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Water Resources Management in Afghanistan: The Issues and Options

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FOREWORD

Afghanistan is a landlocked country of about 65 million hectares and 20 million people, of which 16.5 million live in rural areas. It is characterized by a rugged mountainous landscape, and scattered human settlements. The economy of the country is based on agricultural products and livestock. Majority of the rural population is small subsistence farmers who live of small plots of land. Therefore, management of water resources is a vital factor for the economic growth and to meet the people's needs for food and fiber.

A combination of war, civil conflict, exploitation and enforced neglect have combined to leave a legacy of degraded natural resources including agriculture, especially destroyed infrastructure and fragmented rural institutions. The successive drought of last four years has further added to the miseries of the Afghan people. The challenge for everyone involved in the development of Afghanistan is very clear-improve the land and water resources, which can provide immediate income, food security, a foundation for new livestock practices and much more. Water is central to all of this.

Currently, water sector in Afghanistan has no clear vision for immediate and future development. Improvements in water resources management need to be approached in a strategic manner-it needs planning, guidance and investment. A number of national and international organizations are presently engaged in the assessment of current situation and strategy development for short, medium and long-term projects for the rehabilitation of irrigation systems. Lack of data, the unreliability of the existing data and the collapse of the institutional set up makes it difficult to understand and assess the current situation. Therefore a conscious effort is needed to collect all existing information and data from institutions, private organizations and from people's memories to complete the picture. This report is also an effort in this direction. This report presents the analysis of current status of water resources management in Afghanistan and identify steps for maximizing the use of available water resources to enhance crop productivity and environmental sustainability.

Dr. Asad Sarwar Qureshi
Acting Regional Director

1 INTRODUCTION

1.1 Physiography

Afghanistan is located between 29° 35' – 38° 40' latitude and 60° 31' – 74° 55' of longitude. It is bounded by Turkmenistan, Uzbekistan and Tajikistan in the North, China to the Northeast, Pakistan to the East and South and Iran to the West (Figure 1). Afghanistan is characterized by its rugged mountains with snow-covered peaks of high altitude, up to 7500 meters above sea level (m asl), fertile valleys and desert plains. Lowlands include river valleys and desert regions are located in the northern, western, southwestern and southeastern parts while high lands are generally located in the central part of the country. From topographical point of view the country can be divided into three groups. Low lands with 300-500 m asl; medium land with 500-2000 m asl and high land between 2000-7500 m asl. About half of the country has an altitude of more than 2000 m asl.

The total land area of Afghanistan is about 65 million ha of which approximately 80 percent is either mountainous or desert. The forest cover is only 1.3 million ha or about 2 percent of the total land area. In recent years forest cover has reduced due to continuous demands for fuel wood and illegal logging. The demand for fuel wood by communities is considered less damaging than illegal logging. It is estimated that forest cut rates are exceeding annual growth rates leaving a deficit of about 30,000 ha of forest per year.

Administratively, Afghanistan is divided into 30 provinces (two provinces have very recently been added). The current population of Afghanistan is estimated at about 20 million with a rural population of around 16.5 million. They live in approximately 20,000 villages scattered across Afghanistan. The scatter of villages is mainly based on the existence of water. Majority of the rural population is small subsistence farmers who live of small plots of land.

Although there are marked geographical differences in wealth generating capacities across the country, there is a similar cross-section to village society irrespective of location or agro-ecological zone. This cross-section covers small landholders, landowners, sharecroppers, female-headed households and landless. The average holding was 3 ha in 1967. The vast majority of holding fall in the range of 0.5 to 6 ha. Holding under 20 ha accounted for 60% of land ownership in 1967 and those over 100 ha for 8%. Distribution of farm size in irrigated and rained areas is given in Table 1.

Table 1. Farm size distribution in Afghanistan

Farm size (ha)	Irrigated farms (%)	Rainfed farms (%)
<3	83	8
3-6	14	8
>6	3	84
Median	1.4 ha	6-7 ha

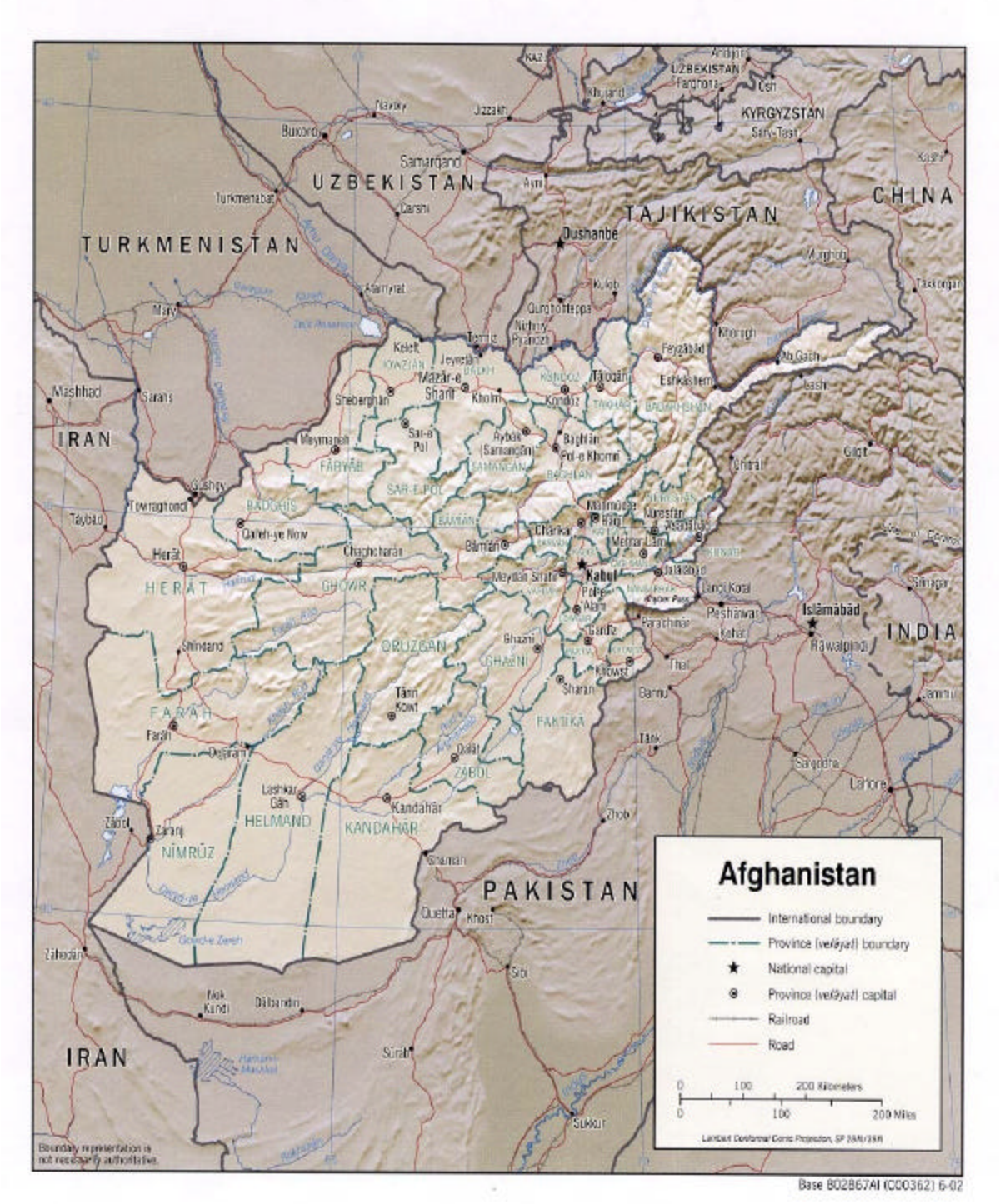

Figure 1. Map of Afghanistan showing its location in the region

1.2 Climate

Afghanistan is characterized by a continental climate, although the presence of mountains causes many local variations. The typical climate varies from arid in the South and Southwest to semi-arid in most other parts of the country. The high mountain ranges of

