Water Allocation in Trans-boundary Basins

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Economic Analysis to Support Decisions on Water Allocation: the Case of Multi-Purpose Water Infrastructure (MPWI)

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Content

- **GREEN Action Programme Task Force and EUWI+ for EaP countries**
- **OECD Council Recommendation on Water and related instruments**; provisions on managing: Water Quantity and Water Risks and Disasters
- Priority uses, typical trade-offs in the water scarcity situation and policy choice translated into respective water allocation rules
- *ex ante* economic assessment of economic implications to support decision-making on water allocation
- **WHAT-IF computer model** as a tool for the *ex ante* economic assessment

*(using the case of Shardara MPWI in Lower Syr-Darya basin for illustration: note that **multi-purpose means multi-sector and multi-stakeholder**)*

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GREEN Action Programme Task Force and EUWI+

- **GREEN Action Programme Task Force:** created 20+ years ago under the UN-led "*Environment for Europe*" process
- **Water Programme** since late 1990ies; helps EECCA countries improve the economic and financial dimensions of water management, incl. WSS
- **OECD / GREEN Action Programme Task Force and UNECE have been strategic partners of the EU Water Initiative (EUWI) over the past decade**
- **EUWI+ launched a year ago focuses on Eastern Partnership countries: Armenia, Azerbaijan, Belarus, Georgia, Moldova and Ukraine (EaP)**
- **Specificity of the EaP region** certain parts of which face water shortage:

- **many trans-boundary rivers, extensive water infrastructure**, often multi-purpose (hydro-power, irrigation, WSS, water transport etc.)
- **Water allocation** – trans-boundary and between competing uses in a given country – **is a common challenge**; several countries plan to address it in new Water Strategies and requested for assistance from OECD and UNECE

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OECD Council Recommendation on Water

- OECD Council Recommendation on Water (adopted on 13.12.2016) and related instruments: Principles of water governance and the Recommendation on managing critical risks
- Adherents implement water policies that are *(a few highlights):*

- Adjusted to local conditions;
- Based on long term water management plans;
    - **River basin/aquifer/transboundary** framework; **Integrated** Incl. surface and groundwater inter-play)
  - Encourage management of quality and quantity;
  - Consider practices that reflect availability, demand, vulnerability to risks and the **economic, social and environmental consequences**

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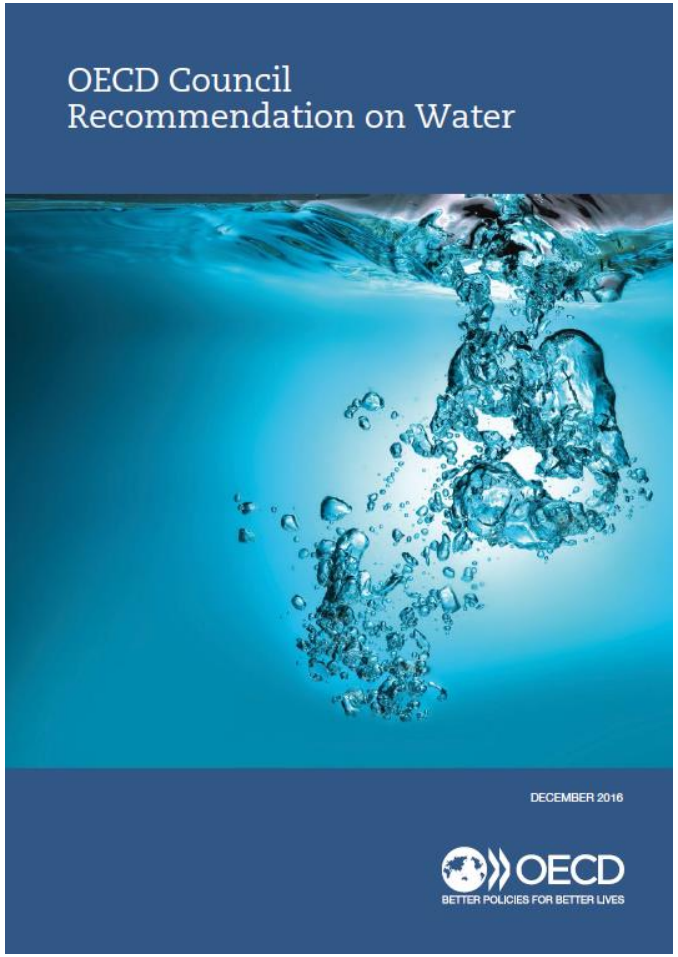
OECD Council Recommendation: Managing Water Quantity



