

Water Resource Development in Northern Afghanistan and Its Implications for Amu Darya Basin

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FOREWORD

The overall purpose of this report is to gain a greater understanding of Afghanistan's role in the use and management of the Amu Darya Basin. The development and management of water resources are critically important for the economic development of Afghanistan. This report focuses on the use of water resources from the Amu Darya basin where great gains for the country could be achieved by moderate investments, largely in rehabilitation of existing schemes. At the same time, the Amu Darya River is an international waterway where numerous interests need to be balanced.

The findings of the report illustrate that the current consumption of water from the basin by Afghanistan is very low, and a sharp increase in water use is not probable in the medium term. Moreover, the maximum amount of water that could be consumed by Afghanistan would never be very significant, and efficient use of water resource in the basin as whole and in particular by the lower riparians would more than offset any increased amount used by Afghanistan. Improved water management regimes could also provide for the necessary environmental flows in the basin to revitalize the environment around the Aral Sea.

Clearly, additional work is needed to establish detailed figures for potential needs and use of water by Afghanistan, but we hope this paper provides a useful overview of Afghanistan's role and interests in water resources management in the Basin.

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EXECUTIVE SUMMARY

There is a new hope for the return of peace and stability in Afghanistan, and this has evoked a strong interest in the international community in supporting Afghanistan in a massive program of economic reconstruction and development. Recovery and growth of the agricultural sector, Afghanistan's traditional mainstay, is at the core of this program, and provision of reliable and sustainable water supply will feature prominently in the upcoming reconstruction and development in Afghanistan. Although water resources management and development are critically important for all of Afghanistan's major river basins, the focus of this paper is on the Amu Darya basin, which, although it constitutes only 12 percent of the Afghan territory, supports about 25 percent of the Afghan population. Already the most productive agricultural region of Afghanistan, the Amu Darya Basin also offers the best return to additional investment in water resource development. Further, this paper will primarily focus on the assessment of surface water resources, particularly rivers with permanent flow to the Amu Darya, and water use in the agricultural sector.

Located in the heart of Asia, Afghanistan has a land area of 652,000 sq km, about the size of France. It is located between latitudes of 29.5N-38.5N and longitudes 60.5E-75E and bordered by Tajikistan, Uzbekistan and Turkmenistan to the north, Iran to the west, Pakistan to the south and east, and China to the far northeast. Much of Afghanistan is mountainous and the presence of the mountain range in the center of the country determines its climate and the precipitation. Areas to the north of the high mountains and ridges have a dry, continental climate. In the northern valleys, annual precipitation averages 300 mm. The south is characterized by a less-continental climate; summer is relatively cool, winter is relatively moderate, and rainfall is higher. Precipitation in the east and southeast is near 800 mm annually, concentrated in the summer when monsoon brings rain, but elsewhere in the south, annual precipitation averages only 170–196 mm.

Afghanistan has a low population density, concentrated in the valleys along major rivers. According to World Bank data, the national population was 27.2 million people in mid-2001 and the population is growing at an annual rate of about 3.6 percent, including the return of refugees from Iran and Pakistan (World Bank 2001). Afghanistan's population is made up of several ethnic groups, major groups include Pashtun, Tajik, Hazara, Uzbek, Turkmen, Baluch and

others. Traditionally, most Afghans have lived in rural areas, but war, growing poverty, years of drought and forced relocation have brought about a move to the cities. Agriculture accounts for 50 percent of the GDP, and employs 85 percent of the labor force. Prior to the war, Afghanistan was self-sufficient in food production, and supplied 62 percent of dried fruit in the world market.

Agriculture by far is the major user of water, accounting for more than 93 percent of total water use in the country. Due to topography and high mountains, potential for hydropower generation is large but very little has been developed so far. Afghanistan can not meet its current energy demand even though present per capita energy consumption is extremely low by the world standards. Afghanistan has a significant amount of water resources, more than 80 percent derived from snowmelt in the Hindu Kush. Recent estimates are that the country has 75 billion cubic meters (bcm) of potentially available renewable water resources annually, of which 57 bcm is surface water and 18 bcm ground water. Surface water resources are also the main source of recharge for groundwater as precipitation is low in Afghanistan. Annual water use for irrigation is 20 bcm, drawn mostly from surface water.

Afghanistan has three major river basins, the Helmand River in the Sistan Basin draining towards Iran, the Kabul River in the Indus Basin draining towards Pakistan, and the Amu Darya River in the Amu Darya Basin draining towards Central Asian States. The Kabul River Basin has the highest annual flows (about 24 bcm) but the least area (79,000 km²), followed by the Amu Darya Basin (about 17 bcm) with an area of about (242,000 km²), and the Helmand River Basin (about 14 bcm) but with the greatest area (320,000 km²).

The Amu Darya basin, however, has the most irrigated lands (about 1.16 million ha) and the highest area under rainfed agriculture, and is therefore, the most important for Afghanistan as indicated above. Although quantity of irrigated land in the Helmand River Basin (1.1 m ha) is comparable to that of the Amu Darya Basin, the Helmand Basin has very little area with rainfed agriculture. The Kabul Basin has the least irrigated area (less than 0.5 million ha) primarily because of topographic limitations.

The Amu Darya Basin in Northern Afghanistan has three sub-basins:

- (i) Local river systems adjacent to the Amu Darya, including the Khulm, Balkh, Sar-e-Pul, and Sherintagau, are mostly consumed locally and reach the Amu Darya only rarely. These are some times called “blind” or national rivers;
- (ii) Transboundary river systems of Harrirud and Murghaab in the Amu Darya Basin flow northward and are shared to varying extent with Turkmenistan, but have lost links with the Amu Darya.
- (iii) Rivers flowing to the Amu Darya include the Wakhan, Pamir and other rivers of Badakhshan, Kokcha and Kunduz Rivers. These are the only rivers contributing to Amu Darya flows and truly are part of the Amu Darya Basin, constituting transboundary flows between Afghanistan and Central Asian States of Tajikistan, Uzbekistan and Turkmenistan.

Major Findings

This study attempts to provide an overview of (a) the amount of Amu Darya flows generated in the northern Afghanistan; (b) the amount of water presently used in northern Afghanistan, prospective use in the near future, and possible impact of the increased use on the riparian states and the Aral Sea; (c) existing agreements between Afghanistan and the neighboring Central Asian States regarding the use waters in the Amu Darya Basin, their relevance and applicability in the present and in the future; and (d) future directions for water resources development and improved water management in the basin.

Scarcity of data and information has been a key constraint in carrying out this study and the main reason for somewhat indefinite answers to the above questions. Adequate data is not available to provide assessment of non-agricultural water uses, such as the supply and potential for hydro-power production and domestic water use, as well as future trends. Non-agricultural water uses

should be addressed in future studies as the information becomes available. This study is primarily a desk study and is based on research and documents collected from institutes working on water resources management and development issues during the Soviet period, the United Nations Repository, work done by the Development Alternatives Incorporated (1993), FAO, and discussion with experts who have knowledge of the water resources in Northern Afghanistan. The major findings are given below:

Water Flows Generated in the Northern Afghanistan. Hydrological observation points that have existed on and along major rivers have not been functioning since 1978, and therefore, data on river flows does not exist. Estimates of river flows are taken from various sources prepared primarily during the 1960s and 1970s. Because flows from all sources/tributaries were never measured, estimates of unmeasured flows were prepared by various experts using different methods, and as a result there are slight differences in the various estimates (see chapter 2, Table 6). Variations in the estimates primarily depend on which parts of Northern Afghanistan and its various sub-basins are considered as part of Amu Darya basin. The “blind” or national rivers (category (i) above) are estimated to have a combined average annual flow of about 2.1 bcm; the rivers flowing to Turkmenistan (category (ii) above) have a combined average annual flow of about 2.7 bcm and rivers with permanent flow to the Amu Darya have 12.2 bcm. For the purpose of this study, only the rivers with permanent flow to the Amu Darya are considered as they constitute the transboundary flows with Tajikistan, Uzbekistan and Turkmenistan, and with the Aral Sea.

Surface Water Use in Northern Afghanistan and its likely impact. The total irrigated area in Northern Afghanistan, in all three sub-basins, is estimated at about 1.16 million ha, 385,000 ha of which is situated on and along the rivers with permanent flow to the Amu Darya. The total water use in Northern Afghanistan is estimated at 9 bcm, including consumption of 2.1 bcm from the blind rivers, 1.7 bcm from rivers flowing to Turkmenistan, and 5 bcm from tributaries with permanent flow to the Amu Darya.

In 1965, water diversions from the tributaries which flow to the Amu Darya were estimated at 2.5 bcm. However, evidence from 1980s indicates a total diversion of 5 bcm in the sub-basin. This estimate is consistent with the general per hectare water use of 13,000 cubic meters (cm) on the total area of 385,000 ha. Assuming a delivery and application efficiency rate of 40 percent, per hectare use of water would come to 5,200 cubic meters. This use rate seems to be consistent with the biological water requirements of crops grown in the area. There are some return flows from the irrigated areas and therefore, the net diversion from Amu Darya tributaries may be less than 5 bcm. The diversions at present are likely to be much lower than this figure due to deteriorated irrigation systems.

When the irrigation systems are rehabilitated and areas under inactive irrigation come under full production, it is safe to assume that the water diversions in the region would be around 5 bcm. Evidence indicates that a 15–20 percent expansion in irrigated area would be feasible on technical grounds (availability of suitable soils and based on various studies) if additional investments are made in expanding the irrigated areas. This means a total area of about 443,000 ha in this region, and therefore a total water diversions of about 5.8 bcm or at the most 6 bcm, (because water diversion rates for the new lands would be higher because of low water use efficiency). Consequently, based on available information and analysis, a drastic increase in water use in Northern Afghanistan is unlikely. Water use of 6 bcm would mean a 20 percent increase over the historic withdrawals by Afghanistan, but less than 2 percent of the total water resources of Amu Darya. While this level of diversions may be achieved by Afghanistan 20 years from now, over the course of the next decade the focus will be on rehabilitation of the irrigation systems and possible expansion during the second decade. Thus, the impact of increased withdrawals in Northern Afghanistan on the riparian states would be negligible, and if any, it is likely to be felt only during the dry years. Tajikistan would not be affected by potential developments in Northern Afghanistan. Some impact is conceivable on Uzbekistan and Turkmenistan during dry years, but if the present practice of passing on the deficit (to the extent possible) to the Aral Sea continues, then the Sea would be impacted, rather than the irrigated lands.

Although Afghan water diversion is likely to increase from the current low levels, water management improvements in Uzbekistan and Turkmenistan should compensate for additional water use by Afghanistan, supply additional water to the Aral Sea, and enhance those riparians' productivity of irrigated agriculture. The significant amounts of drainage water now being generated that are at present evaporated in desert sinks could be better used. Water application for several crops, including cotton and rice, is several times more in Turkmenistan and Uzbekistan than any other place in the world, and could be reduced. Farm management practices such as a simple and inexpensive land leveling could reduce water application significantly. At present, the average level of drainage effluent in the Amu Darya Basin (particularly by Uzbekistan and Turkmenistan) is about 5,000 m³/ha which could easily be reduced to 3,000 m³/ha with improved water management practices. This would result in additional water savings of about 8 bcm (taking 4 million ha of irrigated area in Uzbekistan and Turkmenistan in the Amu Darya Basin), much more than the possible increase in water use in Northern Afghanistan. In the absence of water savings, the most likely scenario is continuation of the present situation where the deficit would be passed on to the Aral sea.

Water Sharing Agreements. Several international agreements between Afghanistan and the Union of Soviet Socialist Republics have been signed, and the most notable are the 1921, 1946, and 1958 agreements, focusing primarily on the issues related to the border between the two countries. A focus of these agreements has been on delineating the borders along the Amu Darya River, rights of navigation in the river, and maintaining water quality in the river. In the 1958 treaty, the parties agreed that any major construction on the Panj and the Amu Darya, both frontier waters to Afghanistan and the former Soviet states, should take place only after agreement between the parties.¹ These above agreements, based on international law principles, are still applicable. However, no agreements exist regarding water allocations, in the form of volume or share between the parties. It is likely that the reason for this was because water use within Northern Afghanistan was very limited and therefore there was no need for agreement on the issue.

There are various agreements among the other Central Asian States that limit withdrawals from the Amu Darya by them. These limits were introduced in recognition of the problem of Aral Sea decline. Currently, these agreements serve as the basis for water allocation and management in the basin. Details regarding these and various other agreements related to Northern Afghanistan are given in Chapter 5 of the report.

Future Directions. As shown above, water use in Northern Afghanistan at present is very low, and a substantial increase is not expected during the next two decades. While many water experts are concerned about the status of water use agreements between Afghanistan and other riparians of the Amu Darya and consider conclusion of new agreements a priority, analysis shows that increased water use by Northern Afghanistan is not a major issue. Therefore, in the short run, the focus should be on cooperation with Afghanistan at the technical level, which would be helpful in improving water assessment and management in the basin and reaching more definite water use agreements if they are needed in the future. Consultations and collaboration with the riparian states of the Amu Darya should begin at the technical level, between the hydromet staff, water planners and operation of major water/river systems. These consultations would be the initial stage of deepening the dialogue for the future basin-wide water management and development.

The study recommends that future work for water management in Northern Afghanistan should move in four main directions: (i) improvements in hydrological data base, including measurements of flow at key points in the river system; (ii) improved assessment of past and present irrigated areas and of potential for developing new irrigated lands; (iii) assessment of key hydraulic infrastructure, including the rehabilitation requirements; (iv) consultation and collaboration with the other riparians of the Amu Darya. Details are provided in chapter 6 of the study.

1. See Treaty Between The Government of the Union of Soviet Socialists Republics and the Royal Government of Afghanistan Concerning the Regime of the Soviet-Afghan State Frontier, January 18, 1958, Afghanistan-U.S.S.R., United Nations Treaty Series, Vol. 321, p. 176, 182

INTRODUCTION AND BACKGROUND

The hostilities that began in 1978 have devastated Afghanistan. Shelling has turned many urban areas into rubble, and the underpinnings of a formal economy beyond subsistence farming and animal herding have been all but destroyed. Public infrastructure, including the ability to deliver the most basic health, education, and other social services, has collapsed. Published data may not be reliable, because validated national data has been impossible to obtain since 1978; however, the best estimate is that Afghanistan's per capita GDP is US\$280/year. Infant, child, and maternal mortality rates are believed to be among the highest in the world; the proportion of disabled people, the rates of injury due to land mines and the number of personal weapons per person are also among the highest in the world; literacy, life expectancy and food availability are among the lowest in the world. An estimated five million Afghans live as refugees in neighboring Pakistan, Iran and elsewhere in the world, and an additional one million conflict-displaced people are scattered within Afghanistan.

Today, renewed hope for the return of peace and stability to Afghanistan has evoked a strong interest in the world community in supporting Afghanistan's new government in a massive program of economic reconstruction and development. Recovery and growth of the agricultural sector, Afghanistan's traditional mainstay, is the core of this program. It is certain that consideration of water resources will feature prominently in plans for the reconstruction and development of Afghanistan. Although water resources management and development are critically important for all of Afghanistan's major river basins, the focus of this paper is on the Amu Darya Basin, which, although it comprises only 12 percent of the Afghan territory, supports about 25 percent of the population (FAO/WFP 2001). Already the most productive agricultural region of Afghanistan, it is also the one best able to generate a return on additional agricultural investment. This paper will primarily focus on the assessment of surface water resources in Northern Afghanistan. Further, it will assess implications of increased water use in the agricultural sector on the Amu Darya Basin as a whole.

Physical Setting

Location and Topography. Located in the heart of Asia, Afghanistan has a land area of 652,000 sq km, about the size of France. It is located between latitudes 29.5N-38.5N and longitudes 60.5E-75E.

It is bordered by Tajikistan, Uzbekistan and Turkmenistan to the north, Iran to the west, Pakistan to the south and east and China to the far northeast. Much of Afghanistan is dominated by the Hindu Kush, the westernmost extension of the Karakoram and the Himalayas. The Hindu Kush and the lower mountain ranges of Baba and Safed Koh divide the country into its Northern and Southern regions. Map 1 shows Afghanistan's topography, elevation, and relief.

About 65 percent of Afghanistan's area is comprised of mountain ridges and massifs. Average height in this area is 1850 m. The snow line is between 4000–5000 m, so there is little permanent snow and there are few glaciers. Outside the mountainous areas that dominate the center, much of Afghanistan is arid plainland. Deserts of different types occupy about 18 percent of Afghanistan. Only 17 percent of Afghanistan's area is occupied by river valleys, which include the valleys of the Amu Darya, Harrirud, Helmand, and Kabul, as well as smaller rivers. Runoff from the mountains into the Kunduz, Kabul, Helmand, and Harrirud Rivers is heavy for a brief period during the spring thaw, sometimes causing floods and landslides. During the rest of the year, runoff tends to be irregular and low.