Hindu Kush and Pamir are moderate humid and covered by permanent snow and glaciers at altitudes above 5,000 m. With a few exceptions of some locations receiving sufficient rainfall in spring (Northern slopes of Hindu Kush above 1,000m altitude), the climate is not favorable for rainfed agriculture. During winter, temperatures are low and precipitation occurs in form of snow whereas during summer, temperatures are high and rainfall is virtually zero. Without irrigation supplies, these arid to semi arid areas cannot support any irrigation.

In Afghanistan, the water availability for irrigation purposes is mainly a function of effective rainfall and surface as well as groundwater resources - which depend in turn on the amount and distribution (time and space) of precipitation. Therefore, considering variations in precipitation as the most decisive parameter, Afghanistan can be divided into 6 climatic zones. The general features of these climatic zones are given in Table 2.

Table 2. General features of 6 climatic zones of Afghanistan

Zone	Name	Precip. (mm)	Dry (months)	Frost (months)
1	Badakhshan (without Wakhan)	300 - 800	2 – 6	1 - 9
2	Central and Northern mountains	200 - 600	2 - 9	0 - 8
3	Eastern and Southern mountains	100 - 700	2 - 9	0 - 10
4	Wakhan corridor and Pamir	<100 - 500	2 - 5	5 - 12
5	Turkestan plains	<100 - 400	5 - 8	0 - 2
6	Western + South-western Lowlands	<100 - 300	6 - 12	0 - 3

There is a strong relationship between the amount of precipitation, length of growing season and altitude. At greater altitudes, precipitation is high and the growing seasons are shorter due to frost hazard. In the mountainous zone of the country (zones 1-4) where precipitation is sufficient, the availability of agricultural land (due to frost) is a limiting factor. In the flat areas (zones 5-6), growing seasons are sufficiently long even for double cropping but the limiting factors are effective rainfall and irrigation water availability. .

Table 3 presents the 12-year average records of precipitation, temperatures and evapotranspiration for19 meteorological stations located in 18 provinces. The annual distribution of precipitation (Table 3) shows the picture of an essentially arid country, with more than half of the area receiving 100 mm to 300 mm of precipitation. The remaining 50% of the country (having altitude of more 2000 m asl) receives 300 mm to 800 mm of precipitation. About 50% of the precipitation occurs in winter (January to March), much of which falls in the form of snow. A further 30% falls in spring (April to June) and the remaining 20% during summer and autumn.

The daily (20°-30°C) and the seasonal (35°-40°C) variations of temperatures prevailing all over the country lead to different lengths of growing seasons, and require a careful selection of the most suitable crop for an area. This is reflected in many regions well known for their particular agricultural products (e.g. grapes, melons, rainfed wheat) or their natural forest cover (pistachio trees, pines). In the South-western desert plains, frost can occur in any month of the year even when temperatures reach a daily maximum of up to 40° C. Daily

minimum temperatures in the Northern (Turkestan) plains can be as low as -20° C in winter and as high as +50° C in summer at one and the same location.

Table 3. Precipitation, temperatures and evapotranspiration at different locations of Afghanistan

Location	Altitude [m asl]	Precipitation [mm/a]	Temperature [°C]	Annual ETP [mm/a]	Daily ETP [mm/d]
Shiberghan	360	214	-2 - +38	1,420	8
Mazar-i Sharif	378	190	-2 - +39	1,530	9
Kunduz	433	349	-2 - +39	1,390	8
Baghlan	510	271	-2 - +37	1,100	6
Jalalabad	580	171	+3 - +41	1,350	7
Farah	660	77	~0 - +42	1,610	8
Lashkargah	780	89	~0 - +42	1,720	8
Maimana	815	372	-2 - +35	1,310	7
Herat	964	241	-3 - +36	1,720	10
Qandahar	1,010	158	~0 - +40	1,790	8
Khost	1,146	448	-1 - +35	1,390	6
Faizabad	1,200	521	-5 - +35	1,020	6
Qadis	1,280	323	-3 - +30	1,240	6
Jabul-Saraj	1,630	499	~0 - +31	1,610	9
Kabul	1,791	303	-7 - +32	1,280	7
Karizimir	1,905	433	-7 - +31	1,100	6
Ghalmin	2,070	222	-8 - +29	1,100	6
Ghazni	2,183	292	-11 - +31	1,420	7
Lal - Sarjangal	2,800	282	-21 - +25	950	5

Annual evapotranspiration rates are relatively low in the Hindu Kush (1,000-1,300 mm) because of severe and long winters. They vary between 1,300 mm and 1,500 mm in the Northern plains and reach up to 1,800 mm in the Southern and Southwestern plains. However, summer evapotranspiration rates are high everywhere showing a daily peak of 6-8 mm in July/August. Due to strong winds occurring particularly in Mazar-i Sharif and Herat (bad-e sad-o bist ruz), maximum daily evapotranspiration rates are 9 mm and 10 mm, respectively.

1.3 Agriculture

The arable agricultural resource base of Afghanistan is about 8 million ha, which is 12 percent of the total land area. Major arable lands for permanent crops are located in the north and western parts of the country as shown in Figure 2. The irrigated land is usually located in the river basins of the North, West, and the Southwest. Though there are irrigated lands in the southern and eastern parts of the country, the proportion is small compared to North, West, and the Southwest.

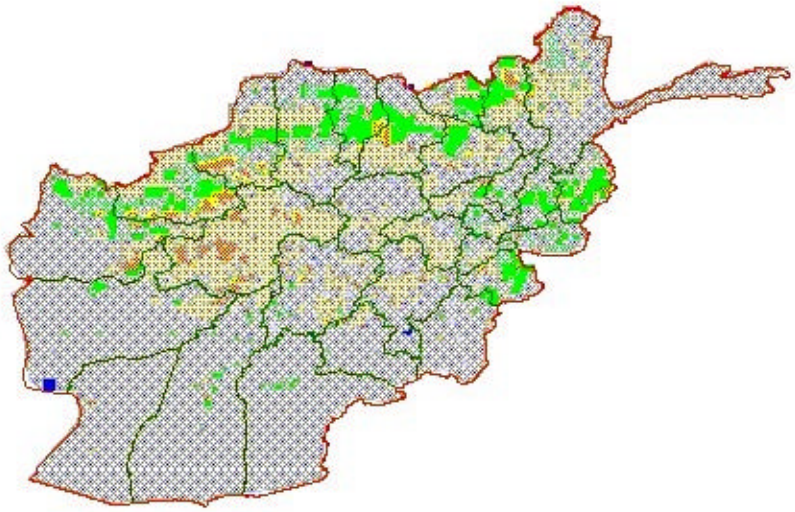

Figure 2. Arable permanent crops in Afghanistan

There are roughly 3.9 million ha of cultivated land of which 1.3 million ha is rain fed and 2.6 million ha is irrigated. This irrigated area produces almost 85 percent of all agricultural productions. In 1978, the total area (irrigated and rain fed) under cereal crops was about 3.4 million ha. The total production was 4.15 million tons of which 2.65 million tons was wheat. Table 4 gives the details of cultivated area, production and yields of major cereal crops in 1978.

