



Experiences and Drivers of Food Insecurity in Guatemala's Dry Corridor: Insights From the Integration of Ethnographic and Household Survey Data

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Specialty section:

This article was submitted to
Land, Livelihoods and Food Security,
a section of the journal
Frontiers in Sustainable Food Systems

Received: 04 April 2019

Accepted: 30 July 2019

Published: 22 August 2019

Citation:

Beveridge L, Whitfield S, Fraval S, van Wijk M, van Etten J, Mercado L, Hammond J, Davila Cortez L, Gabriel Suchini J and Challinor A (2019) Experiences and Drivers of Food Insecurity in Guatemala's Dry Corridor: Insights From the Integration of Ethnographic and Household Survey Data. *Front. Sustain. Food Syst.* 3:65. doi: 10.3389/fsufs.2019.00065

Eradicating hunger is a complex and multifaceted challenge, requiring evidence bases that can inform wide scale action, but that are also participatory and grounded to have local relevance and effectiveness. The Rural Household Multi-Indicator Surveys (RHoMIS) provides a broad assessment of household capabilities and food security outcomes, while ethnographic approaches evidence how individuals' perceptions, experiences and local socio-political context shape food security experiences and intervention outcomes. However, integrating these research approaches presents methodological and ontological challenges. We combine a quantitative approach with life history interviews to understand the drivers, experiences and outcomes of food insecurity in Guatemala's dry corridor region. We also reflect on the effectiveness and challenges of integrating the two methods for purposes of selective sampling, triangulating evidence, and producing a cohesive analyses of food insecurity in the region. Variables with a statistically significant association with severe food insecurity in the region are: coffee cultivation (when market participation is low), dependence on agricultural labor income, and poverty level. Drivers of food insecurity experiences most commonly identified by participants are: consecutive drought; ill health and displacement of income for medicine; social marginalization; high start-up costs in production; absence or separation of a household head; and a lack of income and education opportunity. Ethnographic approaches identify a broader range of drivers contributing to food insecurity experiences, and add explanatory power to a statistical model of severe food insecurity. This integrated analysis provides a holistic picture of food insecurity in Guatemala's dry corridor region.

Keywords: household survey, ethnography, food security, underlying drivers, Central America, participatory, agriculture, climate

INTRODUCTION

The 2015 Sustainable Development Goals (SDGs) and Agenda for Sustainable Development have created a political drive for action to end hunger and poverty by 2030, and a demand for metrics and monitoring of progress toward the achievement of these globally standardized goals. Food security is constructed as an overall goal in SDG II under two principle aims: “to ensure all people . . . have access to safe, nutritious and sufficient food all year round,” and to “end all forms of malnutrition” (UN General Assembly, 2015).

Multiple indicators are increasingly applied to derive multidimensional food security information from household or nutrition surveys, reflecting food access, nutrition, utilization and safety. There is a drive toward standardization of surveys on food security (Nicholson et al., 2019), for example in the application of the Rural Household Multi-Indicator Survey (RHoMIS), which is increasingly used by CGIAR research institutes and their partners. RHoMIS has been designed to enable a more holistic assessment of progress toward the SDGs, specifically around goals 1, 2, 5, and 13 in recognition of the interdependence of issues of poverty, food insecurity and gender equality (Frelat et al., 2016; Hammond et al., 2017). It provides a standardized framework—based on best practice—which aims to improve consistency and comparability of data across sectors, organizations and regions, and provides a basis for regression modeling to determine household-level causes and correlates of food security. However, pathways to food insecurity are complex, and causal analyses of food insecurity are constrained by the feedbacks between food insecurity and other socio-economic variables, e.g., poverty, income, health, education. A grounded theoretical understanding of the system is therefore a necessary precursor to a statistical analysis of food insecurity (Pearl, 2009). Within household survey methodologies there are also limits to what can be understood about the context specific ways in which food insecurity is experienced and the contextual factors that shape these experiences. Grounding food security measurement in local context can contribute to a more complete understanding of the way that people experience food insecurity and exercise choice and agency with regards to food (Radimer et al., 1992; Wolfe and Frongillo, 2001; Frongillo et al., 2003), and expose some of the underlying socio-political drivers of food insecurity (Dreze and Sen, 1989).

The SDG mainstreaming framework and sectoral implementing organizations have recognized these contextual experiences, and the variety of drivers of food insecurity, as an integral part of food security assessment, often evoking the need to integrate participatory and ethnographic approaches with monitoring and assessment protocol (United Nations Development Group, 2017; FAO, 2018). Combining inductive ethnographic approaches and the deductive analyses of multi-indicator household surveys offers potential compatibilities, to build food security theory on the basis of observation while testing theory with empirical data. Combining such approaches raises challenges that are both practical and ontological. It requires a simultaneous recognition of food insecurity as both experience and outcome, the metrics of food security as both objective and subjective, and the drivers of food insecurity as

both proximate (e.g., correlates of household characteristics) and underlying (e.g., linked to broader socio-political systems). Furthermore, the potential for systematic oversights or bias in the definition, measurement and management of food insecurity persists within each methodological approach, whether quantitative or qualitative. For example, single application recall surveys might overlook the dynamics of seasonal hunger, or participatory methodologies might give a platform to legitimize powerful voices and miss those that are marginalized (Mosse, 2001). The potential for oversight in any given framing or approach is a good justification for the use of combined methods and comparative analyses, to enable critical reflection on what might be missing from specific survey-indicators and whose voices or experiences may be excluded within our ethnographic processes.

In this paper we describe an attempt to combine an analysis of RHoMIS derived data with ethnographic research to better understand food insecurity. We focused on Guatemala’s dry corridor region, an area where production is heavily affected by drought and where there is a substantial national and international effort to address food insecurity through intervention.

The study has a dual objective:

- To identify the underlying drivers and proximate causes of food insecurity experiences and outcomes
- To compare the insights that emerge from household survey and ethnographic methods, reflecting on the effectiveness and challenges of combining them for purposes of selective sampling, triangulating, and integrating evidence across scales

We conclude by discussing the implications of our description and measurement of food security for appropriate intervention aimed at building food security in the region. Furthermore, we discuss the ways in which new approaches to constructing the evidence base around food security can contribute to a rethinking of how we define, measure and manage this complex issue.

BACKGROUND

Conceptualizing, Measuring, and Analyzing Food Security

The conceptualization of food security has moved on significantly from the immediate post-Second World War era focus on food availability, in terms of both thinking about the pathways through which people become food insecure and how food insecurity is experienced. Sen’s writing popularized the idea that access to food is a function of household entitlements and capabilities (Sen, 1982). Furthermore, Dreze and Sen (1989) and De Waal (1990) unpack the historical and socio-political factors that constrain household capabilities and entitlements and that are root causes of famine. The popularity of the household capabilities and entitlements framing is reflected in the increasing development and use of household survey instruments that capture a variety of socio-economic and physical variables that are known to influence capabilities and entitlements—assets, gender, social and natural capitals,

etc. Within a capabilities framing of food insecurity, survey instruments that include multiple indicators (e.g., RHoMIS) are useful because standardization offer a means to replicable, statistical analysis, while multiple indicators work toward more holistic measurement of household capabilities and dimensions of food security outcomes. Standardization enables the relative comparison of socio-economic status and food insecurity outcomes spatially (e.g., between populations or regions) and temporally (e.g., before and after an intervention), and for these associations to be tested statistically (Fraval et al., 2018).

