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COVID-19 and Livelihoods in Rural Guatemala

Lessons from a Long Term Assessment and the Path to Recovery

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ABSTRACT

The COVID-19 pandemic has had profound effects on livelihoods and food security across rural populations worldwide. This study offers a long-term assessment of the impacts of the pandemic and the path to recovery among smallholder agricultural households in the Western Highlands of Guatemala. We rely on a unique longitudinal survey of 1,262 households collected over four survey rounds between 2019 and 2022. The results show substantial recoveries in incomes, food security, and dietary diversity in the region by mid-2022 compared to 2020, but at levels still worse than pre-pandemic ones. There is also a sustained increase in the intention to emigrate. The households that were initially more affected in terms of food security and nutrition but recovered faster include those located in one (San Marcos) of the three departments and families living above the poverty line, while smallholders affected by the ETA and IOTA tropical storms, non-coffee producers, and indigenous populations have taken longer to recover. In addition, we provide quantitative estimates for a subsample of households interviewed during a fifth survey round at the end of 2022, showing an average decline of about 16 percent in total household income three years after the start of the pandemic, mainly driven by a decrease in agricultural income, combined with a 26 percent increase in expenditures and an important surge in indebtedness. Overall, the study offers valuable lessons regarding the recovery of vulnerable households following a major global crisis and in a context of additional shocks, remarking the importance of continue monitoring the situation of vulnerable households, especially those exposed to recurrent (weather) shocks that also have a more exhausted portfolio of coping mechanisms & express a higher willingness to emigrate.

Keywords: COVID-19, income, food security, dietary diversity, migration, expenditures, debt, long-term effects, recovery, external shocks, agricultural households, rural Guatemala
JEL codes: I30, O15, Q12, R20

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1. Introduction

COVID-19 took the world by surprise in late 2019, quickly turning into a major health shock that killed thousands. By 2020, it had morphed into a major global economic and social shock, putting livelihoods and food security at risk for millions. Vulnerable smallholders in developing countries, in particular, faced multiple challenges because of agricultural supply chain disruptions combined with food and agricultural inputs growing increasingly out of reach due to issues with availability and price hikes, with limited public aid and little recourse in terms of other income-generating activities. Despite the disruptiveness of the COVID-19 environment, beyond the initial surge in academic and public interest on the consequences of the pandemic, scant efforts have been geared towards analyzing its longer-term effects on livelihoods and food security and the path to recovery for affected households.

This paper aims to partially fill this gap, providing a picture of the recovery process and detailed estimates of changes between 2019 and 2022 in rural households' incomes, food availability and prices, food insecurity experiences, dietary diversity, and attitudes towards migration for a sample of agricultural households in the Western Highlands of Guatemala. To do this, we rely on an extensive panel of 1,262 smallholders located across 87 communities in the departments of Huehuetenango, Quiché, and San Marcos, which were followed over four survey rounds from 2019 to 2022. An additional survey round collected at the end of 2022 among a subsample of households further permits to assess concrete quantitative changes on incomes, expenditures, indebtedness levels, and production decisions.

With the onset of the pandemic, the government in Guatemala imposed several restrictions, curfews, and lockdowns, which combined were one of the highest restrictive environments in Central America (Hale et al., 2021). The Government Stringency Index, which measured the strictiness of government policy responses to COVID-19 on a scale 0-100 was over 96 between April and July 2020, dropped to 87 in August 2020, and remained over 50 through the beginning of 2022. Most rural communities additionally closed or limited their access until mid-2021, resulting in further local resutrctions to movement and value chains' disruptions.

The COVID-19 environment and the subsequent global and local market fluctuations were not the only systemic shocks affecting Guatemalan households during the period of analysis. The tropical storms ETA/IOTA and Julia —that hit the country in, respectively, November 2020 and October 2022— and the recent conflict between Russia and Ukraine that started in early 2022, which triggered supply and trade disruptions and important increases in international prices for energy, fertilizers, and agricultural commodities, also represented major events affecting households in the region.[1] Following the same sample of households over the course of three years allows us to track the degree to which they were initially affected, observe any reactions, and analyze the speed and extent of their path to recovery, while considering their exposure to subsequent shocks.

We build upon two previous studies that analyze the initial effects of the COVID-19 environment on food security and nutrition outcomes (Ceballos, Hernandez, & Paz, 2021) and the persistence of these effects (Ceballos, Hernandez, & Paz, 2022) using the same sample of households interviewed over the previous survey rounds. These studies found important qualitative decreases in incomes between 2019 and 2020, followed by a partial recovery during 2021. To face these income shocks, households initially relied on savings, selling assets (mainly livestock), and public aid. By 2021, however, households were reporting a much higher reliance on costlier coping mechanisms such as loans from both formal and informal institutions. In addition, the above studies found a substantial increase in food insecurity episodes and lower dietary diversity after the start of the pandemic —with a decrease in animal source foods (ASF) diversity and an increase in fruits and vegetables (F&V) diversity—, which only partially recovered into 2021. Finally, a clear jump in the intention to emigrate was observed in 2021 that was not present during 2020,

[1] ETA and IOTA caused significant flooding, landslides, and mudflows that affected several rural areas across 16 of the 22 departments in Guatemala (IFRC, 2021), while Julia resulted in floodings across over two thirds of the municipalities in the country (United Nations, 2022). For the continuing repercussions of the Russia-Ukraine conflict, see IFPRI's special series of blog posts, briefs, and events available at https://www.ifpri.org/spotlight/food-prices-war-ukraine (accessed on September 2023).

arguably due to the persistence of economic hardship accompanied by the lifting of restrictions to movement.

This study expands on the above in several dimensions. First, it provides a complete picture of the evolution of a group of key food security and nutrition indicators over the course of three years, a notably longer time period. Second, it studies the path of recovery for selected indicators across different groups of households, considering their geographic location, poverty status, and ethnicity, and whether they were additionally affected by extreme climatic events and the types of crops they produce. Finally, unlike the previous two studies, it provides quantitative estimates for a range of socioeconomic outcomes, including incomes, expenditures, indebtedness levels, and production decisions.

The results show an important recovery in incomes, food security, and dietary diversity by 2022 among study households, but that have not yet reached pre-pandemic levels. Around two fifths of households still report having lower overall incomes than in 2019, a substantial improvement though compared to the situation in 2020 and 2021. The 2022 prevalence of severe food insecurity episodes has dipped below 2019 levels, with that for moderate food insecurity being only marginally higher than pre-pandemic levels and that for mild food insecurity decreasing, compared to 2021, but still about 15 percentage points higher than in 2019. Dietary diversity scores have improved relative to those obtained in 2020 and 2021 and are in some respects even higher than the ones reported in 2019. However, the higher willingness to emigrate observed in 2021 persists in 2022 and more than doubles 2019 levels. The path of recovery, especially in terms of food security and dietary diversity, has been easier for some groups of households, such as those located in the department of San Marcos and those living above the poverty line in 2019, while households affected by the ETA and IOTA tropical storms, non-coffee producers, and indigenous populations have taken more time to recover. Quantitative findings for a subsample of households followed for an additional survey round in late 2022 point to a 16 percent average reduction in total income since 2019, mostly explained by lower agricultural incomes. What is unsettling is that household expenditures have increased by 26 percent, with indebtedness on the rise, including a 53 percent increase in the proportion of households holding debt and a 59 percent increase in the average volume of debt.

The paper contributes to four strands of literature. First, our study adds evidence on the longer-term impacts of the COVID-19 environment on agricultural livelihoods and incomes, as well as those on the broader agrifood value chain (e.g., Ceballos, Kannan, & Kramer, 2020, 2021; Hailu, 2020; Hammond et al., 2022; Hirvonen, De Brauw, & Abate, 2021; Hirvonen et al., 2021; Jeyakumar, Dunna & Aneesh, 2022; Kumar, Padhee, & Kumar, 2020; Mahajan & Tomar, 2020; Mildendorf et al., 2022; Nchanji et al., 2021; Nolte, Sipangule, & Wendt, 2022; Rawal et al., 2020; Van Hoyweghen et al., 2021; and Wang et al., 2022). Second, the study relates to the literature on the food security and nutrition effects of COVID-19 (e.g., Balana et al., 2023; Bundervoet, Dávalos, & Garcia, 2022; Ceballos, Kannan, & Kramer, 2020; Ceballos, Hernandez, & Paz, 2021, 2022; Dasgupta & Robinson, 2022; Diaz-Bonilla et al., 2021; Hammond et al., 2022; Hirvonen, De Brauw, & Abate, 2021; Jeyakumar et al., 2022; Laborde et al., 2020; Mekanna, Panchal, & Li, 2022; Rudin-Rush et al., 2022). Third, we relate to a small but growing strand of the literature on the impacts of compound shocks (Kruczkiewicz et al., 2021; Mahul & Signer, 2020) on businesses revenues (Helgeson et al., 2022), agriculture (Mishra, Bruno, & Zilberman, 2021) and food insecurity (Randell et al., 2021). Lastly, the paper adds to a relatively scarce literature on the quantitative effects of the COVID-19 environment on incomes, expenditures, asset holdings, and indebtedness (Amare et al., 2021; Balana et al., 2023; Hoehn-Velasco et al., 2022; Tefera, Tadesse, & Asmare, 2022).

The closest studies to ours are Amare et al. (2021), Hirvonen, De Brauw, & Abate (2021), Dasgupta & Robinson (2022), Rudin-Rush et al. (2022), Tefera, Tadesse, & Asmare (2022), and Han et al. (2023) who examine the impact of the COVID-19 pandemic on food security and nutritional intake across different countries using household panel data. These studies, however, either rely on solely two survey rounds (before and after the pandemic) or on additional high-frequency survey rounds following the pandemic but only until mid-2021. We extend these studies by relying on annual survey data over a larger time span (until 2022), that permits to better assess recovery paths, and by considering a broader set of outcomes, such as qualitative and quantitative impacts on incomes from a variety of sources, in addition to quantitative impacts on expenditures, indebtedness, and production decisions.

The remainder of the paper is organized as follows. Section 2 describes the data used in the analysis, including a description of the study sample and the key outcome variables of interest. Section 3 explains the methodological approach, while Section 4 presents and discusses the results. Section 5 concludes.

2. Data

The sample frame used for the study corresponds to a sample of households interviewed at the end of 2019 as part of an impact evaluation of a value chain development program for coffee and horticultural producers in the Western Highlands of Guatemala.[2] The original sample consists of 2,142 small commercial coffee and horticultural farmer households who owned cell phones and were located across 87 municipalities in the departments of Huehuetenango, Quiche, and San Marcos.[3]

The main study data comprises a total of four survey rounds —a baseline survey administered in-person in November-December 2019 by a local team of female enumerators and three follow-up survey rounds conducted over the phone by the same team of enumerators during May-June 2020, 2021, and 2022.

The data collected during the baseline survey included demographic characteristics, agricultural production, asset ownership, household income and expenditures, participation in social programs, food security, dietary diversity, perceptions, attitudes towards migration, and anthropometry measurement for children under five years old.

[2] The program is Feed the Future Guatemala Value Chains Project, funded by the United States Agency for International Development (USAID) and executed by two private implementors: Agropecuaria Popoyán and Federación de Cooperativas Agrícolas de Productores de Café de Guatemala (FEDECOCAGUA). The main objective of the program was to increase agricultural incomes and resilience of small farmers and their families in the Western Highlands and improve their nutrition status.

[3] This sample includes project beneficiaries and non-beneficiaries (control group) for the impact evaluation, who are part of the broader population of commercial smallholder farmers in the region. Beneficiary households interviewed in 2019 are a representative sample of the total population of program beneficiaries. Non-beneficiary households belong to neighboring communities with similar characteristics to those within the program's reach. The working sample for this study has roughly an equal share of beneficiaries and non-beneficiaries.

The follow-up surveys were aimed at identifying the potential short-, medium-, and long-term economic and nutritional effects of the COVID-19 pandemic on rural households, while accounting for the implications of other shocks faced between 2020 and 2022, including extreme weather events and the Russia-Ukraine conflict and resulting global price crisis. The first follow-up survey collected qualitative changes in income sources (including remittances) after the lockdown, coping mechanisms to deal with income reductions, food security indicators, dietary diversity, perceptions, and migration intentions. Complete findings from this initial follow-up survey are available in Ceballos, Hernandez, & Paz (2021). The second follow-up survey included the same modules as the first follow-up survey together with additional modules inquiring about changes in agricultural activity, permanent or temporary loss of jobs or businesses, and exposure to ETA and IOTA tropical storms. The full findings from this second follow-up study are available in Ceballos, Hernandez, & Paz (2022). The third follow-up included new modules on availability and prices of agricultural inputs and prices of food staples considering the Russia-Ukraine conflict.

Participation across all follow-up survey rounds was encouraged by providing households with a small airtime top-up (equivalent to 1.33 US dollars) in compensation for their time.[4] Local community leaders were also contacted when a household was not answering repeated calls or had an inactive phone number. Despite these efforts, 880 households were dropped from the study sample over the course of the three follow-up surveys, equivalent to 40 percent of the original sample frame. The attrition rate from the first to the second survey wave was close to 15 percent (318 out of 2,142 households), 10 percent in the third survey wave (212 households), and 16 percent in the fourth survey wave (350 households).[5] The final

[4] Households were given a small in-kind gift (calendar and pen) for the baseline in-person survey.

[5] For the 2021 and 2022 survey rounds, about half of the attrition came from households refusing to conduct another interview, and the rest mostly from not being able to reach the household through either phone calls or the community leaders' support. In the case of the 2020 round we did not collect detailed data on attrition, but most of the excluded households were due to not being able to reach them by phone after several attempts. In all follow-up survey rounds, we attempted to contact all unreached households across different days and different times of the day.

working sample is a balanced panel of 1,262 households interviewed during all four survey rounds. Figure 1 maps the communities where the study households are located across the three departments.

Since attrition between baseline and our working sample is relatively high, we test whether households in these two samples are comparable in terms of observable characteristics (at baseline). As shown in column (4) in Appendix Table A.1, most characteristics are generally balanced across the two samples, with only four exceptions: a higher proportion of male-headed households, a higher household size, higher livestock ownership, and a higher share of households producing coffee as one of their main crops in the final working sample. These imbalances, however, are economically very small such that we do not consider any adjustments for attrition bias in the analyses but still perform some robustness checks as discussed in the next section.

In addition, a subset of households in our working sample participated in a fifth survey wave of in-person data collection, conducted during November-December 2022 as part of the endline survey for the impact evaluation of the value chains project. The questionnaire for this survey round was much more comprehensive and comparable to the baseline survey, allowing for quantitative comparisons across several key socioeconomic outcomes between 2019 and 2022, including households' incomes, expenditures, savings and debts, crop production decisions, and livestock ownership, that we discuss in a separate subsection of the Results.[6] The 777 households that were additionally interviewed in the endline survey generally share similar characteristics to those in our full working sample and in the original sample frame (see columns (5) and (6) in Appendix Table A.1).

