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Managing weather and climate risks to agriculture in North America, Central America and the Caribbean

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ABSTRACT

In recent decades, numerous weather- and climate-related natural disasters have impacted North America, Central America, and the Caribbean, repeatedly demonstrating how vulnerable local agriculture is to extreme episodic events. Given this recent history, and expectations that the frequency and intensity of some episodic events will increase with climate change, it is becoming increasingly important for farmers to proactively manage weather and climate risks to agriculture to protect their livelihoods. Some farmers in this region already apply various strategies to help reduce weather and climate risks and uncertainties, including farming in multiple locations, diversifying crops and varieties, seeking alternative sources of income, and purchasing crop insurance. Such efforts often help farmers maintain a more stable income while also protecting and preserving the productivity of the land. Other farmers, however, have failed to implement basic risk management strategies despite the clear benefits. Reasons for these failures can be attributed to inadequate farmer education and training, a lack of tools to help facilitate the practical application of risk management concepts, and poor communications between the agrometeorological and farming communities. The agrometeorological community can help overcome these obstacles by building upon existing efforts that have successfully educated farmers about weather and climate risks to agriculture and have equipped farmers with the data, tools, and applications necessary to manage these risks. Farmer input is critical to preparing effective educational and training materials and developing user-friendly risk management tools. The agrometeorological community should solicit input from farmers regularly to ensure that farmers are obtaining the information necessary to effectively manage weather and climate risks to agriculture.

1. Introduction

A diverse array of pressures regularly influence local agricultural production, including government policies, current economic markets, the availability of farm supplies, and weather and climate variability. Because of the uncertainties associated with each of these factors, farming is inherently a risky business. Indeed, an examination of crop production for any given commodity or location typically reveals significant inter-annual variability. For example, between 2005 and 2009 approximately 90 percent more cotton was produced in Texas when comparing the most productive and least productive growing seasons (USDA National Agricultural Statistics Service, 2015). Similar comparisons for other crops, locations, and time periods around the globe would likely reveal similar results. Many of the factors that influence local agricultural production are beyond the control of individual farmers. Nevertheless, there are steps farmers can take to manage the risks and uncertainties associated with these external pressures to agriculture (Sivakumar and Motha, 2007).

This paper focuses on the weather and climate aspects of risk and uncertainty in North America, Central America, and the Caribbean. The next section provides an overview of the weather and climate risks to agriculture in the region and identifies the extreme episodic events that most often threaten agriculture. Examples of these extreme episodic events are documented, quantifying impacts on local agriculture. A discussion of current management and coping strategies then follows, describing how individual farmers manage weather and climate risks in the region. The risk management strategies of Florida citrus farmers are highlighted, providing one example of how farmers have successfully managed weather and climate extremes in the wake of previous damaging events. Despite the recent success of Florida citrus farmers and others in the region, more steps need to be

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taken to improve farmer capabilities to manage weather and climate risks and uncertainties. Some steps that can be taken are provided below. Finally, the Southeast Climate Consortium (SECC) has used several approaches to help the local farming community manage weather and climate risks to agriculture in the southeastern United States. SECC activities are presented, summarizing the consortium's success in educating, equipping, and interacting with the farming community.

2. Weather and climate risks to agriculture

The weather and climate varies significantly throughout North America, Central America, and the Caribbean, with mid-latitude cyclones, mesoscale convective systems, and seasonal incursions of hot and cold air dominating northern growing areas and a combination of mid-latitude storms, tropical disturbances, and generally mild to hot air governing southern agricultural areas. Local variables such as latitude, elevation, and proximity to water also have a significant influence on the weather and climate at individual locations. Given the broad spatial extent and widely varying terrain in the region, farmers are exposed to a diverse range of weather and climate phenomena, many of which often take the form of extreme episodic events. Such anomalies include droughts, floods, hurricanes, heat waves, freezes, severe convective storms, blizzards, and wildfires. Recent examples of extreme weather and climate events and the impacts on agriculture follow.

