Climate change impact scenarios in the Aral Sea: sub-regional pathways for adaptation and resilience

Initial results of ESCAP’s Analytical Research on the Aral Sea basin for consultations with key stakeholders
Restoration of Aral Sea holds the key for achieving SDGs in Central Asia

Source: ESCAP SDG Progress 2021
https://data.unescap.org/data-analysis/sdg-progress#
IPCC AR 6, released recently highlights - “The difference between 1.5 and 2 degrees is substantial: every increment of a degree translates into increased risks.”

Introduces climate model “Coupled Model Intercomparison Projects” (CMIP6) that presents new scenarios with greater certainty of the emerging climate risk.

Presents the shared socio-economic pathways (SSP) at different levels of mitigation actions.

Source: ESCAP based on IPCC 6th Assessment Report
ESCAP Climate change study of Aral Sea: Analytical framework

Spatial data
Science ecosystems

Open-source analytical tools

Process Ecosystem

WorldPop
Spatial demographic data

Earth observation
NASA GFSAD 1. cropland 2. Crop types
Digital elevation model
ASTER GDEM, 2018
ASTER Global Water Body Dataset (ASTWBD), 2018.

Climate projection model
CMIP6, 2021

Aridity
CGIAR, 2019

Analysis
MS Excel

3D modeling
ArcGIS Pro

Spatial analysis
ArcMap and QGIS

Analysis and modeling

WB Climate Change Knowledge Portal

IPCC Shared Socio-economic Pathways
2 (moderate) and 3 (rocky):
Adaptation and mitigation
West Central Asia and East Central Asia: Observed increase in hot extremes and high confidence in human contribution to the observed changes (IPCC, AR6 – Summary for policymakers, 2021)

The evidence is mostly drawn from changes in metrics based on daily maximum temperatures; in addition, regional studies using other indices (heatwave duration, frequency and intensity) are used.

#1 Result: Projected increase of annual mean temperature (°C)

- SSP2 – RCP 4.5 (moderate), 2021-2040 (near-term), 2081-2100 (long-term)
- SSP3 – RCP 7.0 (worst-case), 2021-2040 (near-term), 2081-2100 (long-term)

Projected average increase of annual mean temperature under SSP2 near-term to SSP3 long-term is between 1.12 to 4.66°C in Central Asia. The maximum temperature rise between 1.32 to 5.42°C.
West Central Asia and East Central Asia: Observed increase in agricultural and ecological drought, and low due to limited agreement confidence in human contribution to the observed changes (IPCC, AR6 – Summary for policymakers, 2021)

Projected average increase of annual consecutive dry days under SSP2 near-term to SSP3 long-term is between 2 to 4 days in Central Asia. The maximum consecutive dry days increase ranges from 12 to 14 days.

- SSP2 – RCP 4.5 (moderate), 2021-2040 (near-term), 2081-2100 (long-term)
- SSP3 – RCP 7.0 (worst-case), 2021-2040 (near-term), 2081-2100 (long-term)
West Central Asia and East Central Asia: Observed increase in agricultural and ecological drought, and low due to limited agreement confidence in human contribution to the observed changes (IPCC, AR6 – Summary for policymakers, 2021)

- SSP2 – RCP 4.5 (moderate), 2021-2040 (near-term), 2081-2100 (long-term)
- SSP3 – RCP 7.0 (worst-case), 2021-2040 (near-term), 2081-2100 (long-term)
West Central Asia and East Central Asia: Observed increases in heavy precipitation and low confidence—due to limited agreement in human contribution to the observed changes (IPCC, AR6 – Summary for policymakers, 2021)

“The evidence is mostly drawn from changes in indices based on one-day or five-day precipitation amounts using global and regional studies.”

Observed increases in annual precipitation between 1.3 mm and 4.8 mm per decade during 1960–2013 over the elevated part of Central Asia (very high confidence), along with an increase of the frequency and intensity of extreme precipitation” (IPCC, AR6 – Technical Summary, page 92, 2021)
Rainfed agriculture land includes:

- Rainfed: Wheat, Rice, Soybeans, Sugarcane, Corn, Cassava
- Rainfed: Wheat, Barley
- Rainfed Corn, Soybeans
- Rainfed Mixed Crops: Wheat, Corn, Rice, Barley, Soybeans.


"In rain-fed agriculture in semi-arid and arid regions, water is the most limiting factor. It needs additional sources of water in case of lack of rainfall." Irrigation systems can help to solve the problem. However, the sources of water are very limited (FAO, 2016).

Globally, dryland agriculture is dominated by small-scale and resource poor farmers. (FAO, 2020)


Notes: 1. Cascading Hazard Risk is obtained from multi-indicator for climate, by irrigated agriculture and slope under SSP2 and SSP3, 2021-2041 and 2081-2100.
   2. The multi-indicator for climate consist of a) Percent increase of temperature, b) Percent decrease of precipitation, and c) Percent increase of maximum number of annual consecutive dry days.
   3. The Aridity index for arid and semi-arid regions are all values less than 0.5. The classification is based on generalized climate classification scheme for Aridity index values (UNEP 1997).
   4. Dry day is defined as day with mean temperature less than 1 mm.
   5. Rainfed crops include barley, corn, cassava, rice, soybeans, sugarcane, wheat.