The World Food Summit (1996) provided a definition of food security as being a condition in which “all people, at all times, have physical and economic access to sufficient, safe and nutritious food to meet their dietary needs and food preferences for an active and healthy life.” This emphasis on personal preference and cultural appropriateness is supported by research that highlights food insecurity as experience (e.g., of cultural compromise, worry, limited activity) not just a capability (e.g., assets, income) or an outcome (e.g., hunger, malnutrition) (Radimer et al., 1992; Coates et al., 2006). However, the more contextual dimensions of food security, as in the World Food Summit definition, have proven harder to consistently capture within survey tools. Ethnographic methodologies include in-depth interviews, observations, or researcher embedded ethnographies. These approaches aim to produce a contextualized understanding of food insecurity that is grounded in participants’ cultures, experiences and perspectives, and have identified inadequate food quality, insufficient quantity, uncertainty and worry, and social unacceptability as food insecurity experiences (Coates et al., 2006).

Ethnographic approaches also have application in explaining the cross-scale social, political and historical underlying drivers of household capabilities and experiences of food insecurity. In a variety of contexts and geographies, they have shed light on how food insecurity can be influenced by gender (Lemke, 2003; Nyantakyi-Frimpong and Bezner Kerr, 2017); age (in adults) (Vilar-Compte et al., 2017); governance (Pérez-Escamilla et al., 2017); participation and institutions (Leach et al., 2006); food knowledge, preference and education; quality, availability and access to hunted food; addiction (Beaumier and Ford, 2010); political violence and political movements (Wittman, 2009; Altieri and Toledo, 2011; Woertz, 2017); migration (Covarrubias and Maluccio, 2011; Davis and Lopez-Carr, 2014; Aguilar-Støen et al., 2016); land governance, class differentiation and exploitation (Li, 2010; Nyantakyi-Frimpong and Bezner Kerr, 2017); poverty, histories and path dependencies (Yesuf and Bluffstone, 2009). These studies often uncover phenomena or mechanisms that are otherwise difficult to identify, because they are specific to particular contexts or are contingent on other factors. However, limited representativeness across temporal and spatial scales can result in a perceived incompatibility between the evidence produced and the scale of analysis and intervention required by agendas of donors and governments.

Within the Central American Dry Corridor (CADC) specifically, participatory research approaches have been mainstreamed into development practice, for example through the implementation of integrated context analysis, community

based participatory planning, and farmer field schools in recent projects. However there still exists a tension between the need to represent local knowledge, preference and context within measurement and decision-making processes, whilst also evidencing scaling-up of solutions, technology and impact (e.g., WFP, 2015; CATIE, 2017; CCAFS, 2017; FAO, 2017a,b). A role for research, embedded in this context, is to critically consider the capacity of methodological approaches to provide a contextually grounded evidence base for intervention decisions.

Food Security in the Central American Dry Corridor

The Central American Dry Corridor (CADC) is a region on the Pacific side of Central America, passing through Nicaragua, Honduras, Guatemala and El Salvador. Over the last decade, a series of abnormal weather events including extreme precipitation, drought, and heat waves have been attributed as the main driver of a series of food insecurity episodes amongst the rural population (FAO, 2017a).

Episodes of acute malnutrition within the CADC have been attributed to cycles of the El Niño–Southern Oscillation (ENSO) with extended drought occurring in El Niño years, as well as to variability in market prices for coffee, maize and beans, and recently also the impact of coffee rust, a fungal disease that drastically reduced the harvest of coffee, the main cash crop in the area (FEWSNET, 2018). These immediate biophysical triggers of food insecurity occur within a socio-economic context that makes rural families vulnerable to external disturbances. Hunger is generally characterized as “seasonal” and typically occurs during April–August during which time stored food or income from previous harvests has often been used up; investment is needed for fertilizer through the May–October growing season; and peak demand for unskilled labor has passed (October–March) (FEWSNET, 2018). There is also a high prevalence of “hidden hunger” in Latin America where individuals have sufficient calorie intake but micronutrient deficiency (Kennedy et al., 2003), while the proportion of overweight individuals is also increasing (FAO, 2017b).

The presence of international organizations in the region is strong; there exists a complex network of organizations running programs on issues of healthcare, hygiene, family planning, technical training, gender equality, livestock, livelihood diversification, education, reforestation, and others (CATIE, 2017). Among the larger efforts, an agricultural focused World Food Program (WFP) project “Response to the El Niño Phenomenon in the Dry Corridor” (WFP, 2017) responded to the consecutive occurrence of mild to severe drought during 2014–2016, and its accumulated impact on the nutritional status of households affected. The project strategy consists of trainings in water and soil conservation practices such as terracing, irrigation, and organic fertilizer; fruit tree planting; packaging of produce; education in nutrition, finances and crop management, and provides resources including tools such as backpack-sprayers, and seedlings (WFP, 2017).

Food sovereignty scholars and campaigners, who have a particularly strong history in the Latin American context,

highlight the political economy of neo-liberal markets, and issues of food distribution, governance, justice and waste as intrinsic to the persistence of food insecurity in the region (Boyer, 2010; Jarosz, 2011). Furthermore, a history of political instability and violence across the “Northern Triangle” (Honduras, El Salvador, and Guatemala) that includes armed conflict, coups, and corruption, has shaped current patterns of gang violence, narcotic trafficking and organized crime, affecting people’s security, experiences of violence and extortion, and out-of-country migration (Eguizábal et al., 2015).

The last major El Niño event in 2014–2015 caused estimated losses of 80% of crop production in Guatemala, and the WFP reported that \$75 million was needed for emergency food provision in Central America following the loss (WFP, 2015). The problem of food insecurity over this period was conflated with violence, corruption, health epidemics and the movement of people (ICRS, 2019). The crisis in 2014 saw a surge in border crossing to the United States from Central America, evoking a \$750 million of foreign assistance from the US, and a further \$5.4 billion from the “Northern Triangle countries” own funds, toward addressing poverty, violence, corruption, and toward the development of rural business, agriculture, education and energy infrastructure (U.S. Global Leadership Coalition, 2019). Despite these interventions, 2019 has seen food insecurity crises in multiple regions (FEWSNET, 2019), and a significant spike in the number of reported cases of apprehensions and inadmissibles at the U.S Southwest border, with increasing proportions of unaccompanied minors and women with children (Customs Border Protection, 2019), while journeys continue to pose severe risk, and human rights abuses are reported at multiple stages along the route and on arrival (ICRS, 2019). The percentage of the population experiencing food insecurity has increased from an average of 15.6% between 2014–2016, to 16.4% between 2016–2018 (FAO, 2019).

