Chapter 2

# ARE SHOCKS BECOMING MORE FREQUENT OR INTENSE?

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Policymakers, practitioners, and researchers frequently cite an increase in shocks around the world as a reason for focusing on resilience. But have shocks actually increased or become more severe and far-reaching? What does the landscape of shocks look like?

Shocks are external, short-term deviations from long-term trends—deviations that have substantial negative effects (which may be short-lived or long lasting) on people's state of well-being, level of assets, livelihoods, safety, and ability to withstand future shocks. Many shocks are unexpected, but in some cases, such as drought or conflict, the shock may be expected year after year although the individual, community, or system lacks the resilience to prepare for or mitigate it. In other cases, such as climate change, the general shock could be expected but the effect on a particular individual, community, or area could be unexpected.

This brief examines five types of shocks—conflicts, natural disasters, climate change, food price volatility, and health crises—as they relate to food safety and agriculture. It assesses their frequency, severity, or both during the past few decades as part of a selective, nonsystematic review.

## Conflicts

While the number of conflicts worldwide has, in general, decreased or remained stable since World War I, and the number of battle-related deaths has decreased, different forms of conflict may cause concern for future trends. Moreover, the costs of conflict—on human capital, economic growth, poverty reduction, and more—continue to exact a heavy toll on countries around the world.

Overall, the years 2000 to 2009 experienced the least conflict as a decade since the 1970s, (Themnér and Wallensteen 2013) though many conflicts

This chapter was originally published as *Are Shocks Actually on the Rise? A Selective Review of Five Types of Shocks,* 2020 Conference Brief (Washington, DC: International Food Policy Research Institute, 2014).

that persist are related to previous conflicts. All civil wars initiated after 2003 were resumed from previous civil wars, and 90 percent of conflicts since 2000 have been in countries that have already experienced a civil war (World Bank 2011). The nature of conflict has changed over the decades; the number of wars—conflicts leading to particularly high numbers of fatalities—has decreased by nearly 50 percent from the 1980s to the first decade of this century, and battle-related deaths have decreased by 76 percent since 1989 (Human Security Research Group 2012). However, conflicts in which external governments provide military support to one of two interstate warring parties are on average twice as deadly as similar conflicts without external intervention and account for a growing number of the world's active conflicts, increasing from 12 percent during 1950–1989 to 16 percent during 2000–2008 (Human Security Research Group 2012). While conflicts are not increasing, the deadly nature of more internationalized conflicts may be a concerning trend for the future.

## Natural Disasters

### Drought

There is not much agreement on historical drought trends. Some point measurement–based and climate and hydrological model–based studies suggest that the number of droughts has been increasing during the past few decades, although the former lack sufficient geographic coverage to offer strong conclusions. A few observation- and satellite-based studies have found subtle drying trends during the past 20–30 years in such regions as the southern United States and central South America, but disagree on all other regions (Dorigo 2012; Damberg and AghaKouchak 2013). Still other research has found little change in the total area affected by drought during the past 60 years (Sheffield, Wood, and Roderick 2013). The latest Intergovernmental Panel on Climate Change (IPCC) report indicates that the frequency and intensity of droughts are likely to have increased in the Mediterranean and West Africa and to have decreased in central North America and northwest Australia since 1950. The report notes a high confidence that drying in the Mediterranean, southwestern United States, and southern Africa is likely as global temperatures increase under climate change (IPCC 2013). While global data on the direct impacts of drought on food security, such as the effect of water scarcity on crop yields, are scarce, examples of the secondary effects of drought, such as food price spikes triggered by restrictive trade policies and panic purchases following a drought, suggest a serious impact on food security (Kallis 2008).

### Floods

Studies that look back at the past few decades show an increase in global precipitation and runoff, which greatly contribute to flooding. One study found an increase in rainfall extreme averages globally during the past 30 years as well as an estimated 7 percent increase in extreme rainfall intensity for every 1°C increase in global atmospheric temperature. The strongest increases were found in tropical countries, which tend to be some of the poorest in the world, though most weather stations saw an increase. These authors expect more frequent flooding around the world (Westra, Alexander, and Zwiers 2013). Other studies support these general conclusions, finding that annual extreme precipitation events have been increasing in frequency (Alexander et al. 2006) or that northern high latitudes face an increased risk of big floods (Milly et al. 2002). Indeed, higher latitudes and the equatorial Pacific Ocean are likely to see an increase in annual mean precipitation by 2100, while mid-latitude and subtropical dry regions will receive less (IPCC 2013).

### Hurricanes/Cyclones

Whether hurricanes or cyclones have increased in frequency is inconclusive, due to large fluctuations every year and decade as well as scarce historical data for many ocean basins. Many studies, especially those relying on climate models, offer conflicting results on storm frequency. Research suggests, though, that the *intensity* of these storms may have increased during the past few decades. One study showed that the strongest types of hurricanes—category 4 and 5—doubled between the 1970s and 2010, while the number of weaker hurricanes has remained constant (Webster et al. 2005). Another study found a large increase in the amount of energy expended by storms between 1975 and 2005, due to longer storm lifetimes and greater intensities, a record that is highly correlated with sea surface temperatures (Emmanuel 2005). As sea surface temperatures increase, as expected due to climate change according to the latest IPCC report (IPCC 2013), storms may become stronger and more destructive, posing a threat to developing and industrialized countries alike.

