Learning Lessons

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Independent Evaluation ADB

Intense Climate-Related Natural Disasters in Asia and the Pacific

The frequency of intense floods and storms is increasing globally and in Asia and the Pacific amid the specter of climate change, pointing to the need for better mitigation and adaptation to natural disasters.

The rainfall and temperatures associated with these events are becoming more variable and extreme, while the evidence suggests that coastal regions in South, Southeast, and East Asia are at greater risk.

There is also evidence that the more frequent and intense impact of these weather-related disasters results from a confluence of three factors: the changing nature of the hazards, rising exposure of populations, and limited adaptive capacity in many countries. Disasters also seem to be taking a heavier toll on low- and lower-middle-income countries. In other words, exposure, sensitivity, and lack of adaptive capacity turn a hazard of nature into a natural disaster.

Such calamities erode the otherwise dramatic progress on poverty reduction and other development gains of the past two decades. The People's Republic of China and India, for example, have been at the forefront of poverty reduction in the past three decades, yet both are also among the countries in Asia and the Pacific at greater risk from climate-related disasters.

This synthesis presents the lessons drawn from evaluations of information sourced from publicly available databases.[1]

Highlights of Lessons

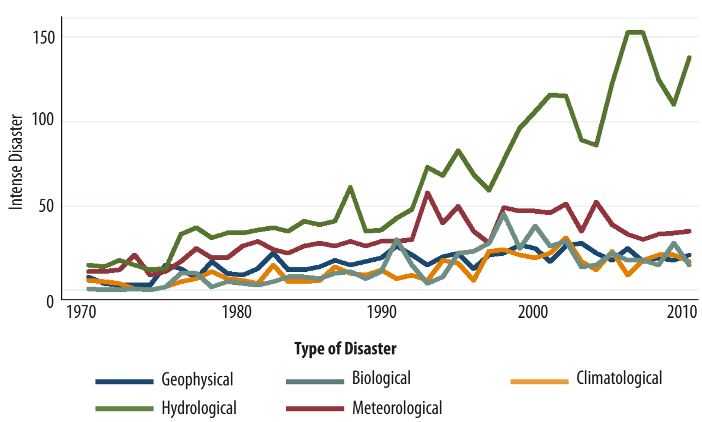
Climate-Related Disasters on the Rise

Natural disaster data sourced from the Emergency Event Database (EM-DAT) established by the Centre for Research on the Epidemiology of Disasters consist of:

- geophysical events (earthquakes, volcanoes, dry mass movements)
- meteorological events
- hydrological events (floods, wet mass movements)
- climatological events (extreme temperature changes (drought, wildfire)
- biological disasters (epidemics, insect infestations, animal stampedes)

Intense natural disaster events—those killing 100 or more people or affecting 1,000 or more— generally increased during 1971 to 2010. Such global trends are largely due to the rise in intense hydro-meteorological disasters (see Figure 1).

Figure 1: Global Frequency of Intense Natural Disasters



Source: EM-DAT

[1] Data were sourced from the Emergency Event Database (EM-DAT), the HADCRUT3 temperature database, the Global Precipitation Climatology Centre database on precipitation, the University of California at San Diego Scripps database on carbon dioxide stock (from Mauna Loa air situ samples), and the World Development Indicators database to examine the nexus of climate-related natural disasters to climate change, population exposure to disasters, and other factors.

The number of intense hydro-meteorological disasters globally in 2001–2010 increased 66% to 2,004 from 1,210 in 1991–2000. During 1991–2000 the number of these disasters rose about 80% over the figure (671) in 1981–1990.

Asia and the Pacific accounts for about two-thirds of the 1.6 million lives lost to intense natural disasters during 1991–2000. Meanwhile, about 234 million people per year globally, on average, were affected by intense natural disaster during 2001–2010, about four times the figure in 1971–1980.

