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Nested vulnerability: exploring cross-scale linkages and vulnerability teleconnections in Mexican and Vietnamese coffee systems

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ARTICLE INFO

Published on line 29 October 2008

Keywords:
Vulnerability
Adaptation
Coffee
Mexico
Vietnam

ABSTRACT

Analyses of the vulnerability of farm populations and food systems to exogenous change, whether in relation to climatic extremes, market shocks, epidemics or other concerns, have typically been approached through a focus on the place of food production or the specific sub-sector exposed to stress. Relatively little attention has been paid to the ways in which national institutions, history and social expectations transform the same signals of global change into very different outcomes in distinct geographic contexts. The channels that convey signals of change from the global to the local may also work in reverse, connecting the responses and choices of households in one geographic context to outcomes and choices of other households in quite distant places. We draw from recent case studies of farm-level vulnerability and livelihood security in Mexico and Vietnam to demonstrate that coffee smallholders' independent responses to the risks and opportunities associated with global scale economic and environmental change, are teleconnected and thus can create feedbacks which in turn affect the present and future vulnerabilities of other smallholders around the globe.

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1. Introduction

Analyses of the vulnerability of populations and individuals to exogenous change – whether in relation to climatic extremes, market shocks, epidemics or other concerns – have typically been approached through place-based and sector-specific frameworks. The importance of the biophysical environment as a source of risk as well as a resource for coping with loss has long been a justification for place-based analyses of vulnerability (Cutter, 1996). Much of the existing research on climate change impacts, for example, has been applied to a defined economic sector (e.g., ‘vulnerability to climate extremes in the urban sector’) and/or geographic

domain (‘vulnerability to climate change in the North American Great Plains’). Similarly, given the importance of national policy and conflict affecting income, food and other resource distribution, analyses of vulnerability to food security and poverty also tend to focus on the local context and geography, albeit within the global political economy (Stephen and Downing, 2001).

Yet while the importance of place-specific meaning in vulnerability cannot be underestimated, the vulnerability of individuals and communities is not bound by geography. The delineation of vulnerability in terms of place or sector can have the unintended consequence of perpetuating a “top-down” perspective of causality and outcomes, in which nested

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doi:10.1016/j.envsci.2008.09.003

drivers – e.g., global environmental change, national policy and local politics – filter down and interact at the local level to define capacities and sensitivities of communities and individuals. Less attention has been paid to the ways in which local adaptive actions, in the context of dynamic national institutions and changing social expectations can feed back to influence the manifestation of global environmental and socioeconomic change in distinct geographic contexts (Adger et al., *in press*). Channels that convey signals of change from the global to the local also may work in reverse, connecting the responses and choices of households in one geographic context to outcomes and choices of other households in quite distant places (Young et al., 2006; Leichenko and O'Brien, 2008). It is also possible that the mechanisms that produce change at one scale of analysis may have quite different influences and outcomes at other scales. Households are thus susceptible not only to the direct impact of environmental, political or economic shocks in their physical domain of production and livelihood but also to the indirect impact of the adaptive responses of other households, elsewhere. We use the term “teleconnection”, used most often in the climate literature, to capture the complexity and uncertainties associated with the diverse mechanisms that enable such adaptive responses to affect the welfare distant households.

In the following sections, we use the case of the responses of farmers in Vietnam and Mexico to the evolution of the global coffee market over the past three decades to illustrate the insights that can be gained from employing a concept of nested and teleconnected livelihood vulnerability. In the case we present here, we argue that the vulnerability of individual farmers to the experience of welfare loss is connected not only through the structure of the global coffee commodity chain, but also through global ideological shifts affecting national policy, the movement of labor, the material flow of coffee stocks, channels of information, and, in reverse, through the broader environmental and institutional implications of local adaptive action. As we illustrate, the welfare shocks that have reverberated throughout the global coffee system in recent decades indicate that the interactions of these diverse drivers of local vulnerability are not well understood in policy realms. In the next section we ground our discussion of the concept of nested vulnerability in both the literature on vulnerability to poverty and social vulnerability to global environmental change. After an overview of the structure of the coffee market, we then present three temporal periods, each characterized by its own distinct range of livelihood, environmental and policy responses to similar forms of exogenous shocks in the coffee world: (1) 1989–1993, characterized by a major institutional change in the global market and domestic market liberalization; (2) 1994–1998, when global coffee prices spiked as a result of a major frost in Brazil; (3) 1999–2003, when coffee farmers world-wide faced the lowest coffee prices in decades. The focus on two major coffee-producing nations, Mexico and Vietnam, and their very different socio-economic histories, allows us to illustrate how local events and outcomes can be seen as both responses to and drivers of both global economic and environmental change, and how livelihoods are linked across space and time.

2. A proposed shift in perspective: from vulnerable places to nested vulnerability

In its most general meaning, vulnerability implies “susceptibility to loss or harm.” Depending on the approach employed, vulnerability research has tended to either emphasize social exposure and sensitivity to exogenous threats (and thus the mechanisms to buffer that exposure) or to focus on the existing capacities of populations to manage risk, cope with loss and adapt to change (see characterization in Eakin and Luers, 2006). The former approach is generally associated with research in the domain of global environmental change and environmental hazards, while the latter approach has been more affiliated with research on poverty, food insecurity and livelihood instability (Adger, 2006: 272; Adger and Winkels, 2007). Both broad traditions increasingly emphasize the contextual complexity of vulnerability and the influence of global economic processes and history on local outcomes (Watts, 1983; Scoones, 1996; Stevens et al., 2003; Eakin, 2005). Nevertheless, these traditions remain largely top-down in nature, focusing on the macro-level processes with influence over contextualized local outcomes.

Livelihood analysis bridges poverty-focused and environmental-risk focused vulnerability research. Livelihood vulnerability is composed of exogenous risks, household responses to risks, and the outcomes of these responses in terms of individual or household welfare. By placing the household as the focus of analysis, livelihood approaches highlight both the exogenous drivers (i.e. the risk and stress factors) and the factors internal to the household (i.e. ability to mitigate and cope with stress) which together influence household security and well-being (Chambers and Conway, 1992; Ellis, 1998). In this article, we follow a livelihood approach and focus on households as the primary “attributes of concern” (Eakin and Luers, 2006) in our vulnerability analysis. While our aim is to demonstrate how their vulnerability is embedded in a complex social-ecological system, ultimately our aim here is not to illustrate the vulnerability of this system as a whole, but rather how the vulnerability of households and their responses to that vulnerability have implications for household vulnerability elsewhere.

Various livelihood frameworks have been proposed (see Carney et al., 1999) and common to most is the conceptualisation of vulnerability as an ongoing process that assesses current exposure to shock and stress and looks forward to consider the effects of this outcome on the future ‘potential’ to experience further losses (Alwang et al., 2001). At any moment in time, a household or community responds to stress with a set of resources which operate within a dynamic context defined by a suite of historical and ongoing socioeconomic and environmental processes which circumscribe the decision process. Both the asset base and the context of decision-making is constantly changing, affecting the outcomes of vulnerability over time, making vulnerability a dynamic process underlying a household’s adaptive capacity, influencing how individuals can react to and cope with livelihood stress (O’Brien and Leichenko, 2001).

