The effects of calamities on water resources and consumption in Afghanistan

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Foreword

The current droughts and turmoil in Afghanistan have imposed negative impacts on water resources and has caused considerable reduction on agricultural production and drinking water as well has ended with the environmental degradation. Regional long-terms data indicate that the entire region has experienced four wide droughts, beside of other zonal droughts, during the last century: 1898-1905; 1944-45; 1970-72, and 1998-2004 (FAO and WFP, 2003). In the recent drought although precipitation increased in 2003 with good distribution, it reduced significantly again in 2004. The available data show that comparing to normal years, irrigation water availability from surface water resource has decreased up to 70% in canals and this has caused the irrigated land to shrink up to 60% all over the country. Similarly more than 36% of the *Kanats(Karezes)* have dried up and the discharge of the remaining has reduced up to 83% of their water production. This has caused 81% decrease in the irrigated land under these systems. As a consequent, the crop production has reduced and more important that around 300,000 families who are dependent on this water source for their drinking purpose have suffered and now are struggling for finding other source; or to move to areas where drinking water is available. Still more than 500,000 families are dependant to the remaining active *Kanats* that are under the danger of drying by the effects of the current drought and unregulated usage of deep wells (FAO, 2003a).

This paper focuses mainly on the impact of the recent drought and the armed conflict on water availability for different users; as considerable negative impact on drinking water, agricultural outputs, in number of livestock, local people displacement, environment degradation and socio-economy in the country have been imposed.

1. BACKGROUND

Afghanistan, with an area of 652,000 sq km, is a landlocked mountainous country located between Central and South Asia, strategically located cross-road of three main regions: the Indian sub-continent in the east, central Asia in the north and the Middle East in the west. Afghanistan is divided into 34 administrative divisions, 40 watersheds and 5 main river basins. Map 1 shows the location of Afghanistan. The topography, climate, and other geographical features of Afghanistan are highlighted by others (Alim and Shobair, 2002, Naimi, 2003 and Shobair 2001).

Total estimated population of Afghanistan is 22.23 million, of which 85% are directly dependent on agriculture (FAO and WFP, 2003). Population annual growth rate is around 3.8%, population density 34.1 person per square km, life expectancy at birth is 41.9 years for male and 43.4 years for female (WHO, 2004), urban population is 21.9% of total. A number of 2,000,000 refugees are still in Pakistan and another 1,500,000 in Iran. Numbers of population killed in War reaches to about 2,000,000.

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Map 1. Location of Afghanistan

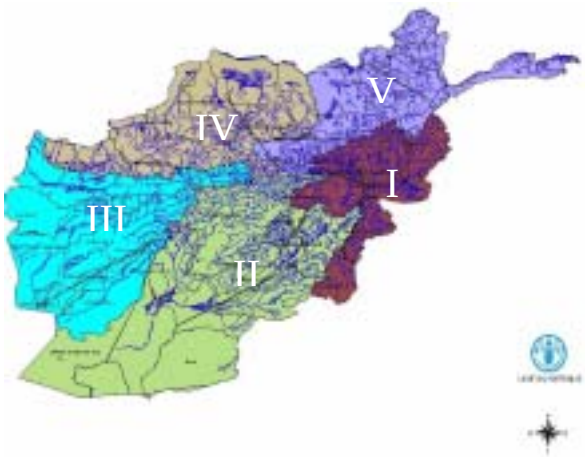
Around 10 million mines planted in 55,000 sq km areas still threaten the life of Afghans.

Before 1978 Afghanistan was self sufficient in food production and significant exporter of agricultural products.

2. AGRICULTURE AND IRRIGATION

12% of Afghanistan's total land is arable, with 4% under forest cover and about 72% rangeland and bare land. Agriculture is practiced between 300m up to 3,500m above sea level (asl) in the central highlands. Considerable differences in agricultural practices and cropping exist in localities. Agriculture varies from sub-tropical areas; such as Jalalabad (315 frost free days), where citrus and sugar cane grows, to temperate cool areas where only barley and wheat are cultivated (less than 180 frost days/year) (Raphy, 2004). 3.2 million hectares (ha) or 5% of Afghanistan's area was the irrigated agriculture, including intensive and intermittent irrigation in 1993. However, according to another FAO study (FAO, 2003a), only 1.9 million ha was irrigated in 2002. Northern, Hilmand and western Basins contain 33% of the one-crop intensively irrigated areas. 85% of agricultural production is wheat, forming the staple of diets of Afghans.

