

## Putting Science into Work: Climate-Smart Actions for Central Asia



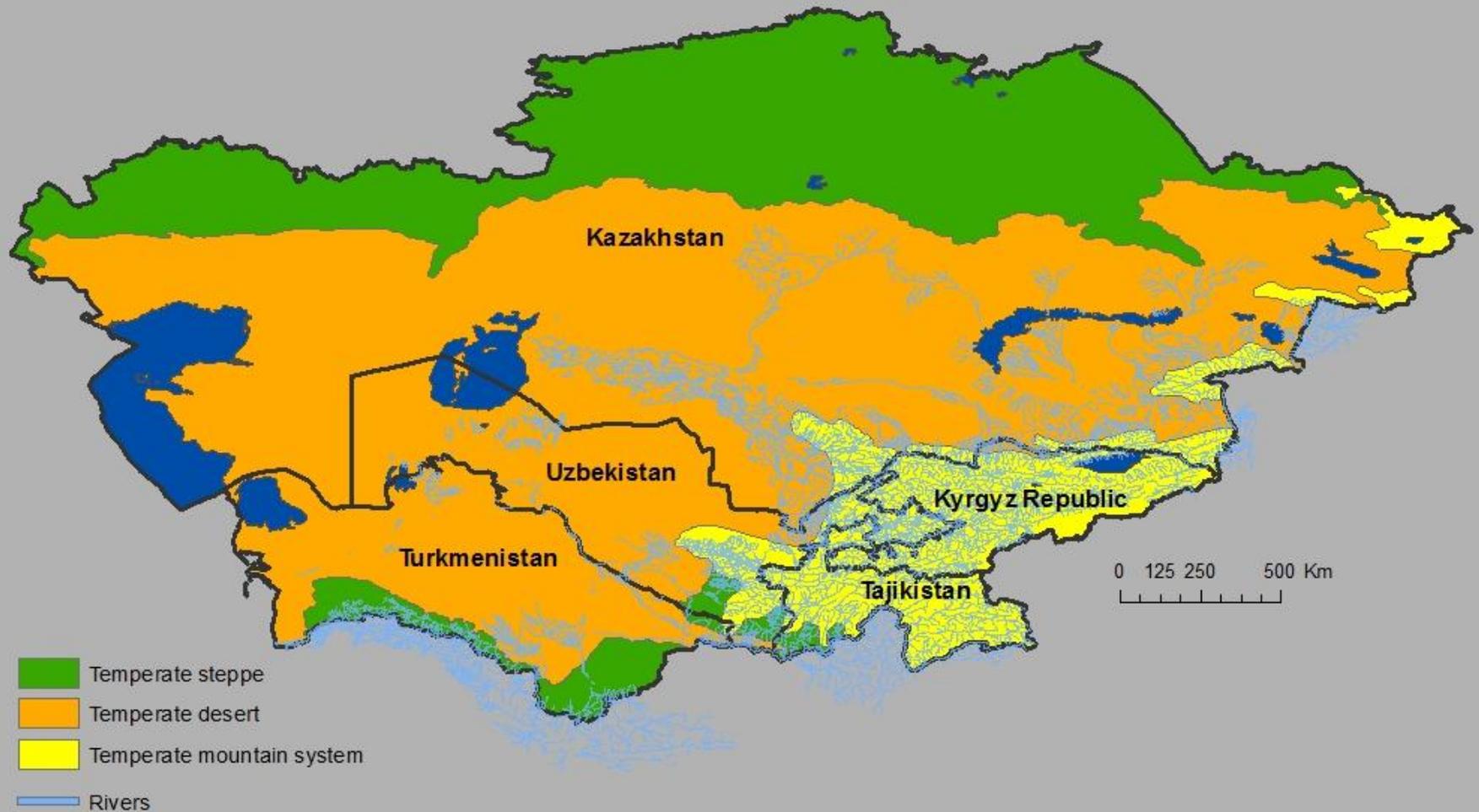
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**Central Asia Climate  
Knowledge Forum:  
Moving Towards  
Regional Climate  
Resilience**

# Project Overview

- Geographic Scope: Country wide, but with consideration of transboundary effects
- Modeling scope: agriculture and irrigation water sectors
  - climate scenarios
  - crop modeling
  - river basin modeling
  - economic analysis
  - stakeholder workshops
- Partners: Ministry of Agriculture, Ministry of Environment, Hydromet, Federation of Farmers, and local University and Research Institute experts (many of which have authored National Communications to UNFCCC)

# Effective Climate Change Adaptation Requires a Regional Focus on Ecological and Water Resources



Source: FAO Global Ecological Zones, 2010

Note: For the purposes of this study, we simplified FAO's ecological zones to the three main zones present in the region.