- Manage water quantity at the appropriate scale;
- Reflect on short and long term projections including uncertainties on supply and demand;
- Promotion of water use efficiency
  - Economic instruments; water efficient technologies, alternative water sources
- **Appropriate allocation regimes that reflect wider policy objectives;**
- Collective management approaches;
- Improved knowledge (data & science) of water use to inform decision making.

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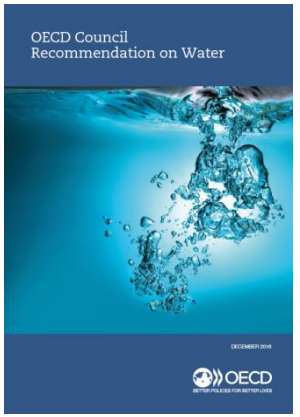
… and Managing Water Risks and Disasters



- **Manage water risks and disasters in a cooperative way**;
- Adopt and regularly review a water risk management policy;
- Invest in risk assessment and awareness;
- Set and regularly revise acceptable levels of water risks that align with societal values;
- Invest in structural and non-structural risk prevention and mitigation measures;
- Invest in emergency response capabilities;
- Develop social policies and financial mechanism to **mitigate losses** and speed up recovery;
- **Improve policy coherence;**
- **Consider specificities to both the agricultural sector and to cities.**

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Priority uses and typical trade-offs

- **Priority uses are often established by national legal regulatory acts. Typically: drinking water supply is top priority** followed by: water for environment (environmental flow), water for cities, for agriculture, for industries. In case of a sever water stress, some industries may be temporary disconnected from supply
- **In Central Asia**, in normal and wet years water is relatively abundant and all demands could be met
- **But**, the volatility of reducing run-off is increasing, while some upstream countries abstract more water than in the past (e.g. China from Ili river; Russia from Ural river). So, in dry and extra-dry years certain basin districts experience water stress resulting in significant economic losses (spectacular recent example: total loss of the harvest of cotton in certain parts of South Kazakhstan in 2016)
- Dry year and forthcoming water shortage could often be predicted; and it is expedient to complement water allocation rules for normal and wet years by special rules for dry and extra-dry years (a kind of emergency allocation rules)

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… typical trade-offs - 2

- **Some key trade-offs**, in case of water scarcity:

- Allocate water for energy in winter times or water for irrigation over vegetation period? Use hydro-electric stations (HES) or thermal power stations as **peak capacity**, especially in winter times?
- to reduce water supply to agriculture and industries at the same rate, or temporary disconnect certain least priority industries and (or) crops (e.g. full supply for production of vegetables but contraction of land planted by water-intensive rice and cotton)

- Policy choice should be made in a transparent way and translated into respective water allocation rules (including special rules for dry and extra-dry years)
- The **rules should be adaptive**, as new irrigation technologies might be introduced and irrigation norms revised; or new water uses may emerge; or broader policy objectives evolve