Map 2. River Basins in Afghanistan



3. HYDROLOGY OF AFGHANISTAN

3. 1 River Basins in Afghanistan

Hydrologically Afghanistan is divided in to 5 following major river basins (map 2):

River Basin I - *Kabul/ Indus River Basin*: This basin is located in eastern part of the country, including the south – eastern river sub-basin. The outflow of River Basin 1 is in Pakistan. The total catchment area of this basin is 143,000 km^2. The main direction of flow is from west to east. Run-off generated in this basin is discharged by Kabul river from Afghanistan and Indus rivers from Pakistan to Indian Ocean.

River Basin II - *Hilmand River Basin:* This basin is located in the southern part of Afghanistan, with a total catchment area of 166,000 km^2. The discharging river mainly flows from east to the west. The run off of upper parts of this basin is collected in Kajaki reservoir. Due to the current drought the amount of water stored in this reservoir has been

reduced significantly and in at least 2 years the water has not been spilled out from the spillways. The water released currently fulfills the needs of upper parts of the basin; while the demand for water in the lower parts remains unmet. Originally the discharge of this basin was drained to Hamoon-e Helmand; partly situated in Iran. The root for the change is accounted to the rainfall reduction and improper management of irrigation water in the middle parts of the river. Some ephemeral rivers also exist in this basin that have outflow to Baluchistan/Pakistan.

River Basin III -*Western Rivers Basin:* This refers to the western watershed of the country. The watershed size of this basin is about 131,000 km^2. Hari Rod, Farah Rod and other smaller streams drain the run off from the area. Harirod defines partially the boundary with Iran. The southwestern river of this basin drains into depressions situated along the Iranian border.

River Basin IV - *Northern Rivers Basin:* Several watershed of the northern part of the country are classified as basin IV. The area of this drainage basin is 116,000 km^2. The runoff is discharged by Murghab, Kashan, Kushk and Gulran rivers out from the basin to Turkmenistan by Amu (Oxus) River. The other rivers, such as Samangan, Balkhab, Saripul and Shirin Tagab however do not reach Amu River.

River Basin V - *Northeastern Rivers Basin*: Basin V is the northeastern river basin of Afghanistan. The size of this watershed is 86,000 km^2. Runoff generated here is rooted to Amu river by Kunduz and Kokcha rivers. Amu River is finally drained to Aral sea.

Most of the rivers in Afghanistan 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 originated by snow melt ending in June/July before diminishing to a minimum in Dec. /Jan. A large amount of the river flow (over 80%) occurs from April to September. Most disastrous floods occur after heavy rainfall in March/April, especially when snow melt is already well advanced.

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 asl which function as a natural storage of water in form of snow. The gradual snowmelt supports perennial flow in all major rivers during summer.

The hydrological data of the rivers were collected regularly through 167 hydrologic stations before the war (Shobair, 2000). Presently most of these recording stations are destroyed; their measurement equipment looted and hence none is operational. The absence of hydro metrological stations has introduced a gap in the availability of hydrological data. Attempts are going on for rehabilitation of these stations.

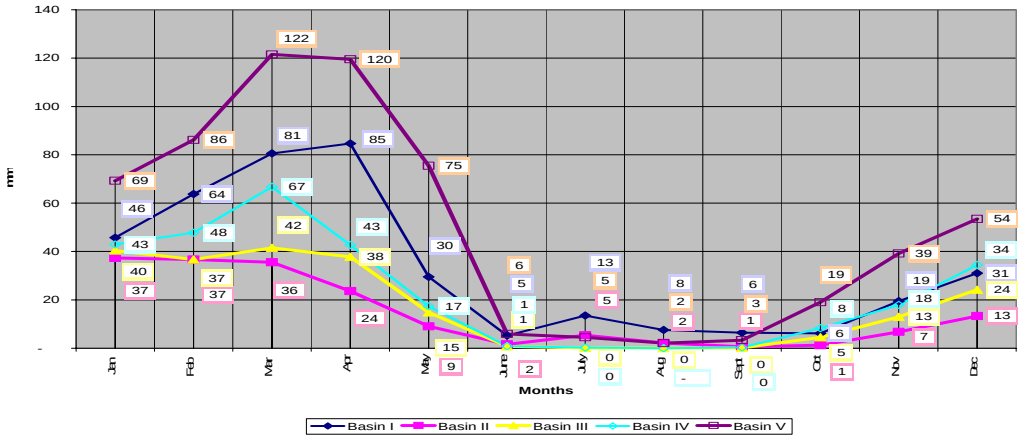
Regarding to groundwater situation in Afghanistan, although no reliable data on annual groundwater recharge exists, an estimation of 15 bcm is made however (Sheladia, 2001). In a same manner, the total amount of water extracted annually from groundwater is estimated to 3 bcm.