Climate and Precipitation. Afghanistan is located at sub-tropical latitudes, but the topography, in particular the range of high mountains in the middle of the country, is the determining factor in its climate and precipitation. Areas to the north of the high mountains and ridges have a dry, continental climate. In the northern valleys, annual precipitation averages 300 mm, most falling from December to May, while in the north overall, annual precipitation averages 400 mm per year. The areas to the south of the high mountains are characterized by a less-continental climate: summer is relatively cool, winter is relatively moderate, and rainfall is higher. Precipitation in the east and southeast is near 800 mm annually, concentrated in the summer when the monsoon brings rain, and elsewhere in the south, annual precipitation averages 170–196 mm. Average annual precipitation on the northern plains is 125 mm, and the average on the southern plains 110 mm. While the overall national average temperature in July is +32°C, and in January –2°C, temperatures drop to –50°C in the Hindu Kush mountains, while in the deserts (Dasht-e Margo) summer temperatures reach +50°C.

Land, Soils and Vegetation. Cultivable land is limited in Afghanistan and mostly confined to the river valleys. Rainfed agriculture is found predominantly in the northwestern part of the country, where temperatures are lower during summer and precipitation is adequate as to amount and reliability. On the high mountains, although precipitation is adequate, the potential for cropping is nevertheless limited by several factors. First, the terrain is rocky and the soil thus not suitable for cultivation. Second, the frost-free period in these areas is short. In most locations of Afghanistan, cropping is impossible without irrigation. Afghanistan's eastern region, its only major forested area, has valleys that have traditionally been fertile. In the south, the growing season is long enough for double cropping, but precipitation is inadequate or erratic. In the north between the blind rivers and the Amu Darya, and in the southwest, where elevation drops below 300 meters, the terrain is mostly desert; there are no water resources and as a result little vegetation. Overall, Afghanistan's natural vegetation is characterized by tarragon, Russian thistle and astragalus at the lower altitudes of 1500–1800 m; saxaul and wild melon in the sandy deserts; wild pistachios and archa trees on hillsides; desert vegetation at altitudes of 2200–2500 m; and on gray-brown soils, European needle grass and some good Alpine meadows.

Socioeconomic Setting

Population and Regions. Afghanistan has a low population density. According to World Bank data, the national population was 27.2 million people in mid-2001 (World Bank 2001). Population growth has been at an annual rate of about 3.6 percent since then, including the return of refugees from Iran and Pakistan. Afghanistan's population is made up of several ethnic groups. Pashtuns account for 53 percent of the population and are concentrated in the east and south; Tajiks account

for 17 percent and are concentrated in the northeast; Turkic groups (mostly Uzbeks and Turkmen) account for 10 percent and live on the northern plains. The remaining 20 percent of Afghans belong to about 20 other distinct ethnic groups, among which the largest groups are the Hazaras and the Aymaks located in the mountainous center, the Baluch in the desert south-west and the Nuristanis in the mountainous east. More than 30 languages are spoken in Afghanistan. Ninety-nine percent of Afghans are Muslims (of which 84 percent Sunni and 15 percent Shia); the other one percent are Sikh, Hindu or of other religions.

Traditionally, most Afghans have lived in rural areas. But war, growing poverty, years of drought and forced relocation have brought about a move to the cities. Kabul's current population of more than two million reflects large-scale migration to the city. Moreover, the conflict that began with the Soviet invasion of 1979 is thought to have claimed the lives of almost two million Afghans and forced five million into exile, mostly to Pakistan and Iran. After Kabul, Kandahar and Herat are the largest cities in Afghanistan.

Pre-War Economy. Afghanistan's economy has traditionally been based on crop production and animal husbandry. Cropping is concentrated in the valleys, where snowmelt water is available to supply irrigation, while animal husbandry is practiced in both valley and mountain regions. Wheat is Afghanistan's main crop, accounting for about three quarters of food grain production. Other important crops include rice, maize and barley. Fruits and vegetables are grown for domestic consumption and also as cash crops. Afghan dried fruits (mainly almonds and apricots) accounted for 60 percent of the world market in 1982, though the share declined by 1990 to about 16 percent and is even lower now. However, this small share remains an important source of foreign exchange. Table 1 presents some trends in crop production, showing the impact of the first fifteen years of war.

The livestock population—estimated in the late 1970s at 6.5 million karakul sheep, 15 million other sheep, 3.7 million cattle, 3.2 million goats, and 0.5 million horses—was also adversely affected by the war. A 1988 survey found that the number of cattle was down by 55 percent, and that of sheep and goats by 65 percent.

Before the Soviet invasion, Afghanistan was largely self-sufficient in food and was a significant exporter of agricultural products. Manufacturing was largely undeveloped having a few plants producing textiles, medicine, cement, and agricultural processed goods. The macroeconomy was balanced, with surpluses in the Government's budget, a market-based competitive exchange rate, and modest foreign and domestic debt. Afghanistan's strategic position during the Cold War period made it a recipient of a large amount of foreign aid, which funded government operations without substantial taxation. Also as a result of foreign aid, the country had relatively good major roads and some other infrastructure, including major irrigation and hydroelectric facilities.

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Current Economy. Data on the development of the economy since 1979 is sketchy. GDP and import/export data from a decade ago are presented in Tables 2 and 3 below, both taken from the 1993 rehabilitation action plan prepared under the auspices of the United Nations Development Program (UNDP). This data shows the economy's deterioration during that time. Currently, the economy of the country depends heavily on imports, and the value of imports is several times larger than that of exports (see Table 3 below).

TABLE 1: AGRICULTURAL PRODUCTION ESTIMATES
('000 tons; fiscal years beginning Mar 21)

Crop	1978	1994
Wheat	2,652	1,728
Maize	765	360
Rice (paddy)	428	300
Cotton	140	20
Sugarcane	100	0
Sugar beet	91	5
Fruits, including grapes	779	680
Potatoes	780	750

Source: Operation Salam, United Nations.

TABLE 2: COMPOSITION OF GDP IN 1989 AND 1991/92

Origins of GDP	1989	1991/1992
Total GDP	Na	USD 1.72 bn
Agriculture	52.6 percent	45.5 percent
Industry and mining	28.5 percent	13.6 percent
Services	1.7 percent	16.9 percent
Trade	7.9 percent	8.4 percent
Construction	5.8 percent	4.5 percent
Transport & communications	3.5 percent	2.7 percent

Source: 1993 Rehabilitation Action Plan, UNDP

TABLE 3: EXPORTS AND IMPORTS

Principal exports 1990	mlns US\$
Fruit & nuts	93
Carpets	44
Karakul (sheep) skins	3
Cotton	3
Principal imports 1988	mlns US\$
Capital goods	293
Food	150
Textile	117
Petroleum products	99
Sugar and vegetable oil	53

Source: 1993 Rehabilitation Action Plan, UNDP

taken over relatively early by the Taliban. This recovery was short-lived. There was large-scale exploitation of natural resources of the country, including opium production. Unsustainable exploitation of natural resources led to deforestation and environmental degradation. From 1998 to 2001, Afghanistan experienced four consecutive years of drought. Crop production was halved and livestock herds were depleted, erasing the gains of 1995–1998. By 2001, there was mounting evidence of widespread famine in the country (still an issue in 2003), including substantially reduced food intake, a collapse in purchasing power, emergency sales of livestock, depletion of personal assets, soaring food prices, increasing numbers of destitute people, and a growing number of internally displaced people.

Though the political environment has changed again, the issues presented by the drought remain to be solved by Afghanistan's new government. Moreover, aid agencies warn that the influx of returning refugees during 2002 is straining scant resources and that more food aid is desperately needed. Nearly a third of the population is dependent on food aid for survival, and the UNDP estimates that 70 percent of Afghans are malnourished. Precipitation was higher in 2002, but not enough to make up for the four-year deficit. Though higher precipitation would help, the food shortage will persist until the irrigation systems are rehabilitated so as to limit producers' vulnerability to annual variations in precipitation and drought risks.

By the mid-1990s, civil institutions were destroyed, both modern and traditional, as were most of the country's limited modern infrastructure and much of its irrigation. Key economic institutions of the state—such as the central bank, treasury, tax collection, customs, statistics, civil service, law and order, and the judicial system—were extremely weak or non-functional. The few large-scale industries that had formerly existed had ceased to function. Much of the irrigation infrastructure that had not been destroyed had become unusable because of lack of maintenance. Agricultural land was heavily mined (even now, Afghanistan is one of the countries most heavily affected by landmines in the world), and a significant area of otherwise valuable land was unavailable for cultivation as a result. Agricultural production had fallen sharply, and livestock herds were depleted.

With the emergence of the Taliban in 1994, there was a modest economic recovery from 1995 to 1998, attributable primarily to the cessation of conflict in over 90 percent of the country and concentrated in areas

WATER RESOURCES

Afghanistan has a significant volume of water resources, ultimately springing from precipitation in its high mountains. More than 80 percent of the country's water resources come from snowmelt in the Hindu Kush. Most of the winter's snow accumulation melts in the summer. In the easternmost part of the country where elevation is highest, there is snow accumulation contributing to long term storage of water resources.

Recent estimates are that the country has 75 billion cubic meters (bcm) of potentially available renewable water resources annually, of which 57 bcm is surface water and 18 bcm ground water. Annual water use for irrigation is 20 bcm, drawn mostly from surface water. Table 4 shows the estimated surface and ground water balance (note that the estimate of ground water resources is on the higher side). The source of groundwater is recharge from the river flows, because precipitation is very limited.

Surface Water—River Systems and Basins

Afghanistan is divided into hydrological units by the mountain range that goes through the center of the country, from which diverge three major watersheds: the Helmand River, the Kabul River, and the Amu Darya. The Helmand River originates on the southern slopes of the Hindu Kush and flows southwest to the Sistan Basin in Iran. The Kabul River originates in the southeastern Hindu Kush and flows south through the city of Kabul, then turns east and joins the Indus River in Pakistan. The Amu Darya originates on the northern slopes of the Hindu Kush and from Wakhan in the Pamir Highlands in Afghanistan. Last, approximately 11 percent of the territory of Afghanistan, some in the southern stony deserts and some in the area between the blind rivers on the northern slope of the Hindu Kush, has no surface water resources.

Hydrological data is not current. Hydrological observation points along major rivers were established from 1939 through 1978, and hydrological studies were carried out during that period, but since 1979 hydrological observations have been intermittent due to war and instability. Estimates based on available data are as shown in Table 5.

TABLE 4: ESTIMATED SURFACE AND GROUNDWATER RESOURCES (BCM/YEAR)

Type of Water Resources	Potential (bcm)	Present Situation (bcm)		Potential Situation (bcm)	
		Used	Unused	Future Use	Unused
Surface Water	57	17	40	30	27
Groundwater	18	3	15	5	13
Total	75	20	55	35	40

Source: FAO, Water Resource Assessment, 1996.

TABLE 5: CHARACTERISTICS OF MAJOR RIVER BASINS OF AFGHANISTAN

	Kabul River/ Indus Basin	Helmand River/ Sistan Basin	Amu Darya River and Basin
Basin area in Afghanistan (km ²)	79,360	320,240	242,400 ^a
Annual flow (average) (km ³)	24.0	14.0	19.0
Share of country's annual flow (%)	42.1	24.6	33.3

Source: 1968 Master Plan, Government of Afghanistan

Helmand River Basin. The Helmand River rises entirely within Afghanistan's borders. Its basin has a total area of 386,000 km², of which about 321,000 km² lies within Afghanistan, about 78 percent of the total. Approximately 20 percent of the basin is in Iran, and the remaining 2 percent in Pakistan. By area, this is the largest river basin in Afghanistan, but the river's average annual flow is only about 14 bcm. In 1993, the Helmand River irrigated about 1.5 million hectares (DAI 1993).

Kabul River Basin. The Kabul River also rises entirely within Afghanistan. Its basin area within Afghanistan is 79,360 km², and the river's average annual flow is 24 bcm. About 0.55 million ha of agricultural land is irrigated by this river. Although the Kabul River has the largest flow of all of Afghanistan's rivers, it can irrigate only a limited area because there is little land suitable for agriculture in the Afghan part of its basin—for the most part, it flows through mountainous or rocky areas.

Amu Darya Basin. The Amu Darya is the longest river in Central Asia. From its headwaters at an altitude of 4,900 m on the Wakhan glacier in Afghanistan, it travels 2,540 km, of which 1,250 km are within Afghanistan or along its border. After confluence of the headwaters (the Wakhan River) with the Pamir River that flows from Zor-Kul Lake, the river is called the Panj; after confluence with the Vakhsh river, a right tributary, it is called the Amu Darya. After passing the frontier settlement of Khamaab, it flows to the Central Asian countries—Uzbekistan and Turkmenistan—and falls into an inland sea, the Aral Sea. It is the main source of irrigation and drinking water supply in the Aral Sea Basin.² As for its area within Afghanistan, estimates vary (as will be detailed below), depending primarily on whether sub-basins of rivers that no longer reach the Amu Darya are included, but it is on the order of 250,000 km². Estimates of average annual flow also vary from 13.3–19 km³, depending both on whether those sub-basins are included, and also on the flow estimate for the Amu Darya's Badakhshan tributaries, which vary significantly (see Table 6 below).

2. The Syr Darya, which originates in the Kyrgyz Republic and passes through Tajikistan, Uzbekistan, and Kazakhstan before terminating in the Aral Sea, has an annual flow about half that of Amu Darya—that is, 40 bcm approximately. It is the Aral Sea Basin's second major source of water.

TABLE 6: WATERSHED AREA AND RIVER RUNOFF IN NORTHERN AFGHANISTAN ACCORDING TO VARIOUS INVESTIGATIONS

Rivers	According to V. L. Shultz		According to Master Plan 1967		According to A. A. Pyatigorsky, 1978	
	Runoff (mlns. M ³)	Watershed area (km ²)	Runoff (mlns. m ³)	Watershed area (km ²)	Runoff (mlns. m ³)	Watershed area (km ²)
(i) Local (Blind) Rivers	2,152	50,100	2,069	48,500	2,048.4	48,400
Khulim	60.8	8,400	67	8,400	58.1	8,400
Balkh	1,762.8	18,700	1,689	18,700	1,650	18,700
Sari-Pul (Safed)	222.5	9,400	212	7800	208.4	7,800
Shirintagao (Kaisar)	106	13,600	100	13,600	131.7	13,600
(ii) Zone adjacent to Turkmenistan	2,543	117,500	2,776	117,500	2,543	117,500
Murghaab	1,576	70,620	1,587	70,620	1,576	70,620
Harrirud	967	46,880	1,189	46,880	967	46,880
(iii) Rivers Flowing Into the Amu Darya	11,639.4	83,200	14,102	90,000	9,307	94,400
Kunduz	3,619	31,300	3,798	37,300	3,594	30,500
Kokcha (Jurm)	5,397	21,100	5,749	21,900	5,713	21,900
Badakhshan rivers (inflow from mountains)	2,623.4a/	30,800	4,555	30,800	— (blind)	42,000
Total	16,334	250,800	18,947	256,000	13,898	260,300

a/Estimated based on a runoff rate of 2.73 l/s/km, using average runoff rate of the basin.

Sources: ICWC, Tashkent, Uzbekistan, Assessment of Water Resourced in Northern Afghanistan, page 13

The Amu Darya's average annual flow is about 75 bcm, ranging up to 108 bcm in high-water years (in 5 percent of years, the flow exceeds this level) and below 47 bcm in low-water years (in 95 percent of years, flow exceeds this level). It freezes only in its lowest reaches, mostly in the delta area prior to its entry into the Aral Sea. Most of the flow in the Amu Darya originates in glacier melt, snowmelt and rainfall in the Pamir mountains of Afghanistan and Tajikistan. Flow is highest in the summer (July-August) and lowest in the winter (January-February), because it is generated mainly by snow and glacier melt, although the pattern of flow in the downstream reaches is substantially modified by diversions and reservoirs in the system. The Amu Darya's main tributaries, after it springs as the Wakhan from the Wakhan glacier, are the Pamir and other rivers of Badakhshan and the Kokcha, Panj, Kunduz, Vakhsh, Kafirnigann, Surkhandarya, and Sherabaddarya Rivers. All of these are mountain tributaries as the Amu Darya has no significant tributaries along the 1,200 km length that flows through the plains. The Kashkadarya and Zarafshan rivers (flowing through Uzbekistan) used to flow into the right bank of the Amu Darya, but no longer reach it.

Within Afghanistan, although the Amu Darya Basin ranks both second to the Sistan in terms of area, and to the Kabul River/Indus Basin in total flow, it is of primary importance for Afghan agriculture. Half of Afghanistan's total agricultural production (including livestock herding) is found in the Amu Darya Basin.

In Afghanistan, the Amu Darya Basin has three types of sub-basin.

- (iv) Local river systems adjacent to the Amu Darya, including the Khulm, Balkh, Sar-e-Pul, and Sherintagau, are mostly consumed locally and reach the Amu Darya only rarely.
- (v) Several transboundary river systems in the Amu Darya Basin flow northward and are shared to varying extents with Turkmenistan and Iran, but no longer contribute to the Amu Darya. The Murghaab connects with the Karakum Canal, which itself is fed by the Amu Darya. The Harrirud (Tijen) today gives out in the Turkmen desert.
- (vi) Several important rivers make up the flow of the Amu Darya, including the Wakhan and Pamir from whose confluence it springs as the Vakhsh, the other rivers of Badakhshan, the Kokcha and Kunduz and other tributary rivers. These are the only rivers in northern Afghanistan that contribute to Amu Darya flows.

