PART 1

KEY MESSAGES: THE NEXUS OF AGRICULTURAL PRODUCTION NETWORKS AND GLOBAL FOOD VALUE CHAINS AND NATURAL DISASTERS

Susan Cutter from the US points out the difference between food production and healthy food production. The US is a major food exporter but 7% of the US population – living in inner cities and more remote rural areas – have no adequate access to healthy food and balanced nutrition. In 2013, an unusual heat wave in Alaska related to an unusual demand in electricity caused major disruptions to the electricity grid. Deep freezers stopped functioning and large quantities of food got spoiled. Since 1960, crop losses due to disasters have accounted for US$3 billion annually or 24% of the total damage. Flooding in 2011 alone caused one US$1 billion damage in Arkansas, Mississippi, and Missouri. Additionally, the harbour infrastructure for bulk transportation of food was destroyed. In October 2015, extreme precipitation in Southern Carolina caused US$600 million losses in agriculture or 5% of the usual agricultural income. Disasters can have different impacts on different individuals. Poor and less-educated people are more vulnerable to disasters. The degree of vulnerability can be measured based on regional and local statistical information with what is known as Social Vulnerability Index.

Margreth Keiler and Sven Fuchs analyse agricultural production networks in relation to the mountain environments of Austria and Switzerland. They provide definitions of risk and hazard and point towards an underrepresentation of mountain risks in international outlines like the Hyogo Framework for Action and the subsequent Sendai Framework. Reducing the vulnerability of agricultural production networks and food value chains is an emerging field of science and is essential in ensuring the resilience of the regional, national – and sometimes also global – food systems. Loss estimation in food value considering the energy balance proposes that 48% of the total calories produced (edible crops, yields, and animal products, including slaughter waste) is lost across the whole food value chain. Infrastructure is an important part of the food value chain. Strategic or critical infrastructure may include, but are not limited, to energy, irrigation, transportation, and telecommunications.

Stefan Anderberg discusses how far organic agricultural production can contribute to an increase in the agricultural value chain and thereby create more employment and reduce poverty. In recent decades, organic agriculture has attracted increasing attention from governments, non-governmental organisations, and development agencies. Organic production has grown and organic products today are traded not only locally but nationally and internationally as well. Anderberg cites examples from four agricultural value chains: cotton, coffee, cacao, and oil seeds, products that belong to global food value chains where producers originate in the south while intermediates and consumers are primarily found in the north.

Chapter 1

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CHAPTER 1

THE PERILOUS NATURE OF FOOD SUPPLIES: NATURAL HAZARDS, SOCIAL VULNERABILITY, AND DISASTER RESILIENCE

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Food insecurity is a problem in developing and developed countries alike where deficits in the quality and quantity of food lead to hunger and malnutrition, impairing the health of millions. Reduction in global hunger was a key element of the United Nations Millennium Development Goals process (2000–2015). With a target to reduce the proportion of undernourished people by 50% by 2015, substantial progress was made. Today, however, 805 million people still remain undernourished, the majority of them living in developing countries (FAO, 2014). The new Sustainable Development Goals are more ambitious and set targets to end hunger and all forms of malnutrition by 2030. They also include goals to ensure sustainable food production systems through resilient agricultural practices and adaptations to environmental changes (United Nations, 2016). The success or failure of such goals will not be known for a decade.

Food security is a complex and intertwined problem of reliability, quantity, and affordability of nutritious food. The global interdependence of food supply chains alters availability of food. When one part of the food production chain is affected (e.g. on contamination, poor harvests, natural hazards, conflict), the consequences reverberate globally with reductions in supply and increase in prices. As most countries import at least some of their food needs such as staples like grains or tropical products such as tea, coffee, or fruits, this creates some dependence on global food chains. Moreover, global patterns of urbanisation are fundamentally altering food systems and, more significantly, food preferences, thus reducing the food security of the planet's 6.5 billion urban dwellers (Seto and Ramankutty, 2016).