3.2 Precipitation and Evapotranspiration (ET) Rates in Afghanistan

Afghanistan is receiving irregular precipitation over the year; which varies from a low of 75 mm in Zaranj to 1,170 mm in south Salang (Walter, Shobair et. all. 1997). Mainly precipitation occurs in winter; particularly from December to April. The wet season is

concentrated in winter and spring when the vegetative cover and crop water requirements are low. In higher elevations, precipitation falls in the form of snow that is highly critical for river flow and agricultural demand in summer. From June to October, Afghanistan receives hardly any precipitation. The southern part of Afghanistan receives less than 300 mm of rain per year; while, the region south of Bust and Farah receives less than 100 mm. The Central Highland and Northern Afghanistan receive between 300-400 mm and the highest mountains in these areas may receive some more. Chart 1 shows the average rainfall of different river basins in Afghanistan during the year.

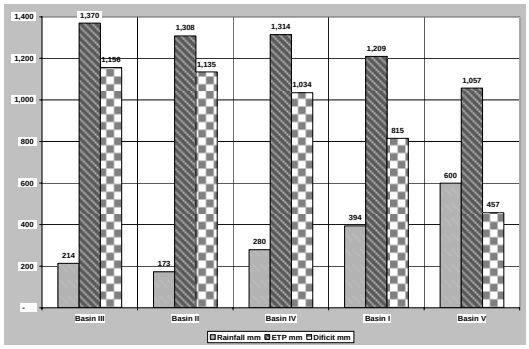
Chart 1. Average monthly rainfall in different basins during the year (mm)



The annual ET rates are relatively low in Hindu Kush (900-1,200 mm) mountain ranges; because of severe and long winters. The ET rates vary between 1,200 mm and 1,400 mm in the northern plains and can reaches up to 1,800 mm in the southern and southwestern plains. However, summer ET rates are high all over the country; showing a daily peak of 5-8 mm in June/July/August (Shobair, 2000). Due to strong winds occurring particularly in Herat and in the southern-western plains, maximum daily ET rates are over 10 mm in this period (max 11 mm in July).

In chart 2 the annul rainfall, ET and the deficit to fulfill the potential ET is presented.

Chart 2. Annual Rainfall, Evapotranspiration and Water Deficit by River Basins.



3.3 Water Consumption

Presently the major water consumer in Afghanistan is the agriculture sector; with more than 21.9 bcm (98% of total). 19.1 bcm (87%) of this amount is met by surface sources and 2.8bcm (13%) from groundwater [1.74 bcm (8%) from *Kanats*; 0.98 bcm (4%) from springs and 0.17 bcm (1%) from deep wells] (FAO, 2003a). The available statistics (FAO, 2003b) show that in 1995 (hydrologically a normal year) there were a number of 21.93 million sheep; 11.56 million

poultry; 9.4 million goat; 1.09 million donkeys; 3.66 million cattle and 0.41 million camels in Afghanistan (FAO, 2003a), but in 2003 the number has decreased considerable to 2.88 million sheep; 4.0 million poultry; 2.4 million goat; 0.52 million donkeys; 1.22 million cattle and 0.06 million camels in Afghanistan. Considering the consumption rates for livestock given by Davis and Lambert (1995), the annual water consumption for the current number of livestock in Afghanistan reached to about 0.05 billion m^3, which is 1.07% of total consumption. The required water for livestock is provided from different sources including surface water (canals) and ground water (*Kanats*, springs and wells).

