



Learning resilience: Household and institutional responses to multiple livelihood threats in the context of Hurricanes Iota and Eta in northern Nicaragua

Christopher M. Bacon (Environmental Studies & Sciences, SCU); William A. Sundstrom* (Economics, SCU, presenting author), Maria Eugenia Flores Gomez, Kylie Griggs, and Raul Diaz (ASDENIC) Santa Clara University

Introduction

Despite converging agendas identifying the importance of farm and livelihood diversification as a key strategy to help reduce disaster risk, conserve biodiversity, reduce climate emissions, improve food security, and build resilience in agriculture and food systems (Kremen and Merenlender 2018; Hufnagel et al., 2020), contentious debates continue about how to accelerate broader food system transformations, who should lead them, and where they are going (e.g., the 2021 UN Food Summit). The influential 2016 report of the International Panel of Experts on Sustainable Food Systems, which analyzed obstacles and opportunities for moving from either traditional subsistence agriculture or industrialized monoculture towards diversified agroecological farming (IPES-Food 2016), helped shift the policy agenda toward an alternative approach to food systems transformation (Gliessman & Ferguson, 2020). However, several assumptions about farmers' initial starting conditions oversimplified how smallholder farmers begin potential transitions. In practice, many smallholders are neither purely subsistence producers nor entirely specialized commodity farmers; instead they combine subsistence and commercial agriculture to try to make a living, feed themselves, shape their cultures, and achieve their self-defined goals (Burnett & Murphy, 2014). Despite recent studies addressing several of these issues (Kerr et al., 2019), research gaps remain, including the absence of broad-based empirical evidence on which diversification strategies are most likely to contribute to farmers' dietary diversity, food sovereignty, food security, women's empowerment, and resilience, and under what circumstances; how smallholders learn about these practices and why they adopt or avoid them; and how cooperatives or other institutions promote (or may retard) them. We seek to fill these gaps using a mixed-methods, place-based study.

Goals

Drawing on two decades of participatory research partnerships with local organizations and cooperatives, our 3.5 year project responds to 4 goals:

1. Describe the extent, motivations & evolution of farmers' diversification strategies.
2. Assess how agroecological vs. conventional diversification relate to disaster risk, livelihoods, food security, diet diversity, gender, water security, & food sovereignty.
3. Explain processes of farmer and institutional innovation, social learning, and the use of smaller vs. transformative responses to climate change and other hazards.
4. Learn from farmers' experiences, experiments, and social movement pedagogies and help co-create methods for sharing agroecological innovations.

We will also critically reflect on how community-based participatory action research partnerships could help foster more transformative changes and build capacities within institutions (e.g., Universities, farmer co-ops) in majority and minority worlds.

This poster focuses on goal 2 – specifically the analysis of relationships linking farm diversity to food security and dietary diversity.

Methods

We report on an analysis of data collected as part of two recently completed community-based participatory action research projects, which included ethnographic work, such as focus groups and interviews, farmer case studies, and international farmer exchanges, as well as surveys of smallholder farm households. Both studies focused on smallholder coffee producers in the Segovias region of Nicaragua (Fig. 1). Study 1 assessed household food and water security in the context of climate change, drought, and other hazards, and included a survey of 334 farmers; Study 2 assessed the impact of farmers' diversification, and included 171 surveys (Table 1). The survey for Study 1 utilized a random sample stratified by affiliation with different farmer institutions, including a leading fair trade coffee exporting co-op that represents over 2000 farmers (PRODECOOP), UNAG, affiliated with the Campesino-a-Campesino (CaC) movement, and similar smallholders unaffiliated to either group. The Study 2 sample was selected from a population of farmers, stratified by past participation in co-op-led diversification projects.



Field Research & Analysis

- Field research activities conducted from 2014-2019, and included household surveys, focus groups, interviews, and participant observation.
- Survey and studies designed as part of a participatory action research process with associated partners and key results have been shared in focus groups.
- Associations between variables for survey and on-farm variables analyzed through visualizations, mean comparisons, and regressions.