Self-sufficiency in food means that a country can meet its own food needs from domestic production, one way that nations reduce food insecurity. In 2013, 77 countries were dependent on international imports to meet their basic food needs, an increase of 57% since 1961. More than 51 countries are more than 50% dependent on imports, while

13 are totally dependent on imports to meet their food needs (Gardner, 2015). The increased dependency on imports is related to population growth, loss of fresh water, loss of fertile agricultural land, and land conversion from food crops production to other uses. Land conversion is especially problematic in the developed world, especially near cities where farmland is rapidly being converted to urban uses such as housing, industry, and transportation infrastructure. For example, urban transformation of farmland in the US is significant, with nearly 4.1 million hectares of land (an area roughly twice the size of New Jersey) converted to urban-related land uses in 1997–2012 (Farmland Information Center, 2016) As part of the global food system, importing countries are highly vulnerable to natural interruptions in supplies (weather-related shocks such as droughts or floods, crop pests, or pathogens) and increased prices as supply and demand fluctuates (Puma et al., 2015). Even food-exporting countries experience growing constraints on production related to water availability, yields, fertilisers and pesticides, and prices. In many regions, farmers make more money on their crops when sold as biofuels or feed for animals rather than as food for people. The most significant, however, is climate change and its potential to negatively influence crop yields in many food-exporting countries, especially Brazil, Russia, and Australia (IPCC, 2014), and globally alter the patterns of food security.

Within national or regional food supply systems, natural hazards can cause disruptions not only in the food resource supply itself but also in the supply chain infrastructure and transportation to and from markets (Reddy et al., 2016). A recent analysis found that within developing nations, 22% of the total economic impact of hazards and disasters was from the agricultural sector: crops, livestock, fisheries, and forestry (FAO, 2015). However, global data are scarce so little is known about the sub-national impacts of hazards on the agricultural sector and the disproportionate burden placed on people reliant on agriculture for their livelihoods. The primary global hazards databases (MunichRe, EM-DAT, SwissRe) have no consistent accounting for direct and indirect agricultural losses from natural hazards, although some national databases separately record agricultural losses (e.g. DesInventar, SHELDUS).

This paper examines food security and the disproportionate impact of disruptions in food supplies on vulnerable populations in a developed world context. Telling the story of where the areas are and who are disproportionately affected by crops losses due to natural hazards in the US, the paper briefly illustrates the spatial and social variability in impacts. A more detailed case study of the 2015 flood in South Carolina and its impact on the agricultural sector and associated livelihoods highlights the difficulties in assessing the true costs of agricultural losses due to natural hazards.

Food Security and Food Production

In the US, food security is mostly an economic condition where households or individuals lack money or resources to acquire food. A typical American household spends almost a third of their income on housing, followed by transportation (17%), and then food (13%) (United States Bureau of Labor Statistics, 2015). The majority of Americans purchase food at grocery stores and supermarkets or from restaurants and other food vendors. The amount of money spent on food by households is a good indicator of their relative level of food security. The US Department of Agriculture found that per capita median weekly expenditures for food of US$37.50 or less produced food-insecure individuals (Coleman-Jensen et al., 2015). Fourteen percent of American households (17.4 million households) were food insecure at some time during the year (skipped a meal, did not eat for a day or more) because of insufficient money for food. The majority of these households have single women with children under 18 years old, individuals living below the poverty line, African-American and Hispanic heads of family, and families living in inner cities and rural areas (USDA, 2016a). The highest rates of food insecurity are in the southern half of the country (Figure 1), regions with significant poverty and minority populations living in both rural and urban areas.

Figure 1: Food Insecurity in the US, 2014

Food insecurity below U.S. average
Food insecurity near U.S. average
Food insecurity above U.S. average

Calculated by ERS based on Current Population Survey Food Security Supplement Data.
Source: United States Department of Agriculture, 2015.

Food is abundantly produced in the US, a food-exporting country. The US exports grains/feed, soybean, and livestock products primarily to Asia (China, Japan, Republic of Korea), the European Union, and North American neighbours (Canada and Mexico). Depending on the crop, food production in the US is highly variable, with California having the most diverse range of crops and being the largest agricultural producer in the country. Grains, grown almost everywhere, are especially prevalent in the Great Plains states. Corn (used for food, silage, and fuel), although grown everywhere, is concentrated in the traditional US Corn Belt stretching from southern Indiana west to Iowa. Peanut is concentrated in Georgia; citrus in Florida, California, Arizona, and the lower Rio Grande Valley; potatoes in Idaho; rice in Arkansas; and apples in Washington and New York.

While food is plentiful, access to healthy and affordable food is problematic for many Americans, especially those in inner city neighbourhoods and rural areas. The lack of access creates food deserts, defined as areas with limited access to affordable and nutritious food (Ver Ploeg et al., 2009). Food deserts arise due to the absence of a large supermarket within the community (within a mile or 1.6 km radius in urban areas; 20 miles or 32 km radius in rural areas); or the lack of transportation to a supermarket or large grocery store located farther away. The absence of large grocery stores or supermarkets (with lower prices and greater choice) close by coupled with lack of transportation to go there define food desert areas for more than 23.5 million Americans (7% of the population) (Ver Ploeg et al., 2009).

