

Supplementary Materials

The supplementary materials included in the paper intitled “Assessment of Water Resources Under Climate Change in Western Hindukush Region: A Case Study of the Upper Kabul River Basin” as followings.

Land use type

The land use map of UKRB includes thirteen major classes which includes intensively agricultural, rainfed area, fruit trees, vineyard, barren land and sand cover, forest close and needle leaved areas, rangeland, marshland, urban area, irrigated agricultural land (marginal irrigation), forest with undifferentiated areas, shrubs with degenerated forests, and water bodies. The area for each land use type is shown in Table S1.

Table S1. shows the land cover classification area in the UKRB in Afghanistan

No	Land cover Types	Area (Km2)	Area (%)
1	Intensively cultivated (1 or 2 crop/yr)	1552.0	6.0
2	Rainfed Ag. land	521.5	2.0
3	Fruit trees	259.1	1.0
4	Vineyard	189.7	0.72
5	Barren/sand cover	2050.9	7.9
6	Forest close and open needle leaved	160.5	0.6
7	Rangeland	19534.2	75.0
8	Marshland	78.1	0.3
9	Urban areas	445.8	1.7
10	Irrigated Ag. land (marginal irrigation)	638.8	2.5
11	Forest undifferentiated	10.8	0.01
12	Shrubs/degenerated forest	72.4	0.3
13	Water/snow	529.0	2.0
	Total	26,043	100

Soil type

Soil data type obtained from FAO/UNESCO website (FAO-UNESCO, 1971). The digitized soil map of the world at 1:5,000,000 scale was in the geographic projection and converted to UTM projections (WGS1984, UTM Zone 42N) using the raster projection in Arc-map before using in SWAT. Table S2 shows the soil classification type, texture, the area, and the soil hydrology group (SHG) in the UKRB.

Table S2. Shows area of soil classifications in the UKRB.

No	Soil Type	Area Km2	Area (%)	Texture	SHG
1	Lithosols- Cambisols-Rankers	9484.7	36.4	Loam	C
2	Lithosols- Xerosols	12271.0	47.1	Loam	D
3	Calcaric Flurisol	4005.7	15.4	Loam	D
4	Glaciers	281.5	1.1	UWD	D
	Total	26,043	100	-	-

Meteorological stations location

Table S3. Show the stations name, elevation and data availability in the study area (UKRB). NAWARA is the abbreviation form the National Water Affairs Regulation Authority, and MAIL is the abbreviation for Ministry of Agriculture, Irrigation and Livestock in the table.

No	Name	Latitude	Longitude	Elevation (m)	Owner	Precipitation	Temperature
1	Bagh-i-Lala	35.15	69.22	1698	NAWARA	Yes	Yes
2	Bagh-i-Omomi	35.15	69.29	1587	NAWARA	Yes	Yes
3	Doabi	35.35	69.62	2059	NAWARA	Yes	Yes
4	Keraman	35.28	69.66	2232	NAWARA	Yes	Yes
5	Khawak	35.56	69.89	2405	NAWARA	Yes	Yes
6	Naghlu	34.64	69.72	998	NAWARA	Yes	Yes
7	Omarz	35.38	69.64	2042	NAWARA	Yes	Yes
8	Pul-i-Ashawa	35.09	69.14	1624	NAWARA	Yes	Yes
9	Pul-i-Surkh	34.37	68.77	2216	NAWARA	Yes	Yes
10	Payin-i-Qargha	34.55	69.04	1970	NAWARA	Yes	Yes
11	Qala-i-Malik	34.58	68.97	2211	NAWARA	Yes	Yes
12	Tang-i-Gulbahar	35.16	69.29	1625	NAWARA	Yes	Yes
13	Tang-i-Saidan	34.41	69.1	1870	NAWARA	Yes	No
14	Badam Bagh	34.55	69.118	1803	MAIL	Yes	No
15	Gul Khana	34.506	69.202	1793	MAIL	Yes	No
16	Kapisa Agri	35.026	69.346	1471	MAIL	Yes	No
17	Kohestan	35.088	69.329	1536	MAIL	Yes	No
18	Logar	33.988	69.046	1922	MAIL	Yes	No
19	Dashtak	35.38	69.48	3401	MAIL	Yes	No
20	Charikar	35.043	69.185	1559	MAIL	Yes	No
21	Seya Gerd	34.999	68.858	1848	MAIL	Yes	No

Hydrological stations location

Table S4. Shows the observed flow stations used during calibration and validation periods. With the 1870 m from see level (m.s.l) Tang-i-Saidan is the highest station. While Shukhi station has the lowest elevation of 1374 m.s.l in the UKRB.