# Our objectives

- A lot of work has been done, but there are still a number of **data, analytic, and stakeholder engagement gaps**
- **Identified “ready to scale” recommendations for adaptation options** and measures with mitigation co-benefits
- Moving forward, it is important to **identify other adaptation options that require additional preparatory work before implementation**

# Our method

- 1. Identify the socioeconomic drivers and climate stressors** that contribute to the region's vulnerability to climate change.
- 2. Assess the impacts of climate change on the region's key sectors** - analyze vulnerabilities, sensitivities, adaptive capacities, and risks of inaction.
- 3. Identify climate-smart adaptation measures** based on:
  - landmark adaptation and mitigation studies
  - feedback from World Bank experts
  - feedback from the first workshop of the Central Asia Technical Working Group on Climate Change

# Losing Arable Land, China Faces Stark Choice: Adapt or Go Hungry

To ensure food security, China is racing to develop new cultivars of staple grains that thrive in a warmer world

**YUCHENG, CHINA**—Hou Ruixing weaves his way through plots of winter wheat, stopping beneath an infrared heater suspended from wooden crossbars. The makeshift lamp and others arranged at 15-meter intervals at Yucheng Integrated Agricultural Experimental Station are simulating climate change by nudging up the thermometer an extra 1.6°C—the average annual temperature increase that models predict

as flood control, drought, wind erosion, and soil alkalinity. To this list of concerns, researchers have now added climate change and its potential impact on grain yields. “We want to know how crops will reflect global warming,” says Tao Fulu, an agricultural meteorologist at the Institute of Geographic Sciences and Natural Resources Research of the Chinese Academy of Sciences in Beijing.

Source: *Science* 14 Feb 2013



# Effect of Climate Change on Uzbek Crop Yields in 2040-2050, With Water Shortfalls Considered

SCENARIO	CROP	DESERT & STEPPE	DESERT & STEPPE	HIGHLANDS	PIEDMONT ZONE	PIEDMONT ZONE
		EAST	WEST	SOUTH	EAST	SW
LOW	Alfalfa	-2%	-13%	-12%	24%	-13%
	Apples	-13%	-23%	-19%	0%	-20%
	Cotton	-11%	-19%	-15%	-3%	-16%
	Grassland	42%	25%	32%	56%	32%
	Potatoes	-11%	-22%	-20%	0%	-19%
	Tomatoes	-8%	-21%	-18%	-2%	-14%
	Winter wheat	-1%	-13%	-14%	19%	-17%
	Spring wheat	-9%	-18%	-18%	5%	-18%
MEDIUM	Alfalfa	-2%	-16%	-15%	1%	-17%
	Apples	-12%	-22%	-25%	-18%	-25%
	Cotton	-10%	-20%	-15%	-17%	-21%
	Grassland	12%	15%	12%	43%	-1%
	Potatoes	-10%	-21%	-24%	-16%	-23%
	Tomatoes	-9%	-23%	-18%	-18%	-24%
	Winter wheat	-2%	-20%	-18%	-7%	-21%
	Spring wheat	-14%	-22%	-28%	-13%	-28%
HIGH	Alfalfa	-33%	-28%	-27%	-39%	-28%
	Apples	-49%	-39%	-43%	-63%	-42%
	Cotton	-36%	-31%	-25%	-49%	-32%
	Grassland	10%	-9%	3%	28%	-5%
	Potatoes	-41%	-37%	-38%	-57%	-37%
	Tomatoes	-45%	-38%	-29%	-56%	-40%
	Winter wheat	-40%	-32%	-31%	-42%	-43%
	Spring wheat	-55%	-41%	-50%	-57%	-49%