2.1. Droughts

Although the weather and climate varies significantly within the major agricultural areas in the region, drought is one constant that almost all farming communities must cope with. One of the most severe, widespread, and prolonged droughts of the 20th century impacted Canada and the United States during much of the 1930s, causing extensive crop losses and a mass migration of farmers out of the drought-plagued Great Plains (Hurt, 1981). Most droughts in the region are not as persistent or as expansive as the Dust Bowl era drought of the 1930s. Nevertheless, drought is a regular occurrence and many droughts have been severe, having substantial social and economic impacts on local, regional, and sometimes national spatial scales. As recent as 1988 and 2012, severe droughts slashed corn, soybean, and other crop production across large portions of the central United States. In 7 of the 10 years between 2000 and 2009, drought caused on average more than 4.7 billion USD in agricultural losses annually across portions of the United States (NOAA National Centers for Environmental Information, 2014). Significantly, only a fraction of the major agricultural areas experienced drought in consecutive years, but a majority of the U.S. agricultural areas experienced drought at some time during this 10 year period. In the summer of 2001, drought severely reduced cereal and vegetable production in Guatemala, Honduras, El Salvador, Nicaragua, and portions of other Central American countries (FAO Global Information and Early Warning System, 2001). As a result of the crop shortages, an estimated 1.6 million people required emergency food aid from regional governments, national and international relief organizations, and the World Food Programme. More recently, in late 2009 and early 2010, a significant drought impacted several Caribbean nations (Farrell et al., 2010). Record to near-record dryness throughout the Caribbean caused reductions in fresh water supplies and crop production, increasing food prices and reducing exports, and thus negatively impacting local economies.

2.2. Floods

On the opposite end of the spectrum, many farming communities in the region are vulnerable to flooding, as evidenced by numerous occurrences of severe local flooding in recent decades. During the spring and summer of 1993, record flooding in the central United States caused approximately 21 billion USD in damage and 48 deaths (NOAA National Centers for Environmental Information, 2014). The flooding completely inundated 77 towns, caused extensive damage to infrastructure, halted barge traffic along the Mississippi and Missouri rivers for roughly 2 months, and led to more than 5 billion USD in crop losses (Lott, 1994). In October and November 2007, heavy rain in southern Mexico caused widespread flooding in Tabasco, inundating approximately 80 percent of the state (NOAA National Climatic Data Center, 2007c). Nearly half a million people were displaced by the flooding and approximately 462 million USD in crops and livestock were lost. Earlier in October 2007, heavy rains in Central America triggered widespread flooding in El Salvador, Honduras, Nicaragua, Costa Rica, and Panama (NOAA National Climatic Data Center, 2007b). The flooding reportedly destroyed local crops and livestock and caused several fatalities. In May 2004, heavy showers and thunderstorms in Haiti and the Dominican Republic resulted in extensive flooding, causing more than 1400 fatalities and leaving in excess of 25,000 families in need of emergency assistance (NASA Earth Observatory, 2004). In Haiti, between 50 and 70 percent of the agricultural production was destroyed in five flood-affected villages (USAID, 2004).

2.3. Hurricanes

Each summer and autumn, tropical storms and hurricanes often form in the warmer waters of the Atlantic Ocean, Pacific Ocean, Caribbean Sea, and Gulf of Mexico. Given their proximity to these bodies of water, much of the Caribbean, Central America, and southern and eastern portions of North America are vulnerable to these tropical systems. The impacts from these storms are not limited to coastal areas. Often the remnants of these tropical systems travel well inland, sometimes causing extensive damage in areas well removed from coastlines. A number of hurricanes have caused incredible damage to local agriculture in the region. In October 1998, Hurricane Mitch devastated portions of Central America, causing tremendous flooding and numerous mudslides. At least 11,000 deaths and approximately 5 billion USD in damage were attributed to Mitch (NOAA National Climatic Data Center, 2009). Local agriculture was severely damaged by the hurricane. Reports indicated that at least 80 percent of the Honduras banana crop, 80 percent of the El Salvador corn crop, and 30 percent of the Nicaragua coffee crop was destroyed by Mitch. In August 2005, Hurricane Katrina brought high winds and a massive storm surge to the Gulf Coast of the United States, claiming more than 1800 lives and causing more than 125 billion USD in damage (NOAA National Centers for Environmental Information, 2014). Although much of the corn, rice, and soybeans in hurricane-affected states had been harvested prior to landfall, millions of chickens were killed, approximately 3 million USD in milk was lost due to electrical outages, and many barns, equipment buildings, fences, and machines were destroyed by the storm (USDA, 2005). Additionally, blocked waterways and damaged ports, bridges, and roadways significantly disrupted the transport of agricultural goods throughout hurricane-affected areas and beyond. In August 2007, an intensifying Hurricane Dean caused considerable damage as it passed near several Caribbean Islands before making landfall on Mexico's Yucatan Peninsula. Dean reportedly destroyed 90 percent of the banana production in Dominica and 95 percent of the papaya crop in Belize (Reliefweb, 2007b). In Jamaica, the storm