



Assessment of the Irrigation Sector in Afghanistan and Strategy for Rehabilitation

Final Report

**Presented to the U.S. Agency for International
Development**

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Assessment of the Irrigation Sector in Afghanistan and Strategy for Rehabilitation

Afghanistan Task Order

“Assisting Afghanistan to Revitalize Agriculture”

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EXECUTIVE SUMMARY

1. Agriculture is estimated to produce 85 to 90 percent of Afghanistan's Gross Domestic Product, and employs 70 to 80 percent of the population. It is the principal source of livelihood for a large sector of the rural population, particularly those living in more isolated regions of the country.
2. Those provinces with the largest irrigated areas include Kandahar, Herat, Balkh, Ghazni, Helmand, plus the two contiguous provinces of Kunduz and Baghlan. These seven provinces have the largest areas of low elevation (flat land) on the periphery of the country, located along the valleys of the four major river basins of the country. These include the Kunduz River in the Northeast, the Kabul River, the Helmand River with its tributaries in the South, and the Hari Rud River in the West.
3. The topography of Afghanistan is characterized by extensive desert plains, high mountainous ranges and scattered fertile valleys along major rivers. Roughly half of Afghanistan is located at an altitude of over 2000 m [6,500 feet].
4. Afghanistan has a dry continental climate. Ninety percent of the country's annual precipitation occurs during the winter months between December and April, mostly falling as snow. The amount of precipitation directly correlates with altitude. Thus, Afghanistan shows a strong correlation between altitude and agricultural potential. In general, rainfed agriculture is subject to chance and of limited productivity, while river flows allow spring and summer irrigation in the plains. These flows are more assured, and permit substantially greater agricultural output.
5. Afghanistan can be divided in four river basins. All main rivers are substantially fed by melting snow, and originate from the Hindu Kush range of mountains in the center of the country.
6. A frequency analysis of past rainfall data in Afghanistan and in neighboring Central and Southwest Asian countries shows that the region has experienced four droughts in the past century. These drought events were as follows: (i) 1898-1905, (ii) 1944-45, (iii) 1970-72, and (iv) 1997-present.
7. There are five basic types of irrigation in Afghanistan. These include (i) modern surface systems, (ii) traditional surface systems, (iii) springs, (iv) karezes, and (v) wells. Modern systems represent approximately 10 percent of the total irrigated agriculture; karezes traditionally have represented about 5 percent; springs represent slightly more than 5 percent, and traditional canal irrigation systems with intakes from various rivers and streams represent more than 80 percent of the total irrigated area.
8. Karez systems are located almost exclusively along the eastern, southern, and western flanks of the Hindu Kush. Drilled wells are rapidly replacing karezes as supplementing surface irrigation systems and some cases bring new land under irrigation. These are

abundant, and noticeable adjacent to the road from Kandahar to Kabul. These wells have become a significant and growing source of irrigation water. At present, no data are available to document the number of these wells, or their contribution as a new source of irrigation water.

9. Modern irrigation systems are generally larger than 10,000 hectares and can be as large as 100,000 hectares. Nine modern systems have been identified with an aggregate command area of somewhat more than 300,000 hectares, representing about 10 percent of the total national irrigated area.

10. Traditional schemes are those which have few or no engineered structures and which generally rely on earthen water conveyance and control structures for water delivery. Typically they have been constructed by the users themselves. Traditional systems can be larger than some of the “modern” systems. Where traditional systems have been selectively improved, the two system types tend to blend seamlessly together. Traditional canal-based schemes are widely distributed in every province in the country. They range in size from a few hectares in high mountain valleys to extensive networks covering as much as 30,000 hectares on the northern plains. They occur most extensively in the larger lowland provinces mirroring the distribution of overall irrigation in the country.

11. Operation and maintenance of traditional and many modern systems are carried out by local water users, typically headed by a *mirab* or watermaster.

12. Karezes are traditional underground tunnels constructed on a slight slope from a source of groundwater, emerging at the ground surface some distance down slope. The karez is an ancient irrigation technology. Estimates of the total number of karezes in Afghanistan range from 7,000 to 8,000. They are concentrated almost exclusively on the eastern, southern, and western flanks of the Hindu Kush. The past 23 years of war and strife have been extremely hard on karezes, which require regular maintenance to work effectively.

13. Springs represent about 5 percent of the irrigated agricultural area in Afghanistan. However, in some locations they are a relatively important source of irrigation and drinking water.

14. Until recently drilled wells were not an important source of water for irrigation. However, there has been a dramatic increase in their usage. In the east, south, and west, thousands of new wells have been constructed as a supplemental source of water, and as a response to the drought. These wells have served an important function, allowing many farmers to keep their orchards and vineyards alive. At the same time, there increasingly appears to be a ‘gold rush’ mentality under way, where new settlers have constructed hundreds or thousands of new farms, where newly drilled wells have become a critical and only source of irrigation water.

15. The trend to deep wells needs to be watched very closely, and could represent a dramatic future policy challenge for the government. If present trends continue, it seems possible that the aquifers which have fed the karezes in the proximity of these wells over many centuries

will start to dry up over the next few years, with far reaching social, political, economic, environmental, and ecological implications. This current land rush is concentrated in the southern and eastern parts of the country, where most of the karezes are located. The eventual collapse of the “gold rush” across the eastern and southern regions of Afghanistan could prove destabilizing for large numbers of people.

16. After 1980, networks of private importers and retailers sprang into existence and these have demonstrated a strong capacity to operate efficiently and effectively. A recent investigation into the private markets for fertilizer and pesticides in Pul-i-Kumri in the northern part of Afghanistan turned up some 40 shops selling Urea.

17. Wheat is the dominant cereal grown in Afghanistan, and bread is the staple food for most of the population. Almost all cereals produced in Afghanistan currently move through private traders to markets. Most major market center towns have a flourishing grain market. These markets appear to work well, and the cost of wheat and other grains appear to be competitive across the country.

18. Agriculture as practiced in Afghanistan is labor-intensive. There are important seasonal issues involved with labor intensive employment strategies. Certain seasons of the year show a relatively heavy demand for on-farm labor. Thus, labor intensive programs should be scheduled in ways that don't compete with peak times for agricultural labor, in order to avoid driving up daily wages. Generally, in temperate climates irrigation and farming work are both curtailed during the winter months.

19. Revitalizing Afghanistan's irrigated agriculture will involve two broad initiatives: (i) Public-Private partnerships using labor-intensive rehabilitation projects in each of the four major river basins of Afghanistan in the north, south, east, and west working through the private sector as much as possible; and (ii) an Inter-ministerial Water Management Council to set policy and coordinate the work of relevant national ministries and help provide guidance for the irrigation sector, including eventual regional-level River Valley Authorities.

20. DAI will support the rehabilitation of selected irrigation projects located along each of Afghanistan's major river valleys. Working with and through Afghan entities DAI will work in most major irrigated regions of the country. Several provisional sub-projects have been identified over the past six weeks. These potential sub-projects are briefly described below:

21. During the first year, for example, In the North, one or two of the substantial irrigation projects on the Kunduz River will be chosen for rehabilitation. In the South, DAI has submitted a proposal to USAID describing a labor intensive rehabilitation program for the Helmand Valley. In the East, the Nangarhar Valley Development Authority (NVDA) could benefit from the repair of one or two structures, with the potential to irrigate an additional land. In the west, several relatively large traditional irrigation systems are located along the Hari Rud River. In the central part of Afghanistan, in order to demonstrate some immediate support for the people of Parwan, DAI proposes to repair one barrel of a major river siphon that was damaged by the Taliban.

22. Following appropriate technical analysis and design for individual proposed subprojects, a Memorandum of Understanding (MOU) or contract will be executed with one or more concerned technical ministries, the local government authorities, and the relevant local Water User's Association, and when relevant private sector entities.

23. DAI understands the management constraints that confront USAID/Afghanistan. To simplify reporting, it proposes to clearly link together the Water IQC work with the Helmand Valley Rehabilitation program under one consolidated management structure. To accomplish this, DAI will create a Senior Management Group, (SMG) that will oversee all DAI program activities, and report on them to USAID.

24. A summary of specific recommendations with specific suggested follow-up actions is given on pages 23 to 25.

CHAPTER ONE

OVERVIEW: IRRIGATED AGRICULTURE IN AFGHANISTAN

Agriculture is estimated to produce 85 to 90 percent of Afghanistan's Gross Domestic Product, and employs 70 to 80 percent of the population. It is the principal source of livelihood for a large share of the rural population, particularly those living in more isolated regions of the country. With approximately 1 million refugees returning to the country in recent months congregating in major urban areas, and perhaps 1 million more set to return in the near future, the need to rapidly expand rural livelihood opportunities is acute. Just one-eighth of the country is cropland and much of this land is not planted every year. The 4 to 5 percent of the land which is irrigated produces 85 percent of crop value annually.¹

Because of a drought extending over most of the country over the past five years, it is difficult to know the current extent of active irrigation in Afghanistan. The most recent reliable information comes from a pair of studies based on remote sensing imagery carried out in the early 1990s, before the recent drought began². These studies are generally consistent with each other, and showed total irrigated areas of approximately 3.30 million hectares.

Those provinces with the largest irrigated areas include Balkh, Kandahar, Herat, Ghazni, and Helmand. Each irrigates more than 200,000 hectares. The two contiguous provinces of Kunduz and Baghlan together irrigate more than 200,000 ha. These seven provinces are large low elevation flatlands on the periphery of the country, located along the valleys of the four major river basins of the country. These include the Kunduz River in the Northeast, the Kabul River in the East, the Helmand River with its tributaries in the South, and the Hari Rud River in the West.

GEOGRAPHY AND HYDRO-GEOGRAPHY

Topography and climate

The topography of Afghanistan is characterized by extensive desert plains, high mountainous ranges and scattered fertile valleys along major rivers, including the Kabul, Kunduz, Hari Rud and Helmand. Roughly half of Afghanistan is located at an altitude of over 2000 m.

¹ Rainfed agriculture represents nearly 12 percent of the total land cover of Afghanistan, but produces only 15 percent of the gross value of the agricultural output, largely because irrigated wheat is 2.5 times more productive than dryland wheat. Rainfed agriculture is common on the northern flanks of the Hindu Kush mountains, where there is sufficient precipitation to support a single crop, in an area extending from Badakshan in the Northeast to Herat in the Southwest. Smaller areas of rainfed agriculture are visible within the Hindu Kush and Safed Koh, and in limited areas in the SE in Ghazni, Paktia, and Northern Kandahar. Sources: FAO. 1997. *Afghanistan Agricultural Strategy*. Rome, and DAI Land Cover and Land Use Report, March, 1993.