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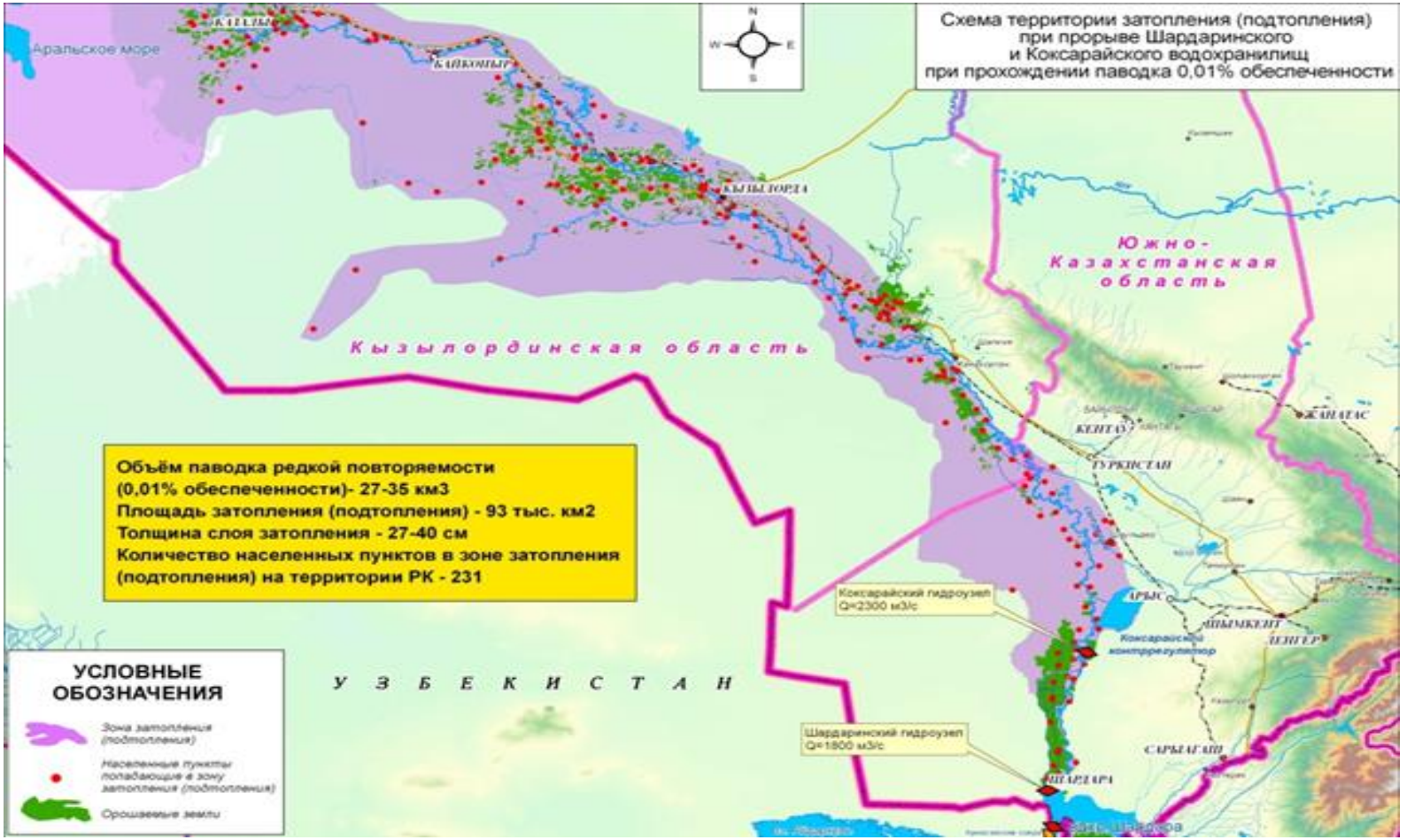
Example of Shardara MPWI: Lower Syr Darya basin up to Northen Aral Sea



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Shardara MPWI: composition and key water uses

- *Shardara* dam and reservoir (5 km3); and *Koksaray* reservoir (3 km3) downstream
- 100 MW Hydro-electric station (HES)
- *Kyzylkum* irrigation canal (see photo) and several others; collector-drainage systems
- Potable water supply (Shardara City)
- Flood protection: emergency discharge into *Arnasay depression* and to *Koksaray*
- *Emerging new uses: commercial fish farming and recreation*

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Ex ante economic analysis can and should inform policy choice

- **Economic, social and environmental implications of each option should be assessed *ex ante*** :

