Introduction to the Water Resources Situation in Central Asia

GEWEX and AUCA International Workshop:

AN EXPLORATION OF CLIMATE SCIENCE IN CENTRAL ASIA - MOVING TOWARDS FRONTIERS OF KNOWLEDGE AND ACTION

Zheenbek Kulenbekov

Associate Professor, PhD.

04-06.10.2021

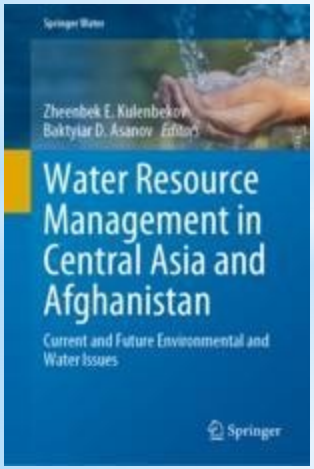
Applied Geology, Environmental Sustainability and Climate Science Department

American University of Central Asia

Impact of climate change on water resources by their effects to hydrological system of Central Asia

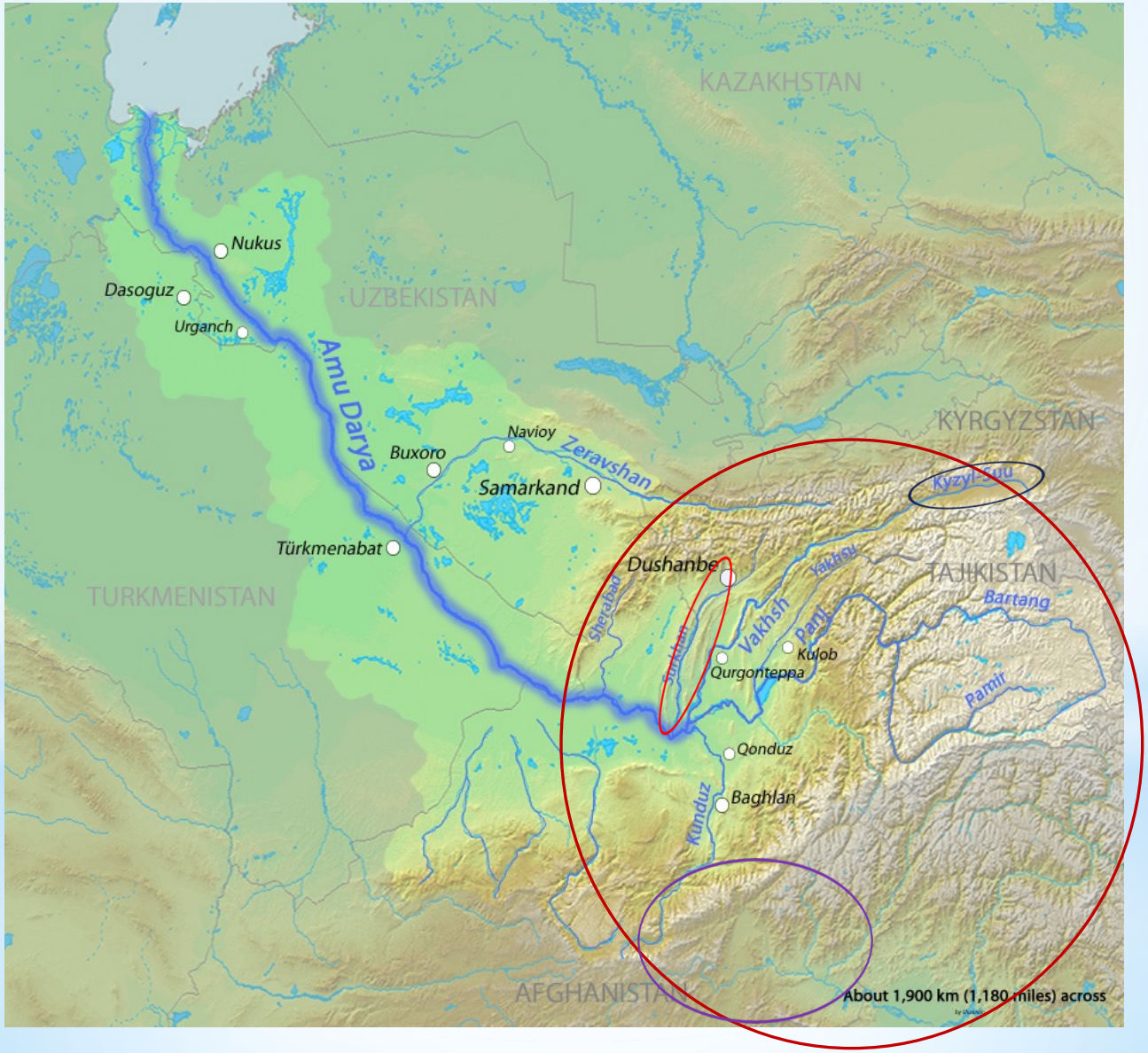
Book: Water Resource Management in Central Asia and Afghanistan Current and Future Environmental and Water Issues

