



NEXUS Gains:
Realizing Multiple Benefits
Across Water, Energy, Food
and Ecosystems

WEF Nexus Modeling: Applying PyWR in Central Asia

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December 4, 2023

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Central Asia



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Covers five former Soviet Republics;
Total pop – 76 million

2022 GDP

Country	GDP/cap (USD)
Tajikistan	1,050
Kyrgyz Republic	1,600
Uzbekistan	2,250
Turkmenistan	7,300
Kazakhstan	11,200

Upstream

Downstream

Data source:
<https://data.worldbank.org/indicator/NY.GDP.PCAP.CD?locations=UZ-KG-KZ-TM-TJ>

Image source: <https://astanatimes.com/2017/05/central-asian-integration-more-real-than-ever/>

Central Asia (cont'd)

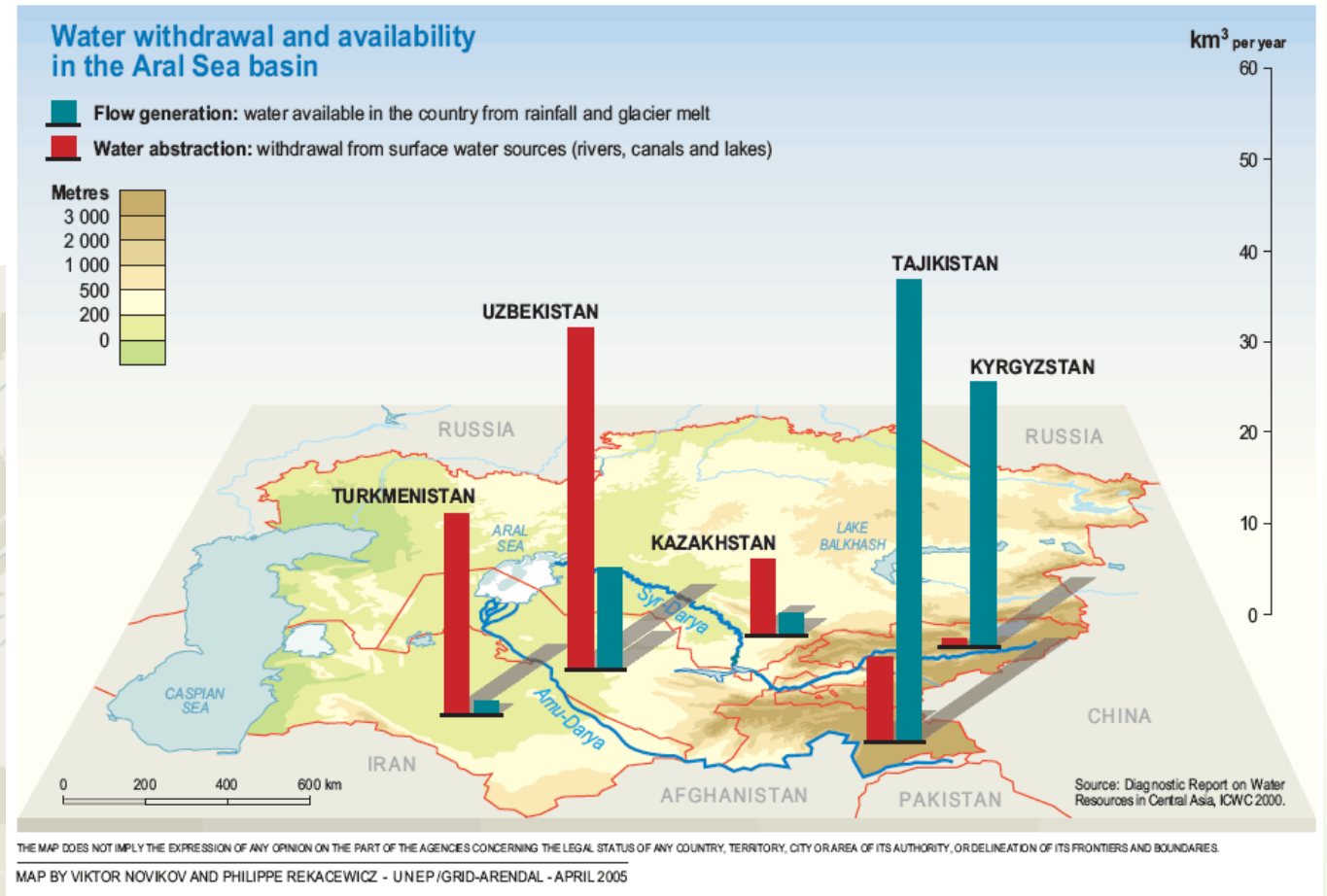


Image source: http://www.cawater-info.net/infographic/index_e.htm



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Central Asia and Pakistan

- Large water consumption by agriculture (WB, 2023):

Ag freshwater withdrawals (% of total freshwater)	2018 value	2019 value	2020 value
Pakistan	94%	94%	94%
Uzbekistan	92%	92%	92%