² These studies were conducted by DAI in conjunction with Earth Satellite Corporation, and FAO respectively

[6,500 feet] The Hindu Kush Mountain Range, covered by permanent snow and glaciers at altitudes above 5000 m are the backbone of the country. The mountains determine the main sources of rain clouds that reach Afghanistan:

- Precipitation originating from the Indian Ocean coming through India and Pakistan; these clouds are mostly blocked by the various mountain ranges of Pakistan; thus little precipitation reaches Afghanistan; and
- Precipitation originating from the Mediterranean, Caspian, and Aral Seas, pushed by northwestern winds in winter and early spring to Afghanistan; this results in sudden storms (mostly snow) in the Hindu Kush Mountains.

Afghanistan has a dry continental climate. Ninety percent of the country's annual precipitation occurs during the winter months between December and April, mostly falling as snow. In summer, it mostly receives warm dry air from the north and northeast with little or no precipitation. The amount of precipitation directly correlates with altitude: it varies from less than 100 mm (4 inches) per year at altitudes below 1000 m (south, north and west), to over 1000 mm (40 inches) above 4000 m (northeast).

Thus, Afghanistan shows a strong correlation between altitude and agricultural potential. Higher elevations produce greater rainfall but provide shorter growing periods and substantially less arable land. Conversely, the plains receive limited rainfall but enjoy large areas of agricultural lands and a more temperate climate. On balance, rainfed agriculture is subject to chance and of limited productivity. River flows allow spring and summer irrigation in the plains, are more assured, and permit substantially greater agricultural output.

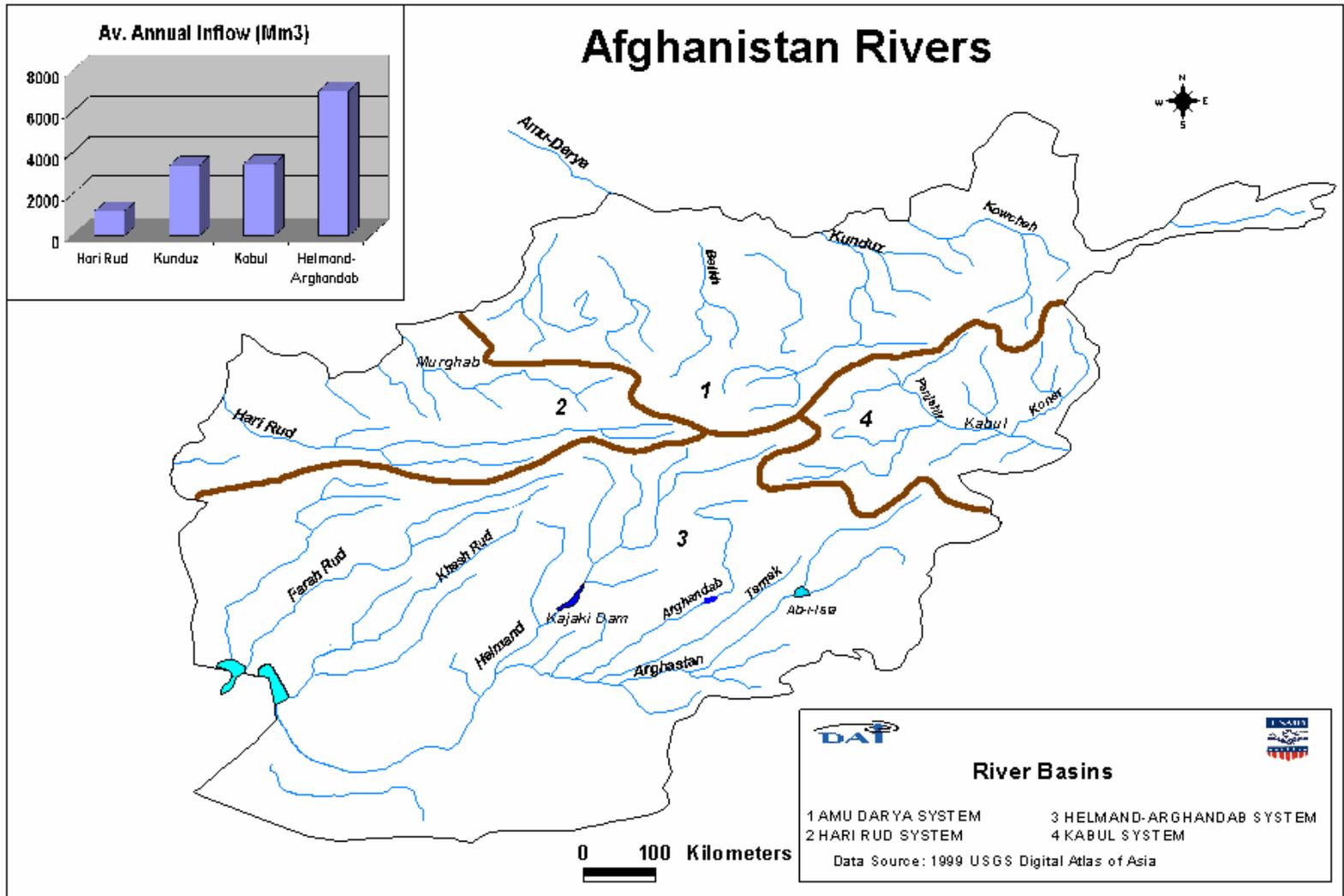
Hydrology

Afghanistan can be divided into four river basins, based on drainage patterns. All main rivers are fed by melting snow, and originate from the Hindu Kush in the center of the country. These include:

- Several tributaries flowing north towards the Amu Darya, the main ones being the Kunduz and Kokcha Rivers. The westernmost of these, such as the Balkh River, become dry before reaching the Amu Darya. (This drainage basin covers 24 percent of the country.)
- The Hari Rud and its tributaries flow west. It dries out in Iran, close to the city of Mashhad. (This drainage basin covers 12 percent of the country.)
- Several tributaries flow east into the Indus River, the main one being the Kabul River. (This drainage area covers 12 percent of the country.)
- Several tributaries flow south into the Seistan depression, the main ones being the Helmand, Arghandab, The Khash Rud, and the Farah Rud. (This drainage area covers 52 percent of the country.)

Figure 1 on the next page shows these main rivers and the four river basins.

Figure 1: Map of Afghanistan Rivers



The flow in these rivers depends on precipitation, including both rain and snowfall. Snowmelt between March and July produces the major part of river runoff in Afghanistan. The altitude of the upstream part of the catchments determines the timing of the flows.

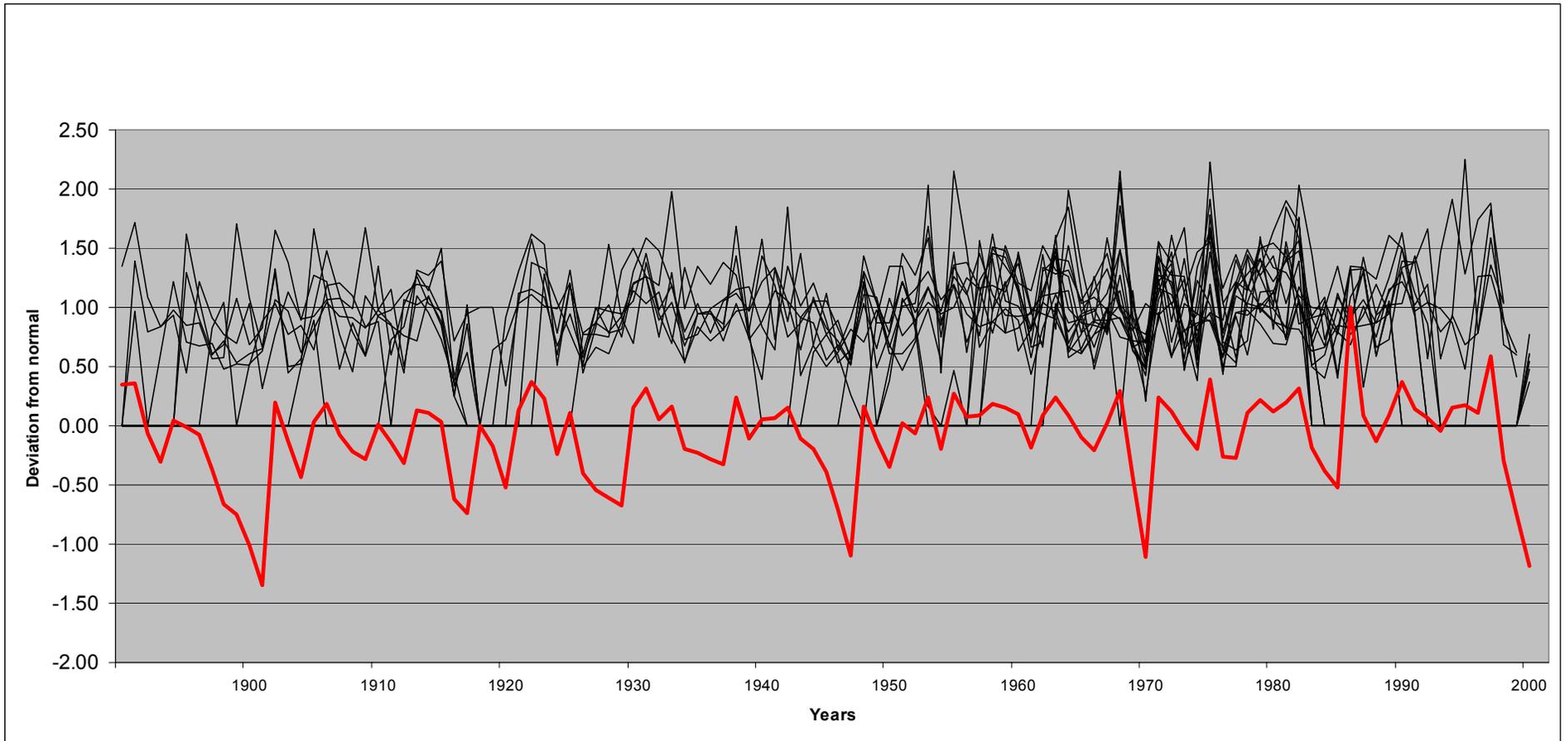
The Drought

The analysis of past rainfall data in Afghanistan and in neighboring Central and Southwest Asian countries shows that the region has experienced four severe region-wide droughts in the past century (see Figure 2 on the next page). This is confirmed by witnesses and oral memory. These drought events were as follows:

- 1898-1905;
- 1944-45;
- 1970-72; and
- 1997-present.