A more detailed description of these sub-basins and rivers are presented below:

Local River Systems, Also Called "Blind" River Systems

The Khulm, Balkh, Sar-e-Pul and Sherintagau River sub-basins, comprising a total area of 49,000 km², belong to the Amu Darya watershed. However, at present the flows from these rivers are consumed within the respective sub-basins and do not reach the Amu Darya. In high-water years, water from the irrigation areas on these rivers is released to closed depressions on the periphery of the irrigated area. Only in very high peak flow periods is water released (usually from the Balkh) to flow into the Kelif Uzboy channel, an ancient bed of the Amu Darya that is now used for the Karakum Canal (and flows away from the Amu Darya). Because these rivers normally do not reach a major water body, but rather disappear in the desert, they are often called "blind" rivers. Between the "blind" rivers and the Amu Darya is an area of about 72,500 km² that is without any surface water resources, and hence without outflow.

The Khulm River starts from the Kara-Kotal pass at an elevation of 3600 m. The river runs along a narrow gorge and then, near Tashkurgan, emerges from the gorge into a wide valley. The total length of the river is about 230 km and watershed area of 8400 km². The road between Kabul and Mazar-e-Sharif runs along this river.

The Balkh River, or Bandi-Amir (or Dara-e-Gez) has five lakes in its upper reaches as it runs through an area high in limestone deposits and with high groundwater resources. In its middle stretches it is called the Wadhab. A significant right tributary is the Dara-e-Suf. The river's length is

400 km and the area of its watershed is 18,700 km². At periods of peak flow, the Balkh flows into the Kelif Uzboy and on to Turkmenistan.

The Sari-Pul River, also known as the Safed, rises from many springs on the northern slopes of the Koh-e-Baba ridge. Near the city of Sari-Pul, these unite and form a river. The river's length is 215 km; width in midstream is 15–20 m; depth is 20 m. Estimates of the watershed's area vary, but are in the range 7800 km²–9400 km².

The Shirintagao River originates on the northern slope of the Tirbandi-Turkistan ridge near Gurzimen. The Maimana is a tributary, which in turn has as tributaries the Abu-Kaisar and Elmar rivers. The area of the watershed is 13,600 km².

Transboundary Rivers Shared with Turkmenistan and Iran, Not Reaching the Amu Darya

The area of the Murghaab watershed within Afghanistan is 46,880 km², and the area of the Harrirud watershed is 70,620 km².

The Murghaab River starts in the high uplands between the Safedkoh (Paropamiz) ridge and Band-e-Turkistan. Downstream from Muhamadhan, river water is diverted for irrigation. Approximately 1000 ha is irrigated just below Muhamadhan, though there are about 5000 ha of suitable land. From Kaisar tributary to Khan-Tapa it runs along the Turkmen-Afghan border. Upstream of Takhta-Bazaar (Turkmenistan) it receives the Kashan and Kushk tributaries.

The Harrirud River rises upstream of Sarjangan by the confluence of several springs near the village of Shahin. From its headwaters to Badgah village (27 km to the west of Daulatyar), the Harrirud runs through a wide valley of irrigated lands and pastures. From the village of Kushnami to the city of Obe, the river runs through a narrow valley. Downstream of Obe, the river widens flowing through a broad, flat valley. A great oasis is located here (of length 150 km and width 30 km) with an irrigation network covering 7000 ha, partly irrigated by the Jaam and Kashefrud rivers, tributaries of the Harrirud.

From its source to the Pul-e-khatum Bridge, the Harrirud is fed by many tributaries. Among these, the Tagaoushlan is important, as are the just-noted Jaam and Kashefrud. Downstream of Obe a number of tributaries cease to flow into Harrirud river. Especially during the summer, flows from the tributaries are fully used for irrigation. Flows from these rivers to Harrirud last three months at most.

Rivers Flowing into the Amu Darya

The Amu Darya has several important tributaries in the eastern portion of its basin where it originates. These tributaries include the Kunduz River, which has a watershed of area 31,300 km²; the Kokcha River with a watershed of area variously estimated from 21,100–21,900 km²; and the rivers of Badakhshan, with a combined watershed area of 30,800 km². Besides the Wakhan and Pamir Rivers, which are actually the uppermost reaches of the Amu, the Badakhshan rivers include the Pamir and several smaller rivers.

The Kunduz River rises near the Shibar pass in the HinduKush. The river has two left tributaries, the Seigan and the Kamerd, and the following right tributaries:

- The Anderab River rises near the Aawak pass (3600 m) and flows to Surhaab near the settlement of Doni. The Anderab has two principal tributaries, the Arezu and the Banu.
- The Khanabad River (which in turn has as tributaries the Warsaj, Host, Chal, and Narak rivers) joins the Kunduz River near the village of Yakalaiy-Zad. It runs through a narrow gorge to the village Churi, then widens to 3 m. Its overall length is 400 km; its width in its lower reaches is 150–200 m; its depth is 3 m.

The Kokcha River is formed from the confluence of three rivers, the Jirm, Warduj and Zardiv, near the city of Faizabad (the provincial capital of Badakhshan). The Kokcha River runs through a narrow gorge. Below Faizabad it is joined by the Deraim, Toshkan and Kishm rivers. It flows into

the Amu Darya near the village of Kala-e-Zanum. The river length from the Parui Pass is 320 km. The river's width in midstream is 10–12 m and its depth is 1–2 m.

The Wakhan (Amu) River. As noted above, the Wakhan River rises at an elevation of 4900 m at the Wakhan glacier. Below its confluence with the Pamir river, it takes the name Panj, and below the confluence with the Vakhsh river, it is called the Amu Darya.

Estimates of Surface Water Flows Generated from Northern Afghanistan

The key results of major studies that have estimated the flows from Afghanistan to the Amu Darya Basin are summarized in Table 6 above. Estimates are very close. Shultz's estimate is 16.3 bcm, which is comparable to the 1967 Master Plan estimate, and also to Pyatigorsky's except for their different estimates of the flow of the Badakhshan rivers. If Shultz's estimate for the latter is used in Pyatogorsky's estimate of the total, then Pyatigorsky's estimate becomes 16.5 bcm, very close to Shultz's and that of the Master Plan. Other estimates have been made besides these three. Besides their varying estimates of the Badakhshan rivers, each studies' estimate utilize varying definitions in principle of the Amu Darya Basin. One reason for the varying estimate for the Badakhshan rivers is that flows from these rivers have never been measured, given the catchment/watershed area of the Badakhshan rivers including the Wakhan an Pamir rivers, and their location being much in the northern and higher altitude, the estimated arbitrary flows are grossly under estimated. Given the above three sources, one possibility is to take all rivers in Northern Afghanistan as within the Amu Darya Basin. By this definition, and taking Shultz's value for the flow in the Badakhshan rivers as correct, the estimated flow is about 17 bcm by all estimates. But an alternative possibility—perhaps more useful for a discussion of Afghanistan's interrelationship with the other Basin riparians—is to include only the rivers that contribute to the Amu Darya. These rivers include the basins of the Wakhan, Pamir, Kunduz, Kokcha, and the other rivers from Badakhshan. Annual flow of these rivers is about 12 bcm. This amount excludes the local (blind) rivers that originate and terminate in Afghanistan because they are not transboundary, but rather are national water resources of Afghanistan, and also exclude the Harrirud and Murghaab because although transboundary, they do not contribute to the Amu Darya. It should be noted, however, that the authors still obtain varying results, even using this latter principle; in some studies, such as that of Pyatigorsky, the smaller Badakhshan rivers are listed as blind rivers.

Ground Water Resources

From 1956 to 1961, hydro-geological and geological engineering surveys were carried out by the Afghan Government, with technical assistance from the former Soviet Union. Preliminary surveys were conducted over a large region to define areas for detailed investigations. This survey covered irrigated areas. From 1962–1963, additional hydro-geological and geological engineering surveys were carried out to assess groundwater resources in quaternary sediments. Hydro-logical maps and maps of quaternary sediments were prepared to provide a comprehensive picture of mineral and thermal contents of water such as carbonate, sulfate, methane and hot springs. In the process, many aquifers were identified, of which nearly 90 percent are from the quaternary age. Their locations generally coincide with traditional water supply and irrigation areas. In 1970, a government study distinguished three hydro-geological regions: the Amu Darya Artesian Zone, the Central Afghan Zone, and the South Afghan Zone (ICWC 1970). Within each zone, groundwater sub-basins were defined. A survey in 1978 provided a basis for the estimates of groundwater resources and use of groundwater for irrigation and drinking water that are provided in Table 7 below.

Further surveys of Northern Afghanistan were performed by the government in 1987–1988 showing that 0.5 bcm of ground water are withdrawn annually from some 723 springs, 276 wells, 592 shaft wells and 15 karezes (also called qanats) (Ministry of Mines and Industry 1988). This study estimated total groundwater resources in Northern Afghanistan at 49 m³/s, or 1.5 bcm/year, rather than the 28 m³/sec (about 1 bcm annually) estimated in 1978 (see Table 7). In 1990, total

TABLE 7: GROUNDWATER RESOURCES AND USE

Hydrological Region	Groundwater Resources			
	Total		In Use in 1978	
	Rate (m ³ /sec)	Annual Volume (bcm)	Rate (m ³ /sec)	Annual Volume (bcm)
1. Amu Darya Artesian Zone	28.2	0.9	2.91	0.09
2. Central-Afghan Zone	56.8	1.8	30.4	1.0
3. South-Afghan Zone	111.78	3.8	22.01	0.7
Total:	196.78	6.5	55.32	1.79

Source: 1978 surveys by Ministry of Water Resource and Power and Ministry of Mines and Industry, Kabul, Afghanistan.

yield of groundwater aquifers in Afghanistan was estimated at about 300 m³/second or about 9.5 bcm annually, and total use at about 70 m³/sec or 2.2 bcm annually.

The estimates suggest that groundwater could be used for irrigation and water supply in several regions of Afghanistan, regions with deficits in surface runoff relative to need; in particular, along the lower reaches of the Helmand River and in the Farahrud River valley (Sistan Basin), as well as in the Harrirud, Balkh and Khulm river valleys of the Amu Darya Basin. Required well depth would vary from 30–80 m. Further studies will be needed to evaluate water quality and to prepare recommendations on intake location and construction in order to complete the regional assessment of water supplies in prospective aquifers. Observations are of special interest in basins where there is a surface runoff deficit and where fertile land and climatic conditions favorable to agriculture are found, especially the Amu Darya Artesian Zone and in particular in the areas of Kunduz, Baghlan and Takhar provinces between the Panj and Kokcha rivers. The groundwater table in these areas is 5–30 m, and thus groundwater development would be relatively easy.

As noted earlier, surface water resources are also the main source of recharge for groundwater as precipitation in Afghanistan is comparatively low. Nonetheless, Afghanistan has seen a boom in diesel wells in the recent past years of drought. As wells have become an increasingly important source of irrigation water, particularly in the southwestern provinces of the country, the water table has been observed to drop by one to three meters per year in recent years in some tubewell areas. Although use of ground water throughout Afghanistan is still quite limited, and the water table may be dropping for reasons other than groundwater exploitation, nevertheless, the data suggest the advisability of a precautionary approach toward further groundwater utilization. Therefore, the diesel well boom could lead to unsustainable groundwater use in some parts of the country. Likewise, an updated inventory of the water resources of the country and a plan to assure their sustainable use are clearly called for.

USE OF WATER RESOURCES

Irrigated Agriculture

Irrigated agriculture is the largest water-consuming sector in Afghanistan, accounting for more than 93 percent of the country's total water use. Afghanistan's history of irrigated agriculture goes back 5000 years, as ancient settlements excavated near Kandahar show. Even today, allocations of land and water remain closely related to customs and traditions of the sedentary population, and maintenance works of irrigation schemes are long-established activities in the farmers' seasonal calendar. Irrigated land is concentrated in areas to the north, west and southwest of the central mountains and highlands.

Extent of Irrigation. The outcome of Afghanistan's successive stages of irrigation development, and of the irrigation network's recent decline, is summarized in Tables 8 and 9. Table 8 details Afghanistan's land use according to DAI's 1993 analysis of satellite imagery, which shows rainfed agriculture practiced on 7.8 million ha, active irrigated agriculture on 2.63 million ha, and inactive irrigated agriculture on 0.72 million ha. The area under effective irrigation is substantially lower than the irrigated area as a result of the destruction and deterioration of irrigation infrastructure and presence of land mines.

Distribution of irrigated and rainfed area by major river basin is given in Table 9. Data by province (used to estimate the irrigated area by river basin) is given in Annex B. Within the Amu Darya Basin, the best estimate is that 1.16 million ha are now being irrigated. That figure includes all the active irrigated land in Northern Afghanistan; however, irrigated land in the sub-basins of rivers that have permanent flow to the Amu Darya is only somewhat over 385,000 ha, including 21,000 ha of inactive irrigated land. The total area under rain-fed agriculture in these sub-basins is 780,000 ha.

Irrigation Systems and Methods

Traditional Irrigation Systems. Afghanistan's traditional irrigation systems are centuries old. Water is supplied by streams diverted with the help of temporary weirs. These systems are often located in remote valleys, and vary in size, each irrigating up to 100 ha. The systems are constructed and maintained in the traditional and informal manner on a communal, village basis. Water rights are

TABLE 8: LAND USE IN AFGHANISTAN

Land Use	Hectares	
	('000)	Percent
Rangeland/Wetland/Others	46,693	69.68
Rain-fed Agriculture	7,748	11.56
Snow	3,151	4.7
Barren	3,080	4.6
Active Irrigated Agriculture	2,629	3.90
Forest/Shrub	2,615	3.90
Inactive Irrigated Agriculture	720	1.07
Water	3,145	0.47
Clouds	39	0.05
Densely Settled	27,	0.04
Total	64,382	100.00

Source: Development Alternative Inc., *Afghanistan Land Cover Land Use Report*, March 1993.

government. Each village has at least one water master who delegates authority to sub-water-masters responsible for allocation of water to different fields of the scheme.

Shallow well (arhad) system. In this system, ground water is lifted from a large-diameter shallow well with the help of an animal-powered wheel (arhad) to supply irrigation water to the fields of an individual farmer. Such an irrigation system waters an area no larger than three ha. Altogether, about 6600 shallow wells irrigate about 12,000 ha.

Springs. When the groundwater table rises above the surface, it forms springs that flow over the surface of the land. There are about 5560 springs in the country irrigating 188,000 ha. Spring flow directly depends on the groundwater level. When the groundwater level goes down, for example, during drought years, this causes a reduction of outflow from springs. Usually, the most-affected areas during droughts are areas heavily dependent on springs. Irrigation from springs is common in the east and in the south.

Karez (qanat) systems. Karezes are underground galleries that tap groundwater from aquifers of the alluvial fans. Underground tunnels with gentle slopes carry water from its source to settled areas. Karezes are small in cross-section but may be many kilometers in length. On average, their discharge

determined and recognized in similar manner.

Large-scale informal surface water systems. These systems are mainly located in the plains and along the main river valleys. Many villages can share water from such a system. According to the water law of 1981, the amount of water needed for irrigation is determined according to the area under cultivation, the kind of crop, the irrigation regime, the water rights document, local practices and the amount of water in its source.³ However, in practice, water is distributed according to local tradition and agreements between farmer, water master (mirab), and the

TABLE 9: AGRICULTURAL LAND BY RIVER BASIN
('000 ha)

Type of Land	Amu Darya Basin	Kabul Basin	Helmand Basin	Total
Active Irrigated Land	1,155	450	1,079	2,681
Inactive Irrigated Land	211	99	410	720
Rainfed Agricultural Land	2,428	9	197	2,634

Source: Development Alternative Inc., *Afghanistan Land Cover Land Use Report*, March 1993.

3. The draft water law was prepared by the government in late 1970s, and it was enacted and adapted by the subsequent 4 governments starting in 1981.

varies from 10 l/s to 200 l/s, but it can be as high as 500 l/s. Karez water is used for irrigation (karezes serve irrigated areas ranging in size from 10 ha to 200 ha) and for drinking water supply.

The karez system has been used for thousands of years in Afghanistan, Iran, the Middle East, and North Africa. It is a relatively economical method of tapping groundwater for irrigation, environmentally safe and powered by gravity. There are 6741 karezes in Afghanistan, irrigating about 163,000 ha of land. Karez irrigation is common in the south and southwest of the country, less so in the north. A disadvantage of karezes is that there is no way to stop water from flowing during winter and other times when there is no need for irrigation. For this reason, about 25 percent of annual total flow through karezes is not used.

Modern Irrigation Systems. Afghanistan's modern irrigation systems are of several types.

Formal surface water system without storage. These systems have permanent intake structures operated and maintained by the Irrigation Department. The management of the irrigation scheme follows the rules of the large-scale traditional surface water schemes, noted above. However, regulation of water flow to the system depends on the interaction between government authorities and the village communities—a significant distinction.

