Global programme Policy Advice for Climate-Resilient Economic Development (CRED)

Economics of climate change adaptation in Kazakhstan

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giz Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH

GWS SPECIALISTS IN EMPIRICAL ECONOMIC RESEARCH

On behalf of:
Federal Ministry for the Environment, Nature Conservation and Nuclear Safety
of the Federal Republic of Germany

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CRED's overall aim: managing economic risks of climate change

- „Policy advice for **C**limate **R**esilient **E**conomic **D**evelopment" on behalf of BMU (Federal Ministry for the Environment, Nature Conservation and Nuclear Safety) and GIZ (German Corporation for International Cooperation)
- Beneficiary: Economics/planning ministries in the 3 pilot countries
- Duration: 2019-2022
- Aims
  - Improve capacities on building economic models in the 3 pilot countries with a focus on climate change
  - Quantify economic impacts of climate change (CC) for the macroeconomy and at sectoral level
  - Develop climate-resilient development strategies
  - Strengthen international exchange on these issues

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What are the impacts of climate change in Kazakhstan?

- Climate change (CC) is characterized by **rising temperatures**
  - Increased average annual temperature of 0.28°C every 10 years
  - Rapid glacial melt
- **More extreme weather events** (EWE) such as droughts, storms and floods.

Table 2.2 – Average annual number of EWEs in Kazakhstan in different periods

EWE	Number of EWEs	
	1990-2002	2003-2015
Heavy rain	20,1	49,3
Strong wind	38	45,8
Heavy snow	9,1	24,9
Strong blizzard	42,4	23,5

Source: GEF, UNDP (2016): Extreme weather events of Kazakhstan in the context of global climate change. Astana, 2016.

➢ CC **causes economic costs and affects economic processes**

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What are the impacts of climate change in Kazakhstan?

- Kazakhstan is a leading **wheat producer and exporter**
  - Drought is a major risk for agriculture (i. e. rain-fed crop production in North-Kazakhstan)
- Kazakhstan exports in particular **crude oil** (~50% of total exports)
  - Climate protection measures hamper oil exports
- Other **key sectors** are metal production, construction, trade, real estate, transport
  - Risk of flooding i. e. in South and East-Kazakhstan which destroys infrastructure
- Income and employment generation is concentrated in a few industries (e. g. trade, agriculture)

➢ Wealth of Kazakh economy is highly vulnerable to shocks affecting key industries

➢ "Kazakhstan is very vulnerable to various effects of climate change" Statement by the President of the Republic of Kazakhstan Mr. Tokayev at the General Debate of the 75th session of the UN General Assembly

Flooding, 2015 in Almaty, East Kazakhstan, Karaganda and Akmola oblasts: Caused **US$ 800 million** damage in East Kazakhstan Oblast, **US$ 8-9 billion** damage in Almaty, Karaganda Oblast and about the same amount in Akmola Oblast.

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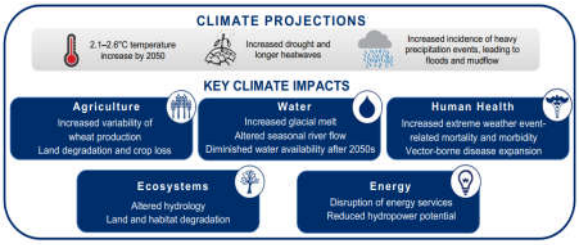
Future climate trends in Kazakhstan

- Climate models indicate that EWE will continue with increased intensity



- Policy makers need to **be aware of what could happen** to the economy ("what if" analysis)
- Policy makers need to **manage adaptation strategies to reduce economic risks** of CC, e. g. building dams, installation of irrigation systems, green roofs

➢ Macro-econometric IO models (and their extensions to **E3** (economy, energy, emissions) **models**) can support policy-makers with these issues

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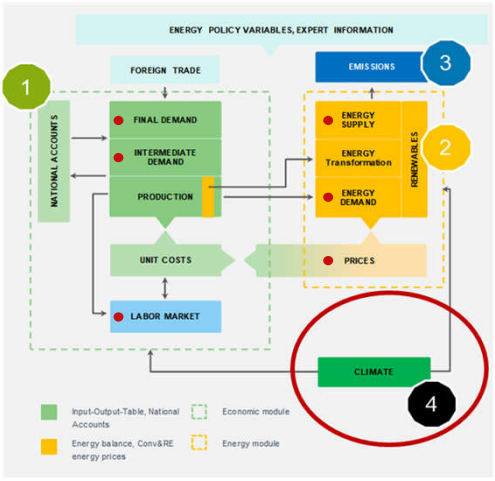
Modeling economic impacts of CC and adaptation with E3.kz