Table 1. Summary of the surveyed population for two studies conducted in 2017

Organizational Affiliation Stratification	Study 1: Farmer food & water security in context of climate change + other hazards			Study 2: Diversified farming & food sovereignty
	PRODECOOP (PRO) Cooperative - leading organic & fair trade coffee-export 2nd level cooperative	Campesino -A-Campesino (CaC) Farmers affiliated with the UNAG's farmer-farmer program that also produced coffee	Un-affiliated farmers Farmers w/ similar size farm area, nearby, and w/out affiliation	Diversified Farmers Affiliated w/ PRO. Farmers included in population included those that had participated in diversification efforts, those with bee keeping, milpas, home gardens & coffee specialists
Number of farmers in sample 2017	143	97	81	171

Findings

Table 2. Demographics of surveyed farmers

	Study 1: By organizational affiliation				Study 2
	All	Unaff.	CaC	PRO.	
Age of respondent	54.1 (13.8)	51.1 (13.9)	52.8 (14.1)	56.7 (13.3)	52.1 (13.3)
Respondent female (%)	34%	32%	32%	36%	43%
Number in household	4.9 (2.1)	4.5 (2.1)	5.0 (1.7)	5.0 (2.3)	4.1 (1.8)
Farm size (ha)	5.0 (5.8)	3.4 (4.4)	5.1 (5.6)	5.8 (6.5)	5.5 (7.0)
Food lean months / yr	2.6 (0.9)	2.6 (0.9)	2.7 (0.8)	2.6 (0.9)	1.6 (2.1)
Number of obs.	297	74	90	133	171