# Ready-to-Scale Climate-Smart Measures for the Agriculture Sector

Information Generation & Dissemination	Institutional Capacity Building	Policy Reform	Investment in Infrastructure
<ul style="list-style-type: none"><li>• <b>Country-Level:</b> Promote soil -water management and conservation agriculture practices . in Kazakhstan.</li><li>• <b>Tajikistan &amp; Kyrgyz Republic:</b> Implement structural and vegetative measures such as terracing, small scale water harvesting etc. to improve productivity and reduce erosion and its associated impacts.</li><li>• <b>Country-Level:</b> To relieve current and future water stress, adopt more efficient water use and sourcing practices.</li><li>• <b>Regional:</b> Share findings of agricultural research centers on best practices and climate-smart measures, particularly across similar agro-ecological zones.</li></ul>	<ul style="list-style-type: none"><li>• <b>Country-Level:</b> Invest in improved research and extension services with the goal of increasing farmer access to technology and information.</li></ul>	<ul style="list-style-type: none"><li>• <b>Country-Level:</b> Implement policies to expand agriculture into areas where conditions are forecast to become more suitable for agriculture under climate change (e.g., provide incentives, build agricultural capacity, etc.).</li><li>• <b>Country-Level:</b> Implement more sustainable management of livestock pastures to reduce erosion (e.g., pasture rotation to avoid overgrazing).</li><li>• <b>Turkmenistan, Uzbekistan, &amp; Kazakhstan:</b> Implement policies to combat desertification, including preventative measures in at-risk areas as well as the restoration of already degraded land.</li><li>• <b>Regional:</b> Increase participation in global and regional systems to share crop diversity and plant breeding expertise.</li><li>• <b>Country-Level:</b> Investigate options for crop insurance, particularly for drought.</li><li>• <b>Country-Level:</b> Invest in programs to provide loans to farmers to purchase equipment and inputs.</li><li>• <b>Regional:</b> Support transition to free trade system to encourage crop diversification.</li></ul>	<ul style="list-style-type: none"><li>• <b>Country-Level:</b> Increase water efficiency by improving irrigation infrastructure (e.g., rehabilitation and maintenance, and implementation of drip irrigation for high-value crops).</li><li>• <b>Country-Level:</b> Improve on-farm vertical drainage infrastructure to reduce soil salinity.</li></ul>

## Examples:

- **Tajikistan & Kyrgyz Republic:** Implement structural and vegetative measures such as terracing, small scale water harvesting etc. to improve productivity and reduce erosion and its associated impacts.
- **Regional:** Increase participation in global and regional systems to share crop diversity and plant breeding expertise.

# Energy Sector - Risks of Inaction

- The physical impacts of climate change threaten to cause over US\$5.7 billion worth of damages over the next forty years, due to:
  1. Reduction in water availability for hydropower
  2. Increase in extreme events
  3. Forecast increases in air temperatures lowering the efficiency of transmission and distribution infrastructure
  4. Changes in the temperature and availability of cooling water for thermal power plants

# Ready-to-Scale Climate-Smart Measures for the Energy Sector

Information Generation & Dissemination	Institutional Capacity Building	Policy Reform	Investment in Infrastructure
<ul style="list-style-type: none"><li>• <b>Turkmenistan, Uzbekistan &amp; Kazakhstan:</b> Improve modeling of the effect of climate change on oil and gas production sites.</li><li>• <b>Country-Level:</b> Train energy planners on tools and methodology to assess climate risks and vulnerability.</li><li>• <b>Regional:</b> Share information on best practices for improving energy efficiency at household level and in industry.</li></ul>	<ul style="list-style-type: none"><li>• <b>Regional:</b> Enhance capabilities of hydromet to generate emergency forecasts and communicate them to emergency planners.</li><li>• <b>Country-Level:</b> Develop contingency plans for better management of power plants under extreme climatic events.</li></ul>	<ul style="list-style-type: none"><li>• <b>Country-Level:</b> Establish policies to require energy providers to demonstrate the ability to respond to future climate stresses such as extreme heat.</li><li>• <b>Country-Level:</b> Update engineering standards for energy generation and transmission infrastructure.</li><li>• <b>Country-Level:</b> Implement policies to promote energy efficiency through demand control (such as tariff reform) and increase the efficiency of power generation.</li><li>• <b>Regional:</b> Develop more efficient and economically beneficial regional energy markets.</li></ul>	<ul style="list-style-type: none"><li>• <b>Tajikistan:</b> Invest in infrastructure to harness hydropower potential.</li><li>• <b>Kyrgyz Republic:</b> Invest in solar potential to help meet peak winter energy demand.</li><li>• <b>Uzbekistan, Turkmenistan &amp; Kazakhstan:</b> Utilize the more water-efficient combined cycle gas turbine (CCGT) technology in new thermal power plants to prepare for future water shortages.</li><li>• <b>Country-Level:</b> Incorporate climate resilience into the maintenance, modernization and rehabilitation of existing energy assets.</li><li>• <b>Country-Level:</b> Invest in more diverse portfolios of energy generation assets to enhance resilience to climate (and market) risks.</li></ul>