- **E3.kz** is suitable for an **integrated economic analysis**
  - Provides a **consistent picture** of the 3 E's, in particular of the economy and its key industries
  - **Mid- to long-term** perspective (until 2050)
  - **Scenario analysis** is used to explicitly implement sector-specific
    - direct impacts (benefits and damages) from **CC** and
    - **adaptation measures** (their costs and benefits)
    - ➢ Based on pre-existing work

➢ Model results show the **consequences of CC** (e. g. foregone export chances due to yield losses) in **monetary terms**

➢ Model results help to **identify adaptation options** with high effectiveness and positive effects on the economy and the environment (e. g. in terms of CO_2 emissions).

➢ Main issue: inherent complexity impedes model implementation



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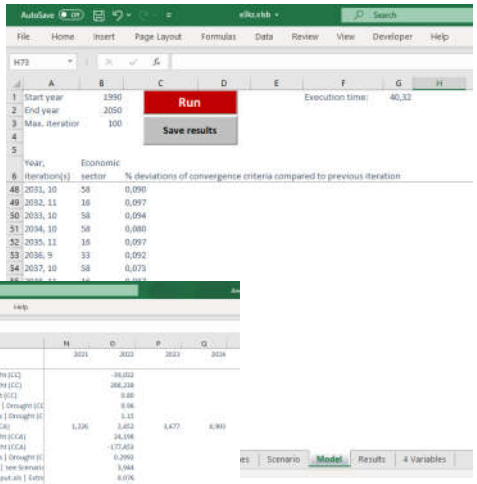
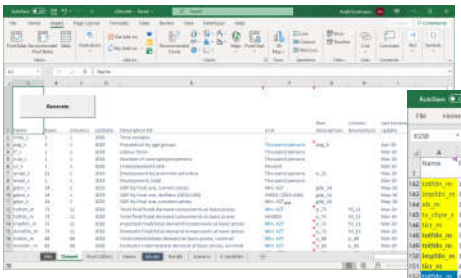
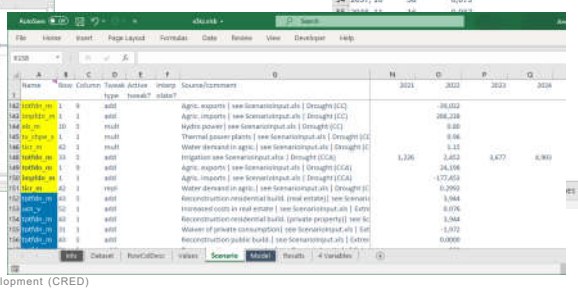
User-friendly, Excel-based E3 modeling approach

- Models are jointly developed under consideration of local capacities (financial, personnel, time), capabilities and data availability
- Active participation of country experts in model development and usage (scenario analysis)
  - ➢ Sustainable capacity building supported by trainings







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Major steps to model the economic impacts of CC and adaptation

1 Identification of EWE and their effects

- How is the country affected by **CC in the future**? **Frequency and intensity** of EWE?
- Collection of **climate damage data from past events** or results from sector models, e. g. agriculture model
- Combination of physical and economic parameters

2 Translation of EWE into model parameters

- Variables that change under CC often cannot be found one-to-one in the catalogue of variables of an economic model
- **Sector-specific economic damages enter the model**, e. g. drought causes yield losses and thus, reduce exports

➢ **CC scenario**

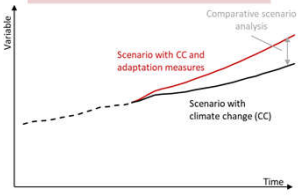
3 Adaptation policies and their effects

- Identification of **adaptation measures** (their costs and benefits), e. g. investment in installation of irrigation systems results in lower yield losses
- Translation into model parameters

➢ **CC adaptation scenario(s)**

4 Simulation and evaluation

- **Comparative scenario analysis:** to see the effects of adaptation, this scenario must be compared to the CC scenario without adaptation
- Policy recommendations



