

Assessing Diversification, Food Security, and Dietary Diversity with Organized Smallholders in Nicaragua

Christopher M. Bacon (Environmental Studies & Sciences, SCU); Maria Eugenia Flores Gomez (CAN, SCU); Vanessa Shin (ESS, SCU) Misael Rivas and Ruddy Espinoza (PRODECOOP Cooperative, Nicaragua); Álvaro Nicolás Benavides González, Henry Alberto Duarte Canales, Francisco Salmerón, y Josué Rocha (Universidad Nacional Agraria, Nicaragua); Gabriella Ballardo, Skyler Kriese, Erica Martinez, Emma McCurry, Gabriela Hamm, and Annalicia Anaya (Santa Clara University)

Introduction

Diversification is a key strategy for reducing the risk of hunger associated with exposure to climate disruption and other hazards. Although evidence suggests that when low input smallholders adopt agroecology-based diversification they can improve food security (UN SDG 2, Zero Hunger), advancing climate resilience (SDG 12, Climate Action) and sustainable land management (SDG 15, Life on Land) (Altieri, Nichols et al., 2015, IPES 2016 Kerr et al. 2019), better explanations and additional empirical research are needed to identify which diversification activities are currently in use, how and why farmers are using them, and the degree to which they contribute to several desired outcomes under different circumstances. This study contributes to filling this research gap. We report on the findings of a community-based mixed methods study conducted with Nicaragua's leading smallholder coffee cooperative union and the national agricultural university.

Objectives

In addition to documenting common farm and income diversification practices among coffee growing smallholders and assessing food insecurity challenges, we aim to start explaining how diversification relates to: 1) food security and dietary diversity, 2) climate resilience, and 3) gender relations. Finally, we critically reflect on how community-based participatory action research (CB-PAR) partnership that integrate smallholder cooperatives and local universities can build capacity and support co-op led strategies that use agroecology to advance their goals with their affiliated members.

Methods

We used a CB-PAR approach to develop this on-farm research project. In 2017, promoters conducted 171 surveys in northern Nicaragua (Fig. 1). A random sample was selected from a population stratified by past participation in co-op led diversification projects or not. In 2018, on-farm monitoring started with 50 farmers using selected diversification strategies.



Figure 1. Map of study site

Key Partner: PRODECOOP Cooperative (2300 affiliated farmers, 10,000 people, >50% certified organic, 35% female members).

Diversification strategies studied include: (1) Milpa, (2) Home gardens, (3), Beekeeping, (4) Diversified coffee, (5) Specialized coffee.

- Field Research, Data Collection & Analysis:**
- Use established food security & household dietary diversity metrics (Bacon et al. 2017)
 - Mapped 50 farm parcels using GPS & GIS.
 - Coffee climate resilience survey from CATIE, also see Rahn et al 2014.
 - Focus groups & interviews often separated by gender to develop ag calendars.
 - Associations between variables for survey a variables analyzed through regression.
 - Reviewed PRODECOOP's annual reports from 2011 and 2019, coded all workshop training titles and sex of participants.
 - Collaborative workshops and farmer-promoter trainings to develop farm and co-op level strategic plans.

