CHAPTER 7. PROTECTION AND PREPARATION: DISASTER RISK MANAGEMENT AND WEATHER FORECASTING

Over the past 30 years, natural disasters have cost ECA countries about $70 billion in economic losses. Most of the damage has occurred in Armenia, Romania, Poland, Russia, and Turkey.

Meanwhile, climate change scenarios project even more frequent weather extremes, including increased flooding, heat waves, and drought, which will cause even greater losses. Changing trends and nonlinear tipping point impacts (such as polar ice sheet collapse) can also set off abrupt disasters.

But whatever the uncertainty of climate projections, floods, heat waves, droughts and snow emergencies will still occur, and still take a toll on human life and health as well as on buildings, infrastructures, and ecological systems. Taking steps to reduce the risks to people and structures from weather-related disasters is a worthwhile endeavor that will always pay off over time.

By investing in strategies and systems for lowering the risk from one hazard, a government is strengthening a society's capacity to prepare for and adapt to a range of other threats. Planning for the extremes will lessen physical damages and save lives, while softening the economic impact.

An essential starting point is to define risk management as a priority. From this base, a range of actions—from hazard warning and monitoring systems to employing financial instruments and disaster insurance products—can help countries manage hazards from or intensified by climate change.

Monitoring the weather to know when extremes are coming is a critical capacity, but one which has deteriorated through underfunding and other pressures that characterize the post-Soviet transition in most of the region. Information technologies have fallen behind, as has training for key personnel. While weather monitoring systems in the region have deteriorated, systems in other parts of the world have become more reliable. In many parts of the world, thanks to improved technology, seven-day forecasts are nearly as accurate as three-day forecasts were in the early 1980s.

For most countries in ECA, there is both the opportunity and the need to catch up with advances in weather forecasting, and to employ improved systems for managing disaster risks. Sophisticated disaster risk management would lessen countries' vulnerability to weather extremes; and improved weather tracking and forecasting would help anticipate emergencies and provide protection for human life and critical structures. By making the necessary investments today, countries would not only contain losses from disasters but build a variety of useful capacities that would benefit productive sectors such as agriculture, aviation, and energy.

What follows is an analysis of the shortcomings and the opportunities in better preparing for weather risks.

Softening the blow when disaster strikes[49]

To handle today's physical and economic climate, countries need strategies to lessen the impacts of natural hazards and the environmental and structural breakdowns they cause. Some aspects of these strategies involve physical structures, while others focus on information systems or financial protection through insurance.

Current capacity in ECA

In the difficult transition from centrally planned economies, the region has overhauled most political, social and administrative structures, demilitarizing and restructuring many disaster management functions. The process of restructuring and decentralization—carried out in an environment of systemic change and in some countries, political instability—inevitably left gaps in responsibility for maintaining and improving existing mechanisms and services.

A 2004 study analyzed the capacities of all ECA countries to manage the multiple risks posed by natural disasters (Pusch 2004). In many European and Central Asian countries the existing mechanisms are insufficient for the current level of vulnerabilities, and will be more inadequate still if the more extreme scenarios projected by climate change models materialize. Some of the principal findings of shortcomings and possible improvements follow:

The concept of hazard risk management is not fully institutionalized. Countries have elements of a new regulatory framework in place, but many governments lack statutory authority to devise and execute comprehensive, multi-sectoral disaster risk management programs.

Coordination mechanisms between authorities are under-developed. Countries need better coordination between sectors, as well as stronger linkages between the central and local levels.

Hazard warning and monitoring systems require improvement. Hydrometeorological systems in the region need to incorporate recent technological advances that have dramatically strengthened forecasting capacities in other countries.

Economic considerations are not fully integrated in investment decisions. Disaster risk management needs to incorporate rigorous cost-benefit or cost-effectiveness analyses so that investment priorities can be solidly established.