Formal surface water systems with storage. Large-scale irrigation system development is relatively recent (1960–1978), but by the late 1970s, five large-scale modern irrigation systems had been built and were in operation. Land tenure is different from that in the traditional systems. Parts of these schemes have been operated under the private land ownership agreements, while others have been operated as state farms, owned by the government. The government heavily subsidized these schemes and farmers have limited choice concerning crop selection or farm practices.

Formal groundwater systems. Very little is documented concerning irrigation schemes supplied by groundwater from wells (whether deep or shallow). In Khost/Paktia province, surface water irrigation schemes were supplied by some 100 deep wells until the late 1980s. In a few cases, particularly in the lower reaches of the large traditional schemes where water shortages are common, individual farmers undertook irrigation from shallow wells. Most wells are located in the south and the southwest. Recent reports by various institutions indicate that the number of wells in the south has mushroomed during the last decade (UNDP 1993; FAO 1993; various World Bank).

Canal Irrigation. Canal irrigation is by far the most commonly-used irrigation method as canals irrigate nearly 1.9 million ha of land. Most of the canal-irrigated land is located in the north, west, and southwest of the country, where canals are filled by snowmelt rivers. Small diversion structures are installed at periodic locations along the river to divert water from the river to the irrigation canals. Some diversions are open; some are fitted with gates. They are traditionally constructed of loose masonry and more recently sandbags; however, some newly-built river diversion structures are designed and constructed at a higher level. From these irrigation canals, water is diverted to small irrigation channels.

Traditional Irrigation Techniques

Wild Flooding Irrigation. Water is diverted in a ditch to the upper part of an unlevelled plot and allowed to spread over the land in a manner dictated by the natural micro-topography. Because the degree of control over the flowing water is minimal, the resulting distribution of water is usually highly uneven. This type of irrigation is mainly used for irrigating small grains, hay and forage crops.

Border Irrigation. In this technique, land is divided into elongated plots that are confined between low earth banks and configured to slope uniformly from the point of supply (usually an

outlet from a conveyance channel). The land is sloped gently, not more than 5 percent, to the direction of flow, and is generally leveled laterally along all cross sections perpendicular to that direction. The entering water moves down the slope as an advancing wave. The area closest to the intake has a longer period of ponding and usually infiltrates more water than does the downslope section. However, a proper design that takes the rates of infiltration and the slope into account can irrigate fairly uniformly.

Furrow Irrigation. The surface is shaped into a series of furrows separated by ridges. At each irrigation, water is conveyed into the furrows. The ridges between the furrows serve as beds for row crops, and absorb water from adjacent furrows by capillary action. The flow rate needed to achieve adequate water distribution in a furrow depends on the length and cross section of the furrow and on the infiltrability and retentivity of the soil.

Basin and Terrace Irrigation. Within small level plots surrounded by low earth dikes, or “basins,” water can be impounded to irrigate small units such as a single tree, or vegetables or other crops grown in patches. Where land surface is sloped or irregular, the basins are small; where it is leveled, the basin is large and could cover a plot. Water is generally delivered to basins from small earth ditches, but can also be supplied from pipes. On sloping land, basin irrigation is carried out in conjunction with terracing. Containment of the water can be a problem where soil has excessive sand or excessive clay. Terraces require considerable labor to construct and maintain, and where the slopes are steep, the basins are necessarily very narrow.

Soil and Vegetation

There have been few studies of the soil properties of Afghanistan. Among these are a 1945 study by A. N. Rozanov and a 1967 study by I. N. Stepanov,⁴ both focusing on Northern Afghanistan. Rozanov concludes that Northern Afghanistan’s short and wet spring, dry and hot summer and short autumn naturally tend to produce a region characterized by desert and transient soils to ephemeris steppes. Stepanov’s 1967 assessment focused on areas that were then being irrigated. He found that, of this area, 30 percent had Class I soil (readily suitable for intensive agriculture), while the remaining 70 percent had soil requiring some degree of development or management. Stepanov’s results are presented in Table 10 below. Land is classified in terms of its capability for agricultural production, taking into account land slope, mineral content, organic matter content, and other criteria. Classes I-III are all suitable for agriculture, but of these, the soils in Class I are the most productive being nearly level, deep, well drained, and with good water-holding capacity. Therefore, Class I soil is productive and readily suitable for intensive cropping. The soils in Class II have some limitations that reduce the choice of crops and require moderate conservation practices.

TABLE 10: NORTHERN AFGHANISTAN SOIL CLASSIFICATION IN EXISTING AND POSSIBLE IRRIGATED LANDS

Soil Class	Currently Irrigated Land	Potentially Irrigated Land
Class I—Most suitable for cultivation—fertile soil	27 percent	15 percent
Class II—Suitable for cultivation	3 percent	12 percent
Class III—Moderately suitable for cultivation, but requiring reclamation work	70 percent	73 percent

Source: “Agricultural Development Schemes in Northern Afghanistan” Tashkent, USSR, 1967, pages 10–12

4. Both cited by ICWC (1970), page 6.

Soils in Class III have yet more limitations, and require special conservation practices and careful management. Soils in Class IV have severe limitations that restrict the choice of crops to only a few and require very careful management. The cultivation of crops in Class IV may be restricted to once every three to four years, and soils in higher classes are not suitable for cultivation of agricultural crops. All of Afghanistan's irrigated land falls into Classes I-III (see Table 10 below).

Water Quality Issues

Although a major problem for Afghanistan's downstream riparians along the Amu Darya, Uzbekistan and Turkmenistan, the quality of water with regard to salinity and possible salt mobilization from the northern areas of Afghanistan to the Amu Darya Basin has not created any problems. River salinity is extremely low in the upper reaches of the Amu Darya exhibiting less than 100 ppm of salt. The high slopes of Northern Afghanistan provide good drainage which protects against increasing soil salinity. However, near the river's delta soil salinity is higher because drainage water is discharged into the river from irrigated lands in Uzbekistan and Turkmenistan. The increased salinity derives from the neighboring riparians' irrigated lands reflecting water logging and inadequate drainage.

Major Schemes and Plans

In light of Afghanistan's potential for productive irrigated agriculture, almost all of the governments of Afghanistan in recent decades have sought to develop agriculture through: (i) construction of irrigation facilities to expand the irrigated area; and (ii) reconstruction, rehabilitation and reorganization of existing irrigation systems to improve water delivery. Foreign assistance and loans, including those of the World Bank, funded implementation of some of these plans. Implementation has tended to focus on the southern basins, those of the Helmand and Kabul Rivers, however, rather than on the Amu Darya Basin.

- In the Kabul River Basin, German assistance established observation of flows in the basin and assisted in development of some irrigated schemes, including construction of the Surubee hydropower dam. As well, works were completed in the Parwan province. In addition, assistance from the Soviet Union developed the Jalalabad irrigation system.⁵
- In the Helmand River Basin, the Soviet Union supported development of the Sarde Dam (used for both power and irrigation) in the Ghazni province, and the United States supported construction of a new irrigation system in the Helmand and Arghandab basins, together with development of new irrigated land in the area. In this basin, the Asian Development Bank was responsible for construction of the Kajaki dam, which is capable of hydropower generation.

The above works brought irrigation to an additional 192,600 ha and improved water supply to an existing 190,000 ha of irrigated land.

In the Amu Darya basin, by contrast, far less area has recently been irrigated or improved. This was not for lack of effort or interest on the part of the central government. Studies of the Khush Tapa Irrigation Systems, carried out in the 1950s and resurveyed in late 1980s, resulted in a plan for development of almost 1 million ha that would have been irrigated directly from the Amu Darya. However, funds for implementation could not be found. Later, at the request of the Afghan Government, Soviet experts prepared a series of proposals to irrigate Afghanistan's northern provinces and to improve water supply to pastures there. Developed between 1964 to 1968, these plans proposed irrigation drawn from the Kokcha River, irrigation of the Kunduz-Khanabad basin, irrigation of the Harrirud River basin, regulation structures on the Panj, a system to divert water

5. See Protocol to the Agreement between the USSR and Afghanistan of March 1, 1956, concerning technical aid to Afghanistan, August 23, 1959, USSR-Afghanistan; see Ginsburgs and Slusser (1981), p. 63.

from the Amu Darya through the Klef Ravine and lift it to the city of Andkhoy, and other measures. For a later stage, the proposal envisioned yet further multipurpose use of the Panj River and Amu Darya on the border between the Soviet Union and Afghanistan. Overall, proposed additional intake from the Kokcha, Kunduz, Panj and Amu Rivers would have been about 3.6 bcm annually. But most of this plan was not pursued further. In 1971, the State Planning Committee of the Soviet Union concluded that:

Though the most of proposed waterworks would be effective, construction of a big waterworks with hydropower stations, generation, and capacity of which considerably exceeds current needs of Afghanistan, requires great investments. In this context, as well as taking into account construction of a large scale hydraulic works on waterways of Central Asia, the USSR only could be interested in developing these water and power resources not earlier than 20 years from now.

The further pursuit of schemes to use the water of the Amu Darya was set aside, with the effect of preserving the waters of the Amu Darya for the use by the Central Asia States, where the area of irrigated agricultural land in the Amu Darya and Syr Darya basins doubled from 1960 to 1980. Because of lack of resources, Afghanistan was not able to further develop the Amu Darya Basin. In the 1980s, the Soviet Union started the development of a dam on the Kokcha river with hydro-power generation capacity, but with the demise of the Soviet Union, the dam was not completed. Only about 60 percent of the dam construction was completed.

In addition to the Soviet proposals, two further initiatives were undertaken in the Amu Darya Basin, both concerning development of the Kunduz River Basin and that of its tributary, the Khanabad. One was a study carried out by Sogreah, a French firm, in 1962–65, proposing works to improve water supply to 94,000 ha of irrigated land and to newly irrigate a further 10,000 ha. These works were not funded. The second was a feasibility study, followed by design, both financed by the World Bank and carried out in the 1970s. The works improved water supply on 30,000 ha and constructed a hydropower station. Further works anticipated under the project came to a halt in 1980 following the Soviet invasion.

Water Use in Northern Afghanistan

The volume of water diversion needed to supply existing irrigation schemes in Northern Afghanistan (including all sub-basins) is estimated at about 9 bcm annually, though the volume of diversion may have dropped as irrigation systems collapsed in the 1990s. Technically feasible expansion would be likely to increase this volume by 0.8 to 1 bcm annually, the additional volume being drawn from tributaries of the Amu Darya with permanent flow to the Amu Darya. The calculation is as follows.

First, about 2.1 bcm is consumed by the irrigated areas along the national/blind rivers in Northern Afghanistan, which seem to have been developed a long time ago. Water consumption records of 1965 show almost all the flow of these rivers being consumed for irrigation (ICWC 1970).

Second, a large proportion of the flow in rivers traversing to Turkmenistan appears to be consumed. A volume estimated at 2.7 bcm on average is generated annually by the rivers Harrirud and Murghaab, from which flow to Turkmenistan averages at 1.2 bcm annually. These rivers do not contribute to the Amu Darya.

Last, the volume of water that is diverted from the rivers that actually feed the Amu Darya appears to have been about 5 bcm in the 1980s. The volume of diversion was estimated in 1965 at about 2.5 bcm, but the 1980s estimate of 5 bcm is consistent with the water diversion per hectare that would be expected if the total irrigated area were 385,000 ha. If per hectare withdrawal were about 13,000 m³, and delivery and application efficiency were 50 percent from the diversion point to root zone, then water application would be 6,500 m³. Alternatively, assuming a more realistic delivery coefficient of 40 percent, withdrawal of 13,000 m³ would be consistent with per hectare application of 5,200 m³, comparing well with the biological crop water requirements in the area.

Net diversion may have been less than 5 bcm, taking into account some return flow from the irrigated areas. In the last decade, diversions are likely to have dropped below the diversion level of the 1980s because of the deterioration in the irrigation network.

This suggests that when the irrigation systems of Northern Afghanistan are rehabilitated and areas under inactive irrigation come into production, restoring the total area irrigated to 385,000, then water diversion from the rivers that contribute to the Amu Darya would return to about 5 bcm. A further expansion of about 15–20 percent in irrigated area would be feasible on technical grounds, taking into consideration the availability of suitable soils and various studies, if additional investments were made. Following a 15 percent expansion, thus with a total area of 443,000 ha under irrigation in this region, forecast water diversions would be about 5.8 bcm, or perhaps as much as 6 bcm considering that diversion rates would be higher for new lands because they would tend to have lower water-use efficiency. The implication of this volume of new diversions is explored in the next section.

Water Use for Hydropower Generation

Afghanistan does not, at present, have sufficient energy to meet its economic needs. Despite its relatively low rate of energy consumption, the development of some reserves of natural gas, and its unexplored oil reserves, Afghanistan still imports energy in the form of oil and electricity. War damage, looting and lack of maintenance and spare parts mean that generation capacity is far below the potential level of 400 MW, which in turn is substantially below the country's needs. For example, in late 1992, the authorities in Kabul estimated the city's winter requirement at 300 MW, compared with installed capacity of 150 MW, much of which had fallen into disrepair. Afghanistan is keen to develop hydropower capacity along its rivers in the north, especially on the two rivers that have constant flow to the Amu Darya. Past water resources development plans for the north foresaw building of a Kelagai reservoir on the Kunduz River, with storage capacity of 800 million m³ and hydroelectric power generation of 50,000 KWh, as well as another reservoir with a hydro-power generation plant on the Kokcha river (see Annex A for details). The reservoirs envisaged in the Northern Afghanistan's Amu Darya Basin have relatively less storage capacity and would not alter the flow regime of Amu Darya significantly even if releases are higher in winter for hydropower generation purposes.

IMPLICATIONS OF THE ECONOMIC DEVELOPMENT OF AFGHANISTAN FOR THE AMU DARYA BASIN AND THE ARAL SEA

The Amu Darya Basin lies in four countries other than Afghanistan, namely the Kyrgyz Republic, Tajikistan, Turkmenistan and Uzbekistan. Its total irrigated area is about 6 million ha (distributed as in Table 11 below). A schematic of the Amu Darya and its major diversion points is provided here in Figure 1. Uzbekistan has the largest area of irrigated land in the basin, 2.3 million ha, followed by Turkmenistan where Amu Darya water is used to irrigate about 1.7 million ha. In Tajikistan, about 0.5 million ha are irrigated by the Amu Darya, and in the Kyrgyz Republic, about 0.1 million ha. In Northern Afghanistan, the total area of irrigated land is about 1.16 million ha, of which about 385,000 ha is in the sub-basins of rivers contributing flows to the Amu Darya. The Kyrgyz Republic will not be further discussed, because it contains only a minor part of the basin and has little dependence on this river. (It is the Syr Darya that is of primary importance for Kyrgyz Republic; the Syr Darya is also shared by Tajikistan, Uzbekistan and Kazakhstan.)

Table 12 lists the share of flow generated from each riparian. As the table shows, most of the Amu Darya's flow is generated in Afghanistan and Tajikistan. However, the downstream countries, Turkmenistan and Uzbekistan, have by far the largest irrigated areas, and in fact are the main consumers of the water. The irrigated crops of Uzbekistan and Turkmenistan include highly lucrative cotton, and it is this that drives the strong past, current and future demand for irrigation water. In the era of the Soviet Union, water sharing quotas among the republics were established with the support of central authority. The respective economies are still largely scaled to make use of the quotas as they then stood.

In this section, we will consider the implications of Afghanistan's agricultural development for Tajikistan, Uzbekistan and Turkmenistan, the riparians for which the Amu Darya is economically very important. Irrigated area and water use in these countries will first be briefly described below.

TABLE II: IRRIGATED LAND IN THE AMU DARYA BASIN

Country	Irrigated Area (mlns. ha)
Tajikistan	0.5
Afghanistan a/	1.16
Uzbekistan	2.3
Kyrgyz Republic	0.1
Turkmenistan	1.7
Total	5.76

a/all of Northern Afghanistan including the blind river, and river flowing to Turkmenistan. Area on rivers with perennial flows to Amu Darya is about 385,000 ha.

Source: USAID, "Transboundary Water and Related Energy Cooperation for the Aral Sea Basin Region of Central Asia," 2002.

area of rainfed agriculture, drought is a significant risk even though Tajikistan as a whole has abundant water resources. In 2000, for example, drought led to near-starvation in some areas. As well, the mountainous areas that endow Tajikistan with water also render its area vulnerable to earthquakes, floods, erosion, mudslides, landslides, and avalanches.

Tajikistan's existing irrigation system uses water inefficiently, in part because it is deteriorating and also in part because of the system's original design. The Nuruk reservoir in Tajikistan is one of the largest on the Vakhsh River, but it provides only seasonal rather than multiyear storage for irrigation purposes; moreover, it has lost a significant share of its capacity as a result of siltation.

On the whole, agriculture in Tajikistan was underdeveloped under the Soviet Union leaving the country vulnerable to food shortages today. The Tajik Government plans to develop large areas of land that it has assessed as suitable for irrigation. About 60 percent of land proposed for development is located in the Amu Darya Basin. The cost of new land development is likely to be very high. The development of additional land will increase Tajikistan's use of water from the Amu Darya. To meet this increased requirement, Tajikistan plans to increase its quota of water from the Amu Darya or else to divert the Zarafshan River. While use of the Zarafshan would facilitate irrigation of areas with high-quality soil, it would be very expensive, and could also cause serious disputes with Uzbekistan, which at present uses 95 percent of the flow of the Zarafshan.