These broad climatic, political and economic processes interact with household level dynamics of resource endowment, access to markets and infrastructure, political marginalization and more to shape individual experiences of food insecurity (Corbera et al., 2007; Jarosz, 2011; Webb et al., 2016). Considering the complexity and interdependence of issues interacting with and exacerbating food insecurity in the region—and the influx of funds and intervention targeted to address these issues—insights into the lived experience of affected people are essential to align the problem framing and management of issues with the complex reality in which intervention is received.

MATERIALS AND METHODS

This analysis was focussed on the Chiquimula Department of Guatemala within the CADC. Chiquimula covers 237,600 ha of land, 55% of which is cropped [GFSAD data as described in Massey et al. (2017)], and at the 2002 census contained a population of 302,485 (Censo, 2002).

A sequential method for integrating household survey and in-depth ethnographic interview methods was followed in this study. It began with the use of household survey data as a basis for categorizing household food security status and sampling households for conducting follow-up in-depth life

history interviews. From these interviews, common drivers of food insecurity were inductively derived, and the significance of their association to food insecurity outcomes within the larger household survey data set. These steps are described here.

Household Survey

Lists of households were collated from organizations active within the CADC region, community groups and community centers. Two households were selected from each participating community to undertake a household survey following the RHoMIS format. Toward the end of the dry season, in March 2015 local technicians carried out the surveys. The RHoMIS method asks a set of standardized questions about the household, livelihoods, agriculture, income and diet, using locally adapted indicators and examples when required, for example in the use of country specific indicators of poverty in the Poverty Probability Index[®] (PPI). Survey responses were used to calculate a set of socio-economic and food security indicators, by applying a standardized R-script also described in Hammond et al. (2017). **Table 1** has been modified from Hammond et al. (2017) to describe the main indicators used in this study and their ranges, and methods of calculation.

Selecting Participant Using Survey Data

From the 220 surveyed households across 110 communities, in-depth interviews were conducted in 14 communities. The location of communities included in the quantitative survey analysis, and communities where additional life-history interviews were carried out are illustrated in **Figure 1**. A purposive sampling strategy was used to identify a range of household types based on production characteristics. Following a maximum variation sampling strategy (Patton, 2002) we analyzed the RHoMIS data to select households that had highest variation in Household Food Insecurity Access Prevalence (HFIAP), livestock holding, crop area cultivated, and market participation, which have relevance to the agricultural development strategies being implemented in the region promoting the production of poultry, livestock and increasing crop production (for subsistence crops and coffee as a cash crop). A total of 28 households in 14 communities were visited during the fieldwork period (September–December 2017). Wilcoxon signed-rank test was used to test for a significant difference in socio-economic indicators between the interviewed subsample and the greater surveyed population to check for representability.

There was no significant difference between socio-economic indicators derived from the RHoMIS between the interviewed sub-sample and the larger surveyed population, with the exception of livestock holding, which was overrepresented in the interview subsample (**Table 2**). Values for key socio-economic indicators were also similarly distributed when comparing the survey and follow up interview subsamples (**Figure 2**).

Life Histories and Interviews

Ethical consent to carry out life history interviews was granted by the Environment Faculty Research Ethics Committee at the University of Leeds. The field research team also reflected on issues of ethics and participation iteratively after each interview and by obtaining feedback from participants on their experience

TABLE 1 | Food Security and Socioeconomic indicators calculated using RHoMIS methods from survey data, adapted from full method description in Hammond et al. (2017).

Indicator	Indicator description	References
Household Food Insecurity Access Prevalence (HFIAP)	The prevalence of experiences of food insecurity is captured using a set of 9 questions defined by Food And Nutrition Technical Assistance (FANTA) (full list in Supplementary Information). These provide a progression of questions that start by asking about the frequency of worrying about food and conclude by asking about the frequency of days where the respondent was not able to access a meal. Responses categorizes households based on severity as: Food Secure, Mildly Food Insecure, Moderately Food Insecure, or Severely Food Insecure. Severe food insecurity is defined as households frequently eating smaller meals or skipping meals, or occasionally lacking access to food.	Coates et al., 2007
Poverty Probability Index (PPI [®])	Poverty Probability Index uses country specific indicators to assess the likelihood that a household is living under FAO defined poverty level \$1.25 per day. It is implemented by asking 10 questions, e.g., What is the main construction material of the residence's floors? (full list in Supplementary Information). The PPI is used to rank households to study relative poverty, but not to measure changes a specific household over time.	PPI [®] , Desiere et al., 2015
Tropical Livestock Units (TLU)	A common unit used to count the abundance of livestock a household keeps, weighted by different type of livestock, based on size and value.	Jahnke, 1982
Market participation	Market participation a proportion (0–1) of on-farm production that is sold to generate income, rather than consumed or traded.	Hammond et al., 2017