Panel A of Table 1 presents descriptive statistics of an array of household characteristics among the full working sample. Households are mainly located in the department of Huehuetenango (58 percent), followed by Quiche (32 percent), and the remaining in San Marcos (10 percent). Most of the households

[6] Not all households were interviewed in the fifth survey round because some could not be located in person, others refused to be interviewed, and there were some difficulties accessing certain locations due to weather conditions at the time of the fieldwork.

grow coffee as one of their main crops (82 percent). Household heads are primarily male (85 percent), middle-aged (average age of 48 years old), and their main language is not Spanish (71 percent). Dwellings typically have finished floors (54 percent), unfinished ceiling (86 percent), and are connected to electricity (84 percent) and to a water system (85 percent) but lack connection to a drainage network (69 percent). The average agricultural land size is 0.9 hectares, and the daily per capita household expenditure is 11.3 quetzales (equivalent to 1.5 US dollars). These socioeconomic characteristics are roughly consistent with the average household characteristics in the three departments comprised in this study (according to the 2018 Population and Housing Census) but are not necessarily representative of the broader rural population in the region (that includes subsistence farmers).[7]

Panel B of Table 1 shows that several households in our study sample are continuously exposed to negative weather events, which are recurrent in the Western Highlands. More than four out of every ten households report having been severely affected (mainly crop losses) by the ETA/IOTA tropical storms in late 2020, while six out of every ten households report having had some degree of crop losses due to a negative weather event over the 12 months prior to the 2022 survey round.[8] In terms of the level of exposure to COVID-19, 9 percent of households report that someone in their household was infected with COVID-19 as of 2022, and 35 percent of households report that someone in their community was infected.[9]

[7] https://www.censopoblacion.gt/ (accessed on September 2023). See Ceballos, Hernandez, & Paz (2021, 2022) for a deeper discussion of the comparability of the study sample with the average rural household in the region.

[8] Half of the households that reported being affected by a negative weather event in 2022 were also affected by ETA and IOTA. In addition, among the subsample of households interviewed in a fifth survey round in late 2022, 71 percent indicated being affected by the Julia tropical storm in October 2022.

[9] The 2022 survey round also inquired about vaccinations and we find that seven out of every ten households report at least one member having been vaccinated (with at least one dose) as of 2022; among households with children between 5 and 12 years old, only four out of every ten households report at least one child receiving at least one dose. The vast majority of households that reported no member receiving any dose indicated that they do not want to get the vaccine, as opposed to an unavailability issue.

Turning to the outcome variables, the study evaluates the evolution of several indicators based on information collected during each survey round, but we pay special attention to households' income, food insecurity, dietary diversity, and migration intentions. For the income indicators, we rely on households' self-reported qualitative changes between 2019 and 2022 in incomes from three major sources: agricultural, non-agricultural, and remittances.[10] In terms of food insecurity, we construct three dichotomic indicators related to food insecurity experiences (based on the Food Insecurity Experience Scale – FIES-, Ballard, Kepple, & Cafiero (2013)).[11] For dietary diversity, we consider three scores: (i) the household dietary diversity score (HDDS), a measure widely used in the nutrition literature as a proxy for diet quality, which focuses on the food groups consumed by a reference household member (the interviewed individual in our case) during the full day before the interview, (ii) the diversity in consumption of animal source foods (ASF score), and (iii) the diversity in consumption of fruits and vegetables (F&V score).[12] Lastly, we focus on an indicator of intention to emigrate, based on a survey question that asks if any household member has the intention to migrate outside of the country, to either live or work, over the following three years.

[10] During the survey, households were asked to provide their answers to these questions by selecting one out of five categories: decreased a lot, decreased a little, remains the same, increased a little, and increased a lot. In some of the analyses below and for simplicity, we lump together the *increased a little* and *increased a lot* categories. In other analyses, we construct a variable capturing whether a given household reported an unambiguous income decrease, defined as the household reporting a decrease in one or more of the three income sources but no increases.

[11] The indicators are based on whether a household experienced mild, moderate, or severe food insecurity episodes during the months prior to being interviewed. Mild food insecurity is defined as the household indicating that in at least one instance household members had eaten only a few kinds of foods because of a lack of money or other resources; moderate food insecurity as having eaten less than they thought they should; and severe food insecurity as having not eaten despite feeling hungry.

[12] The HDDS is based on twelve food groups: (1) cereals and grains; (2) roots and tubers; (3) vegetables; (4) fruits; (5) meats, poultry, and offal; (6) eggs; (7) fish and seafood; (8) legumes and nuts; (9) milk and milk products; (10) oil and fats; (11) sugar; and (12) miscellaneous foods. For additional information on the indicator see FAO (2010). The ASF score is based on seven food groups: (1) beef and pork meat; (2) poultry; (3) organ meat; (4) sausages; (5) fish and seafood; (6) eggs; and (7) dairy products. The F&V score is based on five food groups: (1) fruits rich in vitamin A; (2) other fruits; (3) vegetables rich in vitamin A; (4) green leafy vegetables; and (5) other vegetables.

In the case of the subsample of households interviewed in the additional survey round, we pay special attention to quantitative changes between 2019 and 2022 in household incomes, expenditures, and total amount of debt. Household incomes include total monthly income and monthly income from each of the three major sources. Expenditures include monthly total expenditures, obtained from aggregating all expenditure categories reported by the household, and monthly expenditures on six major categories (food, housing, consumer goods and durables, education, health, and others). The debt measures includes the total amount of debt and the amount of debt from three different sources (formal financial institutions, friends and relatives, and informal lenders).

3. Methodology

The empirical analysis is divided into three sections. First, we perform before-after comparisons for several economic, food security, and dietary diversity outcome variables (Section 4.1). We pay special attention to comparisons between 2019 (pre-pandemic) and 2022, given that the short-term changes (2019 versus 2020) and medium-term changes (2019 versus 2021) for several of the outcomes analyzed are extensively discussed in Ceballos, Hernandez, & Paz (2021, 2022). For income variations, the comparisons are based on qualitative changes in different income sources relative to 2019, self-reported by households during each follow-up survey. A similar approach is followed for the availability and prices of different food groups, where we rely on self-reported qualitative variations during each follow-up survey. For food insecurity experiences, dietary diversity measures (including consumption of animal source foods and fruits and vegetables), and intention to emigrate, the comparisons are based on dichotomic or quantitative indicators collected during each survey round.

In a second group of analyses, we formally assess the evolution of key indicators across different groups of households (Section 4.2) using a multivariate regression framework. The focus in this section is on the quantitative measures available and include experiencing a (moderate or severe) food insecurity episode, dietary diversity scores, and households' intention to emigrate. This set of analyses allows us to determine whether certain groups of households were more or less affected by the pandemic and whether

they took longer or shorter to recover. We separately consider differences in terms of household location (located in the department of San Marcos versus Huehuetenango and Quiche), poverty status, whether a household reported being affected by the tropical storms ETA and IOTA, whether the household produces coffee (among the main four crops produced), and whether the household considers itself to be indigenous.[13]

Based on the longitudinal nature of our data and the fact that household characteristics were only collected at baseline, we follow a panel data approach using household random effects (i.e., assuming that the unobserved, time-invariant household characteristics are independent of the explanatory variables), while controlling for fixed effects at the community level. In particular, we estimate the following generalized least squares (GLS) random effects model,

$$Y_{ijt} = \alpha_0 + \alpha_1 t_1 + \alpha_2 t_2 + \alpha_3 t_3 + \sum_{s=1}^{3} \alpha_{4s} t_s * G_i + X_{ij}\beta + \theta_i + c_j + u_{ijt} \qquad (1)$$

where Y_{ijt} represents the outcome variable of interest (i.e., food insecurity experience, dietary diversity score, or intention to emigrate) reported by household *i* located in community *j* at period *t*; t_1, t_2, and t_3 are dummy variables for the 2020, 2021, and 2022 survey rounds, respectively; G_i is a dichotomic variable identifying whether the household belongs to a specific group (i.e., located in San Marcos, poor, affected by the tropical storms, coffee is one of their main crops produced, and indigenous); X_{ij} is a vector of household characteristics measured at baseline (including the indicator variable for the household group type); θ_i is a household-specific element such that $E[\theta_i | X_{ij}] = 0$; c_j represents community indicators that control for the possible influence of factors common to all households in a given community (e.g.,

[13] A household is considered poor if their per capita daily expenditure is less than 1.9 US dollars (at 2011 national prices), which is the international poverty line defined by The World Bank prior to 2022. While several communities were hit by the tropical storms in 2020, a household is considered as affected by these events for the analysis if they indicated being materially affected (e.g., reported crop losses, livestock and/or backyard animal losses, dwelling damages, or lack of access to basic services, among others). A household is regarded as indigenous if the survey respondent identifies herself/himself as indigenous.

socioeconomic, cultural, and accessibility conditions); and u_{ijt} is an error term. We consider an extensive set of household variables that include age, gender, education, and language of the household head, household size, participation in social programs, dwelling characteristics and access to public services, per capita household expenditure, asset ownership, agricultural variables such as landholding size, having an irrigation system, indicator variables for main crops produced, and if at least one member of the household is a temporal internal migrant (for work purposes). The standard errors are clustered at the community level to account for likely within-community correlation in the modeled outcomes.

Parameter α_0 captures the unconditional mean of each modeled outcome variable, while parameters α_1, α_2, and α_3 capture the unconditional average change in the outcome variable in 2020, 2021, and 2022 with respect to 2019. The parameters of interest are $\alpha_{4s},\ s = 1,2,3$, that permit to depict the evolution over time of the outcome variable distinguishing by the different groups of households considered, after controlling for multiple households' characteristics and location fixed effects.[14] Note that alternatively using household fixed effects (instead of community-level dummies) to estimate Equation (1), would result in omitting the vector of household characteristics X_{ij} (all time-invariant) but would not affect the estimation of $\alpha_{4s},\ s = 1,2,3$, as these parameters are not identified from variations over time within the same household.

Finally, in Section 4.3 we take advantage of the additional survey round conducted at the end of 2022 for a related study, which comprised a subset of our working sample. As with the late-2019 baseline survey, this survey was fielded in person and collected detailed quantitative information on several relevant socioeconomic outcomes (described in Section 2). We implement before-after comparisons of these outcomes between 2019 and 2022, that complement the analyses using the full working sample. In addition, we replicate the model in Equation (1) using as outcomes total income, aggregate expenditures, and total

[14] It is worth noting that the individual parameters for the group indicators can be identified except for household location that is measured at the department level and is absorbed in this case by the set of community-level dummies included in the regressions.

debt, to assess potential heterogeneous variations between different groups of households. We estimate the following GLS random effects model,

$$Ln(Q_{ijt}) = \gamma_0 + \gamma_1 t + \gamma_2 t * G_i + X_{ij}\delta + \theta_i + c_j + u_{ijt} \quad (2)$$

where Q_{ijt} is the corresponding outcome variable of interest (i.e., monthly total income, monthly total expenditures, and total debt amount in 2019 Quetzales); t is a dummy variable for the 2022 survey round; and the remaining variables are the same as those described for Equation (1). The parameter of interest in Equation (2) is γ_2, which measures the differential variation in the modeled outcome in 2022 (relative to 2019) across the different household groups (G_i) considered.[15]

3.1 Potential econometric issues

Considering that the basis of our empirical approach relies on before-after comparisons, it is important to discuss likely sources of endogeneity that could affect our results. These include potential seasonality effects, time-varying unobservable factors correlated with the analyzed outcomes, and measurement error.

Given that the baseline survey was implemented at the end of 2019 while all follow-up surveys were implemented mid-year, the estimations could be affected by seasonal trends in food availability and diversity or food access (income and prices). However, as extensively discussed in Ceballos, Hernandez, & Paz (2021, 2022), seasonal effects among our studied sample (if any) would operate opposite to the observed effects in the wake of the pandemic, which provides additional support to our results.

Similarly, despite we account in the regression analyses for a wide set of (time-invariant) household characteristics and location dummies to control for possible confounding effects on the modeled outcomes,

[15] We focus in this case on differentiated changes between household groups as we can only compare values across two survey waves (years), while in Equation (1) we can assess the evolution of outcomes for different household groups over four survey waves.

we cannot completely rule out time-varying omitted variables such as changes in demographic patterns or migration flows influencing our results, although these were to some extent limited until the first half of 2021 (where the vast majority of communities in the sample reported closing their borders for prolonged periods of time since the COVID-19 outbreak).[16] Still, since around 40 percent of the households in our working sample report a change in household size or composition between 2019 and 2022, we conducted the analyses excluding this subset of households and confirmed the robustness of our main results.[17]

In a related vein, while we analyze the potential influence of the tropical storms that affected part of our study sample on key outcomes, we recognize that the 2022 measures could also be influenced by the Russia-Ukraine conflict and its impact on agricultural input and food staple prices.[18] This could be more accute for the quantitative outcomes collected during the additional survey round at the end of 2022, in that the comparisons between 2019 and late-2022 reported in Section 4.3 may not only be capturing long-lasting pandemic-related effects but also those of the conflict.

Finally, self-reports on qualitative income changes, food insecure experiences, and consumption patterns could be subject to measurement error due to a likely negative perception bias because of the pandemic, especially during the onset of COVID-19, while migration intentions could be misreported due to the sensitivity of the question as there is a high emigration rate (mostly irregular) from rural areas in

[16] See Ceballos, Hernandez, & Paz (2021, 2022) for additional discussion on the closure of communities.

[17] As an additional robustness exercise, we confirmed that the observed variations in food insecurity experiences, dietary diversity scores, and intentions to emigrate persisted when using the full unbalanced panel of households. This is in line with the fact that the households that remained in the sample generally share similar observable characteristics than those that were lost along the three follow-up survey rounds.

[18] As noted earlier, in the third follow-up survey implemented in mid-2022 we included questions around the potential impacts of the Russia-Ukraine conflict and find that the conflict seems to have contributed to a significant increase in the price of agricultural inputs, especially chemical fertilizers, as well as an increase in food prices. When asked about any variations in their farming production decisions, only half of the respondents report having implemented any change (mainly using less fertilizer or cheaper ones). Additional details are available upon request.

Guatemala.[19] Yet, provided these sources of errors are not correlated with other covariates, the parameters in the corresponding regression analyses would be estimated with less precision but remain unbiased.

4. Results

This section presents the empirical results. We first present before-after comparisons on several outcome variables of interest related to incomes, food availability and prices, food security, dietary diversity, and migration intentions. Second, we examine the evolution over time of some of these outcomes across different groups of households to characterize those profiles that resulted most affected by the pandemic or took longer to recover. Third, we assess quantitative changes in incomes, expenditures, indebtedness levels, and production decisions using a subsample of households interviewed both in 2019 and late 2022, and assess heterogeneous variations across different household groups.

4.1. Before and after comparisons

Figure 2 presents self-reported qualitative changes in household income by source for the years 2020, 2021, and 2022, relative to 2019. Overall, we observe a consistent recovery in incomes by 2022, with a substantially lower share of households facing lower incomes relative to 2019 than that in previous survey rounds (despite the resulting global crisis from the Russia-Ukraine conflict). While in 2020, 61, 63, and 93 percent of households reported experiencing lower incomes from agricultural, non-agricultural, and remittances sources, respectively, compared to the pre-pandemic period, only 41, 26, and 46 percent of households report lower incomes in 2022.[20,] Still, on aggregate, 41.2 percent (520 households) report an

[19] According to statistics from the United Nations, net emigration was close to 856,000 people between 2002 and 2021 in Guatemala, equivalent to 5 percent of their current population (https://population.un.org/wpp/Download/Standard/MostUsed/, accessed on September 2023).