Short-term disruptions in food supplies exacerbate the insecurity for many households, not only influencing the availability of food supplies but also food quality and, most importantly, the prices. For example, Alaska imports nearly 90% of produce due to its short growing season, making food expensive to begin with in that state. In 2013, the summer in Alaska was particularly warm and the demand for power for cooling homes and businesses soared. As is true in many regions of this rural state, residents subsist on hunting and fishing for protein. Meat and fish (around 25% of total food consumption) are frozen for later consumption. When the power demand for home cooling soared because of the warm weather, blackouts and power shortages ensued, causing loss of refrigeration and spoilage of meat and fish (Hodges Snyder and Meter, 2015). The power shortages caused loss of protein source for many households. This was significant given that meat is prohibitively expensive and most of the Alaskan fisheries catch is exported and not available for domestic consumption. In addition to high prices for produce, Alaskans also had to pay for meat and fish, thus stretching many household budgets beyond their breaking point. While the example points to a singular heat event, the food insecurity of the indigenous populations in the state is becoming dire as climate change – coastal erosion, thinning sea ice – is not only destroying traditional livelihoods and food systems but also displacing entire coastal communities.

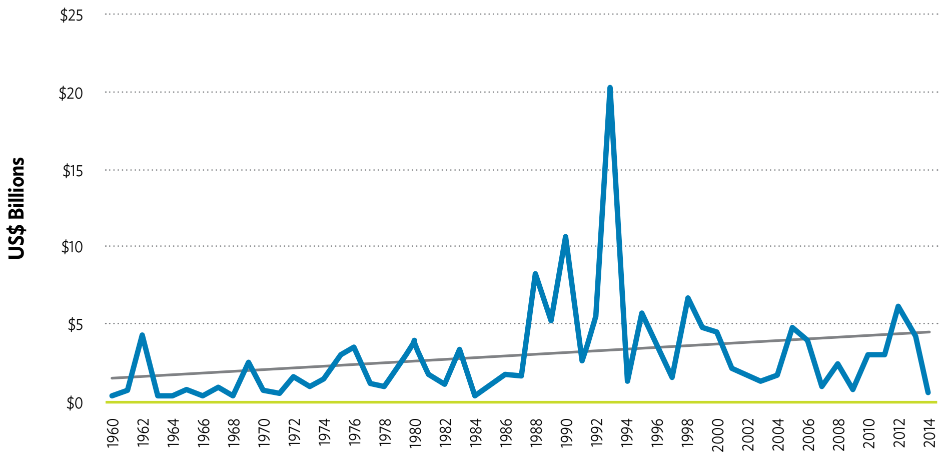
Another example is the 2012 drought that affected nearly 60% of US farms, primarily those devoted to production of corn and soybean used in livestock feed. Within the US, there were short-term increases in prices the following year especially those of beef and dairy and poultry products (Crutchfield, 2013), although the 3% average increase was well below the inflation-driven increases of the past. Locally, farmers and ranchers reduced their herds as a mitigation measure to reduce costs in the short-term. However, with the increasing global demand for meat, the reduction in herds has increased the price of US-exported beef and dairy products. The demand for meat is increasing globally especially in cities and this creates greater food insecurity for importing countries because of higher meat prices. Local changes in farming practices are occurring in both importing and exporting countries where agricultural land is increasingly being used to produce food for animals rather than food for people (Stoll-Kleemann and O'Riordan, 2015).

Losses from Disasters in the US

Since 1960, crop losses in the US due to natural hazards have averaged US$3.0 billion annually (SHELDUS, 2016). This represents roughly 24% of the total losses from natural hazards over the same time period. Crop losses due to natural hazards have steadily increased, along with property losses even when adjusting for inflation and population growth (Gall et al., 2011). As crop losses are weather-dependent, the increasing frequency of more extreme weather events produces greater losses. Coupled with better documentation of such losses, we see a steady upward trend (Figure 2) in crop losses over the past 50 years.

