Impacts of climate change on Hydroenergy sector

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Projections of Water Resource Changes and its impact on energy sector

Sources of information:

• The Second National Communication of Tajikistan to UNFCCC;

• PPCR Phase I:
  – Improving climate resiliency of hydro energy sector in Tajikistan (EBRD)
  – Tajikistan climate science and impact modeling partnership (ADB)
Fluctuation of surface temperature according to reference weather stations in Tajikistan

Years

Annual average temperature, C
10,0 10,5 11,0 11,5 12,0 12,5 13,0 13,5 14,0
Hydrometeorology stations in Tajikistan
Estimation of Water Resources up to 2050

Изменение температуры воздуха в горах Таджикистана
Фактические значения и прогноз по климатическим моделям

Средняя годовая температура воздуха, °C

Источник: ТАДЖИКГИДРОМЕТ и Институт Макса-Планка, Германия
Estimation of Water Resources up to 2050
Observed changes of temperature

Since 1950:
• Annual temperature increase \( \uparrow 1.2^\circ C \)
• Rapid warming is observed in:
  – In the north
  – During autumn and winter seasons

Source: PPCR, EBRD (2011)
Observed changes of precipitation since 1950:

- Annual precipitation: ↑ ↓ 20%
- In the Pamirs, decrease of precipitation is expected during the autumn and winter seasons (level of precipitation in winter remains the same)

Source: PPCR, EBRD (2011)
Forecasted changes of average weather temperature and precipitations for Amudarya and Syrdarya basins as per different projection of emissions up to 2030. Source: Lutz et al. (2013).
Annual runoff changes

Modeling of daily water runoff in the headwaters of Vakhsh (Nurek dam) using runoff modeling based on icemelting (SRM):

• Black line = modeling of ‘base data' on runoff (upper line) 2005 and (lower line) 2001

• Dashed line – runoff in 2050, on the basis 4 climatic scenarios (hot - dry, Central, warm - wet, and arid)

Source: Professor Robert Wilby, Loughborough University, UK
The impact assessment showed that during the whole period of instrumental observations (since 1930s), the glaciation area of Tajikistan decreased by around 30%.
Unidentified implications of climate change for hydropower generation

Projections of future annual average energy production in Vakhsh Cascade

Source: PPCR, EBRD (2011)
Hydro Power Plants in Tajikistan

- 98% of energy from HPPs
- 5% of potential is currently used
Historic and future annual average weather temperature for Vakhsh and Pyanj river basins, also for the Pamirs’ glaciation area

Source: PPCR, ADB, 2012
Historic and future annual average precipitation for Vakhsh and Pyanj river basins, also for the Pamirs’ glaciation area.

Source: PPCR, ADB, 2012
Historic and future annual average river flow in Vakhsh and Pyanj river basins

Источник: ППАИК, АБР, 2012
Estimated full ice volume of Pamir’s glaciation area for the past and future periods
Unidentified implications of climate change on energy production

• **Single projections for 2050**: Temperature increase (no changes in precipitation level) → Increased level of snow and ice melting → Increased level of water flow → Improving capacity of hydroenergy? OR

• **Other projections for 2050**: Temperature increase, decreasing the level of precipitation → rapid melting of snow and ice resources → Decreasing capacity of hydroenergy sector?
Thank you!