About a book published in Springer Nature-Water, 2021, which aims to deliver an awareness about research project, accepted/financed by PEER NAS/ USAID



The book provides a cross-sectoral, multi-scale assessment of development-directed investigations in the main rivers of wider Central Asia and Afghanistan. The book highlights the development of river systems, water reservoirs, ecosystems and risks as well as the impact of climate change on water resources in Central Asian countries and Afghanistan. It provides information on the genesis of river basins, physical and chemical properties of water in rivers, and the hydrological regimes of the rivers of Central Asia and Afghanistan. The book is useful for scientists and researchers whose work focuses on rivers and the use of water resources, irrigation, ecosystems, risks, water supply, climate change and remote sensing, as well as for students and planners, administrations and other stakeholders in the water sector.

The regional project study area, (Fig.1)



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MINING METALLURGICAL INSTITUTE OF TAJIKISTAN

American University of Central Asia

Kabul University
Ministry of Higher Education
Islamic Republic of Afghanistan

Integrated Water Resources Management (IWRM) and SEA of Kabul and Amu Darya Rivers

The international conference was conducted on 24-26 June, 2019, (**Fig.2**)

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ДОНИШКАДАИ КӮХИ-МЕТАЛЛУРГИИ ТОҶИКИСТОН
ГОРНО-МЕТАЛЛУРГИЧЕСКИЙ ИНСТИТУТ ТАДЖИКИСТАНА

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Published brochures (**Fig.3**)

Basic problems

1. **Climate change in Central Asia**
2. **The approach to the assessment of climate changes impact on the rivers runoff on the base of climatic scenarios: problems and solutions**
3. **Climate change impact on water resources of Aral See Basin**
3. **The water resources monitoring**

