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Knowledge Brief

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Adapting to Climate Change in ECA

Key Messages[1]

- **Contrary to popular perception, ECA countries are significantly threatened by climate change, with serious risks already in evidence**. Climate change is causing winter floods, summer droughts, melting of permafrost and glaciers, and is affecting hydrology. Risks from sea level rise, storms and other extremes, and the risk of severe water shortages and desertification, are increasing.
- **The vulnerability and adaptive capacity of ECA countries to climate change over the next two decades will be dominated by socio-economic factors and legacy issues**—notably the dire environmental situation and the poor state of infrastructure—rather than by climate change itself.
- **Even countries and sectors that stand to benefit from climate change are poorly positioned to do so**. Many believe that warmer climate and abundant precipitation in northeastern ECA will open up new agricultural frontiers. However, the current gap between potential and actual yields in ECA is much higher than any gains climate change can bring; the inability of Kazakhstan, Russia and Ukraine to close the productivity gap does not bode well for their capacity to adapt to and benefit from climate change.
- **The next decade offers a window of opportunity for ECA to make its development more resilient to climate change while reaping co-benefits.** Some impacts of climate change will likely remain manageable in the short-term but the costs of poorly designed or implemented policies could rise rapidly.

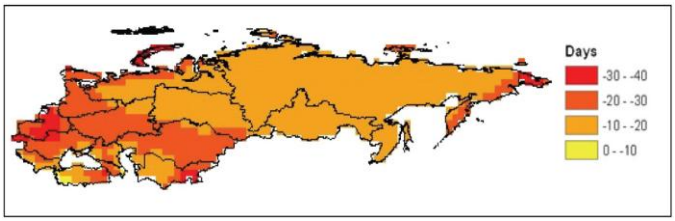
ECA's Legacy of Environmental Mismanagement

The climate is changing and many countries in ECA are vulnerable as they are exposed to the consequences: warmer temperatures, changing hydrology, droughts, floods, heat waves, windstorms, and forest fires. The frequency and cost of natural disasters have increased dramatically in ECA countries. The concentration of greenhouse gases already in the atmosphere guarantees that there will be more climate changes—even if all CO_2 emissions in the world were to stop completely today, changes at least as large as those already experienced would still take place.

The ECA region suffers from a serious adaptation deficit even to its current climate due to socio-economic factors and the Soviet legacy of chronic environmental mismanagement. These issues have increased its vulnerability to even modest global warming. For instance, the expected fall in the level of the Caspian Sea will expose the population to highly dangerous substances (pesticides, arsenic) presently locked into coastal sediments. Poorly constructed and maintained Soviet-era infrastructure is ill-suited to cope with or protect people from extremes like heat waves and floods. While Turkey does not have these legacy issues, it suffers from demographic pressures on fragile natural resources, and inadequate and vulnerable infrastructure.

Climate Change Poses a Significant Threat to ECA

Map 1. Projected Change in Number of Frost Days from 1980-1999 to 2030-2049 (A1B 8 GCMs)



Note: Projections are based on a socio-economic scenario (A1B) of future population, economies, energy, and emissions developed for the Inter-governmental Panel on Climate Change. Climate projection data comes from the general circulation models of 8 different research centers, distributed by the World Climate Research Program's Coupled Model Inter-comparison Project.
Source: Westphal 2008

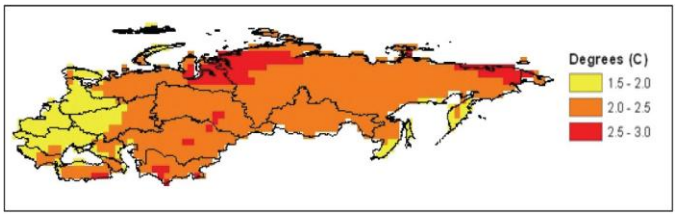
Average temperatures across ECA have already increased by 0.5ºC in the south and 1.6ºC in the north. Temperatures are projected to continue increasing by 1.6 to 2.6ºC until the mid-century, with the average number of frost days declining by 14 to 30 days (Map 1). In the more northern

[1] This note is based on a forthcoming report, *Adapting to Climate Change in Europe and Central Asia*, produced by the office of the Chief Economist of ECA. It was written by Marianne Fay, Rachel Block, Tim Carrington and Jane Ebinger. The report is based on the work of a much larger team which produced detailed background papers on specific sectors; it will be posted at www.worldbank.org/eca.

latitudes, warming will be greatest during the winter months.