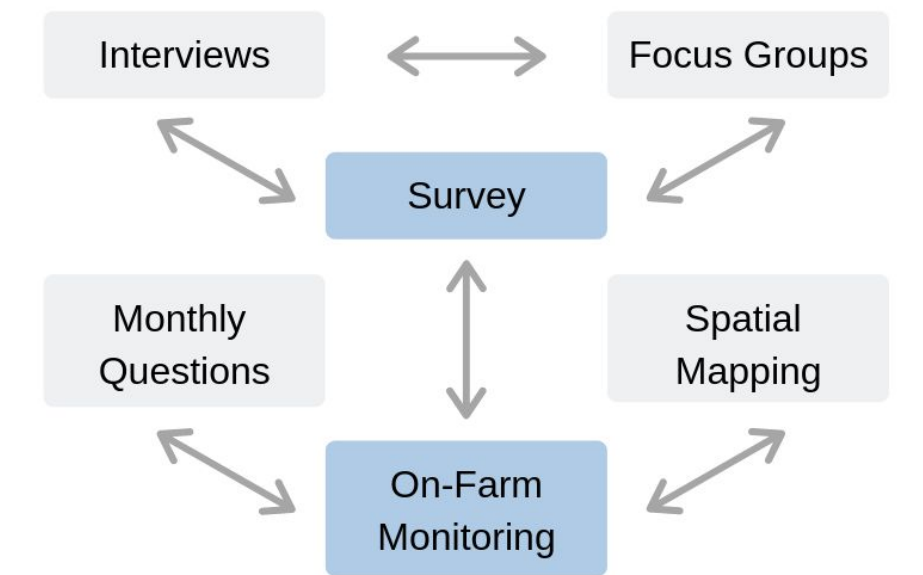


Figure 2. Project components

Table 1: Demographic, agricultural, and food insecurity information

	n	Mean	SD
Age (years)	169	52.1	13.3
Female respondents (binary)	169	43%	--
Total number in household	169	4.1	1.8
Farm size (Ha)	171	4.61	5.59
Gross income (\$USD)	164	2641.64	3324.61
Percent farm area in coffee	164	51%	36%
Number of lean months	171	1.62	2.11
Number of lean months of those reporting food insecurity	85	3.25	1.91