Without clear rainfall and stream gauging data, past drought events are difficult to quantify, or place into meaningful context. Droughts are somewhat episodic, and occur to different degrees in different parts of the country. It is hard for individuals to form an overall picture of what may have happened across an entire country. The current drought that seems to have begun in 1998 in the far western parts of Afghanistan may be approximately comparable to the drought that extended for almost seven years from 1898 to 1905. The other two drought events in the 1940s and 1970s were shorter and less severe, albeit still disastrous for the agriculture of the region. More than 50 percent of Afghanistan's livestock, for example, died in 1970-72. The analysis also tends to confirm the existence of a drought cycle of approximately 30-40 years that occurs repeatedly across Afghanistan's history. At present, there is no clear evidence that drought will end next year, although there is anecdotal evidence that it has abated across the north in 2002. The drought has been linked to the La Nina phenomenon by some scientists. The non-occurrence of La Nina for the first time in four years may represent a possible sign of the abatement of this current drought cycle, but it is in no way a guarantee of relief. Based on the precedent of the 1898 drought, it is possible that this current drought event might continue for an additional year or two, or that there could be a good year of snow, and then the country might relapse into another period of drought. During the seven year drought from 1898 to 1905, for example, the year 1903 was good, followed by two additional years of drought.

Figure 2: Cumulative Precipitation Deficits in a Set of Central/SW Asian Stations
(NB surpluses are not cumulated)



EXTENT AND CONDITION OF IRRIGATION SYSTEMS

There are five basic types of irrigation in Afghanistan. These include (i) modern surface systems, (ii) traditional surface systems, (iii) springs, (iv) karezes, and (v) wells. Modern systems represent approximately 10 percent of the total irrigated agriculture; karezes traditionally have represented about 5 percent; springs represent slightly more than 5 percent, and traditional canal irrigation systems with intakes from various rivers and streams represent more than 80 percent of the total irrigated area. The karez systems are located almost exclusively along the eastern, southern, and western flanks of the Hindu Kush.³ Drilled wells are rapidly replacing karezes or provide supplemental irrigation water sources, and appear abundant in the region from Kandahar to Kabul. These wells have become a significant and growing source of irrigation water. At present no data are available to document the number of these wells and their percent contribution as a new source of irrigation and drinking water. Wells are generally being drilled in the same areas as the karezes, because the aquifers have represented good storage sources for underground water.⁴ Figure 3 on the next page shows the four principal river valley systems of Afghanistan, as well as the areas of irrigation and rainfed agriculture.⁵

Surface Water

Modern Systems

Modern systems are defined as those with engineered intake structures and permanently installed gates for water control at a number of locations along the distribution system. Systems are generally larger than 10,000 hectares and can be as large as 100,000 hectares. Modern systems have been constructed only during the last 50 years. Nine modern systems have been identified with an aggregate command area of somewhat more than 300,000 hectares, representing about 10 percent of the total national irrigated area. These nine systems are shown in Table 1.

Modern irrigation systems are primarily concentrated along three major river valleys: the Kunduz River in the North; the Kabul River and its tributaries in the East; and the Helmand and its tributaries in the South. Modern systems are primarily located in five provinces: Kunduz and Baghlan in the North, Helmand and Kandahar in the South and Nangarhar in the East. These five provinces contain almost 90 percent of the national area irrigated by modern schemes. Smaller modern projects are found in Parwan Province and Ghazni.

³ While the southern slopes of the Hindu Kush have generally been characterized by karez irrigation, dryland agriculture is primarily found across the northern slopes of the Hindu Kush.

⁴ The various DAI teams did not travel to the Northwestern parts of Afghanistan from Mazar-i-Sharif to Herat. The role of drilled wells in this region remains to be explored, as do the surface irrigation systems around Mazar-i-Sharif in Balkh Province.

⁵ The various DAI teams did not travel to the Northwestern or far Western parts of Afghanistan, from Mazar-i-Sharif to Herat. The role of drilled wells in these regions remains to be explored, along with the surface irrigation systems around Mazar in Balkh Province.

Figure 3: Map of Afghanistan Agriculture

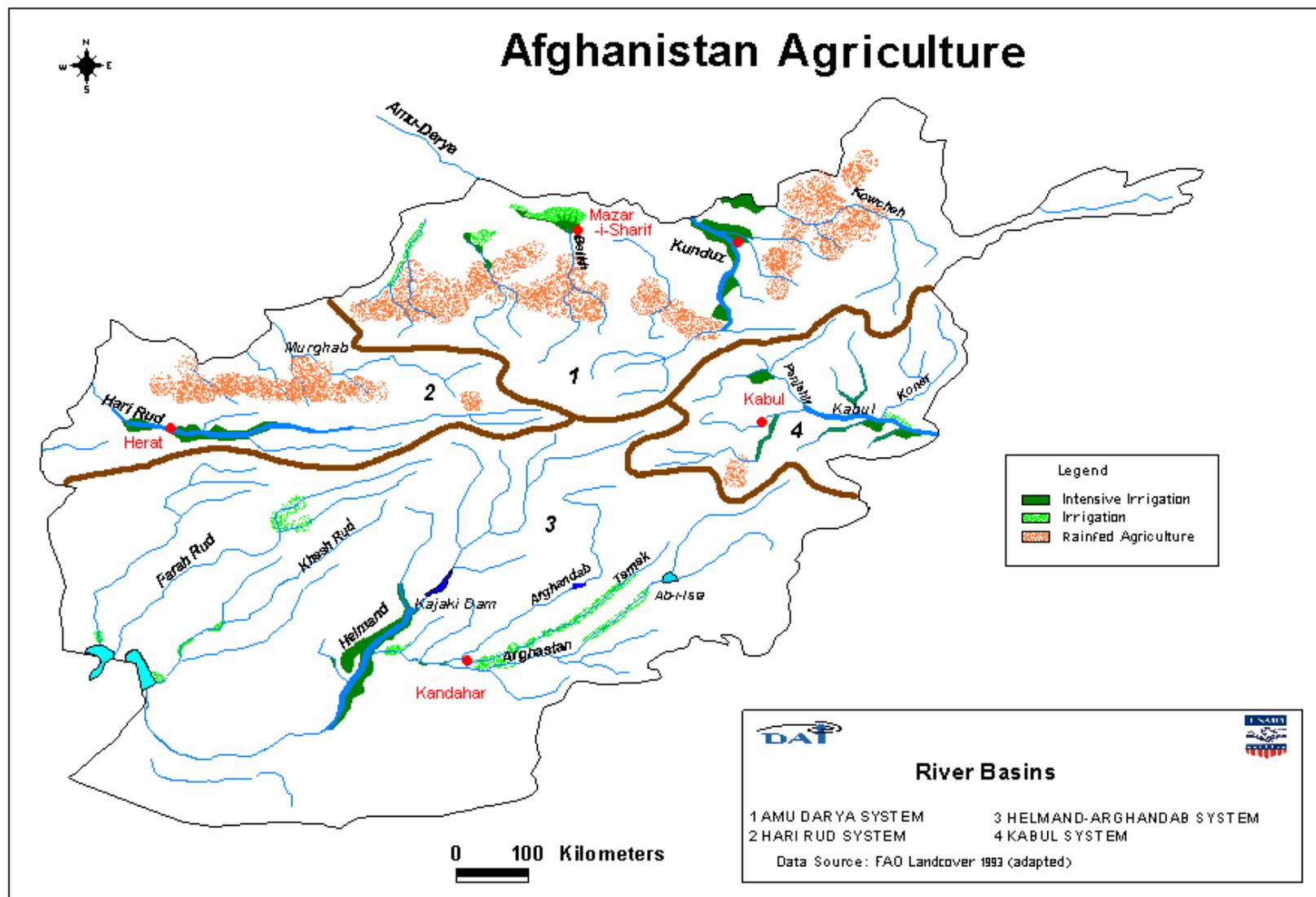


Table 1: Modern Irrigation Projects in Afghanistan

Name/Project	Province	Hectares	Principal Donor(s)	Constructed
1. Kunduz-Khanabad Barrage	Kunduz	35,000	WB	1970s
2. Shahrawan Canal	Kunduz	30,000	GOA, FAO	1970s
3. Ajmir canal		30,000	GOA	1950s
4. Gawargan Project	Baghlan	25,000	ADB	1970s
5. Kalagai Diversion	Baghlan	10,000	GOA, FAO, USAID [?]	1960s
6. Parwan Project	Parwan	25,000	China	1960s-70s
7. Nangarhar (NVDA)	Nangarhar	21,000	USSR	1960s-70s
8. Sardeh Dam	Ghazni	16,000	USSR	1960s-70s
9. Kajakai Dam & Helmand system	Helmand	100,000	USAID	1940s-60s
10. Arghandab Dam & Zahir Shah Irrigation system	Kandahar	60,000	USAID	1940s-60s
Total		350,000		

Traditional Systems

Traditional schemes are those which have few or no engineered structures and which generally rely on brush and log diversions and earthen water conveyance and control structures for water delivery. Typically they have been constructed by the users themselves using local labor and materials. Such traditional schemes usually rely on rock, brush, log, and dirt intake structures. They rarely survive the spring floods and have to be rebuilt each year by the water users. Traditional systems can be larger than some of the “modern” systems, and where traditional systems have been selectively improved, the two system types tend to blend seamlessly together. In a similar manner, over the past 23 years, many of the ‘modern’ systems have been repaired by traditional methods by local people. Due to the lack of skilled engineers, machinery and equipment to operate, maintain, and repair the ‘modern’ systems, local *mirabs* and farmers have relied upon their own native ingenuity, putting rocks, mud and grass in place to supplement or augment modern engineered structures.

Traditional canal-based schemes are widely distributed in every province in the country,⁶ and comprise about 80 percent of the total irrigated area. They range in size from a few hectares in high mountain valleys to extensive networks covering as much as 30,000 hectares on the northern plains. They occur most extensively in the larger lowland provinces on the periphery of the country, mirroring the distribution of overall irrigation in the country. As one moves down the mountains, the size of the systems typically increases, because the land flattens out, and often becomes more fertile and less costly for irrigation and land development.

⁶ While it is currently impossible to provide hard data concerning the total number of traditional systems, there are approximately 16,000 villages scattered across Afghanistan [Gazetteer of Afghanistan, 1975]. Other sources suggest a higher number. By definition, in order to exist, every village has to have access to at least one water source. Some water sources such as large canals provide water to scores of villages; at the same time, many villages have several water sources. Thus, at an assumed rate of one irrigation scheme per village, a rough estimation of the number of traditional irrigation systems might be about 16,000. If the actual number of villages is higher, then this number would go up.