In recent research, economic globalization has been positioned as a significant challenge to existing analytical frameworks of vulnerability (Eakin, 2006; Leichenko and O’Brien, 2008;

Eakin and Lemos, 2006; Young et al., 2006). Globalization not only influences the welfare outcomes of particular livelihood choices, but also can change the economic, social and political context in which livelihood options are formulated and the ways in which local choices, in turn, can collectively influence the direction and dynamics of change at broader scales of analysis (Young et al., 2006). Globalization also has had the effect of integrating households into processes of change that extend far beyond the boundaries of the political systems and social institutions to which their entitlements pertain. Market integration and the globalized structure of commodity chains not only has made some forms of livelihoods more viable than others but also has cemented the livelihood outcomes of particular populations to that of other populations in distant locations. Nepstad et al. (2006) for example, illustrate the global economic “teleconnections” between food scares associated with mad-cow disease in Europe and the rise of a meat-consuming Chinese middle class with the growth of soybean production, cattle herds and associated deforestation in the Brazilian Amazon. Similarly, Sendzimir and Flachner (2007) and Sendzimir et al. (2008) describe how rising Chinese meat consumption drives anticipation of higher grain prices in Europe, locking agriculture land in current intensive uses, and hence, forestalling opportunities to experiment with more ecological agriculture in the Tisza floodplain of Hungary.

Leichenko and O'Brien (2008) argue that the impacts of globalization on social welfare and the environment are important for understanding place-based vulnerability to global environmental change. They propose the use of the metaphor of “double exposure,” in which the simultaneous negative consequences and feedbacks of both market integration and environmental change are considered explicitly in vulnerability analysis. Others have joined this initial proposal, calling for increased attention to the ‘multiple stressor’ context of vulnerability (Turner II et al., 2003). Nevertheless, to date the emphasis in the discourse on ‘multiple stressors’ and ‘double exposure’ has focused more on the *causes*, *context* and *outcomes* of vulnerability in particular places. Very little, if any, vulnerability research emerging from either environmental change or livelihoods traditions explore how the vulnerability of specific populations in different geographic contexts are essentially linked in space and time not only by cause but also through local responses to global changes (Leichenko and O'Brien, 2008). Documenting and describing such linkages is an important step in expanding our view beyond the sector-specific and geographic boundaries that have traditionally defined vulnerability analysis, yet which alone do not adequately explain the causes and cross-spatial consequences of local outcomes and actions.

In this article we use the concept of “nested and tele-connected vulnerabilities” to illustrate how the vulnerabilities and responses of farm households in distinct geographic locations are linked through cross-scalar processes, as well as “teleconnected” in space and time. In a nested system, profound changes in key variables that operate normally only at one level, e.g., within a defined geographic region or administrative domain, can have non-linear outcomes for processes operating at broader scales of analysis (Gunderson and Holling, 2001). Local level processes can episodically influence larger scale phenomena, and such explosive “upward cascades” can

be sources of surprise at distant locations. For example, a contagious zoonotic disease such as SARS can manifest at local scales (e.g., devastating small rural villages) for long periods and never be evident at national levels because rural isolation allows the disease to locally extinguish. However, such local outbreaks can rapidly propagate over vast distances when the links connecting animals, people, places and time that characterizes our global transportation network and travel industry become dense enough (Adger et al., *in press*).

Vulnerabilities are linked by far more than farmer responses to price signals. These linkages are nurtured and reinforced by complex processes that are currently only incompletely understood. To more comprehensively engage this broader complexity of all cross-scale interactions we invoke the concept of “teleconnections”, a term used in climatology in relation to “any transmission of a coherent effect beyond the location where the forcing occurred” (Chase et al., 2005). For example, one of the teleconnections associated with the El Niño-Southern Oscillation effect is severe drought in Northeastern Brazil. Teleconnections are also associated with other climate phenomena such as the North Atlantic Oscillation. The label of “teleconnection” is not explanatory in and of itself, but rather signifies the existence of a correlation in events, and highlights the need to explore the connecting mechanisms and drivers in order to anticipate outcomes. In climatology, the identification of teleconnections has been instrumental in enhancing climate prediction science and improving climate change scenarios. Along these lines, we argue that in the context of an increasingly interconnected world characterized by both by frequent shocks and surprise, it is useful to view vulnerability and adaptation as ‘teleconnected’ phenomena. In our case, we argue that geographically specific signals of change – such as a shift in market opportunities, a drought, a change in public policy or new form of land use in a specific location – can create risks and opportunities important for development planning in distant places. Thus livelihoods and household well-being are not entirely locally determined but rather the result of complex linkages across space and multi-scalar relations (Adger et al., *in press*), not the least of which is the process of global economic integration (Eakin, 2006; see also Nepstad et al., 2006).

3. Coffee production as an exemplary case

Coffee, as a global commodity, exemplifies the complexities and inter-dependencies between smallholder livelihood outcomes and responses, globalization and environmental change in spatially distant locations. Over 90% of production takes place in developing nations in the subtropics, where climate conditions are conducive and labor is relatively cheap. Today the vast majority of the world’s coffee producers – some 20–25 million – are small-scale farmers largely dependent on unpaid family labor and hired labor during harvest season. Coffee production represents a relatively large portion of the annual income for these households, as well as a significant source of foreign exchange for the countries in which they farm. For this reason, the global coffee market and international and domestic coffee policy are inextricably linked to issues of livelihood security and poverty.

The price of coffee is highly volatile and abrupt changes in coffee prices can generate significant shocks to coffee producers. By one calculation, the standard deviation of monthly price returns (one measure of volatility) averaged 24% between 1990 and 2005 (Gilbert, 2005). Historically, a large part of the high volatility in coffee prices can be attributed to climatic shocks affecting Brazilian coffee harvests (Baffes et al., 2005). With a market share of 20–30%, frost and drought that damage Brazilian harvests can generate rapid spikes in world prices, as occurred in 1975–1976, 1994–1995 and 1997–1998. These periodic price spikes have typically generated a positive production response globally, which eventually translates into a decline in farm gate prices given the relative inelasticity of coffee demand and consumption.

The volatility of prices has historically been a source of significant economic uncertainty for producers. As a perennial crop that takes 3–4 years to be productive, investments in coffee are necessarily long-term from the perspective of the constrained incomes of the smallholder. In periods of economic downturn farmers often fall into debt, as they are unable to recoup their investments. Coffee farmers also find it difficult to leave the market once they have made the substantial initial investment in the crop. Their reluctance to abandon coffee is also in part a result of the fact that after decades of planting coffee as a cash crop with significant support from the public sector, many coffee smallholders in Latin America have ceased to plant alternative crops for subsistence (Lewin et al., 2004). Smallholders and their families tend to bear the greatest impact of the global price volatility, though governments also find it difficult to plan development when revenue streams are unpredictable (Brown and Gibson, 2006).

The last two decades have witnessed a significant shift in the structure of the international coffee market, moving from a system of government-mediated market quotas to a neoliberal model, characterized by the elimination of barriers to trade. This precipitated an abrupt restructuring of the relationships between producing nations, traders and consumers, as well as between farmers and domestic institutions, all with direct implications for the livelihood security of coffee producers globally (Lewin et al., 2004). In 1989 the International Coffee Agreement, which had operated a quota system to regulate coffee exports from the world's largest coffee producers, collapsed. In the absence of export restrictions, large amounts of coffee entered the market, inventories of green coffee in importing nations increased and, in the face of relatively stagnant demand, world coffee prices began a phase of steep decline (Ponte, 2002). Concurrent with the closure of the ICA, the market power of a handful of coffee traders and distributors increased (e.g., Proctor & Gamble, Nestlé, and Sara Lee), concentrating profit in the coffee roasting and distribution stage of the commodity chain (Lewin et al., 2004).