Changing Climate and Hazards

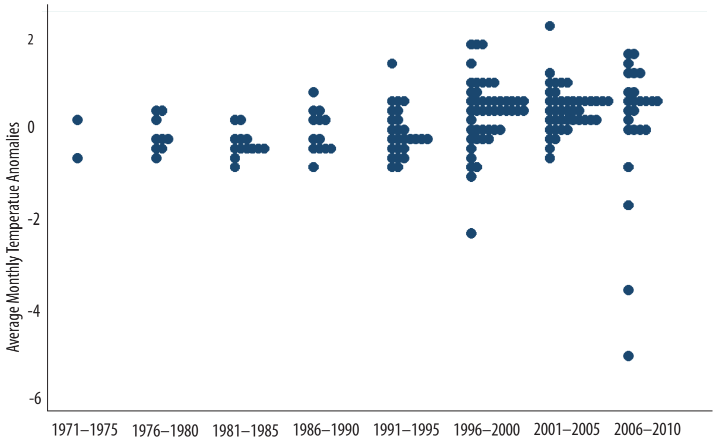
The Intergovernmental Panel on Climate Change in reports put out during 2004–2007 declared that global warming in the past century could not be attributed solely to natural variability.

Changes in temperature anomalies and in precipitation deviations from the norm across Asia and the Pacific have also been empirically linked to increasing greenhouse gas emissions (proxied by rising carbon dioxide concentration). For intense climatological disasters in Asia and the Pacific, concomitant average monthly temperature anomalies are found to have increased and become more variable (see Figure 2). The same is true of temperature during months when intense meteorological disasters occurred.

Disaster Risk Depends on Hazard, Exposure, and Vulnerability

Natural disasters have to be viewed within a framework of risks, which include the hazard itself, as well as a community's exposure and vulnerability to it. A flood may cause less damage in a community where people are more prepared, while the greater the adaptive capacity of a community, the lower its vulnerability. Exposure, sensitivity, and lack of adaptive capacity, in other words, turn a hazard of nature into a natural disaster.

Figure 2: Monthly Temperature Anomalies during Intense Climatological Disasters



Note: Distributional shifts across 5-year periods in monthly temperature anomalies during intense climatological disasters in Asia and the Pacific. The data represent monthly combined land and marine sea surface temperature anomalies.
Source: Climatic Research Unit of University of East Anglia

Some subregions (Southeast Asia, South Asia and East Asia) in Asia and the Pacific, particularly Bangladesh, the People's Republic of China, India, Myanmar, and the Philippines, are more at risk from hydrological and meteorological disasters than other areas in the region.

The results of panel logistic regression models (Table 1) identify major factors explaining the risk from intense, weather-related disasters in Asia and the Pacific. These include (i) the rising number of people exposed to hazards in low-lying cities near coasts (approximated by population growth); (ii) adaptive capacity (high population density and income) (iii) climatic factors (percentage of a country's land that is tropical, amount of precipitation, average temperature).

Table 1: Weather-Related Disaster Risk in Asia and the Pacific (1971–2010)

Variables	Asia and the Pacific	East Asia	South Asia	Southeast Asia	Other subregions
A. Hazard/ Climate Variables					
Annual average temperature anomalies	1.53	5.19**	1.29	1.44	0.75
Annual average precipitation deviations from normal	1.02	0.98	1.07***	1.03**	0.99
Percentage of land in tropics	1.01		1.03**	0.99	1.09***
Percentage of land in temperate zone	0.97*	0.98	0.99	1.00	0.97
B. Exposure Variables					
Population (in natural log) exposure	4.69***	3.53**	4.49***	3.83**	10.37***
C. Adaptive Capacity/ Vulnerability Variables					
Whether economy is low income or lower middle income class, and population density is at least 75 per square-km	1.65	0.56	0.16	3.51*	5.07
Constant	6.45***	3.94	0.21	2.00	9.30
Memo Notes:					
Model Fit Statistics					
Chi^2	90.82	20.05	45.71	37.21	29.66
N	2,320	320	320	440	1,240
Akaike Information Criterion	867.34	150.25	216.87	292.23	194.58
Schwarz Bayesian Information Criterion	907.58	172.86	243.25	320.84	230.44