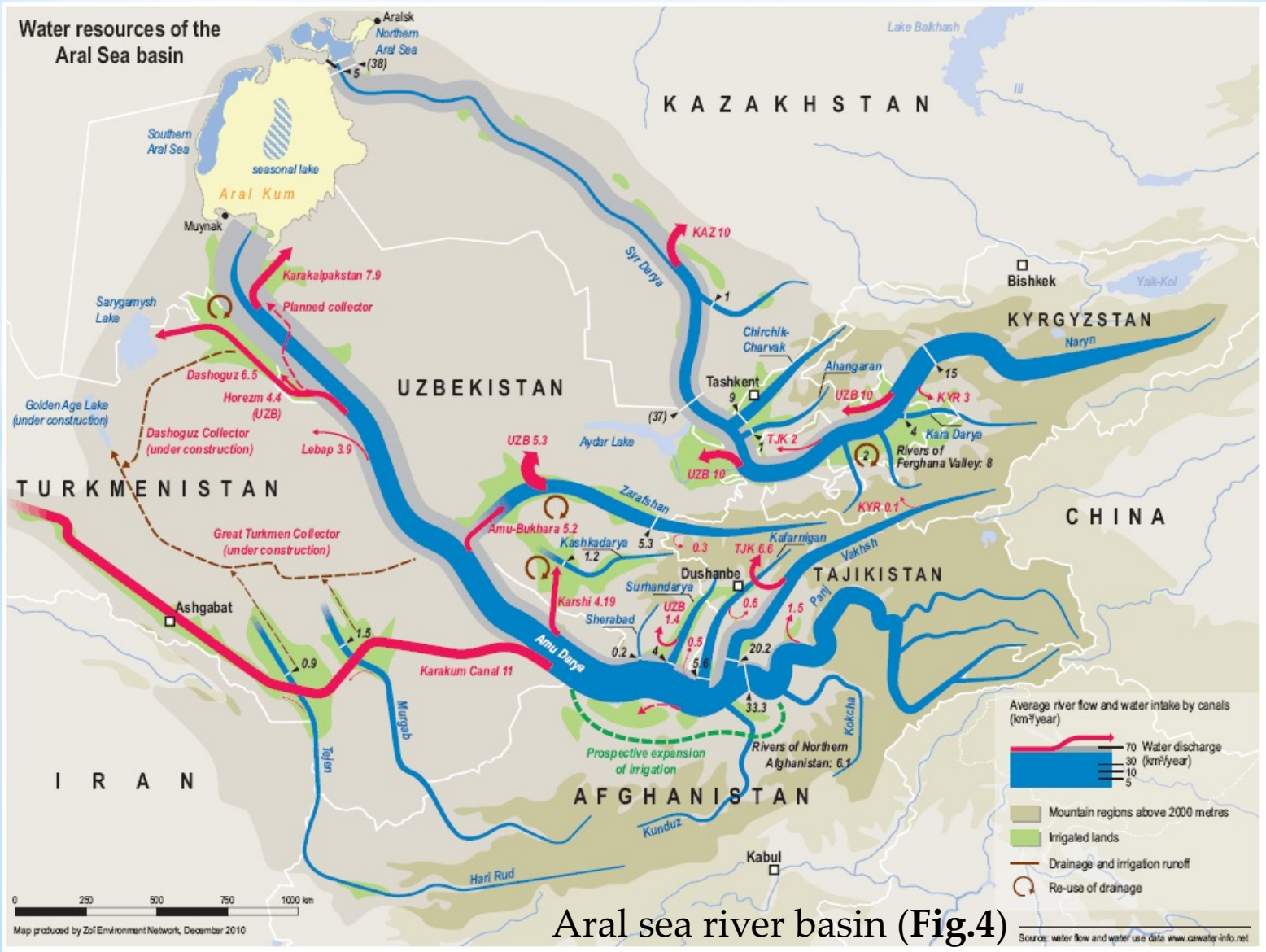
Impact of climate change on water resources by their effects to hydrological system of Central Asia

Modern global climate change has naturally inertial and anthropogenic - determined components since the accuracy of the models of global atmospheric circulation is insufficient, and also the uncertainty of long-term forecasts is still very high.

At present, it is only with a certain degree of probability that it can be argued that the anthropogenic component of warming prevails. Over the past 40 years, climate change has shifted from the topic of scientific discussions to a real problem requiring practical implementations in the modern period. This means forecasts for the future and the development of measures to adapt to changing the environmental conditions.

In Central Asia, climate change will affect river water availability, many of which, both large and small, are transboundary. The snow and ice resources concentrated in them are released during the warm seasons. Their role has increased, particularly in years with insufficient moisture, and in dry years' glaciers become the only sources of nutrition for rivers, and thereby providing water resources to the lower valleys and plains.