The end of the 1980s and early 1990s also marked a period of transition in the domestic policies in many coffee-producing countries, inspired by a global shift in economic and political ideology. The end of the Cold War and the rise of neoliberalism generated a shift in both the political motivations behind economic policy intervention and the participation of coffee-producing countries in global markets. Some authors have argued that support for coffee production in

Latin America was part of the U.S. anti-communist strategy in the 1980s; with the end of the Cold War the interest in using this form of market intervention for achieving political aims also waned, resulting in the U.S. withdrawing of its support for the ICA (Dicum and Luttinger, 2006). Across much of Latin America, decentralization, privatization and the promotion of export-led growth became the dominant theme in agricultural policy (de Janvry and Sadoulet, 1993; Spoor, 2000). In South East Asia, the fall of the Soviet Union and the end of the cold war marked a threshold of new economic openness and trade. Much of the increased demand in the former Soviet states and in Eastern Europe has been for less-expensive soluble coffee, made from Robusta beans, the variety of coffee most popular in the lower altitudes of Brazil and parts of Southeast Asia.

The net result of this restructuring has been a transformation of the domestic and global institutional context for coffee production, affecting all coffee-producing nations, yet, given the diversity of national history and economies—in different ways. For Vietnam, the collapse of the ICA and the adoption of principles of market liberalization provided a new opportunity to enter a market and capitalize on the relative institutional disorder that emerged in the early 1990s. For coffee farmers in other nations – particularly the traditional dominant players in the coffee market such as Brazil, Colombia, Mexico and Guatemala – the transition to a free-for-all international market coupled with the dismantling of state marketing boards and public agricultural service providers introduced a suite of new production risks and challenges that many farmers were poorly prepared to address. In the following sections we draw from a variety of primary and secondary sources to illustrate how the livelihood responses of coffee farmers in Mexico and Vietnam are linked through their integration into global markets and the social and environmental outcomes of their adaptation choices.

4. Livelihoods and nested vulnerability in the coffee sector

One of the main challenges in presenting the connections between human action at the local scale and the feedbacks of these actions across the globe is in capturing the complexity emerging from the mix of different drivers and outcomes at various scales of analysis. In this paper we therefore focus our examination on the causes for, and outcomes of, coffee farmers' vulnerability in Mexico and Vietnam in three periods during which global coffee production and trade underwent significant changes. The aim is to highlight not only how global changes affect smallholders in (dis)similar ways across different coffee-producing nations but also in describing how local responses and livelihood vulnerabilities are linked across space and time. Specifically, we draw on two case studies of coffee-producing households and communities in Mexico and Vietnam in order to provide insights into (a) how household capacities, and thus vulnerabilities, in particular places are circumscribed by the inertia of past policy and state-civil society relations and (b) the teleconnected nature of livelihood vulnerability by illustrating how adaptive gain for some can contribute to losses in distant places; and how global feedback

mechanisms can transform livelihood security in one location into livelihood insecurity elsewhere.

The Mexican case study took place in 2003, as farmers were emerging from the most recent coffee crisis. The research took place in two coffee-producing communities in the region of Coatepec, in Central Veracruz. In addition to interviews with public officials, coffee association leaders, academics and coffee processors and traders, a household survey collected data on the perceptions and responses of 60 households to the coffee situation (Eakin et al., 2006). The project was part of a broader study exploring the implications of climatic variability and change for coffee farming in Mexico (Gay Garcia et al., 2006).

In Vietnam, a study of migrant livelihoods included many coffee farmers, mostly migrants to the Central Highland region (Winkels, 2004). Livelihood surveys and interviews with 81 households originating from the overpopulated Red River Delta in the north provides important insights into both the opportunities and risk of coffee farming at Vietnam's southern mountain frontier when the first signs of the looming coffee crisis became evident in 2000 and 2001.

4.1. 1989–1993 A (coffee) world rocked by institutional change

When the International Coffee Agreement (ICA) collapsed in 1989, Mexico was the world's fourth-largest coffee exporter in terms of volume. Boosted by strong intervention of the Mexican government through its parastatal agency, INMECAFE (Instituto Mexicano de Café), Mexico's share of the world coffee exports rose from 3% to nearly 6% over the course of the 1980s. By the end of the 1980s, Mexico's economic liberalization program was in full swing, and most of the public agricultural service agencies were being privatized and price supports lifted (de Janvry et al., 1995). Plans were already underway to close INMECAFE and to transfer coffee collection, processing, credit and input supply functions to either farmer groups or the private sector (Martínez Morales, 1997). Mexico's coffee harvest also suffered damage from a severe frost in late fall 1989, affecting an estimated 10% of production in Veracruz and Oaxaca (Martínez Morales, 1997). Official data on area planted and harvested indicate that over the period 1989–1991, 3–5% of the planted area in coffee was not harvested.

The response of households to these institutional and environmental shocks depends in large part on local antecedent social, political and environmental conditions for coping and decision-making. While the frost did not have any implications for the global market, in Central Veracruz it precipitated a change in the viability of production: With far smaller harvests than usual, the demand for coffee laborers also declined. Interviews with representatives of an agricultural workers' association in Veracruz reported that households in the upper elevations of the Sierra Madre Oriental who had formerly worked in the coffee plantations below began to seek out new migration routes to the northern Mexican irrigation districts and the United States. While in other regions coffee producer associations used the institutional change as window of political opportunity (Snyder, 2001), in Central Veracruz the local agricultural credit unions and associations that had been the primary vehicle for the

dissemination of INMECAFE's programs, technology and for commercialization began to disintegrate. In response to INMECAFE's interventions many producers had expanded their planted area, resulting in an aggregate increase in coffee area by 37% over the 1980s, replacing sugar cane, subsistence crops and undisturbed forest (see Fig. 1) (Nestel, 1995). With the closure of INMECAFE these monoculture smallholders were in a particularly difficult position, and in debt. They no longer had alternative cash or subsistence crops, and thus the immediate strategy was to ride out the institutional volatility through minimal investment and ceasing any crop expansion (Eakin et al., 2006).

Across the globe, during the 1980s, Vietnam also underwent dramatic political and institutional changes altering the economic landscape for agricultural production. Policy reforms under Doi Moi included the privatisation of collective agriculture and the relaxation of the household registration system allowing people to move more freely and hold titles to their own land. Inevitably, agricultural expansion followed as over 70% of the population's livelihoods derived from agriculture and other natural resource-based activities. At the same time, Vietnam also set in train major external sector reforms and agreements which integrated Vietnam into the world economy after decades of isolation from western markets, including the rationalisation of the exchange rate, relaxation of export and import controls, an initiation of an open door policy to promote foreign direct investment and regional and multilateral trading agreements (Niimi et al., 2003). Despite this strong stimulus for export growth of a number of commodities, coffee export still remained a marginal economic activity until the early 1990s. The planted area covered a modest 30,000 ha and trading was restricted to other communist countries, often on a barter basis (Giovannucci et al., 2004). Worldwide, Vietnam was a minor player, contributing just over 1% to global exports of coffee (ranked 21st of 51 exporting nations according to historical data from the International Coffee Organization, www.ico.org). Nevertheless, locally, the range of choice farmers' faced in their livelihood strategies was beginning to change.