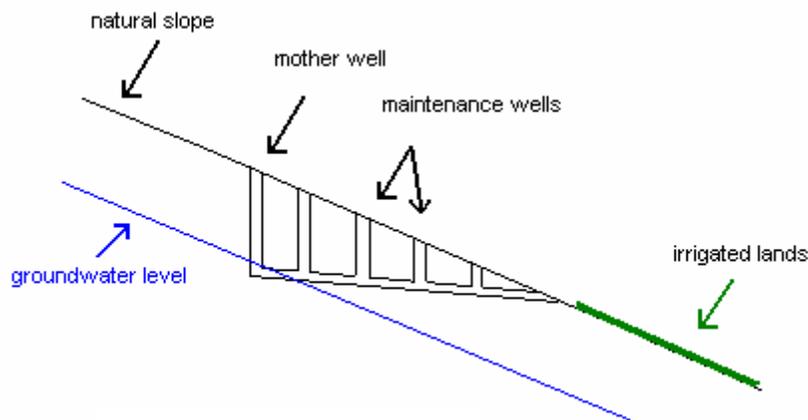
Operation and maintenance of traditional and many modern systems are carried out by local water users, typically headed by a *mirab* or watermaster. Water users associations and the role of the *mirabs* are ancient local institutions commonly found all across Afghanistan. The *mirab*'s job is to control water distribution, perform minor maintenance, and call people together to handle major maintenance or repairs. He also attempts to adjudicate differences over water use between different water users along the length of the canal. Maintenance and repairs includes desilting canals and repairing and extending stone and brush intake structures in the river. The *mirab* is selected from within the local farming community, though he is not necessarily a farmer. On larger systems, the *mirab* will have one or more assistant *mirabs*, called *chak bashis* (in the North) who undertake more of the manual and physical tasks of operation and maintenance.

Groundwater

*Karez*s

Karezes are traditional underground tunnels constructed on a slight slope from a source of groundwater, emerging at the ground surface some distance down slope. Vertical air shafts (“wells”) are spaced periodically along the length of the horizontal tunnel to provide access to the tunnel and to allow removal of earth during construction and cleaning. Karezes usually tap into river aquifers or aquifers below the foothills of nearby mountains. A generic form of a karez is shown in Figure 4, below:

Figure 4: Cross-section of a Karez



The karez is an ancient irrigation technology and thousands of them are scattered the Afghanistan.⁷ Estimates of the total number of karezes in Afghanistan range from 7,000 to

⁷ Very few karezes are found in northern Afghanistan. Only one is known to exist in Baghlan, for example, and none are found in Kunduz or Takhar. Similar structures are found in southern Pakistan, Iran, and all across the Middle East, and over to parts of Central Europe.

8,000. They are concentrated almost exclusively on the eastern, southern, and western flanks of the Hindu Kush Mountains in a belt stretching from Parwan province north of Kabul across southeastern Afghanistan to Kandahar, and in the western provinces of Faryab, Herat, and Farah. While karezes are locally important sources of irrigation and domestic drinking water, they supply just 5 percent of the national irrigated area.⁸ Only in Kabul and Farah provinces do they supply more than 15 percent of irrigation water requirement. Karezes typically are constructed and maintained by a specialized group of artisans called *karezkan*. The task is demanding and dangerous, and *karezkan* generally well-paid by local standards.

The past 23 years of war and strife have been extremely hard on karezes, which require regular maintenance to work effectively. Some have been deliberately destroyed by warfare, or sabotaged or mined to make rehabilitation difficult. Following the various waves of returning refugees, foreign NGOs have provided assistance to clean and restore many of the damaged karezes through food or cash-for-work programs.

Springs

Nationally, springs represent just 5 percent of the irrigated agricultural area.⁹ However, in some locations they are a relatively important source of irrigation and drinking water. They provide more than 15 percent of irrigation water in Uruzgan, Samangan, Ghor, Badghis, Parwan, and Bamyán provinces. In the province of Uruzgan, springs and karezes together supply more than half the irrigation water consumed. As a source of supply, springs require little maintenance or upkeep. Canal distribution systems, which distribute spring water are similar to those of smaller traditional surface systems.

Wells

Until recently drilled wells were not an important source of water for irrigation. However, there has been a dramatic increase in their usage, both in urban and selected rural areas. There are dramatic differences in the roles of drilled wells in the northern parts of the country, for example, and the eastern, southern and western regions. In the North, (at least in the Kunduz and Baghlan areas) dug wells have been used to a limited extent to irrigate agricultural crops, but more often are an important source of drinking water. As such, wells for drinking water in the north should be protected from regional groundwater contamination and from groundwater irrigation which competes with these wells.

In the east, south, and west, thousands of new wells have been constructed as a supplemental source of water and as a response to the drought. These wells have served an important

⁸ The relatively small percent of land that karezes irrigate may be partially offset by their use to irrigate higher value horticultural crops. In Parwan Province, for example, they are extensively used to irrigate high value orchards and grape vines, and across the eastern hills of Afghanistan they are used to irrigate high value temperate fruit crops like apples, peaches, and apricots.

⁹ There are some definitional issues involving spring irrigation. Spring water typically seeps out of cracks and flows down into small streams, and eventually is captured one way or another for irrigation, often through a traditional canal. Where spring irrigation stops and where traditional canal irrigation starts is conceptually somewhat fuzzy.

function, allowing many farmers to keep their orchards and vineyards alive. At the same time, a ‘gold rush’ mentality increasingly appears to be a under way, where new settlers have constructed hundreds or thousands of new farms on government land that previously was desert, outside of traditional irrigated areas, where newly drilled wells have become a critical source of irrigation water. In the past few years large diameter drilled wells have begun to appear in areas north of Kabul on the Shamali Plain, and along the southern flanks of the Hindu Kush from Kandahar up to Kabul. Extensive new communities have grown up in areas north of Kandahar, for example around Qalat and Ghazni, on areas which were largely uninhabited just a few years ago. These new communities are beginning to resemble long-established agricultural communities like Parwan or the Arghandab Regions of Northern Kandahar. In some ways these new settlements may represent a very positive development. At the same time, this land rush, coupled with the drilling of vast numbers of new wells raises several significant concerns:

- To date hydrological studies have shown no substantial amounts of renewable groundwater underlying most parts of Afghanistan.¹⁰
- Historically, karezes have generally proven to be a sustainable way to tap underground water resources.
- Karezes are commonly owned community resources, while wells are individually owned.
- Drilled wells are expensive to install,¹¹ which biases ownership toward larger landowners. They have the potential to withdraw water from the same aquifers tapped by traditional karezes and can reduce the flow to karezes, or even dry them up altogether.
- Wells have the potential to allow individuals owners to exploit a non-renewable resource, or to over-harvest water beyond sustainable levels. This has already happened to a dangerous degree on the plains around Quetta, Baloochistan.
- On the positive side, pumps can be turned on and off at will, while karezes flow continuously, withdrawing water from the groundwater reservoir. Wells can be deepened to follow retreating water tables, while such deepening is significantly more difficult in the case of karezes.
- Well construction has proved extremely difficult to regulate throughout Asia, and while offering benefits, there are also substantial tradeoffs and hazards for existing groundwater users.

The trend to deep wells needs to be watched very closely, and could represent a dramatic future policy challenge for the government. If present trends continue, it seems possible that the aquifers which have fed the karezes over many centuries will start to dry up over the next

¹⁰ This statement is based on recollections concerning the WAPECO study, provided by Eng Mohammad Omar and Eng Abdullah Aini, both members of the DAI design team. The team did not have direct access to this study.

¹¹ Drilled wells appear to cost about 2,000 Pakistani rupees a day to drill, and can cost over 100,000 Pakistani rupees, or US\$2,000. In the Eastern hills they run over 100 meters deep, and appear to average 50 to 55 m.

few years, with far reaching social, political, economic, environmental, and ecological implications. This current land rush is concentrated in the southern and eastern parts of the country, where most of the karezes are located. The eventual collapse of the “gold rush” across the eastern, southern, and western regions of Afghanistan could prove destabilizing for large numbers of people.

The apparent over use of ground water in the karez belt of the country appears to represent a classic case of the ‘tragedy of the commons,’ with individuals over exploiting a commonly owned natural resource. Without efforts to address this looming problem, much of the higher value irrigated agriculture of the eastern, southern and western belt of the Hindu Kush could revert back to desert in a few years. Several strategies that could help to mitigate the challenges of over-exploitation of ground water are given in the consolidated recommendations section at the end of this paper.

Agriculture

Crops

Wheat is the dominant cereal grown in Afghanistan and bread is the staple food for most of the population. Rice production is increasingly important in the Kunduz River Valley, Nangarhar and other parts of the country and is the second most important food crop grown in the country. Maize is important as a grain, often used in corn bread, particularly in the north.

Afghanistan has a strong comparative advantage in horticultural crops and has traditionally been an exporter of fresh and dried fruit and nuts to the Subcontinent, and to Europe. Horticulture is an important growth sector and offers potential substitutes for illegal poppy crops in the south and east. Among other things, such higher value horticultural crops require a regular, reliable irrigation water supply. The eastern flanks of the Hindu Kush Mountain Range are becoming an increasingly important source of such horticultural products, but it is not clear that the underground water supply for such crops is sustainable.

Production of principal crops in 1976 and estimates for 1996 are shown in Table 2.

Table 2: Production of Principal Crops

Crop	Government Statistics 1976			FAO Estimates 1996		
	Area [000 ha]	Yield [kg/ha]	Output [tons]	Area [000 ha]	Yield [kg/ha]	Output [M tons]
Wheat	3,404	1,316	4,479,664	3,600	1,700	6,120,000
Barley	320	1,200	384,000	310	1,150	356,500
Maize	484	1,612	780,208	485	1,700	824,500
Rice	210	2,071	434,910	215	2,100	451,500
Cotton	112	1,429	160,048	80	1,450	116,000
Sugarcane	4	15	60	5	16	72
Sugarbeet	5	20	100	2	19	38
Fruits	140	880	123,200	70	425	29,750
Vegetables	92	7,830	720,360	90	7,900	711,000

Source: FAO, 1997

Inputs, Outputs, and Labor

Input Markets

Before the recent conflicts in Afghanistan, supply of purchased inputs such as seed, fertilizer, agricultural chemicals, and small tools and implements, was dominated by a pair of government parastatal corporations under the Ministry of Agriculture—the Afghan Seed Company and the Afghan Fertilizer Company (AFC).