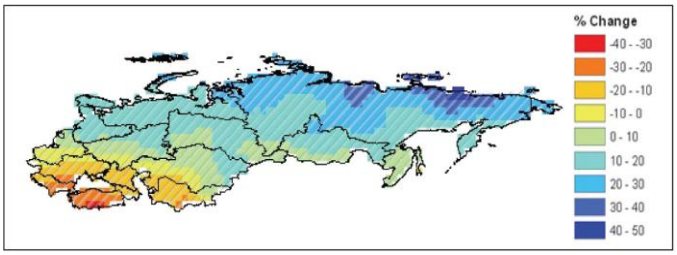
The southern parts of ECA are expected to see the greatest changes in their summers (Map 2), with the number of hot days increasing by 22 to 37 days. This warming trend is significant: by mid-century, countries such as Poland or Hungary are expected to experience the same number of hot days (>30°C) as today's Spain or Sicily, and summer heat waves will likely claim more lives than will be saved by warmer winters.

Map 2. Projected Change in Summer (JJA) Temperature, from 1980-1999 to 2030-2049 (A1B 8 GCMs)



Note: See Map 1
Source: Westphal 2008

Map 3. Projected Changes in Water Runoff from 1980-1999 to 2030-2049 (A1B 8 GCMs)



Note: See Map 1. The hatching indicates where at least 2/3 of the models agree with the sign of the change.
Source: Westphal 2008.

Water availability is projected to decrease everywhere except in Russia, as increased precipitation in many regions (except Southeastern Europe) is offset by greater evaporation due to higher temperatures (Map 3). The most dramatic decreases are likely to occur in Southeastern Europe and Turkey (–25%). Even in the case of Russia, most of the precipitation increase is expected to occur in winter—so it is still possible that higher summer temperatures could offset precipitation and lead to drought conditions, particularly in Russia's primary agricultural areas.

Temperatures are warming at about twice the global average in the Arctic, which could be completely ice-free during summer by the end of the century. The melting of the ice and of permafrost is affecting biodiversity, as well as leading to coastal erosion and the collapse of exposed buildings and infrastructure.

Warmer temperatures also complicate hydrology, with glaciers receding and less winter precipitation falling and being stored in the form of snow. This makes winter flooding more likely in ECA countries while reducing summer availability of melt water, particularly in glacier and irrigation-dependent Central Asia. Precipitation intensity and storm frequency will increase. Thus, even as much of ECA faces possible droughts, floods are expected to become increasingly common and severe.

Sea level rise will affect ECA's four basins (the Baltic Sea, the East Adriatic and Mediterranean coast of Turkey, the Black Sea and the Caspian) and the Russian Arctic Ocean. Poland's heavily populated, low-lying coast is vulnerable to inundation of settlements, infrastructure, and productive lands, as are the numerous ports and towns along the Russian, Ukrainian and Georgian coasts. Storm surge and saltwater intrusion into aquifers threaten the Croatian, Albanian and Turkish coasts. In the Caspian Sea, water level drops caused by increased surface evaporation will imperil fish stocks and affect coastal infrastructure.

Increased temperatures and changing hydrology have already caused substantial forest loss, ecosystem degradation, and health threats in ECA countries. In Russia, 20 million hectares were lost to fire in 2003 alone. For agriculture, net losses are likely for Southeastern Europe and Turkey, the North and South Caucasus and Central Asia. The warming climate is also allowing the northward migration of pests and harmful plant species. Malaria, which had been eradicated from Europe, is making a come-back, as are a number of once rare infectious diseases; meanwhile allergies related to pollen are projected to increase. Hundreds of deaths were attributed to the 2001 heat waves in Moscow and across Croatia, Slovenia and the Czech Republic.

Socio-Economic Factors and Legacy Issues Make ECA More Vulnerable in the Near Future

The resilience of a system—be it human, physical, or ecological—to a changing climate is highly dependent on the system's current state. ECA's ecological resilience is weak due to decades of environmental mismanagement when economic growth was pursued in blatant disregard to natural conditions. When water was needed for irrigation, the rivers feeding the Aral Sea were diverted to the desert to produce rice, fruit and cotton. Uzbekistan became one of the world's largest exporters of cotton, but at the cost of destroying the Aral Sea in the process. Today, the sand and salt blown from the dried-up sea bed onto the surface of Central Asian glaciers is accelerating the heat-induced melting of the glaciers, and Uzbekistan's agriculture—sustained by a wasteful irrigation system—is extremely vulnerable to climate change. Poor management of soil erosion, water resources, pest control, and nutrient conservation are other weaknesses that make the ECA region agriculture system particularly vulnerable.