Crop losses were highest in 1993 as a consequence of the Mississippi Floods of 1993 (Missouri and Mississippi basins) where nearly 20 million acres (8 million ha) were flooded and not harvested of or planted (Changnon, 1996). Damage to the Mississippi River shipping infrastructure was also recorded. Flooding in the same region in 2011 also resulted in more than US$1 billion in agricultural damage in Arkansas, Mississippi, and Missouri alone. Major drought episodes in 1989, 2006, 2011–2012 in the mid-western and Plains states occurred with significant losses in corn, sorghum, and soybean crops. Freezes in December 1998 affected fruit and vegetable crops in California, and again in 1990. In 2005, Hurricane Katrina not only damaged crops but also the ports in New Orleans and in Gulfport, Mississippi. The Port of New Orleans is the terminus of the inland waterway system for the US and the primary transportation infrastructure for transporting bulk cargo such as grains, timber, cotton, and rice. The Port of Gulfport was completely destroyed by Hurricane Katrina and has been slow to rebuild. The agricultural significance of the Port of Gulfport is its being the gateway for fruits and vegetables from Latin America, especially bananas, to markets in the eastern half of the country.

Figure 2: Crop Losses (Adjusted to US$: 2014), 1960-2014



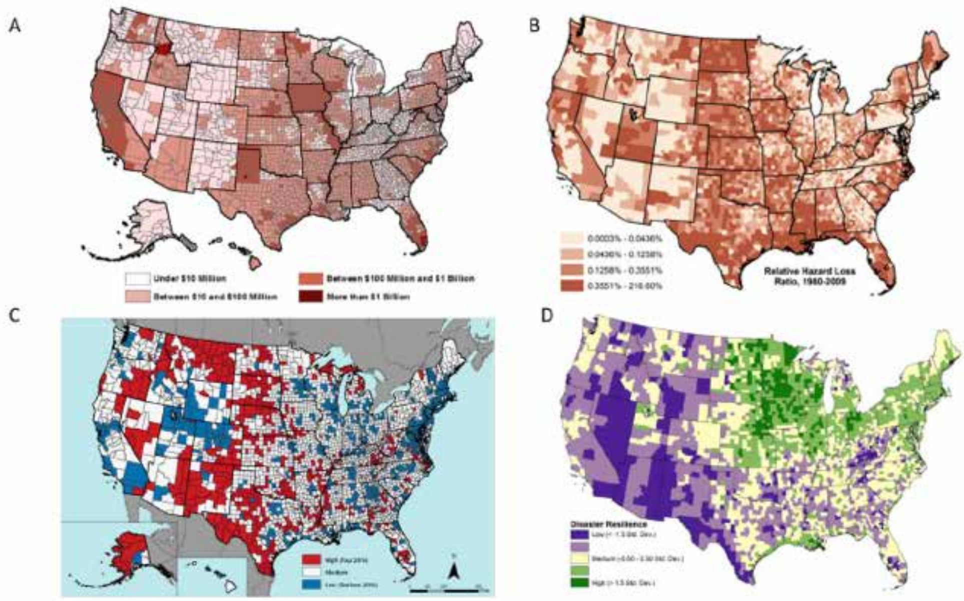
Source: SHELDUS.org.

The spatial patterns of crop losses are quite variable, but again are concentrated in the central US in the largely rural areas (Figure 3A). Droughts and floodings are the primary perils influencing crop losses in the central US, followed by severe storms including hail. Freezes and extreme cold are regionally important in California and Florida.

Measuring Social Consequences: Impact, Vulnerability, Resilience

The social consequences of hazard losses are a function of the exposure and the sensitivity of the populations to those losses. Exposure is the degree to which property (including crops) is at risk of damage from hazards and can be viewed as the pattern of losses in individual places as well as the relative impact of such losses on the economic base of the local area. Data for such assessments are scarce globally but the US has reasonably good data for such computations. The ratio of hazard losses to gross domestic product (GDP) or its equivalent affords the opportunity to refine impacts beyond simple dollar damage. For example, the effect of a million-dollar loss in one locale that has a robust and large economic base is very different from the same million-dollar loss in a place with a smaller and struggling economy. As a larger percentage of GDP, the impact is greater and not only reduces the capacity to absorb and recover from the disaster but may require an influx of external aid to assist in recovery. For the US as a whole, the average relative loss ratio is 0.15% of GDP in 1980-2009 (Ash et al., 2013). Even with costly events such as Hurricane Sandy, the overall impact on the country is minimal as there is sufficient capacity to absorb and recover from the event at the national scale. Regionally and locally, however, it is another story. The mean annual relative loss for the central US, for example, is slightly more than 4% of the county GDP, well above the national average. The relative impact is largely driven by recurring losses from flooding and severe weather (Ash et al., 2013) (Figure 3B). In the hurricane coast along the northern Gulf of Mexico, losses represent 3% of county GDP, largely attributed to periodic tropical cyclones; again, a relative loss significantly above the national average. The relative impact ratios account for the temporal and geographic differences in economic capacities of places, which in turn influence the overall social consequences of hazards at sub-national scales.