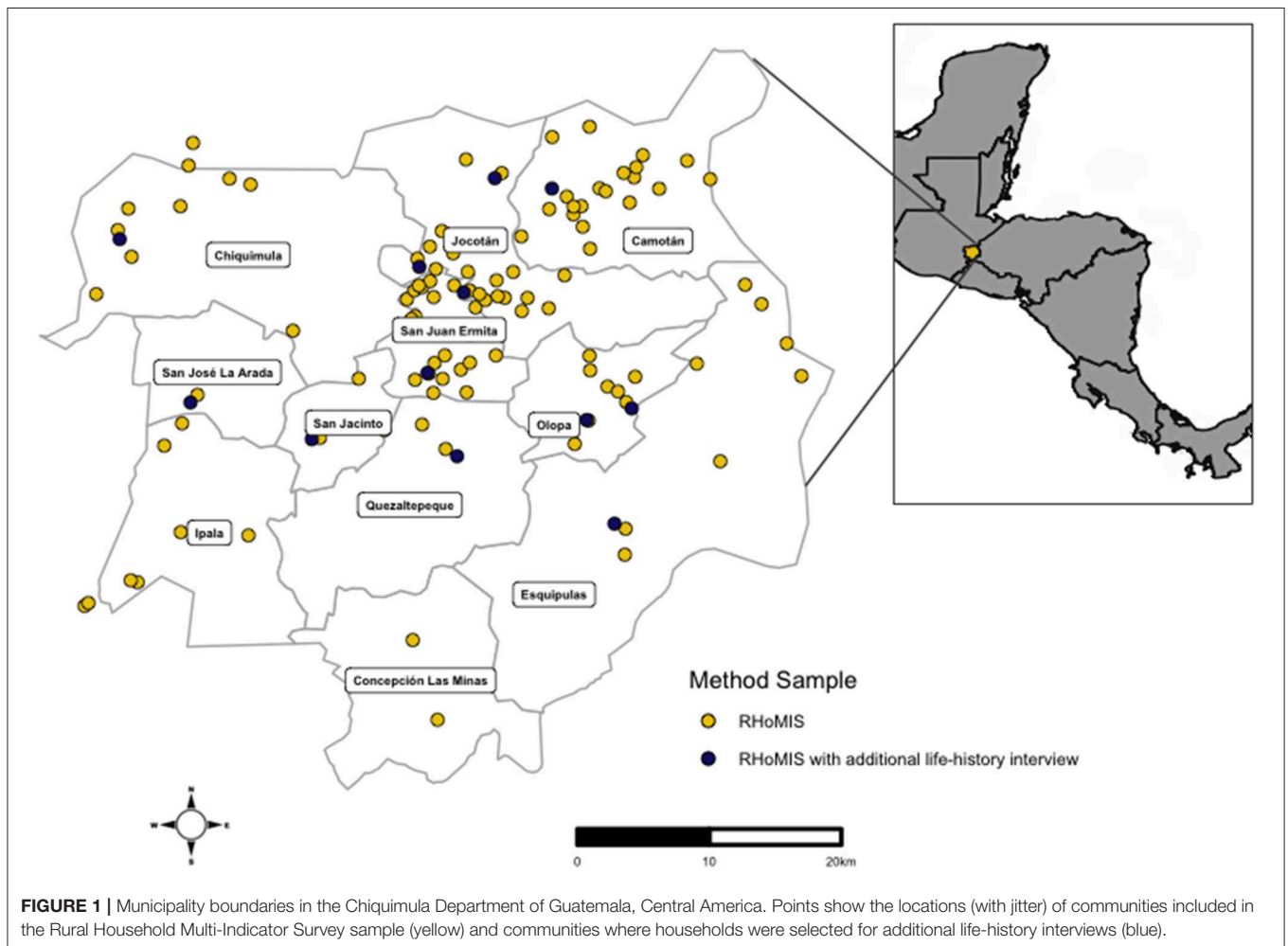


FIGURE 1 | Municipality boundaries in the Chiquimula Department of Guatemala, Central America. Points show the locations (with jitter) of communities included in the Rural Household Multi-Indicator Survey sample (yellow) and communities where households were selected for additional life-history interviews (blue).

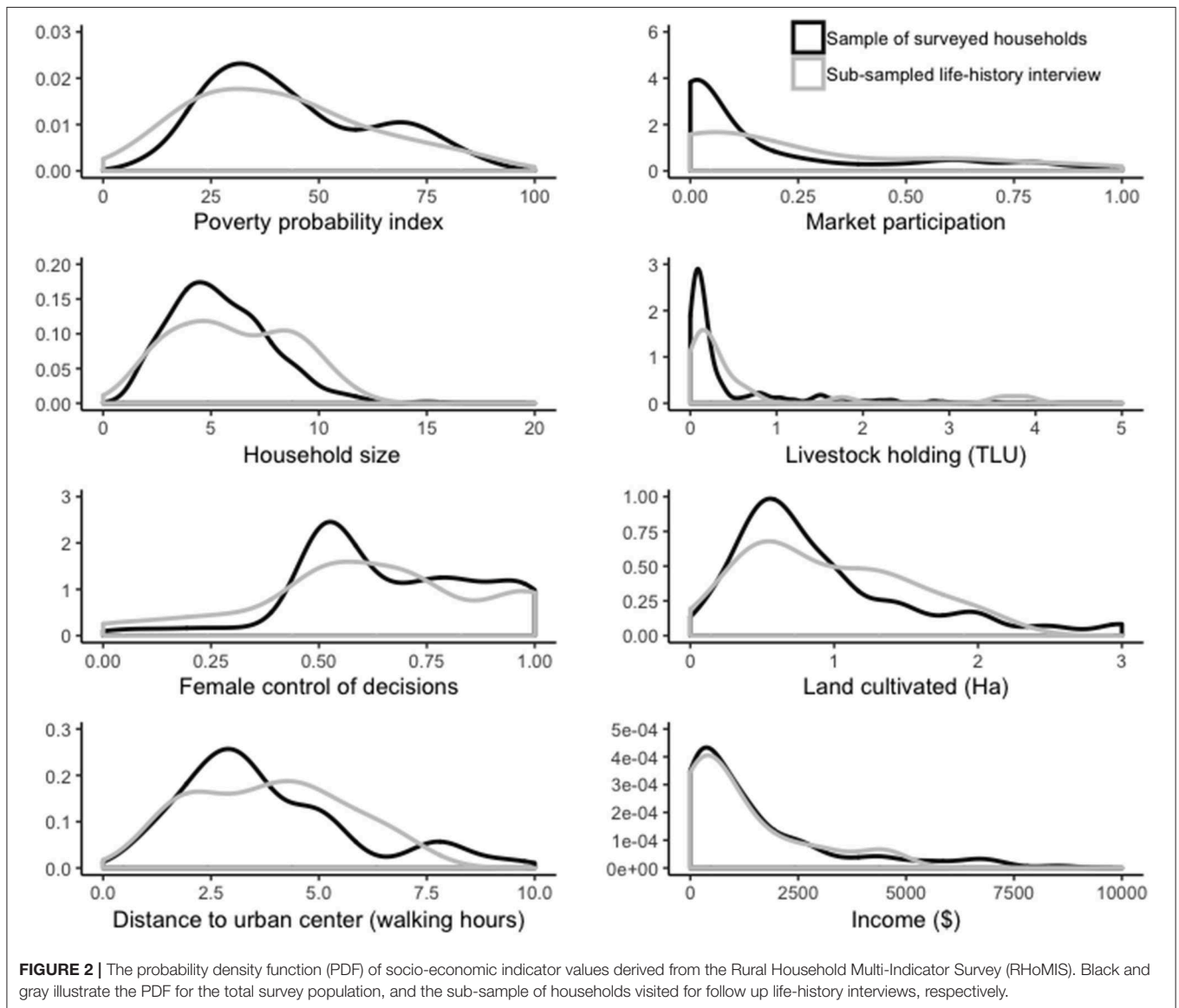
of the interview process and decision to participate. Informed consent was obtained verbally from all participants. In-depth interviews, conducted in participants' own homes, started with a life histories activity (based on Goldman et al., 2003), where

participants and the interviewer together built a timeline of key moments and changes within the participants' lifetime. We then used semi-structured questions following the timeline as a prompt for discussion about the factors that contributed to

TABLE 2 | Summary statistics for households the dry corridor of Guatemala by interviewed subsample, all values give the median with inter-quartile range in parenthesis.