[20] The decrease in remittances is though not aligned with national reports that indicate that family remittances accounted for about 18% of the gross domestic product in Guatemala in 2021 (Maldonado & Harris, 2022).

unambiguous income decrease (i.e., a decrease in one or more of their three income sources but no increases) in 2022.[21]

Figure 3 reports the type of coping mechanisms that households indicating an unambiguous reduction in income have been using to deal with these income losses across survey rounds. The use of savings stands as an important coping mechanism (used by about a third of reporting households), which has remained relatively stable over the years. Selling assets and/or livestock and borrowing from formal or informal sources are also relevant mechanisms that nonetheless show a small reduction in 2022 compared to 2021, potentially indicating the approach to a point of exhaustion after 3 years of pandemic. This view is somewhat supported by the substantial increase in the percentage of households reporting doing nothing to cope with income losses (from 20-25 to 33 percent), in addition to the notable drying up of aid flows from public and private organizations (after reaching up to 23 percent of households in previous years). In this sense, the data indicate a slight shift towards costlier coping mechanisms over the years, an issue to which we return below when analyzing quantitative changes in indebtedness among a subset of households.

Next, we describe the evolution of several food security and dietary diversity indicators from 2019 to 2022. Beyond the important reductions in households' income generating capacity during the COVID-19 pandemic, numerous studies have pointed to substantial negative effects on food security and nutrition (e.g., Amare et al., 2021; Balana et al., 2023; Hammond et al., 2022; Tefera, Tadesse, & Asmare, 2022). Such effects relate both to a reduction in accessibility to food, stemming from reduced incomes and increased prices, and a decline in food availability, due to the initial halt of food value chains and transportation networks. At the same time, said difficulties affected households in different ways, increasing

[21] In terms of geographical variations, in Appendix Figure A.1 we observe that income declines were worst in the department of San Marcos, particularly in agricultural incomes and remittances, where more than seven out of ten households indicate that their income decreased (either a lot or a little) compared to 2019. Given that San Marcos is a department relatively more developed and connected to markets than the other two departments, the COVID-19 environment (as well as the global crisis triggered by the conflict in Eastern Europe) could have had a larger and more long-lasting effect on economic activities. It follows that the overall income recovery described above is mainly driven from households located in Huehuetenango and Quiche.

food insecurity among vulnerable households and affecting diets for most households, not only due to changes in food availability and accessibility but also due to potential substitution effects from changes in relative prices between food groups.

Figure 4 reports the evolution of food availability (panel A) and prices (panel B) in local markets, as reported by households, across five key food groups in Guatemalan diets: dairy products, meats, fruits and vegetables (F&V), roots and tubers, and grains and cereals. By 2022 (similarly to 2021), eight out of every ten households indicated that food availability remained the same or had increased compared to 2019 across the five food groups. This confirms the sustained post-pandemic recovery in the Guatemalan food system, where in 2020 more than nine out of every ten households indicated an overall decrease in food availability (not reported). Regarding food prices, however, most households continue to report higher prices relative to 2019 across all food groups, arguably fueled by the global food and fertilizer price increases around the pandemic and the conflict in Eastern Europe.[22] Although not reported in the interest of space, households also report higher prices for major staple foods in 2022 compared to 2021 (with oil, beans, and poultry exhibiting the highest increases).

Panel A of Table 2 presents, in turn, the prevalence of mild, moderate, and severe food insecurity episodes across survey rounds and the test results for whether the post-pandemic values are statistically different than the pre-pandemic ones. All three observed dimensions of food insecurity (mild, moderate, and severe) increased substantially following the pandemic but gradually improved over time, with 2022 levels comparable to those in 2019. In particular, the 2022 share of households reporting not eating at some point despite feeling hungry (i.e., severe food insecurity) dropped to 7 percent, down from 23 percent in the previous year and even lower than the 11 percent observed in 2019. In the case of the prevalence of moderate and mild food insecurity, these are lower than those observed in 2021 and 2020 but remain slightly higher than that in 2019. The share of households reporting eating less than they thought they should (i.e.,

[22] The average monthly price inflation in the country was 1.8 percent in mid-2020, 5.2 percent in mid-2021, and 4.7 percent in mid-2022 (Central Bank of Guatemala, https://banguat.gob.gt/es/page/inflacion, accessed on September 2023).

moderate food insecurity) decreased to 39 percent in 2022, compared to 58 percent in 2021 and 86 percent in 2020, but it is still higher than the 35 percent observed in 2019, although the difference is not statistically significant at conventional levels. The share of households reporting only eating a few kinds of foods because of a lack of resources (i.e., mild food insecurity) decreased by about 10 percentage points between 2021 and 2022, reaching 73 percent, which is still above the 58 percent observed in 2019.

Panel B of the table shows average dietary diversity scores over the same period. In this case too, dietary diversity in 2022 has improved relative to 2020 and 2021, and even when compared to 2019 for some scores. For instance, the average household dietary diversity score (HDDS) was 6.9 out of twelve possible food groups in 2022, above the 6.8 score observed in 2019 and after reaching a low of 6.5 in 2020.[23] In the case of animal source foods (ASF), households are consuming on average 1.05 out of seven possible animal source food groups (mainly eggs), a small recovery compared to 2020 and 2021 findings but still below the 1.25 score observed in 2019. The average household consumption score for fruits and vegetables (F&V) is 2.4 out of five possible food groups in 2022, higher than the pre-pandemic period (2.1 in 2019) but slightly lower than 2020 and 2021 levels.[24] The switch away from ASF to F&V diversity observed since 2020 thus persists.[25] Regarding women 15-49 years old and children 6-23 months old in the household, we find that the average dietary diversity score for women (WDDS) continued to remain around 4.5 out of nine

[23] While the average HDDS in 2022 is not statistically different to the 2019 score, when comparing the distribution of scores across years we find a higher concentration of households around the average in 2022 (i.e., consuming between 5 and 9 food groups), as opposed to 2019 where the consumption of different food groups was more dispersed (including a larger fraction of households consuming 10 and 11 food groups as well as 3 and 4 groups). See Appendix Figure A.2.

[24] In Appendix Figure A.3, we present the share of households that consumed each of the seven ASF groups (Panel A) and five F&V groups (Panel B) over the four survey rounds. We observe a recovery in the consumption across all seven ASF groups in 2022, but the share of households consuming each food group is still lower than in 2019. For fruits and vegetables, we continue to find increases in consumption among all F&V groups since the onset of COVID, except for the group of vegetables rich in vitamin A.

[25] We cannot conclude, however, whether this substitution has resulted in a higher or lower micronutrient intake as we did not collect quantities consumed during the surveys.

possible food groups during all survey rounds, in contrast to a sustained increase in the dietary diversity for children (DDS), which reached 3.9 out of seven possible food groups in 2022 (compared to 3.4 in 2019), arguably due to a prioritization of young children in the household over the past years.[26]

Finally, Panel C of the table presents the share of households reporting whether any household member intends to emigrate in the subsequent years. Interestingly, the important increase in the fraction of households reporting a member intending to emigrate observed in 2021 (9.8 percent, versus 4 percent in 2019), remains in 2022 (8.5 percent). The higher intentions to leave the country are rather revealing considering that this question is normally prone to underreporting, and they could reflect recurrent economic and financial difficulties faced by households despite the apparent improvement in several food security and nutrition indicators in 2022.

4.2. Evolution of key outcomes by groups of households

We now turn to analyze the evolution of three key outcome variables between different groups of households over the four survey waves. We are interested in assessing whether the evolution of food insecurity (moderate or severe), dietary diversity, and migration intentions followed a different pattern for different groups of households. We choose specific household groups which a priori one could expect to have been more (or less) affected by the pandemic or could have taken longer (or shorter) to recover. We

[26] Similar to the reference household member for the HDDS, the same woman 15-49 years old (in 1,017 households) was followed over the four survey rounds. A different child 6-23 months old was, however, selected during each survey round due to the narrow age range to construct the dietary indicator and the wide time span of the study, that would otherwise have constrained the number of observations for the analysis; the number of households with children 6-23 months are 225 in 2019, 168 in 2020, 168 in 2021, and 143 in 2022. The nine food groups in the WDDS include: (1) cereals, grains, roots, and tubers; (2) dark green vegetables; (3) other fruits and vegetables rich in vitamin A; (4) other fruits and vegetables; (5) organ meats; (6) meat, poultry, and fish; (7) eggs; (8) legumes, nuts, and seeds; and (9) milk and milk products. The seven food groups the children DDS include: (1) cereals, grains, roots, and tubers; (2) legumes and nuts; (3) dairy products (milk, yogurt, cheese); (4) flesh foods (meat, fish, poultry, and liver/organ meats); (5) eggs; (6) vitamin A rich fruits and vegetables; and (7) other fruits and vegetables.

accordingly divide households into two groups based on their loation (department), poverty status, and ethnicity, in addition to whether they were affected by ETA and IOTA and whether they are coffee producers.

Figure 5 shows the results of this exercise, based on the regression framework described in Equation (1) that accounts for a wide set of household controls and location fixed effects. Every data point in the plotted figures corresponds to the estimated outcome variable for each survey year and household group, all else being equal.[27] See Appendix Table A.2 for the full regression results.

In Panel A of Figure 5 we distinguish by household location. While households in the department of San Marcos were initially most affected by the pandemic compared to those in Huehuetenango and Quiche, in terms of an increase in the prevalence of food insecurity experiences and a reduction in dietary diversity, they also show a faster recovery. As mentioned above, San Marcos is overall more developed and connected to markets, which are two factors that could explain the observed pattern. Yet, households in San Marcos exhibit a considerably higher intention to emigrate over the past two years, and the gap with the other two departments has further accentuated during 2022, in line with the larger share of households reporting income decreases compared to the other two departments.

Panel B of the figure reveals that non-poor households showed a larger initial increase in the prevalence of moderate and severe food insecurity but recovered faster. A somewhat similar pattern is observed for dietary diversity, where non-poor households experienced a larger initial decrease but eventually recovered. In the case of intention to emigrate, both groups of households roughly followed a similar pattern until 2022, when the proportion of non-poor households intending to emigrate continued growing (although the change is not statistically significant compared to 2019) while the one for poor households decreased.

[27] In this framework, the 2019 reported outcome variables are equivalent to the sample averages for each household group in that year.

As noted earlier, households in the study region are regularly exposed to weather shocks, and in our working sample 43 percent of the households reported being significantly affected by ETA and IOTA tropical storms in late 2020. In Panel C, we accordingly show the evolution of our key outcomes for the group of households that reported being affected and not being affected by these storms. The tropical storms that occurred between the 2020 and 2021 survey rounds appeared to have delayed the recovery in food insecurity experiences. Similarly, households affected by ETA and IOTA show a larger decrease and a slower recovery in their dietary diversity. The intention to emigrate also remains higher (through 2022) among households affected by the tropical storms. This evidence suggests that extreme weather events not only affect households negatively when they occur, but also reduce their capacity to recover from other shocks, remarking the importance of promoting climate mitigation and adaptation strategies across vulnerable regions.

Lastly, Panels D and E of the figure depict the evolution of the three outcomes distinguishing between coffee producers and non-producers and between indigenous and non-indigenous households, respectively. We find that coffee producers were less affected by the pandemic (in line with the increase in international coffee prices over the past years) but reveal a higher intention to emigrate in recent years, which could be masking other more recent difficulties faced by them.[28] Non-coffee producers, in contrast, have taken longer to recover in terms of food security and nutrition but do not show higher emigration intentions. In terms of ethnicity, indigenous households were affected more strongly by the pandemic and exhibit a slower recovery in food insecurity and dietary diversity than non-indigenous households. We additionally explored heterogeneous variations considering other household characteristics (e.g., gender, age, education of household head, or whether a household produces fruits and vegetables or animal source foods), but we did not find major differences in this regard.[29]

[28] For the evolution of international coffee prices, see http://www.ico.org/new_historical.asp (accessed on September 2023).

[29] Results are available upon request.

4.3. Quantitative estimates

This section presents quantitative estimates for changes in incomes, expenditures, indebtedness, crop production decisions, and livestock ownership between 2019 and 2022. These estimates are based on the subsample of 777 households in our working sample who additionally participated in the fifth survey wave conducted during the end of 2022. As discussed above, these comparisons should be interpreted keeping in mind that they may include both the long-lasting effects of the pandemic and the ongoing impacts of the conflict in Eastern Europe.

Table 3 presents average values for a range of quantitative outcomes reported for 2019 and 2022 and indicates whether the difference between years is statistically significant at conventional levels. Considering the non-negligible inflation in Guatemala after the start of COVID-19, all 2022 monetary values are deflated to 2019 levels using the national consumer price index (CPI), thus allowing for a direct comparison across the two years.[30] It is worth noting that the indebtedness and crop production information for 2019 was asked through recall during the 2022 survey, so the resulting indicators could be subject to anchoring bias and should thus be interpreted with caution (see , e.g., Godlonton, Hernandez, & Murphy, 2018).[31]

Panel A of the table focuses on quantitative differences in household income and expenditures. Overall, we observe a moderate decline of almost 16 percent in the average total household income between the pre-pandemic period and late 2022. When distinguishing by source, the income derived from agricultural activities shows a similar decline to total income, while the one derived from non-agricultural activities exhibits a small but not statistically significant increase of 4 percent. Income from remittances and from transfers, donations, and other sources also show decreases of 25 and 72 percent, respectively, but these represent a much smaller fraction of the total income for the average household in our sample. Total monthly expenditures, in contrast, show a substantial increase of almost 26 percent between 2019 and

[30] Monetary outcomes for 2022 were divided by 1.18, reflecting the total change in the CPI between the date of both surveys, and are trimmed beyond the 1st and 99th percentile to account for potential outliers.

[31] All other quantitative measures were collected during both the 2019 and 2022 surveys.

2022. The expenditure categories that show the largest, statistically-significant increases include food expenses, health expenses, and other expenses (such as transportation and utilities), while education expenses is the only category that shows a decrease. Housing expenses (such as rentals and dwelling improvements) more than doubled across the two years but the change is not significant.