Findings

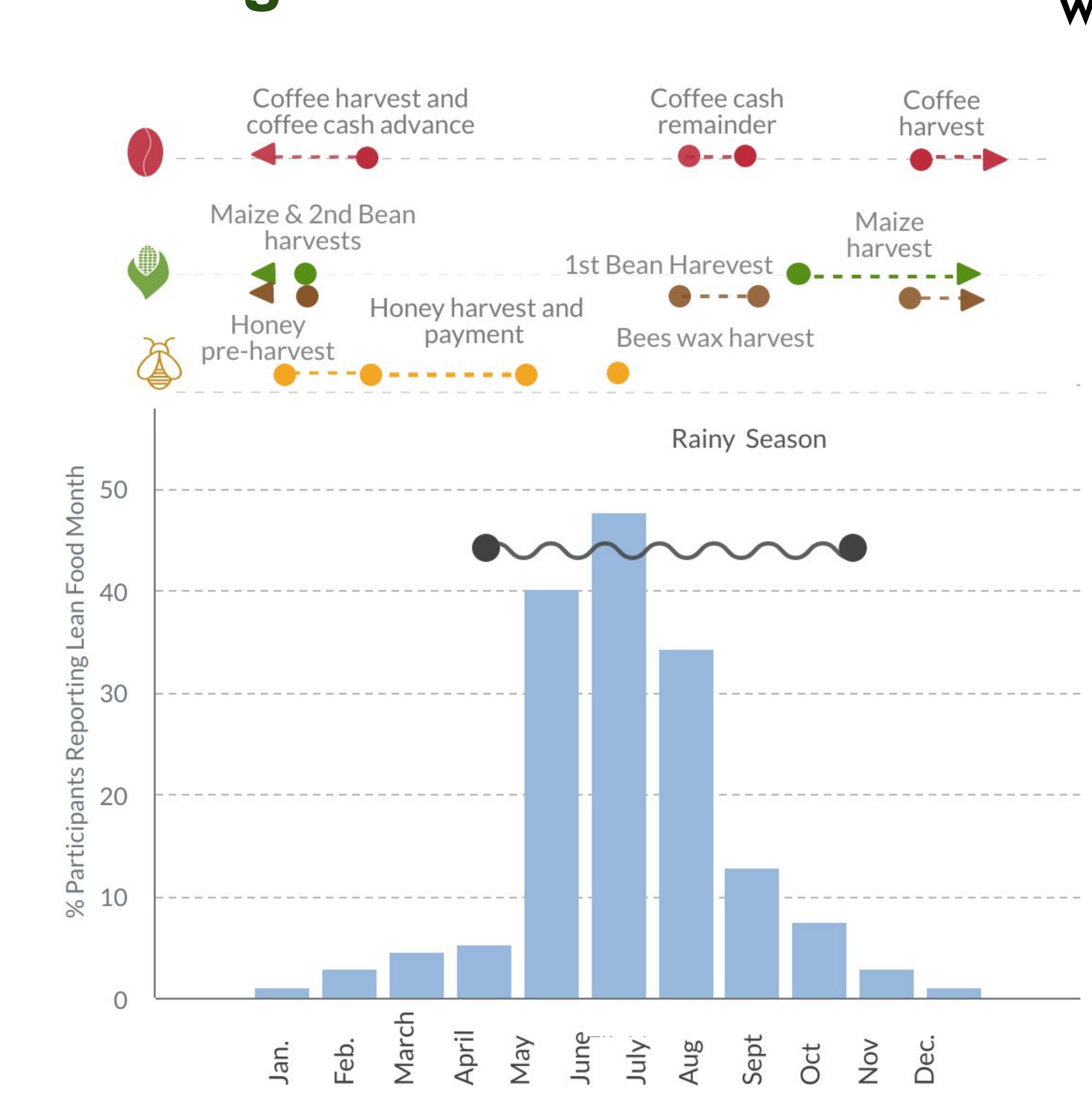


Figure 3. Seasonal incidence of food lean months (n = 171) correlated with agricultural calendar.