Catastrophe risk financing tools are not fully used. Most countries in the region can potentially access capital-market instruments to lessen the risks posed by natural disaster. But officials need expert support to master the available tools that other countries have already begun to use.

Funding of disaster risk mitigation is insufficient. Recovery and reconstruction are much more costly in the aftermath of a disaster; shifting investments away from clean-up towards mitigation of risks can lower costs significantly.

Information and communication systems require upgrading. Countries need the capacity to gather, interpret, and communicate vital information during an emergency. Some countries in the region, including Turkey, Romania, and Croatia, have initiated improvements in their emergency communication and information systems, but many others are lagging behind.

[49] This section is based on: "Climate Change Adaptation in Europe and Central Asia: Disaster Risk Management" by John Pollner, Jolanta Kryspin-Watson, Sonja Nieuwejaar, a background paper commissioned for this report.

There is evidence that countries are already experiencing more frequent episodes of extreme weather. SIGMA, the catastrophe analysis arm of Swiss Re, one of the major global reinsurance companies, has also reported increasing incidences of weather-induced disasters in countries of the region (table 7.1).

TABLE 7.1 REPORTED INCREASED INCIDENCE OF WEATHER-INDUCED DISASTERS IN ECA

Country	Hazard
Bulgaria	Cold wave, floods
Croatia	Floods
Czech Republic	Cold wave, floods
Estonia	Cold wave
Hungary	Wind storms, floods
Latvia	Snow fall, extreme cold, power shortage
Lithuania	Snow fall, extreme cold, power shortage
Moldova	Snow fall, extreme cold, power shortage
Montenegro	Floods
Poland	Cold wave, floods
Romania	Cold wave, floods
Russia	Cold wave
Serbia	Floods
Slovakia	Floods
Turkey	Cold wave, floods

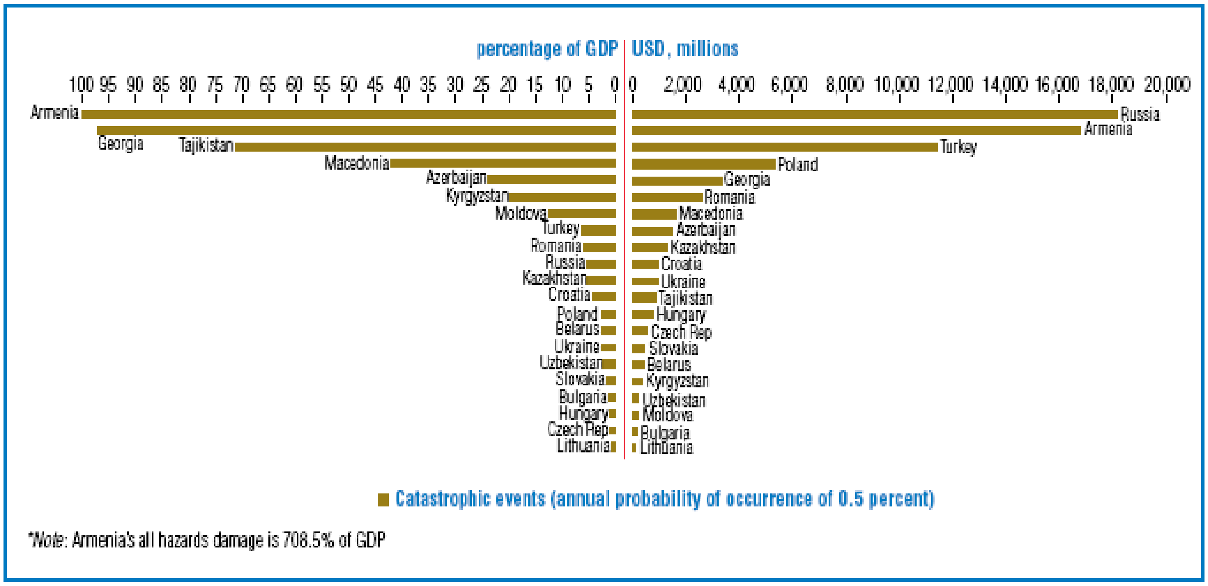
Source: Pollner et al. 2008.