Diversification of farms and livelihoods

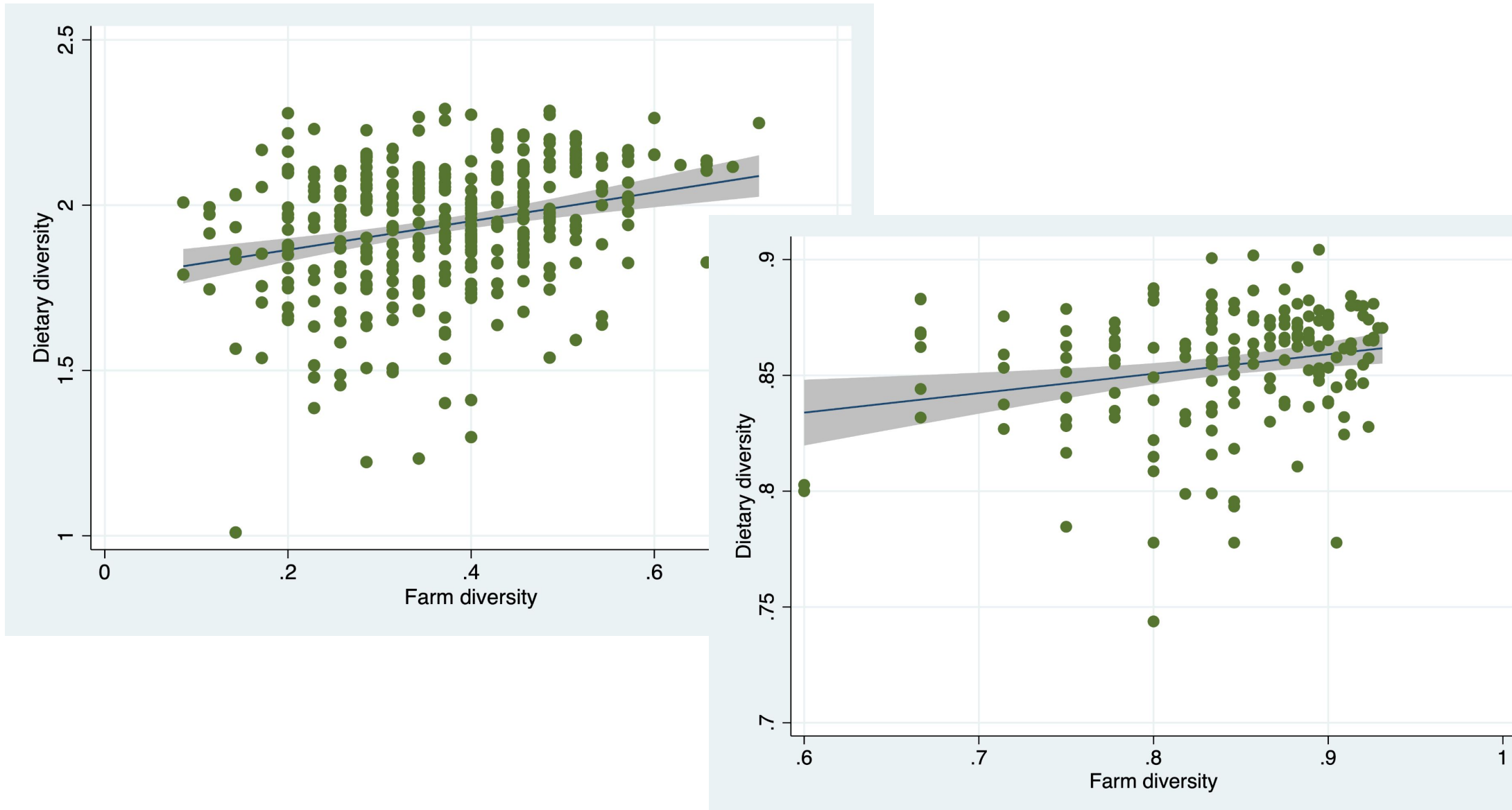


Figure 2. Correlation of dietary and farm diversity in both Study 1 (left) and 2 (right)

Regression Analysis

Strong association of dietary and farm diversity is undiminished by adjusting for farm size and cash income (Study 1):

- $\text{dietary_div} = 1.78 + 0.43^{***} \text{farm_div}$
- $\text{dietary_div} = 1.75 + 0.42^{***} \text{farm_div} - 0.0005 \text{farm_size} + 0.029^{***} \text{income (1000\$)}$

What factors correlate with food diversity and less seasonal hunger (Study 2)?

- Less Lean Months
1. Total farm area*
 2. Total income*
- More Dietary Diversity
1. Farm Diversity***
 2. Total Income*
 3. Fewer lean months*



Sources: 2017 Survey (n=171), Regression results
***p-value < 0.001, *suggestive correlation p-value = <0.1

