Anthropocene 23 (2018) 43–52

Contents lists available at ScienceDirect

Anthropocene

journal homepage: www.elsevier.com/locate/ancene

Invited Research Article

Agricultural change and resilience: Agricultural policy, climate trends and market integration in the Mexican maize system

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ARTICLE INFO

Article history:
Received 22 January 2018
Received in revised form 1 August 2018
Accepted 2 August 2018
Available online 13 August 2018

Keywords:
Food security
Livelihoods
Globalization
Climate trends
Mexico

ABSTRACT

Ensuring that national food systems have capacity to withstand volatility and shocks is a growing concern. Given the complex processes involved, multi-scalar, multi-stressor analyses of critical food systems are needed. This paper presents a multi-scalar analysis of the Mexican maize system to provide insight into the sector's evolution. The literature suggests that, over the last 30 years, climate trends, domestic and international market dynamics, and domestic policy changes have affected Mexico's maize sector. In contrast, this study finds no conclusive evidence of wide-spread abandonment of maize. In addition, while economic globalization and climatic changes are often presented as the primary drivers of change in Mexico's maize sector, results of this study show that domestic policy has been equally, if not more, influential in the sector's evolution. More than international market integration, the relatively recent geographic concentration of commercial supplies within Mexico has increased national sensitivity to idiosyncratic shocks affecting the dominant supply region. In this light, smallholder persistence across Mexico may represent an underutilized strategic asset in policy efforts to enhance both domestic food security and national-level resilience. The Mexican case illustrates the potential role for proactive domestic policy in shaping sensitivities in the national food system to both internal and exogenous shocks.

1. Introduction

In the face of increased farm consolidation, economic integration, and urbanization, the viability of smallholders has long been debated (Akram-Lodi and Kay, 2010). Most of the world's farms are small (<2 ha), and these farmers are often considered particularly vulnerable to emerging processes of environmental change and economic globalization and also individually resilient to exogenous stress (Dasgupta et al., 2014). For example, while smallholders often are characterized as lacking the capital, access to institutional services, and technology needed to effectively reduce their vulnerability to climatic shocks and to take advantage of economic opportunities, many smallholders have developed diverse coping mechanisms (i.e., risk pooling, crop diversification, livelihood diversification) that permit their survival, albeit often in states of chronic poverty (Eakin et al., 2014c). Smallholder farming has thus been surprisingly persistent (Rigg et al., 2016), raising questions concerning the role of smallholders in national and international food system dynamics.

The Mexican maize system—historically characterized by a large "peasant" (*campesino*) population, as well as a vibrant commercial agricultural sector—presents a valuable case for

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https://doi.org/10.1016/j.ancene.2018.08.002
2213-3054/

evaluating the response of food systems to both internal and external shocks at different scales of analysis and the role of smallholders in such responses. Food systems are complex, dynamic, coupled social-ecological systems. They encompass not only the activities essential for food provisioning (from production to waste management) but also broad-scale and local-level social and biophysical drivers of system change (e.g., climate change, demographic shifts), and diverse outcomes: food security, ecological integrity, and social welfare (Ericksen, 2008).

Given Mexico's demand for maize in international markets, the Mexican maize system is of international interest. With an average daily per capita consumption of approximately 267 g (Ranum et al., 2014), maize is fundamental to Mexico's food security. Significant shifts in national policy and trade, together with climatic trends, have raised concerns about the future of maize in Mexico, despite its iconic status. The current international negotiation of the continuation of the North American Free Trade Agreement (NAFTA) in the United States, Canada, and Mexico has once again put maize, land use, and livelihoods into the center of politics (see for example, Semple, 2017).

Mexico's maize sector epitomizes the complex interaction of trade, climatic variability, and politics in rural life. In the late 1980s and 1990s, alarm over the future of Mexico's maize economy escalated, and today the popular press often presents the maize sector as having all but collapsed (see, for example, Carlsen, 2013). Scholars have associated shifts in trade, agrarian policy, and climatic changes with environmentally-induced migration and the growth of illicit economies (Dube et al., 2014; Feng et al., 2010). This narrative of collapse is shaped by two assumptions. First, that the cultural and social foundation of maize farming—the smallholder sector—was decimated by market liberalization in general and NAFTA in particular (Wise, 2009) and second, that climate change and extremes are increasingly making rain-fed production unviable (Monterroso Rivas et al., 2010).

