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Viewpoint

Do markets and trade help or hurt the global food system adapt to climate change?

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ABSTRACT

Rapidly expanding global trade in the past three decades has lifted millions out of people out of poverty. Trade has also reduced manufacturing wages in high income countries and made entire industries uncompetitive in some communities, giving rise to nationalist politics that seek to stop or reverse further trade expansion in the United States and Europe. Given complex and uncertain political support for trade, how might changes in trade policy affect the global food system's ability to adapt to climate change? Here we argue that we can best understand food security in a changing climate as a double exposure: the exposure of people and processes to both economic and climate-related shocks and stressors. Trade can help us adapt to climate change, or not. If trade restrictions proliferate, double exposure to both a rapidly changing climate and volatile markets will likely jeopardize the food security of millions. A changing climate will present both opportunities and challenges for the global food system, and adapting to its many impacts will affect food availability, food access, food utilization and food security stability for the poorest people across the world. Global trade can continue to play a central role in assuring that global food system adapts to a changing climate. This potential will only be realized, however, if trade is managed in ways that maximize the benefits of broadened access to new markets while minimizing the risks of increased exposure to international competition and market volatility. For regions like Africa, for example, enhanced transportation networks combined with greater national reserves of cash and enhanced social safety nets could reduce the impact of 'double exposure' on food security.

1. Introduction

Global trade has grown at twice the rate of the global economy since the 1990s, lifting hundreds of millions of people out of poverty, enhancing competitiveness, expanding economies and improving living standards (WTO, 2016). These benefits have not been felt by everyone. Trade has also reduced manufacturing wages in high income countries and made entire industries uncompetitive in some communities, giving rise to nationalist politics that seek to stop or reverse further trade expansion (Karabarbounis and Neiman, 2014; Timmer et al., 2014).

Increasingly anti-trade rhetoric and protectionist agendas heard in Europe and the United States are emerging as low income countries seek better integration into the global economy (Henson and Loader, 2001; Murina and Nicita, 2015). This demand for participation is particularly acute amongst those countries that suffer a lack of access to sufficient food, since imports can help lower local commodity prices. Over the next decade the food security of hundreds of millions of people will rely heavily on the evolution of global trade.

In the contemporary trade context, a changing climate will present both opportunities and challenges for the global food system. Climate change may affect people and processes in ways that reduce food security by increasing vulnerable people's 'double

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exposure'. Double exposure results when both economic and climate-related shocks and stressors act together to increase overall vulnerability (O'Brien and Leichenko, 2000). Our perspective is that trade openness can reduce both individual and institutional vulnerabilities by (i) enhancing future food security and (ii) reducing the cost of response to climate change-induced food availability shocks – if countries have the necessary physical and institutional infrastructure in place (Brown et al., 2015).

2. Food security and global food systems

Food security is defined as a situation in which "all people at all times have physical, social, and economic access to sufficient, safe, and nutritious food to meet their dietary needs and food preferences for an active and healthy life" (FAO, 2012, 1996). Broadly speaking, food security is comprised of three pillars: food availability, food access, food utilization, as well as the overall stability of each pillar (Pinstrup-Andersen, 2009). Food availability is the existence of food in a particular place at a particular time. Availability addresses the "supply side" of food security, which is determined by food production, transportation, food stocks, storage, and trade (Devereux, 1988).

Once food is present, then the question becomes whether or not a person or group has access to it. Integral to this food security component are issues ranging from the affordability of food to the social roles and responsibilities that govern the allocation of available food within a society (across a range of scales, including intra-nation and intra-household) (Higgins et al., 2015; Ploeg et al., 2012). Utilization, or the ability to use and obtain nourishment from food, includes a food's nutritional value and how the body assimilates its nutrients, and touches on climate-sensitive variables such as food safety, sanitation and health (Crimmins et al., 2016).

Finally, the stability of these pillars also shapes food security outcomes. When stable, food availability, access, and utilization do not fluctuate to the point of adversely affecting food security status, either on a seasonal or annual basis or as a result of unpredictable events (FAO, 2012). For example, in 2012, almost the entire United States experienced severe drought, yet food prices exhibited very little fluctuation. Extreme weather, political unrest, or a change in economic circumstances may affect food security by introducing instabilities in one or more components (Sen, 1990).