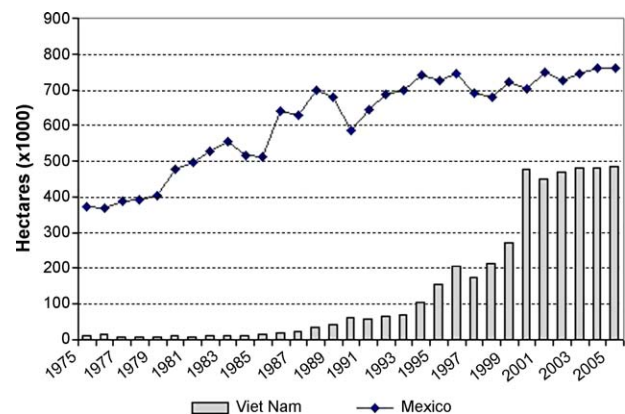


Fig. 1 – Harvested area in Vietnam and Mexico. Note the decline in area harvested from 1989 to 1990 in Mexico, reflecting the frost damage of 1989 as well as difficulties in commercialization following INMECAFE's closure.

4.2. 1994–1998 Climate impacts bring opportunities and losses for coffee farmers worldwide

In 1994 the trajectories of coffee development and smallholder vulnerability in Vietnam and Mexico converged for the first time, linked by two severe frosts occurring in June and July in a third country, Brazil (Coffee Research Institute, 2006). After the closure of the ICA in 1989, world prices for coffee had been steadily dropping as the stock of green coffee accumulated in importing nations. According to data from the International Coffee Organization, following the frosts in 1994 Brazil's production and exports declined by 36 and 15%, respectively. Following the collapse in Brazil's production, world prices increased by over 100% (Fig. 3).

In the case of Vietnam, policy change opened new livelihood flexibility and resource mobility, which had the effect of transforming the international market and climate shocks into stimuli for productivity. Vietnamese rural residents entered the 1990s with unprecedented opportunities for improving their livelihoods, of which coffee was one of the most promising. The combination of market liberalisation and the collapse of ICA provided a favourable environment for the expansion of coffee cultivation as coffee beans could now be competitively traded at the international market. The window of opportunity was enhanced on the one hand by government incentives, preferential loans to growers and exporters and subsidized import of inorganic fertilizer, hastening the uptake of cash crop farming (Giovannucci et al., 2004). On the other hand, coffee production was boosted by an ever-growing and more mobile labor force,¹ eager to leave overpopulated and poverty-stricken areas, resulting in the conversion of forest into crop production and an expansion of new land under cultivation (Dang Nguyen Anh et al., 2003). Thus, while domestic circumstances inhibited Mexico's response to favourable market conditions, Vietnam's coffee production expanded rapidly.

By 1994, Vietnam's coffee plantations had been increasing by 15% a year to over 150,000 ha (see Fig. 1), putting Vietnamese coffee growers in an excellent position to respond strategically to the price rise. According to interviews with coffee farmers in the Central Highland region, the boom in coffee prices resulted in a rapid in-migration, fueled in part by land availability and the demand for seasonal labor for harvesting. The majority of Vietnam's coffee farmers (~85%) planted coffee trees on landholdings of less than two hectares, poverty levels declined in the main production area of the Central Highlands² from 70 to 52% between 1993 and 1998³ (Giovannucci et al., 2004).

The willingness of people to migrate to distant places to farm or harvest coffee, usually supported through their social network connections (Winkels, 2004), was also driven by

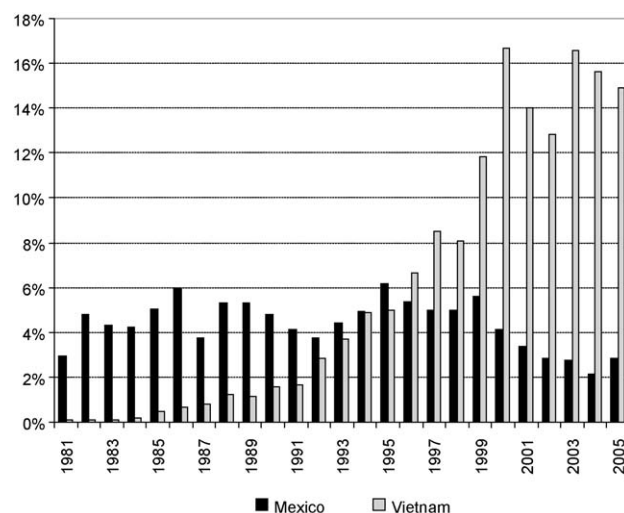


Fig. 2 – Percent contribution to world export volumes, Mexico and Vietnam.

several national and international institutional mechanisms. Important changes to Vietnam's land laws in 1993 provided tenure rights and the use of land as collateral for loans. Thus, by 1994 coffee also became the second largest foreign exchange earner for Vietnam, intensifying the government-led emphasis on export-oriented agriculture. As a result of these influences, Vietnam's production of Robusta beans more than doubled between 1994 and 1997 from over 2.7 to over 6.1 m 60 kg bags (ICO 2007). Vietnam's share of total world coffee exports was now equal to Mexico's at 4.9% (Fig. 2).

In marked contrast to Vietnam, the volatility in the international market occurred in a domestic policy vacuum in Mexico, where production stagnated when farmers who had literally been organized to produce in relation to specific state institutional structures suddenly were unsure where to turn. According to interviews in the region, smallholders in Veracruz were not intensifying their production, despite the influence of the Brazilian frost that increased producer prices by 100% between the start of the harvest season in 1993 and the same period in 1994. By 1995 prices were still rising. The new migration patterns out of Mexico established after the 1989 frost meant that labor was now scarce in the coffee sector, and farmers had not recuperated from the loss of the infrastructure and institutional support of INMECAFE. In 1994 and 1995, when prices were the highest, the harvested volume in Veracruz and coffee yields were the lowest in nearly a decade. Under conditions of labor scarcity and investment constraints, many smallholder farmers responded to higher coffee prices by harvesting less: they achieved their target income with less expenditure and outlay of labor.

Until 1994, Mexican and Vietnamese farm households were both price takers in the coffee market, and thus their vulnerability – or, conversely, opportunities – were linked only through their exposure to market volatility driven by exogenous shocks: global institutional change and climatic extremes in the world's primary coffee producer, Brazil. The differences in their responses can be explained by their independent social and political histories, and the availability

¹ Between 1990 and 2000 over 6 million additional people were employed (Niimi et al., 2003).

² In 2003, Vietnam's Central Highland region included three provinces: Dak Lak, Gia Lai, Kon Tum.

³ Poverty lines are calculated on a constant set of basic food and non-food needs defined by the General Statistics Office and The World Bank. In 2002 this 'goods basket' was VND 1,916,000 per person per year.

of resources such as land and labor locally. Nevertheless, the farmers are also actors in both the global coffee market and the global environment. As the next section illustrates, their independent responses also amplify drivers of change, affecting their own opportunities as well as those of their distant competitors.