Variable	Surveyed population (excluding subsample)	Interviewed subsample	Test for significance
<i>n</i>	195	25	
Household size	5.5 (4.5)	5 (3)	ns
Land cultivated (ha)	0.7 (0.6)	0.9 (0.9)	ns
Land Owned	0.92 (1.79)	0.71 (1.25)	ns
Market Participation (proportion of produced calories sold)	0.11 (0.43)	0.03 (0.15)	ns
Livestock holding (TLU)	0.1 (0.2)	0.24 (0.5)	*
Total Income	752 (1779)	905 (2136)	ns
Nearest town (walking hours)	4 (3.1)	3.3 (2.5)	ns

ns, no significant difference. **P* < 0.05 Wilcoxon signed-rank test.



that livelihood change. Interview transcripts were first coded inductively (Glaser and Strauss, 1967; Harry et al., 2005), then

more deductively by applying a simple categorization to list the factors that contributed to a reported positive and negative

change in well-being, maintaining a broad and participant-defined concept of well-being. For experiences identified as moments of difficulty or crisis, any described coping strategies were also coded. Pseudonyms have been used to protect the identity of participants in all case studies.

Survey Analysis

RHoMIS derived socio-economic indicators were used as inputs to a regression model, in order to gain insight into which factors were significantly associated with severe food insecurity on a broad scale, at the time of the survey. Households were classified as being “food secure,” “mildly food insecure,” “moderately food insecure,” or “severely food insecure” using the HFIAP indicator (described in **Table 1**). The associations between food security classification and selected socio-economic indicators were modeled using logistic multiple regression. The log odds of being “severely food insecure of access” given socio-economic predictors (Equation 1) were estimated using base R (R Core Team, 2014).

$$\text{logit}(p) = \log\left(\frac{p}{1-p}\right) = \beta_0 + \beta_1x_1 + \beta_2x_2 \dots \beta_kx_k \quad (1)$$

Where p is the probability of being severely food insecure, β_0 is log odds when all other predictors are zero and β_1x_1 , for example, is the log odds of being severely food insecure as x_1 changes, holding all other predictors ($\beta_2x_2 \dots \beta_kx_k$) constant. Models were built in an additive fashion, assessing all potential socio-economic variables and interactions that could influence food security of access. Model over-fitting was evaluated using the Akaike Information Criterion (AIC). As this study does not have a predictive objective, variables were retained even with an increase in AIC <5% change, even though this can slightly increase out-of-sample error.

Potential sources of endogeneity in the model include measurement error, simultaneity and omitted covariates of the dependent and an independent variable. Measurement error has the potential to bias beta coefficients downwards (attenuation bias) and would be most prominent in income and crop yield variables. Simultaneity has the potential to result in overestimated coefficients and inconsistency (Verbeek, 2012). Omitted variable bias can result in various biases, including a reversal of the direction of association. The potential biases from simultaneity and omitted variables in the model were assessed iteratively with reference to causal mechanisms identified in life-history interviews and expert opinion. These potential biases are noted along with coefficient estimates in **Table 4**.

RESULTS

Characterizing Households and Food Insecurity Status

Life history interviews contextualize and elaborate on the food security status of households recorded in the survey, providing a narrative of participants experiences of food insecurity in the context of a given socio-economic status, but also recognizing that “status” as an outcome of a dynamic history of livelihood

change and multi-generational processes. Experiences of food insecurity described in interviews are generally concurrent with the survey derived HFIAP status, as exemplified in stories from Manuel and Paula, and Viviana, described here:

Manuel and Paula and their children live a recently finished brick household, reported as mildly food insecure, they grow maize and beans, raise chickens and a pig, but concentrate primarily on producing coffee on a parcel of their own land. They both described growing up in poverty, moving around the country in search of labor work. Manuel contrasted his experiences of food insecurity growing up, and now as he supports his own household and production “Between 12 and 14 years old we worked in Zacapa [Department of Guatemala], we went to work in a place where they grew melons. There we would work until 23:00 pm, but we did not eat during the day, so we worked hard and we starved... Then we went to Izabal [Department of Guatemala], but there we suffered, as we were hungry. We had taken a week’s supply of maize, but the tortillas became spoilt, so we continued to suffer.” Then in reference to his current situation “Thanks to God my children have had food to eat, sometimes a little, but always something. We sow, and we continue to sow, and I have also planted lot of trees for wood. I have to provide, because if not my family does not eat. But as long as I am healthy and there is a good harvest then we can have tortillas and beans.”

Viviana lives in a single room with her 3 young children, a household reported as severely food insecure. She had some chickens and a small amount of maize and beans on her sister’s plot, “In my case we are poor, so I raise little animals, and when I can, sell a chicken to earn some money, apart from that I cannot do anything,” she explained. Keeping “patio chickens” to consume or sell as a way of making income and a coping strategy is a common practice in the region, and Viviana had learnt it her from her mother. Income that her husband earns working by traveling to find labor work around the Country is essential for purchasing food and farm inputs, but Viviana regularly depends on borrowing to be able to buy maize when they don’t produce sufficient from their own plot. When asked about the role of organizations she said they had not come to her community, and about the government aid program she noted “There [at meetings] they gave flour, beans and oil every month” but explained that one year she was part of the program and the next year she was not included, but she didn’t know why “I don’t know why, they didn’t tell us, they said they were going to take other people into account” she off hand remarked a suggestion “maybe the leader [town mayor] knows who needs more help.” She saw this as a reason not to go to meetings and participate in groups within her community “as I say, they choose, and that’s why I don’t go.”

References to “suffering,” “hunger,” “not being able to do anything” in these accounts are reflective of experiences of food insecurity that are largely commensurate with, although not directly translatable into, the HFIAP statuses derived from household survey data. However, in a small number of cases there was variance or inconsistencies between the survey data and the subsequent in-depth interviews. This could be the result of error introduced due to limitations of survey and interview methods. Discrepancies can be due to a change in participant(s) present for the survey and life history interviews (and therefore personal perspective). In other cases, the circumstances of the household

TABLE 3 | Self-identified limiting factors, positive factors (in the context of a change in well-being), and coping strategies mentioned during interviews with 24 participants, with count of mentions (*n*).

<i>n</i>	Limiting factor	<i>n</i>	Positive factor	<i>n</i>	Coping strategy
13	Consecutive drought events	9	Coffee production	9	Use savings
9	Labor work availability	8	Poultry production	9	Migration for labor
7	Cost of medicine	8	Training	8	Borrow
6	Fertilizer dependence	7	Education of children	5	Female household head sources income
4	Absence or separation of a household head	7	Participation in projects		
4	Limited participation	6	Pig production		
4	Loss of income due to ill-health	6	Remittance		
4	Limited education opportunity	6	Children work in labor		
		5	Cash crop production		
		5	Migration for labor		
		4	Cattle production		
		4	Children work in occupations		
		4	Administration of resources		

Codes are included if *n* > 3.

can have changed in the time between the survey and the life history interviews.

Understanding the Drivers of Food Insecurity

Participants stories illustrate some of the mechanisms by which households find themselves in situations of food (in)security, and give examples of some of the coping strategies that are employed. Experiences vary across the 24 interviewed households, **Table 3** summarizes the most frequently discussed positive and limiting factors during life history interviews, in the context of a participant's perception of their own well-being and food insecurity experiences, as well as coping strategies used in times of crisis. In comparison, the regression analysis identified that coffee cultivation, dependence on off-farm income from labor on other farms, and PPI are significantly associated with severely food insecure outcomes within the surveyed population (**Table 4**).