Turkmenistan	94%	59%	61%

Source: <https://data.worldbank.org/indicator/ER.H2O.FWTL.ZS?locations=UZ-PK-TM>

- Downstream Central Asian countries have a high dependence on external water resources
- Similar water stress levels:

Level of water stress	2020 freshwater withdrawal as proportion of available freshwater resources
Pakistan	116
Uzbekistan	170
Turkmenistan	135



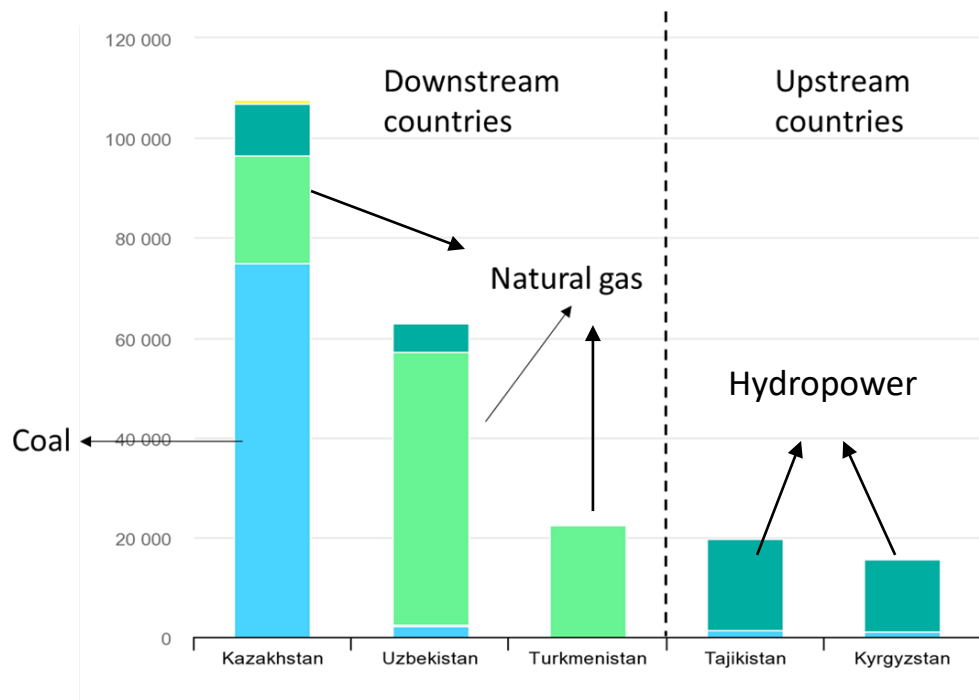
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WEFE Nexus in Central Asia

Upstream countries – mostly energy (fall - winter) and food

Downstream countries – food and environment (spring-summer)

Timing of water demand & operational rules of multipurpose reservoirs



Source: IEA, Electricity generation by fuel in Central Asia, 2018, IEA, Paris <https://www.iea.org/data-and-statistics/charts/electricity-generation-by-fuel-in-central-asia-2018>

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2000

VS

2018

Source: <https://earthobservatory.nasa.gov/world-of-change/AralSea/show-all>



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Emerging WEFE Nexus Challenges in Central Asia