4.3. 1999–2003 Low coffee prices bring about debt and poverty

By the year 1999, the livelihoods of Vietnam's and Mexico's coffee farmers were linked by far more than susceptibility to climate extremes in Brazil. The rapid growth in coffee as a result of Vietnamese farmers' adaptations to exogenous change meant that collectively their land use and livelihood decisions now had the potential to convey signals of change back to the global marketplace. Vietnam now contributed 15% of world coffee exports, second only to Brazil, and Vietnam's production surpassed Mexico's by more than 10 million 60 kg bags. Brazil's rapid recovery from the 1994 frost together with Vietnam's expansion contributed to a glut of coffee in the hands of coffee processors and distributors, and world coffee prices dropped to a 70 years low (Fig. 3). Appraisals by the World Bank, Inter-American Development Bank, the International Coffee Organization and non-governmental humanitarian organizations illustrate that the crisis was severe, affecting coffee investment, migration patterns, crime rates, food security, income and employment in almost all coffee-producing countries (ICO, 2003).

Vietnam's success as a world coffee producer now was coming back to haunt its coffee farmers. Coffee growers interviewed in 2001 were bracing themselves against the price drop from US\$.41/lb at the end of 1999 to an all-time low of

US\$.12/lb by reducing fertilizer and irrigation inputs and delaying the sale of green coffee beans in the hope of increasing prices (see also Dang Van Ha and Shively, 2008). The national policy emphasis on export production had led to crop specialisation (mono-cropping) during the 1990s, fuelled by government need for foreign exchange to service international debt (Giovannucci et al., 2004). As in Mexico a decade earlier, the absence of efficient public and private social safety nets combined with a reliance on a single crop resulted in an increased vulnerability of farmers (de Fontenay and Leung, 2002; Dang Van Ha and Shively, 2008).

The signal of change conveyed through the farmers' actions was not only economic but also environmental, reinforcing local-level vulnerabilities. The poor quality of soils and the arid climate of the Central Highlands mean that coffee plantations require high input of fertiliser and need to be irrigated. In the absence of efficient extension services (Beckman, 2001) the limited experience of coffee farmers in sustainable production practices often results in overuse of fertilizer, which in turn has consequences for both the environment and farm expenditure (Giovannucci et al., 2004). The rapid expansion of coffee farms also puts additional pressure on water resources in the Central Highlands. Every hectare of coffee requires 1500–3000 m³ of water which is extracted from surface water and groundwater sources. It is estimated that the groundwater resources in Vietnam's foremost coffee growing province, Dak Lak, are exploited for over 70% of their capacity (D'haeze et al., 2005). The region is also liable to both localized flooding and droughts (Adger et al., 2001b), adding to the vulnerability of coffee farmers, who had taken loans from both state banks and private lenders to afford the high investment costs of their plantations (Lindskog et al., 2005). Interviews with farmers in 2000/2001

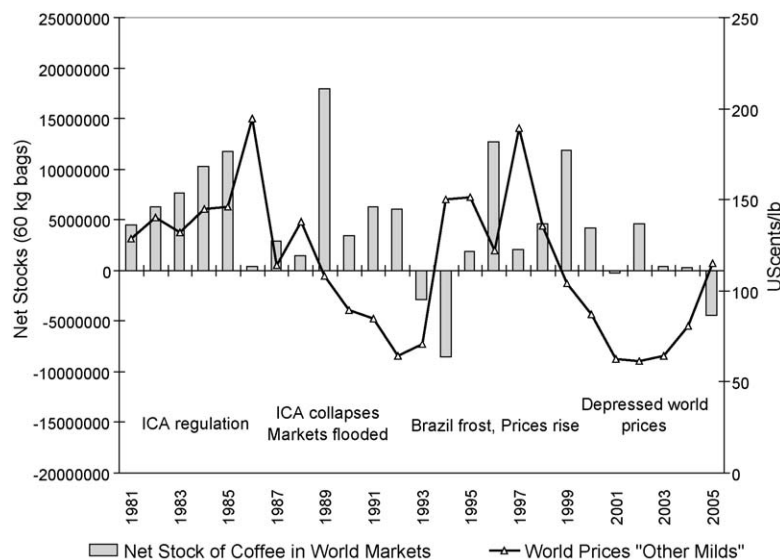


Fig. 3 – Net stock of coffee in world markets. Note: The members of the International Coffee Organization represent 75% of the world's coffee exporters, as well as the world's largest coffee importers. The accumulation of coffee in the world market through the exports of producing countries is in part a function of the relatively inelastic demand in importing nations. The figure illustrates an inverse relationship between net coffee stocks in the world market (difference between total exports and total imports) and world coffee prices from 1989 through 2000. During the peak of the coffee crisis (2000–2003), prices remained low despite a decline in world stocks.

revealed that many were unable to service their debts as a result of the international drop in coffee prices. They reported that they were considering changing to other crops, returning home, or migrating elsewhere in search of non-farm employment. Thus by 2003, despite its comparative advantage of being the key coffee-producing area in Vietnam, the Central Highland region was still one of the country's poorest (Glewwe et al., 2004).⁴

The coffee boom in Vietnam had now turned a full circle. Domestically, farmers were not only struggling with debt, but also were responsible for, and indeed feeling the consequences of, widespread environmental degradation due to deforestation, soil erosion, excessive fertiliser use and unsustainable irrigation practices (D'haeze et al., 2005). Rapid in-migration of lowland (ethnic majority) Vietnamese has further resulted in the marginalisation of local ethnic minority peoples leading to conflict over both resources and freedom of ideological expression (Winkels, 2008).

In an effort to diversify its commodity base and address the emerging welfare crisis in the coffee sector, the Vietnamese government is now planning to increase its total planted area of Arabica coffee trees from 26,500 ha (in 2004) to 100,000 ha (yielding 2 million bags/120,000 tonnes) by 2010. Once again, this adaptation of Vietnam to market volatility for Robusta beans implies a much more direct competition with producers in Latin America. However, analysts consider this target as too ambitious as the rate of planting of Arabica trees by Vietnamese smallholders is very slow. A 20–30% increase in Arabica production is therefore expected in the mid-term (Giovannucci et al., 2004: 33–34, USDA 2001).

While Vietnam's productivity was certainly not the only factor in the collapse in prices, it was an important contribution, and it was through the global markets that Mexican farmers felt the implications of the lack of sustainability in Vietnamese coffee sector growth. In Central Veracruz in 2003, coffee farmers reported leaving 50% or more of their harvests on their trees in light of the high cost of labor relative to market prices. Over half the households in two communities surveyed in 2003 (62%) had stopped investing in purchased inputs and 48% had cut back on pruning, weeding and other maintenance activities (Eakin et al., 2006). With 87% of households reporting declining incomes, those households with outstanding loans faced significant financial hardship. Nearly 80% of households surveyed reported difficulty paying medical expenses and meeting basic needs (Eakin et al., 2006). At a more aggregate scale, the income marginality index monitored at the municipal level by the federal government (CONAPO) suggests that the economic impacts of the crisis were severe across coffee-producing communities in central Veracruz. Of the 13 *municipios* responsible for over half of the state's planted area and coffee production, 44% were in the categories of "high" or

"very high" marginality in 1995. By 2000, 77% of these *municipios* were in these two categories.⁵

In the face of significant economic stress, the pattern of migration by 2000 had also changed: the youth of coffee communities were now leaving to search for employment in the United States, leaving their parents and grand parents to tend to the harvests. The rate of international migration doubled from 1997 to 2003, making Veracruz one of the states with the fastest growth in international emigration (CONAPO, 2006).