Impact of climate change on water resources by their effects to hydrological system of Central Asia



Aral sea river basin (**Fig.4**)

Assessment of Amu Darya Runoff Changes as a Result of Predicted Climate Change and Reduced Glaciation

Russian water researcher's investigations related to water scarcity issues had an affect on limitation of the Central Asia's neighbor states economies and ecosystem conditions. In this study Amur Darya river basin model demonstrated the reduction of snow reserves and degradation of glaciers because of global warming.

Some conclusions:

- The estimates obtained show a reduction in water resources in the Amu Darya basin.
- Observational data in the Amu Darya river basin and model calculations show a steady decrease in carryover snow reserves and degradation of glaciers.

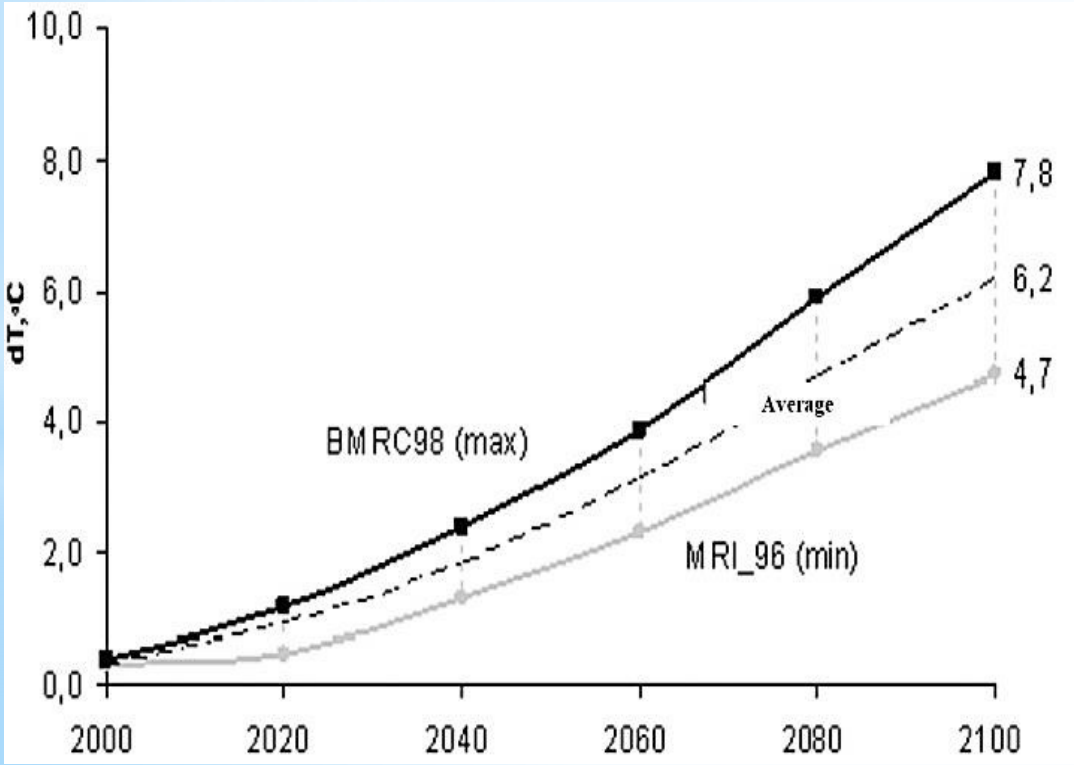
- The task of forecasting changes in the water resources of the Amu Darya River is due to possible climate changes and it is becoming urgent. The value of such estimates will increase every year due to a variety of economic reasons, for example, due to high specific water consumption.

Source: Bolgov M.V

Climate Change Forecast in Kyrgyzstan for 2050 and 2100

Forecast of Air temperature by Climate Scenarios for the Period of 2050 and 2100

Forecasting climate change, climatic scenarios were created using the MAGICC/SCENGEN software package. For each calculation region and two adopted scenarios, the dependence of the temperature change over the years are constructed with the allocation of minimum, maximum, and average model temperature changing. The names of the GCM (Global Climate Models) are given to determine the minimum and maximum temperature changes in 2020, 2050, and 2100.