With climate change contributing to the increase in weather extremes, disaster risk management becomes an urgent component of any climate change adaptation program. To reduce vulnerability, a disaster risk management program must incorporate five key elements:

- Risk assessment
- Mitigation investments addressing specific hazards
- Catastrophe risk financing
- Institutional capacity building
- Emergency preparedness and management

What might seem like a low-probability event can translate into a major blow to the economy. Catastrophic events that have an annual probability of occurrence of 0.5 percent threaten an economic loss for Armenia, Azerbaijan, Georgia, Macedonia, and Tajikistan that exceeds 20 percent of GDP; 10 percent for the Kyrgyz Republic and Moldova; and 5 percent of GDP in Kazakhstan, Romania, Russia, Turkey, and Southeastern Europe. Figure 7.1 shows the economic loss potential of catastrophic events on the GDP of each ECA country.

FIGURE 7.1 ECONOMIC LOSS POTENTIAL OF CATASTROPHIC EVENTS FOR ECA COUNTRIES



Source: Pusch 2004. *Notes:* Does not include drought, forest fire, or industrial accident hazards.

Spreading the risk: budgeting, facilitating and accessing insurance protection

For the most part, current government budgets in ECA are grossly insufficient to finance large losses from extreme events, while insurance protection is mostly inadequate to make up for the shortfall. An exception in the region is the Czech Republic. Flooding in 2002 caused €3 billion in damages, but after absorbing lessons from the experience of flooding in 1997, the Czech government could report that 40 percent of losses in 2002 were insured (CEA Insurers of Europe 2007). A rational fiscal policy would budget annual premiums for insurance, avoiding the greater disruption of having to make massive expenditures once a disaster hits.

Within the global catastrophe insurance market, insurance premiums for extreme events fluctuate, complicating budget planning for government. However, vulnerable countries can protect themselves against catastrophic risk *and* premium volatility by using capital markets. The annualized risk of extreme losses from weather events induced by climate change to date has been in the 1 percent range, a level of risk that is normally acceptable to the markets. Thus, there is room for the broader private financial sector to absorb and spread the risks, both domestically and internationally. Two potentially useful mechanisms for more efficient management of catastrophic risk are pooled insurance coverage supported by liquidity and credit enhancement facilities, and weather-indexed bonds to securitize risk.

Multilateral development institutions can support the development of these mechanisms, while still ensuring actuarially fair premiums. For example, the Caribbean Catastrophe Risk Insurance Facility implemented a risk pool with World Bank support, which reduced the cost of premiums paid by the island governments for coverage for extreme hurricane and earthquake events. The World Bank also assisted Mexico in launching an indexed catastrophe bond for coverage in the event of a massive earthquake.

Currently, the Bank is assisting a number of ECA countries in establishing the Catastrophe Risk Insurance Facility, which will pool individual disaster risks and provide coverage to homeowners and businesses in Southeastern and Central Europe.

Reinsurance from foreign companies can lower the price of disaster insurance, but the reinsurance itself can be costly. When the domestic insurers shift all but very low levels of risk to reinsurance companies abroad, the coverage is generally expensive because of the high likelihood that it will be triggered. Contracting reinsurance only for much higher levels of loss would lower the premiums.

But when catastrophic events occur, and reinsurance companies experience massive payouts, premiums rise and extreme event reinsurance markets then tighten. Thus, while helpful, reinsurance is not a panacea.

When global insurance and reinsurance markets become too costly, an alternative is the “catastrophe bond” market, which exists in Japan, Europe, and the United States. Investors buy high-yield bonds from the party that seeks to be insured. These bonds can either be backed by premiums collected on insured assets, or can be structured as a financial option using other calibrations. Many of these risk management methods could be adapted for use in ECA countries.