While the impact of the coffee crisis on livelihood security has been largely negative,⁶ the local ecological impacts of the households' responses were mixed. On the one hand, there was some indication that households at lower elevations were beginning to replace their shade-grown coffee with sugarcane (the area planted in sugarcane area increased by 20,000 ha state wide in the 1990s), and interviews with urban planners in the towns of Xalapa and Coatepec indicated that much of the recent expansion of urban development was now on former coffee farms. On the other hand, in many communities in the region alternative crops were not economically viable (Hauermann and Eakin, 2008). Emigration of youth from the coffee-producing areas had not only reduced labor availability but also left production in the hands of older residents who were less inclined to experiment with new crops or economic activities (*Servicios Profesionales Integrales para el Desarrollo Regional*, 2003: 61; Eakin, 2004). Thus coffee was often not likely to be replaced but rather abandoned, with the expectation that recuperation of prices would make the crop viable once again.

Mexico's cloud forests are already heavily fragmented, and researchers attribute a significant net release of carbon into the atmosphere to the conversion of both undisturbed and disturbed forest into open agricultural use (Cairns et al., 2000). Research in the neighbouring state of Oaxaca by the organization Resources for the Future found that the coffee crisis was associated with increased forest fragmentation as a

⁴ While the national poverty rate (the fraction of the people who cannot attain 2100 calories per day) has decreased from 37% to 29% between 1998 and 2002, the poverty rate in the Central Highlands remained constant (52%) over the same period. Out of the 561,000 coffee growing households in Vietnam (3.4% of its total population), 46% are classified as poor according to the 2002 Vietnam Household Living Standard (World Bank, 2003). 79% of all coffee farmers live in the Central Highlands.

⁵ The latest figures from 2005 suggest that economic marginality in some *municipios* has decreased to some extent since 2000, but have not yet declined to pre-crisis levels (which were not low in any case). While in 1995, 31% of the 13 *municipios* (4) were classified as "low" or (in one case) "very low" marginality, in 2005 only 15% (2) of these *municipios* were in this category while 54% (7) were classified as "high or "very high." (Conapo, "Índices de Marginización por Municipio" 1995, 2000, 2005. www.conapo.gob.mx/publicaciones/indices/pdfs/000.pdf). The marginalization index is composed of a series of variables derived from the National Population and Housing Census, including housing construction, access to sewage, public water supply and electricity, population earning less than two minimum salaries, education levels and illiteracy rates, and the size of the residential community. The methodology can be reviewed in CONAPO, 2001, *Índices de Marginación* 2000, CONAPO, México, DF. <http://www.conapo.gob.mx/publicaciones/indices/pdfs/000.pdf>.

⁶ Interviews with producers in the Central Veracruz region revealed that some farmers have been able to transform their production systems to take advantage of niche markets (gourmet, organic and Fair Trade coffees). Organic production has been identified as a successful strategy for improving livelihood security in Central America (see Bacon, 2005) and the Mexican states of Chiapas and Oaxaca. Participation in these markets is less common in Veracruz.

result of the conversion of land to subsistence maize production in areas distant from urban centers and road networks (Blackman et al., 2007). Similar analyses have not yet been undertaken for Central Veracruz, but a wealth of literature has emerged on the value of Central Veracruz's coffee ecosystems for biodiversity, carbon sequestration and erosion control (Manson, 2004; Pineda and Halffter, 2004; Pineda et al., 2005; Gordon et al., 2007). If non-farm activities become the primary income alternative for rural households, then some of the cloud forest may well recuperate, incorporating abandoned coffee and shade trees into forest cover.

5. Regions define adaptive responses to teleconnected stressors

The challenge of evaluating aspects of both agency and structure in the production of vulnerability has been a central theme of vulnerability research. Insights from critical political ecology have long called into question the simplistic characterisation of vulnerability as the results of inappropriate resource management of impoverished populations, exposed to independent (and apolitical) exogenous shocks (Watts, 1983; Adger et al., 2001a; Eakin, 2005). Yet an alternative perspective that privileges the role of global forces of political-economic change in structuring vulnerability can also deny the agency of individual resource managers in shaping their own futures (Bebbington, 1993). As others have noted (O'Brien, 2006; Young et al., 2006), in the context of unprecedented global interconnectedness, a more complex and nuanced framework for understanding vulnerability and the implications of adaptation is required, which not only accounts for the position of local actors in processes global environmental and global economic change, but also illuminates the complex interactions of cause and consequence of action at different scales across space and time.

As the case studies showed, the last three decades of change in the global coffee market, and the responses of smallholders to environmental (climatic) and market (price) shocks in Mexico and Vietnam are illustrative of the spatial and temporal complexity of agency and structure in the evolution of livelihood vulnerability and adaptive action. At macro-scales the global links seem obvious and dominant. Even prior to the entry of Vietnamese farmers into the global coffee commodity chain, the livelihoods of rural residents in Mexico and Vietnam were linked by the decline of the Soviet Union in 1989, and the subsequent global spread of market liberalization, which produced associated domestic land tenure and agricultural reforms in both countries in the early 1990s. The drivers of vulnerability are similar in the two geographic contexts: global market volatility, in part driven by climatic shocks; inelastic market demand; increasing access to productive resources through concurrent processes of economic liberalization and institutional reform. While both regions initially experienced successful coffee expansion, though at different times, ultimately the interactions between these drivers and the regional contexts, fragile hillside environments and the chronic poverty of farmers, produced a crippling bust after the initial boom.

In fact, the specific geographic contexts – the political and institutional histories of Vietnam and Mexico, the local context of land reform, migration, and environmental change – are distinctive and highly relevant for existing adaptive capacity and how they translated global stressors into distinctly different local outcomes. In Mexico, the event of a region-wide frost followed by the implementation of land privatization, at a point when world coffee stocks were at a high, contributed to an increase in emigration and a period of labor scarcity in Central Veracruz that has persisted for over a decade. Economic opportunities in the United States, the opening of trade relations from the North American Free Trade Agreement in 1994, coupled with the simultaneous devaluation of the Mexican peso in 1994 and a growing labor force, increased the rate of emigration (Boucher et al., 2007). Without labor, the capacity of Veracruz smallholders to respond to climate shocks (local or distant) and to adapt to market change is diminished. In contrast, in Vietnam land reform and market liberalization coincided with a peak in world prices as a result of Brazil's frost in 1994. The migration generated during this period acted as the engine for coffee expansion, and Vietnam's surge to dominate world coffee markets.

As the households in both locations simultaneously move to secure their livelihoods—adapting to distant and local risks they in turn influence the global community of coffee producers and traders. Thus the adaptations of some contribute to driving the vulnerability of others both locally and across the globe. These 'ripple effects' or teleconnections are both economic and environmental, channeled through the same networks of influence that communicated global signals of stress, and generated the farmers' initial responses.

Locally, the decline of coffee viability and market response capacity in Veracruz coupled with out-migration precipitated a crisis in rural livelihoods in the late-1990s. Initially, the opposite occurred in Vietnam, at least for coffee farmers to the Vietnamese highlands. The farmers who migrated from the lowlands initially found that their capacity to purchase land and take out loans combined with new opportunities for export agriculture provided previously unheard of economic security. Today, with Vietnamese exports now overwhelming world markets, the initial entrepreneurial adaptations of the Vietnamese farmers, largely in the absence of institutional support, are translating into a maladaptation for themselves, and contributing to the vulnerability of others. Furthermore, while Mexico's position as a price taker still makes it unlikely that local climatic events will affect world prices, Vietnam now joins Brazil in exerting influence over prices through regional supply shocks caused by climatic extremes. In Vietnam, the rapid expansion of coffee has resulted in an erosion of the countries' natural resources and economic capacities, while the contribution of Vietnam to world coffee stocks has translated into increased market risk exposure for themselves as well as for Veracruz growers.