Table 4. Cultivated area, production and yields of cereal crops in Afghanistan in 1978.

Crops	Area		Production Million tons	Yield Tons/ha
	Million ha	% age of Total		
Wheat	2.35	69.3	2.65	1.13
Maize	0.48	14.2	0.76	1.58
Rice	0.21	6.2	0.40	1.91
Barley	0.31	9.1	0.30	0.97
Other cereals	0.04	0.1	0.04	0.81
Total	3.39	100	4.15	1.22

The recent succession of dry years has reduced the annually cultivated rain fed area to less than 0.5 million ha. Currently, rain fed cereal production has fallen to about 0.6 tons/ha, which is 10 percent lower than the expected production in a normal year. As a result, food security is becoming a challenge particularly in the northern areas where rain fed agriculture is widely undertaken.

1.4 Communities and Rural Economy

The structure of rural society consists of numerous settlements (over 30,000 clusters into about 18,000 communities) many of which have very limited access to basic needs of life. Majority of the population in Afghanistan do not have access to safe drinking water and

sanitation. It is estimated that coverage of safe drinking water in the country amounts to 24% only while that for sanitation coverage amounts only to 11.8% (Water Sector Strategy, 2000). In urban areas like Kabul the daily average per capita water consumption amounts to about 30 liters while this number is almost half in rural areas. Shortage of water has exacerbated the mortality rates among millions of children, particularly through malnutrition. It is possible to attribute millions of deaths over the years through either directly or indirectly to lack of safe drinking water.

The economy of the country is based on agricultural products and livestock. The total cultivable area of Afghanistan is about 8 million hectare, which is 12 percent of the total area. There are roughly 3.9 million ha of cultivated land in Afghanistan, of which 1.3 million ha is rainfed and 2.6 million ha irrigated. This irrigated area produces almost 85% of all agricultural productions. Livestock is a main sector in the economy of the country.

Livestock is a main sector in the economy of the country. During 1997-98, the total population of livestock in the country was 3 million cattle and 23 million sheep and goat. Livestock and their products are main contributors to farm draught power, family nutrition, the raw material for household goods (wool, hair, hides, dung) and tradable products. A decade ago, the livestock sub-sector was accounting for 40 percent of the total export earnings but presently this number has reduced to half. This decrease can be attributed to loss of livestock, decreased production due to declining feed and overgrazing, animal diseases and shortage of water. The total grazing area or pastures in the country are about 54.7 million ha land (FAO, 2001). The total area under evergreen forests is 2.2 million ha. If the productivity levels can be restored to levels similar to the rest of the region, then Afghanistan should be able to resolve medium to long-term food security concerns.

It is generally accepted that families with less than 0.5 ha of irrigated land have great difficulty in earning their livings solely from agricultural production in most parts of the Afghanistan. Therefore off-farm income generation activities are an integral part for about 65 percent of farming families to achieve a modest living. Afghan farmers use centuries old farming techniques with oxen providing the draught power. The majority of women in Afghanistan work in agriculture. They constitute a large portion of the agricultural labor force; estimates indicate that they account for over 70 percent of the labor. Being an agricultural country, the future growth of Afghanistan depends on the development of agriculture and related industry.

2 WATER RESOURCES OF AFGHANISTAN

2.1 Surface Water Resources

Although Afghanistan is located in half deserted atmosphere, it is still rich in water resources mainly due to the series of high mountains such as Wakhan, Hindokush and Baba covered by snow. Over 80 per cent of the country's water resources have their origin in the Hindu Kush mountain ranges at altitudes above 2,000 m which function as a natural storage of water in form of snow during winter and thus support perennial flow in all major rivers by snow melt during summer.

Afghanistan is part of 3 large river basins: The *Amu Darya* basin in the North separated by the Hindu Kush mountain range from the *Desert* basin in the South, and the *Indus* basin in the East. Because of practical reasons related to the quantification of available surface water volumes, the hydrological classification is based on principal watershed units. Based on the hydrological and morphological systems, the country can be divided into four main river basins. General characteristics of these four river basins are shown in Table 5.

Table 5. General Characteristics of four river basins of Afghanistan.

River basin	Rivers included in this basin	Catchment area (Km2)	Storage capacity (Billion m3)
Amu Darya basin	Wakhan, Kokcha, Kundz, Pamir/Panj, Marghab, Shrin Tagab, Sur pul, Bulkh, Kashan, Kushk, Gulran	302,000	24
Helmand river basin	Helmand, Arghandab, Ghazni, Trank, Arghastan, Musa Qala,	218,600	6.5
Western rivers basin	Khash, Farharod, Aderskan, Harierod etc	85,300	2.5
Kabul/Indus basin	Kabul, Kunar, Alishing, Alinegar, Logar, Pangshir, Shutol, Ghorbund, Laghman, Maidan	72,000	22
Total			55

Recent estimates indicate that the country has 75 billion cubic meters (BCM) of potential water resources of which 55 BCM is surface water and 20 BCM is groundwater. The annual volume of water used for irrigation is estimated to be 20 BCM, which is 99 per cent of all water used. Total groundwater extraction amounts to some 3 BCM. Approximately 15 per cent of the total water volume used annually originates from alluvial groundwater aquifers (9 per cent) and springs (7 per cent), and almost 85 per cent from rivers and streams. Ground water used from deep wells counts for less than 0.5 per cent. The annual per capita water availability is approximately 2500 cubic meter, which compares favorably with other countries of the region, for example, with Iran (1400 cubic meter per capita per year) and Pakistan (1200 cubic meter per capita per year). A qualitative assessment shows that Afghanistan's water resources are still largely underused which is supported by the data presented in Table 6:

Table 6. Estimated Surface and Ground Water Balance (BCM per year)

Water Resources	Potential	Present use	Balance	Future use*	Balance
Surface Water	57	17	40	30	27
Groundwater	18	3	15	5	13
Total	75	20	55	35	40

* All existing irrigation schemes rehabilitated and managed efficiently.

It is not clear, however, how much of this 'potential' resource can be accessed without damage to people and ecosystem. For example, how much of the groundwater can be extracted without leading to an excessive decline in groundwater levels and reaching to a stage of 'water mining'.

