

Vulnerability to Cumulative Hazards: Coping with the Coffee Leaf Rust Outbreak, Drought, and Food Insecurity in Nicaragua

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Summary. — Recurrent food insecurity in the highlands of Central America has been exacerbated by the recent convergence of a coffee leaf rust outbreak that began defoliating crops in 2011 and a drought that started in 2014. In the context of these multiple challenges, this paper explores how seasonal hunger is related to smallholder organizational affiliation, farm and farmer characteristics, and post-hazard household-level coping strategies. The study integrates qualitative research, hydro-climatic data analysis, and a survey of 368 households completed in 2014. A number of household capacities correlate significantly with shorter periods of seasonal hunger: households with larger farms, with off-farm employment, and that produce more than half of their food, maintain more fruit trees, and harvest more coffee reported fewer lean months. We find evidence consistent with path dependence in how households cope with a sequence of environmental hazards, as the reported use of less preferred coping responses to past events (e.g., Hurricane Mitch and the 2009 drought) tended to correlate with their continued use after subsequent hazards. A comparison of coping responses of households affiliated with a farmer-to-farmer institution promoting subsistence-oriented production with those affiliated with cooperatives prioritizing sustainable coffee exports shows that farmer institutions were not strongly correlated with the number of lean months or coping mechanisms. © 2017 The Authors. Published by Elsevier Ltd. This is an open access article under the CC BY-NC-ND license (<http://creativecommons.org/licenses/by-nc-nd/4.0/>).

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1. INTRODUCTION

Seasonal hunger is a well-known livelihood challenge that remains the most common type of food shortage in the agricultural communities of developing countries (Devereux, Vaitla, & Swan, 2008). Notably, the world's more than 470 million smallholders (Lowder, Skoet, & Raney, 2016) constitute a substantial portion of the food insecure population worldwide (FAO, 2014a), in spite of their contributions to food supplies and the conservation of agricultural biodiversity (Tscharnatke *et al.*, 2012).¹ For smallholders, a hungry season typically starts in the months prior to the first harvest in a growing season, when the previously harvested and stored food supplies are depleted, household incomes are low, and food access is limited by unfavorable prices and other factors, giving rise to a recurring period of lean months (Chambers, Longhurst, & Pacey, 1981). When households face crop failures from pathogens or hydro-climatic variability and change (Battisti & Naylor, 2009), or suffer decreased purchasing power with which to buy food (Sen, 1987), the hungry season lasts longer and may become more severe. Smallholders and institutions have developed coping mechanisms that seek to sustain access to food and other basic necessities in the context of persistent seasonal hunger and frequent hazards.

There is a need for explanatory theories that link these livelihood insecurities to the vulnerability context (Watts & Bohle, 1993; Klasen & Waibel, 2015; Ribot, 2014) and help to identify resilience-enhancing adaptations for different circumstances (Ensor, Park, Attwood, Kaminski, & Johnson, 2016; Hinkel, 2011). Although integrated studies about livelihood vulnerability to multiple stressors continue to emerge (Gloede, Menkhoff, & Waibel, 2015; McCubbin, Smit, & Pearce, 2015), more research is needed to understand the cumulative effects of several hazards (Cutter *et al.*, 2008), and how exposure to these hazards relates to household cop-

ing responses, and local institutions (Ostrom, 2005; Smit & Wandel, 2006; Wise *et al.*, 2014).

In this paper, we employ an interdisciplinary approach and a case study to offer a situated assessment of coffee-producing smallholder vulnerability and coping responses to a sequence of environmental hazards. We identify household capacities and farming approaches that are associated with shorter periods of seasonal hunger and the use of less severe post-hazard coping responses. We are especially interested in assessing the importance of two potential determinants of resilience to hazards in the context of our study area. First, we compare the coping responses of smallholders affiliated with farmer

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institutions pursuing different strategies (diversified farming *vs.* coffee exports), as they navigate two recent droughts, a coffee pathogen outbreak, and changing commodity prices. Second, in light of the succession of droughts, hurricanes, and other hazards that have impacted Central America, we explore how a household's response to past hazards influences the coping response to subsequent ones and the extent to which a path-dependent evolution of coping responses could perpetuate poverty or alternatively help households "bounce back better than before" (Frankenberger, Constan, Nelson, & Starr, 2014, p. 3; Folke, Biggs, Norström, Reyers, & Rockström, 2016).

The remainder of the paper proceeds as follows. Section 2 provides an overview of the conceptual framework we employ, linking our approach to the literature on livelihoods, vulnerability, and adaptive capacity. Section 3 presents our research questions. Section 4 describes hazards, coffee, and food security issues relevant to our research area in northern Nicaragua, and Section 5 explains our methodology, which combines qualitative and quantitative social science with hydroclimatic analysis. Section 6 presents and then discusses our primary findings, and Section 7 concludes.