## Examples:

- **Regional:** Share information on best practices for improving energy efficiency at household level and in industry.
- **Country-Level:** Develop contingency plans for better management of power plants under extreme climatic events.

## Six key findings (1)

1. Substantial *risk of inaction*
2. *The greatest and most serious risks are focused on the agriculture, energy, and water resources sector nexus*
3. *Adaptation actions are needed.* However:
  - *Existing efforts focus on individual countries.*
  - *These studies focus on individual sectors.*
  - *Existing studies reflect qualitative analyses*

## Six key findings (2)

4. Even with these limitations, the existing research base provides *a basis for taking some actions now*
5. *Ready-to-scale actions have been identified here at two geographic scales - national, and regional.*
6. For many other potentially important actions, *there is a need for further project preparatory work.*

# IDENTIFY CLIMATE-SMART MEASURES IN KEY ECONOMIC SECTORS

Improve use efficiency, reuse and recycling, and demand management

Invest in infrastructure to harness hydropower potential

Implement conservation agriculture

Develop strategies for region-scale pollution control

Improve research & extension

Develop efficient regional energy markets

Improve research & extension

Develop climate-smart engineering standards

Strengthen inter-sectoral coordination on water use

Share crop diversity and plant breeding expertise

Conduct targeted analyses of changes in groundwater and surface water under climate change

Adopt more efficient water use and sourcing practices

Expand agriculture into areas more suitable under climate change

Invest in more diverse portfolios of energy generation assets

Develop regional water allocation system

Improve hydromet modeling and information dissemination

Train energy planners on assessing climate risks

Note: The above measures are a sampling of the group of measures identified in the Climate-Smart Solutions Note.

agriculture

energy

water

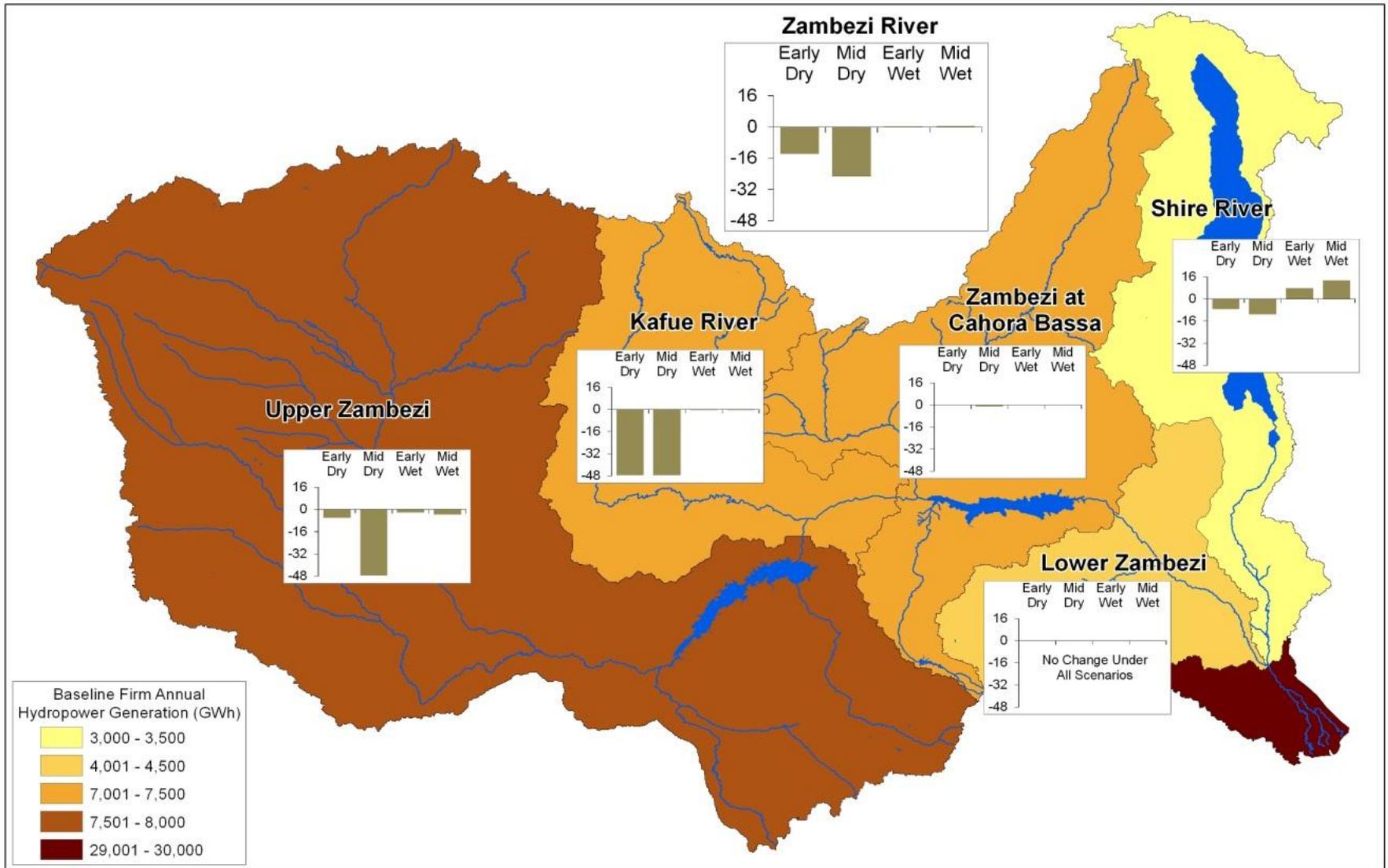
ENGAGE KEY STAKEHOLDERS AND EXPERTS TO  
PRIORITIZE MEASURES THROUGH MULTI-CRITERION  
DECISION MAKING PROCESS

