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Risk Perception and Adaptation to Climate Risk in the Coffee Sector of Chiapas, Mexico

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Introduction

Perception of hazard risk has long been recognized as a critical determinant of human response to environmental shocks and change (e.g., Burton et al., 1978; Kasperson et al., 1988; Stehr, 1995; Oliver-Smith, 1996; Weber, 1997). Nevertheless, recent research has expanded on this foundational literature to explore the socio-cognitive influences on adaptation more fully (Burch and Robinson, 2007; Grothmann and Patt, 2005). In Grothmann and Patt's (2005) socio-cognitive Model of Private Proactive Adaptation to Climate Change (MPPACC), perception is a key variable illustrated as influencing or being influenced by all the model's determinants of adaptive behavior. Segmenting the process of adaptation into "risk appraisal" and "adaptation appraisal," they argue that perception of hazard risk is an important determinant of adaptation, but so are perceptions of adaptation efficacy, costs and capacity to adapt.

Adaptive capacity, or the factors that enable social systems to respond proactively to environmental change, has emerged as a core domain of global change research (Burton 1996; Smit and Wandel 2006; Nelson et al. 2007). Much recent conceptual and empirical research focuses on identifying the demographic, economic, geographic, and some socio-political factors that diminish or enhance adaptive capacity (e.g., Yohe and Tol, 2002; Adger and Vincent, 2005). Relatively less attention, however, has been paid to the role of motivation in the process of adaptation. Whatever external pressures they experience, individuals must perceive a need, an ability and motivation to act. Thus full comprehension of the adaptation process may require further disaggregation of the complex relationships among the characteristics of individuals, how they perceive and acquire information about risk, and the role of social identity in their motivation to act.

Individuals are not only motivated by information about risk but also by their direct experience with loss and harm brought about by living with hazards. In hazards geography, *risk* is commonly characterized as the product of the probability of a risk event and the magnitude of its consequences (Kasperson et al., 1988). How an individual *perceives* risk is influenced in part by the type of hazard to which he or she is exposed and the perceived severity and frequency of that exposure (Kasperson et al., 1988).

The vulnerability of coffee farmers to climate stress is associated with the economic and geographic marginality of the farm households, as well as the direct sensitivity of the crop to climate stress (Eakin et al., 2006). Coffee farmers have become increasingly dependent on a coffee economy following a trend of reduced biological diversity on their plantations since the 1990s. Dependency on cash crops and lack of economic diversity creates an increased vulnerability to coffee-price fluctuations and to climate change (González Jácome, 2004; Eakin et al., 2006; Eakin and Wehbe, 2008). Climate changes such as shifts in the rainy season and variations in temperature and precipitation can negatively affect coffee plant physiology, flowering and fruiting resulting in reduced yields (Gay et al., 2006). Detrimental imbalances in the agroecosystem include increases in coffee pests and fungi, soil degradation, and reduced biodiversity. Based on current trends and projections of climatic conditions in 2020, Gay et al. (2006) found that in a worst case scenario, coffee production in Mexico could decline by as much as 34%.

Methods

Our case study involves smallholders from two communities in the municipality of Cacahoatán in the state of Chiapas (Figure 1). Cacahoatán neighbors the major city of Tapachula, which has nearby port

access and is the terrestrial gateway to Guatemala. Cacahoatán communities have easy access to Tapachula by paved roads with van and taxi services. One site, Agustín de Iturbide, is 37 km north of Tapachula and the other, El Águila, less than 5 km further northeast. Both study communities are characterized by modest wood or brick houses with multiple rooms and tin sheet roofs. Residents are non-indigenous and most speak only Spanish. Small-scale coffee socio-agroecosystems present an excellent context for exploring the theoretical framework described above. Because such systems are highly codependent on social and biological processes and the majority of coffee farmers represent economically and geographically marginalized populations, their vulnerabilities, social relations, and information flows are perhaps more easily identified than in other human-environment systems.