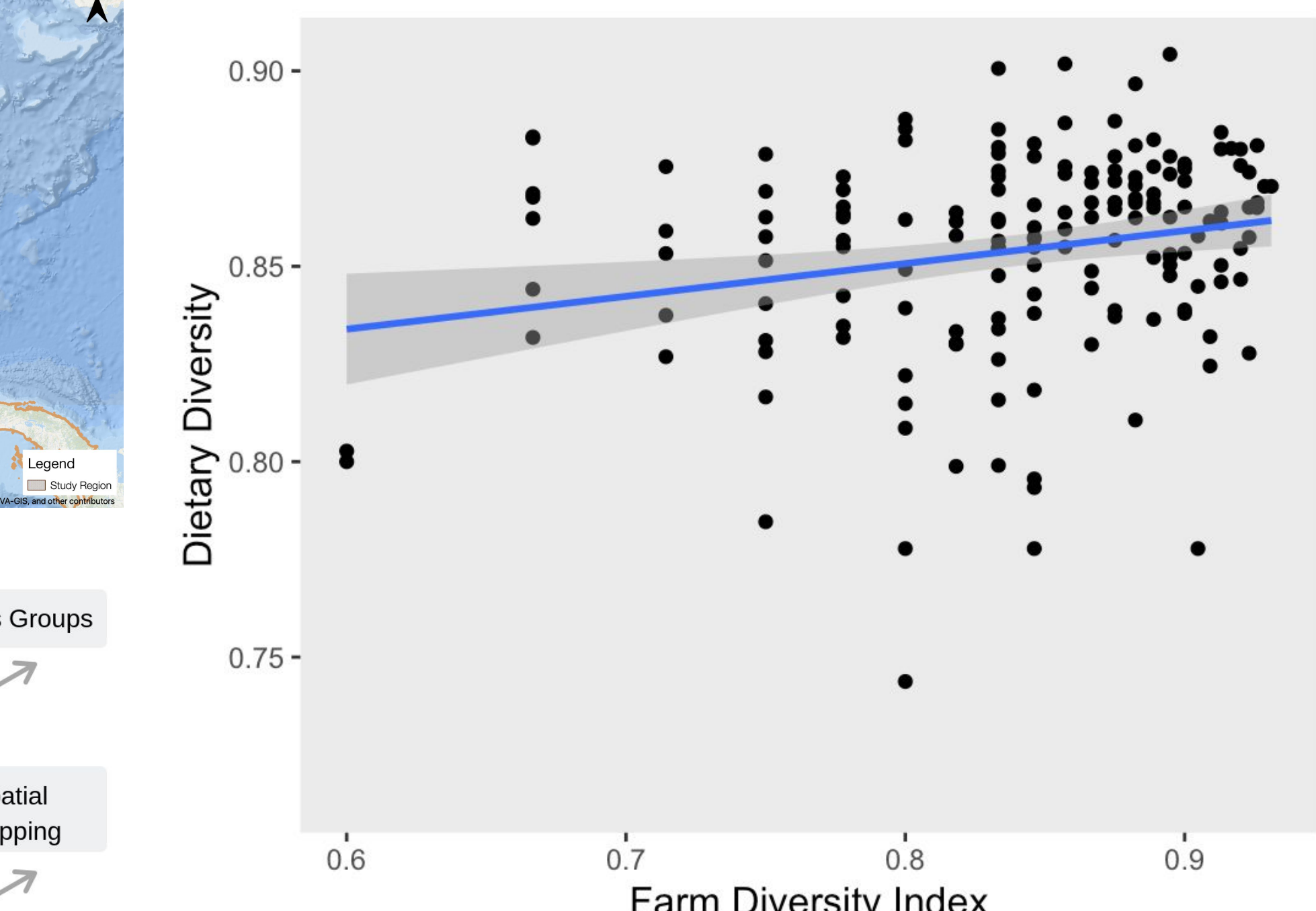


Figure 4. Correlation of dietary and farm diversity (n = 165)

What factors correlate with food security?

- Fewer Lean Months**
- Total farm area*
 - Total income*
- More HH. Dietary Diversity**
- Farm Diversity***
 - Total Income*
 - Fewer lean months*
- Sources: 2017 Survey (n=171), Regression results
***p-value < 0.001, *suggestive correlation p-value = < 0.1