Panel B compares savings and debt indicators. In line with an increase in expenditures and a decrease in income, we observe increases both in the extensive and intensive debt margins. The proportion of households reporting having debt from any source increased by more than 10 percentage points between 2019 and 2022, equivalent to a 53 percent increase from the 20 percent of households that reported holding debt in 2019. Most of this increase is driven by an increase in the percentage of households reporting holding debt from formal financial institutions, with only a slight but not significant increase in the fraction of households holding debt from family or relatives, and no seeming increase in the proportion of households holding debt from informal lenders. In terms of indebtedness levels, the overall debt amount increased by more than 59 percent, again mostly driven by debt from formal financial institutions and only marginal increases in the other sources of debt elicited. Regarding savings, on aggregate, the proportion of households reporting holding savings increased from 18 percent in 2019 to 24 percent in 2022 (equivalent to a 30 percent increase). Yet, among households reporting having savings in 2019 and/or 2022 (212 households), 24 percent of them indicate that their amount of savings decreased.[32]

Panels C and D analyze changes in crop production decisions and livestock ownership, respectively, with the aim of assessing whether the pandemic pushed households to diversify or specialize their agricultural production, or shift it towards certain products which could have potentially fared better during the study period. We generally find few differences in crop portfolios between the two years, both in terms of the number of crops produced (including total and by different categories) and the proportion

[32] Indicators around savings should be interpreted with caution, since due to the high rate of extortions in Guatemala households are usually reticent to disclose whether they hold savings or whether their savings have increased or decreased. These concerns should not apply to debt indicators, which should suffer from considerably less reporting bias.

of households reporting producing a given category of crops or coffee and cardamom, the two most important cash crops cultivated in the Western Highlands. The only exceptions are a slight decrease in the fraction of households producing subsistence crops (maize and beans) and the number of subsistence crops produced, and a slight increase of 1.4 percentage points in the fraction of households producing cardamom. While statistically significant, such differences do not seem to be economically important. Noticeably, we observe a very large increase in the proportion of households reporting owning hens (with no differences in ownership of bulls and cows or pigs). This pattern could be linked to a potential diversification of income generation activities that households may have been pursuing after the pandemic, and could be related to the fact that poultry farming was encouraged by the value chains program in which almost half of our study sample participated.[33]

Finally, similar to Section 4.2, in Table 4 we assess differentiated changes in total income, expenditures, and debt levels between different groups of households, based on the regression framework described in Equation (2). In line with the findings above, we see that income decreased to a larger extent for households located in San Marcos and non-poor households. The changes in household expenditures, however, show varying patterns across groups. While expenditures increased for households in Huehuetenango and Quiche (who also exhibit a lower prevalence of income declines), expenditures in San Marcos did not change significantly. In addition, non-poor households show a decline in expenditures, in contrast to poor households, who report an increase. Coffee producers also exhibit a larger increase in expenditures than non-coffee producers, while we do not find major differences in expenditure changes among households affected or not by the ETA and IOTA tropical storms and by ethnicity.[34] Finally, we generally do not find major variations in the increase in debt levels across groups, except for location where

[33] Most of the increase in the share of households owning hens in our sample is driven by the beneficiaries of the value chains program.

[34] The indicator variable capturing whether a household was affected by the ETA and IOTA tropical storms also includes whether the household was affected by the Julia tropical storm in October 2022.

households in San Marcos did not increase their debt level in contrast to households in Huehuetenango and Quiche.

5. Conclusions

In the year following the COVID-19 outbreak, the academic literature flourished with articles analyzing the short-term effects of the COVID environment on livelihoods, food security, and nutrition across the developing world. Shortly after, however, the stream of studies came to a halt, with scant recent efforts to assess extended effects of the COVID environment and of the path to recovery. This study intends to fill this gap by providing a long-term assessment of the effects of the pandemic and the recovery process in a context of subsequent shocks, across a sample of rural households in the Western Highlands of Guatemala. We exploit a rich array of panel data collected over four survey rounds between 2019 and 2022, that allows us to depict the evolution of a range of economic, food security, and nutrition outcomes, including income variations from various sources, the prevalence of food insecurity experiences, dietary diversity, and attitudes towards migration. A subsample of the study households was additionally interviewed during a fifth survey round at the end of 2022, further allowing us to examine quantitative changes in incomes, expenditures, indebtedness levels, and production decisions. Importantly, the analysis is enriched by considering the exposure of households to additional shocks, such as the tropical storms that hit the country during the study period and the implications of the recent Russia-Ukraine conflict.

The results reveal an important recovery in incomes, food security, and dietary diversity among households in the study region, although the levels have overall not yet reached pre-pandemic ones. In particular, around one third of households still report lower incomes in 2022 compared to 2019. While food availability levels have returned to normal, prices have continued their upward trend across all food groups, in line with global food price inflation. The prevalence of severe food insecurity is lower than in 2019, but that of moderate and, in particular, mild food insecurity still remains higher than pre-pandemic levels. Dietary diversity scores have generally recovered, although the switch away from animal source foods (ASF) to a more diverse consumption of fruits and vegetables (F&V) persists since the onset of the

pandemic. The increase in migration intentions observed in 2021 continues into 2022, more than doubling 2019 levels.

The path of recovery, in turn, has not been equal for all, particularly in terms of food insecurity and dietary diversity. Households located in the department of San Marcos and who were above the poverty line in 2019 were initially more affected by the pandemic but recovered faster, while those affected by the ETA and IOTA tropical storms, non-coffee producers, and indigenous populations have taken longer to recover than their peer groups.

Quantitative estimates for a subset of households interviewed in an additional survey round indicate a 16 percent reduction in average total household income between 2019 and 2022, mostly driven by a decline in agricultural income. More worrisome, the reduction in income has been accompanied by an increase in household expenditures (26 percent) and an increase in indebtedness from formal institutions in both the extensive and intensive margin. The proportion of households reporting holding debt has increased by 10 percentage points (from a baseline of 20 percent), while the average level of debt held has overall increased by 59 percent.

All in all, we observe an important degree of recovery three years after the start of the pandemic, although this was attenuated to an extent by the additional global and local shocks faced by households. Nevertheless, the recovery trend should not serve to put policymakers' minds at rest. While food security and dietary diversity have been increasing and approaching pre-pandemic levels, incomes are still lagging, combined with higher expenditures and indebtedness. In a context of a relative drying up of public and private aid, our findings show that more focus should be put into programs targeting vulnerable groups. The increasing debt burden on study households similarly demands a closer look at the terms and conditions of loans from formal institutions (which could be including some instances of predatory lending) and points to the importance of expanding more flexible financial mechanisms. Finally, the evidence shows a slower recovery path among households affected by the ETA and IOTA tropical storms, which remarks the need of promoting climate mitigation and adaptation initiatives, especially in a setting of recurrent extreme weather events such as the Western Highlands in Guatemala. In the wake of future climate or other systemic

shocks, special attention should be paid to affected households, since these tend to be the most vulnerable households in the region and after several years of the COVID-19 pandemic and subsequent shocks face a much more exhausted portfolio of coping mechanisms.

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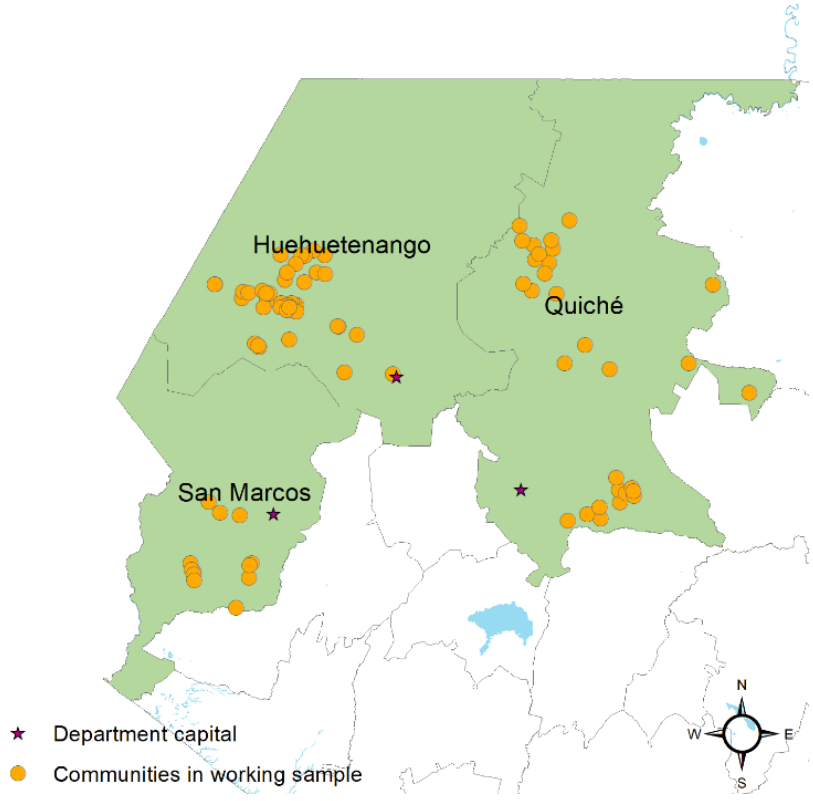
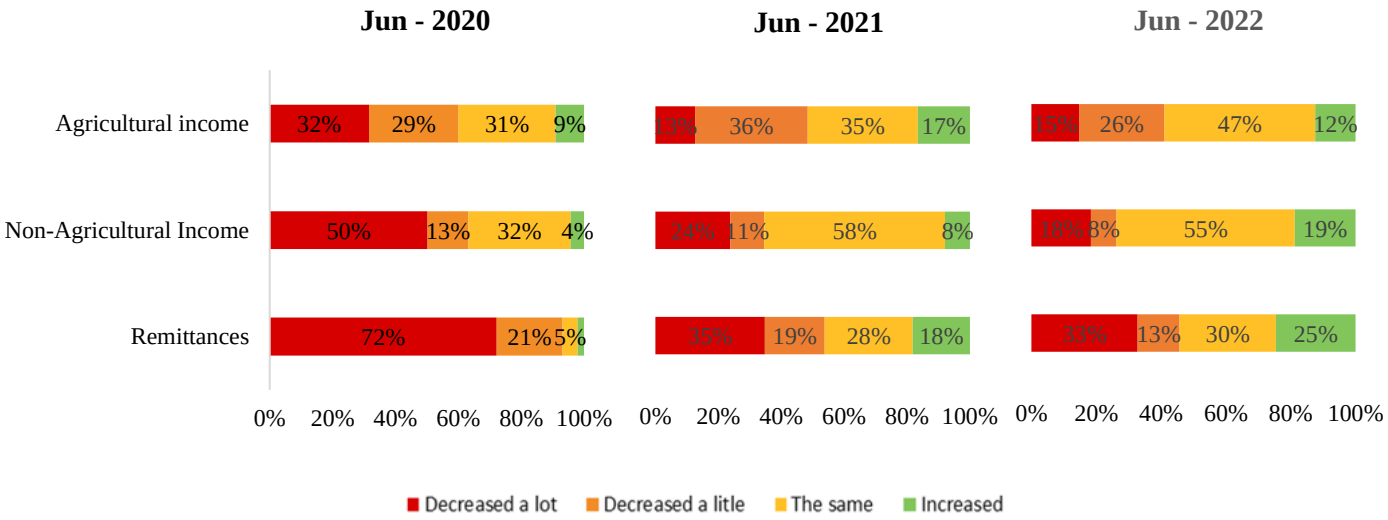
Figure 1. Households in the working sample



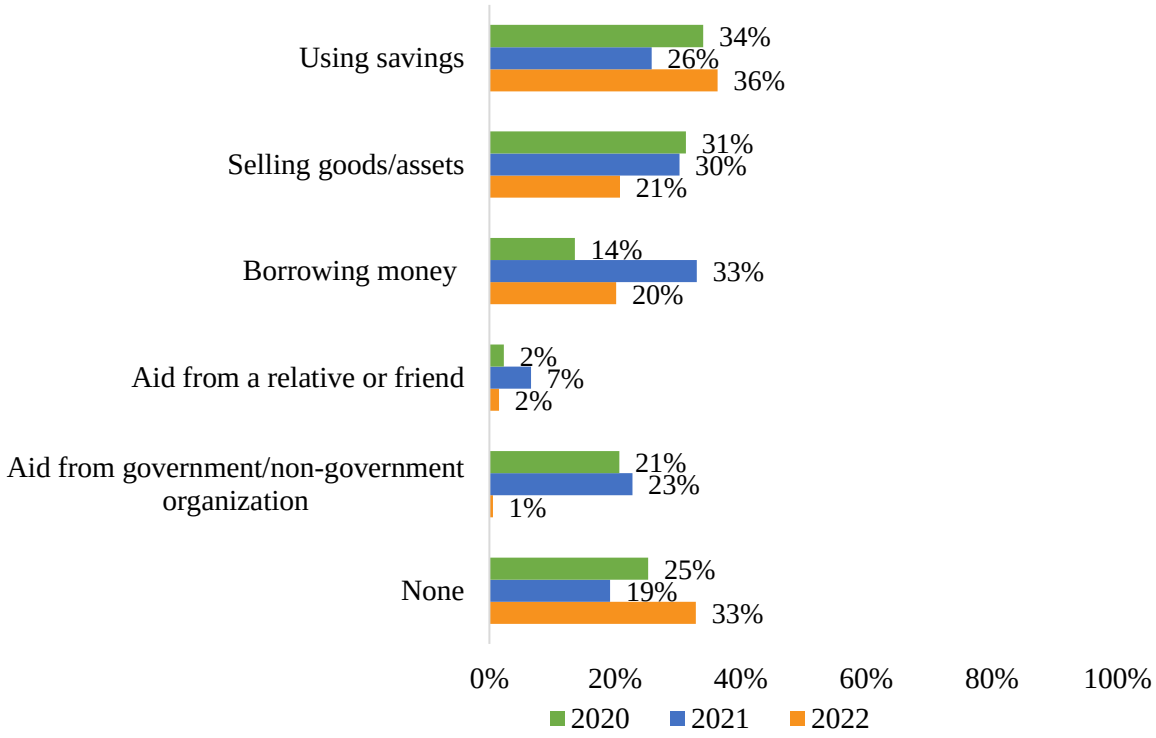
Note: This figure maps the location of all visited communities in 2019, 2020, 2021, and 2022. The location of a community is determined by taking the average coordinates across all households interviewed in it.

Figure 2. Changes in income by source (relative to 2019)



Note: This figure shows the percentage of interviewed households that reported changes in incomes in 2020, 2021, and 2022 with respect to 2019, by income source. The total number of observations is based on 1,262 interviewed households in the case of the change in agricultural and non-agricultural incomes; and on 392, 353, and 387 households, respectively, in 2020, 2021, and 2022 for households who report receiving remittances in the baseline survey and/or each corresponding follow-up survey. Answer categories in the questionnaire were symmetric, with households being able to declare that their income had increased either a lot or a little; however, these are lumped together in a single "Increased" category for clarity of exposition.