Use of water resources for energy is a very important issue for Tajikistan, which has the basin's largest potential for hydroelectric power generation. Tajikistan is keen to develop hydropower resources to break its current dependency on electricity imported from neighboring countries. At present, Tajikistan has an overall energy deficit and limited indigenous fossil fuels, and lacks the financial resources to purchase fuel for its 198 MW-capacity combined heat and power plant in Dushanbe. Tajikistan would be able to meet its energy needs easily from hydropower. The 3600 MW Ragun project has been under consideration for many years, and some work has been done at the site. However, the cost estimate for completion of the first stage of the Ragun is reportedly US\$200 million. Another option is enhancement of the hydropower produced by the existing Vakhsh scheme by diversion of water from the Panj by means of a 66 km tunnel or canal. Increased hydropower would help to resolve Tajikistan's energy problem, but besides the major investment

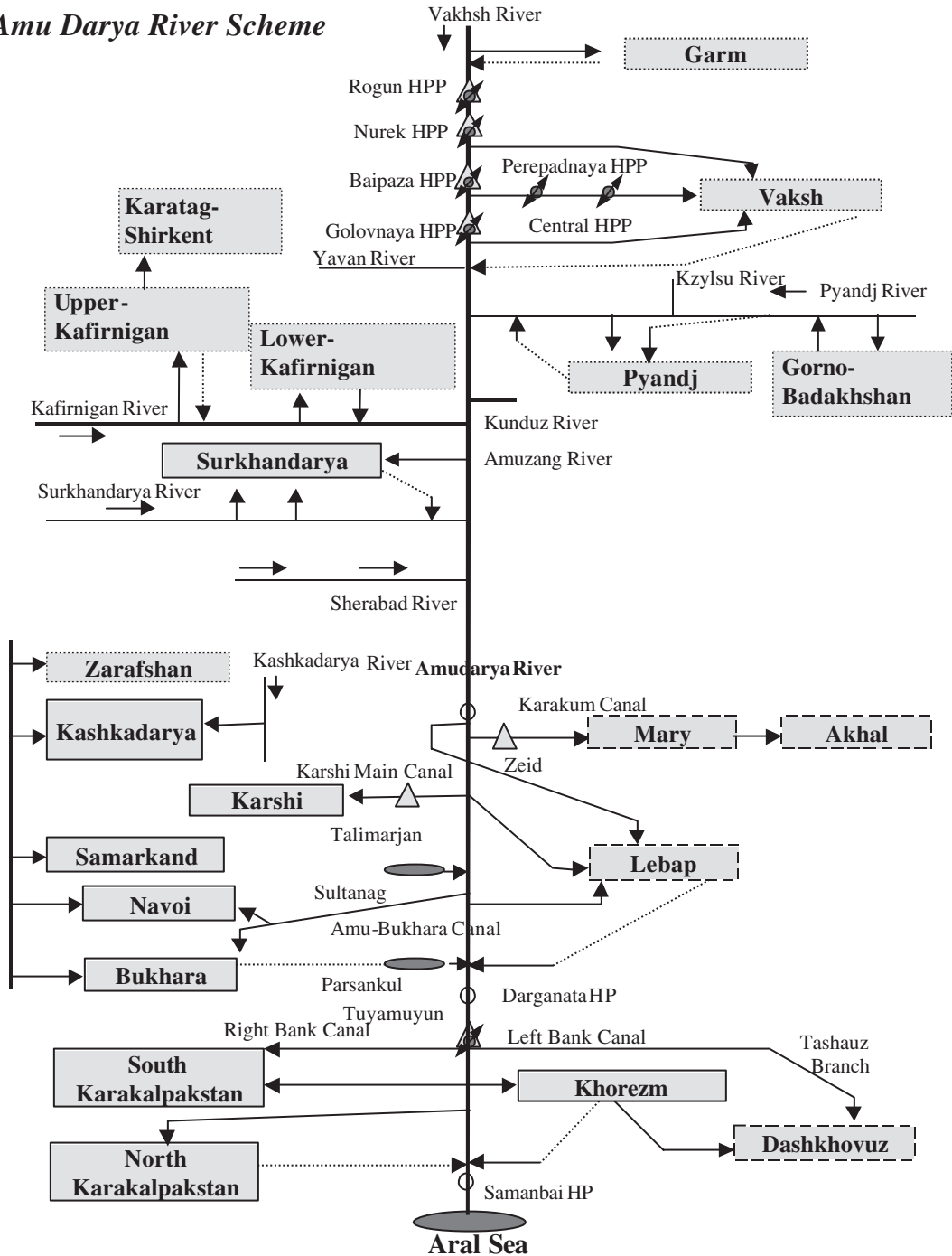
Tajikistan

Tajikistan is the poorest of the other riparians. It has an irrigated area of about 0.5 million ha in the Amu Darya basin, a rural population of 4.5 million, and a population growth rate of about 3 percent. Tajikistan has considerable water resources with almost two-thirds of the flow of the Amu Darya originating within the country. The supply of land with suitable soil, not the supply of water, is the main constraint to irrigated agriculture. Under a 1987 agreement, Tajikistan's allocation is about 9 bcm annually.⁶ Because of its limited irrigated area, by contrast with its large

6. See Protocol 566: Improvement of the Scheme on Complex Use and Protection of Amu-Darya Water Resources by Scientific & Technical Council, Ministry of Land Reclamation and Water Management of the USSR, September 10, 1987.

FIGURE 1: AMU DARYA RIVER SCHEME

Amu Darya River Scheme



Legend

- | | | | | | |
|--|-------------------------|--|--------------------|--|-----------------|
| | Rivers | | Intakes into PZ | | In Tajikistan |
| | Reservoirs | | Discharges into PZ | | In Turkmenistan |
| | Hydropower Plants (HPP) | | Hydroposts (HP) | | In Uzbekistan |

Source: USAID, "Transboundary Water and Related Energy Cooperation for the Aral Sea Basin Region of Central Asia," 2002.

TABLE 12: AVERAGE ANNUAL FLOW OF THE AMU DARYA BY RIPARIAN COUNTRY

Country	Avg. Annual Flow Generated (bcm)	Percentage of Total
Tajikistan	49.6	66 percent
Afghanistan b/	17.0	23 percent
Uzbekistan	5.1	7 percent
Kyrgyz Republic	1.6	2 percent
Turkmenistan	1.5	2 percent
Total	74.8	100 percent

Source: USAID, "Transboundary Water and Related Energy Cooperation for the Aral Sea Basin Region of Central Asia," 2002.

install thermal power plants using their own natural gas, and to export electricity to other countries including Tajikistan.

Uzbekistan

The Amu Darya runs through three Uzbek provinces, Surkhandarya, Bukhara, and Khorezm, and finishes its course at the Aral Sea in the Autonomous Republic of Karakalpakstan. Uzbekistan has the largest population in the Amu Darya Basin and the largest irrigated area with 2.3 million ha. It is the largest consumer of water in the basin, but generates little of the needed water on its own territory, a consequence of national boundaries drawn in the Soviet era to correspond to economic activity. A substantial volume of water is wasted by a poor water management practices from an era of plentiful water. One of these is that water is not supplied "on demand." As a result, when water is available it is used in excessive quantities. Moreover, water is used for leaching, a water-intensive practice which would not be necessary if drainage were improved. In turn, leaching promotes a vicious cycle of water overuse, as it raises the water table, increasing soil salinity, requiring further cycles of leaching prior to future years' planting. Waste is amplified by irrigation and drainage infrastructure that is in poor condition, partly because of its age and partly because of lack of recent maintenance. The challenge for Uzbekistan's farmers is to implement the national policy of self-sufficiency in grains/cereals and to meet the Government's quotas for cotton, while farming land that is a desert if unwatered, saline if not watered enough, and both saline and waterlogged if overwatered. While cotton places great demands on the water supply, it is highly important to the economy as a source of foreign exchange.

In accordance with the water sharing agreement of 1987, Uzbekistan and Turkmenistan divide the water of the Amu Darya at Kerki, taking equal shares at the point where the Karakum Canal takes off.⁷ In a good year, Uzbekistan receives 22 km³ by this arrangement. However, inter-state sharing does not work ideally. Some observers charge that Turkmenistan takes more than its share, and even if that is not so, the Uzbeks consider the fifty-fifty division unfair because Uzbekistan has more irrigated land and a higher population than Turkmenistan.

Turkmenistan

Turkmenistan is the largest per capita consumer of water from the Amu Darya basin. Most of the country is desert, and only 1.7 million ha is irrigated. Turkmenistan's most important source of water is the Karakum Canal, supplied by the Amu Darya. The Canal runs more than 1000 km, mostly through the Karakum Desert, irrigating about 1 million ha and providing drinking water to

required, it would have a negative impact on the access of downstream riparians to water supplies during the irrigation season. Because energy requirements are higher during winter than summer, additional hydropower generation would shift the releases to Amu Darya to winter, reducing the water availability for irrigation during summer. Therefore, an agreement with the downstream countries would be necessary, in particular with Turkmenistan and Uzbekistan, which are major irrigation users. Both of these countries also have ambitions to

7. See 1996 Agreement between Uzbekistan and Turkmenistan.

South Turkmenistan. Other irrigation/water requirements are met by 1.2 km³ drawn annually from the Murghaab and Tijen (Harrirud) Rivers. Like the other countries in the region, Turkmenistan uses more water for its irrigation requirements than international practice suggests is actually necessary. Its water management practices are unsustainable, both as to volume of water used and as to the effects on land and water quality.

Turkmenistan is currently developing plans to construct a drainage lake in the Karakum desert. This proposal may be constrained by the large estimated cost, but if implemented, it is likely to lead to increased off take from the Amu Darya to the Karakum Canal; that is, it will reduce the flow to Uzbekistan and to the Aral Sea.

Aral Sea

The decline of Aral Sea started in the 1960s as increasing amounts of water were diverted from the Amu Darya and the Syr Darya for irrigation. Between 1960 and 1990 the surface area of the sea decreased by some 50 percent (from 67,000 km² to 30,000 km²) and the sea level dropped by 16 meters. The desiccation of the Aral Sea and the damage to the river deltas has resulted in serious economic and social consequences, including consequences for human and animal health and for the environment.

After independence in 1991, the five former Soviet republics, Kazakhstan, the Kyrgyz Republic, Tajikistan, Turkmenistan and Uzbekistan (hereafter, the Basin States) recognized the urgency of the Aral Sea crisis and sought assistance from international donors. The Basin States prepared a comprehensive Aral Sea Basin Program (ASBP) with the support of the international community (Boison de Chazournes 1998). The ASBP was conceived as a broad program, comprising eight programs and twenty projects. It was approved by the Basin States and launched in 1994. However, it was widely recognized that the goal of restoring the Aral Sea to previous levels was not achievable in the foreseeable future. To restore the sea in 25 years would require 75 bcm of water annually—more than half of the combined annual flow of the Syr Darya and Amu Darya—an unrealistic means of the saving the Sea as it would require closing most of the Basin's irrigation systems. Small scale interventions proposed under the ASBP to improve the water supply in the areas most affected by the desiccation of the Sea, together with restoration of delta lakes and the Northern Aral Sea, are the interventions selected by the ASBP. They are expected to significantly minimize the catastrophic effects of the decline of the Aral Sea. The Bank and other stakeholders today seek to promote an environmental flow that will help to restore wetlands and preserve biodiversity in the delta of the Amu Darya.

Providing a secured flow to the Aral Sea remains a great challenge, however, given the increasing demand for water by the Basin States and reduced coordination in the task of managing the basin's water resources. During the Soviet era, many dams were built in Tajikistan and the Kyrgyz Republic to store water in winter and spring and release it in summer, mostly to meet the demand for water for irrigation of cotton and wheat in the downstream republics of Uzbekistan, Turkmenistan, and Kazakhstan. The generation of hydroelectric energy at these dams was only a secondary use and followed therefore the water release pattern in summer. Most of the energy generated was also consumed downstream. The upstream republics, although rich in water and hydro-power potential, are poor in fossil fuels, while the downstream countries are poor in water resources but rich in fossil fuels. During the Soviet period the downstream republics therefore met the needs of the upstream republics for fossil fuels, particularly during winter when energy requirements were highest for heating. In the context of a centrally managed economic system, this exchange was a relatively simple process.

After independence of the Basin States in 1991, this situation changed drastically. The need for exchanges of resources (water, coal and gas) remained but the resource ownership became subject to sovereignty. In 1992, the Basin States agreed to continue the interstate agreements for water (by the Almaty Agreement) with the underlying premise that the storage dams would

continue to be operated in the irrigation priority mode.⁸ However, for various reasons the supply of fuel and electricity to upstream republics was either reduced or delayed and often interrupted, the result being that the upstream republics changed the operation mode of the reservoirs from the irrigation mode to the power-generating mode, mainly for the purpose of generating electricity for heating in winter. This resulted in substantial water releases in winter, of which a large part was lost from the systems and from irrigation use. This has affected agricultural production, especially in the lower Syr Darya Basin. Conflicting priorities for use of interstate waters have been a cause of uncertainty in water supply to the downstream areas and a major source of contention among the riparian states. To address these issues, the Basin States entered into agreements such as a multi-lateral agreement essentially using the energy trade as a proxy for water trading.⁹ However, these have rarely worked satisfactorily, one main reason being that the upstream republics do not have the foreign exchange to pay for fossil fuels supplied by downstream riparians, and another main reason being that downstream countries do not want to pay for water, as they claim riparian rights to the water of these rivers.

Despite various efforts and good intentions by all stakeholders, due to the conflicting demands just described, the flow to the Aral Sea has not increased significantly. It averaged about 20 bcm annually during the 1990s. These flows are higher than those of the 1980s, primarily because after independence the irrigated area shrank, particularly in Kazakhstan's share of the Syr Darya sub-basin. A contributing factor is that most years during the 1990s were relatively high-water years. The Aral Sea receives far less water during dry years, the Sea being generally treated as a residual, rather than an active, user of water. It appears that increase in use of water by a riparian in the basin does not much affect the water use by another riparian; instead the deficit is most likely to be transferred to the Aral Sea.

Impact of Water Use in Northern Afghanistan

As noted above, based on the size of Afghanistan's presently irrigated area, its inactively irrigated area that could fairly easily be brought back into irrigation, and the area that would be suitable for irrigation if investment funds were available, our assessment is that a large, near-term increase in water use by Afghanistan over its levels of the 1980s is unlikely. Even following a 15 percent expansion of the irrigated area within the basins of the rivers that contribute to Amu Darya, water withdrawals are likely to rise to 6 bcm annually at most. This would be an increase of about 20 percent over Afghanistan's withdrawal level of the 1980s (more than 15 percent because the new lands are likely to require larger diversions per ha), but a decrement of less than 2 percent in the flow of the Amu Darya. This appears to be the highest level of diversion that is significantly probable in the next two decades, representing as it would a very ambitious program of investment and expansion. Among the Amu Darya's riparians, Uzbekistan and Turkmenistan would be relatively more affected, especially during dry years.

To see what the impact would be, trends in Uzbekistan and Turkmenistan can be briefly noted as well. The impact of withdrawals by Afghanistan may be mitigated by improved water management practices that are known to be necessary to improve the productivity of irrigated agriculture in any case. If Uzbekistan and Turkmenistan take these up such improvements could compensate

8. See Protocol 566: Improvement of the Scheme on Complex Use and Protection of Amu-Darya Water Resources by Scientific & Technical Council, Ministry of Land Reclamation and Water Management of the USSR, September 10, 1987; see also Protocol 413: Improvement of Scheme of Complex Use and Protection of Water Resources of Syr-Darya Basin, February 7, 1984.

9. See Agreement between the Governments of the Republic of Kazakhstan, the Kyrgyz Republic, and the Republic of Uzbekistan on the Use of Water and Energy Resources of the Syr Darya Basin, March 17, 1998 at http://www.dundee.ac.uk/law/iwlr/Research_Documents_International.html, visited July 14, 2003 (Under "Central Asia," 1. Framework Agreements, 1.3. Agreement on the Use of Water and Energy Resources of the Syr Darya Basin, 17 March 1998, Bishkek, Kazakhstan-Kyrgyzstan-Uzbekistan).

for additional water use in Afghanistan and also supply additional water to the Aral Sea. The easiest improvement of this kind would be better use or conservation of the significant volume of drainage water now being generated that is at present evaporated in desert sinks. A different approach would be to reduce water application, which for some crops, especially cotton, is several times more in Turkmenistan and Uzbekistan than any other place in the world, and likely could be reduced. Farm management practices such as simple land leveling could reduce water application. Whichever approach is taken, at present the average level of drainage effluent in Amu Darya Basin is about 5,000 m³/ha (it is particularly high in Uzbekistan and Turkmenistan), which might be reduced to 3,000 m³/ha with improved water management practices. If such savings were realized over 4 million ha of irrigated area in Uzbekistan and Turkmenistan, this would result in additional water of about 8 bcm, which would much more than compensate for possible increase in water use in Northern Afghanistan. In the absence of water savings, the most likely scenario is that, as in present situation, the deficit would be passed on to the Aral Sea.