On Farm Monitoring Findings

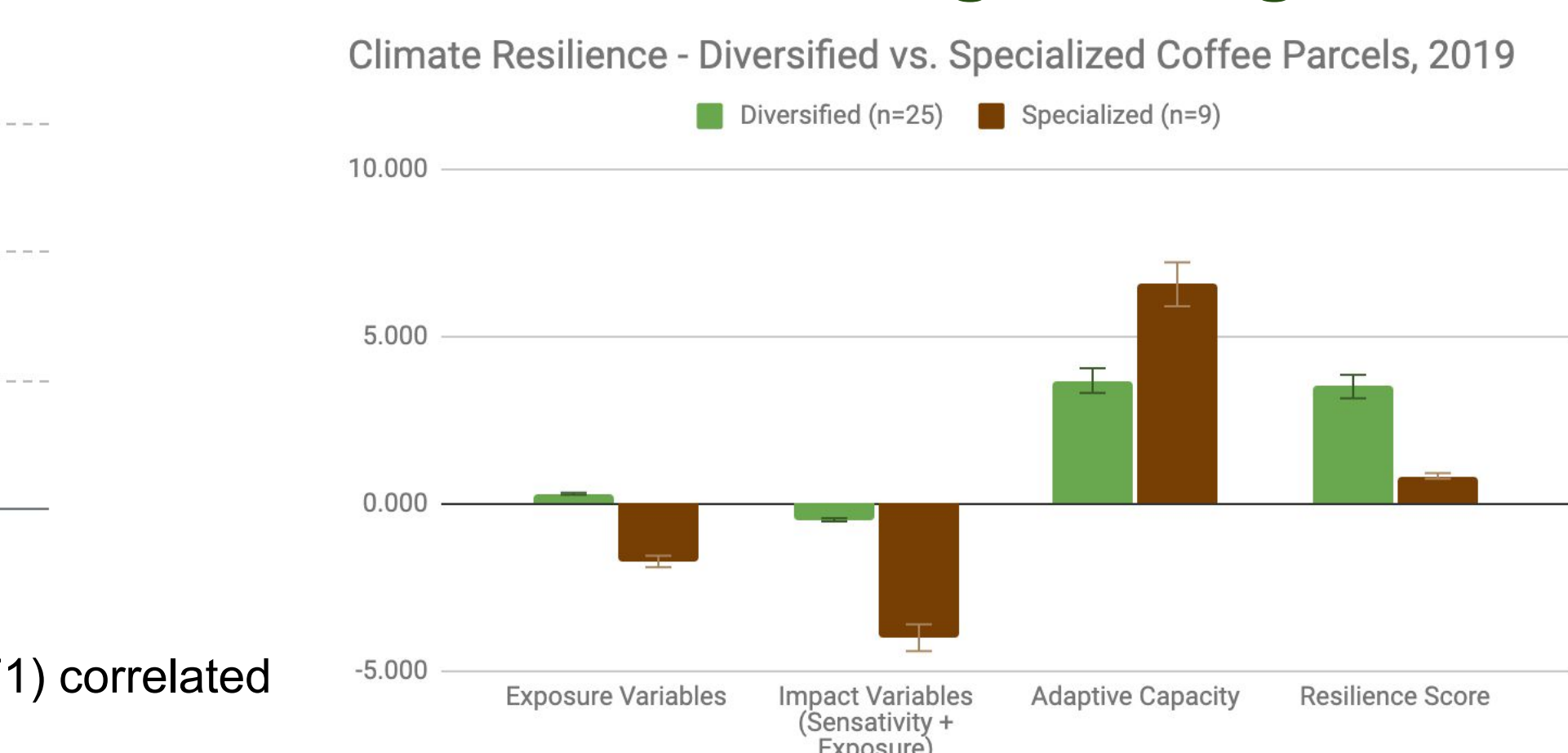


Figure 5. Comparing two coffee systems' climate resilience

Gender, Labor, Annual Calendars, & Training

- Family labor key, hiring external labor is common.
- Labor bottlenecks usual from Nov- Jan.
- Labor into productive activities Feb to April could reduce lean months.
- Women report a income benefit from beekeeping.
- New diversification > more burden on women's labor.
- Analysis of extension trainings show that female participation in gender trainings > than those on diversification and all other trainings.

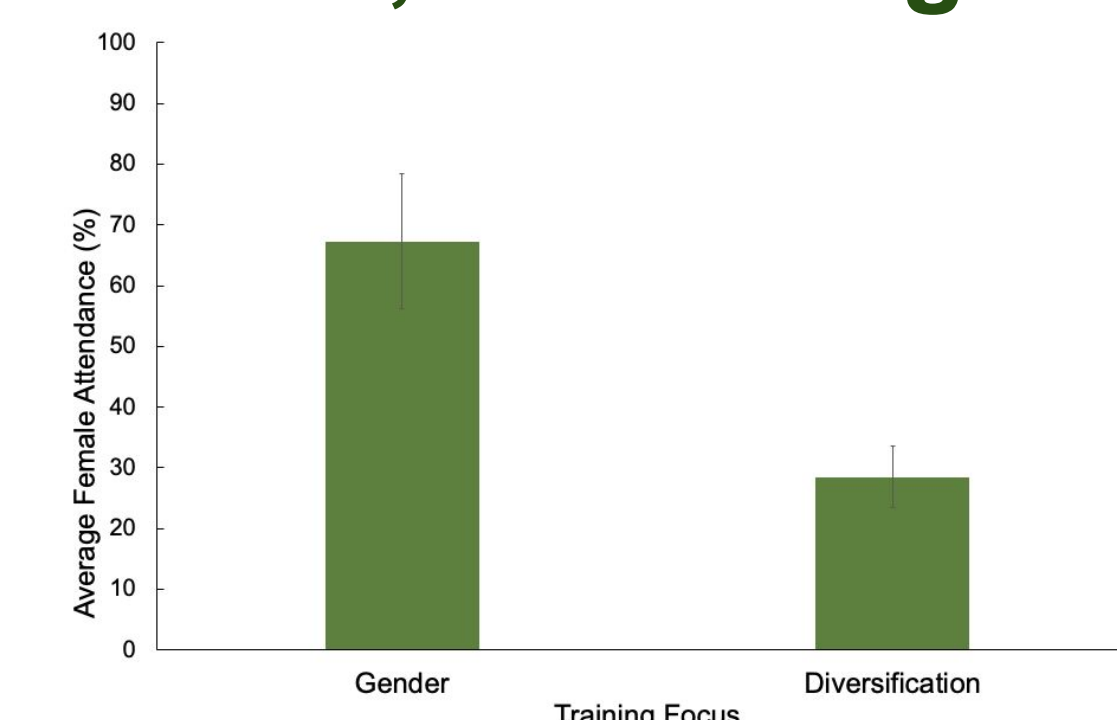


Figure 7. Average sex distribution of participants in gender vs. diversification related training from 2011 to 2019. Source: Our Analysis of annual reports.