IMPLEMENT CLIMATE-SMART ADAPTATION PLAN

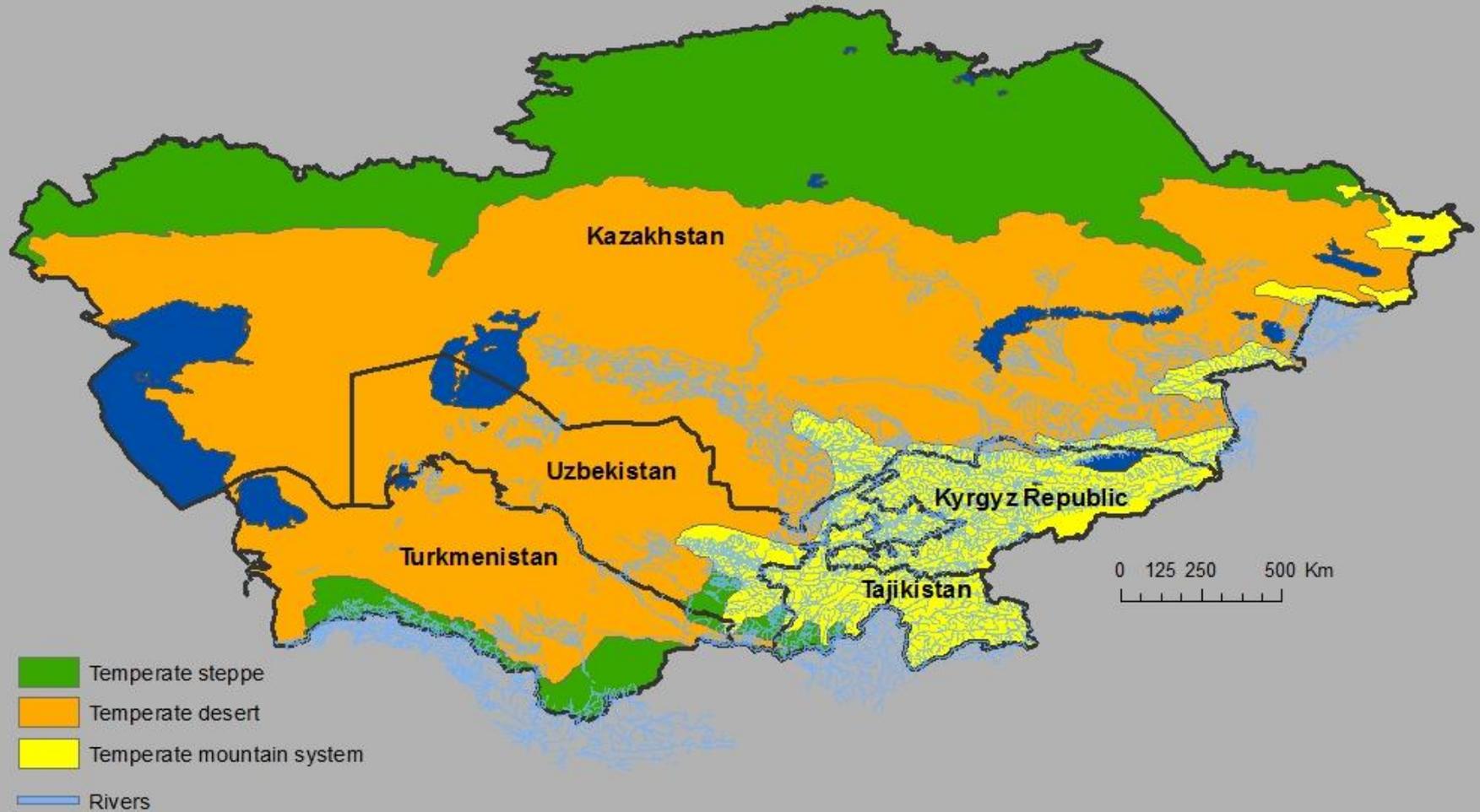
## Next steps

1. Technical committee jointly assess readily scalable measures using the following criteria:
  - Cost effectiveness
  - Good today and tomorrow
  - Adaptation and mitigation
  - Social vulnerability
  - Scalability
  - Ease of implementation
2. Start a regional cooperative analytic effort to assess the remaining measures

# Zambezi River Basin: Annual Firm Hydropower Projections



# Effective Climate Change Adaptation Requires a Regional Focus on Ecological and Water Resources



Source: FAO Global Ecological Zones, 2010

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# Preliminary Assessment of Priority Climate-Smart Measures for the Water Resources Sector - Country-Level Results

Information Generation & Dissemination	Institutional Capacity Building	Policy Reform	Investment in Infrastructure
<ul style="list-style-type: none"> <li>• <b>Regional:</b> Conduct targeted analyses on the changes in groundwater and surface water flow that could result from climate change and their impacts on hydropower generation and agricultural productivity, in particular.</li> <li>• <b>Regional:</b> Collaborate on improving hydromet modeling and information dissemination systems, and establish unified approaches for monitoring and for data collection, management and sharing.</li> <li>• <b>Regional:</b> Build stronger cross-border cooperation and communication around water release schedules and O&amp;M of irrigation and drainage infrastructure.</li> </ul>	<ul style="list-style-type: none"> <li>• <b>Country-Level:</b> Alleviate current and future water shortages by improving water use efficiency, reuse and recycling of water, and demand management measures. In particular, improve the capacity of Water User Associations to provide leadership and guidance on water-efficient practices for agriculture.