- E.g. using thermal power stations *versus* using HES as **peak capacity**: economic implications of the former option: less demand for water (foremost for cooling) over winter times but much higher unit costs of electricity (hence **higher tariffs** for end-users, **or higher subsidies** and higher levy on public budget)
- **Contraction of irrigated land planted by some crops**: economic losses, and financial losses of many farmers specialising in producing the discriminated crops
- Reducing water supply to all farmers at the same rate: lower yields (for some crops the yield reduction will be disproportionally higher) or shift to less water intensive crops; hence impact on crop supply and prices anyway…
- Ideally, the implications should be discussed with stakeholders through a dialogue, before making the final decision and translating it in respective water allocation rules; with the view of maximising social welfare while keeping social and environmental risks at acceptable level

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Economic implications for key stakeholders

- **Key stakeholders** the economic implications for which should be assessed are :
- riparian countries/ provinces and basin districts (e.g. in Lower Syr Darya basin: Kyzyl Orda oblast specialising in rice production *versus* South Kazakhstan oblast specialising in fruits and vegetables, and cotton production;
- key sectors (agri-food, energy, …)
- main groups of economic agents in each sector (producers, consumers and the state - fiscal implications)
- Typically, there are winners and losers; **compensations for losers** would help mitigate social risks or political resistance and are often used at national level
- However, it requires a **quantitate assessment** of surplus (changes in the surplus) for each country / province / basin district, sector and group of economic agents in each sector, which is a challenging task - **OECD has developed a tool to address it**
- **Trans-boundary dialogue** on this matter is politically very difficult (though positive examples exist), but chances are higher if it is informed by bold verifiable figures

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WHAT-IF Model
for economic assessment of MPWI

- **Purpose:** assess economic implications of various choices to support decision making on water use, use and development of existing multi-purpose water infrastructure in a given river basin (or river segment).
- ***Schematic*** is one of key inputs to the model. The model simulates:
- **Land use and crop choices:** The farmers must decide which crops to plant on which irrigated areas
- **Reservoir management**: Monthly discharges must be decided in order to balance the need for irrigation with the need for thermal & hydro-power
- **Irrigation choices:** how much water to use for each crop in each zone
- **Model's objective function** is maximisation of the social welfare
- WHAT-IF can be used for economic assessment and prioritisation of water uses and policy actions (e.g. capital investments in MPWI development, application of specific water allocation rules, or change in crop mix)