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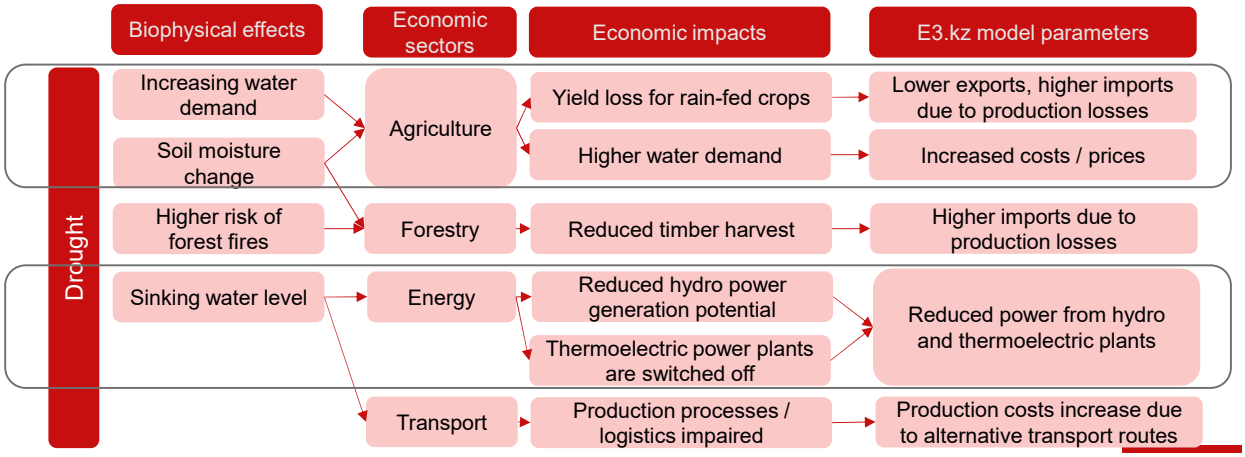
Integrating drought impacts into the model e3.kz

- Impact chains: who is affected and how? 1 2



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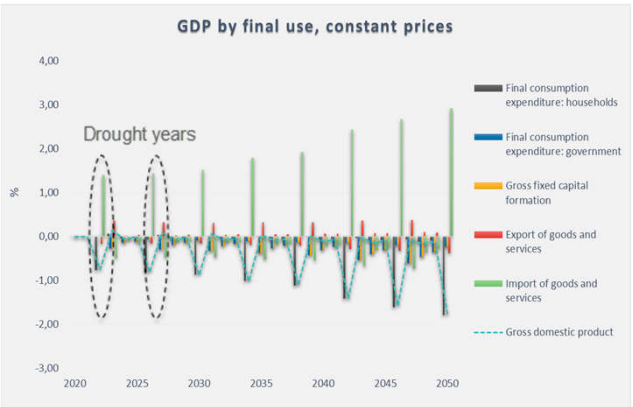
Economic impacts from drought events

- Selected **sector-specific impacts** of droughts
  - Wheat yield losses in agriculture (up to -30%)
  - Higher water demand (up to +15%)
  - Reduction in hydro power generation (up to -20%)
  - Reduction in thermoelectric power potential (-4%)

➢ Results are given as differences to a hypothetical "no CC scenario"

- Macroeconomic results
  - Forgone exports chances and higher agricultural and electricity imports
  - Lower employment and income levels reduce the spending opportunities of private households
  - ➢ **Negative GDP impacts**



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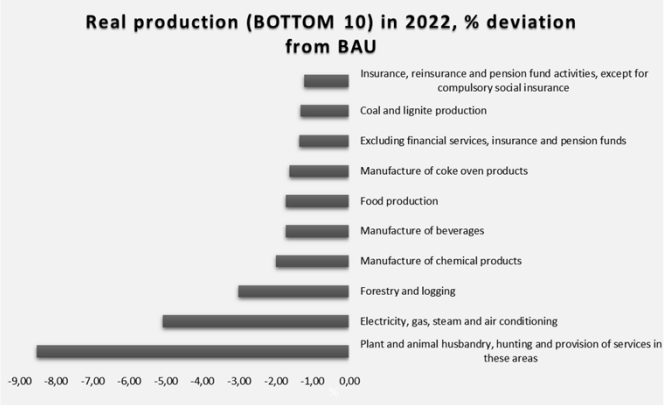
Economic sector impacts from drought events