</li> <li>• <b>Country-Level:</b> Strengthen inter-sectoral coordination on water resources planning and use, with a focus on integrated water resources management.</li> </ul>	<ul style="list-style-type: none"> <li>• <b>Regional:</b> Develop a regional water allocation system that is beneficial economically and from an environmental standpoint through intergovernmental agreements on the use of transboundary water resources.</li> <li>• <b>Country-Level:</b> Particularly with respect to competing demands of energy and water-intensive agriculture, coordinate allocation of water between sectors to maximize multi-sector benefits.</li> <li>• <b>Country-Level:</b> Alleviate current and future water shortages by creating incentives for efficient water use.</li> <li>• <b>Regional:</b> Develop strategies for cross-border and region-scale water pollution control, for example through payment for ecosystem services or more stringent treatment regulations.</li> <li>• <b>Regional:</b> Continue work on Aral Sea restoration and development of a management plan that involves all five countries.</li> </ul>	<ul style="list-style-type: none"> <li>• <b>Tajikistan &amp; Kyrgyz Republic:</b> To capture benefits of near-term springtime glacial melt, expand storage capacity where feasible.</li> <li>• <b>Country-Level:</b> Ensure that dams and other water-related infrastructure are constructed or rehabilitated with consideration of climate risks as well as efficiency concerns.</li> </ul>

Note: Recommended measures may be applicable to many countries, but are assigned as priority based on relevant country-level vulnerabilities.