Our investigation into the role of risk perception in adaptation is based on surveys of farm households conducted in 2007. The survey data represents a subset of households extracted from a larger survey of coffee farmers organized by the Colegio de la Frontera Sur (ECOSUR). This larger survey entailed 318 coffee farm households in the two municipalities of Cacahoatán and Jitotol in Mexico's southernmost state of Chiapas. These surveys, conducted orally, were designed to collect data including household demographics and economics, agricultural practices, perceptions of risk, and economic and agricultural adaptations to various social, economic, and climatic stresses. The availability of the survey data permitted the creation of a risk perception index as a proxy for risk perception. In this paper, we use survey data from a subset comprised of a total of 70 cases: 48 from Agustín de Iturbide and 22 from El Águila.

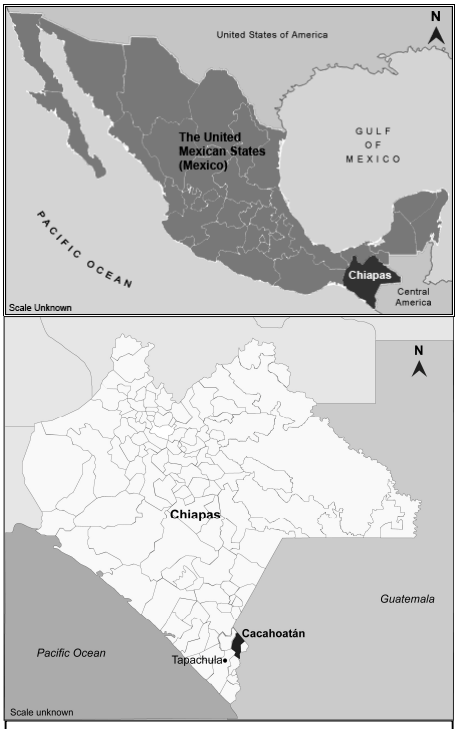

Figure 1. Location of Chiapas in Mexico and of the sampled municipality and adjacent major city within the state.

Results and Discussion

The survey data revealed that farmers are experiencing climate changes and impacts on their production. The majority of farmers in El Águila reported impacts primarily from torrential rain in the past ten years, while those in Agustín de Iturbide reported impacts from a greater variety of climate events, particularly drought and hailstorms, in addition to torrential rains. In both communities farmers perceived an increased frequency of most of the climate event types they reported. The climate impacts and frequencies reported by the farmers permitted the assessment of farmers' risk perception levels. Table 1 below illustrates the percent of farmers classified in each level of the Climate Risk Perception Index.

Table 1. Frequency and percent of households at each climate risk perception level (CRPL).

		Frequency	Percent	Valid Percent	Cumulative Percent
Climate Risk Perception Level	**Low**	19	27.1	28.4	28.4
	Moderate	20	28.6	29.9	58.2
	High	28	40	41.8	100
	Missing Value	3	4.3		
	Total	70	100		

Further probing on climate impacts was achieved in the in-depth interviews with farmers in the sub-sample. The interviewed farmers confirmed a general perception of an increase in the frequency and severity of diverse climate events, and a preoccupation for the implications of these climatic changes for their production. The impacts experienced by farmers included direct loss of coffee fruit and to a lesser extent loss of coffee plant foliage, both caused by strong rains and excessive moisture. Other impacts mentioned include increased coffee pests and diseases from excess moisture, delay or prevention of coffee plant flowering and fruiting due to temperature extremes or too much rain, and drying of the coffee fruit on the plant resulting from excess heat.

Consistent with Sjöberg (1998), parenthood appears to be an important influencer of risk

perception indicating that other differences in perception-motivation links may exist between parents with young children and non-parents or parents with grown, independent children. Among the nine possible sources of risk identified by farmers as potentially preoccupying, only climate and coffee pests were significantly associated with households with larger numbers of children younger than age 15 (Table 2). In comparison with other frequently identified sources of preoccupation (coffee prices, family health, access to credit, and employment) climate and pests could be classified as concrete, sensory risks and thus according to Sjöberg (1998) considered more salient. The number of children younger than 15 in a farmer's household was found to be significantly (p = 0.01) associated with his or her level of climate risk perception (Table 3).