Figure 3: Spatial Patterns of Damage, Social Vulnerability, and Community Resilience, A) Total Crop Losses, 1960-2014 (in US$); B) Relative Property Loss Ratio; C) Social Vulnerability Index (SoVI®); D) Baseline Resilience Indicators for Communities (BRIC) Index



Source: SHELDUS.org; sovius.org; Ash et al., 2013; Cutter et al., 2014.

Social Vulnerability

Social vulnerability examines the susceptibility to harm from disasters. It permits the examination of the abilities of individuals and places to prepare for, respond to, recover from, mitigate, and adapt to hazards. The Social Vulnerability Index (SoVI®) is a county-based analytical tool that comparatively assesses social vulnerability for the US (Cutter and Morath, 2014). Based on 29 social and demographic variables that the research literature confirms as contributors to reducing a community's susceptibility to hazards, SoVI® provides an empirically based measure of social vulnerability. When mapped, SoVI® scores graphically illustrate the geographic variability in social vulnerability, highlighting those places where additional resources might be necessary to reduce vulnerability and, more significantly, areas where hazard recovery might lag. In disaster response and emergency planning in the US, SoVI® is used by 17 state governments in hazards mitigation plans, and recently became part of the suite of geospatial products used in federal response to disasters. The most recent utilisation of SoVI® was in the determination of targeted areas for disaster recovery resources in the aftermath of the 2015 flooding in South Carolina. Replications of the SoVI® algorithm using customised local data have been done for a number of countries and regions including Norway, Indonesia, Brazil, and the Yangtze River Delta region in China.

Regionally, levels of high social vulnerability are concentrated in the middle of the US, stretching from Texas in the south to the Canadian border, the Great Plains states. Other agricultural areas also exhibit high levels of social vulnerability, such as the lower Mississippi Valley and southern Florida (Figure 3C).

Community Resilience

Enhancing community resilience is one mechanism designed to reduce the impacts of natural hazards on people and places. Resilience as a concept has a variety of meanings and applies to many different sectors and components of communities: economic, infrastructural, social. This paper uses the definition of resilience proffered by the United States' National Research Council: 'the ability to prepare and plan for, absorb, recover from, and more successfully adapt to adverse events' (2012:1). Many different approaches to assessing resilience exist, ranging from qualitative to quantitative approaches. Some focus solely on assets or baseline conditions while others look at characteristics or capacities. There is no dominant methodological approach to resilience assessment and no geographic scale preference (local to global) (Cutter, 2016). The lack of a core set of resilience indicators has defined disaster resilience research to date, especially in the US.

Notwithstanding the lack of consistent methodologies or core indicators, one empirically based measure of resilience, the Baseline Resilience Indicators for Communities (BRIC), has gained some traction as a policy prescriptive approach. BRIC assumes that communities are systems of systems with different components working individually and collectively to produce the pre-existing (or inherent resilience) within places. In other words, BRIC measures the baseline of disaster resilience existing within a community before the hazard event occurs, and is useful for taking stock of capacities and assets. Using a sub-index structure, six different components are measured: social, economic, institutional, infrastructural, community, and environmental. Each sub-index has a number of variables used as proxies, and these variables are normalised and then averaged to create the sub-index score. Each composite sub-index score is then summed to produce values ranging from 0 (low resilience) to 6 (high resilience) (Cutter et al., 2014). The BRIC scores can then be mapped to display the spatial distribution or dis-aggregated to examine the specific drivers of disaster resilience for individual study areas. The latter is significant as it can highlight where investments could be made to improve baseline conditions in disaster resilience.

Resilience and vulnerability are related concepts but they are not the inverse of one another. In testing the association between the two as measured by BRIC and SoVI®, Cutter et al. (2014) found that SoVI® only explained 25% of the variability in the BRIC scores. A similar finding by Sherrieb et al. (2010) found only 14% of the variance between SoVI® and their measures of community resilience – economic development and social capital - were shared. While social vulnerability most closely tracks with social and economic resilience, these factors are only part of what constitutes disaster resilience for communities.