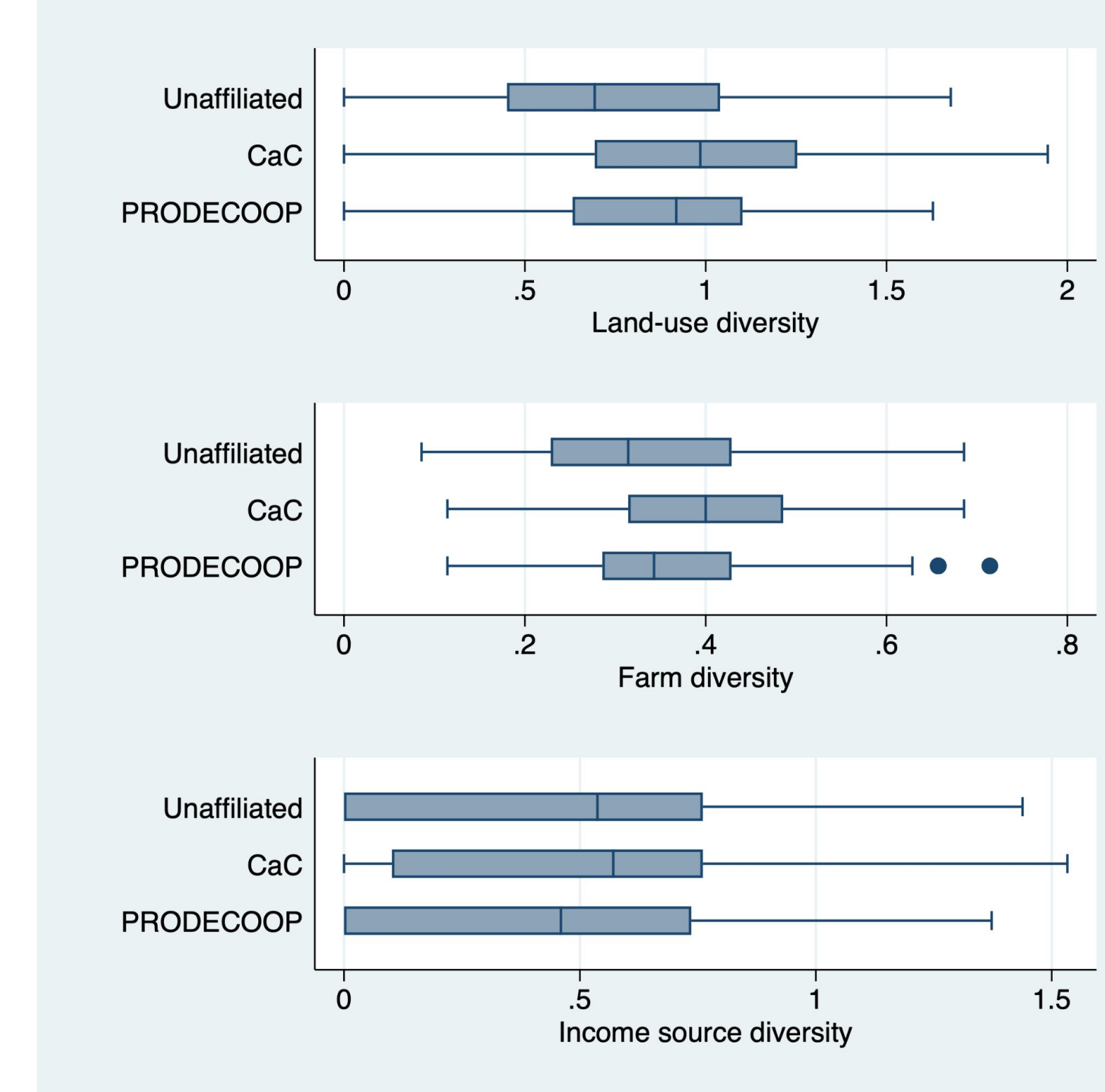


Figure 3. Diversity indexes by organizational affiliation, Study 1, 2017 survey

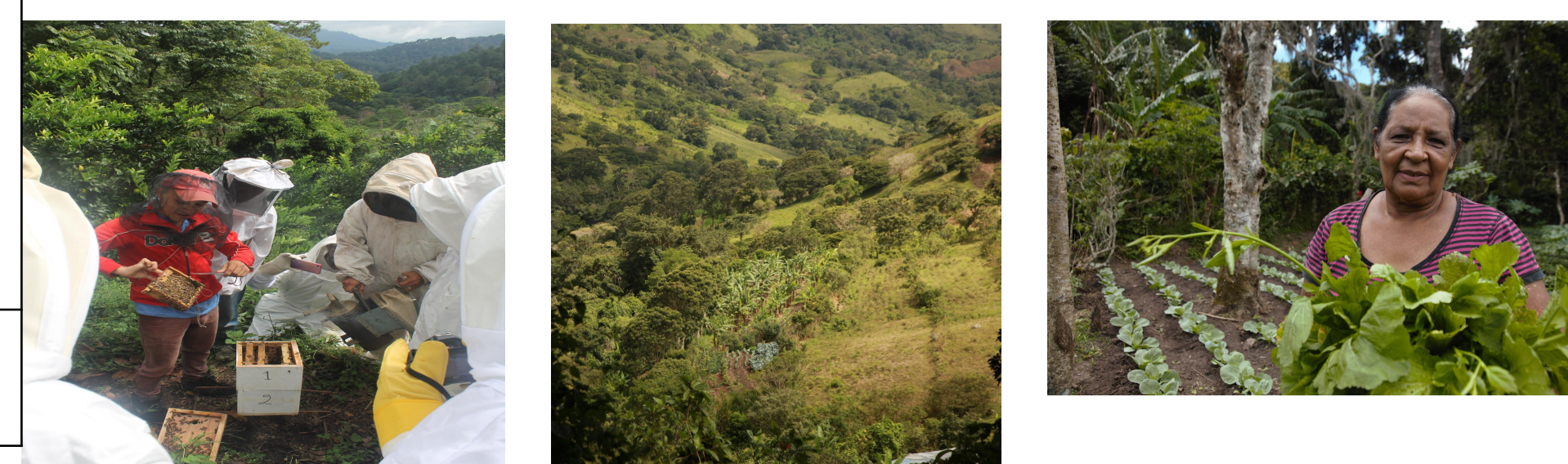
Table 3. Diversification and farmer organizations (OLS regressions)

	Dependent variable: Diversity index		
	Land use	Farm	Income
PRODECOOP affiliation	0.0585 (0.0614)	0.00766 (0.0170)	-0.0630 (0.0559)
CaC affiliation	0.199*** (0.0638)	0.0422** (0.0180)	-0.0000186 (0.0587)
Farm size (ha)	0.0198*** (0.00745)	0.00589*** (0.00124)	0.0181*** (0.00393)
Constant	0.644*** (0.0556)	0.321*** (0.0146)	0.430*** (0.0445)
Observations	318	319	312
R-squared	0.107	0.097	0.068

Notes: * p<0.1 ** p<0.05 *** p<0.01.