When the AFC became inactive in the 1980s, networks of private importers and retailers sprang into existence and these have demonstrated a strong capacity to operate efficiently and effectively. A recent investigation into the private markets for fertilizer and pesticides in Pul-i-Kumri in the northern part of Afghanistan turned up some 40 shops selling Urea.¹² Marketing margins are razor thin and dealers appear to operate in a very competitive and efficient manor. Other private dealers sell veterinary supplies and agricultural chemicals procured from India, Pakistan, and Iran. Recent conversations at the ministerial level indicate strong support for the concept of private provision of virtually all purchased inputs for agriculture.

Output Markets

Almost all cereals produced in Afghanistan currently move through private traders to markets. Most major market center towns, for example, have a flourishing grain market. These markets appear to work well, and the cost of wheat and other grains appear to be competitive across the country.

Draft power

A recent survey of livestock in the country by a group of international agricultural research centers¹³ found a shortage of draft animals constituting a serious potential constraint to expanding agricultural production. While outside the purview of an irrigation-focused project, this deficiency needs to be addressed since it constrains irrigated production and livelihood creation for returning refugees.¹⁴ At the same time, tractors and related agricultural machinery—particularly threshers—are widely available at least in the southern and eastern parts of the country in Helmand, Kandahar, and bazaars like Ghazni.

¹² DAI teams have found similar supplies of insecticides, pesticides, and fertilizers in the market towns of Kunduz, Kandahar, and Lashkar Gah.

¹³ The centers of the Consultative Group for International Agricultural Research (CGIAR). The effort in Afghanistan is lead by ICARDA and includes participation by ICRISAT and IWMI. A visit to a weekly provincial livestock bazaar in Baghlan confirmed a serious paucity of draft animals. Interviews with farmers in Kunduz and Baghlan suggest that wealthier farmers use bullocks to plow their fields; poorer farmers reportedly rent tractors.

Labor

Agriculture as practiced in Afghanistan is labor-intensive, and as such it provides employment for perhaps 80 percent of the population. There are important seasonal issues involved with labor intensive employment strategies. Certain seasons of the year—particularly the spring and the fall planting seasons—show a relatively heavy demand for on-farm labor. Thus, labor intensive programs should be scheduled in ways that don't compete with peak times for agricultural labor, in order to avoid driving up daily wages.

Labor Intensive Employment vs. Poppy Harvesting Strategies

An alternative more proactive strategy might be considered for those times of the cropping cycle that coincide with the peak labor demand for opium harvesting. Under such a strategy, cash or food for work programs could be deliberately scheduled to coincide with peak demand for labor for opium harvesting, thereby reducing labor available for opium harvesting, and/or making opium production less profitable.

CHAPTER TWO STRATEGY FOR REVITALIZATION

Revitalizing Afghanistan's irrigated agriculture involves two broad initiatives:

- Public-Private partnerships need to be established using labor-intensive rehabilitation projects in each of the four major river basins of Afghanistan in the north, south, east, and west, *working through the private sector as much as possible*; and
- An Inter-ministerial Water Management Council should coordinate the work of relevant national ministries and help provide policy guidance for the irrigation sector, including regional-level River Valley Authorities.

The labor intensive approach described in this paper will have a broad positive impact on Afghanistan's agricultural production in time for the spring planting season of 2003. Working with other key stakeholders, DAI can immediately initiate a set of labor-intensive rehabilitation projects in the major river valleys of Afghanistan. These initial projects could serve as models, testing how to:

- Best form public-private partnerships;
- Build in suitable government involvement;
- Incorporate relevant private sector technical expertise; and
- Draw upon local labor and regional leaders to support irrigation rehabilitation.

Over the past few years, much recent small-scale irrigation rehabilitation work has been implemented by NGOs in ways that bypassed government. Afghanistan today calls for a different strategy. Thus, this new program will coordinate with responsible local and regional government agencies while working as directly as possible with local water users associations and private sectors groups and organizations to lay the groundwork for larger-scale more comprehensive interventions.

The second part of the proposed strategy calls for the creation of an Inter-Ministerial Water Council. This Council will link together various stakeholders involved with rehabilitating the agriculture and irrigation sectors. It would draw upon the resources of the Ministries of Agriculture, Irrigation, Rehabilitation and Rural Development, plus various NGOs and the private sector. To accomplish this, DAI and other stakeholders will support efforts at the national level that coordinate inter-ministerial interests, provincial interests, NGOs and the private sector. These efforts will be supported by a small cadre of senior-level Afghans, Afghan-Americans, and international experts.

DAI has also established a preliminary methodology for reviewing potential irrigation rehabilitation projects. This methodology is summarized on the next page and detailed in Annex B. It can be used to screen all project proposals submitted to USAID.

A FRAMEWORK FOR SCREENING IRRIGATION REHABILITATION PROJECTS

Labor-Intensive Traditional Irrigation Systems

There is a strong demand for programs that provide immediate income to unemployed Afghans, including refugees, landless, and the poor. Rehabilitating degraded irrigation systems through food or cash-for-work programs represents an important vehicle to reduce poverty, expand employment, put money into people's pockets, and increase agricultural productivity.

To provide a mechanism for reviewing proposals to rehabilitate irrigation systems, DAI proposes the following requirements and criteria. These are summarized below, and explained in more detail in Annex B.

- **Requirement One:** A well defined management structure;
- **Requirement Two:** Rehabilitation will not damage a Water User's Association or *mirab system*;
- **Requirement Three:** Sufficient surface water is available to irrigate any proposed additional land;
- **Requirement Four:** The project should support geographical dispersion;
- **Requirement Five:** The irrigation system being rehabilitated should be larger than 500 hectares, and the source is surface water, not groundwater. Once these five basic requirements are met, a series of technical criteria would then be applied. These include:
 - **Criterion One:** A positive cost/benefit analysis.
 - **Criterion Two:** The value of person days of labor funded by the project;
 - **Criterion Three:** The amount of gravity fed water flowing through the rehabilitated irrigation system; and
 - **Criterion Four:** The proposed start up date for the activity should begin immediately; Screening would not be a mechanical calculation based on points to select activities for possible funding. Rather proposals containing specified data furnished by the organization requesting USAID funding would be analytically reviewed. If appropriate, DAI can design a proposal format incorporating the requirements and criteria described above, review grant applications, and offer insights on the proposal's potential value to national-level agricultural rehabilitation.

Complex Modern Irrigation Systems

Another category of irrigation rehabilitation also requires support. Larger systems with degraded facilities can't always be repaired by labor-intensive methods. Modern systems may have been traditionalized, or traditional systems may merit modernization. Typically such systems require professional engineers to design or re-design water control structures and/or carry out main canal rehabilitation. Some modern systems have main canals that are too large to be cleaned by hand methods, for example. Control gates may be missing or damaged. Sometimes thousands of hectares of additional land can be brought under irrigation command if relatively inexpensive technical solutions are put into place, using relevant technical expertise. DAI with its cadre of experienced senior Afghan engineers can support such knowledge-intensive irrigation rehabilitation efforts, and provide the necessary technical engineering oversight to rehabilitate such systems.

The requirements and criteria for selecting complex modern irrigation systems would be the same as for traditional systems except for the elimination of Criteria Number Two. (above.)

The Implementation Model

As its principal implementation model, DAI proposes to work through public-private partnerships involving the public sector, the private sector, and the NGO community, with a bias towards working as directly as possible with local water user's associations and relevant private sector entities. DAI technical staff will visit each proposed irrigation site together with personnel from participating national Ministries and departments, as well as provincial administrations. Depending upon the specifics of a particular project, this could include the Ministry of Agriculture, Irrigation, or Rural Development. For modern systems, the Ministry of Irrigation could become the designated national-level counterpart ministry. For traditional systems—particularly those involving labor-intensive rehabilitation activities—these generally would be the responsibility of the Ministry for Rehabilitation and Rural Development, (MRRD). At present, the Nangarhar Valley Development Authority is under the formal authority of the Ministry of Agriculture. The Helmand Arghandab Valley Authority currently reports both to the Ministry of Agriculture and to the Ministry of Irrigation, as well as to the Governor's office in Helmand.

Following appropriate technical analysis and design for individual proposed subprojects, a Memorandum of Understanding (MOU) would be executed with one or more concerned technical ministries, the local government authorities, and relevant local Water User's associations. If necessary one or more NGOs would be brought into the project to help organize and supervise the local workforce. If relevant, private sector groups could also be contracted for specific construction activities. The MOU would clearly specify what inputs would be provided by national level ministries, and/or by DAI, as well as what would be expected of the local-level responsible organizations. The MOU would clearly state the expected outputs and the time frame for completion. DAI administrative staff working from a central office in Kabul or a satellite office in Helmand would manage the funds and the accounting systems to satisfy USAID requirements.

IRRIGATION REHABILITATION PROJECTS TO BE IMPLEMENTED BY DAI AND OTHER STAKEHOLDERS

DAI working through the Planning and Coordination Unit under the umbrella of the National Water Management Council will directly support the rehabilitation of selected irrigation projects located along each of Afghanistan's four major river valleys. Such an effort will:

- Support public-private partnerships involving national ministries, provincial-level governments, local NGOs, and the private sector;
- Provide immediate employment through labor-intensive rehabilitation activities that significantly increases land under irrigation;
- Demonstrates how knowledge-intensive irrigation rehabilitation can be accomplished utilizing professional Afghan engineers, while providing on-the-ground training for relevant Ministry staff; and
- Lay the groundwork for developing an Inter-ministerial Water Management Council and regional-level River Basin Authorities for each of Afghanistan's four major river basin basins.

Design work on the following projects can begin in September, 2002, with selection based on the framework criteria proposed above. It is important for U.S. government assistance to Afghanistan to be highly visible, and geographically dispersed. DAI, working through Afghan entities would initiate work in all major regions of the country starting this Fall. Several provisional candidate sub-projects have been identified over the past six weeks. These potential sub-projects are briefly described below:

Northern Afghanistan

In the North, for example, during the Fall of 2002, one of two substantial irrigation projects on the Kunduz River would be chosen for rehabilitation:

- The semi-modern Qalagai Irrigation Project, on the Kunduz River is a hybrid system, with a war damaged modern intake and barrage, and a traditional management and distribution system. The main intake needs repairs, and the large main intake canal requires desilting. Approximately half of the 17 km long canal was cleaned over the past two years, with support from an NGO. The remaining 8 km needs desilting. Rehabilitation will require some modest engineering structural work, including repair or reconstruction of the barrage and intake gates, some flood overpasses, turnouts and repair of a couple of small bridges that cross over the canal. This rehabilitated system can be back in service in time for the spring irrigation season of 2003 and will add approximately 4,000 ha of regularly irrigated land to the canal's capacity. It will encourage an estimated 1,500 refugee families to return to Baghlan province. Total costs for rehabilitation work is estimated to be less than \$500,000.