The geography of disaster resilience in the US shows an interesting pattern, with the highest levels of disaster resilience in the central US in the Northern Plains and Midwest states (Figure 3D). High levels of disaster resilience are also found along the Gulf Coast extending from Texas to Louisiana. A second concentration is in the urbanised Northeast. What is interesting about the pattern of disaster resilience is the focus on rural America, especially in the food production region in the central US. These are the same areas that have significantly vulnerable populations and major crop losses from natural hazards, and that experience the greatest relative impact of hazards on the local economy (Figure 3).

Case Study: October 2015 Flooding in South Carolina

As noted earlier, the SoVI® methodology was utilised by the state disaster recovery office in the post-event recovery from the October 2015 flooding in South Carolina to identify target areas across the state that would require assistance to lessen the impacts of the flooding. It was used to illustrate an 'apolitical' approach for recovery resource allocations that reflected both the worst affected areas and the most vulnerable populations who could not bounce back on their own from this disaster.

Background and Context

South Carolina, located in the southern US, is one of the original 13 colonies and the eighth state to ratify the US Constitution. It has a varied political history that explains some of the present-day social and economic patterns within the state. For example, in the colonial period (18th century) South Carolina was a wealthy state, known for its natural harbour, Charleston, and the fertility of the coastal soils. The cultivation of indigo and rice, fueled by slave labour from West Africa, made South Carolina one of the most prosperous states in the US at the time. Intolerance for slaves by the northern states and the 1860 election of President Abraham Lincoln, who opposed the expansion of slavery, led to South Carolina's secession from the United States, and the beginning of the American Civil War (1861-1865). After being soundly defeated, South Carolina never regained its economic dominance and continues to be amongst the poorest and most disadvantaged states in America.

With a land area of 32,020 square miles, South Carolina is roughly the size of Austria. Its 4.8 million inhabitants are located in the three major metropolitan centres: Columbia (the state capital), Charleston (along the coast), and Greenville-Spartanburg (in the Upstate). Most of the state retains its rural character, the remnant from its agrarian past. The state population is 64% white, 28% African-American, 5% Hispanic, 2% Asian, and 1% mixed race/ethnicity. The coastal counties contain the greatest disparities in wealth and racial makeup. Along the coast, wealthier and white residents maintain vacation and year-round homes with recreation and tourism as the dominant economic drivers (along with manufacturing and shipping in Charleston, and the military in Beaufort). Further inland is the coastal plain and the historic cotton-growing region. Still largely agricultural, these counties contain significant African-American populations and are amongst the most economically disadvantaged in the state. The Central Midlands (where Columbia is located) and the Upstate are more diversified in terms of economic livelihoods and racial makeup, although the percentage of African-Americans in the Upstate is the lowest of all the regions. The private sector contributes 83% of the total economic output for the state followed by the government at 17%, the latter including several large military bases and federal facilities in addition to state and local governments.

Despite its agrarian past, agriculture only contributed 0.8% of the state's GDP of US$190 billion (or US$1.52 billion) in 2014 (SC Department of Commerce, 2016). Regionally, however, agriculture is significant. The most important commercial crops grown in terms of acreage are soybean, corn, cotton, and wheat. Most of the farms in the state are family owned and operated. The average size of farms is 180 acres (73 ha), but the majority of farms are smaller than this (10-49 acres in size; 4-20 ha). For 62% of the farms, direct sales are less than US$5,000 annually (USDA, 2012). There is ample food production in locally based farming on small plots and backyard gardens. With an average growing season of 220 days (between first and last frost), both cool-season and warm-season crops are grown, with surpluses sold in local farmers markets or roadside stands.