No	Stations	Latitude	Longitude	Elevation (m)	Location	Drainage area (Km ²)
1	Tang-i-Saidan	34.40897	69.104411	1870	Maidan river	1642
2	Sang-i-Nawishta	34.41818	69.19113	1813	Logar river	9718
3	Tangi-i-Gharu	34.56988	69.402169	1775	Kabul river	12,810
4	Tang-i-Gulbahar	35.15932	69.288683	1625	Panjshir river	3527
5	Pul-i-Ashawa	35.0888	69.141886	1624	Gorband river	4008
6	Shukhi	34.93616	69.484394	1374	Panjshir river	10840

Data Sources

Table S5. Sources of data used for the present and future simulations of runoff in the UKRB. The data description includes, data type, time period the data used and the provider of the data.

Data Type	Name	Resolution	Period used	Source
Spatial data	DEM	30 m	-	USGS Website, https://earthexplorer.usgs.gov
	Land use	30 m	-	FAO/MAIL, https://www.fao.org/publications/card/en/c/21ba617f-cbaa-498f-a8cd-0ec49daea6ab/
	Soil type	1:5000,000, or 50 km	-	Harmonized world soil database v1.2 FAO SOILS PORTAL Food and Agriculture Organization of the United Nations
Meteorological data	Precipitation, temperature	Daily	2009-2019	NAWARA, MAIL
Hydrological data	Discharge	Monthly	2010-2018	NAWARA
Historical and Future Data				
APHRODITE data	Precipitation, temperature	0.25°	1986-2005	https://www.chikyu.ac.jp/precip/english/products.html
RCMs output	Precipitation, temperature	0.44°	2030-2049	
(RCP4.5 & RCP8.5)			2080-2099	https://esgf-data.dkrz.de/search/cmip5-dkrz/

The future precipitation and temperature data from four RCM/GCM outputs used in this study includes:

1. RCA4/CanESM2, from the Swedish Meteorological and Hydrological Institute (SMHI) in Sweden
2. RCA4/Miroc5, from the Swedish Meteorological and Hydrological Institute (SMHI) in Sweden
3. RegCM4-4/NOAA-GFDL-ESM2M, from the Indian Institute of Tropical Meteorology (IITM) in India
4. REMO2009/MPI-ESM-LR, from the Max Planck Institute for Meteorology- Climate Service Center (MPI-CSC) in Germany

Annual water balance diagram

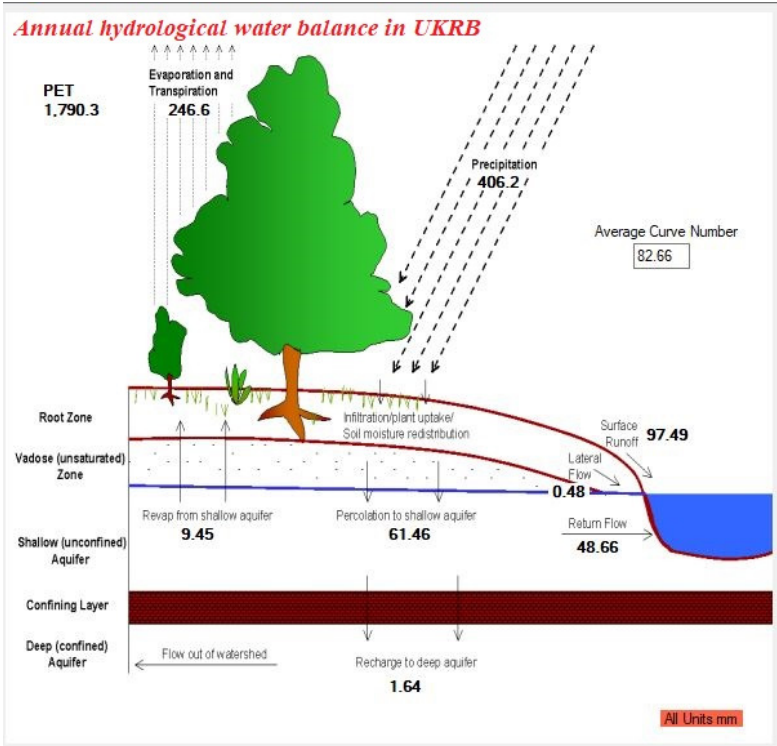


Figure S1. The diagram shows the annual water balance in the upper Kabul river basin (UKRB) under current scenario (2010 to 2019).