Direct government involvement can play a part in insuring against losses from extreme events associated with climate change, with catastrophe bonds or reinsurance arrangements available as options. Another insurance innovation which national governments could facilitate is the creation of a central fund for catastrophe risks. A mechanism could be established in which liquidity and credit enhancement facilities support insurance coverage against catastrophic risks. The domestic insurance industry would transfer catastrophic coverage to a central fund regulated by the government but operated by the insurance industry itself. The risks covered would not be reflected on the balance sheets of local insurers but would be liabilities of the pooled fund. The international insurance industry could then reinsure climate induced catastrophic coverage under the fund up to a specified loss limit. Multilateral institutions might provide contingent credit at the next highest loss level, supporting the liquidity of the fund in the event of immediate large losses in the initial years of operation.

Finally, weather-indexed bonds are another insurance instrument that can mitigate climate-related risk. Catastrophe bonds, based on payouts linked to measurable weather events (as reflected in weather indexes or parametric measures), have the advantage of being relatively easy to implement once a reliable weather measurement mechanism is identified. They bypass the traditional insurance loss adjustment process, which requires site-by-site evaluation of losses before indemnity is provided. The payout is simply based on the weather index reaching a certain range.

The main risk with weather-indexed instruments is that the payout is not directly linked to actual losses. A payment might be made—with the bondholder losing interest and principal—even though the insured experiences no loss. Alternately, the insured party may experience a loss but receive no indemnity because the parametric index was not triggered. The instrument might be attractive to international investors for portfolio diversification, since natural disasters have little or no correlation with global financial market trends.

Mitigating the risks

Insurance schemes help countries transfer the costs of a disaster brought on by extreme weather. But it is also important to take steps that actually mitigate the risks by making structures, people, and ecological systems less vulnerable to damage from a weather-induced disaster. Following are ways—several already alluded to in previous chapters—that government can lower the risks:

Retrofitting: the modification of existing structures to withstand natural disasters. Examples include installing back-up valves in sewage and water pipes, elevating structures, and installing storm shutters or foundation strengthening.

Regulations: by controlling the use of land and the construction of buildings, governments can significantly reduce the potential losses from disasters. In some cases, risks could be lowered simply by enforcing existing zoning and building codes.

Protective structures: structures such as sea walls and levees can protect buildings and people and mitigate the impact of floods and storms.

Natural resource management: better managing of natural resources—controlling erosion, managing forests, and restoring wetlands—preserces ecosystem services that minimize the risk of disasters.

A critical element in reducing vulnerability is an analysis of human settlements and infrastructure in the high-risk areas. Geographic Information Systems (GIS), with layers of digital data, can be used to create risk maps and data sources that help decision-makers to assess and locate risks, take preventive and preparedness measures, and set investments priorities.

Some risk mitigation steps will need to be specific to particular hazards. Fire protection is an important component in protecting forest and grassland, particularly in Southeastern Europe, where the growing frequency of wildfires highlights the risks. Particularly helpful might be the development of an early warning system to predict when and where forest fires are more likely to occur, as well as a monitoring system that helps with response coordination.

Understanding when extreme weather is coming[50]

Thirty years ago, weather forecasting and overall hydrometeorological (hydromet) services in many ECA countries were among the most advanced and reliable in the world. However, the status of most weather services among the ECA countries has deteriorated considerably in the last two decades, mainly as a consequence of persistent under-financing during the arduous transition that followed the end of central planning and the break-up of the Soviet Union.

Performance has deteriorated in virtually all the region's weather services, and certain agencies are on the brink of collapse. Surface data collection stations have closed, and those that remain open record a more limited set of parameters on a less frequent basis using instruments that are aging and failing. Communications equipment to convey station data to headquarters for analysis is often obsolete, unreliable, labor-intensive, and expensive. Training is inadequate both to keep the skills of senior staff current, and to prepare a sufficient number of incoming staff.