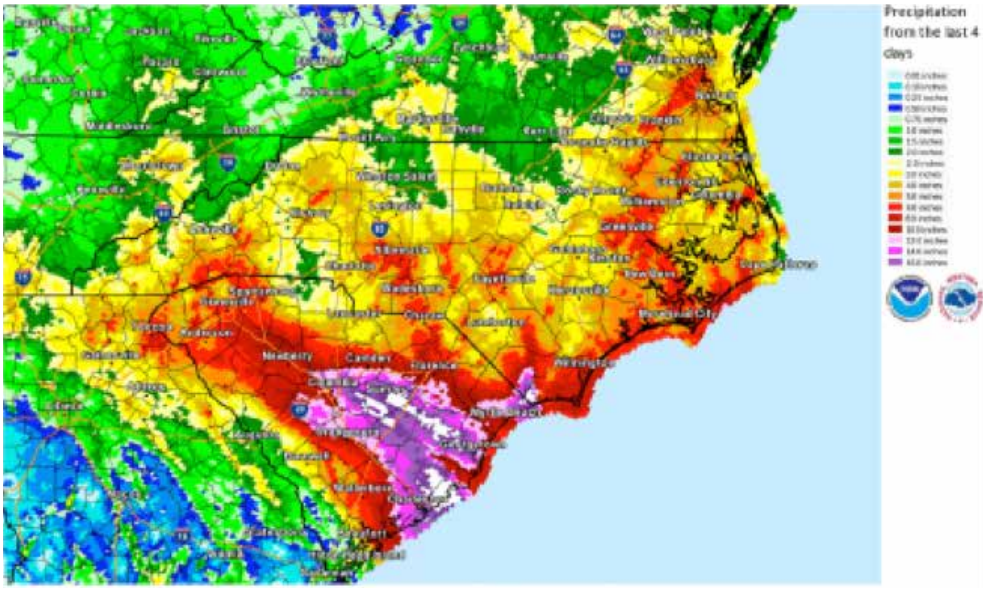
The Event

An unprecedented rainfall event in 1-15 October 2015 resulted in more than 27 inches of rainfall along the coast and inland of South Carolina. A combination of a stalled cool frontal system and a slow-moving low-pressure system to the south brought tropical moisture from the Caribbean into the state and this, in turn, interacted with moisture from Hurricane Joaquin hundreds of miles away to the southeast. These two streams of moisture coalesced into an atmospheric river of moisture that continually dumped rainfall into South Carolina over 4 days (Figure 4). During the most intense period of rain, 16.6 inches of rain were recorded, breaking the 24-hour records throughout the state. The atmospheric river of moisture resulted in catastrophic flash flooding in the urban areas and riverine flooding downstream, affecting many of the rural agricultural counties. The state received a Presidential Disaster Declaration which included 75% of the state's counties (35 out of 46 counties).

Economic Impact

Flood losses were over US$1.2 billion (Collins, 2015; O'Connor, 2015), less than 1% of the state GDP in 2014, well within the range of low relative impact, based on national averages. Estimates of agricultural losses were in the US$600-million range or about 5% of the annual cash receipts for all agricultural commodities. Agricultural crops were already stressed by a summer drought with harvests expected at half of normal before the flooding. Forestry was also depressed due to the decline in the paper market, but was on the verge of recovery after a long recession. Beyond direct crop damage and loss, additional losses were incurred as a result of soggy fields, prohibiting the fall and spring planting of winter wheat, vegetables, and fruits. The major crops affected were peanut, soybean, corn, and wheat and the cash crops of cotton, tobacco, and timber. Cotton, peanut, corn and soybean are planted in April and harvested in early October. The timing of the flood right before harvesting resulted in lower yields for all four crops (Table 1). Preliminary estimates of 2016 planted acreage compared to 2015 plantings illustrate the effect of the floods: corn (up 8%), cotton (down 19%), peanut (down 2%), soybean (down 7%), and winter wheat (down 47%) (USDA, 2016b). Geographically, the most affected counties contained some of the most socially vulnerable populations (Figure 5A).

Figure 4: Rainfall Totals for October 2015 Rainfall and Flood Event



Source: National Weather Service, 2016.

As most of the farmers did not have any type of agricultural insurance as they were too small, the state allocated US$40 million to help them recover from the flood. No other sector received such support from the state in the aftermath of this disaster.

Table 1: Agricultural Production, 2014-2015

	2014			2015			Percent Change 2014/2015		
	Acreage Planted (acres)	Production	Yield/ acre	Acreage Planted (acres)	Production	Yield/ acre	Acreage Planted (acres)	Production	Yield/ acre
Cotton	280,000	528,000 bales	912 bales	235,000	155,000 bales	547 bales	-16.1	-70.6	-40.0
Soybean	450,000	15,400,000 bushels	35.0 bushels	475,000	9,805,000 bushels	26.5 bushels	+5.6	-36.3	-24.3
Peanuts	112,000	410,400,000 pounds	3,800 pounds	112,000	262,400,000 pounds	3,200 pounds	0	-36.1	-15.8
Corn	295,000	32,760,000 bushels	117.0 bushels	295,000	24,180,000 bushels	93.0 bushels	0	-26.1	-20.5