- A second possible activity on the Kunduz River would involve rehabilitation of the Ajmir Canal, a large traditional irrigation system that supplies about 24,000 ha with a 57 km long canal. The upper 40 percent of the canal requires hand-labor desilting, and the system would be improved by construction of a series of canal-side roads, to allow easier access up and down the length of the canal. This project could add up to 7,000 ha of irrigated land to the system, and is estimated to cost approximately \$400,000.

Southern Afghanistan

DAI has submitted a proposal to USAID describing a labor intensive rehabilitation program for the Helmand Valley.¹⁵ This proposal is currently being reviewed by USAID, and is incorporated by reference into this document. While funding for this package of activities would be under a separate mechanism, DAI's proposed Helmand initiative would be managed as part of the national-level Water IQC contract, under a shared management structure. The HAVA proposal includes funding for immediate disbursement, primarily directed at labor-intensive desilting and repair of drains and canals and improvement of the Helmand road network. The project would generate more than 500,000 person-days of paid employment. It would also require technical engineering support for re-construction activities requiring more than hand labor. Through improved drainage, for example, it will desalinate more than 5,000 ha of land by the spring of 2003. DAI and other stakeholders in the Valley are prepared to initiate labor intensive rehabilitation work immediately upon a grant award.

Eastern Afghanistan

The Nangarhar Valley Development Authority (NVDA) is located in Nangarhar Province on the Kabul River, with an irrigation system currently serving 21,000 ha. With the repair of one or two siphons, NVDA has the potential to irrigate an additional 2,000 ha. Some additional technical support is required for main and secondary canal gates and water control structures. Rehabilitating this modern irrigation system will require approximately 2 months of professional design assistance. Work can start almost immediately, with a high return on a modest investment of approximately \$250,000.

Western Afghanistan

Several relatively large traditional irrigation systems are located along the Hari Rud River, in Herat Province. A number of these systems will be assessed by DAI during the Fall. One such potential rehabilitation project is the Anjir Canal, located a few miles upstream from Herat City. One or more such systems will be selected for improvements by a design team in September after the beginning of Phase II of the Water IQC project. Operational activities in Herat would be managed from Helmand, as this will be more cost effective than technical

¹⁵ *Quick Impact Project: Helmand Valley Rehabilitation*, Technical Proposal, submitted to the Central Asia Task Force, Maybe 16, 2002, following upon an earlier submission in January, 2002.

management from Kabul. A project in Herat would employ several thousand local laborers, add significant hectares of irrigated land for the spring planting season of 2003, and cost no more than \$500,000.

Central Afghanistan

The Parwan Project on the Panjshir River was built by with support from the Chinese Government in the 1960s. The system is complex, significantly degraded after more than 20 years of war, and now represents a synthesis of a modern and several traditional irrigation systems, which have been blended together by local people. The project is economically important for Parwan Province, and for Afghanistan, since Parwan is an important producer of grapes and raisins, and an important source of foreign exchange. To repair the entire modern and inter-related traditional systems will be an expensive and complex undertaking costing millions of dollars, requiring several years of work. To demonstrate some immediate support for the people of the area, DAI proposes to repair one barrel of a major two barrel River Siphon that was damaged by the Taliban. The structure is located about 500 meters west of the village of Pul-i-Matak, where it crosses under the Ghorband River. The siphon is slightly more than a kilometer long, and consists of two large reinforced concrete barrels. The system was designed to convey 28 m³/sec. With only one barrel operating, the siphon can currently convey approximately half the designed amount of water. Repairing this structure would essentially double the amount of water that could be carried through the Parwan Canal, allowing for the irrigation of up to 10,000 additional ha. Repair of the siphon is estimated to cost \$250,000.

PROJECT MANAGEMENT

DAI appreciates the management constraints that confront the USAID Mission to Afghanistan. To simplify reporting, it proposes to create a Senior Management Group that will oversee all DAI program activities, and report on them to USAID. Two or more members of this senior management group would be available in Afghanistan at all times to directly answer questions USAID might have about on-going or proposed DAI projects or programs.

A STRUCTURE FOR EXPANDING AND SUSTAINING IRRIGATION REHABILITATION

The first part of our Strategy focuses on providing fast relief to the Irrigation Sector in Afghanistan. But the corresponding activities and their impacts will be short-lived if an institutional structure is not set up to ensure conditions for the sustainability of the rehabilitated irrigation systems.

Thus, the second part of the strategy calls for the creation of an inter-ministerial Water Management Council, supported by a Policy and Coordination Unit.

Inter-ministerial Water Management Council

Responsibilities: The IWMC will serve as an Advisory Board for the Government. As an inter-ministerial body, it will coordinate the actions of the various ministries dealing with water management issues, provide policy oversight for river basin development, and make recommendations about best practices most suited for Afghanistan's fragile ecology. In the initial phases, the IWMC will help define a framework for prioritizing and implementing irrigation rehabilitation activities. Over time, the IWMC will also define and help to setup procedures for individual River Basin Authorities, including recommendations about the composition of their boards of directors, and proposed operating procedures.

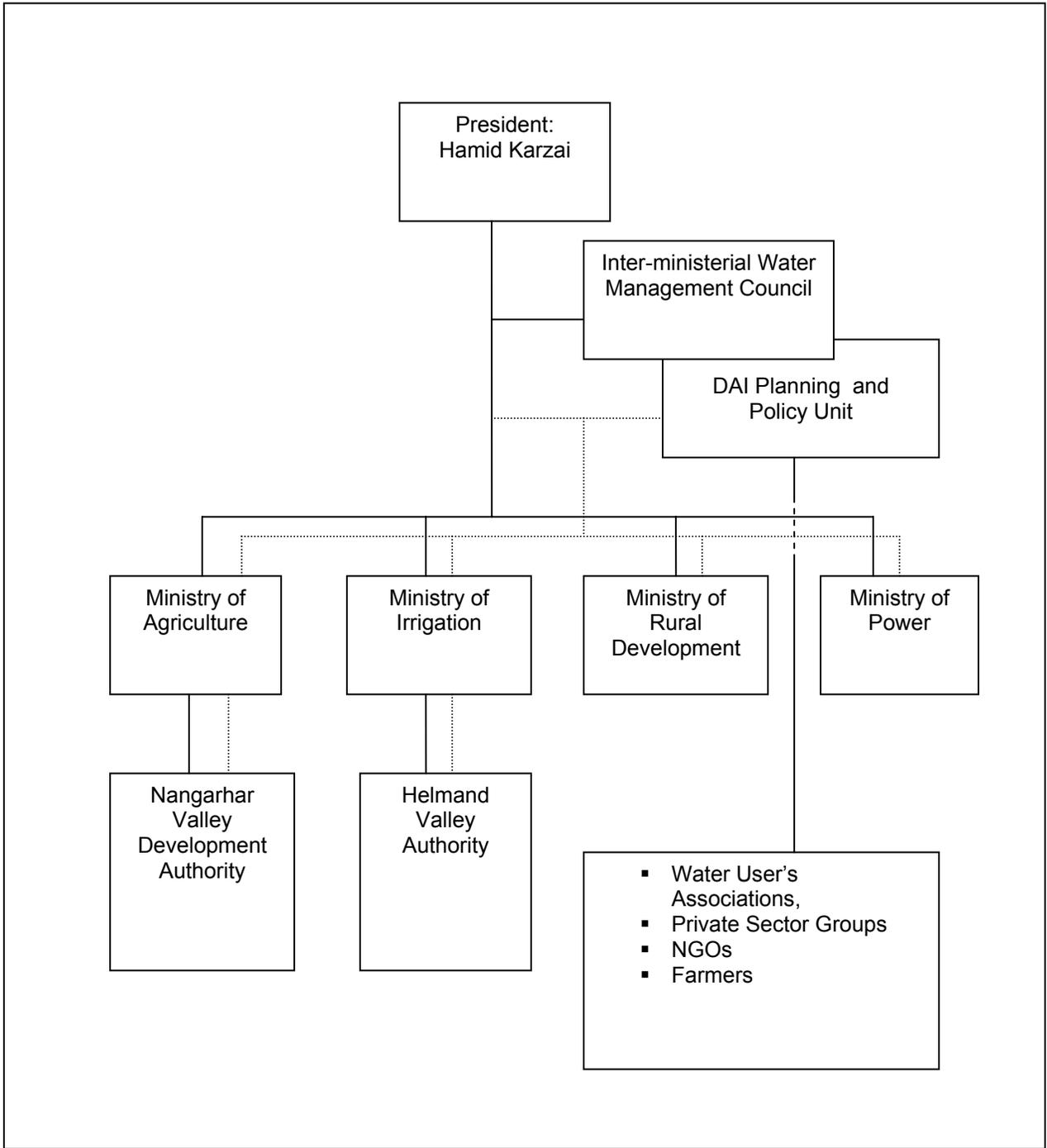
Composition: The Council would be headed by President Hamid Karzai, and include representatives of the Ministries of Agriculture, Irrigation, Rural Development, Power, plus various governors, and other relevant parties at the discretion of the President.

Planning and Policy Unit (P&P Unit)

Responsibilities: The P&P Unit would work under the authority of the IWMC. It will be the home for DAI's technical assistance team. It will support analysis of the water and irrigation sector as directed by the IWMC, and provide technical assistance to individual ministries and departments. It will also work directly with NGOs, water users associations, and the private sector, in order to initiate immediate activities across Afghanistan.

Composition: will be determined in consultation with President Karzai, members of the IWMC, and USAID. Its staff will involve a small cadre of senior-level Afghans, Afghan-Americans, and international experts.

Figure 5: Proposed Structure for Expanding and Sustaining Irrigation Rehabilitation



CHAPTER THREE

SUMMARY OF RECOMMENDATIONS AND PROPOSED AND FOLLOW-UP ACTIONS

The IQC Work Order describes three specific tasks. Recommendations that address these tasks and proposed follow-up actions are summarized below, followed by additional recommendations concerning longer-term capital intensive investment priorities.