New interventions

- expanding agricultural lands
- construction of new dams
- construction of Qosh Tepa canal by Afghanistan
- weak regional cooperation



Image source: <https://www.washingtonpost.com/world/2023/08/20/afghanistan-taliban-canal-amu-darya/>






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WEFE Nexus modeling in Central Asia



Image source:
<https://ecommons.cornell.edu/bitstream/handle/1813/2997/Fig%201-5%20RBM%20table.jpg?sequence=1&isAllowed=y>



ARTICLE |  Open Access |  

The nexus across water, energy and food (WEF): Learning from research, building on evidence, strengthening practice

B. Holmatov , J. Lautze, S. Uhlenbrook

First published: 21 October 2023 | <https://doi.org/10.1111/1477-8947.12352>

Trends from a global review:

- WEF Nexus modeling is not in short supply
- over ~ 100 studies used Nexus modeling;

Other general observations from the review:

- WEF Nexus is driven by the water sector;
- stakeholders are not sufficiently engaged;
- very few practical outcomes (less than 3% of ~~All~~ reviewed documents)

WEFE Nexus modeling in Central Asia

NEXUS Gains (CGIAR initiative)

Realizing Multiple Benefits Across Water, Energy, Food and Ecosystems (Forests, Biodiversity)

Consists of 5 WPs

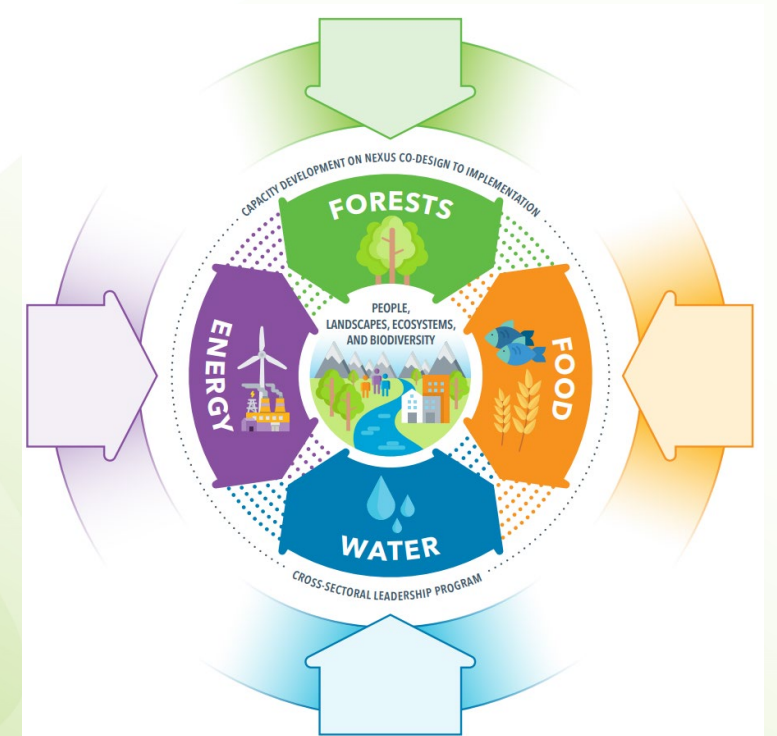
Within WP1: **Modeling Nexus tradeoffs and benefits**. We are using **PyWR** to model multi-scenario simulation to understand impact of interventions in different basin.

PyWR is a model for solving network resource allocation problems at discrete timesteps using a linear programming approach -