REVIEW OF WATER SHARING AGREEMENTS

Because of the implications of future water use in Northern Afghanistan for other riparian users and the Aral Sea, even if the effects are negligible, Afghanistan will have to collaborate with other riparians on basin-wide water management in the Amu Darya Basin. This section reviews existing agreements to assess the adaptability of the present framework to improve collaboration between Afghanistan and other riparians.

Agreements Among Central Asian States

Prior to independence in 1991, the sharing of water among the Soviet republics of the Aral Sea Basin was established in a series of resolutions and protocols in the 1980s. The Scientific and Technical Council of the Ministry of Water Resources established water distribution limits for the Amu Darya on March 12, 1987 (Table 13). The four Soviet riparians of the Amu Darya formally endorsed this agreement in Moscow on September 10, 1987 as Protocol 566.¹⁰ This Protocol is still the main basis for water allocation among those states. In determining the limit to total annual extraction (61.5 bcm) from the Amu Darya by those four states, diversion by Afghanistan of 2.1 bcm was assumed.

In the water allocation context, it is useful to take note of the related issues of the Syr Darya Basin, because the Syr Darya and Amu Darya basins together comprise the Aral Sea Basin, which has been treated as a unit for many purposes. The five Soviet republics that lay within or partly within the Aral Sea Basin include Kazakhstan and the four riparians of the Amu Darya (the Kyrgyz Republic, Tajikistan, Turkmenistan and Uzbekistan).

During late eighties, the Soviet Union became concerned about the crisis of the Aral Sea. The above agreement (Protocol 566) was concluded in order to limit the water use in the basin and to secure additional flows (called Ecological/Sanitary flows) to the Aral Sea. Pursuing that objective, on September 19, 1988, the Council of Ministers of the Soviet Union issued Decree 1110, “Measures for Radical Improvement of Ecological and Sanitary Situation in the Region of the

10. Protocol 566: Improvement of the Scheme on Complex Use and Protection of Amu-Darya Water Resources by Scientific & Technical Council, Ministry of Land Reclamation and Water Management of the USSR, September 10, 1987.

TABLE 13: WATER DISTRIBUTION LIMITS IN THE AMU DARYA BASIN

	Limit (bcm/year)	Share percent
Uzbekistan	29.6	48.2
Tajikistan	9.5	15.4
Kyrgyz Republic	0.4	0.6
Turkmenistan	22.0	35.8
Total for Basin:	61.5	100
Allocations downstream of the Kerki gauging site		
Uzbekistan	22.0	50
Turkmenistan	22.0	50

Source: Protocol 566: Improvement of the Scheme on Complex Use and Protection of Amu-Darya Water Resources by Scientific & Technical Council, Ministry of Land Reclamation and Water Management of the Soviet Union, September 10, 1987.

this scheme, the respective Ministries should specify the volumes of water required every year to be delivered to the Aral Sea, including the limits on water use for irrigation and economic needs from the basins of the Amu Darya and Syr Darya.

The breakdown of the Soviet Union in 1991 devolved responsibility for protection of the Aral Sea to the newly independent republics. The estimates of water releases for Aral Sea provided in Decree 1110 are still considered by the now-independent Republics the main, agreed and therefore valid basis for providing water to delta areas and Aral Sea.

Agreements Among the Post-Soviet Independent Republics

On February 18, 1992, within a year of their independence, the five post-Soviet states in the Aral Sea basin reached an agreement concerning transboundary water resources.¹¹ In this Agreement, the five post-Soviet states agreed to maintain and adhere to the division of the transboundary water resources as set out in Protocol 566 for the Amu Darya (noted above), and in another document, Protocol 413, for the Syr Darya.¹² As well, the 1992 agreement established an Interstate Commission for Water Coordination (ICWC) and designated it as the body responsible for the definition of seasonal allocations in line with the annual agreements. It was further agreed that the Basin River Organizations, BVO Syr Darya and BVO Amu Darya, would be incorporated into the ICWC structure as implementing agencies responsible for the control of water allocations.¹³

11. Agreement between the Republic of Kazakhstan, the Kyrgyz Republic, the Republic of Tadjikistan, Turkmenistan and the Republic of Uzbekistan on cooperation in interstate sources' water resources use and protection common management, February 18, 1992.

12. Protocol 413: Improvement of Scheme of Complex Use and Protection of Water Resources of Syr-Darya Basin, February 7, 1984.

13. See Agreement between the Republic of Kazakhstan, the Kyrgyz Republic, the Republic of Tadjikistan, Turkmenistan and the Republic of Uzbekistan on cooperation in interstate sources' water resources use and protection common management, February 18, 1992; see also Vinogradov and Langford (1999), in which footnote 23 states “[u]ntil recent changes, the ICWC was responsible for the development of regional water management policies to ensure rational utilization of water resources and to provide incentives for adherence to the regional water allocation regime. The ICWC also governed the activities of the two regional Basin Water Management Bodies (Bassejnovoe Vodnoje Ob’edinenie—BVO): BVO “Amu Darya” and BVO “Syr Darya,” both for short and long-term water development and allocation planning, water quality control, conservation and environmental protection.”

Aral Sea, Enhancing the Efficiency and Use to Strengthen the Protection of the Water and Land Resources in its Basin.” This Decree specified minimum inflow to the deltas of the Amu Darya and Syr Darya and to the Aral Sea (including drainage waters) as follows: 8.7 km³ in 1990; 11 km³ in 1995; 15 km³ in 2000; and 20 km³ by 2005. The Decree further requested that relevant Ministries, Departments, and Councils of Ministers of the Union Republics develop and submit by 1999 a scheme for approval of the Council of Ministers of the Soviet Union. This scheme would that would specify the multi-purpose use and conservation of water and land resources of the Aral Sea Basin up to 2010. On the basis of

In 1998, several riparians of the Syr Darya Basin enter into a water and energy sharing agreement.¹⁴ The original parties to the agreement were the Kyrgyz Republic, Kazakhstan and Uzbekistan.

No multilateral water and energy sharing agreement has yet been reached among the riparian states of the Amu Darya Basin. Tajikistan has proposed such an agreement to the other riparians on numerous occasions since 1998, so far without success, as Uzbekistan and Turkmenistan do not yet see the need for such an agreement. A bilateral agreement between Uzbekistan and Turkmenistan concerning sharing of the Amu Darya waters downstream of Kerki was signed on January 16, 1996 by the respective heads of state. This agreement specifies conditions the management and operation of the irrigation and drainage facilities crossing the territories of the two countries and mechanisms for resolving issues in this regard. It has since been implemented by the two countries without significant difficulties, except for the concerns noted above by some analysts who question whether the Turkmen offtake is not larger than it should be, and the concerns of others that the agreement does not give adequate priority to the water requirements of the lower reaches of the river basin and the delta of the Aral Sea.

Agreements Between Great Britain/Afghanistan with Russia/Soviet Union

The first modern treaty with regard to the territory of Afghanistan was the Treaty of Commerce and Navigation between Great Britain and Russia signed on January 11, 1843 in St. Petersburg.¹⁵ This treaty stipulated conditions of navigation and commerce on the Amu Darya. However, the October 17, 1872 and January 31, 1873 Exchange of Letters between Great Britain and Russia delimited the possession of territories belonging to the Ameer of Cabul.¹⁶ This Agreement established “that Badakhshan and Wakhan from Lake Sari-Qul west along the Amu Darya to its junction with the Kokcha River formed part of Afghanistan. The Amu Darya remained the northern boundary as far as the ferry at Khwaja Salar” (Krishna 2002). The Protocol of London provided for the “delimitation of the north-western frontier from the River Hari Rud to eastwards of Oxus (Amu)” and followed by 19 additional protocols from 1885 to 1888.¹⁷

Among the numerous subsequent protocols on the issue of Afghan-Russian frontier delimitation and demarcation, the Protocol of St. Petersburg entitled also the “Protocol No. 4 between the United Kingdom (Afghanistan) and the Russian Government for the Demarcation of the north-west frontier of Afghanistan” described the demarcation by a joint commission.¹⁸ On November 12, 1893, the United Kingdom and the Amir of Afghanistan concluded an agreement¹⁹ requiring Afghanistan to evacuate territory it had occupied in 1884 north of the Oxus (Amu Darya) (Krishna 2002) and called for the delimitation of the boundary east of Lake Sari-Qul (U.S. Department of State 1983). In an Exchange of Letters on March 11, 1895, the British and Russian Governments reached agreement on their relative spheres of influence with the British articulating their sphere

14. Agreement between the Governments of the Republic of Kazakhstan, the Kyrgyz Republic, and the Republic of Uzbekistan on the Use of Water and Energy Resources of the Syr Darya Basin, March 17, 1998 at http://www.dundee.ac.uk/law/iwlr/Research_Documents_International.html, visited July 14, 2003 (Under “Central Asia,” 1. Framework Agreements, 1.3. Agreement on the Use of Water and Energy Resources of the Syr Darya Basin, 17 March 1998, Bishkek, Kazakhstan-Kyrgyzstan-Uzbekistan).

15. U.N. Food and Agriculture Organization, *Systematic Index of International Water Resources Treaties, Declarations, Acts and Cases by Basin*, Vol. 1, p. 47 citing 6, Hertslet’s Commercial Treaties, 762 (E, F); see also *Index of British Treaties*, 2 Vol. 3, p. 219, citing F.O. 94/361B and 362; P. 462, (1843) LKI 325; 31 B.S.P. 5; 6 H.C.T. 762; 5 Martens (III) 8.

16. Exchange of Letters Between the British and Russian Governments, 1872–1873, in Polat (2002).

17. Krishna (2002); see also Protocol of London, September 10, 1885, in Polat (2002).

18. Protocol No. 4 between the United Kingdom (Afghanistan) and the Russian Government for the Demarcation of the north-west frontier of Afghanistan, July 22, 1887, in Polat (2002); see also *Index of British Treaties*, Vol. 5, p. 407, citing 78 B.S.P. 267; 13 A. 247; see also Food and Agriculture Organization of the United Nations, *Systematic Index of International Water Resources Treaties, Declarations, Acts and Cases by Basin*, Vol. 1, p. 129, citing 14 Martens, N.R.C., Ser. II, 180 (Schulthess).

19. Food and Agriculture Organization of the United Nations, *Systematic Index of International Water Resources Treaties, Declarations, Acts and Cases by Basin*, Vol. 1, p. 146, citing 24, Hertslet’s Commercial Treaties, 7 (E).

“between the Hindu Kush and the line running from the east end of Lake Victoria to the Chinese frontier shall form part of the territory of the Ameer of Afghanistan, that is shall not be annexed to Great Britain.”²⁰ Also, in the Letter from the Earl of Kimberley, representing Great Britain, he asserts among other issues that “Her Majesty’s Government and the Government of His Majesty the Emperor of Russia engage to abstain from exercising any political influence or control, the former to the north, the latter to the south, of the above line of demarcation.”²¹

In the aftermath of the Soviet Revolution, the first principal document forming the basis of relations between the Russian Soviet Federation and Afghanistan was the Treaty of Friendship of February 21, 1921.²² Although in principal the Treaty does not concern issues of the Amu Darya and frontier rivers, it does provide for the establishment of the border along the Panj and Amu Darya left bank. Article 9 of the Treaty provides the Soviet Union return the frontier districts which belonged to the Afghans in the 19th century stating:

In order to accomplish the promise given by the R.S.F.S. Government of Russia through its President, Mr. Lenin, to the Minister of His Majesty’s Government of Afghanistan, which promise being to effect that the Government of Russia agrees to return to Afghanistan all the lands situated in the frontier zone, and which has belonged to Afghanistan in the past century, it is hereby agreed that a separate agreement will be signed by the plenipotentiaries of the High Contracting Parties in the basis of the plebiscite of the nationals living in those lands.²³

On February 1, 1926, a Protocol between the Soviet Government and Afghanistan concerning the removal of Soviet troops from the Island Urta-Tugai in the Amu Dary River, the entry of Afghan troops to the Island, and the establishment of a joint commission to determine its ownership.²⁴ The island of Urta-Tugai was transferred to Afghanistan by Protocol signed on August 18, 1926.²⁵ In the spirit of neighborliness, Afghanistan and the Soviet Government agreed²⁶ to the appointment of frontier commissioners to handle the settlement of disputes on boundary issues in the year after the parties concluded a Treaty of Neutrality and Non-Aggression on June 24, 1931.²⁷

More relevant to the paper are the agreements concluded between Afghanistan and the former-Soviet Union that directly relate to water utilization by the co-riparians of the Amu Darya Basin. There are two significant agreements that allocate water use between the parties: (1) the Frontier Agreement Between Afghanistan and the Union of Soviet Socialist Republics,²⁸ and (2) Treaty

20. Exchange of Notes Between Great Britain and Russia, March 11, 1895 in Polat (2002).

21. Ibid.

22. De Martens, *Nouveau Recueil general de Traites, troisieme serie*, tome XVIII, p. 323; see also Slusser and Trista (1959), citing *Sobranie uzakonenii i rasporiazhenii rabochego i krest’ianskogo pravitel’sstva RSFSR*, 1924, I, No. 36, 1921.

23. See U.S. Department of State (1983), citing Treaty of Friendship Between Afghanistan and the Soviet Union, Signed at Moscow, February 28, 1921.

24. See Slusser and Trista (1959), citing Teplinski, L. B., “Sovetsko-Afganskii otnosheniia za sorok let sushchestvo-vaniia nezavisimogo Afghanistana,” in *Nezavisimyi Afghanistan. 40 let nezavisimosti, sbornik statei*. Moscow, Izadetel’svo vostochnoi literatury, 1958, p. 15. (Akademiia nauk SSSR, Institut Vostokovedeniia.)

25. Ibid.

26. See Exchange of Notes Regarding Settlement of Frontier Disputes, September 13, 1932; see also Slusser and Trista (1959), citing Shapiro, Leonard, ed. *Soviet Treaty Series. A collection of bilateral agreements and conventions, etc. concluded between the Soviet Union and foreign Powers*. Washington, D.C. Georgetown University Press, Vol. 2, pp. 57–59; see also U.S. Department of State (1983); see also Krishna (2002).

27. League of Nation Treaty Series, Vol. 157, pp. 372–81 (R, Persian, E, F); see also Slusser and Trista (1959), citing LNTS, 157, pp. 372–81.

28. Frontier Agreement Between Afghanistan and the Union of Soviet Socialist Republics, June 13, 1946, Afghanistan-U.S.S.R., United Nations Treaty Series, Vol. 31, p. 158.; see also Slusser and Trista (1959), p. 213, citing UNTS, 31, p. 147–67, “Protocol provides that Arts. 9 and 10 of the treaty of friendship of Feb. 28, 1921, have expired. Supplemented by 2 exchanges of notes: (1) ‘Exchange of Notes between the USSR and Afghanistan concerning demarcation of a sector of the Soviet-Afghanistan border’, and (2) ‘Exchange of notes between the USSR and Afghanistan concerning use of water from the Kushka River’ ”; see also U.S. Department of State (1983).

Between the Government of the Union of Soviet Socialist Republics and the Royal Government of Afghanistan Concerning the Regime of the Soviet-Afghan State Frontier.²⁹

On June 13, 1946, a Soviet-Afghan agreement was concluded concerning the demarcation of the Soviet-Afghan border. Along a portion of the frontier, the parties set the border along the mid-stream of the Amu Darya River and its upstream section referred to as the Pyandzh. This assured Afghanistan the right of navigation along these rivers. Article 1 of the Frontier Agreement states:

The State frontier line between Afghanistan and the USSR on the river Amu-Darya and the navigable part of the river Pyandzh shall follow the thalweg. If it should appear impossible to establish the position of the thalweg, the frontier line shall follow the median line of the principal fairway of those rivers and the median line of the unnavigable section of the river Pyandzh.³⁰

Moreover, accompanying the Frontier Agreement were a Protocol and several Exchange of Notes between the parties. The third Exchange of Notes provide for specific prohibitions which would impact the flows and relative usage of waters in Afghanistan. The Letter from Mr. Molotov, the Soviet Minister of Foreign Affairs, to Sultan Ahmed Khan, Afghanistan's Ambassador to Moscow, states:

I have the honour to inform you that, guided by the desire to settle in a spirit of friendly relations between both Parties the question of the utilization of the waters of the river Kushka and the question of the construction of a dam on the river Murghab, the Soviet Government agrees to cancel the order prohibiting the Afghan Party from using water from the river Kushka north of Chilil Dukter as was provided in the documents of the Anglo-Russian Demarcation Commission of 1885-1888. Nevertheless, the Afghan Party shall not increase the quantity of water taken from the river Kushka in this area and shall observe the status quo in this respect.