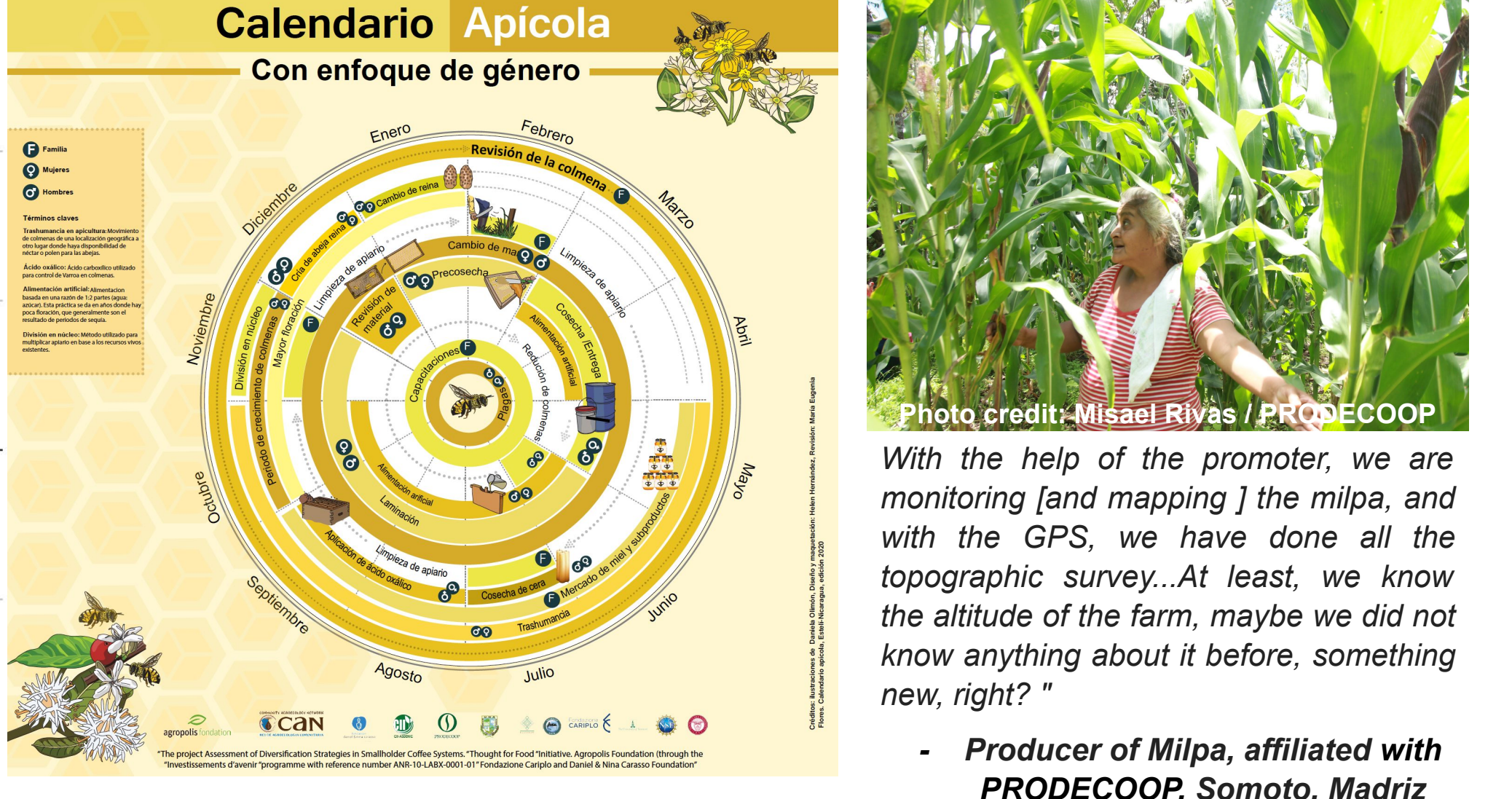


Figure 8. Beekeeping circular calendar

Conclusions

Food insecurity - remains a persistent challenge. More than 50% of the sample reported >= 1 lean month (Fig 3), nearly 100% report >= 1 food insecurity coping response (n=171). In this and other studies (Bacon et al. 2017), we find that larger farm sizes and incomes correlate with improved food security. **We found a significant positive correlation between dietary diversity and farm diversity.**

Land and labor - can limit diversification. Maps of farms show dispersed plots, and family labor alone is insufficient during harvest months for coffee, corn, and beans.