TASK 1: IDENTIFY, ASSESS, AND PRIORITIZE AREAS FOR REHABILITATION OF IRRIGATION AND OTHER CRITICAL AGRICULTURAL INFRASTRUCTURE

- USAID should focus the bulk of its efforts upon high visibility quick impact projects that will employ tens of thousands of people on irrigation systems located along four major river valleys: the Kunduz River, the Kabul River, the Helmand River and its tributaries, and the Hari Rud River in Herat.
 - Action: We have provisionally identified one or more suitable irrigation systems to be rehabilitated along each of Afghanistan’s four major rivers.
- USAID should work on large irrigation systems in order to have broad-gauged impact on Afghans’ livelihoods (by end of the year through labor intensive activities) and on Afghanistan’s agricultural production (by next spring).
 - Action: We have developed a framework that provides criteria to select large irrigation systems along the major rivers for rehabilitation. (See Annex B).
- USAID should work in all major regions of the country, including the North, South, East and West, in order to demonstrate geographical and ethnic neutrality.
 - Action: The systems we have identified cover the major irrigated regions of Afghanistan.
- USAID should focus significant resources upon rehabilitation work in the Helmand Valley, which can serve as a model for developing other parts of Afghanistan.
 - Action: We have identified immediate activities that will contribute to increasing 2003 agricultural output in Helmand Valley; HAVA also represents a potential model for the establishment of River Basin Authorities.
- USAID should concentrate the bulk of its efforts on surface water irrigation.
 - Action: The current expansion of groundwater use may not be sustainable and should not be supported. Nevertheless we think some collateral activities (such as awareness

campaigns) can contribute to a better understanding and management of groundwater resources.

- USAID should initiate a comprehensive program to study the water balances in the four river basins of Afghanistan; the objective would be to assess the current demand and the availability of water resources, notably the availability of groundwater resources. It appears that there is a serious chance of over exploitation in the next few years, leading to desertification for large parts of Afghanistan (notably the eastern and southern regions).
 - Action: A draft scope of work is attached in Annex C.
- USAID should initiate immediate training programs for dam operators and maintenance technicians for the principal water storage and diversion dams that exist in Afghanistan, including the Arghandab Dam in Kandahar, the Kajakai Dam on the Helmand River, and Band-i-Sardeh Dam in Ghazni Provinces. Following 23 years of Soviet invasion and civil war, these dams are no longer being maintained or monitored, and are operated by untrained local staff.
 - Action: A draft scope work for this is attached in Annex C.
- USAID should initiate a highly visible program of constructing small community-based check dams and recharge structures that can be built upstream in dry washes to slow the runoff from flash floods and encourage recharge efforts.
 - Action: Appendix D provides a short discussion of the principles and potential of check dams and recharge structures.

TASK 2: STRENGTHEN THE AFGHAN GOVERNMENT'S STRATEGIC PLANNING AND POLICY-MAKING CAPACITIES

- USAID should support the development of an Interministerial Water Management Council that will coordinate the work of the key ministries involved with water and agriculture, oversee River Valley Authorities, and facilitate an on-going policy dialogue with senior policy makers involving irrigation and agriculture.
 - Action: We have initiated a dialogue with Chairman Karzai and other senior policy makers in the GOA, who appear sympathetic to such an approach.
- The Interministerial Water Management Council should be closely linked with the Chairman's office, and should help to coordinate the work of various ministries as well as international groups working in key river valleys of Afghanistan.
 - Action: The Chairman appears interested in this idea.

- At the Regional level, USAID should support Regional-level River Basin Authorities that can carry out strategic planning activities for individual river basins, and key river valleys.
 - Action: USAID is already exploring work in the Helmand Valley and in the Nangarhar Basin. Field construction this fall on other rivers will open up opportunities to look at the establishment of River Basin Authorities on Rivers such as Kunduz and the Hari Rud in Herat.

TASK 3: PROVIDE TECHNICAL SUPPORT FOR GRANTS TO LOCAL NGOS...AND ESTABLISH A SMALL UNIT TO PROVIDE TECHNICAL ASSISTANCE TO MINISTRIES

- Under the framework of a Interministerial Water Management Council, (IWMC) USAID should authorize the establishment of a small Planning and Policy Unit, with relevant in-house Afghan and expatriate experts to provide technical support to national ministries and international and local NGOs.
 - Action: DAI is prepared to initiate activities immediately.
- The Planning and Policy Unit under the IWMC should facilitate the establishment of public-private partnerships that link together national and provincial administrations, as well as NGOs and the private sector.
 - Action: The proposed P & P Unit would become the principal home for DAI's technical assistance team.

ADDITIONAL RECOMMENDATIONS CONCERNING CAPITAL INTENSIVE INVESTMENT PRIORITIES

The DAI Team came across three capital intensive investment opportunities that relate to water and/or hydro-power during the course of their travels around Afghanistan. These priorities are important for Afghanistan's near term development, and should be considered by USAID or other major donors. These include:

- Installation of additional gates on Kajakai Dam on the Helmand River. The ADB began funding the construction of these gates in the 1970s, and the work is approximately 60 percent complete. Completion of these gates will virtually double the storage capacity of Kajakai dam from 1.7 billion cubic meters to 3 billion cubic meters of water. Given the drought situation, it is important to increase the water storage capacity around Afghanistan, as well as the efficiency with which water is used.
- The Kajakai Dam currently includes a power plant with two General Electric turbines (capacity of each 16.5 MW). These turbines are now more than 25 years old, and in need of rehabilitation. In addition, the Southern region of Afghanistan has grown substantially

over the past four decades. Towns like Lashkar Gah and Kandahar appear to have increased by 300 to 400 percent. Demand for electricity has increased by at least the same level. The original design for Kajakai included a third penstock for a third turbine. It is important that this turbine be installed in the near future. The operations of the third turbine may require the completion of the gates atop Kajakai, in order to provide sufficient water. The relationship between the gates and the turbines needs further analysis.

- The World Bank funded the construction of the Kunduz-Khanabad Irrigation Barrage on the Kunduz River. This barrage has been systematically dis-enabled, probably by the Russians, but the barrage itself remains structurally sound, although the irrigation canals have been seriously silted up, or in some cases completely filled in. The original design for the barrage included provision for a power house to generate 10 MW of hydropower, at a site approximately 1.5 km downstream from the barrage on the left bank canal. This upper portion of this canal requires some desilting, but the barrage and the canal itself can fairly quickly be repaired. Construction of the power house with the relevant turbines would provide significant hydro-power for the regional economy of Kunduz and Khanabad, both of which are important market towns, as well as centers of agricultural production.

ANNEX A
DROUGHT REPORT

DROUGHT REPORT

“Kabul be zar bashad be barf ne.” (Kabul can be without gold but not without snow.)

ANALYSIS OF HISTORICAL PRECIPITATION DATA IN AFGHANISTAN

Precipitation data has been collected from the world precipitation database of the University of East Anglia (UK), and directly from the Meteorological Department in Afghanistan. For most stations in Afghanistan, reliable consistent data starts in the late 50s, or early 60s. Due to the Soviet invasion and the subsequent civil strife, most stations stopped collecting data in the 1980s. This means that precipitation time series span at best 30 years.

For the purpose of identifying drought years, frequency analysis has been carried out for the 10 main rainfall stations in Afghanistan, with a dry year being defined as having a period of return of 5 years or more (i.e. a statistical probability of occurrence of $1/5=20$ percent or less in any given year). Given the dispersion of data, this usually also means a precipitation deficit of 25 percent or more. The following conclusions can be drawn from the previous analysis:

- The various regions of Afghanistan experience one-year or two-year droughts, but these usually affect only one region and not the entire country (i.e. 1965-66 in the south, 1974-75 in the north); and
- Afghanistan endured a major country-wide drought in the years 1970-1971.

Given the lack of longer precipitation series, it is difficult to put the 1970-1971 drought in quantitative perspective. However interviews with Afghan hydrologists, meteorologists, agriculturists and farmers indicate that this drought was a serious and rare event, with little equivalent in memory. Afghan livestock was reduced by more than 50 percent during this drought.

ANALYSIS OF RECENT PRECIPITATION DATA IN AFGHANISTAN

Some scarce recent (1999-2001) data is available. The following conclusions can be drawn from the analysis of this data (as also confirmed through interviews with Afghan hydrologists, meteorologists, agriculturists and farmers):

- The current drought shows an ongoing series of 3 or 4 dry years with annual precipitation deficits being consistently greater than 25 percent; this drought appears substantially more severe than the 1970-71 drought whose impact was disastrous for Afghanistan; and
- This drought is country-wide but may affect different regions in different ways; it appears that the drought started in some regions of Afghanistan earlier than in others (i.e. as early

as 1997 in the West); there may also be signs of relief in some areas but not others for the past rainy season (winter-spring 2001-2002).

ANALYSIS OF HISTORICAL PRECIPITATION DATA IN CENTRAL AND SOUTHWEST ASIA

In order to provide some perspective on the precipitation data of Afghanistan, a frequency analysis has been carried out on several neighboring stations (in Iran, Pakistan, Uzbekistan, and Turkmenistan), particularly those stations with long time series. The objective is to identify multi-year droughts (and their geographic extent) as larger scale events.

The following conclusions can be drawn from this data:

- The Central and Southwest Asia region is prone to severe droughts that can last two years in a row; these droughts (1944-45, 1970-71) affect most of the region;
- Droughts which last more than two years are not unheard of (although there is a saying in Central and Southwestern Asian countries that rainfall can be short two years in a row, never three); the period 1898-1905 saw such a drought impact across most of the region, from Iran to Western Pakistan;
- The critical conclusion from this analysis is that multi-year droughts may occur, and that once started may last up to 5 or 6 years, where the probability of the following year also being dry is higher than usual.

ANECDOTAL EVIDENCE AND POSSIBLE FUTURE OF THE DROUGHT

Regarding the future of the drought and the return to normal conditions, there are contradictory signs:

- Kajakai reservoir almost filled up this spring for the first time in 3 years, but Arghandab reservoir remains almost empty;
- Sardeh Dam in Ghazni is also virtually empty, and two relatively large lakes in Ghazni are both totally dry, an event that is without precedent in living memory;
- Northwest India is still experiencing a very poor monsoon this summer for the third year in a row; and

- The disappearance last winter (2001-2002) of the La Nina conditions¹⁶ prevailing over the past 3 years (since winter 1998-99) is a favorable sign (but in no way a guarantee) for a return to more normal precipitation in Central and Southwestern Asia.

Even if precipitation returns to normal levels, the effects of the present drought will take years to dissipate. Severely depleted water tables will take time to replenish. Likewise agricultural outputs may take 10 years or more to reach prior production levels, notably because of the severe depletion of assets such as livestock, orchards, and vineyards.

¹⁶ Although climatology remains an imprecise science, recent research papers suggest that the current Central/SW Asian drought may be related to the large-scale variations in the climate across the Indian and Pacific Oceans, and notably somewhat linked to the El Niño phenomenon, and its La Niña counterpart (colder-than-usual central Pacific, warmer-than-usual Western Pacific, more precipitation on Southeast Asia, less on Southwest Asia). It is still an open question as to whether these large-scale fluctuations are either natural decadal-scale fluctuations or direct consequences of global climate change.