The Soviet Government waives the right to construct a dam on the river Murghab and to utilize the Afghan bank of the river for this purpose, on the condition that the Afghan Party does not construct such a dam on its territory in the frontier sector as would diminish the flow of water from this river on to Soviet territory.³¹

Concurrently, the Afghanistan Ambassador signed a Letter agreeing with all the provision of Mr. Molotov's Letter above.³² However, neither the Kushka which flows into the Murghab, nor the Murghab itself converge with the Amu Darya River as the former eventually deposits into the Kara Kum Canal in Turkmenistan.

On January 18, 1958, the two government again signed a treaty with regard to the regime on their mutual border. Part II of the Treaty was entitled "Regulations Governing the Use of Frontier Waters and of Main Roads Intersecting the Frontier Line."³³ Article 7 explains that the "term frontier waters in this Treaty means those waters along which the frontier line runs," and it concerns the Panj (Pyandzh) and Amu Darya river along which the border runs for 1260 km. Moreover, paragraph 2 of Article 7 asserts:

The Contracting Parties shall take measures to ensure that in the use of frontier waters, and of the waters of rivers which flow to the frontier or into frontier waters, the provisions of this Treaty and the special agreements between the Government of the USSR and the Government of Afghanistan are observed and the mutual rights and interests of both Contracting Parties are respected.

29. Treaty Between The Government of the Union of Soviet Socialist Republics and the Royal Government of Afghanistan Concerning the Regime of the Soviet-Afghan State Frontier, January 18, 1958, United Nations Treaty Series, Vol. 321, p. 166; see also Ginsburgs and Slusser (1981), citing United Nations Treaty Series, Vol. 321, pp. 77-237 (R, Afg, F, E); see also U.S. Department of State (1983).

30. Frontier Agreement Between Afghanistan and the Union of Soviet Socialist Republics, June 13, 1946, Afghanistan-U.S.S.R., United Nations Treaty Series, Vol. 31, 158.

31. *Ibid.* at 164.

32. *Ibid.* at 166.

33. Treaty Between The Government of the Union of Soviet Socialist Republics and the Royal Government of Afghanistan Concerning the Regime of the Soviet-Afghan State Frontier, January 18, 1958, Afghanistan-U.S.S.R., United Nations Treaty Series, Vol. 321, p. 176.

Afghanistan and the Soviet Union, as well as their successors in territorial interests, are committed to adhere both to agreements and to the “mutual rights and interests” of both parties which presumably would allow a breadth of interpretation in the quality of the parties use of water. At the same time, paragraph 3 states “this article shall not apply to those waters of the Contracting Parties which are national internal waters and which are covered by the national legislation of the Contracting Parties.” Thus the regime of the use of Afghan and Soviet rivers from their tributaries is limited. However, Article 16 clearly addresses the source for interpreting water use on the pertinent waterways stating “[q]uestions concerning the use of waters that are connected with frontier waters shall be governed by special agreements between the Contracting Parties.”

The remainder of Part II goes on to characterize the use of rivers for navigation (Article 8), watering livestock (Article 14) and to stipulate mutual obligations on river preservation and maintenance, cleaning, pollution prevention, etc. (Articles 9, 10, 11, 12, 13, 15). Importantly, Article 17 mandates government agencies to cooperate through mutual information exchanges “concerning the level and volume of water in frontier rivers and . . . precipitation in the interior of the territory” of each. Article 18 is concerned with drainage flow to the river prohibiting the construction of obstacles that would impede waters drainage, and requiring the “competent authorities . . . shall agree on a system of drainage into frontier waters, the diversion of water and on other matters associated with the use of frontier waters.” Also, the Treaty limits each parties ability to impede the flow of the river through construction on the watercourse except by agreement by the parties (Article 19). Finally, the parties establish in Part IV the position of “Frontier Commissioner” responsible for frontier interrelations, including water-related objects.

There are additional agreements the parties signed in this period that affected rivers and water use in Northern Afghanistan including an Agreement between Afghanistan and the Soviet Union concerning technical aid to Afghanistan.³⁴ On March 1, 1956, an agreement was concluded concerning technical assistance in construction of 16 diverse works that included three dams (Naghlu, Puli-Khumri, Jelalabad) and the Jelalabad irrigation canal. However, Jelalabad is located in the eastern part of Afghanistan along the Kabul River which eventually flows into Pakistan, and therefore does not affect the Amu Darya Basin. Based on the agreement, a protocol “About technical assistance to Afghanistan in construction of Jalalabad irrigation system,” was signed on August 23, 1959; the protocol expected Soviet technical aid in construction of the Jelalabad irrigation canal and the training of maintenance personnel.³⁵

Pertinent to water use and development on the Amu Darya River Basin, on June 25, 1958, the Soviet Union and Afghanistan signed a protocol entitled “Complex use of Amu Darya transboundary water resources.”³⁶ Subsequently, Afghanistan and the Soviet Union entered into an agreement on economic and technical cooperation and an agreement on joint survey of possibility of complex utilization of the hydrographic and power resources of the Pyandzh and Amu Darya based on the June 25, 1958 protocol. The agreement was signed on July 19, 1964 and the economic and technical agreement was concluded on October 16, 1961. These documents provide a treaty basis for prohibiting any construction work on Panj and Amu Darya whether by Afghanistan or by the other Central Asian republics (Tajikistan, Turkmenistan and Uzbekistan) without consultation, although

34. Agreement between Afghanistan and the USSR concerning technical aid to Afghanistan, March 1, 1956, Afghanistan-U.S.S.R.; see also Slusser and Trista (1959), citing *Izvestia*, March 4, 1956, “The USSR to aid in construction of 2 hydroelectric stations, 3 automobile repair shops, a road, physical and chemical laboratories, irrigation systems, nitrogen plants, and airports, under an earlier credit of \$100 million.”

35. Protocol to the Agreement between the USSR and Afghanistan of March 1, 1956, concerning technical aid to Afghanistan, August 23, 1959, USSR-Afghanistan; see Ginsburgs and Slusser (1981).

36. Protocol between USSR and Afghanistan concerning joint execution of work for utilization of the water resources of the Amu Darya river in the border section, June 25, 1958, Afghanistan-U.S.S.R.; see also Slusser and Trista (1959), citing *Izvestia*, March 4, 1956. The agreement is referred to by Slusser and Trista as the Protocol between USSR and Afghanistan concerning joint execution of work for utilization of the water resources of the Amu Darya river in the border section.

Afghanistan may, without consultation, use and regulate water on tributaries of the Panj and Amu Darya, provided it meets restrictions limiting release of pollutants (ICWC 1970). However these did not address obligations concerning water allocation.

No information is available at this stage on the existence of water-sharing agreements that address the Murghaab-Kushk River Basin, except as noted among the Exchange of Letters signed June 13, 1946, which Afghanistan shares with Turkmenistan, or the Harrirud (Tijen) River Basin or Atrek River Basin, both of which Afghanistan shares with Iran and Turkmenistan.

Application of Past Agreements

As commented above, Afghanistan has been a party to various international agreements with the various riparians of the Amu Darya River. However, the devolution of the former Soviet republics from the Union of Soviet Socialist Republics in 1991 raised the issue of the legal obligation to Afghanistan by the successor states derived from international agreements with the Soviet Union. The successions of states problem is characterized by one career diplomat as “[w]hen a state becomes party to a treaty, a legal nexus (connection) is established between the treaty and the territory of the state. Problems can arise when another state then becomes responsible for the international relations of all or part of the territory” (Aust 2000). There are two pertinent questions regarding past agreements with Afghanistan: (1) whether these agreements are still applicable, and (2) whether they specify water allocations for Afghanistan or a mechanism for sharing Amu Darya water resources.

Despite general uncertainty in the practice of state’s succession to international obligations, territorial agreements of a predecessor state have been consistently recognized to continue the rights and obligations to successor states. In *Boundary Issues in Central Asia*, Necati Polat addresses the issue with regards to the obligations of the former Soviet republics stating:

Under customary international law, boundary agreements of the predecessor state remain unaffected by succession. Undisputed and consistently reflected in state practice, the rule has been codified in Article 11 of the 1978 Vienna Convention on Succession of States in Respect of Treaties. The former Central Asian republic of the ex-USSR are therefore bound by a series of agreements concluded by the predecessor state in the second half of the 19th century on the delineation of the border areas in the region with the adjacent states of Iran, Afghanistan, and China.³⁷

The Vienna Convention’s provisions maintain territorial integrity and boundaries between successor countries, but in issues of water relations the Convention does not provide definite recommendations. Dr. S. Vinogradov, a Senior Research Fellow at the University of Dundee, Scotland, a former member of the Water Resources Committee of the International Law Association, and editor of the Kluwer Law book series on International and National Water Law and Policy, notes:

. . . [J]uridical succession from one state to another is a very interesting and complex question. As a general principle, according to international water rights, successive state remains bound by the former obligations including issues of border, territory and water resources. In accordance with Almaty Declaration 1991, former republics of the Soviet Union have taken responsibility for all obligations of the Soviet Union and continue with water allocations mechanisms agreed by during Soviet period. Of course, each treaty and agreement has to be analyzed separately, but agreements on territorial issues are considered as valid for successive parts of the former state.

37. Polat (2002) states: “The Afghan boundary of the ex-USSR, approximately 2,087 km long, has been succeeded by three Central Asian states, Tajikistan, Turkmenistan, and Uzbekistan. The boundary was fixed between Russia and Britain through a series of agreements in 1872–1873 (the Amu Darya section of the border extending eastward until lake Zorkul in the Pamirs, presently the entire Uzbek-Afghan boundary and parts of the Turkmen-Afghan and Tajik-Afghan boundaries), in 1885–1888 (the section between the Amu Darya and the point where the territories of Afghanistan, Iran and the ex-USSR converge, presently the Turkmen-Afghan boundary), and in 1895 (the section between Lake Zorkul and the Afghanistan, China, the ex-USSR trijunction, presently the Tajik-Afghan boundary).”

The late Dr. Dante Caponera notes that: “[A]ccording to international law the newly independent countries took as heritage from the former Soviet Union responsibility for enforcement of the above mentioned agreements.”

Therefore, the existing agreements between Afghanistan and the former Soviet republics are applicable. However, evidence is not available that water allocations, in the form of volume or share, were defined in any of these agreements. Probably because water use within Northern Afghanistan was very limited, sharing water resources with Afghanistan was not an issue, and there was no need, at that time, for such a detailed agreement. Even today, data available suggests that water use in Afghanistan is much lower than the available flows, and drastic increase in water use in the future is highly unlikely.

FUTURE DIRECTIONS

The future work for water management in Northern Afghanistan should move in four main directions: (i) improvements in hydrological data base, including measurements of flow at key points in the river system; (ii) improved assessment of past and present irrigated areas and potential for developing new irrigated lands; (iii) assessment of key hydraulic infrastructure, including the rehabilitation requirements; (iv) consultation and collaboration with the other riparians of the Amu Darya. While many water experts are concerned about the status of the water use agreements between Afghanistan and other riparians of the Amu Darya, and consider such agreements as a priority, from the above it is apparent that water allocation use by Northern Afghanistan is not a major issue. Water use at present is low and a steep increase is not expected, at least over the next two decades. Therefore, in the short run, the focus should be on cooperation at the technical level, which would be helpful in improving water assessment and management in the basin in the short run and reaching more definite water use agreements if they are needed in future.

Improving the Hydrological Database. Hydrological records are lacking in Afghanistan but they are crucial for water resources assessment, effective planning and use. It is essential to improve the water measurements on the rivers and for that purpose make at least 13 stations functional in Northern Afghanistan. The exact number and location must be determined after a preliminary survey and in consultation with Afghan water specialists. A rough number and distribution is provided here to give a sense of overall scope and cost estimates.

Existing stations, if any, can be rehabilitated, and new equipment can be installed. Most of the stations can be equipped simply with modern electronic-type stage recorders, and a few current meters can be provided for calibration of stage discharge at the flow measuring stations. In addition, training must be provided to the station operators and other staff in water measurements, calibrations of the equipment and river sections for developing stage discharge relationships, data collection, storage and processing. The outcome of this would be publication of monthly reports showing water flow and use data in Northern Afghanistan.

Improved Assessment of Irrigated Area. A more accurate assessment of the cropped area is necessary in order to improve assessment of water use, as well as to identify areas which need rehabilitation or

**TABLE 14: PROPOSED FLOW MEASURING STATIONS
IN NORTHERN AFGHANISTAN**

River	Number of Stations
Rivers with Permanent Flows to Amu Darya	
Kunduz	2
Kokcha	2
Rivers flow to Amu Darya from Badakshan Area	1
Sub-Total	5
Local Rivers	
Khulm	1
Balkh	1
Sar-e-Pul	1
Sirintagou	1
Subtotal	4
Rivers Flowing to Turkmenistan	
Murghaab	1
Harrirud	1
Subtotal	2
Amu Darya Main Stem	
Panj	1
Wakhan, Pamir	1
Subtotal	2
TOTAL	13

where further expansion would be possible. It is suggested that first assessment of cropped area be made using the satellite images. For that purpose, it would be of interest to identify the cropped areas of the 1970s, 1980s, and 1990s. Additionally ground surveys should be undertaken to identify the areas for expansion of irrigated agriculture. This would include verification of the soils suitable for irrigation, assessment of water availability and diversion facilities, and possible crop types.

Assessment of functioning and safety of key hydraulic infrastructure. A rapid assessment of the condition of key hydraulic infrastructure, including diversion structures from the rivers, canal control structures, major canals, and water distribution structures, should be carried out. The assessment would cover rehabilitation requirements, area controlled/ affected by the structure, priority and cost estimates for rehabilitation.

Consultation and Collaboration with Riparian States. Afghanistan should

now begin consultations and collaboration with the riparian states of Amu Darya (i.e., Tajikistan, Kyrgyz Republic, Turkmenistan and Uzbekistan) and participate in dialogue for improving water management in the basin. This should begin by consultations at the technical level, between the hydromet staff, water planners and operation of major water/river systems. The consultations among the hydromet staff could begin by jointly agreeing on location of the flow measurement stations on Panj and Wakhan/ Pamir rivers. In addition, during 2003 at least two workshops can be organized in which Afghanistan should participate, one with the aim of improving flow measurements, assessment of snow deposits and snowmelt, flow recording and forecasting in Amu Darya Basin, and the second to improve water distribution and management from the Wakhan/Pamir River to the Aral Sea. As noted above, consultations on technical aspects at this stage will be helpful in deepening the dialogue for the future concerning basin-wide water management and development.

ANNEXES

PENDING SCHEMES FOR WATER RESOURCES DEVELOPMENT IN THE AMU DARYA BASIN IN NORTHERN AFGHANISTAN

There are a number of planned schemes for development of water resources in the Northern Afghanistan. A description of each along with status of their reparation/implementation is provided below. Implementation of these plans would improve water supply to 146,000 ha of existing irrigated land and 162,000 ha of new land under irrigation.

I. Schemes on Kokcha River:

Irrigation System on the River Kokcha. During the 1970s, a dam on the Kokcha River with hydro-power generation capacity was planned with the assistance from the Soviet Union. The dam was located in on the Kokcha river between Kunduz and Takhar provinces. The objective of the project was:

- Irrigate 12,120 ha (gross) of new lands on the right bank of the River Kokcha;
- Improve water supply to 7740 ha (gross) of already-irrigated lands located in the command area of the Nawabad (Zulm) canal (Map 1);
- Secure water intake throughout the growing period to the left-bank Nar-e-Archa Canal and improved water supply to 25,400 ha (gross) of already-irrigated lands within the command zone of this canal;
- Increase potential for future irrigation of 5,300 ha (gross) of new lands in the Nowabad massif and about 12,000 ha (gross) of fallow lands that have irrigation systems, but now unused due to the lack of water in the Kari-Archa Canal; and
- Generate 10–20 KWh of electricity.

A preliminary estimated cost of the proposed scheme, excluding hydropower station in the early 1970s was US\$33.43 million plus 2181.2 million Afghani. Work begun in 1980, and about 60 percent of the actual dam is completed, but the project was halted with the collapse of the Soviet Union.

Sheermai Steppe Irrigation. It was proposed that the steppe be irrigated from the Shahrawan canal, following an increase of the canal's capacity to 80 m³/s, through a system of lift irrigation with a water lift height up to 100 m. Despite the very large energy that would be consumed by such a design, this option was preferred over gravity water supply to Sheermai steppe from Kokcha waterworks. The flow at the head of the canal would be 100 m³/s and the canal's length about 90 km including a 7-km tunnel. The canal would irrigate the Nowabad massif (5000 ha) and the Sheermai steppe (40–45 thousand ha). In addition, the Nari-Archi system, an area of 25,400 ha, and possibly the Shahrawan system, an area of more than 40–45 thousand ha, would be connected to the canal.

Nar-e-Archi Irrigation System. The Archi irrigation system is located in the Takhar province of Northern Afghanistan. The Nari-Archi Canal carries water diverted from the River Kokcha near the Pul-e-Ishim bridge to irrigate the massif. Water is diverted to the canal through an intake dam. The head site is regularly washed out by flood waters and repaired by local population. Bank protection measures were to be implemented in the zone of water intake, the head of the canal reconstructed, and several structures built at the sites where the canal crosses river channels. At present, an area smaller than 12,500–13,000 ha is irrigated. The capacity at the head of the canal is no more than 15–17 m³/s.