Legend: *p<.05, ** p<.01, ***p<.001

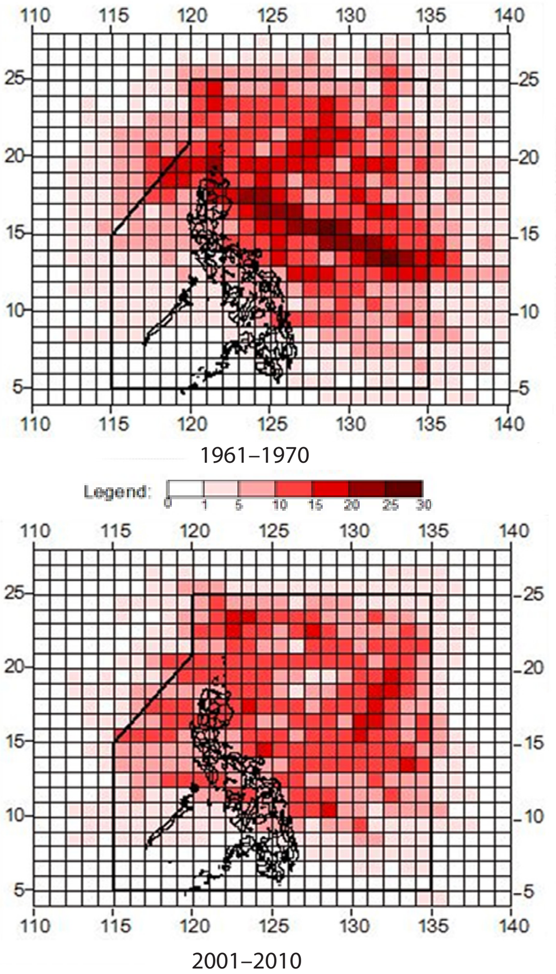
Note: Table entries reflect odds ratios for panel logistics regression models identifying determinants of weather-related disaster risk in Asia and the Pacific.
Sources: EM-DAT and WDI Indicators, World Bank (2011)

The strength of these risk-factors depends on location. The amount of precipitation (deviations from normal) explains weather-disaster risk in South Asia and Southeast Asia; in East Asia, temperature anomaly deviations explain weather-related disaster risks. The lower the adaptive capacity, indicated by high population density and low income, the greater the risk. Southeast Asia comes out prominently on this measure. In South Asia, the greater the percentage of land in tropical zones, the more prone the country is to weather disasters.

Climate and Weather Trends in the Philippines

Climate is changing in the Philippines, as are all the elements of risk: hazard, vulnerability, and exposure. While the annual frequency of tropical cyclones shows no trend, damage and casualties are rising, with huge recent damage from tropical cyclones of lower intensity than typhoons, but with much heavier rains. The typical path of tropical cyclones has also changed in the past sixty years. In the 1950s and 1960s, the most frequent tropical cyclone activity was in the eastern part of the country; by the 1970s, the activity had shifted toward northern Luzon, albeit with lower frequency in the last two decades. The path of tropical cyclones has also shifted to the central Philippines (Visayas) in the latest decade.

Figure 3: The Frequency of Tropical Cyclones per Decade in the Philippines (1961–1970 vs 2001–2010)

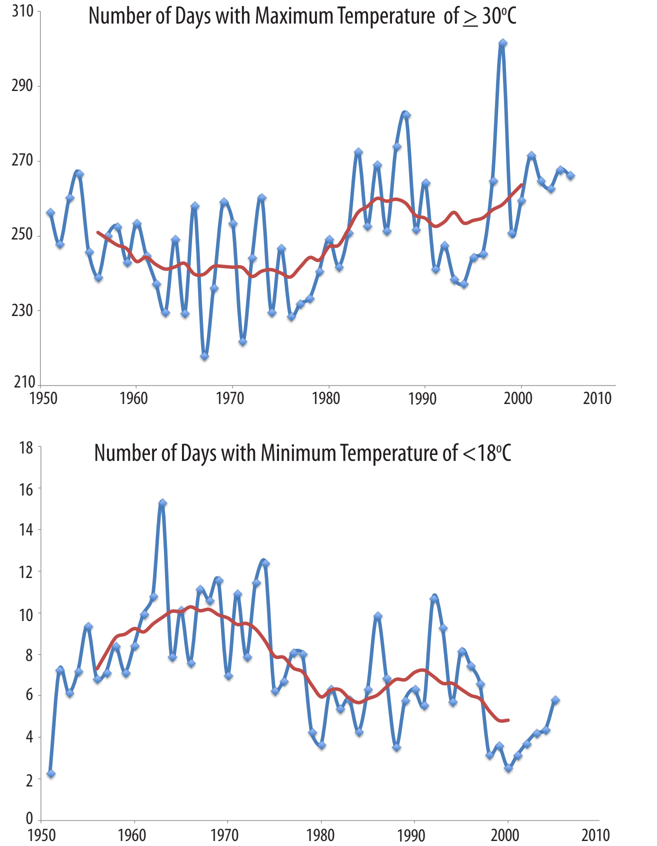


Note: The graph represents the spatial distribution of the frequency of tropical cyclones during the 1961–1970 and 2001–2010 in the Philippine area of responsibility.
Source: Philippine Atmospheric, Geophysical and Astronomical Services Administration (PAGASA)