Some factors are directly comparable across interview and survey analyses (summarized in **Tables 3, 4**, respectively), for example coffee cultivation, livestock, and remittance. Other factors identified in interviews could be indirectly related to an indicator in the survey, for example decision-making (reported as the proportion of household decisions controlled by a female or male household head) as a survey based proxy for the reduced capabilities perceived by some participants when their partner was separated or away from the households. Type of off-farm income also acts as a survey based proxy for the limitations described by labor-dependent households due to low wages, insecurity of income, and a lack of time to develop their own livelihood (**Tables 3, 4**, Hector and Clara case study). A further set of factors raised in interviews were not present in the survey analysis, for example the supporting role of children's education and income, money administration, costs of medicine, and limited participation in working groups or local projects (**Table 3**).

TABLE 4 | Associations of socio-economic indicators with Household Food Insecurity Access Prevalence (HFIAP), logistic regressions using the rural household multiple indicator survey (RHoMIS) output from households in the dry corridor of Guatemala in 2015.

	Estimate (s.e.) [†]
Intercept	0.23 (0.79)
Household inhabitants (adult eq.)	0.03 (0.06)
Land owned	-0.02 (0.15)
Livestock holdings	0.13 (0.20) ‡
Market participation	-2.00 (1.03)
Coffee cultivated (yes)	0.83 (0.38) *
Gender female control of decisions	-0.57 (0.70)
Poverty Probability Index [®]	-0.03 (0.01) *
Distance to nearest urban center (walking hours)	0.04 (0.03)
Off-farm income from other farm in community	1.06 (0.34) **
Remittance	-0.95 (1.11)

[†] Reference category is "not severely food insecure." *Pr(>|z|) < 0.05. **Pr(>|z|) < 0.01.

[‡] Potential for overestimation from simultaneity with dependent variable.

Life history interviews identified a broader range of factors associated with food insecurity outcomes compared to survey analysis. The most commonly discussed limiting factors were: consecutive drought impacting crop or animal production; unstable or inaccessibility of labor work; the cost of medicine displacing income from food purchase, livelihood investment and creating debt; social marginalization; absence or separation of a household head; and the cost of fertilizer, considered essential to maintain a viable level of production (**Table 3**). Life history interviews also elicited important detail and context about a given factor. For example, the interviewees described the different mechanisms by which this reduced participation in community and programs had occurred, including the precarity of presence within the community due to migration periods, social relations within the household, and power dynamics and control of project resources within the community.

Regression analysis of the household data shows severe food insecurity is significantly associated with the receipt of

income from other farms within the community and coffee cultivation. On the surface, this contradicts the results of the coding analysis of interviews, as coffee cultivation was the most commonly reported “positive factor”—identified by participants as contributing to an improvement in well-being (Table 3). It is important to realize, however, that the contribution of the different variables in a multiple regression model depends on the presence of the other variables. Coffee cultivation only appears as a significant variable when market participation is also included in the regression model (it is what is known as a “pipe”; Pearl, 2009). This means that coffee cultivation is significantly positively associated with severe food insecurity when market participation is held at its mean (0.19). This interaction nuances that it is households that cultivate coffee but that also have relatively low market participation that are more likely to be classified as severely food insecure (Supplementary Table 2).

Ethnographic insights can also contribute to our ability to interpret and make sense of this potential contradiction. The experience of Hector and Clara, whose household was recorded as severely food insecure in the 2015 survey, is summarized below:

Hector and Clara lived with their three children in two mud-walled rooms, they kept a small farm where they had recently invested in growing coffee and banana to sell, alongside the maize and beans they have always kept to feed their family. Clara described the impact of living without a shelter “If you don’t have a house it is difficult, I appreciated the help when the mayor gave us some metal sheets to build a roof, but we still had no kitchen, so when it was raining we were dry, but we still went to bed without food.” Clara identified the positive role of external support on their livelihoods, in terms of cash for food, training and family planning. As their first child was able to start working in labor, the extra income had been the catalyst for them to start cultivating their own coffee and banana. Hector explained “I started growing coffee 3 years ago when I left labor work. I was working with Hermano Pedro from church and he gave me the idea and knowledge that enabled me to start growing coffee. I learnt how to plant bananas [as shade] and how to make a nursery. I have always cultivated beans, but this idea to grow coffee was new. Now I work in coffee, I don’t have to buy plants, I have my own seeds. Before I used to work for others until 18:00, and I didn’t have time to work my own land, but now I do a small amount of labor [for others] and work on my own land. When I worked doing labor for another person I would get a quintal of fertilizer, but now when we buy the fertilizer the children have to put up with being hungry. We have to put up with being hungry sometimes because we have invested 3 years in the coffee, but I keep working, and so does my son.”

Hector described a dependence on off-farm labor despite its limited returns, and the trade-off between time spent in off-farm labor and managing his own production and food generating activities. This contributes to explaining the statistical association between off-farm income from other farms and severe food insecurity outcomes (Table 4), which has also been observed in other contexts (Jayne et al., 2014). In this case, the additional off-farm income contributed to the household by Hector’s son had enabled their recent investment in cash crop production (coffee). Hector describes the sacrifice they have made to invest

in coffee and the lead time to this becoming a marketable crop, which corresponds with, and adds explanatory weight to, the observation of market participation being a mediating factor between coffee production and food insecurity.

The interview with Juliana pointed to a further mechanism by which on-farm production and market participation was mediated, via an interaction between land access, participation in local programs and production.

Juliana lived in a single room with her 3 children, her husband was away looking for work. The household was recorded as severely food insecure. Juliana felt that their limited access to land was the main barrier to improving their livelihood “We only had 4 tareas [land unit], and we rent the land, so even when we have a good rainy season we don’t have access to more land, so we cannot cultivate more to improve our livelihood.” She felt mistrust of local groups after being promised tree saplings, seeds, and chickens through various projects, that had never arrived, and felt excluded from participating in several projects due to her lack of land and resource “The benefits from projects are good, but unluckily we are poor, so we don’t receive any. Here is it the people who have the land who receive the benefits.”

PPI also has a significant association with food insecurity, and this is unsurprising as it represents a proxy for wealth (a higher score means lower probability of poverty). This association may relate to several causal pathways, however. Wealth may be associated with higher levels of savings that can be accessed in difficult times, as well as having increased capabilities (e.g., farm equipment, employment opportunities or social capital). Multiple causal pathways between PPI and food security outcomes were also evidenced in life history interviews, for example in the use of capabilities to develop multiple livelihoods in the case of Mavis, in stark comparison to the story told by Clara who had a limited capability to prepare food due to a lack of roof or kitchen in her home.