6. Teleconnections as linked counterflows

The teleconnections described in the narrative above can be distilled into different sets of linkages that convey signals of change from globally distant events through flows of material,

Table 1 – Global teleconnections in the coffee market.

Vehicle of connection	Role of teleconnection	Facilitating organization(s)	
		Name(s)	What is transmitted
Information (price)	Conveys (abrupt) signals of change in supply and demand from place-based environmental shocks as well as shifts in consumer and producer behavior and practices	Commodity Exchanges (NY); International Coffee Organization; USDA (US); National Commodity Boards and Agencies	Access to markets, historic, current and future financial information and projections
Coffee beans	Satisfaction of demand for globally recognized commodity.	Commodity Exchanges; Multinational coffee roasters and distributors	Standardization of production process; efficiency in distribution and quality criteria
Ideas, Concepts, Paradigms	Ontologies and ideology concerning functioning of markets, role of specific actors, significance of technology	Hegemonic nation-states (US, USSR); affiliated policy organizations (World Bank); academics and think tanks; NGOs	Direction of policy, rationale for change in resource allocation, justification for decision-making
Institutions and technology	Norms, rules, conventions and policies that regulate flows and coordinate behavior	WTO, IMF, World Bank, national policy agencies, private sector companies and NGOs	Transmission of non-monetary values in commodity chain (e.g., ecoservices; fair trade); barriers and opportunities for markets; change in resource use
People	Skills and labor power for production, innovation, capital conservation and investment	Communities of producers, traders, roasters, distributors, consumers	Transmission of motivation, capital, ideas into production process and natural and social resource base

information or influence (Table 1). In the case of globalized food systems, the physical trade of commodities such as coffee is the most obvious link. International commodity chains now render seasonality of production meaningless with flows of foods spanning hemispheres. How place-specific demand and, conversely, a sharp change in supply of a commodity is balanced by counterflows of price information through markets, generating place-specific responses is a fundamental principle of economics. Similarly disparities in the supply and demand for labor, and associated human capital, generate flows of international migration.

However, other forms of teleconnections also play important roles in linking resources and livelihoods of distant places. The efficiency of global commodity exchange depends on the coordination of rules, through regulation, prices, quality standards and production processes, in order to establish and sustain a basis for common understanding and trust among actors so that these “pipelines” of exchange remain open (Table 1). For example, diverse actors in commodity markets establish and maintain commonly agreed standards of product quality that enhance commodity flows by minimizing questions at all stages of the chain about what is being transmitted (Sawin et al., 2003; Murdoch et al., 2000). The norms, technologies and standards of exchange in different commodity chains in turn reflect ideologies governing the economic and non-economic values of what is exchanged and the roles of particular actors such as the state, businesses and non-governmental organizations.

The teleconnections described in Table 1 are conveyed graphically in Fig. 4. The hierarchy of levels is shown as three vertical layers, starting from the most local (in our case, a region within Mexico and Vietnam) and building to larger and larger scales (national and international). Each lower layer is nested within the next level of broader spatial scope and

political administration. Interactions are shown as arrows linking pairs of variables.⁷ The flows and counterflows (described in Table 1) that characterize these teleconnections are labeled in bold italics down the central axis. Moving from top (global scales) downwards, the coffee global commodity market mediates flows of coffee and price information integrating inputs from different regions where production is variably affected by different stresses and shocks. These markets also are the forum through which participants negotiate the rules, regulations and norms that define the standards of production and exchange. Further, the figure also incorporates the role of ideology: the collapse of the Soviet Bloc catalyzed a paradigm shift that led to a new hegemony of neoliberalism, establishing trade liberalization as a common goal for intergovernmental cooperation. This shift also led to an increase in influence of international finance organizations (such as World Bank and Asian Development Bank) in support of export production in Vietnam, as well as that of private sector actors seeking investment and market opportunities. Together these actors enhanced the flows of market, policy and technology information to national governments and domestic actors through direct investment, international finance and brokered treaties on trade.

As was the case in Vietnam and Mexico, the result tends to be new national policies and institution reforms opening borders (represented as “X-border Portals” in the diagram) to greater investments from abroad and increased exports of coffee. The resulting increased flow of coffee to international distributors and roasters boosts international stocks and

⁷ In system dynamics modeling, a (+) signifies that *ceteris paribus* (all thing held equal) change by one variable results in change in the same direction as the other variable, and a (–) signifies change in the opposite direction (Stermann, 2000).

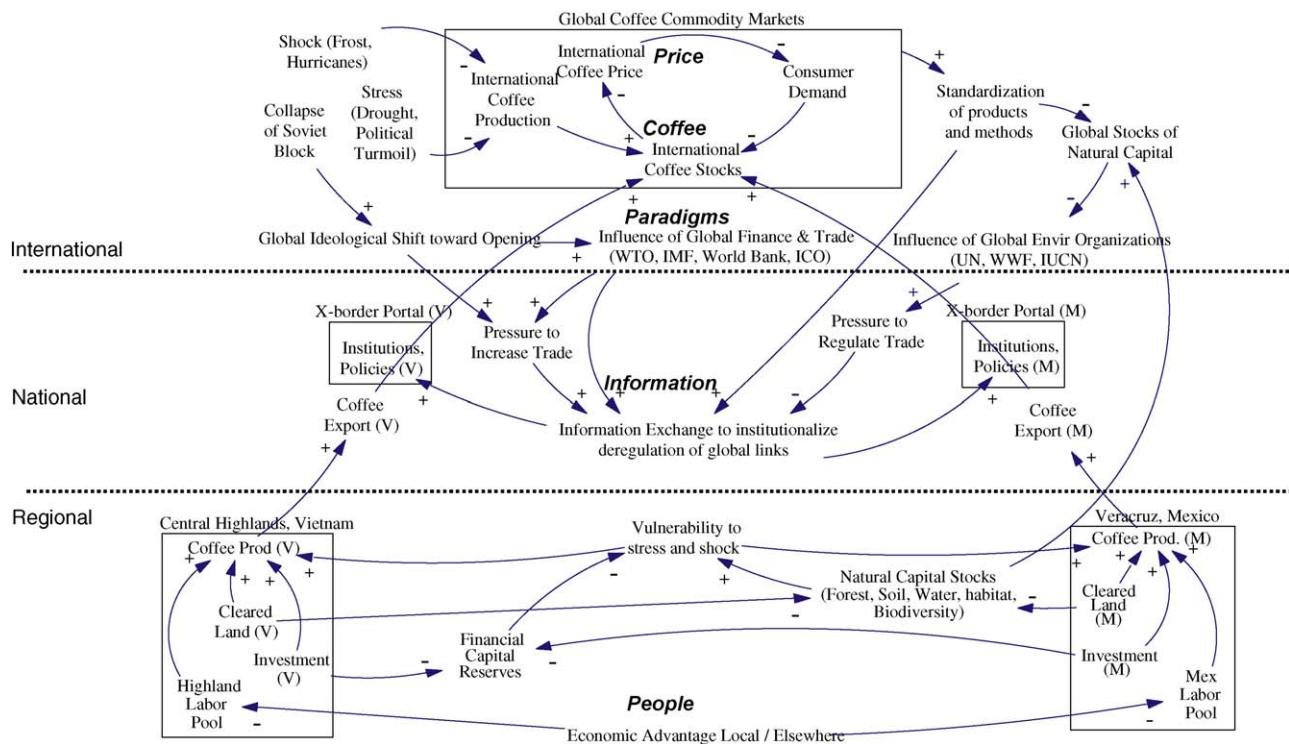


Fig. 4 – Mechanisms of teleconnections in the coffee market.