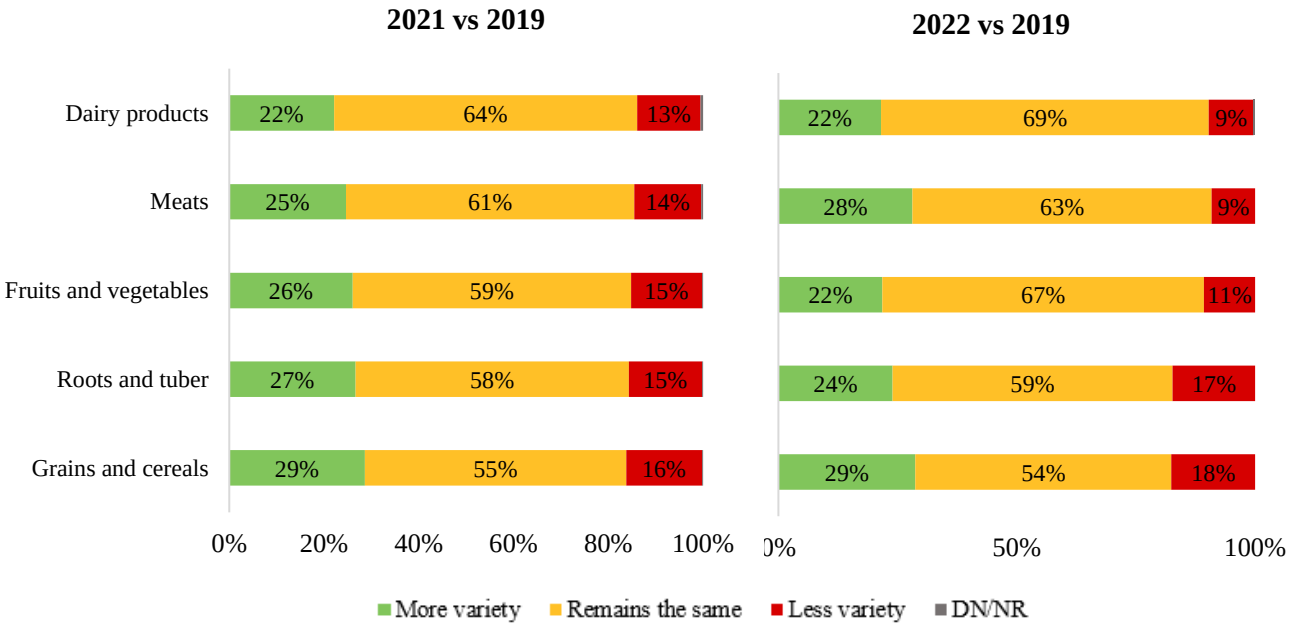
Figure 3. Coping mechanisms against income losses



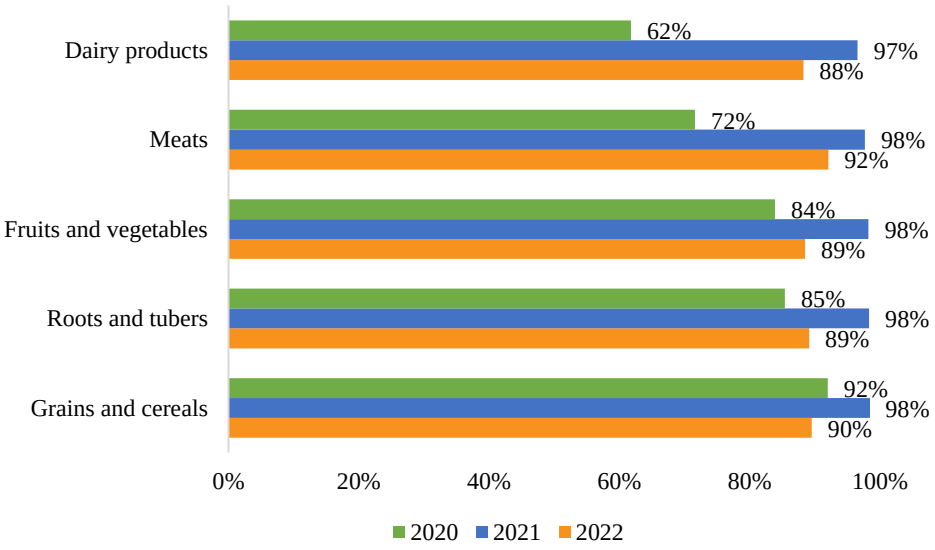
Note: This figure shows the percentage of interviewed households that reported using different coping mechanisms (multiple choice answers) when reporting an unambiguous decrease in their total household income (relative to 2019) during each follow-up survey round. The values are based on a sample of 866, 681, and 520 households that reported an unambiguous decrease in total income in, respectively, 2020, 2021, and 2022.

Figure 4. Changes in food availability and prices (relative to 2019)

Panel A. Percentage of households reporting changes in food availability



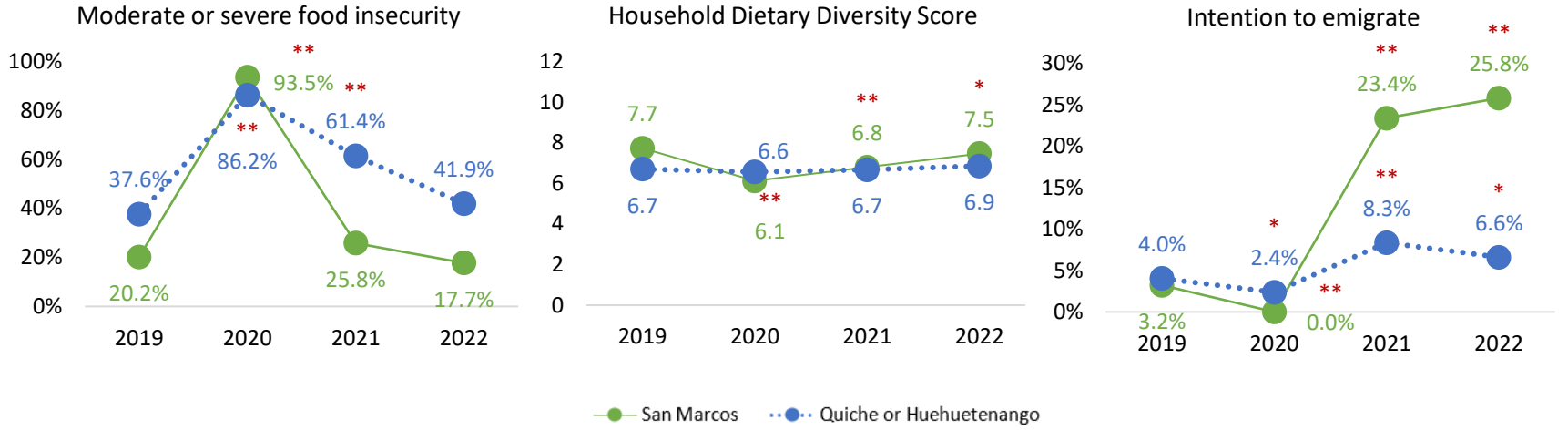
Panel B. Percentage of households reporting increases in food prices



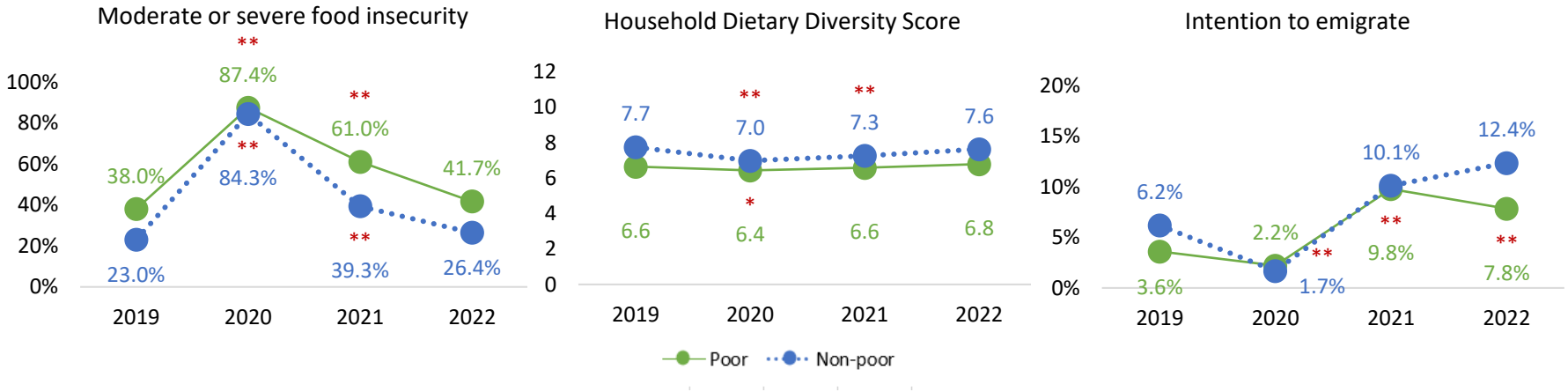
Note: Panel A shows the percentage of interviewed households that reported changes in food availability at their local market in 2021 and 2022 (relative to 2019) by food group. Panel B shows the percentage of households that reported increases in food prices at their local market in 2020, 2021, and 2022 (relative to 2019) by food group. Answer categories for the food prices question were: increased, decreased, remains the same, or don't know; however, the figure only shows the "Increased" category for clarity of exposition. The values in both panels are based on a sample of 1,262 interviewed households.

Figure 5. Food insecurity, dietary diversity, and intention to emigrate over time by household groups

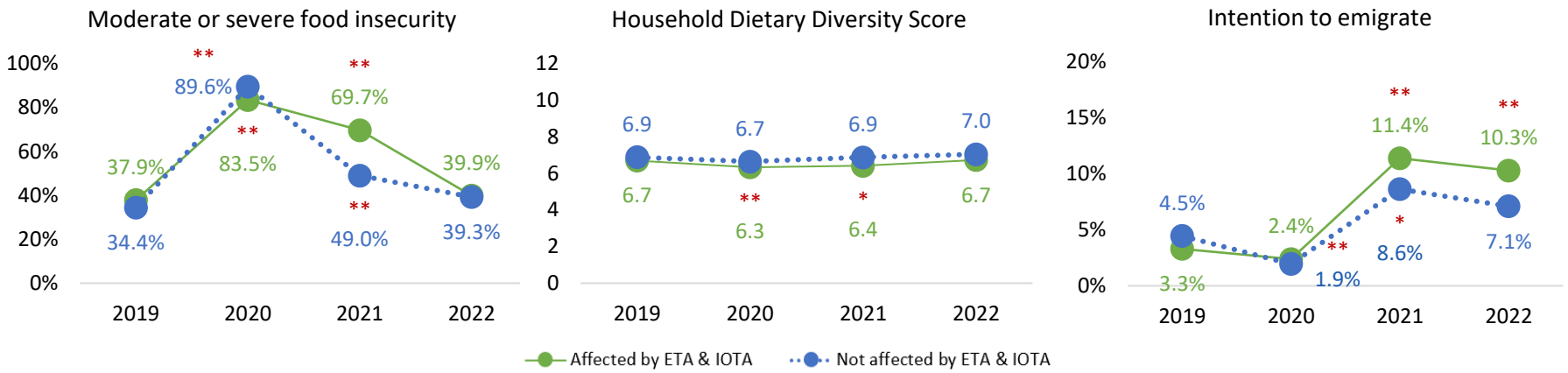
Panel A: Evolution of outcomes by location



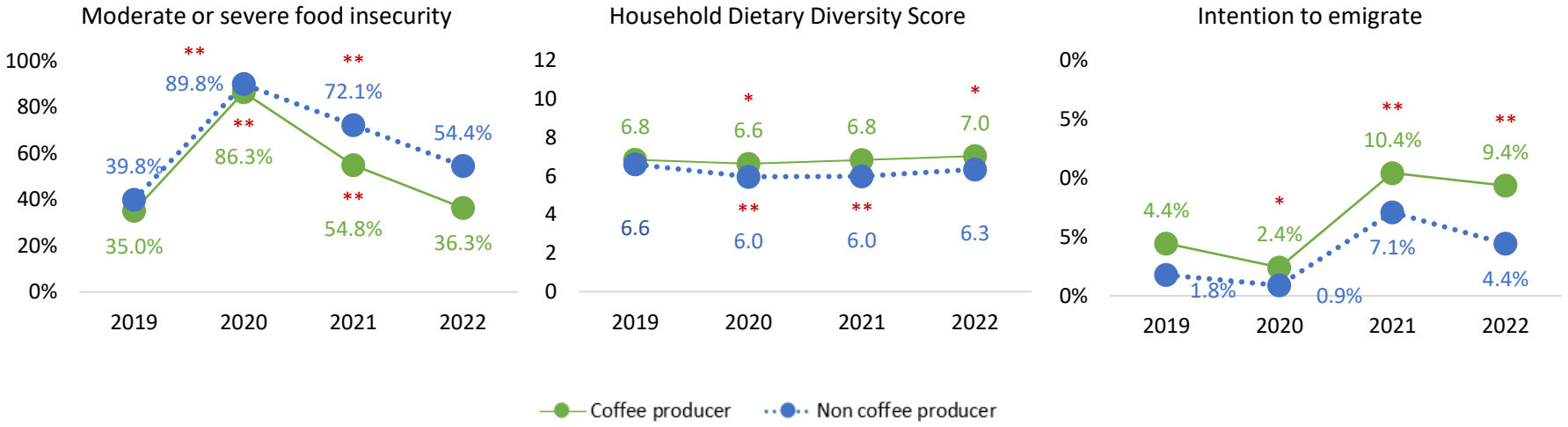
Panel B: Evolution of outcomes by poverty level



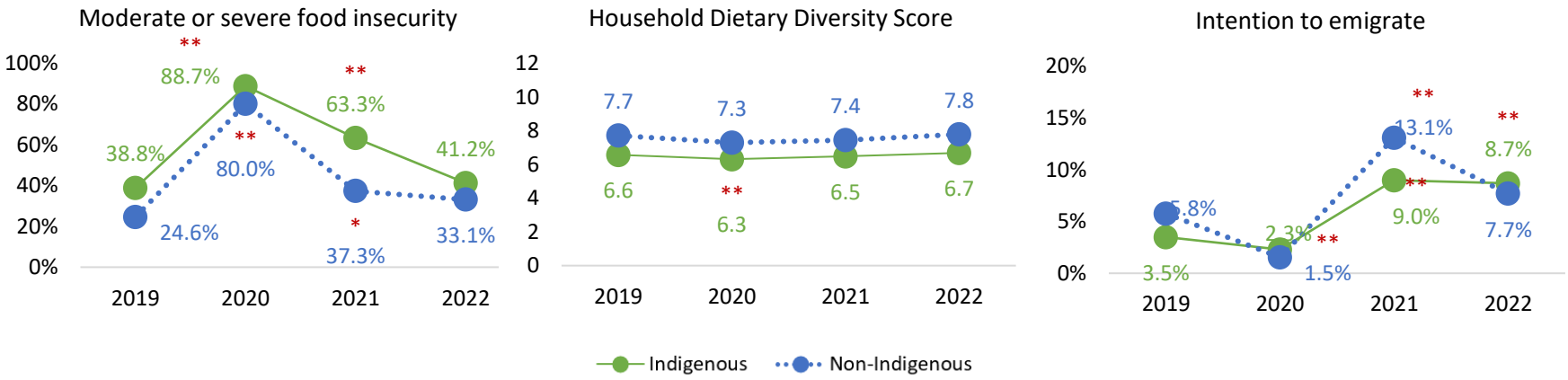
Panel C: Evolution of outcomes by exposure to tropical storms



Panel D: Evolution of outcomes by being a coffee-producer



Panel E: Evolution of outcomes by ethnicity



Note: This figure shows the evolution over time of key outcome variables for different groups of households. The sample includes 1,262 households interviewed across all four survey rounds. In Panel A, the total number of households located in San Marcos is 124 versus 1,138 in Quiche or Huehuetenango. In Panel B, the total number of poor households is 1,084 versus 178 non-poor households. In Panel C, the total number of households affected by the tropical storms ETA and IOTA is 544 versus 718 non-affected households. In Panel D, the total number of coffee producer households is 1,036 versus 226 non-coffee producer households. In Panel E, the total number of indigenous households is 1,002 versus 226 non- indigenous households. See the main text for more details about the household groups. The 2019 values reported in all figures are equivalent to the sample average for each household group in that year. The 2020, 2021 and 2022 values are obtained from generalized least squared (GLS) random effects estimations of Equation (1) for each outcome variable, accounting for a host of household socioeconomic characteristics collected during the 2019 baseline survey and community fixed effects. Asterisks indicate whether the outcome change between the 2019 baseline and each follow-up survey are statistically significant at the 95% (**) or 90% (*) levels.