This literature provides the basis for several hypotheses. First, given the sensitivity of maize crops to climatic stress, we would expect to see the effect of climatic stress on maize yield trends. Second, we would anticipate that over the last 30 years, much of the land area in maize would have been abandoned, as climatic stress and increased market competition are presumed to have driven farmers off the land, into the cities, and across the U.S. border (Carton de Grammont, 2009; Feng et al., 2010). Case study research, for example, suggests that maize imports have displaced domestic production (González Alvarado, 2012), maize fields have been replaced by forests or houses (Klooster, 2003; Lerner et al., 2013), and non-farm livelihoods—including involvement in the illicit drug trade—are now more viable options in the rural sector (de Janvry and Sadoulet, 2001; Dube et al., 2014; Eakin and Appendini, 2008). Finally, we would anticipate that market liberalization—embodied by the implementation of NAFTA—would have resulted in greater integration of U.S. and Mexican maize markets, potentially increasing the sensitivity of the sector to external environmental and economic shocks stemming from increased interdependency with the U.S. policy and environmental context (Wise, 2009; Fitting, 2006).

Nevertheless, the findings of individual case studies may not provide an accurate picture of the overall state of the maize system, bounded at the national scale, and the factors that drive its dynamics: multi-scalar analyses are required. Vulnerability research, for example, has demonstrated that processes that have strong explanatory power at one spatial scale can be muted at other scales (O'Brien et al., 2004b) and that households' adaptive strategies can collectively affect broader systems dynamics in ways that ultimately undermine local vulnerability mitigation efforts (Eakin and Wehbe, 2009). Studies that have applied the concept of "double exposure" (O'Brien and Leichenko, 2000) have repeatedly demonstrated that the impacts of global processes are filtered by institutional, socio-cultural, and environmental conditions at different scales (Manuel-Navarrete et al., 2011; O'Brien et al., 2004a; Silva et al., 2010). The hegemonic presence of globalization and climate change in current global change discourse, however, can bias interpretation against the role of local- and regional-level processes that can mediate or amplify the influence of global change processes. For these reasons, there is a need for empirical research that systemically evaluates the sector's sensitivity to the combined stressors of climatic, market integration, and policy change at different scales of analysis.

This study uses a multi-scalar, interdisciplinary approach to explore the interaction of global change processes, represented as market integration and climatic trends, with national- and regional-level processes such as demographic shifts and changes in policy priorities in order to assess the current state of maize production in Mexico in relation to market shocks and climatic stress. We evaluated the evolution of the sector's sensitivity to market integration, associated domestic policy changes, and trends in climatic parameters over the period from 1980 to 2014. Of particular interest is the role of rain-fed smallholder farms in national maize sector dynamics and national-level vulnerability. The vulnerability of the maize system is a function of the exposure and sensitivity of the system to economic and climatic shocks, both regionally and nationally, and the system's ability to buffer and recover from such shocks over time, in terms of maintaining maize production (supply, regional distribution) and price stability. To explore evidence of the sector's sensitivity to these stressors, we ask three questions. What is the evidence of maize sector sensitivity to climatic and market stress? What evidence is there that markets have become more integrated, and what is the association of market integration with sensitivity to external and internal shocks? And finally, at the national scale, what has been the role of domestic policy in the maize system's evolving vulnerability? We expected to find evidence of maize abandonment in the post-liberalization period, consistent with economic projections of the impact of NAFTA and Mexico's domestic policy trends, exacerbated by the stress of climatic variability. Given the heterogeneity of Mexico's maize sector and agroclimatic landscape, however, we anticipated that the effects would be far from uniform.

2. Maize farming in Mexico

Maize is produced in Mexico under highly variable conditions. Most maize produced is the culturally preferred white maize used in domestic cuisine and commercial tortilla and maize flour manufacturing. Yellow maize—the type most commonly produced in the U.S.—is considered inferior for human consumption and is primarily produced for the livestock market (Appendini, 2014). Farmers in central and southern Mexico plant traditional varieties of white maize in large part because they are robust to local agroclimatic conditions (Mercer et al., 2012). Farm scale and market orientation also vary widely, from subsistence and semi-subsistence production on small rain-fed parcels to large-scale commercial (irrigated) operations that can reach sizes of several hundred hectares (Eakin et al., 2014b). The most recent agricultural census data indicate a slight increase in maize producers from 2.75 million in 1991–2.83 million in 2007 (Instituto Nacional de Estadística y Geografía (INEGI), 2007). Nationally, large-scale producers (>20 ha) constitute only 1.2% of maize producers, although collectively they are now responsible for 25.5% of production (Eakin et al., 2014b). Smallholders with less than 5 ha still represent the majority—83.2%—of producers in Mexico, farming over half the planted area and accounting for more than one-third of total maize produced (Eakin et al., 2014b).