As in many parts of the world, temperatures are rising in the Philippines. The annual average temperature rose at a rate of 0.65 °C during 1951–2010, or an average of 0.0108 °C annually. The rate of increase in temperature during the last 30 years (0.0164°C per year) is also faster than the long-term rate of increase. The number of hot days and warm nights is increasing, and the number of cold days and cool nights decreasing (Figure 4).

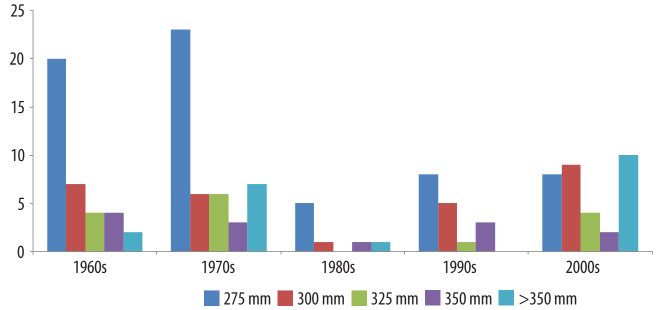
There is also evidence of increasing frequency of extreme daily rainfall. For example, over Luzon, the northern most and largest of the three major island groups of the Philippines, Figure 5 illustrates that more frequent rainfall of greater than 350 millimeters is recorded in the latter part of the 2000s, than the 275 millimeter events of the 1960s and 1970s.

Figure 4: Frequency of Hot Days and Cold Days in the Philippines (1950–2010)



Notes: (a) Annual number of occurence days per station calculated from data taken at 28 observation stations, (b) the thin line shows the annual number of days per station, (c) the heavy line shows the 11-year running mean.
Source: PAGASA

Figure 5: Frequency of Heavy Rainfall Events in Luzon



Source: Manila Observatory

Conclusions

- Intense climate-related disasters, especially weather-related, are rising, particularly in some subregions of Asia and the Pacific. The concomitant distribution of temperature and precipitation conditions of these events appears to be becoming more variable and extreme.
- The main effects of climate change may well be in the near future. There is evidence that the increasing frequency of intense weather-related disasters is caused by a confluence of the changing nature of hazards that are affected by climate change, including human-induced climate change, rising population exposure, and limited adaptive capacity.
- Disaster risk varies from country to country, with coastal countries in Southeast, South, and East Asia more prone to weather-related disasters, particularly Bangladesh, the People's Republic of China, India, Myanmar, and the Philippines. The evidence suggests that disasters are taking a heavier toll on such low-income and lower-middle-income countries.
- Data from the Philippines illustrates these issues well, with the path and frequency of tropical cyclones changing and the number of hot days and warm nights increasing.
- Better mitigation and adaptation, such as accelerating plans for the clean development mechanism of the Kyoto Protocol, as well as refining hazard mapping and various risk assessment systems, are needed. Mainstreaming disaster management and climate adaptation is ultimately about reducing disaster risk, aside from mitigating the impact of the consequences of disasters.

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About the Asian Development Bank
ADB's vision is an Asia and Pacific region free of poverty. Its mission is to help its developing member countries reduce poverty and improve the quality of life of their people. Despite the region's many successes, it remains home to two-thirds of the world's poor: 1.8 billion people who live on less than $2 a day, with 903 million struggling on less than $1.25 a day. ADB is committed to reducing poverty through inclusive economic growth, environmentally sustainable growth, and regional integration.

Based in Manila, ADB is owned by 67 members, including 48 from the region. Its main instruments for helping its developing member countries are policy dialogue, loans, equity investments, guarantees, grants, and technical assistance.

Learning Lessons is a synthesis of key lessons drawn from evaluations of ADB-supported projects and programs. This synthesis may include contexts derived from literature review. Lessons presented in this brief are not prescriptive, and users are advised to carefully review these lessons in the context of country, sector, and thematic conditions.

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