Table 1. Household characteristics

Characteristics	Mean	Standard Deviation	Min.	Max.
Panel A: Household characteristics at baseline (2019)				
Household head is male	0.849	0.358	0.000	1.000
Household head age (in years)	48.034	13.428	16.000	94.000
Household head has no education	0.369	0.483	0.000	1.000
Household head did not complete elementary education	0.299	0.458	0.000	1.000
Household head completed elementary education or higher	0.332	0.471	0.000	1.000
Household head main spoken language is Spanish	0.288	0.453	0.000	1.000
Household size	5.884	2.708	1.000	18.000
Household is beneficiary of social school program	0.265	0.442	0.000	1.000
Dwelling has finished walls	0.457	0.498	0.000	1.000
Dwelling has finished ceiling	0.138	0.345	0.000	1.000
Dwelling has finished floors	0.539	0.499	0.000	1.000
Dwelling is connected to electricity	0.840	0.367	0.000	1.000
Dwelling is connected to water network	0.851	0.356	0.000	1.000
Dwelling is connected to drainage network	0.313	0.464	0.000	1.000
Cooking fuel of household is electricity or gas	0.032	0.177	0.000	1.000
Daily per capita expenditures (in Quetzales)	11.254	12.325	0.167	108.972
Household owns a TV or radio	0.728	0.445	0.000	1.000
Household owns a vehicle	0.243	0.429	0.000	1.000
Household owns livestock	0.595	0.491	0.000	1.000
Agricultural land size (in hectares)	0.907	1.339	0.007	21.840
Agricultural land has irrigation system	0.147	0.354	0.000	1.000
Coffee is among main crops produced	0.821	0.384	0.000	1.000
Cardamom is among main crops produced	0.119	0.324	0.000	1.000
Corn is among main crops produced	0.471	0.499	0.000	1.000
Beans is among main crops produced	0.176	0.381	0.000	1.000
Household had an internal migrant in the last 3 years	0.040	0.197	0.000	1.000
Household is located in Huehuetenango	0.582	0.493	0.000	1.000
Household is located in Quiche	0.320	0.467	0.000	1.000
Household is located in San Marcos	0.098	0.298	0.000	1.000
Panel B: Weather shocks and COVID-19 exposure				
Household affected by tropical storms ETA and IOTA in 2020	0.431	0.495	0.000	1.000
Household affected by weather event over 12 months prior to 2022 survey	0.601	0.490	0.000	1.000
Someone in household infected with COVID-19 as of 2022	0.089	0.284	0.000	1.000
Someone in the community infected with COVID-19 as of 2022	0.353	0.478	0.000	1.000
Number of observations				1,262

Note: This table shows summary statistics of different household characteristics collected during the baseline survey in 2019 (Panel A) and of household reports indicating exposure to weather shocks and COVID-19 (Panel B) for the full study sample. The indicator for a household being affected by the tropical storms ETA and IOTA is based on household reports from the 2021 follow-up survey. Indicators for COVID-19 exposition (infection) are based on household reports from the 2021 and 2022 follow-up surveys.

Table 2. Food insecurity, dietary diversity, and intention to emigrate over time

	(1)	(2)	(3)	(4)
Indicator	**2019**	**2020**	**2021**	**2022**
Panel A: Prevalence of food insecurity				
Mild food insecurity	0.577	0.899***	0.830***	0.732***
	(0.494)	(0.301)	(0.375)	(0.443)
Moderate food insecurity	0.349	0.865***	0.579***	0.392
	(0.477)	(0.342)	(0.494)	(0.488)
Severe food insecurity	0.113	0.212***	0.231***	0.074**
	(0.317)	(0.409)	(0.422)	(0.263)
Panel B: Dietary diversity indicators				
Household Dietary Diversity Score (HDDS), scale 0-12	6.803	6.513**	6.677	6.910
	(1.854)	(1.602)	(1.578)	(1.560)
Animal Source Food (ASF) score, scale 0-7	1.255	0.833***	0.872***	1.048***
	(1.023)	(0.789)	(0.849)	(0.926)
Fruits and Vegetables (F&V) score, scale 0-5	2.136	2.496***	2.482***	2.395**
	(1.442)	(1.340)	(1.418)	(1.336)
Women Dietary Diversity Score (WDDS), scale 0-9	4.503	4.510	4.591	4.546
	(1.430)	(1.253)	(1.271)	(1.271)
Children Dietary Diversity Score (DDS), scale 0-7	3.378	3.863***	3.554	3.930***
	(1.632)	(1.233)	(1.467)	(1.226)
Panel C: Intention to emigrate				
Intention to emigrate over subsequent three years	0.040	0.021**	0.098***	0.085***
	(0.195)	(0.145)	(0.298)	(0.279)

Note: This table reports the average and standard deviation (in parentheses) of different outcome variables of interest over the four survey rounds. Asterisks in columns (2), (3), and (4) indicate the statistical significance of tests of equality of means between baseline (2019) and each follow-up survey, based on estimations of Probit regressions (for outcome variables in Panel A and C) and OLS regressions (for outcome variables in Panel B), with standard errors clustered by community. The prevalence of food insecurity reported in Panel A corresponds to situations experienced over the months prior to each survey round and are part of the eight Food Insecurity Experience Scale (FIES) items proposed by Ballard et al. (2013). See the main text for the food groups comprised in each dietary diversity score reported in Panel B. Panel C reports whether a household member has the intention to migrate out of the country over the next three years. All reported indicators are based on 1,262 households surveyed in the four rounds, except for WDDS and children DDS. The number of surveyed households with women is 1,017 for the four rounds; the number of households with children is 225 in 2019, 168 in 2020,168 in 2021, and 143 in 2022. ***, **, and * denote statistical significance at, respectively, the 99%, 95%, and 90% levels.

Table 3. Quantitative changes in income, expenditures, indebtedness, crop production decisions, and livestock owernship between 2019 and 2022

	(1)	(2)	
Indicator	**2019**	**2022**	
Panel A: Monthly income and expenditures			
Total income (in 2019 Quetzales)	3,068.789	2,564.368	***
	(3,452.328)	(3,203.572)	
Agricultural income (in 2019 Quetzales)	1,542.244	1,271.855	**
	(1,998.749)	(2,155.379)	
Non-agricultural income (in 2019 Quetzales)	766.168	793.489	
	(1,510.047)	(1,588.172)	
Income from remittances (in 2019 Quetzales)	609.184	456.013	
	(1,882.374)	(1,328.379)	
Income from transfers, donations, and other sources (in 2019 Quetzales)	151.193	43.011	***
	(688.670)	(267.897)	
Total expenditures (in 2019 Quetzales)	1,543.316	1,937.097	***
	(1,201.197)	(1,788.483)	
Food expenses (in 2019 Quetzales)	624.315	719.612	***
	(508.358)	(536.826)	
Housing expenses (in 2019 Quetzales)	52.646	110.616	
	(212.923)	(734.462)	
Consumer goods and durables expenses (in 2019 Quetzales)	166.487	199.880	*
	(242.262)	(459.699)	
Education expenses (in 2019 Quetzales)	48.187	30.299	*
	(126.012)	(196.245)	
Health expenses (in 2019 Quetzales)	97.290	143.937	**
	(177.582)	(504.547)	
Other expenses (in 2019 Quetzales)	554.392	732.754	***
	(614.193)	(914.164)	

(Cont.)

	(1)	(2)	
Indicator	**2019**	**2022**	
Panel B: Savings and debts			
Holds savings	0.181	0.237	***
	(0.386)	(0.425)	
Holds debt	0.196	0.299	***
	(0.397)	(0.458)	
Holds debt from formal financial institutions	0.149	0.223	***
	(0.357)	(0.416)	
Holds debt from informal lenders	0.010	0.010	
	(0.101)	(0.101)	
Holds debt from friends and/or relatives	0.048	0.079	
	(0.213)	(0.269)	
Total debt (in 2019 Quetzales)	4,067.638	6,460.247	***
	(14,945.935)	(18,396.063)	
Debt from formal financial institutions (in 2019 Quetzales)	3,294.353	5,314.831	***
	(14,161.076)	(17,055.918)	
Debt from informal lenders (in 2019 Quetzales)	152.042	275.187	
	(1,869.903)	(3,912.808)	
Debt from friends and/or relatives (in 2019 Quetzales)	621.244	870.229	**
	(4,658.907)	(6,477.964)	
Total debt (in 2019 Quetzales), conditional on reporting debt in 2019 and/or 2022	11,800.791	18,742.084	***
	(23,623.609)	(27,444.121)	

(Cont.)

	(1)	(2)	
Indicator	**2019**	**2022**	
Panel C: Crop production			
Number of crops produced	2.077	2.023	
	(1.232)	(1.197)	
Number of subsistence crops produced	0.830	0.782	**
	(0.836)	(0.837)	
Number of other grains and tubers produced	0.022	0.026	
	(0.147)	(0.159)	
Number of fruits and vegetables produced	0.306	0.287	
	(0.799)	(0.722)	
Produces subsistence crops	0.551	0.517	**
	(0.498)	(0.500)	
Produces coffee	0.739	0.741	
	(0.439)	(0.439)	
Produces cardamon	0.144	0.158	**
	(0.351)	(0.365)	
Produces other grains and tubers	0.022	0.026	
	(0.147)	(0.159)	
Produces fruits & vegetables	0.176	0.185	
	(0.381)	(0.389)	
Panel D: Livestock ownership			
Owns bulls/cows	0.073	0.076	
	(0.261)	(0.265)	
Owns hens	0.521	0.767	***
	(0.500)	(0.423)	
Owns pigs	0.225	0.268	
	(0.418)	(0.443)	

Note: This table reports the average and standard deviation (in parentheses) of different outcome variables of interest in 2019 and 2022. Monetary values (i.e., incomes, expenditures, and debts) reported for year 2022 are adjusted to 2019 prices using the national Consumer Price Index (CPI). Income and expenditures reported include both monetary and non-monetary values. Monthly total expenditures correspond to the aggregation of food, housing (e.g., housing or land rental, dwelling construction, expansion and improvements), consumer goods and durables (e.g., clothing, home furnishing, household assets), education (e.g., tuition and fees, books, school supplies, uniforms), health (e.g., medicines, health exams, hospitalizations), and other expenses (e.g., communication, transportation, utilities, household and personal services, miscellaneous) reported by the household. Subsistence crops include maize and beans. Indicators in Panel B and Panel C are based on 2019 recall data (reported in 2022) and 2022 concurrent data. Monetary indicators are trimmed beyond the 1st and 99th percentile to account for potential outliers. Asterisks indicate the statistical significance of tests of equality of means between baseline (2019) and the fifth survey wave (December 2022), derived from estimations of Probit regressions (for dichotomic outcome variables) and OLS regressions (for amounts and/or numeric outcome variables), with standard errors clustered by community. All reported indicators are based on 777 households surveyed across the five survey rounds, except for the conditional total debt indicator that is based on 263 households reporting debt in 2019 and/or 2022. ***, **, and * denote statistical significance at, respectively, the 99%, 95% and 90% levels.

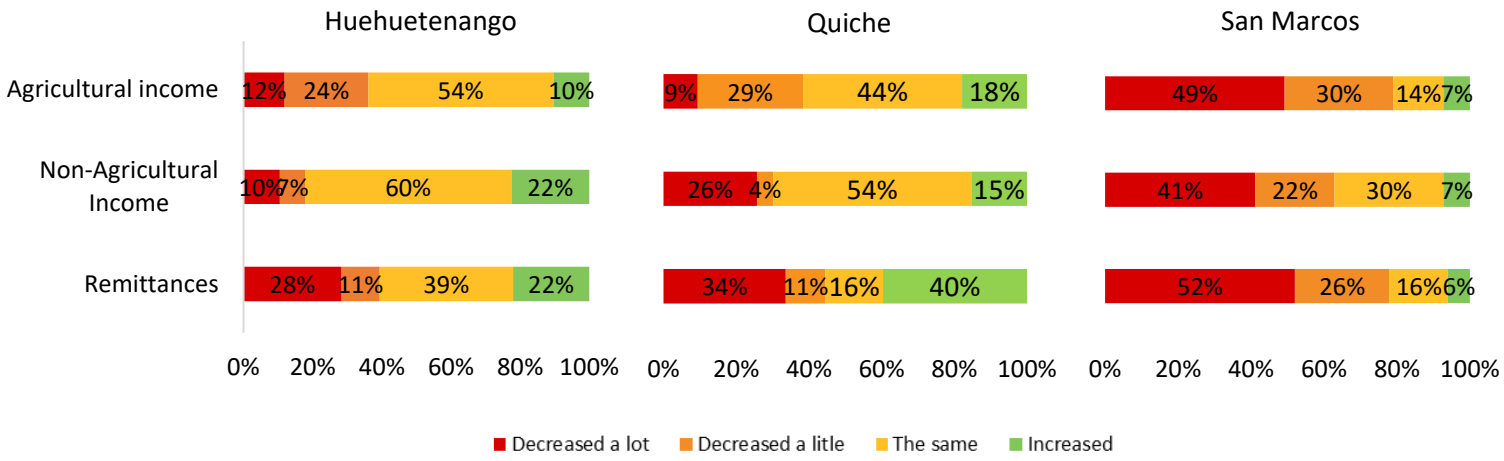
Table 4. Income, expenditure, and debt by household groups

Coefficients	Household group:				
	(1)	(2)	(3)	(4)	(5)
	San Marcos department	Poor	Affected by tropical storms	Coffee producer	Indigenous
	Panel A: Monthly total income				
2022 survey round	-0.141	-0.526***	-0.200	-0.288**	-0.286***
	(0.090)	(0.115)	(0.123)	(0.129)	(0.078)
Household group indicator		-0.380***	0.097	-0.101	-0.028
		(0.128)	(0.098)	(0.200)	(0.134)
Group indicator x 2022 survey round	-0.418***	0.379***	0.000	0.112	0.115
	(0.140)	(0.129)	(0.123)	(0.149)	(0.123)
Overall R-squared	0.230	0.224	0.227	0.227	0.227
Number of observations	1,524	1,524	1,524	1,524	1,524
Number of households	762	762	762	762	762
	Panel B: Monthly total expenditures				
2022 survey round	0.227***	-0.286***	0.210***	0.019	0.152**
	(0.040)	(0.083)	(0.059)	(0.057)	(0.075)
Household group indicator		-0.799***	0.064*	-0.080	-0.084
		(0.063)	(0.039)	(0.084)	(0.067)
Group indicator x 2022 survey round	-0.198**	0.557***	-0.018	0.226***	0.063
	(0.093)	(0.085)	(0.066)	(0.066)	(0.083)
Overall R-squared	0.482	0.411	0.480	0.483	0.480
Number of observations	1,526	1,526	1,526	1,526	1,526
Number of households	763	763	763	763	763
	Panel C: Total debt holdings				
2022 survey round	1.026***	0.544	0.610*	1.292***	0.573
	(0.233)	(0.495)	(0.315)	(0.474)	(0.373)
Household group indicator		-1.286**	0.151	0.384	-0.146
		(0.505)	(0.343)	(0.637)	(0.404)
Group indicator x 2022 survey round	-0.999***	0.400	0.497	-0.506	0.423
	(0.357)	(0.513)	(0.349)	(0.515)	(0.422)
Overall R-squared	0.273	0.276	0.274	0.272	0.272
Number of observations	1,526	1,526	1,526	1,526	1,526
Number of households	763	763	763	763	763
Household characteristics	Yes	Yes	Yes	Yes	Yes
Community fixed effects	Yes	Yes	Yes	Yes	Yes

Note: This table reports generalized least squared (GLS) random effects estimation following Equation (2) for the dependent (outcome) variable indicated in each panel. Outcome variables are converted to 2019 Quetzales and are expressed in natural logarithms (Ln) except for outcome variables equal to zero that are set to zero. Monthly total income and expenditures include both monetary and non-monetary components. The household group indicator is a dummy variable that varies across columns to identify household's location (column (1)); poor households (column (2)); households affected by tropical storms Eta, Iota, and/or Julia (column (3)); coffee-producer households (column (4)); and indigenous households (column (5)). See the main text for a detailed description of the dependent variables and the household groups in each column. For a few cases where household baseline characteristics were missing, we imputed the median value at the municipality level, and included a dummy variable capturing whether that observation is imputed or not. Robust standard errors clustered by community are reported in parentheses. ***, **, and ** denote statistical significance at, respectively, the 99%, 95%, and 90% levels.