The cost of construction was estimated in the 1970s at US\$7 million plus 3.8 million Afghani. It was anticipated that construction would take 13–15 years.

II. Scheme on Balkh River:

Reservoir Chashma-e-Shefah. A detailed design for the Chashma-e-Shefah Reservoir on the Balkh river (a blind river) was elaborated in 1970s for the purpose of improved water supply to about 7000 ha of the existing irrigated land. Although the scheme was in the government books for a long time, in 1974, under the Daoud Administration's Seven Year Plan, the scheme was reassessed with the help of technical assistance from India, and the following works were included:

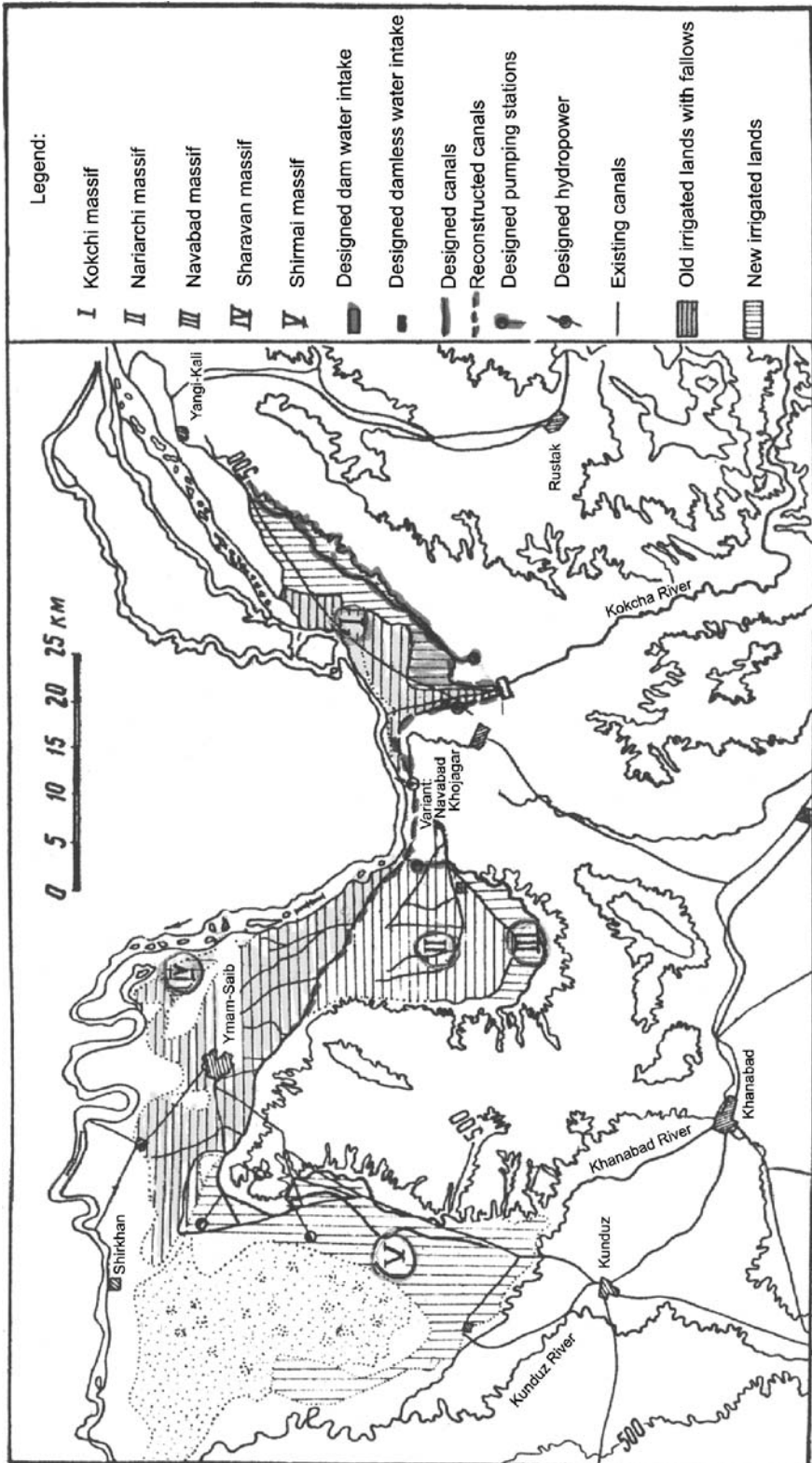
- A dam with a height of 62 m and crest length of 230–250 m, made of local construction materials;
- Water intake structures;
- Off-take regulator;
- Reservoir with capacity of 440 million m³;
- Secondary structures and a village for operating personnel.

It was also anticipated that the possibility of constructing a small hydropower station would be assessed. A preliminary estimate of the cost of the construction (estimate is as of 1975) was US\$18 million plus 777 million Afghani, not including the cost of resettlement of people from the flood zone or the cost of partial reconstruction of the existing irrigation system. The detailed design of reservoir Chashma-e-Shefah was to be finished in November 1979; it was never completed.

III. Schemes on Kunduz River:

Construction of the Gawhargan-Chardara Irrigation System. Projects to reconstruct existing irrigation systems, including Gawhargan in Baghlan province and Chardara in Kunduz province, were considered for support by the Asian Development Bank. These projects anticipated construction of a head intake structure on the River Kunduz, reconstruction of existing canals of the system Gawhargan, construction of a pumping station and a new Larkhabi Canal for lift irrigation, construction of a head intake structure for the Chardara Canal on the River Kunduz, and reconstruction of major canals in this region. Implementation of these projects would have provided guaranteed water intake for irrigation needs during the whole growing season, introduced 3450 ha of new irri-

SCHMATIC FIGURE 2: NORTHEASTERN AFGHANISTAN, KOKCHA AND LOWER KUNDUZ RIVER BASINS' IRRIGATION STRUCTURES



gated lands, and improved the water supply to 24,860 ha of land with irrigation infrastructure already installed—of which approximately 30 percent was not actively irrigated due to lack of water. The total cost of these works was estimated in 1970s at US\$7.49 million plus 12.46 million Afghani.

Lift Irrigation of Ali-Abad Massif. The Ali-Abad Massif is located in the northern part of Afghanistan between city Kunduz and village Ali-Abad, on the right bank of Kunduz river. The massif lies along the Kunduz River, with three and four terraces. The total area of land suitable for irrigation is 4365 ha (gross area). The maximum altitude of these lands above the river's water level is 30 to 65 m. Water would be supplied from the Kunduz River to the irrigation massif through a pumping station.

- Topographically, the Ali-Abad massif is divided into two zones, the first and second lift zones. The pumping station for the first lift would be located on the bank of the River Kunduz. Water would be transported at 4 m³/s through a steel pipeline with a diameter of 1020 mm, to a height of 30 to 32 m. The length of each pipe run would be 787 m.
- The pumping station for the second lift would be located 4 km from the first pumping station and would be able to pump 2.3 m³/s. The height of water lift would be 31 to 32 m. Water would be transported through a steel pipeline with a length of 250 m,

Land would be irrigated from the lift irrigation canals AMK-1 and AMK-2. The length of AMK-1 would be 17 km, and its command area would be 1149 ha (net). The length of AMK-2 would be 17.54 km and its command area 2112 ha (net). Water inlets, check structures, falls, siphons, bridges, amounting to 410 small and large structures, were planned within the area of the massif.

The capital required to implement this project was estimated at 301 million Afghani in 1970s, of which 235 million Afghani was the estimated cost of construction and 66 million Afghani the cost of agricultural development.

Construction of Reservoir and Hydropower Station Kelagai on the Kunduz River. To improve water supply for 56,000 ha of existing irrigated land that do not receive sufficient water during the low water years, and to develop additional 25,000 ha of new land along the Kunduz river, the Kelagai reservoir was planned about 11 km down stream of Pul-e-Kumri city. The scheme included the following works:

- A dam with a height of 80 m and crest length of 665 m;
- Spillways and a hydropower station, with a capacity of up to 50,000 kWh;
- Reservoir with active capacity of 800 million m³;
- Off-take regulator;
- Secondary structures and other subsidiary objects.

The total cost of construction was estimated in the 1970s at US\$45.4 million plus 2069.8 million Afghanis not including costs related to resettlement of people from the reservoir zone or to design and construction of irrigation systems for the 81,000 ha that would receive new or improved supply of irrigation water. The Institute "Saogidproyekt" prepared a feasibility study for the Kelagai Reservoir, with an anticipated date of its completion of November 1978.

IV. Schemes on the Panj and Amu River:

Bank-protection measures on the Panj and the Amu River. An authority that would be responsible for measures to protect the bank of the Panj and Amu Darya was established in 1975, with an office in a village in the Imam-Saheb district. It was made responsible for implementation of the following measures:

- Bank-protection within the territories of the Yangi-Kala, Nar-e-Turkmen, and Darkod settlements;
- Protection for the head intakes of major canals diverting water from the Panj River: the Shahrawan (irrigation area: 34,000 ha); the Nar-e-Turkmen (irrigation area: 6,000 ha); and the Yatim-Tapa (irrigation area: 1,500 ha).

By 1978, the authority had carried out the following works:

- Construction of more than 150 km of motor roads with gravel-sand surface, including 40 small bridges;
- Bank-protecting roads on Shahrawan waterworks (2.5 km) and on Nar-e-Turkmen waterworks (1.6 km);
- Construction of groins at Shahrawan waterworks (330 m) and Yangi-Kala (200 m);
- Working of quarry in Kuturbulak and Boyawa;
- Construction of a village to house authority staff, including organization of power and water supplies.

The 1978 Plan set out the following basic works to be performed:

- Reconstruction of the Shahrawan head intake;
- Bank-protection measures near Nary-Turkmen, with a length of 2 km (of which 1.1 km was finished);
- Construction in several areas of motor-roads with gravel surface: Around Kadam with a length of 13 km (8 km was completed); around Buta-Kashan (construction was completed); and in the area of Nary-Turkmen with a length of 12 km.

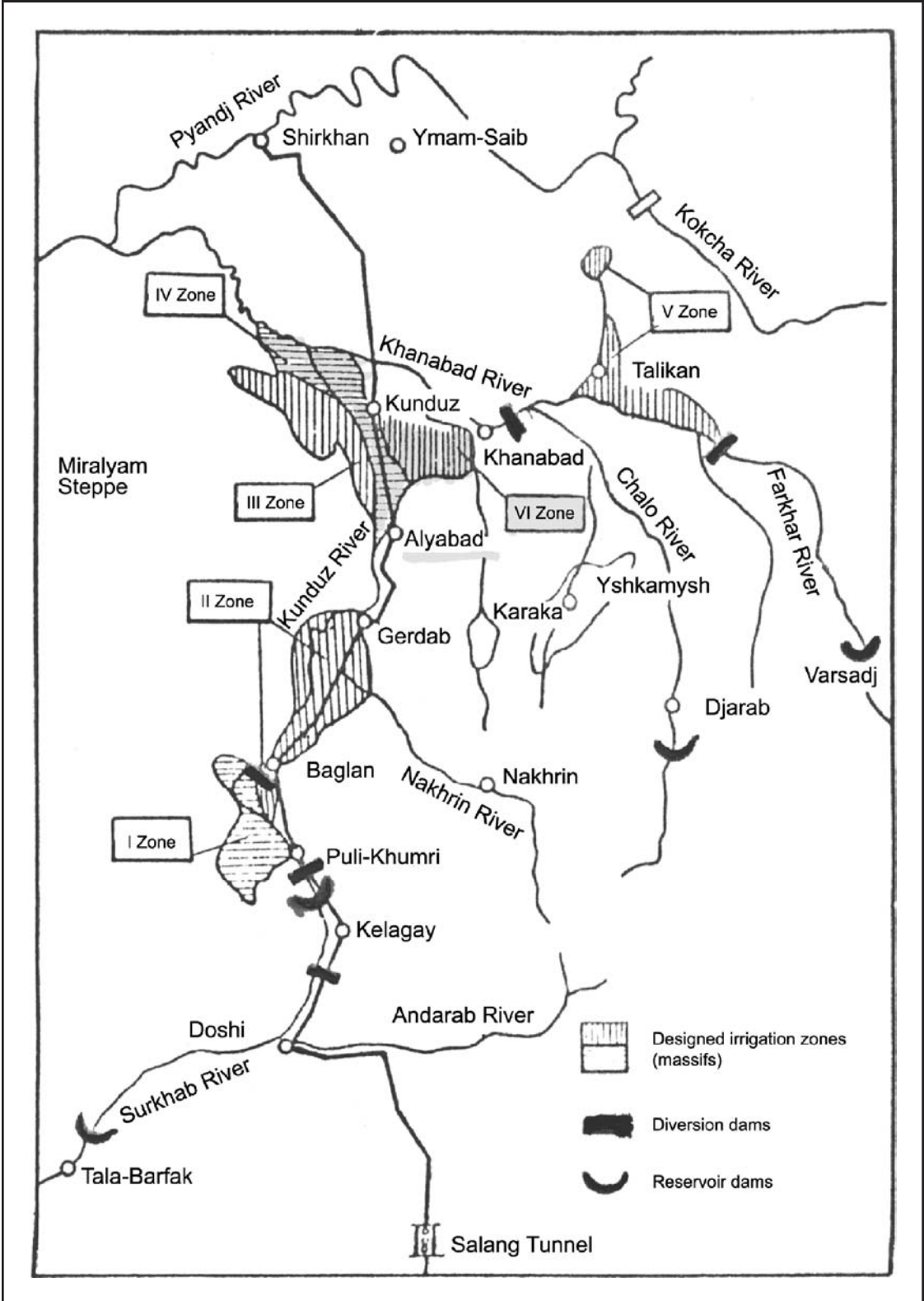
Proposals of the Transitional Government gave first priority to the following water-supply works:

- Construction of 300 drilled wells with hand pumps for stable drinking water supply (estimated cost: US\$1.5 million (US\$5000 each in 2002 dollars));
- Improvement of the water supply in Samangan and Balkh provinces through rehabilitation of 20 qanat, 50 wells, a number of conveying passages, and power lines (estimated cost: US\$1.14 million in 2002 dollars);
- Replication of project to additional ten provinces with estimated total cost of US\$13.3 million. This expanded version would have about two million beneficiaries, and would drill and install more than 5,000 wells. The proposed project would also include surveys, equipping, and training of local staff.

Khush Tapa Irrigated Land Development Plan

Kush Tapa is located between Kunduz and Samangan province on the bank of the Amu Darya with about one million ha of land suitable for agriculture. A survey in 1950s conducted by Afghanistan foresaw development of these land through left irrigation. But lack of funds for development of such a large scheme has not been found. Khush Tapa represents the largest land development in the Northern Afghanistan.

SCHEMATIC FIGURE 3: PLANNED SCHEMES ON THE KUNDUZ AND KHANABAD RIVER BASINS



TOTAL AGRICULTURAL LAND BY PROVINCE, 1993

Provinces	Active Irrigated areas	Inactive Irrigated Areas	Total Irrigated Area	Rainfed Agriculture Area
Badakhshan	42,240.80	1,052.10	43,292.90	84,709.20
Badghis	40,332.70	11,131.20	51,463.90	503,345.50
Baghlan	94370.7	14,559.40	108,930.10	188,355.50
Balkh	158,766.20	35,147.80	193,914.00	340,911.90
Bamyan	54,732.40	4,204.60	58,937.00	2,009.10
Farah	137,837.50	89,065.60	226,903.10	1,890.40
Faryaab	125,465.60	22,148.20	147,613.80	571,600.40
Ghazni	147,037.50	63,060.80	210,098.30	11,117.30
Ghor	120,739.20	0.00	120,739.20	6,705
Helmand	201,228.80	29,990.20	231,219.00	16,289.50
Heart	176,299.10	66,495.10	242,794.20	139,054.90
Jawzjan	224,006.20	61,922.00	285,928.20	295,863.20
Kabul	54,333.60	2,781.10	57,114.70	303.90
Kandahar	152,340.60	119,090.00	271,430.60	66,110.00
Kapisa	40,647.30	0.00	40,647.30	1,060.80
Kunar	16,814.50	3,462.10	20,276.60	3,467.20
Kunduz	147,474.70	4,555.10	152,029.80	104,400.10
Laghman	26,837.60	0.00	26,837.60	0.00
Logar	30,922.40	6,184.00	37,106.40	2,666.20
Nangrahar	80,923.20	19,087.10	100,010.30	0.00
Nimruz	43,097.10	1,158.30	44,255.40	0.00
Paktia	98,263.60	129,062.10	227,325.70	2,792.40
Parwan	46,969.40	2,746.00	49,715.40	38.00
Samangan	33,705.90	13,453.10	47,159.00	284,981.80
Takhar	80,187.80	678.50	80,866.30	402,744.20
Uruzgan	113,364.10	390	113,754.10	0
Wardak	78,709.70	675.50	79,385.20	1,128.50
Zabul	62,209.60	17,937.80	80,147.40	48,640.20
Total	2,629,857.80	720,037.70	3,349,895.50	3,080,185.20

Source: Development Alternative Inc. (DAI).

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