I think that diversification has totally changed things in the last five years, as I speak of diversification and the savings that we have in income not used to buy another productIt does not solve 100%, but it helps in those difficult months.

- Diversified Farmer, affiliated with PRODECOOP, Miraflo, Esteli Nicaragua.



Farmer perceptions of hazards 2016-17

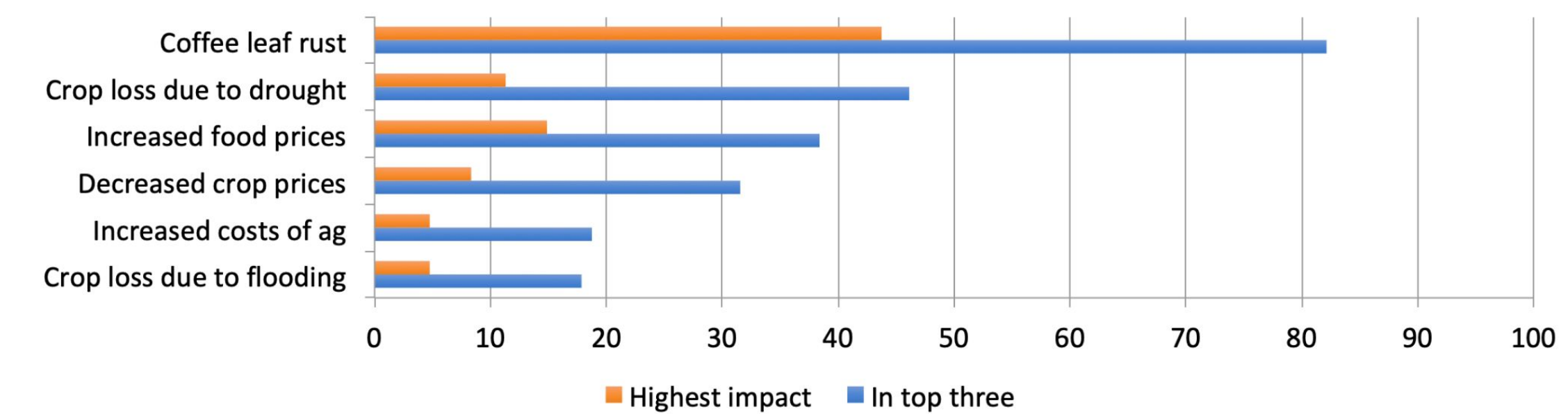
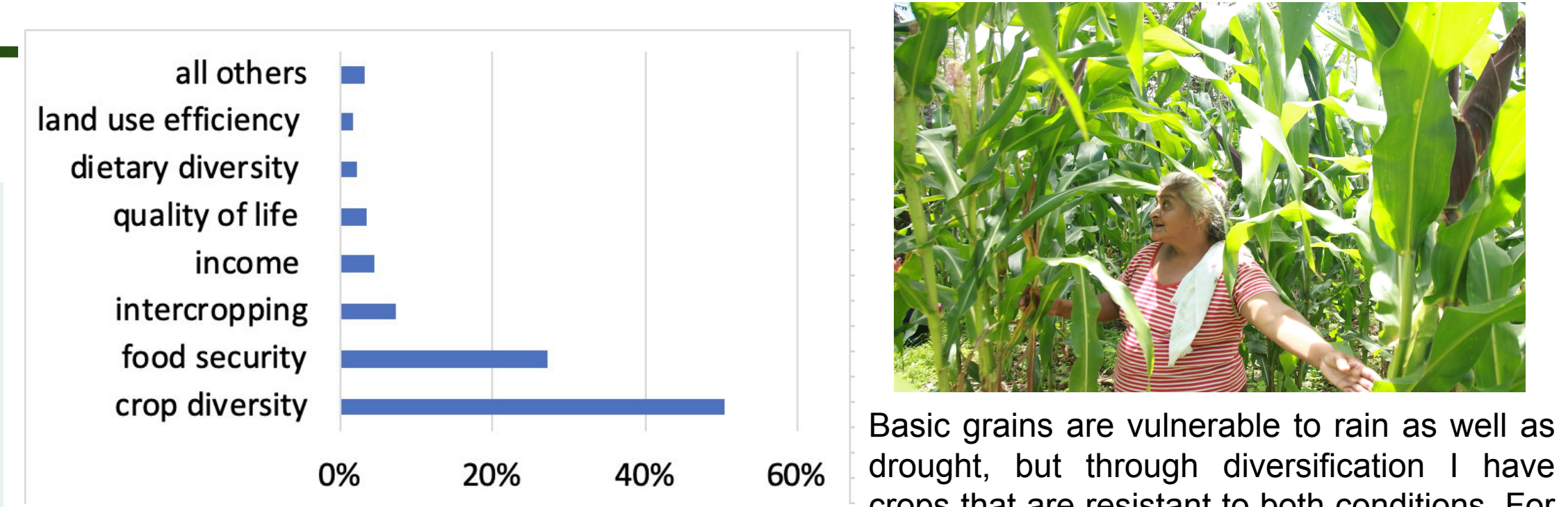


