation rehabilitation, restoring incomplete bulk water supply systems (such as dams and reservoirs), installation and operation of hydro-meteorological networks; preparation of river basins water master plans in addition to capacity development and institutional strengthening. The World Bank also plans to allocate US\$200 million for a four-year follow-up phase based on multi-donor funding basis and inter-ministerial coordination (FAO-Water, 2011).

Between 2004 and 2011, FAO-assisted irrigation projects helped Afghanistan increase its crop productivity and coverage of irrigated land. Some 778 000 ha of land have been rehabilitated, of which 158 000 is newly irrigated. As a result, wheat productivity in project areas has increased by more than 50 percent (FAO, 2012).

USAID has rehabilitated three major rural irrigation systems – Char Dara, Bala Doori and Darqad – and returned more than 300 000 ha of cultivated land to full irrigated production. This included de-silting and widening irrigation canals, repairing and replacing water intakes, canal banks, protection walls, turnouts and sluice gates. In general, the completed projects are providing a reliable source of water for irrigation and could potentially double the regions' crop yields. The irrigation projects were all completed in 2004. Hundreds of local farmers were employed on the project sites (USAID, 2009).

USAID has allocated US\$1.5 million to introduce hydroflumes, a simple water-saving system. The system is designed to increase domestic crop production through the efficient distribution of water. Officials at MAIL said the technology could improve productivity, but how rural farming communities access and use it will be a challenge, since most farmers are illiterate and uneasy about using new technology (IRIN, 2009).

With the support of the United States agribusiness development teams, canals across provinces in eastern Afghanistan are being restored to protect the nation's valuable water resources. Major irrigation rehabilitation projects in Nangarhar have focused on strengthening the capacity of the provincial level agriculture ministry's ability to develop, execute, monitor and assess water management projects. The Nangarhar Provincial Directorate of Agriculture, Irrigation and

Livestock has recently rehabilitated 24 major rural irrigation systems and returned more than 240 ha of cultivated land to full production (US Central Command, 2011).

It is important to note that a great deal of information, resources and institutional capacity for accurate monitoring and reporting on natural resources were lost during the years of conflict. While significant efforts are underway to fill the information void, many inaccuracies and gaps remain (Rout, 2008).

Policies and legislation

The Afghanistan Government instituted the 1981 Water Law to improve the situation of water rights. The Water Law, however, needs updating and revision before it is ready to be enforced. The Water Law has seven chapters, including issues such as ownership of water, which belongs to the public and is preserved by the government. Drinking water and water for other living requirements has been given priority over other uses. Use of water is free of charge. The Law deals with special regulation of the use of water for agriculture (water rights, water distribution, water user associations, *mirab*, and tax breaks for converting dry cropping land to irrigated land); drinking water and water for transportation; water pollution, water distribution, etc. Chapter two mainly deals with assigning authority and responsibility to MWE (ICARDA, 2002).

ENVIRONMENT AND HEALTH

Afghanistan faces many environmental problems, mainly the degradation of water tables and wetlands and deforestation (some 40 percent of forests have been cut down) (IRIN, 2003).

Excessive use of groundwater for a variety of purposes has significantly depleted water tables and aquifers throughout Afghanistan and, if the trend is not reversed soon, the country will face a severe shortage of drinking water. The recurrent droughts, low precipitation and poor water management have exacerbated the water crisis. Over the past several years, groundwater sources have been reduced by about 50 percent. Limited access to surface water has prompted many farmers, mostly in the drought-stricken south and north, to increasingly use groundwater to irrigate agricultural land or dig deep wells. The majority of the population uses groundwater as its prime, and often only, source of drinking water. As groundwater reduces, therefore, the number of people with access to drinking water declines (IRIN, 2008).

Surface water quality is excellent in the upper basins of all rivers throughout the year and good in the lower basins in spite of large irrigated areas. As far as known, the presence of saline soil in irrigated areas is not caused by poor water quality but rather by either over-irrigation (waterlogging) or lack of irrigation water (fallow fields and high groundwater table) (Qureshi, 2002).

Groundwater quality is generally good, but varies from place to place. In lower reaches of river valleys, groundwater is frequently saline or brackish and not usable for either drinking or irrigation (Favre and Kamal, 2004).

The problems in a river basin are usually intricate and interlinked. Therefore, no single and isolated solution can work effectively. A holistic and integrated approach is needed to tackle the problems. It essentially requires the setting of goals, preparing plans, collaborating with different institutions and stakeholders and above all effective implementation of the proposed management options (ICARDA, 2002).

Floods are generally violent and can cause serious damage to agricultural land or inhabited areas. About 50 gabion river protection works and 50 flood protection masonry walls were constructed before the war, mostly in the Nangarhar and Parwan provinces, in the eastern region.

Across the country 174 hydrological stations are being installed, the network of stations will measure rainfall, relative humidity, water level, water quality, temperature and sunshine (FAO-Water, 2011).

PROSPECTS FOR AGRICULTURAL WATER MANAGEMENT

The long-term development of the irrigation sector should consider the following key issues (Rout, 2008):

- improving system efficiency and productivity through enhancing infrastructure, increasing the equity of water allocations and developing water storage systems;
- enhancing system operation and maintenance by improving the organization of informal systems, financial self-sufficiency, design of structures to reduce de-silting, protection against water loss and approaches to maintenance;
- increasing sustainability of water resources through development of integrated catchment management plans and sustainable environmental management.

There is great potential for developing both shallow and deep groundwater systems for irrigation and other uses, but precaution must be taken to avoid adversely affecting users of existing systems (Rout, 2008).

Afghanistan does not use the water from the Amu Darya river as it should. Proper use of water from the Amu Darya river would bring thousands of hectares of land under irrigation in northern Afghanistan (ICARDA, 2002).

With rehabilitation of systems and improved management, it is estimated that water use will increase to 35 km³ per year (Rout, 2008).

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