Gender relations - are addressed in the co-op's gender program, but could improve with more women in trainings. Honey production could contribute to women's economic empowerment. New activities risk creating double or triple labor burdens.

Coffee plot climate resilience - was higher in diverse shade parcels, but these farmers need more investment in organic production to build adaptive capacity.

CB-PAR and Capacity Building - generated results reports used for farm resilience plans and co-op led strategic plan using agroecology for diversification for food security and sovereignty. Co-op staff now considered agroecologists. New partnerships with Nicaragua's Agricultural University led to 35 undergraduate theses, 3 Masters degrees, and opportunities for rural youth.

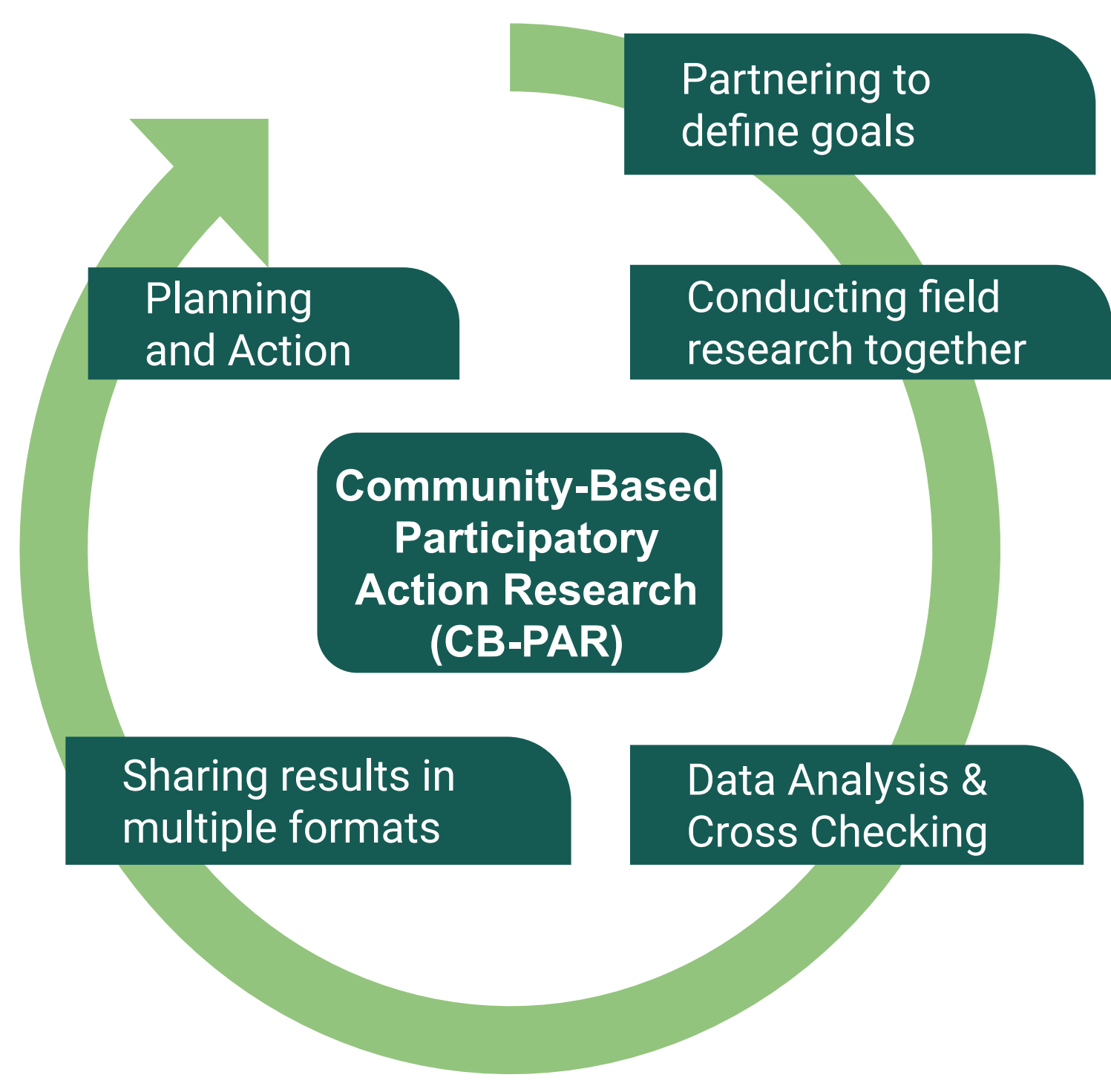
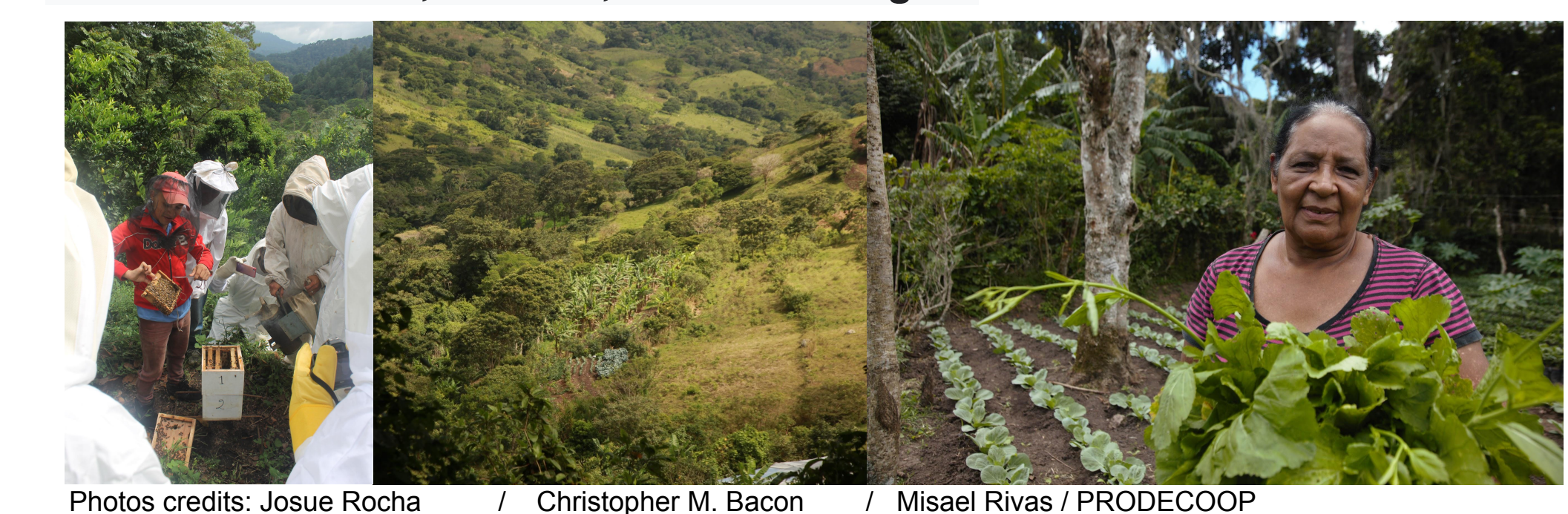


Figure 6. Community-Based Participatory Action Approach

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, Mirafior, Esteli Nicaragua.



References

Altieri, M. A., Nicholls, C. I., Henao, A., & Lana, M. A. (2015). Agroecology and the design of climate change-resilient farming systems. *Agronomy for sustainable development*, 35(3), 869-890.

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.

Rahn, E., Läderach, P., Baca, M., ... & Shriver, J. (2014). Climate change adaptation, mitigation and livelihood benefits in coffee production: where are the synergies? *Mitigation and Adaptation Strategies for Global Change*, 19(8), 1119-1137.

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.

IPES-Food. *From uniformity to diversity: A paradigm shift from industrial agriculture to diversified agroecological systems*. International www.ipes-food.org

Acknowledgements
Financial support: Agropolis Foundation, France (Thought for Food Initiative). Assessment of Diversification Strategies in Smallholder Coffee Systems. Thanks to collaborators from ASDENIC, including Raul Diaz and Helen Hernandez, to the team of farmers and promoters that have helped collect this data, and to SCU student researchers, Kimy Grandi, Chloe Gentile-Montgomery, and Paige Whittaker.