<https://www.waterstrategy.org/>

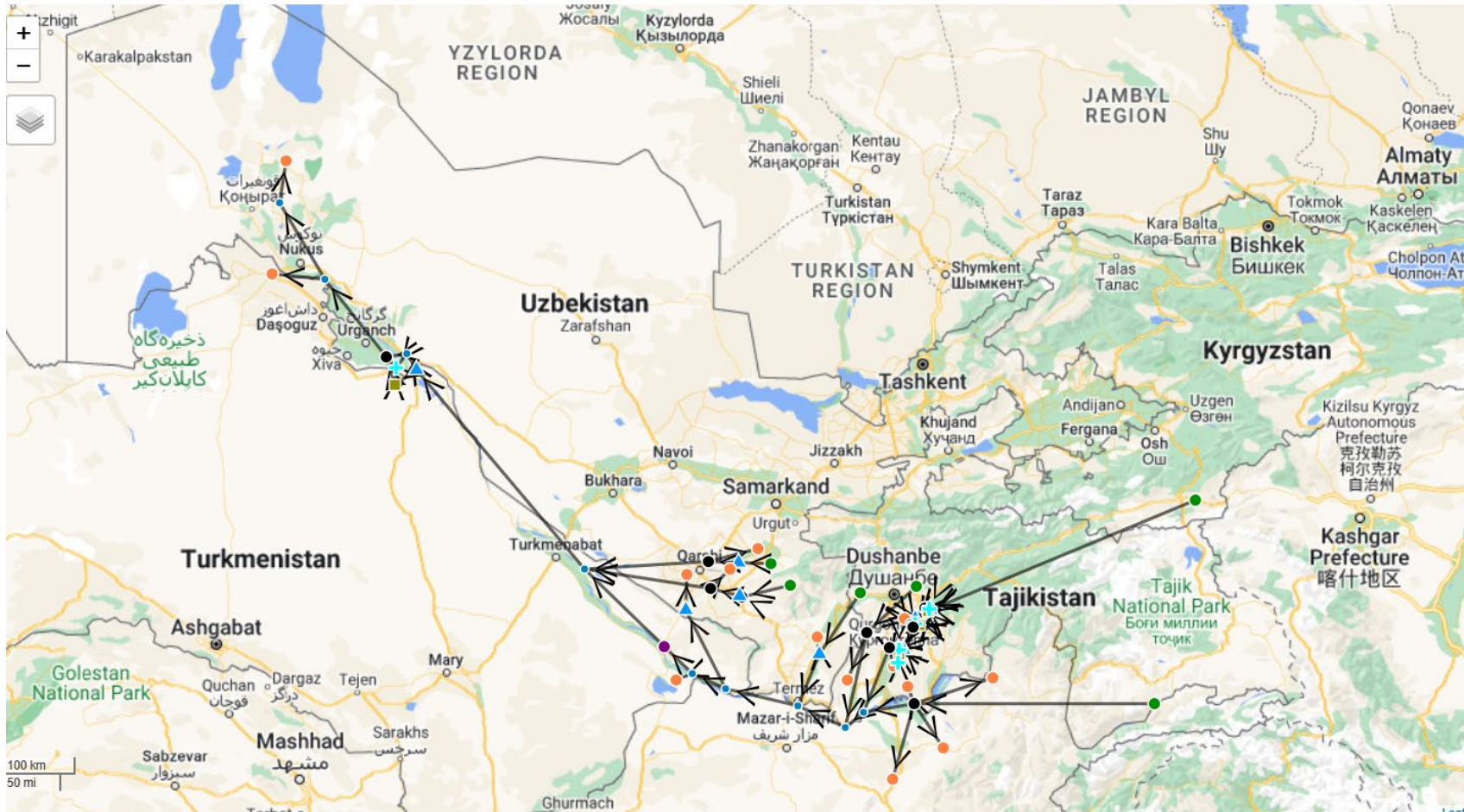
Helps track resource stocks and flows within the system

Pywr - water resources module includes hydropower (separate modules for energy and food)



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WEFE Nexus modeling in Central Asia – Amudarya River basin (work in progress)