At present, almost there is no major industrial production in Afghanistan to be considered as industrial water consumer. Table 1 shows a water balance from surface and groundwater in Afghanistan. This estimation is based on available data at national level (FAO, 2003b) and other assumptions.

Table 1. Estimated Surface and Groundwater potential Consumers (bcm per year)

Type of water resources		Potential	Present used in billion cubic meter				Total	Balance	Future use*	Balance/environment
			Agriculture	Live stock	Water supply	Industry				
		bcm	bcm	bcm	bcm	bcm	bcm	bcm	bcm	bcm
Surface Water/canals		57	19.07	0.05	0.14	0	19.25	37.75	30	27
Ground water	*Kanats*	15	1.74		0.03		3.04	11.96	5	10
	Springs		0.93		0.01					
	Wells**		0.17		0.17					
Total		72	21.9	0.05	0.35	0	22.29	49.71	35	37

Note:

* All existing irrigation schemes are assumed rehabilitated and managed efficiently,

** It is assumed that out 0.34 bcm extracted water form shallow and deep wells, partly half of it is used for irrigation and half for water supply (Potable water) .

The drainage area of each basin with mean annual volume, estimated volume used in 2002 which more or less is the same in 2004 and percentage of usage out of existing resource is shown in table 2.

Table 2. Estimated water volume in billion m^3 used for irrigation in each river basin

Name river Basin	Catchment Area (km^2)	Mean Annual Volume (bmc)	Estimated volume used in 2002	% of available or used in 2002
River basin IV- Northern	116000	3.34	19.99	59%
River basin III- Western	131000	3.33	0.96	29%
River basin I- Kabul	143000	21.74	4.15	19%
River basin II- Helmand	166000	7.50	7.86	105%
River basin V- North-eastern	86000	48.12	4.12	9%
Total All Basins	642000	84.03	19.07	23%

4. EFFECT OF CALAMITY ON IRRIGATION/AGRICULTURE

4.1 The reduction of Agricultural production

Afghanistan is a drought prone country. Sever droughts are generally linked to low winter rainfall in two consecutive years here. Rainfall records suggest that low winter rainfall in

two successive years occurs at least once every 10 to 15 years (Shobair, 2001).
During the current drought, which is almost in its seventh year (1998 to 2004), although there were signs of recovery in 2003 with good rainfall and good distribution, the amount of cereal production has dropped to around 3 million metric ton (FAO, and WFP, 2004). A recent crop and food assessment survey conducted by FAO and WFP (FAO, and WFP, 2003) shows that in 2003 Afghanistan's agriculture has suffered from widespread crop failure; caused by below average rains and loss of animals due to diseases. The report adds that drought conditions are particularly acute in the west, southwest and south of the country, where more than half of the crops have failed. In areas north of Hindu Kush Mountains, pests and diseases as well as untimely rains were mainly responsible for the low harvest. The above report also mentions the lower harvests resulted from severe water shortages in some areas; where the water table has dropped by up to four meters. Ironically, seasonal flash floods in the same areas have also been reported; indicating a severe lack of irrigation infrastructure to store and distribute water temporally and spatially. Wheat prices on average are nearly 30 % higher than prices at the same months last year (Kamal, Shobair et. al., 2004).

Chart 3 shows the total amount of crop production (wheat, rice, barley and maize) for different years, from 1964 to 2003. Cereal production in Afghanistan has not been sufficient to meet consumption requirements since 1976.
Civil unrest since 1978 has contributed to a steady decline in production throughout 1980s. The agricultural recovery of the 1990s was halted by severe drought for three consecutive years between 1999 and 2001 and again in 2004.

Chart 3. Total crop production (wheat, rice, barley and maize) from 1964 to 2004 (FAO, 2004)