Figure 4. Ranking of impact of adverse events during the past 12 months, 2017 survey (% of respondents Study 1; Bacon, Sundstrom et al. 2021)

Farmer interpretations of diversification



Basic grains are vulnerable to rain as well as drought, but through diversification I have crops that are resistant to both conditions. For example, I am going to harvest oranges either way, unless there is a big drought. One has assurance that he has a Plan B. In addition, I consider improvement of the soil to be an important aspect of diversification. We have started recovering eroded soils that were previously abandoned for lack of harvests."

- PRODECOOP-Affiliated Producer

Conclusions & research plans

Evidence on the relationships between farm diversity and household dietary diversity suggests a strong positive correlation linking production diversity to dietary diversity as measured by household food group consumed. As shown in Fig. 2 this relationships is significant for the data collected in both study 1 and study 2. Further regression analysis showed that this relationship remained statistically significant while controlling for other variables, such as farm size and income.

Our findings from study 1 also suggest that organizational affiliation correlates with several measures of farm diversity. The analysis in Figure 3 and Table 3 suggest that farmers affiliated with Campesino-a-Campesino (CaC) have a higher farm diversity measure compared to unaffiliated farmers. CaC is a farmer-to-farmer movement that prioritizes smallholder diversification for food sovereignty (Bacon et al. 2017). Finally, farmers' self-reports in study 2 suggest that diversification activities are motivated by food security, income and quality of life.

Next steps in this research will consist of a broad set of research activities to respond to overarching goals. This will include a third longitudinal survey to assess the evolution of diversification over time and in response to recent hazards (e.g., Hurricanes Eta and Iota), as well as qualitative research to assess agroecological learning and innovation networks.

References

- Bacon, C. M., Sundstrom, W. A., Stewart, I. T., & Beezer, D. (2017). Vulnerability to cumulative hazards: coping with the coffee leaf rust outbreak, drought, and food insecurity in Nicaragua. *World Development*, 93, 136-152. <https://doi.org/10.1080/03066150.2013.876995>
- Burnett, K., & Murphy, S. (2014). What place for international trade in food sovereignty? *The Journal of Peasant Studies*, 41(6), 1065-1084. <https://doi.org/10.1080/03066150.2013.876995>
- Gliessman, S., & Ferguson, B. G. (2020). Keeping up with the agroecology movement: priorities for agroecology and sustainable food systems. *Agroecology and Sustainable Food Systems*, 44(1), 1-2.
- Hufnagel, J., Reckling, M., & Ewert, F. (2020). Diverse approaches to crop diversification in agricultural research. A review. *Agronomy for Sustainable Development*, 40(2), 14. <https://doi.org/10.1007/s13593-020-00617-4>
- Kerr, Rachel Bezner, et al. "Participatory agroecological research on climate change adaptation improves smallholder farmer household food security and dietary diversity in Malawi." *Agriculture, Ecosystems & Environment* 279 (2019): 109-121.
- Kremen, C., & Merenlender, A. M. (2018). Landscapes that work for biodiversity and people. *Science*, 362(6412), eaau6020.
- IPES-Food. *From uniformity to diversity: A paradigm shift from industrial agriculture to diversified agroecological systems*. International www.ipes-food.org
- Acknowledgements**
Financial support: This project is supported by National Science Foundation (BCS 2117976), some of previous data collected was supported by NSF (BCS 1539795), the Agropolis Foundation, The Community Agroecology Network, and Santa Clara University. Any opinions, findings, and conclusions or recommendations expressed in this material are those of the author(s) and do not necessarily reflect the views of NSF. Past and present collaborators involved in parts of research include: Maria Eugenia Flores, Misael Rivas, Ernesto Mendez, Alejandra Guzman Luna, Iris Stewart-Frey, and Janica Anderzen, and Rose Cohen.