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[50] This section is based on "Weather and Climate Services in Europe and Central Asia," by Lucy Hancock, Vladimir Tsirkunov, and Marina Smetanina (World Bank Working Paper No. 151).

Worrisome examples of shortcomings proliferate in ECA. Turkmenistan has no upper-atmosphere sensing stations at present, which compromises the safety of aviation in Ashgabat. Tajikistan's network of weather stations was severely damaged in the conflict of 1992–1998, and reliable weather time series are relatively unavailable. Kazakhstan does not have meteorological radars or specialized stations to receive satellite data. In Georgia, most meteorological and hydrological stations have closed, upper air observations have halted, and only one meteorological radar is in operation. In Ukraine, 90 percent of all instruments have exceeded their intended service life, and many facilities are in urgent need of repair.

In sum, the range of the accumulated problems is so great that, without massive modernization, networks in some ECA countries are on their way to becoming completely dysfunctional. No longer able to count on their own weather services, countries would be forced to depend on low-resolution forecasts prepared by others that often would miss significant local and rapid-onset hazards, including floods, frosts, and severe storms. The perils of a weakening forecast capacity have become evident in Russia's system, where the share of hazardous weather phenomena that were not picked up and forecast increased from 6 percent at the beginning of 1990s to 23 percent only ten years later.

Recent research underscores the value of investment in hydromet services. A study in China concluded that expenditures on the meteorological service had a cost/benefit ratio of between 1 to 35 and 1 to 40 (Guocai and Wang 2003). An estimate in Mozambique suggested a cost benefit of 1 to 70 for investment in the meteorological service, which needed to be rebuilt after that country's civil war. Mozambique saw directly the consequences of being uninformed and unprepared: when floods swept the country in 2000, it cost Mozambique nearly half its GDP.

A number of easily accessible technologies and available upgrades to weather forecasting systems would be generally affordable, as long as governments budget, staff, and equip hydromet services at adequate levels. Some examples:

Bandwidth. A global telecommunications system organized by the United Nations World Meteorological Organization (WMO) shares global forecasts and data. Yet ECA's underfunded agencies are often unable to make full use of this resource for lack of bandwidth to download large files.

Satellite dishes. Weather satellites launched over Europe broadcast low-cost, or no-cost, images of storm systems, fires, coastal zone pollution, and other environmental data. However, many weather agencies in ECA cannot make use of this critical data because they lack satellite dishes or processing capacity.

Local area modeling. Global communities of experts have jointly devised open-source models for weather prediction that lend themselves to local weather forecasting that can be run on computers only slightly more powerful than commonly used desktops. Many countries would benefit from training in use of these packages.

Forecasting workstations. In some countries, satellite and radar data from neighboring countries would be available, but weather agencies often lack the workstations and software to make use of the data for forecasting purposes.

These widely available tools won't take the place of the more comprehensive modernization that most ECA hydromet systems need. To manage more frequent weather extremes and changing patterns in heat and precipitation, national systems will need to draw on data from radars, surface weather stations, upper-air sounding stations, hydrological stations, and specialized networks. These inputs will need to flow to a national headquarters through efficient telecommunications networks. Staff will need training to produce accurate forecasts covering a three-day period, along with useful seven-day forecasts specific to locations within 10 kilometers. This level of performance would not only help countries to warn citizens of pending weather catastrophes, but would provide valuable information to the agriculture, water management, and transport sectors.

Often, the benefits of timely and accurate forecasts, for reducing disaster impacts (box 7.1) or improving decision making in agriculture, can be easily measured. Increased accuracy in forecasting would assist in the timing of fertilizer application and pest and disease control, avoiding over-application that raises input costs and exacerbates environmental damage. There is abundant evidence that farmers in Tajikistan, Montenegro, Uzbekistan, and Albania would benefit significantly from improved monitoring and forecasting.