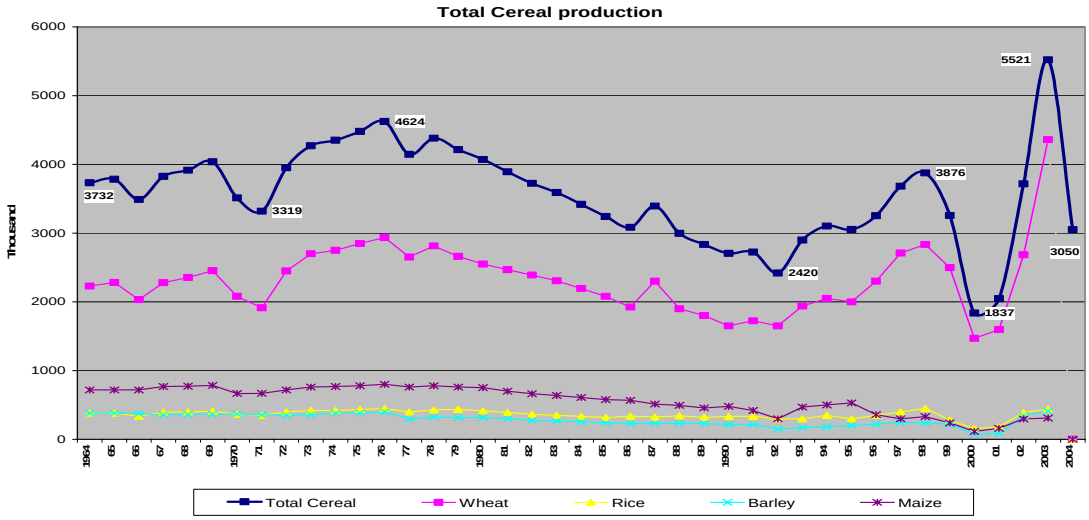
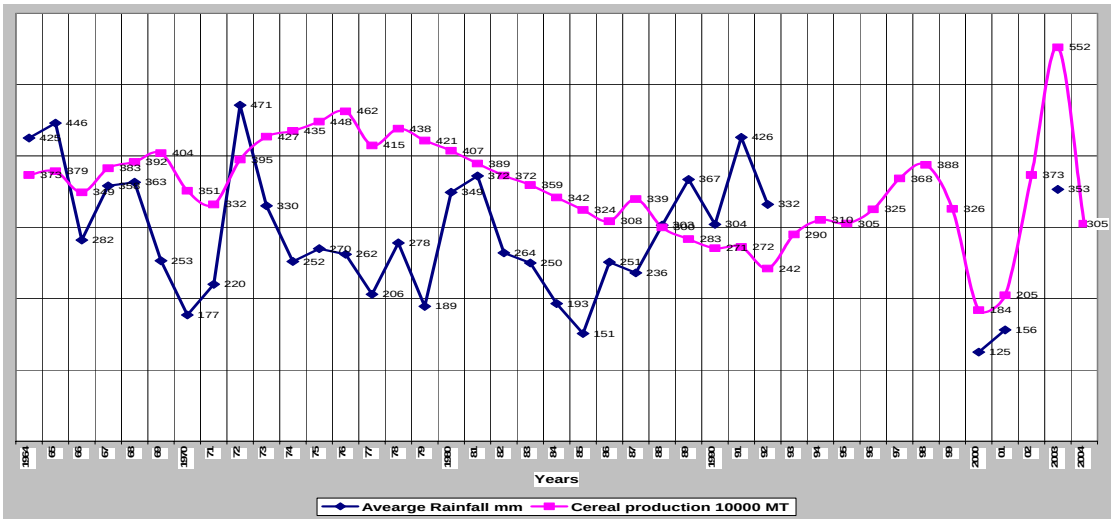


Chart 4 shows a direct relation between the total amount of crop production in the country and the annual rainfall distribution in Kabul (used as an indicator) for years 1964 to 2003. It can be seen that there is high sensitivities between the frequency of rainfall during different years and crop production.

Chart 4. Long term rainfall distribution and crop production



Note: in the chart there is a gap of rainfall data from 1992 to 2000. This is due to destruction (by war) of almost all of meteorological stations in the country. The chart shows that the crop production depends both on the amount of rainfall available and on the effects of war and recovery.

4.2 Reduction of Surface Water for Irrigation and the Arable Land

The FAO study of 2002-2003 (FAO, 2003b) shows a decline of 66% of water flow in canals. This has caused a reduction by 58% of the irrigated land area. Main reasons for the reduction in irrigation schemes are as follows:

i. Severity of the droughts and reduction of water in the main sources,
ii. Effect of war and improper operation and maintenance of canals (siltation in the canals, damaged regulating systems in the canals etc…) - including improper irrigation water management which causes low water use efficiency,
iii. Lack of sound irrigation structures (mainly 90% of irrigation systems in the country are the traditional schemes; and additionally water conservation appropriate technologies are not yet introduced widely).