There are plenty of individual discharge data of many of Afghanistan's rivers, particularly from the Kabul and the Helmand rivers as well as from their tributaries. However, no reliable documentation is available about the systematic quantification of surface water resources at watershed level. In Table 7, an attempt is made to quantify the annual surface water resources at watershed level. The limited reliability of data collected did not allow presenting the surface water resources potential at regional level. Most of the rivers listed in the table are perennial although many of them fall dry at their lower reaches during late summer due to the diversion of water for irrigation purposes. Discharges are rising continuously from March onward caused by snowmelt culminating in June/July before receding to a minimum in Dec./Jan. Most disastrous floods occur after heavy rainfall in March/April, especially when snowmelt is already well advanced.

Surface water quality is excellent in the upper basins of all rivers throughout the year and good in the lower basins in spite of large irrigated areas. As far as it is known, the presence of saline soils in irrigated areas is never caused by poor water quality but rather by over-irrigation (water logging) or lack of irrigation water (fallow fields and high ground water table).

2.2 Groundwater Resources

Afghanistan possesses huge reserves of groundwater. According to FAO estimates of 1996, the annual potential of the groundwater in the country is about 20 BCM. At present, only 3 BCM is being used and it is projected that in the next 10 years it can increase to 8 BCM due to increase in irrigation and domestic water supplies requirements.

More than 15% of Afghanistan’s irrigated land gets water from traditional underground systems such as karezes (Qanats), springs and shallow wells (locally called as Arhads). Karezes are underground systems, which tap groundwater by gravity from the aquifer to provide water for irrigating crops and domestic purposes. Ten top provinces of Afghanistan having highest percentage of area irrigated with groundwater irrigation are given in Table 8.

According to an estimate, all traditional groundwater irrigation systems have reduced or dried up completely. About 60-70% of the karezes are not in use and 85% shallow wells are dried out. The population dependent on these systems has suffered badly due to failure or reduction in discharges of these systems. The main reason for the low discharges is low precipitation and consequently low recharge to the groundwater. In addition, boring of deep wells in the vicinity of karezes and shallow wells had adversely affected the production of these traditional irrigation systems. This has threatened the sustainability of these systems in the future too.

In most of the urban areas, shallow wells are used to get water for drinking and other household activities. As the water levels continue to fall, around 0.5 to 3 meter each month depending on the place, the poorer families are unable to dig their wells deeper and thus are forced to get water from communal wells. Many of these wells are already dried up and people (often women and children) are forced to walk miles to meet their daily water demands.

Table 7. Estimated Surface Water Potential.

No.	Name of River Basin	Drainage Area (km²)		Mean Ann. Vol. (mln m³)
AMU DARYA BASIN				
1.	North-eastern river basins			
	Panj	27,800	(+ 29,000 in Tajikistan)	36,420
	Kokcha	21,100		5,700
	Kunduz	37,100		6,000
	Total North-eastern river basins	86,000	(+ 29,000 in Tajikistan)	48,120
2	Northern river basins			
	Murghab	26,200		1,350
	Kashan, Kushk, Gulran	12,200		110
	Samangan (Khulm)	8,300		60
	Balkhab	19,300		1,650
	Saripul	10,800		40
	Shirin Tagab	12,100		100
	Amu Darya deserts	27,100		30
	Total Northern river basins	116,000		3,340
3	Hari river (Harirud) basin	39,000		1,600
DESERT BASIN				
4	South-western river basins			
	Farah	27,800		1,250
	Harut (Adraskan)	23,800		210
	Gulistan (Bakwa desert)	9,100		40
	Khash	10,500		170
	Kajrud	20,800		60
	Total South-western river basins	92,000		1,730
5	Helmand river basin			
	Ghazni	19,200		350
	Helmand at Kajakai dam	42,200		6,000
	Musa Qala	3,700		220
	Arghandab	53,000		820
	Lower Helmand	47,900		110
	Total Helmand river basin	166,000		7,500
6	Southern river basins	70,000		70
INDUS BASIN				
7	South-eastern river basins			
	Gomal	10,700		350
	Margo, Shamal, Kurm	8,300		400
	Total South-eastern river basins	19,000		750
8	Kabul river basin	54,000	(+ 14,000 in Pakistan)	20,920
	Panjir	11,000		3,130
	Kunar	13,000	(+ 14,000 in Pakistan)	15,250
	Kabul (without Panjir & Kunar)	30,000		2,540
	Total Kabul river basin	54,000	(+ 14,000 in Pakistan)	20,920
	Total	642,000		84,000

Table 8. Ten provinces with the highest percentage of irrigated area with groundwater.

Name of the Province	Area under GW irrigation (ha)	Percentage of total area (%)
Uruzgan	73910	58.4
Ghazni	43170	36.7
Farah	36890	29.3
Helmand	27280	16.8
Zabul	24870	39.8
Kandahar	21870	18.5
Kabul	18270	32.5
Ghor	16940	23.3
Nangarhar	13820	32.6
Badghis	13050	39.2

(Source: FAO, 2001)

3 IRRIGATION IN AFGHANISTAN

The history of irrigated agriculture in Afghanistan goes back to more than 4,500 years ago (ancient settlement near Kandahar). Except for a few areas where rainfed agriculture can be practiced, agricultural production in most of the country is not possible without irrigation as the rainfall is either meager or unreliable. The allocation of water and land is closely related to customs and traditions of the sedentary population, and maintenance works of irrigation schemes have always been a well-defined activity in the farmers' seasonal calendar. Irrigation systems in Afghanistan can be divided into two categories: Traditional irrigation systems and modern irrigation systems.

3.1 Traditional Irrigation Systems

Small-scale informal surface water systems:

These are centuries old systems. Water is supplied by stream flow diverted with the help of temporary brush weirs. They are often located in remote valleys along a stream or river and vary in size (up to 100 ha). These systems are constructed and maintained in a traditional informal manner on a communal village basis and water rights are also determined and recognized in the similar manner.

Large-scale informal surface water systems:

These systems are mainly located in the plains and along the main river valleys. They can cover an area of up to 200,000 ha. Although they are called informal, their operation and maintenance was highly structured involving different communities of different ethnic origin. Many villages can share water from such a system. According to the water laws of 11981 the amount of water needed for irrigation is determined according to area under cultivation, the kind of crop, the irrigation regime, the water rights document, the local practices and the amount of water in its source. The regulations concerning the use of water in agriculture in Afghanistan is given in Annex I. Each village has at least one water master (mirab) who delegates his authority to sub water masters responsible for the allocation of water to different fields of the scheme. Lawyers (vakil) support the mirabs in disputes over water

rights and provide the linkage to government authorities for the registration of land and water rights. Repair and maintenance works are executed by mobilizing large gangs of labor for a long period, and farmers in the command area have to contribute in labor, cash or kind. Historically, large parts of these schemes have been abandoned because of the impact of wars, water logging and salinization, particularly in the Harirud, Farah Rud, Balkhab, Murghab and Helmand valleys.

Shallow wells (Arhad) system:

Ground water is lifted from shallow wells with the help of Persian wheel (arhad) supplying irrigation water to the fields of an individual farmer. The size of the irrigated land does not exceed 3 ha. The total number of shallow wells in Afghanistan is 8595 that irrigate around 12060 ha of land.