Forecasts also would enable mitigation of frost damage, which is a serious problem for agriculture in Ukraine, Turkmenistan, Montenegro, Moldova, Armenia, Macedonia, Kazakhstan, and Bosnia, among others. Tools to mitigate the effects of sudden freezes are being developed globally, but cost-effective application depends on accurate forecasting.

BOX 7.1 POLAND'S FLOOD DISASTER LEADS TO STEPPED-UP PREPARATION

Poland, caught by surprise in massive floods in 1997, resolved to face future weather extremes better prepared. A Flood Emergency Project, supported by the World Bank and the European Bank for Reconstruction and Development, included development of a monitoring, forecasting and warning system, flood prevention planning, and upgrading of flood prevention infrastructure. It also supported development of non-structural measures to limit damage, including regulations for economic use of risky areas, flood impact minimization plans prepared by local communities and groups, warning systems, and flood insurance, among other measures.

The upgraded system cost $62 million to establish and $8 million a year to maintain. The investment is small when set again the costs of the 1997 disaster: the floods inundated dozens of cities, and hundreds of villages, costing 55 people their lives and causing $3.4 billion in damages.

Extreme weather doesn't respect national borders. Countries in the region have unnecessarily suffered because critical weather information wasn't shared properly among neighboring countries. Damaging weather patterns of special importance include Atlantic and Mediterranean cyclones and intrusions of cold air from the far north. Rapidly changing, dangerous events are best monitored through transboundary data sharing that goes beyond WMO requirements (Ogonesyan 2004).

However, gaps in data sharing persist in ECA, often because of political instability and conflict. The Caucasus region and the Balkans have experienced significant breaks and gaps in data sharing as a result of the clashes and upheavals of the past decade.

Other parts of the world have had some success with regional multi-hazard centers, and public-private partnerships, where private firms play a role in processing or disseminating weather data. Both these approaches could prove useful in rebuilding ECA's forecasting capacity.

Different sub-regions within ECA face different challenges in upgrading their systems. In the mountainous Balkans, there is a relatively sparse network of weather stations, limiting countries' ability to update and localize global weather data. Accessing and incorporating data from Greek weather stations would be helpful. Similarly, the Caucasus region suffers from a paucity of operating weather stations, and might benefit from heavier use of data from Turkey.

In the water-stressed, mountainous areas of Central Asia and the Caucasus, weather systems are especially critical for water management. In these countries, where snow and glacier melt feeds local rivers, monitoring of snow accumulation and glacier volume is needed to project water resources and water quality. Central Asia's mountains pose other challenges. Oceanic air masses moving over them can first appear to exhaust their supply of moisture, but then rise and cool, collecting sufficient moisture to cause heavy rains and flash flooding in the Kyrgyz Republic, Tajikistan, Kazakhstan, and Uzbekistan. Additional monitoring stations would help forecasters track the changing air patterns.

Conclusion

ECA countries are not the world's most vulnerable to weather extremes. According to data assembled from ministries responsible for emergencies in a number of ECA countries, annual losses from weather events range from 0.5 percent to 1.9 percent of GDP. That compares to a global range of 0.1 percent to 5 percent.

However, unusually large storms and floods can cause, and have caused, damages that far exceed these averages. And as weather extremes become more frequent, it makes sense to act early to minimize the losses.

Investment in forecasting systems that provide reliable and timely warning is critical, with analyses demonstrating that outlays to modernize hydrometeorological systems pay for themselves many times over. Equally critical are disaster risk management measures, both to lessen physical exposure to weather-related disasters, and to limit or transfer economic losses when disasters do occur.

Another critical concern is to provide adequate safety nets for those who, despite improved warning systems and disaster risk management plans, suffer devastating losses in disasters. Analysis of the adequacy of existing safety net programs, and recommendations for practical ways of filling existing gaps, will be a high priority for ECA countries and their international partners given the additional strains of a changing climate.