Disclaimer: The boundaries and names shown and the designations used on this map do not imply official endorsement or acceptance by the United Nations.
Hotspots of Rainfed agriculture exposure to drought

Indicators: decrease of rainfall, increasing number of dry days and temperature, aridity and slope

Irrigated agriculture land includes:

- Irrigated Wheat and Rice
- Irrigated mixed crops: Wheat, Rice, Barley, Soybeans

Water Bodies:
- Inland intermittent
- Inland perennial
- Ocean or Sea
- Irrigated area
- Irrigated area
- Dry salt flat


Notes:
1. Cascading Hazard Risk is obtained from multi-indicator for climate, by Irrigated agriculture and Slope under SSP2 and SSP3, 2001-2041 and 2081-2100.
2. The multi indicator for climate consist of a) Percent increase of temperature, b) Percent decrease of precipitation, and c) Percent increase of maximum number of annual consecutive dry days.
3. The Aridity Index for and semi-and semi-arid regions are all values less than 0.5. The classification is based on generalized climate classification scheme for Aridity Index values (UNEP 1997).
4. Dry day is defined as day with mean temperature less than 1 mm.
5. Irrigated crops include barley, rice, soybean and wheat.

Disclaimer: The boundaries and names shown and the designations used on this map do not imply official endorsement or acceptance by the United Nations.
3D visualization of Hotspots of rainfed agriculture exposure to drought

Indicators: decrease of rainfall, increasing number of dry days and temperature, aridity and slope

SSP2 (moderate scenario) Near-term (2021-2040)

Rainfed agriculture area comprises 70 - 82% of the total agriculture land in Central Asia (calculation based on NASA GFSAD1KCD v001 2017 and FAO State of Food and Agriculture 2020)
EXISTING RISK HOTSPOTS
Kazakhstan: north

INTENSIFYING RISK HOTSPOTS
Uzbekistan: central

INTENSIFYING RISK HOTSPOTS
Turkmenistan: south

INTENSIFYING RISK HOTSPOTS
Kazakhstan: south

INTENSIFYING RISK HOTSPOTS
Kyrgyzstan: north & central , & west

INTENSIFYING RISK HOTSPOTS
Tajikistan: south west and north-west

INTENSIFYING RISK HOTSPOTS
Uzbekistan: south east

3D visualization of Hotspots of rainfed agriculture exposure to drought

Indicators: decrease of rainfall, increasing number of dry days and temperature, aridity and slope

SSP3 (worst-case scenario) Long Term (2081-2100)
Key Points

01. The key indicator of climate change in Central Asia is the state of glaciers and snow cover, as well as growing desertification in the region.

02. Floods will be more severe and prolonged, and droughts will be more frequent and lengthier.

03. Adaptation measures must include integration of the climate change scenarios into various long-term plans, programs, etc., both at the national and regional level.

04. Climate change adaptation measures are one of the important areas of regional cooperation among the Aral Sea Basin countries.
Taxonomy of solutions for climate change adaptation and DRR
Sub-regional context of a transboundary hazard – the Aral Sea that represents shared vulnerabilities and risks

Sub-regional solutions
Joint climate change adaptation measures through regional co-operation among the Aral Sea Basin countries

National Adaptation Plan that includes transboundary risks
• National DRR strategies
• Voluntary National Review
• Nationally Determined Contributions

Sectoral (Agriculture, Water, Energy..) to include transboundary risks
<table>
<thead>
<tr>
<th>Improving dryland agriculture crop production</th>
<th>Making new infrastructure resilient</th>
<th>Making water resources management more resilient</th>
<th>Nature based solutions: green infrastructure</th>
<th>Multi-hazard risk assessment and early warning systems</th>
</tr>
</thead>
</table>
| ![2 Zero Hunger](image1.png)  
13 Climate Action  
15 Life on Land | ![9 Industry Innovation and Infrastructure](image2.png)  
11 Sustainable Cities and Communities | ![1 No Poverty](image3.png)  
2 Zero Hunger  
13 Climate Action  
14 Life Below Water  
15 Life on Land | ![14 Life Below Water](image4.png)  
13 Climate Action  
15 Life on Land | ![1 No Poverty](image5.png)  
2 Zero Hunger  
13 Climate Action  
15 Life on Land  
11 Sustainable Cities and Communities  
12 Climate Action  
3 Good Health and Well-being |

5 Adaptation priorities for managing and mitigating in-land water disasters in the Aral Sea that also support simultaneous progress on multiple SDGs.
Aral Sea: Adaptation and resilience pathways

Annualized Average Loss of climate related hazards in NCA is $9.2 billion, adaptation costs $1.8 billion. Every dollar invested to adaptation to climate hazards can get about US$ 5 in return.

Economic losses caused by transboundary floods and mudslides, droughts and frosts, avalanches, hailstorms, strong winds and other dangerous weather events are quite significant and average 0.4 to 1.3 percent of GDP per year in the region.

Capitalize on Central Asia Hydrometeorology Modernization Project (the World Bank, IFAS EC, and the national hydrometeorological services)
Next Step: Towards a sub-regional co-operation mechanism

Managing in-land water disasters in the Aral Sea

1. Focus on knowledge and capacity development
   - Multi-hazard risk assessment and early warning systems
   - Nature-based solutions, dryland agriculture and water resilient infra

2. Toolkit for risk informed planning /investments
   - ESCAP Risk and Resilience Portal – decision support system for managing transboundary hazards - Aral Sea: Support to VNR, NDC, NAP, DRR Strategies

3. Sub-regional partnership platforms
   - NCA SDG Forum, Adaptation platform. Climate outlook forums
   - To be discussed???
Outlining a subregional co-operation mechanism

Risk reduction and resilience building for inland water disasters in the Aral Sea basin

- Gaps, entry points
- Existing co-operation mechanisms
- Key stakeholders, Institutional arrangements, partners
- Have a clear value-proposition of the mechanism
- Alignments - SDG, Sendai, adaptation platforms

Start from outstanding issues, Suggest products and services
Thank you for kind attention

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