Springs:

When groundwater table reaches above the ground surface, it starts flowing on the surface and form springs. There are about 5558 springs in the country, which irrigate about 188,000 ha of land. Springs are directly dependent upon the groundwater level. When the groundwater level goes down, e.g. during drought years, it results in a reduction of outflow from springs. That is why some of the worst drought stricken areas of the country are located in region where they depend heavily on spring water for irrigation. Spring irrigation is common in the east and in the south.

Karez (qanat) systems:

Karezes are underground galleries that tap groundwater from the aquifers of alluvial fans. Underground tunnels with gentle slopes carry water from the source to the settled areas. Karezes are usually small in dimensions but may be many kilometers in length. On average, their discharge varies between 10 l/s to 200 l/s but can in some cases reach up to 500 l/s. Karez water is used for irrigation purposes (irrigated area ranges from 10 ha to 200 ha) as well as for drinking water supply.

The technique has been used for thousands of years in Afghanistan, Iran, the Middle East and North Africa. It is one of the most economical methods of tapping groundwater for irrigation purposes. It is environmentally safe and water is drawn by use of gravity. There are 6741 karezes in the country. These karezes irrigate about 163,000 ha of land. Karez irrigation is common in the south and southwest of the country and less in the north of the country. One of the disadvantages of the karezes is that there is no mechanism to stop water from flowing during winter or when there is no need for irrigation. In each karez about 25% of total annual volume of water is wasted. Province-wise distribution of different irrigation systems in Afghanistan is given in Table 9.

3.2 Modern Irrigation Systems

Formal surface water systems without storage:

They have a permanent intake structure, which is operated and maintained by the Irrigation Department. The management of the irrigation scheme itself follows the rules of the large-scale traditional surface water schemes described above. However, the significant

difference is that the regulation of water flow to the system depends on the interaction between government authorities and the village communities.

Table 9. Province-wise distribution of different irrigation systems in Afghanistan

No.	Province	Canals	Springs	Karez	Wells	Mills
1	Badakhshan	212	82		54	730
2	Badghis	120	50	30		500
3	Baghlan	109	63			565
4	Balkh	250	92	3	82	912
5	Bamyan	179	137		300	651
6	Farah	312	94	352	327	260
7	Faryab	157	79	960	867	1030
8	Ghazni	818	604	1516	636	994
9	Ghor	804	570	4	263	500
10	Helmand	227	135	276	60	516
11	Heart	302	153	228	450	1302
12	Jawzjan	382	87	2	443	475
13	Kabul	177	81	321	436	616
14	Kandahar	279	258	631	252	383
15	Kapisa	285	72	49	176	638
16	Kunarha	223	67		13	681
17	Kunduz	88			55	363
18	Laghman	45	3			561
19	Logar	154	169	124	91	433
20	Nangarhar	274	210	495	15	1001
21	Nimroz	193	2	18	140	133
22	Paktia	625	392	528	800	171
23	Parwan	120	93	34		756
24	Samangan	20	73	7	271	190
25	Takhar	316	288		509	653
26	Uruzgan	363	429	84	210	1266
27	Wardak	589	519	336		822
28	Zabul	199	756	743	148	373
		7822	5558	6741	6598	17475

Formal surface water systems with storage:

Organized large-scale irrigation system development is a relatively recent innovation (1960-1978). However, by the late1970s five large-scale modern irrigation systems had been built and were in operation. Land tenure was different from traditional systems. Parts of the schemes were operated under private land ownership agreements, while others were operated as State farms “owned” by the government. The Government heavily subsidized these schemes and farmers were given very limited choice of crop selection or farming practice.

Formal ground water systems:

Very little is known about the irrigation schemes supplied by ground water from deep and shallow wells. In Khost/Paktia province, surface water irrigation schemes were supplied by some 100 deep wells until the late 1980s. In the 1970s about 100,000 ha are said to have been under sprinkler irrigation (private and government owned) and plans existed to introduce drip irrigation. In few cases, particularly in the lower reaches of large traditional schemes where water shortage is common, individual farmers undertook irrigation from shallow wells.

Cropping intensity varies widely from system to system according to the scarcity of water versus land. It reaches 200 per cent in the upper part of the irrigation schemes while in the lower parts up to two thirds of the command area is kept fallow each year on a rotational basis. Flood damages to irrigated land are common, particularly in the large schemes supplied by rivers changing their course frequently due to their high sediment load and unfavorable geo-morphological conditions.

3.3 Irrigation Methods and Efficiencies

Irrigation practices today are characterized by the necessity to irrigate "by all means" leaving little room for proper irrigation system management. Where village communities were able to organize themselves in a peaceful manner and received assistance in the rehabilitation of destroyed (intakes) or obsolete (conveyance canals) irrigation structures, irrigation is mostly practiced in the traditional way: operation and maintenance of the schemes as well as water distribution are managed on a communal basis under the supervision of mirabs, and disputes over water rights are solved by vakils. In many other cases where communities share the same water resource for the irrigation of their individual fields but are ruled by different "authorities", farmers are less fortunate and struggle to make their irrigation scheme some how operational.

About 85 per cent of all crops in Afghanistan are grown under irrigation. Canal irrigation is by far the most commonly used method of irrigation in Afghanistan. Canals in Afghanistan irrigate nearly 75% or 1.9 million ha of land. As is evident from Figure 3, the proportion of canal-irrigated land is much greater than any other form of irrigation. Most of the canal-irrigated land is located in the north, west, and southwest of the country. These canals primarily get water from the snowmelt rivers in the region. At different locations along the river, small diversion structures are installed to divert water from river to the irrigation canals. These diversions are both open or gate fitted. Newly build Logar dam and a typical gate fitted diversion point is shown in Figures 4 and 5. From these canals, water is diverted to small irrigation channels (watercourses). According to the water laws of 1981, the amount of water given to each farmer is determined according to its area under cultivation, the kind of crop, the irrigation regime, the water rights document, the local practice and amount of water present in the main source. However, these regulations are not strictly followed and water distribution is mainly done on informal agreements among the farmers.

In traditional as well as in modern irrigation schemes the dominant irrigation method is basin/border irrigation for cereals and furrow irrigation for vegetables and grapes. Farmers usually lack knowledge about crop water requirements and over-irrigation of crops is a

common practice. Overall efficiency is only about 25 to 30 per cent for both modern and traditional irrigation schemes due to the following reasons:

- high conveyance losses in traditional schemes with earth canals,
- high operation losses in modern schemes with lined conveyance canals,
- high on-farm distribution losses (over-irrigation, poorly leveled land) in both traditional and modern schemes.