Access, availability, utilization, and the stability of these three pillars take shape in the context of a global food system (Vermeulen et al., 2012). This system connects producers and consumers through markets that operate at different scales. On one hand, these interconnections can facilitate increased production by providing the income and capital needed to spur new investments in agricultural production or transportation infrastructure that increase the movement of food from producers to consumers.

These investments can lower the cost of such production and transportation, reducing the price of food and facilitating greater access and choice to most people within this system (WTO, 2015). On the other hand, for some populations there are situations in which the global food system can produce challenges. For example, the increased interconnectedness of food producers and consumers globally can result in the transmission of price shocks produced by distant production crises to people who previously were insulated from such events, such as seen in the food price spikes of 2008 and 2011 (Anderson et al., 2014; Baltzer, 2013).

3. Climate and the food system

Climate change, identified by changes over an extended period in the average and/or variability of properties such as temperature and precipitation, is already affecting major agricultural regions in the world (Walthall et al., 2012). The Intergovernmental Panel on Climate Change (IPCC) finds that human activities have resulted in large changes in Earth's climate over the last few centuries, and much larger changes are projected in the coming decades due to increases in greenhouse gas (GHG) emissions (Crimmins et al., 2016; O'Neill et al., 2014; Rosenzweig et al., 2014; Teixeira et al., 2013; Stocker et al., 2013).

These changes have multiple implications for the global food system. The effect of global climate change on food production (and therefore availability) is well-documented, but is also highly specific to both place and the crop or animal commodity in question (Challinor et al., 2007; Rosenzweig et al., 2014; Sivakumar, 2006; Wang et al., 2009). The effects of changes in climate on crops tend to be gradual until a threshold is reached (IPCC 2013). As the planet warms, more regions may experience temperature-related yield stagnation and even declines, affecting overall food production. Climate change risks can extend beyond agricultural production to other elements of food systems (Vermeulen et al., 2012). Processing, packaging, and storage are very likely to be affected by temperature increases that could increase costs and spoilage. An example is the cooling of fruits and vegetables following harvest to extend shelf life (Kurlansky, 2013), which entails higher energy costs (Moretti et al., 2010).

Packaging and logistics companies in some countries now collaborate with farmers and organizations that seek to reduce food waste to develop packaging that provides ventilation and temperature control (Verghese et al., 2013). Climate change could also make utilization more difficult by increasing food safety risks throughout various stages of the food supply chain (Jacxsens et al., 2010; Tirado et al., 2010). For example, increased temperatures are known to cause an increase in diarrheal diseases (which can lead to malnutrition); bacterial foodborne diseases grow and reproduce faster at elevated temperatures (Bandyopadhyay et al., 2012; Tirado et al., 2010).

The impacts of climate change on access are less well understood. Much of the information we have on availability is tied to prices. While the price of food is also an important factor in shaping food access, it is hardly the only factor, and in many cases, may not be the most important factor. Instead, the roles and responsibilities that dictate who has access to food and why can produce food insecurity in places where prices are low, or result in distributions of food that offset the worst food security outcomes in situations where food prices spike (Bellemare, 2015).

Further, even from a market-centric perspective, ports, riverine barge systems, and roads in regions experiencing sea-level rise and changing frequency of climate extremes such as heat waves and drought due to climate change may impede the movement of food from places with surpluses to places with deficits (Attavanich et al., 2013). Such impacts can shape availability and utilization of food in particular places, and also have an impact on access when this infrastructure results in local shortages.

4. Coupled climate, crop, and economic models

Framed as a product of double exposure, it is critical to evaluate food security outcomes as the product of linked economic and environmental changes now and into the future if we are to build relevant, productive policies that address future food security (O'Brien and Leichenko, 2000). To this end, coupled climate, crop, and economic models have been used in recent analyses that use scenarios of both high and low GHG emissions to better understand the likely impact of economic and environmental changes on food security (Antle and others, 2015).