The available discharge in canals in 2002, the percentage of decline and the command area and its percentage of decline for surface water in all river basins are shown in tab. 3.

Table 3 Available discharge in the canals and command area in 2002-3 and its percentage of decline

River basins	Accumulated Discharge in 2002 (m^3/sec)	% decline of discharge	Command Area in 2002 (ha)	% decline of irrigated area
River basin I- Kabul	400	72%	328,434	48%
River basin II- Helmand	758	62%	734,088	61%
River basins III- Western	92	69%	68,148	67%
River basins IV- Northern	192	69%	241,891	61%
River basins V- North-eastern	397	60%	266,425	49%
Total all basins	1839	66%	1,638,986	58%

4.3 *Decrease of available water in Kanats/Karezes and arable land irrigated*

The impacts of droughts and war in Afghanistan are apparent in the discharge of *Kanats* and as a consequent on agricultural productivity, human settlement and on livestock condition. During the war many of *Kanats* were destroyed intentionally or damaged due to lack of maintenance. This is examined on the available discharge in the *Kanats* and the size of command area in 2002-2003 and its percentage of decline in table 4 (Please see next page). The table shows that the *Kanats* in river basin I have reduced their water flow by up to 90% and this has caused a reduction of 88% of irrigated land. In river basin II the *Kanats* have reduced their water flow and land under irrigation by 88% and 85% respectively and in river basin III the *Kanats* have reduced their water flow and land under irrigation by 80% and 78% respectively. From this analysis it can be visualized that in these 3 river basins where the *Kanats* exist, the groundwater level has depleted significantly. The main reasons for the decline are accounted to the following causes:

i. the severity of the drought and reduction in the recharging of groundwater,
ii. effect of war (bombing/mining) and improper operation and maintenance of *Kanats*,
iii. drilling of deep wells close to the *Kanats* (Shobair, 2000)
iv. non technical and non-scientific use of groundwater.

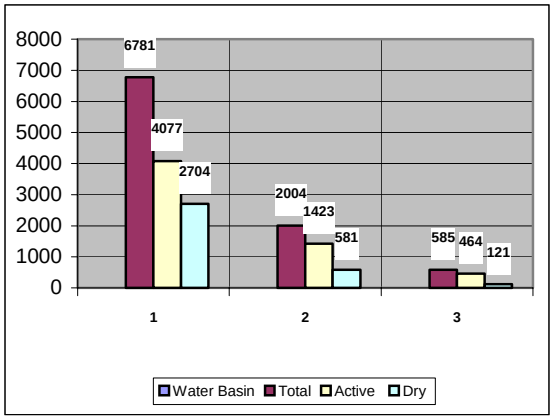
Table 4. Discharge in *Kanats* in 2002-2003 and percentage of decline in discharge and in command area.

River basins	No of surveyed *Kanats*	Discharge in (m^3/s)	% reduction of discharge	Command Area in (ha)	% reduction in command area
River basin I- Kabul	4,669	30.0	90%	31,226	88%
River basin II- Hel.	4,116	21.0	88%	26,322	85%
River basins III- West.	585	5.0	80%	5,380	78%
Total all basins*	9,370	56.0	89%	62,927	87%

Note:

* The *Kanats/Karezes* are only found in three above mentioned river basins

Chart 5. Number of Active and dry *Kanats*

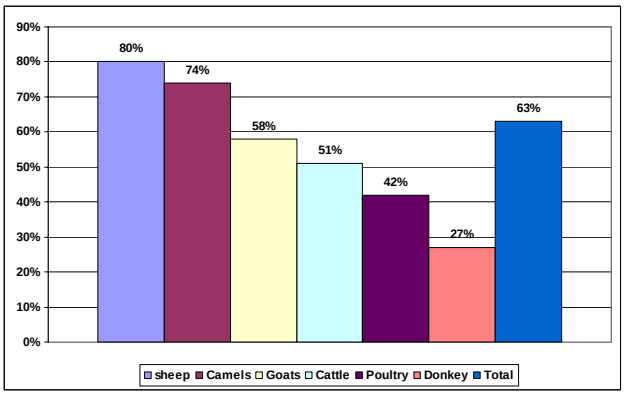


In a same manner, the result of a survey on the functionality of *Kanats* in Afghanistan shown in the above table reveals that from a total number of 9370 *Kanats* in Afghanistan, a number of 3400 (36%) are dried. Nevertheless, the lack of supervision and maintenance must also be considered for the non-functionality of these *Kanats*. It is worthy to mention that recently some displacements of the local population has taken place because of drying up of these *Kanats* ; as they are usually the source of drinking water of villagers. Chart 5 shows the number of dried and active *Kanats* in 2002-3 in Afghanistan.