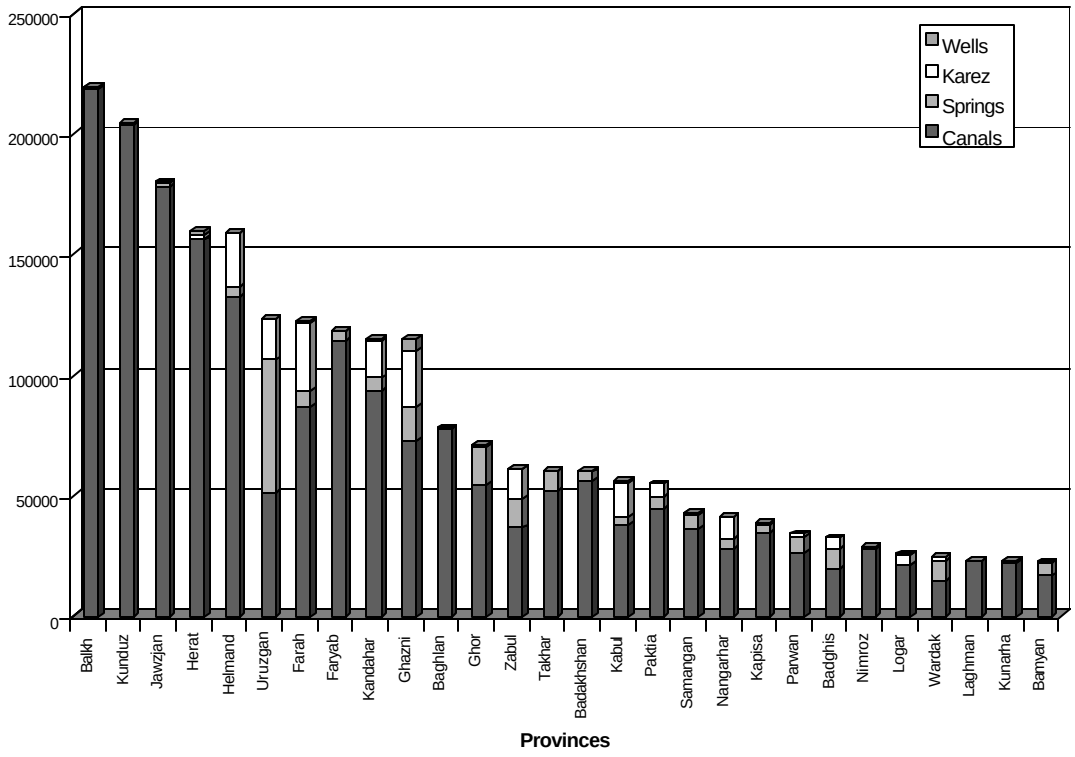

Figure 3. Area of irrigated land (ha), irrigated by different irrigation schemes in Afghanistan.

Additionally, there is usually a waste of irrigation water in traditional schemes during the first half of the growing season due to unregulated flood water entering the conveyance canal, and a shortage of water during the second half when river flow decreases to its annual minimum.

Due to low water use efficiencies and lack of inputs, crop yields are very low. Present drought conditions have caused further reduction in crop yields e.g. average yield of wheat was about 1.1 tons/ha in 1978 as compared to 0.8 tons/ha of today. In Table 10, total area, production and yields of different cereal crops for 1978 are presented. The total area (irrigated+rainfed) under cereal crops was about 3.39 million ha. The total cereal production was 4.15 million tones of which 2.65 million tones was only wheat.

Figure 4. New Dam on the Logar River.

Figure 5. A typical gate fitted canal intake.

Table 10. Cultivated area, production and yields of different cereals in 1978

Crop	Area		Production Million tonnes	Yield Tons/ha
	Million ha	Percent		
Wheat	2.35	69.3	2.65	1.13
Maize	0.48	14.2	0.76	1.58
Rice	0.21	6.2	0.40	1.91
Barley	0.31	9.1	0.30	0.97
Others	0.04	0.1	0.04	0.81
Total	3.39	100	4.15	1.22

4 WATER RESOURCES MANAGEMENT ISSUES

Afghanistan is predominantly an agrarian society with 80 percent of the population living in rural areas, and directly dependent on natural resources for livelihoods (small scale farming, pastures and forest products). Since rainfall is scanty and highly variable over most of the country where topography and soils are suitable for agriculture, there are few areas where rainfed crops can provide a reliable basis for livelihoods. The surveys of 1978 have indicated that 80 percent of wheat and 85 percent of all crops were produced on irrigated lands. This is also reported to be true for the present day situation. Hence the evolution and growth of agriculture and food security in Afghanistan is very much dependent on the development of irrigation.

Water resources management in Afghanistan is primarily irrigation water management because at present the annual water used for irrigation is about 99% of the all water used. Nearly 90 percent of all irrigation systems in Afghanistan, covering about 2.3 million ha, are traditional schemes developed and built by farmers and operated and maintained by them according to traditional communal customs and practices. Total developed irrigated area in 1978 was estimated to be 2.63 million ha of which only 1.44 million ha had sufficient water supply to support double cropping in a year (FAO, 1997).

The effects of war and neglect on these systems have not been systematically assessed. However, according to FAO estimates of 1997, about 1.7 million ha required rehabilitation, and another 0.68 million ha required improved on-farm water management conditions. Canal management has completely collapsed. Canals are completely silted, breached, and not delivering as in the past. About 46% of the irrigation structures are damaged and 88% of the irrigation structures are traditional which are responsible for the 40% of the total water loss. For example, irrigation provided under the Parwan project declined from 25,000 ha to 10,000 ha due to sedimentation in canals and poor maintenance. Similarly, irrigated land declined sharply since 1978, from 2.8 million ha to about 1.2 million ha. This is primarily due to drought and lack of maintenance of surface water facilities-small dams and canal systems.

The indirect impact of war on modern irrigation systems is much more serious than the traditional schemes. The intake structures of modern irrigation schemes are out of function due to the missing of mechanical parts looted during the war and lack of professional staff to repair and operate these systems. However, the direct negative impact of war on irrigation

infrastructure was less a consequence of destruction but much more a consequence of the migration of farmers to other countries leaving behind the irrigation schemes unattended. Farmers have abandoned about 40% of the land due to lack of maintenance and 10% of the land is completely destroyed due to war. About one half of all irrigation schemes are in need of rehabilitation.

Surface water irrigation systems are performing less than half of the 1980 levels. As a result, irrigated area has drastically reduced. Estimates of the irrigation department indicate that currently only 1.4 million hectares are being irrigated, which is half that of 1980 levels. This has resulted in an estimated overall national food deficit of 30 per cent.

Afghan farmers use centuries old farming techniques with oxen providing the draught power. While agriculture is the basis of economy little knowledge on new irrigation technologies and cultural practices is available to the farmers, and institutional credit facilities are almost absent. As a result, irrigation system efficiencies are rated to 25-30 percent and productivity levels are low even by regional standards. About 20 percent of all irrigation systems require improvement of on-farm water management to avoid under-irrigation (low crop yields) or over-irrigation (water logging and salinization). By promoting technology transfer, production potential of these lands can be improved substantially even under low and variable rainfall regimes.

Afghanistan has an annual potential of about 20 BCM of groundwater out of which only 3 BCM is in use. It is expected that due to irrigation and water supply demand, groundwater use in future will increase to 8 BCM. Due to continuous drought of last four years, all traditional groundwater irrigation systems have reduced in capacity or dried up completely. About 60% of the karezes are not in use and 85% of the shallow wells are dried out. Boring of deep wells close to karezes and shallow wells had an adverse effect on the production of these traditional irrigation systems. This has threatened the sustainability of these traditional systems in the long run.