2. LIVELIHOODS, VULNERABILITY, AND RESILIENCE

The livelihoods perspective (Scoones, 2009) offers a useful framework for analyzing food security and vulnerability (Reed *et al.*, 2013). This perspective situates a study in the context of how and where people are making a living and what they do to make it meaningful (Bebbington, 2000), integrating foundational theories drawn from Sen's entitlement approach (Dre'ze & Sen, 1989) with human capabilities (Nussbaum, 2011) and an analysis of institutions (Potete, Janssen, & Ostrom, 2010). There are four types of entitlements (Sen, 1987) relevant to the determination of food security and vulnerability to hazards in our study: *Production* entitlements determine how much food a household can command at different points in the year from assets, such as land and equipment; *employment-based* entitlements entail income-based access to resources; *trade-based* entitlements are a function of the terms of exchange among goods bartered or sold; and *transfer entitlements* consist of food aid, gifts, and related sources. Food security is also a function of individual capacities, such as education, health, and the degree of autonomy *versus* structural forces that constrain local choice (Eakin, Lemos, & Nelson, 2014). These factors influence household engagement with institutions, markets, and farm management shaping their ability to command food entitlements.

Smallholder households and institutions in rural Central America have developed a wide range of adaptive responses as they seek to sustain their food entitlements and navigate risk (Adger, 2006). The choice of coping mechanisms and adaptive actions in response to a given hazard in a specific context is influenced by a complex web of factors, including the hazard exposure, commodity price fluctuations, cognition, development project histories, geography, and institutional responses (Kuruppu & Liverman, 2011; McSweeney & Coomes, 2011; Wood, Jina, Jain, Kristjanson, & DeFries, 2014). Some adaptive responses—such as crop diversification or off-farm employment—could reduce vulnerability and alleviate lean periods, while others—such as liquidating assets—could potentially exacerbate future risks. The dynamic and sequential nature of responses to hazards suggests a focus on "pathways of change and response" (Wise *et al.*, 2014, p. 325), an idea that informs our research question on path dependent hazard responses.

The terms *vulnerability*, *adaptive capacity*, and *resilience* are often employed in different ways, suggesting the need to start with clear definitions, scales of analysis, and relationships (Ensor *et al.*, 2016; Hinkel, 2011). Conflicting interpretations often focus on a systems-level analysis *vs.* a human-centered approach (Eriksen, Bohle, & Stewart, 2010), and consideration of political economic context *vs.* an analytic focus limited to quantitative comparisons (Turner, 2014; Weichselgartner & Kelman, 2015). We focus on both context and quantitative analysis, and adopt the IPCC's (2014) definition of vulnerability as "the propensity or predisposition to be adversely affected." Given exposure to a hazard (such as a drought), vulnerability is a function of sensitivity (such as dependence on rain-fed irrigation) as well as adaptive capacity (such as flexibility of crop mix or diversity of income sources).

Building adaptive capacity is an iterative process that links strategies and practices that enhance risk management (*specific* adaptive capacity) with those that address structural deficits (*generic* adaptive capacity) through time (Lemos *et al.*, 2013). Generic capacities include income, education levels, health, mobility, and—at the system level—economic productivity, poverty levels, inequality, and governance. Specific adaptive capacities concern traditional risk management strategies (e.g., crop diversification), formal and informal insurance at the household level, as well as early warning systems, disaster compensation, and insurance provisioning at the systems level (Eakin *et al.*, 2014, p. 2; Nelson & Finan, 2009). Finally, we use the term *resilience* to describe the capacity of a household to recover reasonably quickly (bounce back) from a hazard (Frankenberger *et al.*, 2014, p. 3).

Informed by this conceptual framework, our research questions focus on understanding how vulnerability, adaptive capacity, and resilience interact to determine livelihood outcomes, and are in turn shaped by the specific institutional context of our case study region and the sequence of hazards to which its households have been exposed.

3. RESEARCH QUESTIONS

We focus on three research questions: (1) Which livelihood strategies and adaptive capacities are associated with shorter periods of seasonal hunger and greater resilience to environmental hazards among coffee growers in northern Nicaragua? (2) Did affiliation with different types of farmer organizations influence vulnerability to seasonal hunger, the coffee rust outbreak, or drought? (3) To what extent does a household's response to past environmental hazards influence the coping mechanisms in response to subsequent ones?

Our first research question is motivated by the hypothesis that specific adaptive capacities, such as subsistence-oriented diversified farming and organic certification, and generic adaptive capacities, including income and wealth, are proximate determinants of both the duration of seasonal hunger and degree of resilience to hazards (Eakin *et al.*, 2013).

Our second and third research questions move beyond identifying these proximate determinants to explore the influence of institutional affiliation and historical experiences on household capacities and outcomes. In the context of our study area and population, farmer organizations play a potentially important role in influencing household strategies and resources. The two principal farmer organizations working in the area emphasize alternative strategies, and thus provide an interesting comparison: fair trade cooperatives (FTCs) pursue a market-oriented sustainable value chain approach through sales of certified fair-trade and organic coffee, whereas the *Campeño a Campeño* movement (MCaC) places a

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