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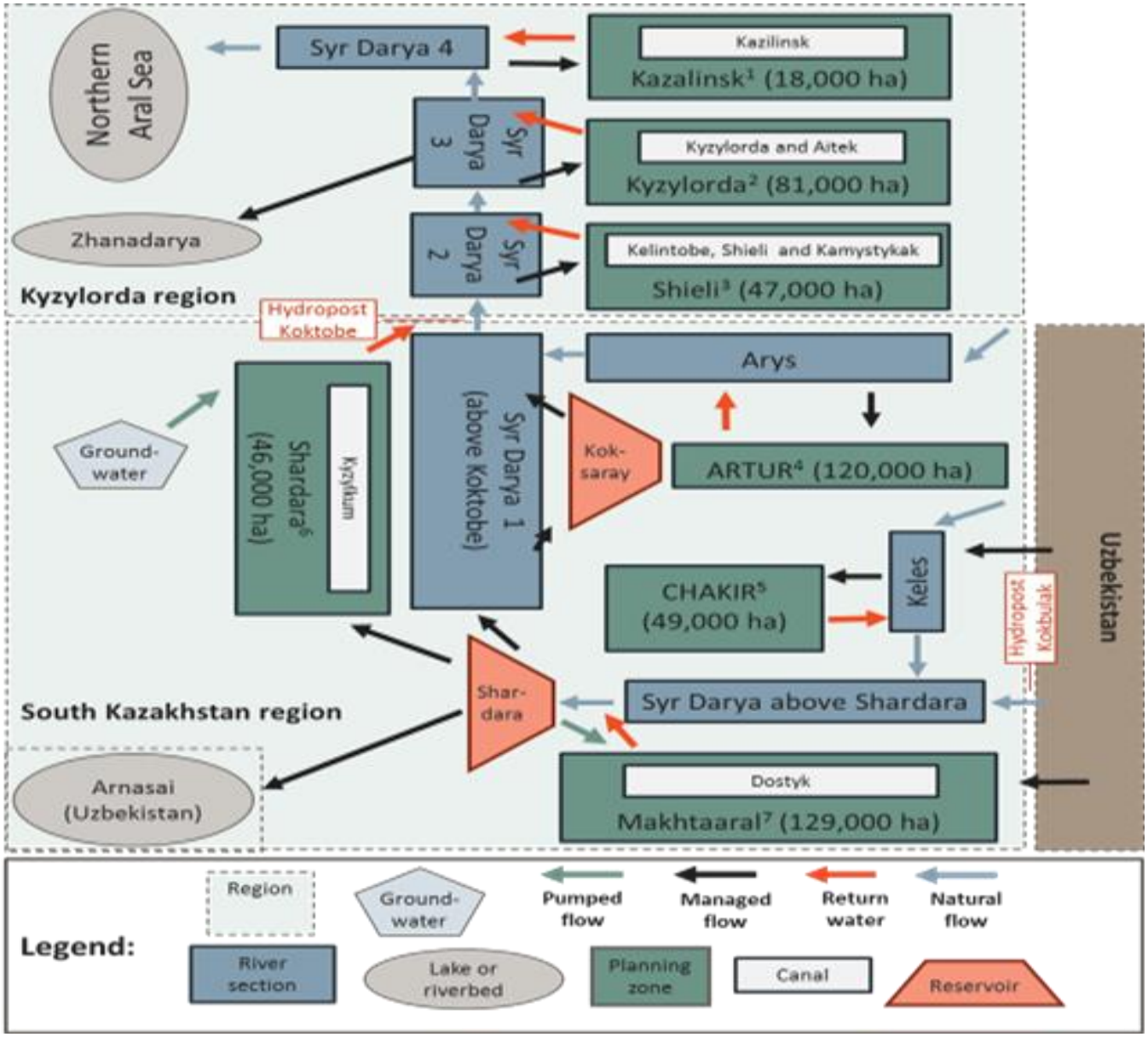
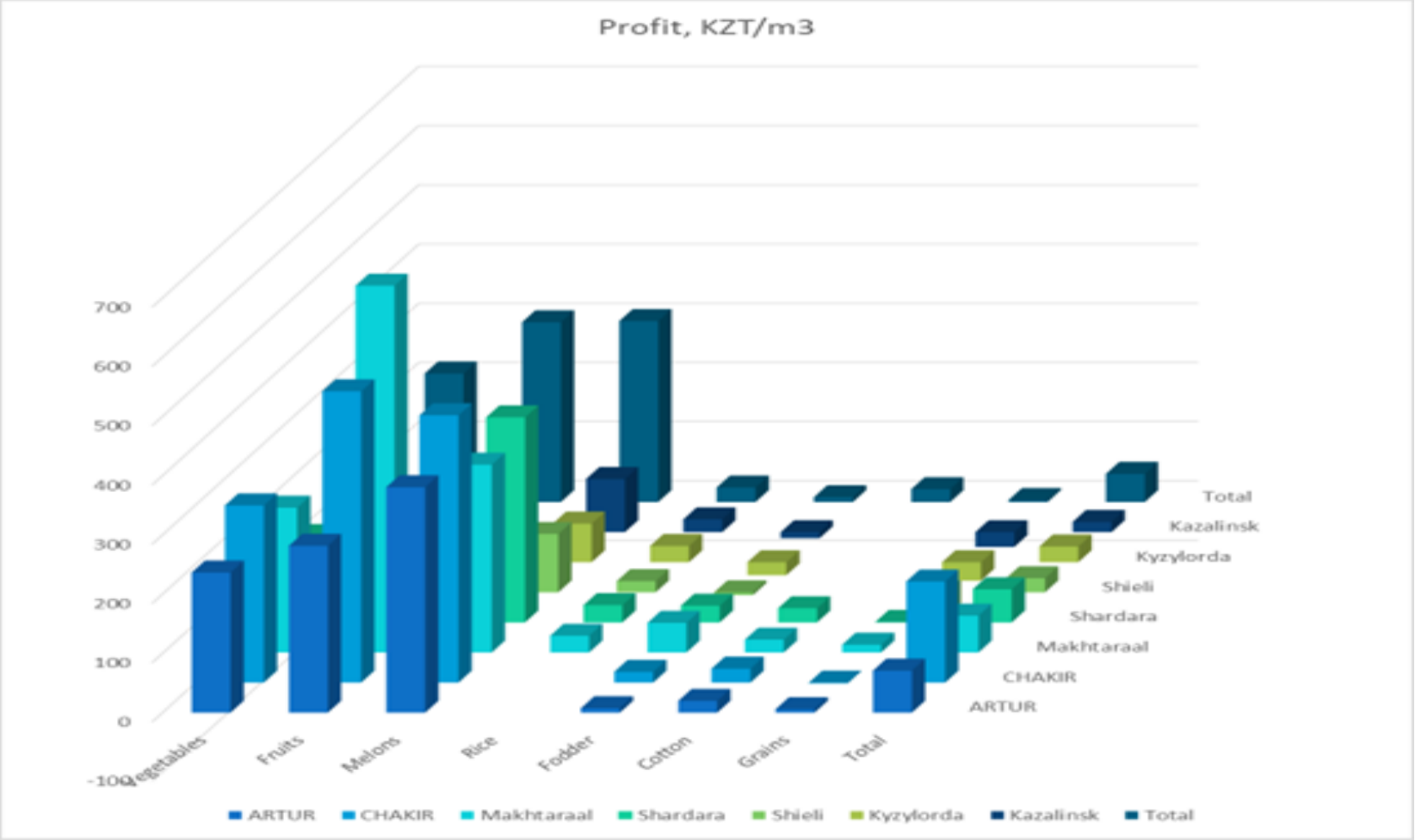
Schematic for Shardara MPWI