Non-climatic factors, such as a legacy of inefficient water use and continued unsustainable demand, will be the main drivers of water stress in Europe and Central Asia over the

next couple of decades.[2] Poor land use and river basin management, and not just increased precipitation, can worsen floods, and existing pollution increases the risks of climate change. For instance, on Estonia's coast, radioactive waste at the Sillamae industrial center is separated from the sea only by a narrow dam that is threatened by coastal surge. Landfills around the Black Sea are pollution hotspots and coastal erosion could increase the amount of pollutants flushed to sea, threatening the fishing industry.

Poor quality housing in several ECA cities (especially Soviet-era buildings with prefabricated concrete panels) could increase the human toll of climate change as heat waves turn poorly ventilated buildings into furnaces and heavy rains bring leaks and mold. Crumbling and badly managed infrastructure compounds the situation—particularly in water and sanitation utilities. The power sector is hard pressed to respond to the peaks in electricity demand associated with rising summer temperatures. In addition extreme weather threatens the ability of the aging networks to function as intended. ECA's poorly maintained roads and other transport infrastructure are also vulnerable to the stresses of climate change—intense precipitation destabilizes pavement subgrade and retaining walls, and long droughts can lead to settling around foundations. Extreme temperatures also stress roads: in Central Asia, truck travel has been limited during hot summer days when the asphalt softens.

What Drives the Vulnerability of Different ECA Countries?

A simple vulnerability index created for ECA countries combined three indicators that captured each country's exposure, sensitivity and adaptive capacity to climate change.[3] The first indicator, *exposure*, was based on an index measuring the strength of future climate change relative to today's natural variability, and was based on both annual and seasonal temperature and precipitation indicators. The second indicator, a country's *sensitivity* to climate change, was based on indicators likely to increase the impact of climate shocks (available renewable water resources, extent of air pollution, economic structure, reliance on hydroelectric power, infrastructure, etc.). The third, *adaptive capacity*, was estimated by combining social (income inequality), economic (GDP per capita) and institutional measures.[4]

Combining the three components into a single index of vulnerability yielded the ranking shown in Figure 1a. Figure 1b uses a different scale to show how exposure and sensitivity increase, and adaptive capacity decreases, a country's vulnerability. Thus, amongst the most vulnerable, Albania suffers from relatively high exposure, while Tajikistan and Kyrgyz Republic are estimated to have social and productive structures that make them very sensitive to the impact of a changing climate. Russia, with its vast territory, stands out for its high exposure and limited adaptive capacity being offset by relatively low sensitivity.

Figure 1a. An Index of Vulnerability to Climate Change for Different ECA Countries

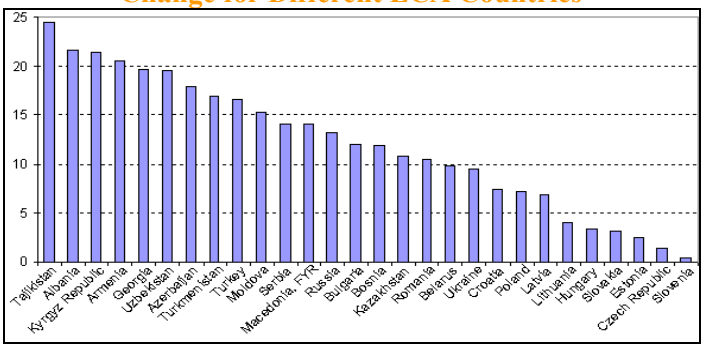
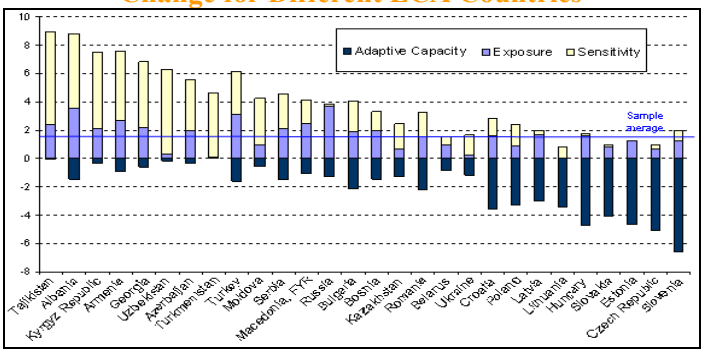


Figure 1b. The Drivers of Vulnerability to Climate Change for Different ECA Countries



Note: Adaptive capacity decreases vulnerability hence is shown here as taking negative values. Slovenia has very high adaptive capacity, which is therefore large and negative, while Tajikistan has very low adaptive capacity, close to zero. The overall indicator is rebased to vary from zero to 25, to be comparable to Fig. 1a.
Source: Fay and Patel (2008).