# Preliminary Assessment of Priority Climate-Smart Measures for the Transportation Sector - Country-Level Results

Information Generation & Dissemination	Institutional Capacity Building	Policy Reform	Investment in Infrastructure
<ul style="list-style-type: none"> <li>• <b>Country-Level:</b> Develop new information and communication systems to ensure accurate and timely storm warnings and weather information for emergency response and transportation planning officials.</li> <li>• <b>Regional:</b> Share best practices on engineering standards and construction guidelines that increase resilience to climate risks.</li> </ul>	<ul style="list-style-type: none"> <li>• <b>Country-Level:</b> Conduct climate risk assessments for trade-critical corridors.</li> <li>• <b>Regional:</b> Develop institutionalized mechanisms for knowledge sharing and communication between climate scientists and transportation professionals.</li> </ul>	<ul style="list-style-type: none"> <li>• <b>Country-Level:</b> Particularly in large cities, develop climate-smart transport policies (such as rail, increased fuel efficiency, public transport systems).</li> <li>• <b>Country-Level:</b> Implement policies (potentially including incentives, taxes, or regulations) to promote a cleaner and more fuel-efficient vehicle fleet.</li> </ul>	<ul style="list-style-type: none"> <li>• <b>Country-Level:</b> Update engineering &amp; design standards for transport infrastructure to incorporate resilience to climate change and extreme events.</li> <li>• <b>Country-Level:</b> Develop “intelligent transport systems” that incorporate sensor technologies in key structures to monitor for the effects of climate effects, heat stress in particular.</li> <li>• <b>Regional:</b> Invest in improving cross-border and regional connectivity to facilitate the movement of goods and people and increase the climate resiliency of the region.</li> </ul>

Note: Recommended measures may be applicable to many countries, but are assigned as priority based on relevant country-level vulnerabilities.

# Preliminary Assessment of Priority Climate-Smart Measures for the Human Health Sector - Country-Level Results

Information Generation & Dissemination	Institutional Capacity Building	Policy Reform	Investment in Infrastructure
<ul style="list-style-type: none"><li>• <b>Regional:</b> Strengthen system of epidemiological monitoring of climate-related infections and diseases.</li></ul>	<ul style="list-style-type: none"><li>• <b>Country-Level:</b> Build institutional capacity in relation to extreme weather event preparedness response, infectious disease surveillance and response, and respiratory disease early detection and response.</li></ul>	<ul style="list-style-type: none"><li>• <b>Regional:</b> Create mechanisms for interagency coordination on public health in a changing climate.</li><li>• <b>Country-Level:</b> Develop heat wave emergency preparedness and response plans.</li><li>• <b>Country-Level:</b> Implement anticipatory flood control policies (including control actions to reduce water levels when rainfall forecasts predict flood levels, and zoning in flood plains to reduce potential flood losses).</li></ul>	<ul style="list-style-type: none"><li>• <b>Country-Level:</b> Incorporate resilience and energy efficiency into design and implementation of hospitals and emergency care facility projects and upgrades.</li></ul>

Note: Recommended measures may be applicable to many countries, but are assigned as priority based on relevant country-level vulnerabilities.

# Preliminary Assessment of Priority Climate-Smart Measures for the Forestry Sector - Country-Level Results

Information Generation & Dissemination	Institutional Capacity Building	Policy Reform	Investment in Infrastructure
<ul style="list-style-type: none"><li>• <b>Regional:</b> Invest in cross-border early warning systems for wildfires and outbreaks of pest insects and diseases.</li></ul>	<ul style="list-style-type: none"><li>• <b>Country-Level:</b> Mainstream adaptive forest management into national forestry services, including 1) explicit planning of future forests by function; 2) goal-oriented selection of species composition; 3) optimizing the structure of forest stands; 4) adjustment or development of new forest protection systems; and 5) optimization of major technical indicators of sustainable harvest.</li></ul>	<ul style="list-style-type: none"><li>• <b>Country-Level:</b> Reduce deforestation and support afforestation and reforestation, especially on abandoned agricultural land.</li><li>• <b>Country-Level:</b> Manage forests to maximize connectivity and reduce fragmentation to increase ecological resilience.</li><li>• <b>Country-Level:</b> Implement policies to support agroforestry (for example, by promoting it in farming systems, incentivizing the use of trees in agricultural areas, investing in research extension and capacity building, etc.).</li><li>• <b>Regional:</b> Implement policies to control the spread of exotic species (including invasive species monitoring, preventative measures, and control techniques).</li></ul>	<ul style="list-style-type: none"><li>• <b>Regional:</b> Improve fire-fighting infrastructure, such as regional fire control centers and firefighter training centers.</li></ul>