Risk perception is also likely influenced by a person's age cohort, where age can signify norms of social interaction as well as experience associated with specific stages in the life cycle. Table 3 illustrates that the Climate Risk Perception Level is higher overall among farmers in their 20s and 30s and in those 60 and older than it is among farmers in their 40s and 50s. In addition, farmers in the youngest and oldest age groups also reported significantly higher values of a General Risk Aversion Index than those in the middle age group (p = 0.00).

Table 2. Cross tabulation of risk source by parental status.

Climate is a source of highest preoccupation*		No	Yes
Children younger than 15			
	0	52%	48%
	1-2	41%	59%
	3-6	25%	75%
	Total	41%	59%
Coffee pests are a source of highest preoccupation**		**No**	**Yes**
Children younger than 15			
	0	85%	15%
	1-2	59%	41%
	3-6	63%	38%
	Total	70%	30%

Significant at the 0.05** and 0.10* levels (baseline is total)

Table 3. Cross tabulation of climate risk perception level by parental status, age group and source of risk.

Climate Risk Perception Level		Low	Moderate	High
Children younger than 15* **				
	0	48%	33%	19%
	1-2	30%	26%	44%
	3-6	6%	25%	69%
	Total	31%	29%	40%
Age groups	**40s and 50s***	44%	28%	28%
	20s and 30s & 60s+*	24%	29%	47%
	Total	31%	29%	40%

Significant at the 0.01***, 0.05**, and 0.10* levels (baseline is total)

Table 4 below combines various demographic and socio-economic variables hypothesized to be associated with a higher CRPL, according to our conceptual model. The multivariate approach reveals which variables, if any, explored above in cross-tabular analysis remain independent predictors of our outcomes of interest when modeled with other independent co-variates and control variables. Demographic factors remain important predictors. Household heads in the prime of their productive years were negatively associated with high climate risk, suggesting a confidence in this age cohort in agricultural management and practice in the face of climate hazards. Households with young children however tended to perceive higher risk associated with climatic factors, confirming the association of parenthood and risk described above. In addition, farmers' experience with coffee pests and torrential rains in particular emerged as significant (and positive) predictors of high climate risk perception, as one might expect among farmers who are dependent on coffee farming as a primary source of income. Somewhat surprisingly, households with more assets were also associated with higher risk perception.

Table 4. Logistic regression: High Climate Risk Perception Level

	B	S.E.	Wald	Exp(B)
Head of household middle aged (40-59)**	-1.33	0.70	3.59	0.27
Coffee pests perceived as main problem**	1.33	0.67	3.90	3.77
Children under 15***	1.32	0.45	8.42	3.73
Heavy rain affected crops**	1.91	0.93	4.24	6.77
Index of household assets***	0.43	0.20	4.55	1.54
Constant	-4.89	1.45	11.37	0.01
Nagelkerke R Square		**0.47**		

Significant at the 0.01***, 0.05**, and 0.10* levels (baseline is total)

Conclusions

Investigations of climate adaptation have largely focused on technological interventions and geographic and socio-economic characteristics of adaptive capacity. Much less research has examined how risk perception motivates individuals to take adaptive actions. Less research still has examined farmers who produce for export but persist at a subsistence level. While we cannot measure climate change effects in se, we can and do measure proxies of climate change through frequency and severity of drought and precipitation, and associated infestations. We use logistic and linear regression analyses to predict risk perception and perceived sources of risk based on a survey of coffee producers in Chiapas, Mexico.

We model the statistical significance of several hypothesized socio-economic, demographic, and risk perception variables. Regression results suggest higher socio-economic and education status, migrant history, and household dependency burden of minors are inversely predictive of number of sources of climate-related risk perceived while high climate risk perception is predicted by history of torrential rains and coffee pests, household age structure, and level of household assets. The demographic findings point towards the importance of household life cycles in assessing perceptions of risk, vulnerability, and adaptive capacity, and resulting adaptive motivation. These findings have rich policy implications for adaptation management and smallholder production security. They merit further investigation to identify how, where and why climate risk perception plays a role in adaptive motivation and adaptation in other geographic areas of vulnerability worldwide.

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