Example of output data: Profits by water use (crop) and planning zone in South Kazakhstan



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BaU *versus* alternative policy actions and scenarios

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- "Business as usual" (BaU) assumes application of present allocation rules (or any rules fixed as the baseline option) in wet, normal, dry and super-dry years – for BaU the model calculates the overall economic surplus for the basin in question, as well as for each riparian province (or country), each key sector (agri-food, energy,…) represented in it, and for producers and consumers in each sector, and the state (fiscal implications)
- For alternative allocation rules derived from respective policy choices regarding key trade-offs, the model assesses the change in the economic surplus – again for the whole basin, as well as for each riparian province (or country), each sector, producers and consumers in each sector …
- Comparison of the simulated options helps identify: allocation rules under which the total social welfare will be maximised; winners and losers, and quantify required compensations to get to a win-win-win situation .

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Process technology: In a dialogue with key stakeholders:

- **Collect data and develop schematic**
- **Identify policy choices to be made** (options and scenarios) regarding water allocation in wet, normal, dry and super-dry years
- **Collect data and assess economic implications of each option for:** riparian countries/ provinces and planning zones; key sectors (agri-food, energy); producers and consumers in each sector and the state
- **Select a preferred option (scenario) and translate it into water allocation rules for different years; apply the rules**
- **Revise the rules if and when environment changes substantially** (new uses, new policy priorities, new technologies etc.)
- What is key – **transparence and confidence** in input data, assumptions and science underlining model algorithms: need for bold input data and shared assumptions. In WHAT-IF model this is all transparent and verifiable

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Open Source in the Public Domain

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The WHAT-IF model (programming code) is Open Source in the Public Domain, available for free upon request

Thank you! Благодарю за внимание!