The results of the calculated the temperature change **A2-ASF** emission scenario is presented in **Fig. 5**.

Source: Chontoev D. T. and Bazhanova L.V.

Climate Change Forecast in Kyrgyzstan for 2050 and 2100

(Chontoev D. T. and Bazhanova L.V.)

Conclusion

- The findings of a trend analysis of average annual temperature and temperature growth rate resulted in the contention that warming will not be so significant compared to what previous forecasts predicted for climatic scenarios.

- Provided that the trend and pace (speed) of warming are maintained during the extrapolation of the trend of average annual temperature to 2050 and 2100, the predicted temperature increase will be on average 1.40°C and 3.60°C, respectively.

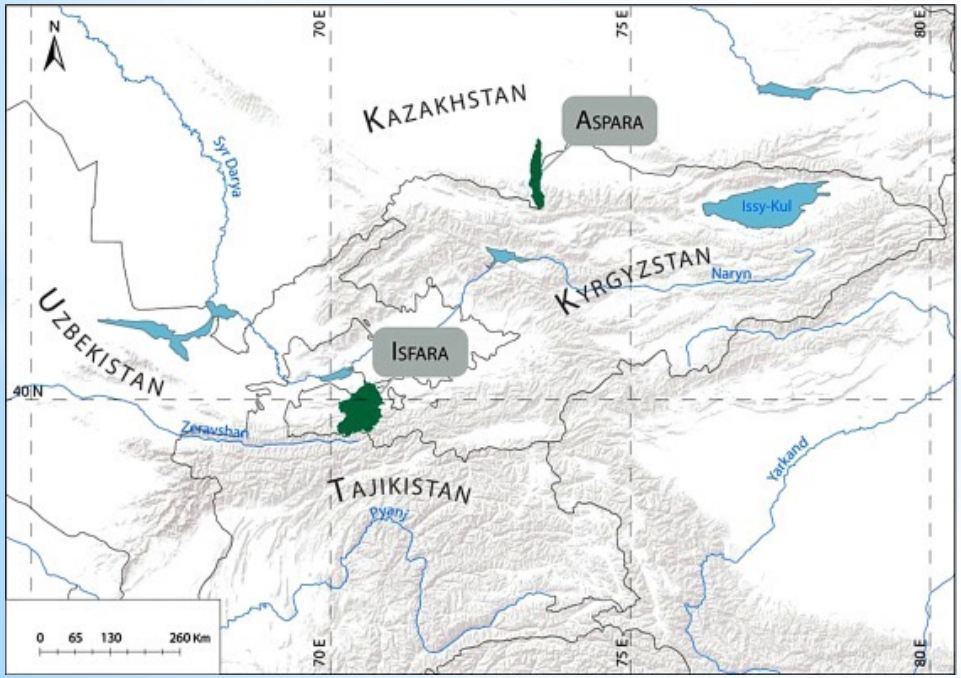
- Climate change is especially significant in regional warming.

- The temperature increase is confirmed by the observational data of all supporting MS of Kyrgyzstan.

- Climate warming affects many ecosystems, whose condition depends on the temperature regime, like rivers, lakes, glaciers, soil moisture, biodiversity, etc.

Reactions and Dynamics of Drains on Small Trans-boundary Rivers with Various Feeding Types and the Effect on Climate Change (

The article presents the calculation results and analyzes the dynamics of water content in the rivers of small transboundary basins which are included in the CAREC project, “WATER, EDUCATION AND SCIENCE”: the northern region - Kurkure-Suu (Talassky) and Aspara (Chui basins); southern region - Isfara, Ak-Suu and Isfana, Padysha-Ata (Syrdarya basin). Based on the results of a trend analysis and the extrapolation for the forecast period 2050 to 2100. The forecast-consultation of the average annual water discharge from these rivers is given.