In most of rural areas local population is dependent on groundwater for drinking and domestic supplies. Over-exploitation of groundwater has resulted in water table decline in most of the areas. As the water table continues to fall, around 0.5 to 3 m each month depending to the place, the poorer families are unable to dig their wells deeper and thus are forced to get water from communal wells. Many of these wells, often located in the mosques, have either already dried up, forcing people (often children) to walk long distances to meet their daily water needs. In addition, billions of dollars of investment made earlier in providing these facilities would be wasted.

Community infrastructure related to agricultural production, such as irrigation systems and water impoundments, bridges and roads are badly damaged. Participation of local communities (particularly women) in decision making for economic development has been poorly focused although community based approach for development has traditional foundations in Afghanistan. The possibilities of installing old mirab/vakil system of water distribution among the farming community are very low. These circumstances made and still make it difficult to rehabilitate large traditional irrigation schemes.

Currently, very few skilled professionals are available in the country to undertake the development programs. This requires an urgent strategy to address the anticipated shortfall. While improving capacity, it is essential that specific strategies are developed to support and improve the involvement of women both in Governmental institutes and in the rural communities.

The absence of coherent government over many years has led to the involuntary withdrawal of line ministries from their traditional roles at national and provincial levels. Presently, there is no institution capable or authorized to monitor groundwater extraction or surface water use; there is virtually no water resources management taking place at present. There are five ministries who are directly involved in the management of water resources in Afghanistan. Ministry of Rural Development and Reconstruction, Ministry of Irrigation, Ministry of Mining, Ministry of Agriculture, Ministry of Public Works, and Ministry of Power.

The Ministry of Rural Development deals with minor irrigation, water supply, and sanitation projects in rural areas. The Ministry of Irrigation deals with major irrigation infrastructure of the country. They are in charge of planning, building, and maintaining major water storage and water conveyance facilities. The Ministry of Mining is responsible for groundwater resources of the country. The Ministry of Public Works, through its Water Supply Authority is responsible for water supply for major cities in the country. Presently, all these ministries lack coordination, which is affecting the effective water resources management.

5 THE WAY FORWARD

The problems of water resources management in Afghanistan are complex and a straightforward solution seems impossible. In order to increase agricultural production and sustainability of irrigated agriculture, the overall strategy should be to increase water capital and make better use of water. Government must take lead in putting in place the coordination mechanism and providing effective oversight. For quick recovery of water sector, increase in crop production and improvement in water use efficiency and environmental sustainability, following steps may be identified.

- For the formulation of strategy for the rehabilitation of irrigation systems, a comprehensive database and information systems should be established. This is absolutely necessary for the accurate and up to date assessment and spatial locations of the rehabilitation work need to be undertaken.
- Rehabilitation of irrigation systems should be given a priority. All systems within the basin or sub-basin should be systematically surveyed and assessed before priorities are selected. This is necessary to ensure that traditional water rights and allocations are preserved and upstream and downstream impacts and conflicts are minimized and mitigated. This process should be completed with the consultation and participation of local communities (i.e. *mirabs* and farmers).
- Before 1980, there were about 18 well-equipped meteorological and hydrological stations working across Afghanistan. These stations were the main source of data for the planning and operation of water resources systems. All these stations have been completely destroyed during the years of war and conflict and presently no information is being collected for the analysis of present situation and future projections of the water

resources. Special attention should be given to the re-installation of these stations to get systematic assessment of hydrological and irrigation systems.

- Given the country's variable climatic conditions and vulnerability to drought, water availability for agriculture is likely to be a subject of debate both for rainfed as well as for irrigated agriculture. Therefore the conservation efficient use of water must be the foundation for a fully productive agriculture sector. Farmers should be encouraged to use water harvesting and watershed management, including more water storage structures both small and large. Farmers should be introduced and trained in the use of modern water saving technologies and crop varieties, which has proven successful in other arid environments similar to Afghanistan.
- Although Afghanistan has limited water resources, it does not make efficient use of what is available. Farmers are ignorant of actual crop water requirements and irrigation-scheduling practices are still largely based on the maximum amount of water a farmer can capture. Therefore present irrigation practices of farmers include a tendency to over-irrigate, whereas the opposite should be accomplished. To address this very important issue, research studies focusing on the revision of irrigation planning based on maximum water saving should be initiated.
- Increasing demand for water has put enormous pressure on the groundwater resources. Consumption of groundwater is presently 3 BCM and it is projected that in next 10 years it will reach to 10 BCM due to increase in domestic and irrigation supply demands. Due to this excessive use coupled with the successive drought, groundwater tables in different parts of Afghanistan have declined to the extent that about 60-70 percent of traditional groundwater irrigation systems (i.e. Karezes) have dried up. This over-exploitation of the resource has caused devastating impacts on drinking water supplies for urban and rural population. For the preservation of this future resource, Government needs to develop appropriate policies to effectively manage and monitor groundwater development and use. Steps should be taken for the revision and enforcement of 1981 water laws. Communities should be directly involved in the campaign of artificially recharging the aquifers and in the conjunctive use and management of surface and groundwater resources.
- Afghanistan has a history of drought of varying severity and will continue to experience it in the coming times. Traditional coping and mitigating strategies have been broken down under growing population pressures and the collapse of the rural economy. For poverty alleviation, farmers should be provided with the opportunities to generate off-farm incomes. Traditionally, the main sources of off-farm income have been hired labour, forest products and small-scale enterprises like carpet weaving, bee-keeping, skin processing and handicrafts.
- Appropriate institutional arrangements should be made for proper coordination of different ministries and line agencies involved in the management of water resources. The roles and responsibilities of these organizations should be clearly defined to avoid overlapping and to ensure effective management of water resources at all levels.
- An enormous amount of technical expertise has been lost in the water sector over the past 20 years. This loss of human capital should be replaced as quickly as possible if the sector has to recover its former status, reduce dependency on external expertise and enable citizens to develop their potential. Therefore a strategy should be developed to create training opportunities for farmers, quality sector managers and technical staff.

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ANNEX I REGULATIONS CONCERNING THE USE OF WATER IN AGRICULTURE

Chapter One: General Provision

Art. 1.The regulations were enacted according to article 43 of the Water Law with a view to using water in agriculture.

Art. 2. Water needed for agriculture shall be made available to users based on the plan or use of water and likewise the valid documents on land ownership and water rights in accordance with local practice.

Art. 3. Use of water according to a plan shall ensure equitable distribution thereof to users and effective utilisation of irrigable lands.

Art. 4. The following terms connote the following meanings in these regulations:

1. Use of water means water utilisation by a person deserving water for the purposes of agriculture.
2. Irrigation systems means the complex of irrigation installations to meet the needs of farmers, cooperatives state farms and users in connection with irrigation.
3. Irrigation regime means the aggregate irrigation specifications and technology consisting or irrigation frequency specifying the irrigation times, period, amounts and norms.
4. Irrigation norms means the necessary amount of water needed for one jerib i.e. half an acre under irrigation for raising certain crops in one irrigation.

Chapter Two: Water Distribution

Art. 5. A person can use water for irrigation whose water rights pertaining to a specific area under irrigation are recorded in his documents concerned, based on local practices.