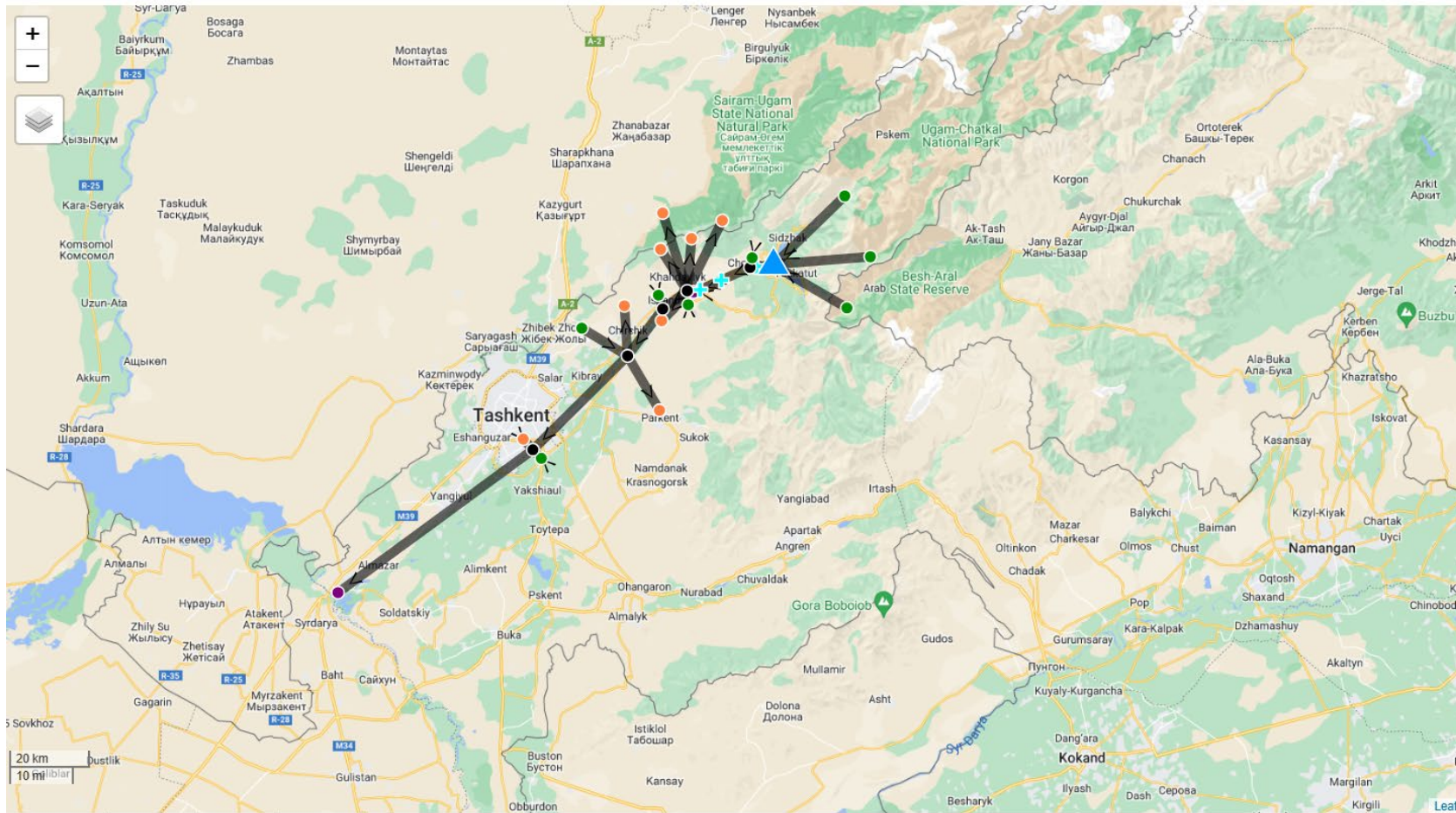
Challenges:

- limited data;
- access to data;
- quality of data;
- stakeholder buy-in and cooperation;



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WEFE Nexus modeling in Central Asia – Chirchik River basin (work in progress)



- small scale & good data availability;
- collaborating with SIC-ICWC (a parity collective body of Central Asian states);
- results can be used to expedite stakeholder buy-in and support for larger scale studies



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Lessons learned

- WEFE Nexus analysis and modeling: learning by doing
- Small scale may be practical to start (systems are human constructs)
- Stakeholder involvement is crucial
- Good quality data is a pre-requisite for meaningful results
- Share experiences/outcomes (social learning)
- Think of who will use the model (Nexus is about technical and also governance)
- Patience



Thank you for your attention!

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