4.4 Decreases in Availability of Water for Livestock Consumption and in Number of Livestock

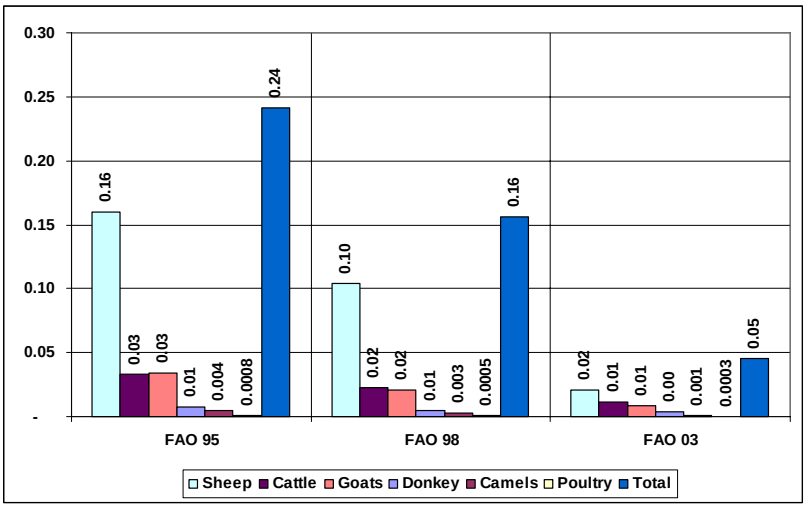
Livestock play important role in providing foodstuff for Afghan people. Pastoral land is the main source of feeding for some of the livestock. This land covers about 45% of total area of the country. The total number of livestock declined in 1980s. Although this recovered to the pre-war level in the 1990, the current drought imposed negative impact on the number of livestock, mainly because of shrinkage of pastoral land and shortage of consumption water to them. Comparing the results of studies conducted on this regard in 2003 (FAO, 2003b) and a census made in 1995 show a reduction of 80% in the number of sheep and 70% in the number of camel. In Afghanistan, mainly sheep and camels are grazing in the pastoral lands. The overall reduction in the number of livestock from 1995 to 2003 is estimated 63%. Chart 6 presents the percentage of reduction in the number of different types of livestock in 2002 compared with the number of same livestock in 1995.

Chart 6. Percentage of Decline of Number of Livestock in 2002 Compared with 1995



The impact of water shortage for livestock during the drought period can be examined by estimation of water consumption for different species for years 1995, 1998 and 2003. The data shows the decrease of fodder and the consumption water for livestock in recent years. The result is shown in chart 7.

Chart 7. Decline in the amount of water consumption in (bcm) by livestock in different years



5. Conclusions and Recommendations

1. National water security for national food security: For fulfilling the timely demands of agricultural and other water consumers, construction of small and medium size storage reservoirs, and completion of all reservoirs under construction in the country including rehabilitation of existing schemes in all regions is highly necessary,
2. Watershed management is highly essential for appropriate water utilization and enhancement of agricultural production,
3. Drought assessment, preparedness and mitigation planning plays important role for securely living environment of the ecosystem,
4. Improvement of the on-farm and out-farm water management through rehabilitation and modernization of existing irrigation schemes is highly essential for a friendly water source utilization and achieving maximum efficiency,
5. Introducing appropriate and simple water conservation technologies along with a capacity building of the farmers are critically needed for efficient water utilization,
6. Introducing new rainwater harvesting techniques to harvest water for drinking and irrigation usage and ground water recharge should be enhanced in all river basins; considering the existing traditional water harvesting techniques,
7. Awareness of the communities/farmers about efficient use of water and the inverse affects of over/improper usage of surface and groundwater resources through country wide extension service.

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