### Earthquakes

Earthquake frequency has seemingly remained somewhat constant since record keeping began. A more pertinent question is whether earthquakes are causing more fatalities. One study found that the average annual number of fatal earthquakes has been increasing throughout the 20th century, an increase attributed to population growth and increasing urbanization (Nichols and Beavers 2008). Other research has found that the fatality rate of earthquakes is falling due to

better infrastructure and health services (Daniell 2013). Looking to the future, the frequency of earthquakes with fewer than 5,000 fatalities can be reliably predicted, while those with more than 30,000 are too irregular for reliable predictions, even though they account for most of the fatalities. However, as the world urbanizes, earthquakes are more likely to hit some of the world's largest cities, which are located along plate boundaries. Eighty percent of these at-risk cities are in the developing world (Bilham 1995).

### Climate Change

Climate change is any variation in climate by magnitude, frequency, or persistence, over a period of time, usually a few decades or longer (IPCC 2013). The warming of the world's climate is "unequivocal" and "human influence on the climate system is clear" (IPCC 2013). During each of the past three decades, surface temperatures have been higher than in the previous decade; the pH level of ocean surface water has decreased by 0.1 from preindustrial times; and the levels of carbon dioxide and methane now surpass preindustrial levels by 40 percent and 150 percent, respectively (IPCC 2013). These trends are projected to continue or even worsen.

Climate change may benefit some farmers while devastating others. In areas with plentiful precipitation, warmer temperatures can lengthen the growing season, reduce frost damage, and enlarge plants' root surface area. In arid and semiarid regions, warmer temperatures may worsen droughts, exacerbating heat stress on crops and reducing yields (St. Clair and Lynch 2010). Indeed, climate change may worsen food insecurity in regions that are already food insecure, such as Africa and South Asia, with the worst yield losses occurring in maize, millet, sorghum, and wheat (Wheeler and von Braun 2013; World Bank 2009). If temperatures rise by 2.2°C –3.2°C, at the lower range of the business-as-usual scenario, global wheat and maize yields are projected to decline by 14–25 percent and 19–34 percent, respectively, from 2000 to 2050 (Deryng, Sacks, Barford, and Ramankutty 2011). These projections are supported by historical trends: each degree-day above 30°C in the period 1980–2008 reduced maize yields in Africa by 1 to 1.7 percent (Lobell, et al. 2011).

The effect of climate change on food security will depend on factors such as mitigation efforts, income, and population growth. An optimistic scenario, with strong income growth and perfect mitigation, is projected to lead to a 37 percent decline in the number of malnourished children in poor countries (Nelson 2010). But more pessimistic scenarios have been estimated to increase child malnourishment in low-income countries by 18 percent and increase

severe stunting by 23–55 percent in Africa and 61 percent in South Asia (Lloyd, Kovats, and Chalabi 2011).

## Food Price Volatility

The world has seen two major food price crises during the past six years. Local and international staple commodity prices rose steadily in 2006–2007 and then sharply early in 2008. They decreased significantly by the end of 2008 but then rose again in 2010, with another, less pronounced peak in February 2011 (Torero 2012). Prices remain high, second only to the heights reached in the 1970s. International prices of grain, including maize, rice, and wheat, were significantly more volatile in 2007–2010 than in 2003–2006. Going back even further, the volatility of international rice and wheat prices doubled from 1980–2006 to 2007–2010 (Minot 2013).

Studies have probed how much international price volatility is transmitted to regions and countries. A study of 11 countries in Africa found that although national-level food price volatility is high, it has not increased during the past few years (Minot 2013). Another study suggested that the 2008 crisis may have increased the total global undernourished population by some 63 million people (Tiwari and Zaman 2010). The factors believed to have contributed to international price volatility, including increased biofuel production, weather shocks, and speculation, are still at work, suggesting that volatility is likely to continue at least until the end of the next decade (Headey and Fan 2010).

## Health Crises Related to Food Safety and Agriculture

The transmission of pathogens from animals to humans, or through contaminated food or water, is often the cause of health crises related to food safety and agriculture. These pathogens create public health threats when ecological, social, and biological factors—such as increased density and movements of human and animal populations, changes in farming systems, or climate change and variability—compound one another (Bett 2011).

Zoonotic diseases—those that can be transmitted from animals to humans—account for 60.3 percent of emerging infectious diseases and are significantly increasing (Jones 2008). Some sources estimate one billion cases of endemic zoonoses, causing millions of deaths, each year (Karesh 2012). Zoonotic diseases can be devastating to a poor household whose livelihood depends on livestock, such as when its animals die from these diseases or a family member responsible for the care of livestock falls ill (Catelo 2006).

Mycotoxins, the highly toxic natural byproducts of molds that grow on crops—and build up in response to a variety of factors including drought, high rains, or high moisture—also pose a threat to human and animal health and may continue to do so as the climate changes. High incidences of aflatoxins, common carcinogenic mycotoxins, have been reported in years following severe droughts in semiarid countries such as parts of Kenya, while warm countries may experience dangerous levels of them with rains at or near harvest (Shiferaw, et al. 2011).

## Concluding Remarks

Although this brief does not represent an exhaustive review of shocks, the evidence suggests that while some shocks have not increased, others have become more severe or intense and will continue in this direction in the near future. A more robust and higher-quality body of evidence can inform policy decisions to help vulnerable populations better prepare for future shocks. Investments are also needed in continued monitoring and tracking of shocks, as well as in new tools and methods to improve detection and ensure frequent transmission of information.

Many of the trends described above suggest that poor people will be among those hit hardest. Investments are needed in early warning systems, infrastructure, education, and sustainable agriculture to enable these populations to prepare for and withstand shocks. As countries, institutions, communities, and individuals assess their capacity to predict, prevent, and recover from these shocks, they will also need solutions that bring together policy action, innovative technologies, and social support programs.

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