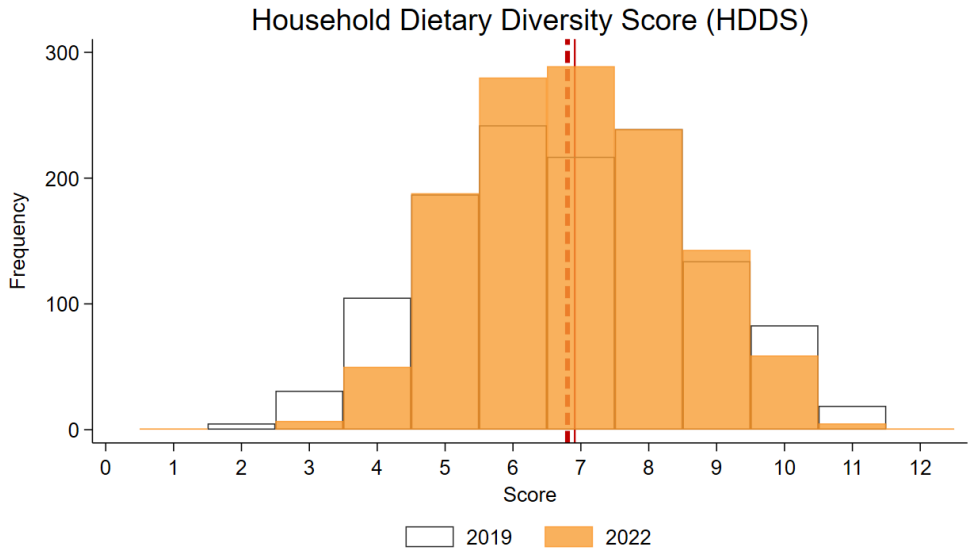
Appendix. Supplementary Figures and Tables

Figure A.1. Changes in income between 2019 and 2022 by source and department



Note: This figure shows the percentage of interviewed households that reported income changes between 2019 and 2022, by source and department. The number of observations is 734 in Huehuetenango, 404 in Quiche, and 124 in San Marcos in the case of the change in agricultural and non-agricultural incomes. The change in remittances is based on a sample of 236, 101, and 50 households that reported receiving remittances at baseline and/or the 2022 survey round in, respectively, Huehuetenango, Quiche, and San Marcos. Answer categories in the questionnaire were symmetric, with households being able to declare that their income had increased either a lot or a little; however, these are lumped together in a single "Increased" category for clarity of exposition.

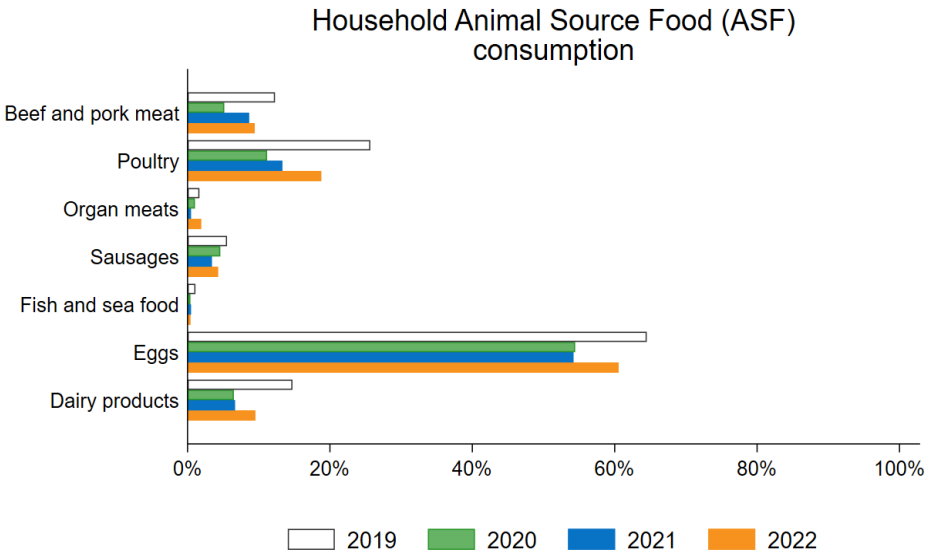
Figure A.2. Distribution of the household dietary diversity score in 2019 and 2022



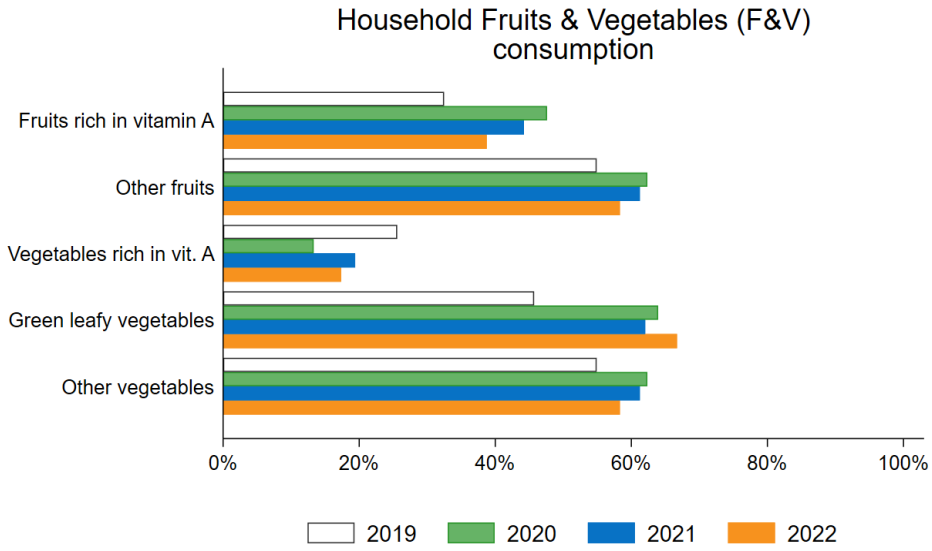
Note: This figure shows the distribution of the household dietary diversity score (HDDS) in 2019 and 2022 for the 1,262 surveyed households. The white histogram bars correspond to 2019 and the orange bars to 2022. The vertical dotted red line on the figure indicates the average score in 2019 while the solid red line indicates the average score in 2022. The HDDS measures the number of food groups (up to twelve) that a reference member of the household consumed over the 24 hours prior to each survey. See the main text for the groups comprised in the score.

Figure A.3. Household consumption of animal source foods and fruits & vegetables

Panel A: Animal Source Food (ASF) consumption



Panel B: Fruits & Vegetables (F&V) consumption



Note: This figure shows the percentage of households reporting having consumed the corresponding animal source food (ASF) groups in Panel A and fruits and vegetables (F&V) groups in Panel B over the 24 hours prior to each survey. The white bars correspond to 2019, the green bars to 2020, the blue bars to 2021, and the orange bars to 2022. The values in both panels are based on the full sample of 1,262 households.

Table A.1. Orthogonality tests between households surveyed at baseline, across the four survey waves, and across the five survey waves

Characteristics at baseline (2019)	(1) Households surveyed at baseline	(2) Households surveyed across four survey waves	(3) Households surveyed across five survey waves	(4) p-value (1) vs (2)	(5) p-value (2) vs (3)	(6) p-value (1) vs (3)
Household head is male	0.830	0.849	0.858	0.005	0.252	0.015
	(0.012)	(0.012)	(0.014)			
Household head age (in years)	47.591	48.065	49.233	0.158	0.024	0.005
	(0.727)	(0.725)	(0.797)			
Household head has no education	0.357	0.369	0.393	0.254	0.119	0.065
	(0.021)	(0.023)	(0.028)			
Household head did not complete elementary education	0.312	0.299	0.308	0.189	0.468	0.781
	(0.019)	(0.019)	(0.026)			
Household head completed elementary education or higher	0.331	0.332	0.300	0.917	0.043	0.087
	(0.018)	(0.021)	(0.026)			
Household head main spoken language is Spanish	0.303	0.288	0.355	0.399	0.013	0.095
	(0.053)	(0.050)	(0.062)			
Household size	5.772	5.887	5.932	0.037	0.504	0.075
	(0.113)	(0.130)	(0.152)			
Household is beneficiary of social school program	0.275	0.266	0.225	0.269	0.016	0.001
	(0.018)	(0.021)	(0.022)			
Dwelling has finished walls	0.467	0.457	0.477	0.485	0.326	0.685
	(0.035)	(0.033)	(0.039)			
Dwelling has finished ceiling	0.141	0.138	0.147	0.740	0.375	0.689
	(0.016)	(0.018)	(0.022)			
Dwelling has finished floors	0.546	0.540	0.583	0.649	0.053	0.149
	(0.037)	(0.033)	(0.036)			
Dwelling is connected to electricity	0.831	0.841	0.861	0.589	0.264	0.161
	(0.050)	(0.040)	(0.047)			
Dwelling is connected to water network	0.852	0.851	0.855	0.918	0.890	0.919
	(0.029)	(0.034)	(0.036)			
Dwelling is connected to drainage network	0.302	0.313	0.332	0.385	0.382	0.255
	(0.043)	(0.045)	(0.053)			
Cooking fuel of household is electricity or gas	0.033	0.032	0.033	0.958	0.830	0.894
	(0.005)	(0.007)	(0.008)			
Daily per capita expenditures (in Quetzales)	11.594	11.263	11.248	0.229	0.970	0.470
	(0.671)	(0.743)	(0.855)			

(Cont.)

Characteristics at baseline (2019)	Households surveyed at baseline	Households surveyed across four survey waves	Households surveyed across five survey waves	p-value (1) vs (2)	p-value (2) vs (3)	p-value (1) vs (3)
Household owns a TV or radio	0.741	0.729	0.750	0.271	0.326	0.634
	(0.023)	(0.028)	(0.025)			
Household owns a vehicle	0.238	0.244	0.275	0.544	0.049	0.067
	(0.024)	(0.028)	(0.033)			
Household owns livestock	0.568	0.596	0.574	0.045	0.222	0.799
	(0.034)	(0.033)	(0.040)			
Agricultural land size (in hectares)	0.943	0.908	0.949	0.420	0.391	0.922
	(0.097)	(0.080)	(0.082)			
Agricultural land has irrigation system	0.141	0.147	0.154	0.505	0.579	0.472
	(0.021)	(0.023)	(0.027)			
Coffee is among main crops produced	0.780	0.822	0.797	0.038	0.189	0.573
	(0.053)	(0.042)	(0.052)			
Cardamom is among main crops produced	0.141	0.119	0.144	0.212	0.099	0.906
	(0.056)	(0.044)	(0.051)			
Corn is among main crops produced	0.479	0.471	0.466	0.577	0.795	0.606
	(0.042)	(0.040)	(0.049)			
Beans is among main crops produced	0.177	0.176	0.190	0.912	0.166	0.402
	(0.024)	(0.022)	(0.027)			
Household had an internal migrant in the last 3 years	0.038	0.040	0.033	0.466	0.180	0.473
	(0.006)	(0.007)	(0.008)			
Number of observations	2,142	1,262	777			

Note: This table reports the results of orthogonality (balance) tests of baseline characteristics between households included in the baseline sample (2,142 households interviewed in 2019), households included in the final working sample (1,262 households interviewed at baseline and in all the three-follow-up surveys), and households included in the five survey rounds (777 households interviewed at baseline, in all the three-follow-up surveys, and at endline). Columns (1), (2), and (3) report the corresponding averages and, in parentheses, standard errors clustered by community. The p-values reported in column (4), (5), and (6) relate to the orthogonality test between both indicated groups of households. A value larger than 0.05, e.g., indicates that the difference in means between the two compared groups is not statistically significant at a 95% confidence level.

Table A.2. Food insecurity, dietary diversity, and intention to emigrate over time by household groups – Full regression results

Coefficients	Panel A: Moderate or severe food insecurity				
	Household group:				
	(1)	(2)	(3)	(4)	(5)
	San Marcos department	Poor	Affected by tropical storms	Coffee producer	Indigenous
2020 survey round	0.486***	0.612***	0.552***	0.500***	0.554***
	(0.030)	(0.062)	(0.027)	(0.054)	(0.058)
2021 survey round	0.238***	0.163**	0.146**	0.323***	0.127*
	(0.059)	(0.067)	(0.069)	(0.066)	(0.066)
2022 survey round	0.043	0.034	0.049	0.146	0.085
	(0.056)	(0.057)	(0.068)	(0.093)	(0.079)
Household group indicator		0.024	0.016	0.035	-0.049
		(0.046)	(0.046)	(0.060)	(0.052)
Group indicator x 2020 survey round	0.248***	-0.119*	-0.096*	0.013	-0.055
	(0.053)	(0.063)	(0.052)	(0.061)	(0.066)
Group indicator x 2021 survey round	-0.182**	0.067	0.172**	-0.125	0.118
	(0.072)	(0.065)	(0.070)	(0.078)	(0.086)
Group indicator x 2022 survey round	-0.067	0.003	-0.029	-0.133	-0.061
	(0.069)	(0.058)	(0.075)	(0.096)	(0.095)
Household head is male	-0.005	-0.004	-0.007	-0.005	-0.004
	(0.016)	(0.016)	(0.016)	(0.016)	(0.016)
Household head age (in years)	0.001	0.001	0.001	0.001	0.001
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Household head did not complete elementary education	-0.008	-0.009	-0.008	-0.008	-0.008
	(0.013)	(0.013)	(0.012)	(0.013)	(0.013)
Household head completed elementary education or higher	0.000	-0.002	0.001	0.000	-0.001
	(0.016)	(0.016)	(0.016)	(0.016)	(0.016)
Household head main spoken language is Spanish	-0.011	-0.012	-0.009	-0.011	-0.031
	(0.022)	(0.023)	(0.023)	(0.022)	(0.022)
Household size	0.001	0.002	0.001	0.001	0.001
	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)
Household is beneficiary of social school program	0.006	0.007	0.007	0.006	0.005
	(0.012)	(0.012)	(0.012)	(0.012)	(0.012)
Dwelling has finished walls	-0.007	-0.008	-0.006	-0.007	-0.007
	(0.016)	(0.016)	(0.016)	(0.016)	(0.016)
Dwelling has finished ceiling	-0.053***	-0.054***	-0.054***	-0.053***	-0.053***
	(0.018)	(0.018)	(0.017)	(0.018)	(0.018)
Dwelling has finished floors	-0.009	-0.010	-0.009	-0.009	-0.009
	(0.018)	(0.018)	(0.017)	(0.018)	(0.017)
Dwelling is connected to electricity	-0.032	-0.032	-0.033	-0.032	-0.030
	(0.026)	(0.026)	(0.026)	(0.026)	(0.026)
Dwelling is connected to water network	0.016	0.016	0.015	0.016	0.017
	(0.021)	(0.021)	(0.021)	(0.021)	(0.021)

(Cont.)