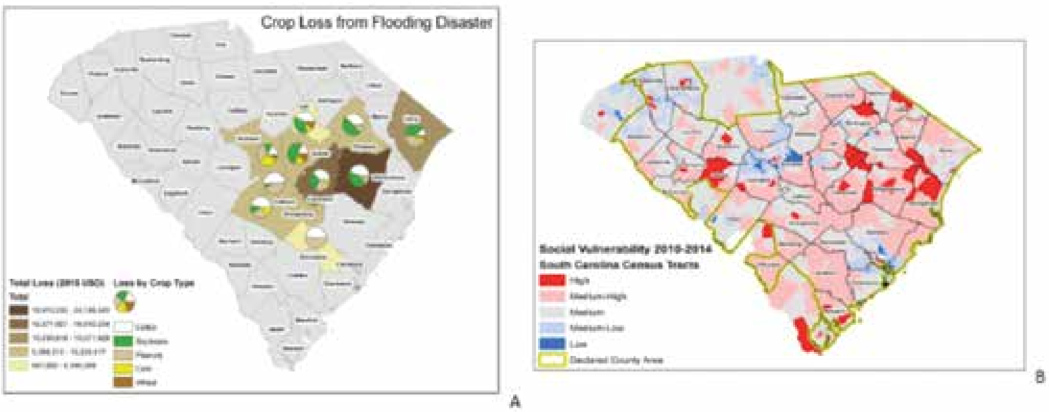
Source: USDA, 2016b.
https://www.nass.usda.gov/Statistics by State/South Carolina/Publications/County Estimates/index.php

In addition to crop damage, the transportation infrastructure damage was significant for most of the state. In the immediate aftermath of the flooding, more than 365 roads closed and 166 bridges damaged. This included more than 90 miles of interstates including Interstate 95, the main corridor for commerce along the US east coast. The funding to repair publicly owned infrastructure came from federal resources under the federal disaster declaration. Many of the secondary roads were also damaged, delaying harvesting of crops that were not directly affected by the rainfall and flooding.

Social Impacts

The flooding resulted in 17 fatalities, most due to drowning while trying to drive through high water, especially in the urban areas. The largest social impact was damage to homes. In the Columbia metropolitan area, flash flooding and small dam failures created a geographic concentration of damage to houses that disproportionately affected moderate to higher income communities (selected areas shown in blue in Figure 5B). Downstream riverine flooding was the cause of housing damage in the rural agricultural areas, and disproportionately affected lower-income and African-American residents (shown in pink and red in Figure 5B). Most of the damaged houses did not have flood insurance, so recovery progressed slowly, especially in the rural counties. While nearly 100,000 households had applied for federal assistance for housing and home repairs, only 27% of those applications were approved. Because of the unmet need, the state established the South Carolina Housing Trust Fund Flood Initiative (using private, non-profit, and state funding) to assist low-income residents with the highest need to begin repairs. To date, at least US$1.7 million have been spent to repair such houses for the most socially vulnerable populations.

Figure 5: Impact of 2015 Flooding: A) Crop Losses and Commodity, B) Location of the Most Socially Vulnerable Residents, Many Living in the Rural Agricultural Counties with Significant Flood Losses



Lessons Learned and Relearned

Direct losses to agriculture and food supply systems due to natural hazards happen everywhere. Some events produce catastrophic and longer-term damage both nationally and globally, such as persistent droughts, while other events create short-term variances in supplies that have little impact beyond local to regional scales. Food security is a challenging problem in and of itself, but when natural hazards are added to the mix, the global food system can become compromised and unreliable, exacerbating hunger conditions in many countries.

At present, there is no consistent accounting of agricultural losses due to natural hazards nor any systematic accounting by specific peril. Disaster loss accounting is more of an art than a science at this point. Not all losses are included (crops, for example), and many are not counted the same way. Until the time that a global full-cost accounting of natural hazards losses is in place, we will not know the true extent of the impact of natural hazards on agriculture and global food supply chains. To develop mitigation (and longer-term adaptation) strategies, such loss-accounting information is vital so actions can be taken to lessen the adverse impacts.

The social consequences of natural hazards are often experienced by the most socially and economically disadvantaged populations and this is true in both the global North and the South. Empirically based measurement of social vulnerability and community resilience help to geographically distinguish the likely burdens of disasters, and that also illustrate the differential capacities to respond to and recover from natural hazard events, including disruptions in food supplies. As illustrated by the 2015 flooding in South Carolina, there is considerable variability in the capacity of local places to prepare for, respond to, and recover from natural hazards.

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