Note: Recommended measures may be applicable to many countries, but are assigned as priority based on relevant country-level vulnerabilities.

# Climate-Smart Measures that Address Social Vulnerability

Sector	Measures that Address Social Vulnerability
Water Resources	<ul style="list-style-type: none"><li>• Strengthen accountability mechanisms of state water authorities and WUAs towards their clients and members (e.g., better linkages between payments made and water received).</li><li>• Improve flood protection and drainage systems, particularly in areas that are highly vulnerable to natural disasters.</li><li>• Invest in water quality protection and access to clean water, though more research is needed on the impact of climate change on water quality.</li></ul>
Agriculture	<ul style="list-style-type: none"><li>• Due to high vulnerability to natural disasters, investigate options for crop insurance for climate hazards such as landslides, droughts, and floods.</li><li>• Strengthen “value chains” of farm produce.</li><li>• Implement programs to provide loans to smallholders to purchase equipment and inputs.</li></ul>
Energy	<ul style="list-style-type: none"><li>• Upgrade and expand transmission and distribution systems (insulate lines, etc.) to be more climate resilient, particularly in remote, rural areas.</li></ul>
Transportation	<ul style="list-style-type: none"><li>• Enhance transportation connectivity for both goods and people.</li></ul>
Health	<ul style="list-style-type: none"><li>• Use mass media to aid public response to extreme weather events (such as heat waves and floods) or epidemics.</li><li>• To address the potential impacts of climate change on livestock health, which threaten milk and meat production, develop emergency response capacity to mitigate the impacts of contagious animal diseases.</li></ul>
Forestry	<ul style="list-style-type: none"><li>• Promote participation of local people in forest conservation.</li><li>• Encourage agroforestry (and horticulture), as many forest products are more resilient to climate change than field crops.</li></ul>

# Climate-Smart Measures with Mitigation Co-Benefits

Sector	Mitigation Co-Benefits
Water Resources	<ul style="list-style-type: none"><li>• Improve the energy efficiency of water storage and transportation infrastructure in order to reduce emissions due to pumping.</li><li>• Increase water use efficiency through water reuse and recycling, demand management measures, and more efficient irrigation technology.</li></ul>
Agriculture	<ul style="list-style-type: none"><li>• Decrease agriculture-related emissions through the promotion of agronomic practices that are less GHG-intensive, such as conservation agriculture, and the development and use of crops and crop varieties that require fewer inputs.</li><li>• Promote climate-smart management of agricultural areas to maximize the carbon-fixing ability of farmland (e.g. through agroforestry systems).</li></ul>
Energy	<ul style="list-style-type: none"><li>• Implement policies to promote energy efficiency through demand control and increases in the efficiency of power generation and transmission.</li><li>• Invest in feasible renewable energy technologies such as wind, solar, and hydropower.</li></ul>
Transportation	<ul style="list-style-type: none"><li>• Implement policies to promote cleaner and more efficient vehicle fleets.</li><li>• Develop climate-smart transport policies (such as rail, bus rapid transit, etc.).</li></ul>
Health	<ul style="list-style-type: none"><li>• Incorporate climate resilience and energy efficiency considerations into the construction and rehabilitation of hospitals and other health care facilities.</li></ul>
Forestry	<ul style="list-style-type: none"><li>• Reduce deforestation and support afforestation and reforestation, especially on abandoned agricultural land.</li><li>• Implement policies to support agroforestry.</li><li>• Improve the resilience of Central Asia's forests by improving wildfire control and prevention capacity, implementing policies to control the spread of pests, diseases and invasive species, and managing forests to maximize connectivity and reduce fragmentation.</li></ul>