ECA Countries and Sectors that Could Benefit from Climate Change are Poorly Positioned to Do So

Areas in the higher latitudes—the Baltics, Poland, parts of Kazakhstan and Ukraine, and most of Russia (except for the North Caucasus)—could benefit from improved conditions for agriculture in a changing climate. The potential for gains is uncertain, however, as it could be offset by increased variability and extreme events.

Many studies about future food production assume ECA countries will help offset the decline in world production of staple grains resulting from decreasing yields in lower latitudes (also impacted by climate change). However, the current gap between potential and actual yields in ECA is significantly higher than any gains climate change can

[2] Vörösmarty et al. 2000.
[3] The index uses principal component analysis (PCA) to identify important variables capturing sensitivity and adaptive capacity, as well as to combine all three indicators into the overall vulnerability index. PCA is a statistical technique that weights the included variables so as to best explain the variance in the data. The exposure indicator was from Baettig (2007) and uses a simple linear formula to combine the underlying variables.
[4] The institutional measures are from the Worldwide Governance Indicators Project (Kaufmann et al. 2008) and include measures of voice and accountability; political stability and absence of violence; and an aggregate governance measure of government effectiveness, regulatory quality, rule of law, and control of corruption.

bring. The inability of Kazakhstan, Russia and Ukraine to close the productivity gap or respond to the recent increase in crop prices on world markets does not bode well for their capacity to adapt to and benefit from climate change. Indeed, the key challenge will be to close the existing productivity gap rather than ride the climate change wave to a new time of prosperity. Increasing farm outputs by expanding cultivation into newly temperate lands would require large investments in land-clearing, production, marketing and transport infrastructure; instead, improving the productivity of land currently under cultivation is the more feasible and beneficial place to begin.

Forests too show a similar pattern to agriculture: estimates indicate that potential forest stock increases in Europe from improved management and stronger forest institutions are two to three times the projected benefits from climate change. There is also real risk of losses in forestry from expanded ranges of pests and forest fires.

ECA Countries Can Make Their Development Resilient to Climate Change and Reap Co-benefits

Much of the adaptation needed to make ECA more resilient to climate change has substantial co-benefits. Improved water resource management, better performing water utilities and energy systems, and upgraded transport infrastructure are needed, independent of climate change. The gains from improved agricultural practices would be many times more significant than changes expected from climate change. Similarly, cleaning up of environmental hotspots, stepping up disaster management, and renewing investment in hydro-meteorological services would also be beneficial for individual welfare and economic output.

In the immediate future, ECA could focus on areas and sectors vulnerable under current climate conditions. Policy makers could plan actions with positive impacts for the population—actions that are clearly beneficial, regardless of the climate change scenario.

However, some decisions are required today about long-term investments, under conditions of substantial uncertainty. Thus, Albania, which derives 97 percent of its electricity from hydroelectric plants but faces an uncertain hydrological future, must develop a forward-looking electricity strategy. Poland, with over five million poor quality flats, needs a renovation plan. They can learn from countries like Australia and the UK that have developed methodologies, standards and databases to help organizations and individuals create adaptation plans in the context of uncertainty.[5]

The experience of these countries shows the importance of basing adaptation plans on an assessment of today's vulnerabilities to the current climate, and circumventing the paralysis that a highly uncertain future can inspire. Another approach for handling uncertainty that is gaining traction is focusing on 'robust strategies'—meaning strategies that are robust to a range of possible climate outcomes.[6] These strategies essentially amount to scenario-based planning, with climate change policies evaluated as solutions to a contingency problem rather than an optimization problem.

Policymakers should also involve stakeholders in climate change adaptation planning; it will help ensure that plans are implemented and adaptation concerns mainstreamed. Stakeholders usually have a good understanding of current vulnerabilities and ideas on how to reduce them.

In sum, ECA countries need to act. They can learn from other countries on how to manage uncertainty and assemble the right participants and information to guide climate-resilient practices. In ECA, uncertainty, more complex risks, and opportunities for gain should be reasons for action rather than inaction.

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[5] UKCIP 2003, Australian Government 2005
[6] Lempert and Schlesinger 2000

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