Art. 6. The amount of water needed for irrigation shall be determined according to the area under cultivational, the kind of crop, the irrigation regime, the water rights documents, the local practice and the amount of water in its source.

Art. 7. Water shall be used in irrigation system based on plans for use and distribution of water from the same system approved by the Ministries of Water and Electricity and Agriculture and Land Reform.

Art. 8. Irrigation norms for the crops shall be prepared and approved by the Ministries of Water and Electricity and Agriculture and Land Reform. In the case of absence of such approved norms, those commensurate with local practices shall be used.

Art. 9. During drought years, the organs of the ministry of Water and Electricity in cooperation with the Ministry of Agriculture and Land Reform and in participation of the chief water supervisors and their assistants shall adopt the necessary measures on time about the redistribution of waters taking into account the priority of certain crops.

Art. 10. In case the irrigation system begins to exploit a new source of water, new documents are prepared to record the water rights of farmers with lands under irrigation by the system from the same source.

Art. 11. Should the dry-cropping lands be converted into irrigated ones as a result of building irrigation systems paid for by cooperatives and farmers, this shall not affect the areas owned by cooperatives and farmers. Based on the conditions provided in paragraph I of this article, the cooperatives and farmers will enjoy land tax concessions under article 25 of the Water Law.

Art. 12. Dry cropping or fallow lands can use the existing irrigation system when there is available in the system some surplus water certified by the organs of the Ministries of Water and Electricity and Agriculture and Land Reform.

Art. 13. Flour mills operated by water and non-agricultural organisations can get the water they need from the main or subsidiary canals under the following conditions:

1. if there exists in the anal some surplus of water,
2. if the lands under irrigation and the residential are not affected,
3. if the water for drinking is not polluted and its quality not changed,
4. special permits shall be necessary from the organs of the ministry of water and Electricity in agreement with the ministry of Agriculture and Land Reform.

Art. 14. In case the headworks of an irrigation system in a certain province are fed by a source whose water is needed for the same province, the water shall be distributed according to a plan drawn by the provincial organ of the Ministry of Water and Electricity.

Art. 15. In case the source of water is used by two or more provinces, its water is distributed through the ministry of Water and Electricity in agreement with the Ministry of agriculture and Land Reform based on plans prepared for water use by each province.

Art. 16. Disputes arising from use of water among the water users shall be settled according to articles 39 and 40 of the Water Law.

Chapter 3: Management of Irrigation Systems

Art. 17. While the irrigation system is maintained by the organs of the ministry of Water and Electricity, the management and supervision of water reservoirs together with their annexes, the main canals and their installations, the distribution dykes for irrigation shall be the duty of the Irrigation Department concerned.

Art. 18. Repair and improvement of the irrigation system and promotion of agricultural affairs in the areas under the same irrigation system shall be carried out and the areas to be irrigated shall be taken into account when drawing the plans fro water use.

Art. 19. Canals and their installations located lower than the water distribution shall be included in the land ownership using the same dyke for irrigation supervised by the chief water supervisor or his assistant.

Art. 20. The plan for use of water in areas under the irrigation system shall be prepared by the irrigation technician or assistant water distribution supervisor according to the rules approved by the Ministries of Water and Electricity and Agriculture and Land Reform, taking into account the area under cultivation, the irrigation norm the types of crops and other factors affecting the use of water, with the help of Local Government Organs and the ministry of Water and Electricity.

Art. 21. The provincial irrigation organs shall prepare and submit to the office of the provincial government one month ahead of the irrigation season for approval the general water distribution plan according to the rules approved by the Ministries of Water and Electricity and Agriculture and Land Reform, taking into account then amount o water flowing into the water sources.

Art. 22. The water distribution plan form the irrigation system shall include the areas under the amount and norm of irrigation and such likes for a span of three to five years. However, minor changes are permissible in this plan.

Art. 23. The main duties of the provincial irrigation organs of the Water and Electricity Ministry are as follows:

1. study and survey water sources and supervise the same,
2. determine the right of using water form irrigation systems,
3. draw annual plans for use of water,
4. supervise the effective utilisation of water from the water sources or irrigation installations,
5. determine the volume of work and prepare the plans of participation of land users in collective work in connection with the irrigation system concerned,
6. organise collective work to combat floods and other unpredictable phenomena in cooperation with the Emergency Preparedness Department of the Council of Ministers,
7. control the management of the provincial irrigation system,
8. adopt measures to develop irrigation,
9. participate in the election of the chief water supervisor and his assistant for the irrigation system whose maintenance costs are paid for by the water users.

Art. 24. The main functions of the provincial organs of the Agriculture and Land Reform Ministry are:

1. implement the irrigation regime and plans for watering the crops according to modern technology,
2. help in effective utilisation of water needed for irrigation
3. assist in the activities of assistant water distribution supervisors in connection with water distribution to lands belonging to state farms, cooperatives and farmers based on their water rights whose maintenance costs are paid for by the water users,
4. submit proposals to the authorised organs about redistribution of water needed to irrigate the areas under cultivation in case of unpredictable phenomena such as drought, earthquakes, ..

5. prepare the documents concerned for the settling of disputes arising from use of water between individual water users and state farms,
6. cooperate in preparing the water distribution plans with the local organs of the Ministry of Water and Electricity,
7. cooperate in the activity to prepare the irrigation and drainage systems for the irrigation season and maintaining the installation concerned.

Art. 25. The irrigation departments shall guide the activity of the public irrigation systems, carry out matters related to water conservation, bringing water from the headworks to the areas under irrigation according to the plan for use of water, rendering to water users technical assistance in utilising water installations.

Art. 26. Maintenance of irrigation systems paid for by farmers, cooperatives and other water users shall be the duty of the farmers' committees elected at the general assembly of water users under the guidance of the chief water supervisor or his assistant.

Art. 27. The general assembly of irrigation system users shall be held at least twice a year with the participation of Local Government Organs to settle the following matters;

1. elect the chief water supervisor and members of the farmers' committees for a set period
2. fix the remuneration of the chief water supervisor and those of his assistants,
3. review and certify the proposals of the chief water supervisor or those of his assistants regarding the distribution of water among the users during irrigation season,
4. identify all type of collective works including clearing repairing and improving the irrigation systems, the period in which such peaces of work are carried out and the volume of work done by each water user,
5. certify the contracts with organisations repairing or constructing irrigation systems or installations,
6. certify the application for credit from the Agricultural Development Bank for repairing or improving the irrigation system,
7. consider the report of the chief water supervisor or that of his assistants regarding activities concerning water distribution and consumption, the credit obtained from the Agricultural Development Bank and the results of collective work,
8. review other matters to be settled collectively.

Art. 28. The chief water supervisor and representatives of water users shall submit to the local organ of the ministry of Water and Electricity the application for the water needed in special forms indicating the period for which the water is required. The chief water supervisor and his assistant showing special ability in preparing this application form shall be appreciated by the Ministry of Water and Electricity.

Art. 29. The chief water supervisor and his assistant will cooperate with the organs of the ministries of Water and Electricity and Agriculture and Land Reform on technical matters with respect to systems maintained on the expenses of water users. The activities of state farms shall be guided by their technicians.

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