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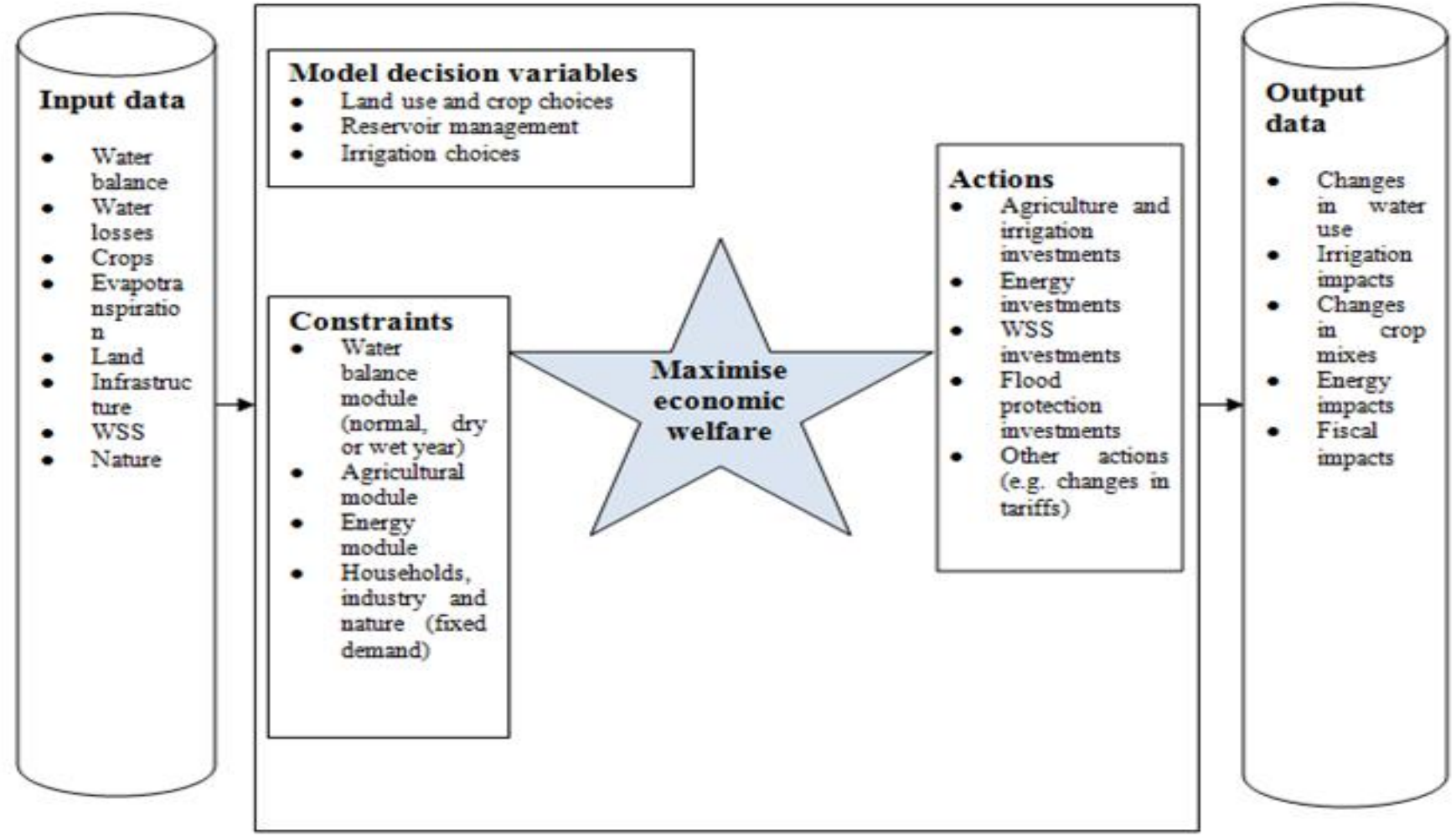
ANNEX: Model structure



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Key Modules

- **Hydrological mass balance module:** Flow of water through rivers and reservoirs respecting flow constraints of the user defined river system.
- **Agricultural module:** Farmers' optimisation of which crops to grow and how much water to apply given constraints on water and land use.
- **Energy module:** Energy production by thermal and hydro power stations, optimisation of the timing of reservoir discharge choice, and the economic value of the energy measured as the costs of the thermal energy production it replaces.
- **Output data module**: incl. estimated economic surplus of producers and consumers in each sector, and the state (fiscal implications)

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