Coefficients	Panel A (cont.): Dependent variable: Moderate or severe food insecurity				
	Household group:				
	(1)	(2)	(3)	(4)	(5)
	San Marcos department	Poor	Affected by tropical storms	Coffee producer	Indigenous
Dwelling is connected to drainage network	-0.019	-0.020	-0.021	-0.019	-0.017
	(0.015)	(0.016)	(0.016)	(0.015)	(0.015)
Cooking fuel of household is electricity or gas	-0.072**	-0.073**	-0.071**	-0.072**	-0.075**
	(0.032)	(0.032)	(0.032)	(0.032)	(0.032)
Tercile 2 of Daily per capita expenditures	-0.015		-0.015	-0.015	-0.015
	(0.014)		(0.014)	(0.014)	(0.015)
Tercile 3 of Daily per capita expenditures	-0.029		-0.030	-0.029	-0.031
	(0.020)		(0.019)	(0.020)	(0.020)
Household owns a TV or radio	-0.014	-0.016	-0.014	-0.014	-0.014
	(0.017)	(0.016)	(0.017)	(0.017)	(0.017)
Household owns a vehicle	-0.041**	-0.044**	-0.040**	-0.041**	-0.043**
	(0.019)	(0.018)	(0.019)	(0.019)	(0.019)
Household owns livestock	0.014	0.014	0.015	0.014	0.012
	(0.013)	(0.013)	(0.014)	(0.013)	(0.013)
Agricultural land size (in natural logarithms)	-0.023***	-0.023***	-0.024***	-0.023***	-0.023***
	(0.006)	(0.006)	(0.006)	(0.006)	(0.006)
Agricultural land has irrigation system	-0.020	-0.021	-0.020	-0.020	-0.020
	(0.020)	(0.019)	(0.020)	(0.020)	(0.019)
Coffee is among main crops produced	-0.026	-0.025	-0.026		-0.024
	(0.027)	(0.027)	(0.027)		(0.027)
Cardamom is among main crops produced	-0.016	-0.017	-0.013	-0.016	-0.016
	(0.018)	(0.018)	(0.018)	(0.018)	(0.018)
Corn is among main crops produced	0.031**	0.032**	0.031**	0.031**	0.033**
	(0.014)	(0.014)	(0.014)	(0.014)	(0.013)
Beans is among main crops produced	0.028	0.027	0.027	0.028	0.027
	(0.018)	(0.018)	(0.018)	(0.018)	(0.018)
Household had an internal migrant in the last 3 years	0.015	0.017	0.016	0.015	0.015
	(0.028)	(0.028)	(0.028)	(0.028)	(0.028)
Community fixed effects	Yes	Yes	Yes	Yes	Yes
Overall R-squared	0.313	0.306	0.314	0.306	0.308
Number of observations	5,048	5,048	5,048	5,048	5,048
Number of households	1,262	1,262	1,262	1,262	1,262

(Cont.)

Coefficients	Panel B: Dependent variable: Household Dietary Diversity Score (scale 0-12)				
	Household group:				
	(1)	(2)	(3)	(4)	(5)
	San Marcos department	Poor	Affected by tropical storms	Coffee producer	Indigenous
2020 survey round	-0.147	-0.764***	-0.233	-0.642***	-0.427
	(0.121)	(0.217)	(0.144)	(0.197)	(0.295)
2021 survey round	-0.038	-0.489***	-0.008	-0.619***	-0.277
	(0.103)	(0.174)	(0.098)	(0.195)	(0.187)
2022 survey round	0.148	-0.112	0.163	-0.261	0.065
	(0.111)	(0.238)	(0.114)	(0.179)	(0.180)
Household group indicator		-0.447***	0.128	-0.154	-0.349*
		(0.160)	(0.132)	(0.180)	(0.185)
Group indicator x 2020 survey round	-1.458***	0.552***	-0.133	0.428*	0.172
	(0.267)	(0.200)	(0.178)	(0.224)	(0.301)
Group indicator x 2021 survey round	-0.898***	0.422**	-0.273*	0.601***	0.190
	(0.232)	(0.195)	(0.157)	(0.227)	(0.202)
Group indicator x 2022 survey round	-0.414**	0.255	-0.130	0.448**	0.052
	(0.176)	(0.248)	(0.162)	(0.210)	(0.210)
Household head is male	0.061	0.047	0.061	0.061	0.067
	(0.057)	(0.060)	(0.057)	(0.057)	(0.057)
Household head age (in years)	-0.007***	-0.007***	-0.007***	-0.007***	-0.007***
	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)
Household head did not complete elementary education	0.174***	0.188***	0.174***	0.174***	0.171***
	(0.047)	(0.048)	(0.047)	(0.047)	(0.047)
Household head completed elementary education or higher	0.189***	0.208***	0.189***	0.189***	0.183***
	(0.068)	(0.072)	(0.068)	(0.068)	(0.068)
Household head main spoken language is Spanish	0.412***	0.418***	0.412***	0.412***	0.312***
	(0.107)	(0.105)	(0.107)	(0.107)	(0.115)
Household size	-0.009	-0.021**	-0.009	-0.009	-0.008
	(0.010)	(0.009)	(0.010)	(0.010)	(0.010)
Household is beneficiary of social school program	0.166***	0.165***	0.166***	0.166***	0.159***
	(0.057)	(0.056)	(0.057)	(0.057)	(0.056)
Dwelling has finished walls	0.178***	0.191***	0.178***	0.178***	0.178***
	(0.062)	(0.063)	(0.063)	(0.062)	(0.062)
Dwelling has finished ceiling	-0.079	-0.069	-0.079	-0.079	-0.076
	(0.069)	(0.071)	(0.069)	(0.069)	(0.069)
Dwelling has finished floors	0.105	0.120*	0.105	0.105	0.103
	(0.069)	(0.070)	(0.069)	(0.069)	(0.069)
Dwelling is connected to electricity	0.154*	0.158*	0.155*	0.154*	0.164*
	(0.085)	(0.085)	(0.085)	(0.085)	(0.084)
Dwelling is connected to water network	-0.050	-0.047	-0.050	-0.050	-0.044
	(0.074)	(0.072)	(0.074)	(0.074)	(0.073)

(Cont.)

Coefficients	Panel B (cont.): Dependent variable: Household Dietary Diversity Score (scale 0-12)				
	Household group:				
	(1)	(2)	(3)	(4)	(5)
	San Marcos department	Poor	Affected by tropical storms	Coffee producer	Indigenous
Dwelling is connected to drainage network	-0.048	-0.030	-0.048	-0.048	-0.040
	(0.060)	(0.061)	(0.062)	(0.060)	(0.062)
Cooking fuel of household is electricity or gas	0.170	0.170	0.169	0.170	0.156
	(0.160)	(0.159)	(0.160)	(0.160)	(0.157)
Tercile 2 of Daily per capita expenditures	0.174***		0.174***	0.174***	0.174***
	(0.067)		(0.067)	(0.067)	(0.067)
Tercile 3 of Daily per capita expenditures	0.322***		0.322***	0.322***	0.316***
	(0.079)		(0.079)	(0.079)	(0.078)
Household owns a TV or radio	0.031	0.056	0.031	0.031	0.031
	(0.064)	(0.065)	(0.064)	(0.064)	(0.063)
Household owns a vehicle	0.134**	0.162**	0.134**	0.134**	0.123*
	(0.067)	(0.066)	(0.066)	(0.067)	(0.066)
Household owns livestock	0.011	0.011	0.011	0.011	0.000
	(0.053)	(0.053)	(0.053)	(0.053)	(0.052)
Agricultural land size (in natural logarithms)	0.079***	0.087***	0.079***	0.079***	0.075***
	(0.026)	(0.026)	(0.026)	(0.026)	(0.026)
Agricultural land has irrigation system	0.059	0.078	0.059	0.059	0.056
	(0.075)	(0.076)	(0.075)	(0.075)	(0.075)
Coffee is among main crops produced	0.215*	0.200	0.215*		0.228*
	(0.125)	(0.136)	(0.125)		(0.125)
Cardamom is among main crops produced	0.086	0.095	0.085	0.086	0.084
	(0.107)	(0.109)	(0.108)	(0.107)	(0.109)
Corn is among main crops produced	-0.173***	-0.185***	-0.173***	-0.173***	-0.161***
	(0.057)	(0.058)	(0.057)	(0.057)	(0.057)
Beans is among main crops produced	-0.020	-0.017	-0.020	-0.020	-0.025
	(0.063)	(0.063)	(0.063)	(0.063)	(0.062)
Household had an internal migrant in the last 3 years	-0.061	-0.082	-0.061	-0.061	-0.061
	(0.108)	(0.111)	(0.108)	(0.108)	(0.107)
Community fixed effects	Yes	Yes	Yes	Yes	Yes
Overall R-squared	0.270	0.260	0.262	0.263	0.262
Number of observations	5,048	5,048	5,048	5,048	5,048
Number of households	1,262	1,262	1,262	1,262	1,262

(Cont.)

Coefficients	Panel C: Dependent variable: Intention to emigrate				
	Household group:				
	(1)	(2)	(3)	(4)	(5)
	San Marcos department	Poor	Affected by tropical storms	Coffee producer	Indigenous
2020 survey round	-0.017*	-0.045***	-0.025**	-0.009	-0.042**
	(0.010)	(0.015)	(0.012)	(0.012)	(0.017)
2021 survey round	0.043**	0.039	0.042*	0.053	0.073**
	(0.019)	(0.033)	(0.022)	(0.034)	(0.036)
2022 survey round	0.025*	0.062	0.026	0.027	0.019
	(0.014)	(0.045)	(0.020)	(0.018)	(0.029)
Household group indicator		-0.036*	-0.015	-0.012	-0.011
		(0.021)	(0.014)	(0.023)	(0.022)
Group indicator x 2020 survey round	-0.016	0.031*	0.016	-0.011	0.030
	(0.018)	(0.019)	(0.017)	(0.016)	(0.020)
Group indicator x 2021 survey round	0.159***	0.022	0.039	0.007	-0.018
	(0.044)	(0.035)	(0.030)	(0.038)	(0.041)
Group indicator x 2022 survey round	0.200***	-0.019	0.043*	0.023	0.033
	(0.045)	(0.044)	(0.024)	(0.023)	(0.031)
Household head is male	0.000	0.001	-0.000	0.000	0.000
	(0.011)	(0.011)	(0.011)	(0.011)	(0.010)
Household head age (in years)	-0.000	-0.000	-0.000	-0.000	-0.000
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Household head did not complete elementary education	-0.003	-0.003	-0.003	-0.003	-0.003
	(0.010)	(0.010)	(0.010)	(0.010)	(0.010)
Household head completed elementary education or higher	0.017	0.017	0.017	0.017	0.017
	(0.013)	(0.013)	(0.013)	(0.013)	(0.013)
Household head main spoken language is Spanish	-0.006	-0.006	-0.005	-0.006	-0.006
	(0.019)	(0.019)	(0.019)	(0.019)	(0.019)
Household size	0.007***	0.007***	0.006***	0.007***	0.007***
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Household is beneficiary of social school program	-0.004	-0.003	-0.003	-0.004	-0.004
	(0.009)	(0.009)	(0.009)	(0.009)	(0.009)
Dwelling has finished walls	0.010	0.010	0.010	0.010	0.010
	(0.011)	(0.011)	(0.011)	(0.011)	(0.011)
Dwelling has finished ceiling	-0.008	-0.008	-0.008	-0.008	-0.008
	(0.013)	(0.013)	(0.013)	(0.013)	(0.013)
Dwelling has finished floors	0.007	0.007	0.006	0.007	0.007
	(0.010)	(0.010)	(0.010)	(0.010)	(0.010)
Dwelling is connected to electricity	-0.015	-0.014	-0.015	-0.015	-0.015
	(0.012)	(0.012)	(0.012)	(0.012)	(0.012)
Dwelling is connected to water network	0.016	0.017	0.016	0.016	0.016
	(0.018)	(0.018)	(0.018)	(0.018)	(0.018)

(Cont.)

Coefficients	Panel C (cont.): Dependent variable: Intention to emigrate				
	Household group:				
	(1)	(2)	(3)	(4)	(5)
	San Marcos department	Poor	Affected by tropical storms	Coffee producer	Indigenous
Dwelling is connected to drainage network	0.014	0.014	0.013	0.014	0.014
	(0.014)	(0.014)	(0.014)	(0.014)	(0.014)
Cooking fuel of household is electricity or gas	-0.039**	-0.043**	-0.039**	-0.039**	-0.039**
	(0.019)	(0.018)	(0.019)	(0.019)	(0.019)
Tercile 2 of Daily per capita expenditures	0.004		0.004	0.004	0.004
	(0.008)		(0.008)	(0.008)	(0.008)
Tercile 3 of Daily per capita expenditures	0.010		0.010	0.010	0.010
	(0.011)		(0.011)	(0.011)	(0.011)
Household owns a TV or radio	0.015	0.016	0.015	0.015	0.015
	(0.012)	(0.011)	(0.012)	(0.012)	(0.012)
Household owns a vehicle	-0.019	-0.022	-0.019	-0.019	-0.019
	(0.014)	(0.014)	(0.014)	(0.014)	(0.014)
Household owns livestock	-0.006	-0.006	-0.006	-0.006	-0.006
	(0.010)	(0.010)	(0.010)	(0.010)	(0.010)
Agricultural land size (in natural logarithms)	0.001	0.001	0.000	0.001	0.001
	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)
Agricultural land has irrigation system	0.013	0.013	0.013	0.013	0.013
	(0.014)	(0.014)	(0.014)	(0.014)	(0.014)
Coffee is among main crops produced	-0.008	-0.007	-0.008		-0.008
	(0.018)	(0.017)	(0.018)		(0.018)
Cardamom is among main crops produced	0.001	0.001	0.002	0.001	0.001
	(0.017)	(0.017)	(0.016)	(0.017)	(0.017)
Corn is among main crops produced	0.003	0.003	0.003	0.003	0.003
	(0.009)	(0.009)	(0.009)	(0.009)	(0.009)
Beans is among main crops produced	0.003	0.004	0.003	0.003	0.003
	(0.010)	(0.010)	(0.010)	(0.010)	(0.010)
Household had an internal migrant in the last 3 years	-0.010	-0.012	-0.010	-0.010	-0.010
	(0.020)	(0.020)	(0.019)	(0.020)	(0.020)
Community fixed effects	Yes	Yes	Yes	Yes	Yes
Overall R-squared	0.089	0.077	0.077	0.075	0.076
Number of observations	5,048	5,048	5,048	5,048	5,048
Number of households	1,262	1,262	1,262	1,262	1,262

Note: This table reports generalized least squared (GLS) random effects estimations based on Equation (1) for the dependent (outcome) variable indicated in each panel. The household group indicator is a dummy variable that varies across columns to identify households' location (column (1)); poor households (column (2)); households affected by tropical storms Eta and Iota (column (3)); coffee-producer households (column (4)); and indigenous households (column 5). See the main text for a detailed description of the dependent variables and the household groups in each column. For a few cases where household baseline characteristics were missing, we imputed the median value at the municipality level, and included a dummy variable capturing whether that observation is imputed or not. Robust standard errors clustered by community are reported in parentheses. ***, **, and * denote statistical significance at, respectively, the 99%, 95%, and 90% levels.

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