Study areas, **Fig.6**

Source: Chontoev D. T. and Bazhanova L.V.

Reactions and Dynamics of Drains on Small Trans-boundary Rivers with Various Feeding Types and the Effect on Climate Change (Chontoev D. T. and Bazhanova L.V.)

Analysis of Water, Hydrological Justification and forecast of River for the Period 2050 and 2100

For a trend analysis of the dynamics of river flow against the background of ongoing and predicted climate changes (temperature, precipitation, evaporation), a continuous long series of observations is required. With the Aspara River, the hydrological post of Kyryghydromet operated for 49 years (1927-1975). The selection of a river with a long series of observations (after 1975) to restore the interrupted series of observations did not yield positive results.

Period	Number years	Runoff reduction	Water consumption according to the forecast	Decrease from base Expense
		m^3/s	m^3/s	%
1975-2000	24	0,34	2,94	-10
1975-2050	74	1,04	2,24	-32
1975-2100	124	1,74	1,54	-53

The trend of the average annual water discharge of the Aspara River was created only for the observation period and has a negative trend (**table 1**).

Conclusion

- According to the forecasting results, by 2050 a significant decrease in surface run-off is expected for transboundary rivers of small basins, regardless of the type of feeding.

- The reduction in average annual water consumption for all the rivers under consideration will be phased from 20% to 52%. The reduction will occur due to the reduction of the glacial component of runoff, subject to the partial and complete disappearance of glaciers by 2050 through until 2100.

- Under climate scenarios (2nd UNDP Report on Climate Change in Kyrgyzstan), surface runoff is expected to increase until 2020-2025.

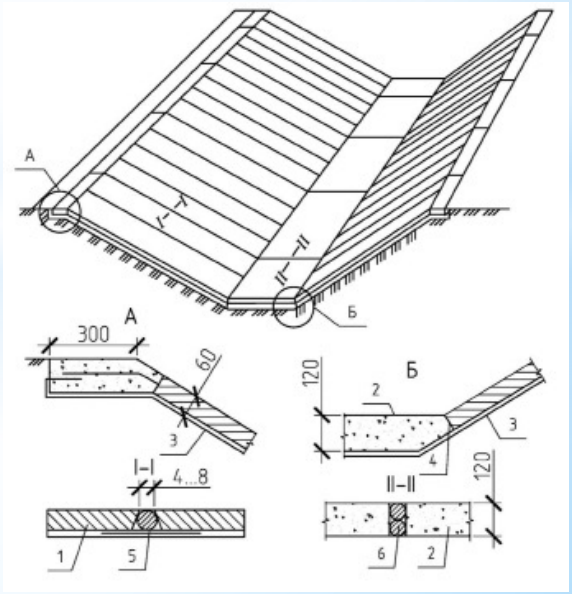
- Due to an increase in the glacial component, by the period between 2050 and 2100, it is expected to decrease to approximately 42.4-20.4 km2, which is 43.6-88.4% of the runoff from 2000 on all rivers of the Kyrgyz Republic. According to the forecast given in the article, the reduction in runoff will not be as significant as previously thought.