Mavis’ household, which includes her husband and three young children, was recorded as food secure in the 2015 survey. She explained how cash crop production and diversification had successfully enabled them to incrementally improve their economic status and food security to reach a point where they feel comfortable and food secure. “The municipality gave us a greenhouse and we planted tomato, pepper, chili, coriander. The greenhouse was from a municipality led project, only a few people received the benefit, but my husband knew someone and so we got it. We planted onion too, and then we started to raise pigs and produce poultry. We also always planted beans and maize.” Through these examples she illustrated how their access to credit from banks, friends and on-farm income itself had enabled them to keep investing in more strategies and build a diverse portfolio of income sources, including chickens, pigs, a range of crops, and most recently cars, buying two 4x4 cars to run a local school and taxi service.

DISCUSSION

Local and National Scale Factors

Livelihoods in the dry corridor region of Guatemala are shaped by sets of highly contextualized, historic, social, political and

environmental factors that have relevance for food insecurity outcomes (**Table 3, Supplementary Table 1**). These overlap with, and extend beyond factors included in the household survey. Analysis of a standardized set of survey variables, revealed the broad-scale association between severe food insecurity in households and coffee cultivation (when market participation is constrained), dependence on off-farm income from labor on other farms, and poverty. Interviews have identified where decision-making and trade-offs can be a proximate cause of food insecurity in households suffering from poverty and food insecurity, these trade-offs often involve survey-measured variables, but the interviews elicited detail of their interaction and dynamics, e.g., prioritizing fertilizer for coffee production over access to a sufficient diet during a 3 year investment, or time constraints from labor work limiting on-farm production. Interviews identified further underlying social-political factors that were not represented or paralleled within the survey, and would likely be challenging to categorize or enumerate within a survey setting, for example, the marginalization from groups that have control over development resources. Here we discuss four factors—cash crop production, health, participation and agricultural labor—to illustrate the explanatory power of integrating these two methods, compared to a single-survey application, and its relevance to intervention planning across scale.

Risks of Coffee Investment

Survey data showed that the relationship between cash cropping and food security was mediated by market participation, and that coffee-growing households with low market participation had an increased likelihood of being severely food insecure (**Table 4, Supplementary Table 2**). Interviews concurred that coffee is a high-risk strategy, given the challenges of drought and coffee rust affecting the region, and the long-term investment needed for crop establishment, but also indicated high-rewards when successful. Interviews detailed how establishment costs, lag times in producing marketable crops, land access, and levels of market participation shape households' experiences and success in cash crop production, which evidences the need for holistic and tailored strategies that go beyond general promotion of crops or agronomic practices. For those households that have few or no safety nets pursuing cash crop production, this finding highlights the severity of production and livelihood risks. Climatic variability and instances of crop disease can substantially reduce income; increased capital expenditure can deplete capital reserves, leaving no resources for crop inputs or other household needs. Provisioning of risk mitigating production support and safety nets will fall under the remit of a range of institutions and organizations, across scales.

III Health and Cost of Medicine

Although it would have remained unidentified in the survey application, participants commonly identified the burden of ill health and injury as a principle factor that displaced income away from food access or livelihood investment, foremostly via the cost of medicine, but also the loss of income. Within

Central America, Guatemala has the highest rate of out-of-pocket expenditure for health (as a % of total expenditure) and the second lowest government health expenditure (as % of GDP) (World Development Indices, 2019). The financial burden of ill-health falls mostly on economically poor and rural households, due to lack of insurance and decreased access to public services (Bowser and Mahal, 2011), while exertion in labor work in unsafe and unhealthy working conditions can further contribute to the burden of ill health and loss of livelihood in labor dependent households (LO/FTF Council, 2014; Dally et al., 2018). In this case interviews have evidenced an underlying driver of food insecurity that is likely to require coordinated intervention or policy change at a national scale in order to address this constraint on the health, food security and production of households in the dry corridor region.

Participation

Inclusion and participation within existing support systems and structures was an important part of the stories of many of the households that were interviewed, but was not evidenced in the survey. Training and resources disseminated through existing farmer group networks were shown to be unlikely to reach severely food insecure households that are socially marginalized or have limited participation in local groups. These incidences of exclusion from projects also indicate a wider issue of representation in the local implementation of participatory development projects (cf. Cleaver, 2014). Multiple contexts for reduced participation or marginalization were identified, including corruption—indicating the need for independent processes by which to review the inclusion of participants in projects.

Agricultural Labor

The integrated analysis has identified the vulnerability and increased likelihood of severe food insecurity in households that are dependent on agricultural labor, through multiple mechanisms: low wages, instability of income, extortion, the risk of injury and ill-health, a lack of health care provision, restricted community participation and reduced household capabilities when household heads are traveling in search of available work. Improvements in working conditions of inter-regional day laborers have been identified in some productive regions in Central America through state commissions and workers unions. However, many labor markets remain informal, utilize private middlemen, recruit daily, provide little security of employment, protection, or health insurance, while hundreds of thousands of laborers are reported to work in unsafe and unhealthy working conditions, for example in Guatemala's agro-export processing centers. Corruption and disappearances of trade union leaders have also historically inhibited progress toward achieving labor rights in Guatemala (LO/FTF Council, 2014; Van Roozendaal, 2015). Implications for directing policy include the promotion of transparency and labeling in production chains, and creation, across ministries, of a policy environment that enforces safety standards, a fairer wage, and employment security within existing agricultural industries.

The complex and cross-scale mechanisms by which food insecurity comes about is such that climate conditions, crop choices, agronomic training, health, credit access, gender, market access, and social and political participation are all inherently wrapped up in the individual experiences and narratives of participants. Livelihood decisions, economic and social circumstances also mediate the exposure and vulnerability of households to dynamic stressors such as climate (consecutive drought), labor availability, and market prices. This observed transmission of risk and impact between non-climatic and climatic factors corroborates with ethnographical research on food insecurity in other regions in Latin America (Zavaleta et al., 2018). Purely relying on survey data may lead to interventions that are technical, but not holistic. An intervention designed to stimulate cash crop production, for example, that does not also coordinate effort to address issues of participation and access to land, water and health services, are likely to have limited effectiveness, and at worst entrench existing inequalities. Identifying these complex mechanisms and analyzing their prevalence requires integrated research methods. Below we reflect on the specific approach of integrating household survey data and ethnographic research adopted in this study.

Integrating Household Surveys With Ethnographic Approaches

This study used a multi-indicator household survey to assess what socio-economic factors were significantly associated with severe food insecurity, based on HFIAP scores. Indicators of households' production type were analyzed to select a subset of households -with maximum variation- to participate in life history interviews. Analyses were iterative, as interview derived understanding then further informed the building and interpretation of the regression model.