- Production is in particular constrained in the agriculture and energy sector
- Water sector benefits from higher demand in agriculture and at the same time burdened by lower demand from water-intensive sectors (e. g. energy)
- Other sectors are affected by economic interlinkages (e. g. chemical industry from agriculture)
- Lower consumer expenditures on food, among other things, causes further production adjustments
- Employment follows production considering sectoral labor-intensities



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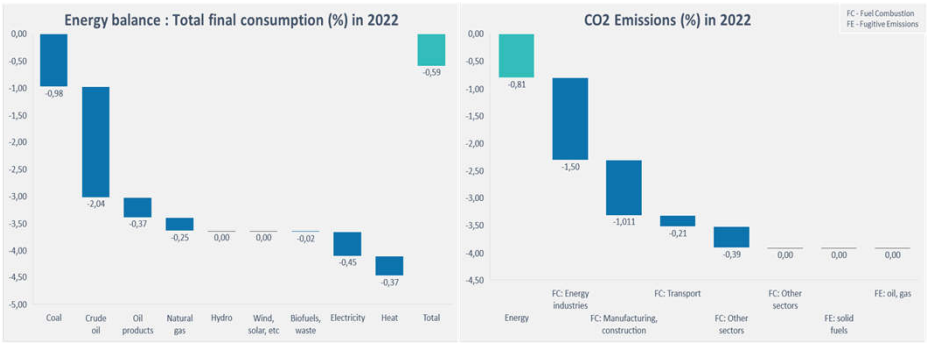
Environmental impacts from drought events

- Results for energy demand and CO_2 emissions
  - Limited economic growth results in **lower energy demand** and **CO_2 emissions**.
  - Another positive impact is related to the temporary reduction of the thermoelectrical plants mainly operating with fossil fuels.



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Possible adaptation measures to droughts

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- Adaptation to CC anticipates the adverse effects of CC
  - Installation of irrigation systems → prevention of crop failures
  - Expand water-saving technologies (drip-irrigation), renovate water infrastructure → saves water

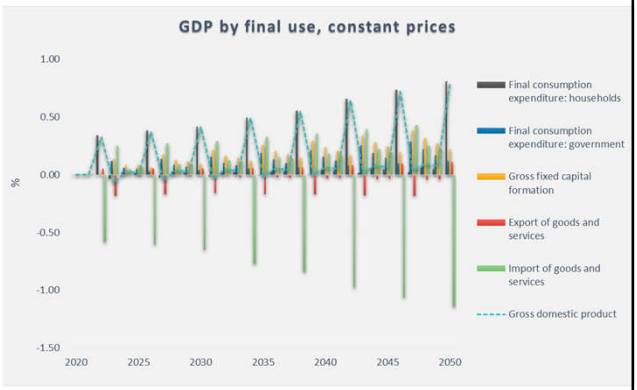
Ministry of Energy et al. 2017, p. 183

- Implementation into e3.kz
  - **Additional investments** in irrigation systems (in total 570 bn. KZT)
  - Measures are expected to **reduce yield losses** in agriculture by 27% and to **increase water use** by of 20%

Adaptation costs ⇅ Climate change damages

Possible adaptation measures to droughts

- Results given as differences to the drought scenario
  - With adaptation measures **negative impacts of a drought event are reduced**.
  - Yield losses in agriculture are lower. Thus, agricultural exports increase, and agricultural imports decrease.
  - **Positive GDP** and **employment effects**
  - Additional **investments support GDP** but
  - **Imports** of irrigation systems **reduce GDP growth**



Benefits of the Excel-based E3 modeling approach

- No steep learning curve: **Excel knowledge reused & extended** (model programming in Visual Basic for Applications)
- **No "black-box"**: Excel workbook includes the full model (data, model code, scenario inputs, results)
- **Inexpensive** setup

- Useful tool to **support policy makers in evidence-based decisions**
  - ➢ Scenario analysis is used to search for "better" adaptation measures and policy mixes.
  - ➢ No knowledge in programming needed for conducting scenario analysis
  - ➢ Fast scenario computation (less than one minute per scenario)

- E3 approach attracts both the Ministry of Environment and Economy

➢ Excel-based E3 modeling approach can be applied to other countries without „reinventing the wheel".

➢ E3 modeling is not limited to CC adaptation. Other examples: COVID-19 impacts in Georgia and mitigation scenarios in Algeria.

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