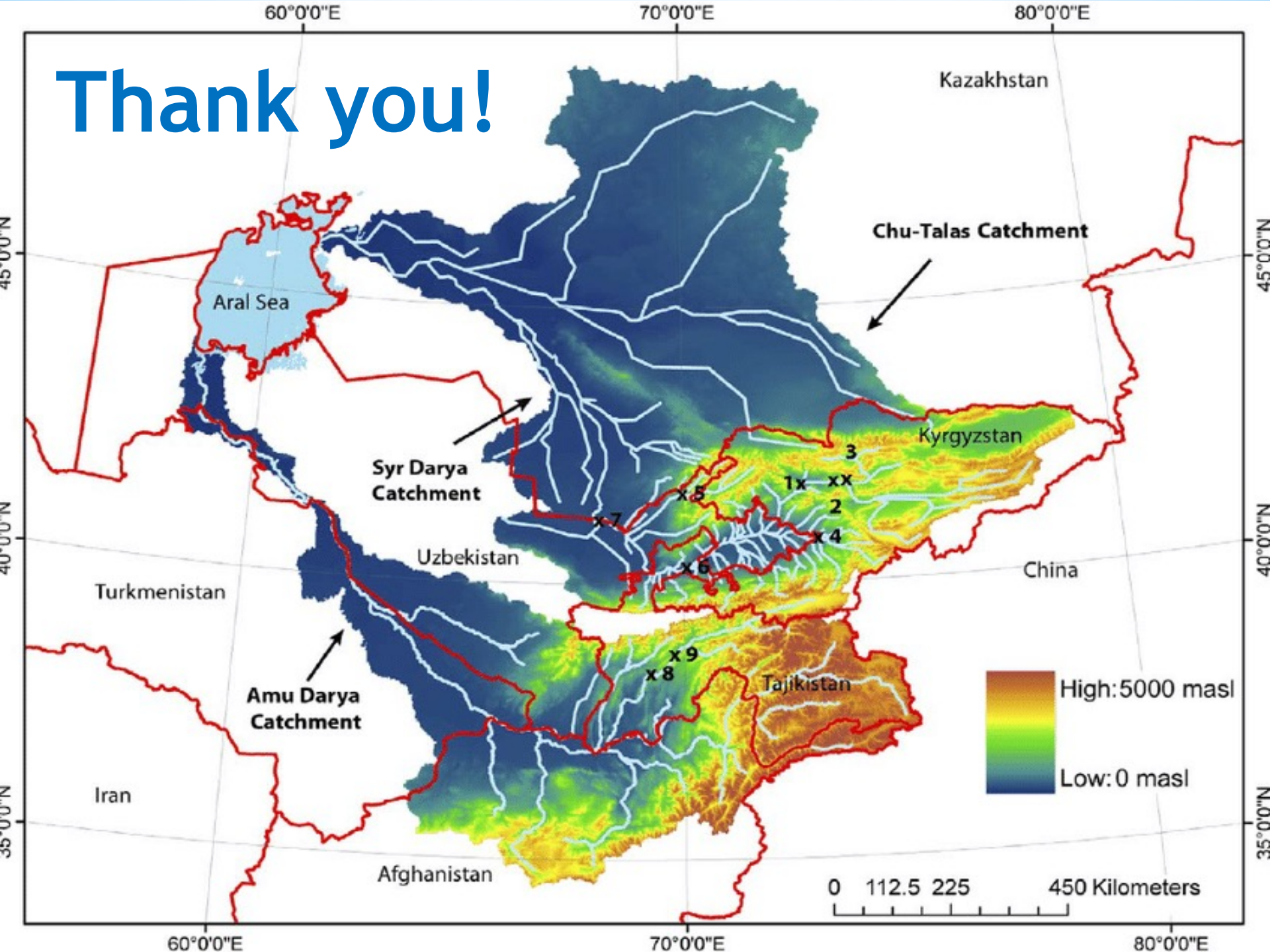
- A reduction of water availability without adopting appropriate adaptation measures can significantly affect the main consumers of transboundary water resources of Kyrgyzstan and neighboring Central Asian states.

Drip irrigation, (Fig.7)

Drip irrigation

Irrigation channels and Melioration

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Kazakhstan
Chu-Talas Catchment
Aral Sea
Syr Darya
Catchment
Kyrgyzstan
Uzbekistan
China
Turkmenistan
Amu Darya
Catchment
Tajikistan
Iran
Afghanistan
High:5000 masl
Low: 0 masl
0 112.5 225 450 Kilometers