Assessment of Climate Change Impact on Water Resources in the Kabul River Basin, Afghanistan

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• Afghanistan total area is 652,000 km\(^2\) KRB is less than 10% of total area.
• Total Population: 33 Millions, around 40% KRB.
• Afghanistan is divided into five river basins. K
• Mainly water resources originated from Snow melt.
• IWRM approach is adopted based on Water law.
Problems statement in Afghanistan

✅ **Challenges** regarding natural resources in Afghanistan

- **Figure .1:** Population increase
- **Figure .2:** Fresh water scarcity
- **Figure .3:** Deforestation
- **Figure .4:** Decreasing snow package
- **Figure .5:** Flash floods in spring
- **Figure .6:** Drought & Desertification
Objectives of the study


2. Climate change scenarios analysis to evaluate the impacts on hydrology components in the Basin till the middle of 21 century

3. Present and future water stress estimation based on population increase under GCM and scenarios
The Indus river system with distribution of glaciers

- The Indus Basin shared by Afghanistan, China, India and Pakistan
- Indus river called Father River in HKH region
- Indus Basin provide water for about 215 million people
- The Indus river has an estimated annual flow of 207 Km³
- Indus river basin divided into three basins, The Kabul basin, Upper Indus and Panjnad
- The Indus basin had a total of 18495 glaciers

<table>
<thead>
<tr>
<th>Kabul River Basin</th>
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</thead>
<tbody>
<tr>
<td></td>
</tr>
<tr>
<td>Parameter</td>
</tr>
<tr>
<td>Number of Glaciers</td>
</tr>
<tr>
<td>Total Glacier Area</td>
</tr>
</tbody>
</table>
Study Area (Kabul River Basin)

- **Catchment Area**: 65202 km²
- **Elevation**: (400-7500m)
- **Climate**: Arid & Semi arid.
- **Annual Precipitation**: 516 mm
- **Potential ET**: 1219 mm
- **Mean Temperature**: 9°C
- **Population**: 13 million in 2015
Precipitation density recorded in the Upper and lower Kuner, whereas high temperature recorded in the Nangurhar area.
Result. 1: Water Balance components

Water resource available (mm/year) = Precipitation - ET ± Total losses.

Annual Water Balance - Kabul River Basin

Finding: The result of water balance analyze in the KRB shown that 50% of annual precipitation losses (evaporate to atmosphere) due to being high average temperature in the basin.
Result. 2: Changes in monthly precipitation regime

- Precipitation change analysis using SWAT Model output

**Finding:** The regime of precipitation is changing and expected to change in the Winter and Spring seasons will result in flash flood. On the other hand, decreasing 41% precipitation in Summer and Autumn will result in serious drought and water deficit in the middle of 21 century.
Result.3: Changes in the pattern of Precipitation

Decreasing snowfall under GCM

Precipitation pattern trend analysis based on GCMs under (A2) scenario

Finding: The result of Global Climate Scenario (GCM) analysis demonstrated that there will a decrease of (40 – 50%) snowfall in 2045 in the KRB.
Result. 4: Temperature trend analysis

• Present and Future climate data analysis

✓ Temperature Trend analysis

Finding: The average annual temperature is increasing by (2.5° - 4°C) and expected to early melting the snow covers and resulted flash flood in the spring season.
Finding: Projection of mean monthly stream flow compared with past (1969 – 1973) at Dakah gauging station, the result of simulation shown that stream flow regime will change and peak runoff will shift from July to May in the middle of the 21st century (2046 – 2064).
Result 6: Comparison of water availability and demand

Monthly sectoral water demand and water availability in the Kabul river basin excluding Kunar river (2008-2012)

Figure 7.6 Monthly sectoral water demand and availability in the basin including Kunar river

Projected monthly sectoral water demand and available water resources excluding Kunar river in the Kabul river basin (2046-2064)

Projected monthly sectoral water demand and available water resources including Kunar river in the Kabul river basin
Result 7: Annual water availability assessment based on A1B scenarios in the Kabul River Basin

Finding: The result GCM demonstrated that annual water availability will decrease dramatically due to increasing mean T& ET
## Result 8: Water stress assessment in the Kabul River Basin

<table>
<thead>
<tr>
<th>Years</th>
<th>Population (million)</th>
<th>Per Capita Water Availability (m³/year)</th>
<th>Falkenmark Index</th>
</tr>
</thead>
<tbody>
<tr>
<td>1961 - 2000</td>
<td>4.1</td>
<td>4612</td>
<td>No Stress</td>
</tr>
<tr>
<td>2008 - 2012</td>
<td>12</td>
<td>1268</td>
<td>Stress</td>
</tr>
<tr>
<td>2046 - 2064</td>
<td>22</td>
<td>667</td>
<td>Scarcity</td>
</tr>
</tbody>
</table>

**Finding**: by increase of population and average annual temperature, expected **serious water stress** in the basin in 2046.
Result 9: The Future changes in hydrological components using SWAT Model

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<tr>
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<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Precipitation (mm)</td>
<td></td>
<td>517</td>
<td>507</td>
<td>1.9 Decreasing</td>
</tr>
<tr>
<td>Temperature (°C)</td>
<td></td>
<td>7.9</td>
<td>10.4</td>
<td>31 Increasing</td>
</tr>
<tr>
<td>PET (mm)</td>
<td></td>
<td>1219</td>
<td>1412</td>
<td>15 Increasing</td>
</tr>
<tr>
<td>Streamflow (mm)</td>
<td></td>
<td>162</td>
<td>148</td>
<td>8.6 Decreasing</td>
</tr>
<tr>
<td>Groundwater (mm)</td>
<td></td>
<td>91</td>
<td>84</td>
<td>7.7 Decreasing</td>
</tr>
</tbody>
</table>
Recommendations

• Dam construction in midstream and upstream of the Kabul river basin to balance monthly water demand for Agriculture, domestic, environment and industry and feed ground water aquifer.

• Expansion of hydro meteorological networks in whole the basin are essential to create accurate and reliable database for future planning, research and development.

• Adaptation and mitigation policy in the framework of IWRM can reduce the risk of water stress and water shortage in the basin.

• Integrated watershed management should be the priority of the government for water resources development.

• Decentralization and distribution of population based on employment can reduce the risk of water stress.
Thank you

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