Ethnographic interviews revealed some of the important variables that were not represented in the survey. However, simply extending surveys to be all encompassing is unlikely to be a feasible response to the complexity and context dependency of the lived experience of food insecurity documented in this region, due to the pressure that would put on data quality, for example by increasing time-cost, participant fatigue and recall accuracy (Kilic and Sohnesen, 2015). Before extending surveys, it is important to address the current limitations to produce insight from surveys due to issues of data quality and biases, as detailed in Fraval et al. (2018). We also note that some experiences and topics do not fit the standardized structure of a survey. A validated approach to tackle sources of uncertainty in survey data is the use of multiple methods to test the consistency and quality of responses, by making more precise physical measurements with a subsample of the surveyed population. We have applied this approach to ethnographic methods, to provide both a broader evidence base, and enable triangulation of evidence from quantitative and qualitative sources. Triangulation of evidence from interviews in iterations of analysis and model building enabled us to shape the model around associations that have grounded evidence. Conversely, it also helped to identify and explore the presence

of endogeneity, confounding variables or spurious associations when specifying the model.

The effectiveness of using qualitative data to inform quantitative analysis is dependent on the quality and quantity of interview data afforded. Low "positive" counts for qualitative factors derived from life-history interviews limited our capacity to test for statistically significant associations between reported positive or limiting factors and survey based food insecurity outcomes, e.g., the relationship between reports of consecutive drought and HFIAP status. However, these causal mechanisms identified ethnographically, can each now be explored across a range scales using alternative data with a grounded justification. Under time and resource restrictions the application of ethnographic methods to a stratified subset of surveyed households manifests as a trade-off to the sample size of the larger survey effort. However, a critical evaluation of survey data was able to capture significant differences and trends in survey indicators that are representative of the wider population using sample sizes of hundreds, while many survey efforts typically reach into the thousands suggesting there is room for the inclusion of more mixed methods in standardized assessment and monitoring protocol (Fraval et al., 2018).

Interview methods have their own set of biases and limitations for consideration, for example the breadth of issues raised in interviews is likely to be sensitive to the framing and biases of the researcher, as well as participant selection effects due to low sample sizes (minimized through purposive maximum variation sampling); effects of the interviewer identity and position; reliability of participants; accuracy of recall; and subjectivities in interpretations, coding and analysis (Alsaawi, 2014). Identifying drivers from qualitative interviews has limitations, especially in extrapolating to the wider population. The sub-sample of interviewed households is shown to be representative of the wider survey population, however the list of drivers is sensitive to recall biases relating to the timing of the interview, and hindsight bias relating to the exposure of interviewees to external narratives surrounding recent events. For example, at the time of this research there had recently been a drought and multiple intervention projects working in the region were framed around resilience to drought and climate; hence the prevalence of consecutive drought in the qualitative analysis is likely to have been—at least in part—a reflection of these effects. Results therefore need to be applied and interpreted within contextual bounds of the time and place of data collection.

The position of the researcher conducting life-history interviews and analysis will be an important methodological consideration when embedding ethnography into existing survey-based assessment or research protocol. Through critical reflections during fieldwork, we identified that perceived and explicitly stated independence of the interviewer from intervention-implementing organization was an essential methodological criterion to maximize representation of actors, narratives, and voices across the surveyed population. Some sensitive subjects raised by participants in interviews, such as processes of social exclusion, familial disagreements, gun violence, or alcoholism, were not represented in the survey, but are still likely to be under-represented in ethnographically

informed interview approaches applied here. Furthermore, some social issues known to be present in the region, e.g., narcotic movement across country borders, or religious tensions, were not raised in surveys or interviews despite indicators of their presence within visited communities, suggesting that some narratives remained hidden. Through the use of more ethnographic approaches, such as including observation or photovoice, these limitations could be mitigated (Lykes, 2001; Lorenz and Kolb, 2009). Adding more in-depth ethnographic approaches in this case has potential to both expand the system boundary and deepen understanding, especially in the context of marginalized or disadvantaged individuals or communities (Lardeau et al., 2011), but integrated methods inevitably have a greater cost than singular methods applications. Integrated methods therefore require iterative methodological discussion between researchers about the trade-off between the depth of knowledge produced and its coverage—with respect to the system boundary of included topics and spatial scale.

CONCLUSIONS

Combining survey and life history interview approaches enabled us to evidence a broader set of underlying drivers of food insecurity, widening the system boundary of measurement, and extending it to review interactions between food security outcomes, intervention and policy at local and national scale. The analysis of a standardized set of surveyed variables enabled us to identify household characteristics that are significantly associated with the prevalence of severe food insecurity across the region, while our analysis of life history interviews is founded in a more constructivist epistemology to bear witness to the heterogeneous and context specific experiences and drivers of food insecurity, as identified through the participants' own narratives. Variables with a statistically significant association with severe food insecurity in the region are: coffee cultivation (when market participation is low), dependence on agricultural labor income, and poverty level. Drivers most commonly identified by participants are: consecutive drought; ill health and displacement of income for medicine; social marginalization; high start-up costs in production; absence or separation of a household head; and a lack of income and education opportunity. This evidences the need for more inclusive and joined-up policy-making, e.g., to tackle inequalities in wages and working conditions, access to land, resource, education, and health care, which current limit households' capabilities and capacity to participate in developing rural livelihoods. From this broader and grounded perspective, survey based insight can be critically viewed and contextualized. This approach aligned measurement and monitoring with the broadly accepted WHO 1996 definition of food security by visualizing elements of choice, culture and agency, and with the participatory agenda by conceptualizing food insecurity and its drivers through a process that includes both deductive and inductive evidence building.

DATA AVAILABILITY

The datasets for this manuscript are not publicly available because: they contain confidential information about participants, and could not be fully de-identified. Requests to access the datasets should be directed to LB, eelb@leeds.ac.uk.

ETHICS STATEMENT

All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards. Ethical approval was granted by: AREA 16-179 [approved 15/08/2017] ESSL, Environment and LUBS (AREA) Faculty Research Ethics Committee, University of Leeds.

INFORMED CONSENT

Informed consent was obtained verbally from all individual participants included in the study. Written consent was not obtained due to illiteracy or limited literacy proficiency of participants.

AUTHOR CONTRIBUTIONS

RHoMIS designed was developed by JH, MvW, and JvE, and the overall study was designed and developed by LB, SW, AC, JvE, and MvW. Survey data was designed and collected by JH, JG, LM, JvE, MvW, and analyzed by LB and SF. Interview data was designed and collected by LB and LD. The main body of text was written and compiled by LB and SW, with contributions from SF, MvW, JvE, LD, LM, JH, JG, and AC.

FUNDING

This research was funded by the UK National Environment Research Council SPHERES DTP Ph.D Studentship with support CASE funding from Bioversity International.

ACKNOWLEDGMENTS

We would like to acknowledge the participants who contributed their time and knowledge to this research, and the team of field technicians who implemented the household survey, and the team at the Tropical Agricultural Research and Higher Education Center (CATIE) who coordinated the survey.

SUPPLEMENTARY MATERIAL

The Supplementary Material for this article can be found online at: <https://www.frontiersin.org/articles/10.3389/fsufs.2019.00065/full#supplementary-material>

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Conflict of Interest Statement: The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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