lowers prices. The opportunities and incentives in Mexico (1980s) and Vietnam (1990s) for increased export growth, in turn leads to increases in production and, consequently, a decline in natural capital as local farmers expand the cultivated area into forests, and, in the case of Vietnam, draw down groundwater and borrow to heavily to intensify their production. The consequent financial insecurity and mining of natural capital generates a feedback response, lowering the farmers' capacity to adapt to stress or shock, thereby increasing their individual and collective vulnerability, even as their commitment to coffee leaves them little chance to quickly diversify or enter other markets. Labor flows also play central roles in livelihood vulnerability: In Vietnam, coffee production is dependent on the availability of incoming labor and capital from the lowland regions. In Mexico, livelihood vulnerability is linked to the exodus of family and hired labor to the United States and the loss of coffee quality from neglected farms.

While the teleconnections described in Table 1 communicate environmental and political-economic shocks across space through mechanisms of price and commodity flows, the nested nature of the coffee system means that place-specific responses to these teleconnections can also 'scale-up' to have broader significance. If we consider global environmental change to be not only the large-scale processes of global warming, sea level rise etc, but also the cumulative global impact of local environmental degradation (Turner II et al., 1990), then the strategies employed by farmers in Mexico and Vietnam become important not only for what these strategies mean locally for the resource base (local environmental

services), but also for the global environmental commons. For example, the rapid expansion of sun-grown coffee plantations in Vietnam has led to increased rates of deforestation, land degradation and groundwater depletion. A reduction in forest cover of 19% between 1986 and 1996 is a clear result of the expansion of agricultural development (Bergeret, 2002). The dry climate of the Central Highlands also makes irrigation of coffee shrubs necessary during the dry season, and the coffee boom has threatened groundwater supply.⁸ Producing for niche markets (e.g., "bird-friendly" or "organic") is challenged by the deforestation that has accompanied Vietnam's expansion into coffee, and by the country's specialization in sun-grown Robusta coffee beans using large quantities of fertilizers (ICO, 2005).

In Mexico, it is the specter that farmers will decide to plant alternatives to shade grown coffee that is raising concern in global change communities. Locally, while not a substitute for the native tropical montane forest, shade grown coffee has also been recognized in Veracruz as a land use associated with high biodiversity and the provision of hydrological services (Manson, 2004; Pineda and Halffter, 2004; Pineda et al., 2005). Shade grown coffee in Mexico is also a potentially viable crop for the Clean Development Mechanism of the Kyoto Protocol, permitting international investment in reforestation as a

⁸ It is estimated that groundwater resources in Dak Lak province are presently exploited for 71% of their total capacity (95.5% of the extracted water is used for irrigating perennial industrial crops, 4% is used for urban areas and 0.2 % for the industrial sector (Luu, 2002 cited in D'haeze et al., 2005).

means of sequestering carbon, and thus contributing to the global mitigation of green house gases (De Jong et al., 1997). If large areas in coffee are converted to sugarcane, pasture or other forms of other non-agro-forestry use, the global ecological benefits that are associated with coffee will be threatened.

Mapping out these relationships as explicitly as possible using best available information can provide a rubric in which policymakers (and other actors) can consider both appropriate points of intervention locally, and the possible consequences of interventions at distinct scales. The potential important feedback between land use conversion in Mexico and carbon flux, for example, means that within the coffee sector there is a need to coordinate the incentives for land use change with Mexico's objectives and obligations internationally in climate change negotiations. For example, there is a possibility that through Fair Trade, carbon trading and organic niche markets the same global commodity chains that have become drivers of vulnerability in Veracruz may be transformed into incentives for increased livelihood security (see discussion in Bacon, 2005).

Similarly, the multiple linkages demonstrated between smallholders in Vietnam and the welfare of smallholders in Mexico may be a useful framework for non-governmental peasant farm organizations within each country to collaborate internationally in lobbying and advocacy efforts associated with international trade and economic forums. For example, in the effort to combat global poverty, scholars have highlighted that there is a need to think beyond the limitations of markets, to explore the role of other forms of geographic and even moral ties (Wood, 2003: 461). Empowering distant but similarly vulnerable producers demands channels of communication and flows that emphasize the multiple dimensions of economic relations, or, what Klooster (citing Polyani, 1957 and Wood, 2003) describes as the moral, social and non-material motivations of individual actions and engagement in economic exchange (Klooster, 2006: 544). Farmers around the globe are already recognizing that their livelihoods are “teleconnected”—not only in terms of vulnerabilities but also in terms of their positive responses to stress. Public policy can help by enabling the formation of organizations that can serve to channel these diverse forms of information among producer and consumer groups and thus facilitate adaptation to global change (Folke and Hahn et al., 2005).

This framework also provides a structure for international and bilateral aid organizations for developing policies to promote adaptation and vulnerability reduction. The interventions of such organizations are often simultaneous in distant places, and providing insights into how such interventions may be connected to outcomes elsewhere can potentially be valuable for institutional coordination. While not all the connections will be equally known or certain for different sectors and populations, some negative feedbacks may be avoided if scenarios are first explored using general categories of linkages we outline in Table 1.

7. Conclusion

Vulnerability is not a linear outcome of place-based exposure combined with the local characteristics that make populations

sensitive or incapable of managing impacts. In the current era of tightly integrated markets, vulnerability is a nested and teleconnected phenomenon, in which the independent actions of individuals, groups and governments to enhance security and improve welfare can have synergistic or contrary effects at broader scales and in distant places. Addressing vulnerability in this context thus requires an improved understanding of the temporal geographies of economic and environmental cycles. It also requires identifying and analyzing the specific mechanisms that link risk, outcomes and opportunities in distant places.

The concept of teleconnected and nested vulnerability is particularly important as countries move forward to reduce vulnerability to the anticipated impacts of climate change, while recognizing that social processes are as complex and dynamic as the climate system. Despite the direct sensitivity of crop production to the local climate shocks, it is likely that many farmers (if not most) will also be adapting to the direct and indirect signal of climate change as communicated by markets transmitting the cumulative adjustments of consumers, distributors, producers and policy makers, elsewhere.

Similarly, in such interdependent and tightly networked markets, the autonomous movements of independent producers become sources of global environmental change in their own right. Thus how farmers cope with the challenges and opportunities of the evolving market will in part determine their influence over the global environment, and, conversely, their responses to local environmental degradation or shocks can have distant livelihood impacts. Farmers are thus ‘victims’ of climatic extremes and rising temperatures, as well as wardens of biodiversity and carbon sinks, and participants in processes of environmental change. Their actions are embedded in a complex web of institutional, ideological, and economic relations. As they negotiate their place and livelihood security, it is important to recognize that together these networks can enable their agency to extend beyond the confines of their fields, from national policy to global markets.

Acknowledgements

The preparation of this article was supported by a Tyndall Visiting Fellowship to H. Eakin. Research in Mexico was supported by the InterAmerican Institute for Global Change Research (Small Grant #1-15); Research in Vietnam was made possible through grants from the John D. and Catherine T. MacArthur Foundation and the British Academy.

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