ANNEX B

**A FRAMEWORK FOR SCREENING IRRIGATION
REHABILITATION PROJECTS**

A FRAMEWORK FOR SCREENING IRRIGATION REHABILITATION PROJECTS

LABOR-INTENSIVE TRADITIONAL IRRIGATION SYSTEMS

There is a strong demand for programs that provide immediate income to unemployed Afghans, including refugees, landless, and the poor. Rehabilitating degraded irrigation systems through food or cash-for-work programs represents an important vehicle to reduce poverty, expand employment, put money into people's pockets, and increase agricultural productivity.

To provide a mechanism for reviewing proposals to rehabilitate irrigation systems, DAI proposes the following methodologies, adapted to the special conditions that exist in different areas of the country. The methodologies divide into two categories: requirements, which are essentially pre-conditions (or conditions precedent,) followed by a series of individual selection criteria. These requirements and criteria are described below:

- **Requirement One**: Implementor possesses a sufficiently well defined management structure to ensure the proposed activities will proceed as designed, deliver the specified output, employ appropriate laborers, and maintain financial records that allow review.
- **Requirement Two**: Assurance that the rehabilitation project will not damage or otherwise undermine the ongoing operations and management systems where Water User's Associations utilize *mirabs* to distribute water and organize maintenance of canals.
- **Requirement Three**: Assurance that there will be sufficient water to irrigate any additional land proposed for irrigation in Criteria One, (described below),¹ as well as sufficient water for local consumption for drinking water.
- **Requirement Four**: The project should support geographical dispersion and be targeted at refugees and areas of poverty, when compared with other possible irrigation projects.
- **Requirement Five**: The irrigation system being rehabilitated is larger than 500 hectares, and the source is surface water, not groundwater.

Once these five basic requirements are met, a series of technical criteria would then be applied. These include the following:

- **Criterion One**: A simple cost/benefit analysis. The gross value of agricultural production of any additional land to be irrigated should increase as a consequence of rehabilitation compared to the cost of the project. (Larger is better). Benefits would comprise the following.

- Summer irrigation of ____ additional hectares X crop output price per hectare
- Winter irrigation of ____ additional hectares X wheat output price per hectare

Costs would be total project costs.

- **Criterion Two:** the value of person days of labor funded by the project as a percentage of total project costs, where the larger the total is better.
- **Criterion Three:** a larger percentage of gravity fed water flowing through the rehabilitated irrigation system is better. (Gravity fed systems reduce running costs, and are more economical to operate than pumped systems, particularly in today's Afghanistan.)
- **Criterion Four:** the proposed activity should begin immediately and should be completed in time for expanded irrigation for the winter wheat season of 2002 and/or the summer cropping season of 2003. (Sooner is better.)

Screening would not be a mechanical calculation based on points to select activities for possible funding. Rather proposals containing specified data furnished by the organization requesting USAID funding would be analytically reviewed. If it seems appropriate, the DAI team can design a proposal format incorporating the requirements and criteria described above, review grant applications, and offer insights on the proposal's potential value to national-level agricultural rehabilitation.

COMPLEX MODERN IRRIGATION SYSTEMS

Another category of irrigation rehabilitation also requires support. Larger systems with degraded facilities can't always be repaired by labor-intensive methods. Modern systems may have been traditionalized, or traditional systems may merit modernization. Typically such systems require professional engineers to design or re-design water control structures and/or carry out main canal rehabilitation. Some modern systems have main canals that are too large to be cleaned by hand methods. Control gates may be missing or damaged.

Sometimes thousands of hectares of additional land can be brought under irrigation command if relatively inexpensive technical solutions are put into place, using relevant technical expertise. DAI with its cadre of experienced senior Afghan engineers can support such knowledge-intensive irrigation rehabilitation efforts, and provide the necessary technical engineering oversight to rehabilitate such systems.

The requirements and criteria for selecting complex modern irrigation systems would be the same as for traditional systems except for the elimination of Criteria Number Two. (above.)

ANNEX C
SCOPES OF WORK

SCOPES OF WORK

SOW FOR CAPACITY-BUILDING DAM O&M

Context

Afghanistan possesses several large dams (such as Kajakai on the Helmand river, Arghandab on Arghandab river, Sardeh on Jilga river, and Naghlu and Daronta on Kabul river). Most of these were built in the 1950s and 60s, and provide invaluable hydropower and irrigation diversion facilities. Due to the 25 years of war, most of these dams are no longer being maintained or monitored, and are operated by untrained local staff.

In order to protect the investment that these dams represent, and optimize their operation, it is important to rebuild local capacity for sustainable operation and maintenance of these dams.

Recommended Activities

The 4 or 5 largest dams in Afghanistan will be assessed.

1) The first step will be to conduct a diagnostic analysis of the large dams (20 m+) in Afghanistan. This analysis will focus on both structures (dam body, spillway, intakes and canals,...) and equipment (gates, electrical equipment, power supply, monitoring devices). The objective is to:

- Assess the condition of structures and equipment;
- Identify issues and assess the urgency for rehabilitation/repair/replacement; and
- Evaluate corresponding costs.

This will be an excellent opportunity for on-the-job training for technical staff (both dam-based and ministerial). During this process, we will also develop a methodology to serve as a guide for carrying out such monitoring visits (which should be compulsory for large dams, both out of safety concerns and for economic preservation of the investment). This methodology will also offer prioritization guidelines in order to help the GOA make appropriate decisions regarding the allocation of funds for dam repair.

Requirements: 1 month STTA, two experts + local counterparts:

- One civil engineer
- One mechanical engineer

NB. During this process, it is also important to reconstitute the technical knowledge of each dam. For this, it is important to:

- Recover and centralize design and construction drawings and documents; and
- Interview people involved in the design, construction, or the operation of these dams in order to identify specific issues and solutions that were experienced. Much is learnt during the lifetime of a dam, each being specific in terms of site (geology, topography) and structure (profile, type of material).

2) The second step would be to develop procedures for the operation and maintenance of these large dams and to organize a training program for their proper understanding and use. These procedures must detail:

- The decision-taking process (Who decides? When? Based on what information/data?) or the timing of actions (periodicity, or event-related);
- The operational process (prior material check-up, successive operational steps, final check-up at completion); and
- The reporting of the actions (when, why, who).

Regarding the operation of the dams, procedures would address activities such as the opening/closing of gates, the monitoring and optimization of releases, the management of floods and other critical situations, and monitoring the reservoir level.

Regarding the maintenance of the dams, procedures would address activities such as painting, the addition of oil, small repairs, regular maneuvering tests for rarely used (but safety-crucial) equipment. Finally we will define the proper procedures for the monitoring of the condition of the dam.

NB. The development of procedures will be partly generic and partly specific to each dam. The training can be more generic and focus more on the logic and implementation of the procedures without necessarily looking into their specificities.

Requirements

One month STTA, two experts + local counterparts:

- One hydrologist
- One mechanical engineer

SOW FOR ASSESSMENT OF WATER BALANCES PER MAJOR RIVER BASIN

Context

Afghanistan is a water-stressed country, with limited precipitation and water resources. The past 23 years of war have confused the situation in terms of water resource supply and (more significantly) demand. Moreover, due to the current drought, there has been a country-wide development of groundwater use (digging of thousands of wells, purchase and installation of pumps), while the availability of groundwater resources is not well known.

To ensure a better understanding of water balances and allow for better and more informed decision-making as well as a sustainable use of water resources, it is crucial to assess both supply and demand in various regions of the country.

Recommended Activities

The water balance assessment will focus on both supply and demand of water resources. Supply: both surface water and groundwater resources have to be evaluated:

- Regarding surface resources, this can be done through the analysis of past hydrological data (yearly hydrological books were published in the 1960s and 70s). The impact of the current drought and the storage capacity of existing dams also has to be taken into account; and
- Regarding groundwater resources, little is known in terms of availability (quantities, recharge potential and location). The analysis will take advantage of the recent drilling of thousands of wells (to identify through field investigations) and define the position and importance of the various aquifers.

Demand: Water uses (for irrigation, power generation and drinking purposes) have to be inventoried for each of the main rivers. The variation of these uses during the year will be assessed. The difficulty here will be to assess the current number of wells and pumps (which have increased dramatically the past few years) and their withdrawal rate. NB. The evaluation of the current use of groundwater resources is especially crucial as it is totally unknown, and may very well be unsustainable.

Trends will also be identified to predict the future evolution of these water balances. The potential end of the ongoing drought will be a crucial factor in this regard.

Based on the findings of this study, we will recommend steps for the GOA to:

- Establish a data collection network for monitoring water resources (stream-gaging stations, piezometers, etc.);

- Develop setup and procedures for a better allocation of resources on watershed-basis; and
- Deliver awareness campaigns (through various media) towards water users for the preservation and efficient use of scarce water resources.

Requirements

1 month STTA, two experts + local counterparts:

- One water resources specialist
- One hydrogeologist

ANNEX D

CHECK DAMS AND RECHARGE STRUCTURES

CHECK DAMS AND RECHARGE STRUCTURES

As part of program supporting flood protection and encouraging ground water recharge, USAID should consider funding a Civilian Conservation Corps (CCC)-type program directed at the construction of small check dams and recharge structures in the upper catchment areas of the various river valleys of the country. Such recharge or infiltration galleries can be built entirely of local materials, or if necessary they could be reinforced with some gabion wire. Such dams would be low walls across *wadis*, built perhaps 1-2 meters high, constructed every few hundred yards along the length of dry stream beds. The area behind such check dams would normally silt up after one or two floods, but this would not matter if local people became oriented to going back and putting another meter of rocks along the top of the dam following each flood event. The management and ownership of such recharge dams should be structured to be the responsibility of local villagers or local water user's associations. Virtually every irrigation system in the country is owned and operated by a Water User's Association, from the smallest spring or *karez* to the biggest systems including the Helmand Arghandab River Valley Authority (HAVA), which at some level is simply an umbrella over many other smaller WUAs.¹⁷ In effect, the Operations and Maintenance (O & M) activities of such dams might become the expanded responsibility of individual *mirabs*, who are now directly responsible for the O & M issues along a particular canal or irrigation system. Such an approach might be analogous to the idea of 'social forestry' where local people are encouraged to take responsibility for their part of a forest, or in this case, a local watershed area.

Such a program might be designed to resemble the Civilian Conservation Corps of the New Deal that was set in place by President Franklin Roosevelt. It could contribute to demobilization of young mujahideen, and might also be linked to reforestation and re-vegetation programs around the country. USAID's role should be directed at setting in place demonstration programs, to publicize the approach, rather than trying to construct tens of thousands of recharge structures around the country.

¹⁷ The only major exception of this rule appears to be the Nangarhar Valley Development Authority, which consisted of four state farms, plus a significant amount of privately owned and privately farmed land.