UNIVERSITY OF CALIFORNIA

Santa Barbara

Development, livelihoods and food security in Guatemala: Using primary and secondary data to better understand household well-being.

A dissertation submitted in partial satisfaction of the requirements for the degree

Doctor of Philosophy in Geography

by

Corbin James Hodges

Committee in charge:

Professor Stuart Sweeney, Chair

Professor Susan Cassels

Professor Bayron Milian, University of San Carlos, Peten, Guatemala

Dr. Frank Davenport, Assistant Researcher

Professor Kathy Baylis

December 2020

The dissertation of Corbin James Hodges is approved.

Susan Cassels

Bayron Milian

Frank Davenport

Kathy Baylis

Stuart Sweeney, Committee Chair

December 2020

Development, livelihoods and food security in Guatemala: Using primary and secondary data to better understand household well-being.

by

Corbin James Hodges

Acknowledgements

I want to express my sincere appreciation and gratitude to the chair of my committee, Dr. Stuart Sweeney, for being a true mentor and for his incredible patience in guiding me on this long journey. I would also like to thank my committee members, Drs. Susan Cassels, Bayron Milian, Frank Davenport, and Kathy Baylis for the excellent feedback that has helped to improve this dissertation. I look forward to working with all of you in the future.

I am grateful to all of those in the Geography Department with whom I have had the pleasure to work. Many members of the staff including Jose, Mo, Alex, Dylan and Alycia have helped me keep an even keel in moments of panic. Fellow graduate students Lumari Pardo-Rodriguez, Karly Marie-Miller, Jeff Kirkby, and Ian Irmischer provided much help and many laughs over the years.

Last, a person could not have a better group of friends. Alex Davies, Andy Chimenti, Natalie Giufreda, and Jenn Allen from J.C.C.; Craig Lowe, Craig Martin, Mark Juncosa, Chris Boitnott, Larissa Bifanno and Bill Parks from C.U. and most recently Ryan Hostetter, Tyler Bersbach, Rich Graziano and Amy West from S.L.O. have all helped me along the way. Finally, Ken Brandstetter and Melissa Paris have learned more about this dissertation than they ever wanted and are probably more relieved than I am that it's finished.

Nobody has been more important to me in the pursuit of this research than my niece and nephews; Gracie, Matthew, and Sammy. Their youthful energy keeps me motivated and curious about the World.

Last, this work would not have been possible without the financial support of the Borlough Fellowship, the Mertes Scholarship, multiple Broom Center Graduate Student and Research Travel Grants, and numerous TA-ships provided by the UCSB Geography Department. Additionally, I have been working with and funded by the UCSB Basic Needs Evaluation Team and Katie Maynard over the past several quarters and am looking forward to continuing this work in the future.

Curriculum Vitae
Corbin J. Hodges

EDUCATION

Ph.D. Geography	*University of California, Santa Barbara,* SantaBarbara, CA. 2020.
M.S. Biology	*California Polytechnic State University,* San Luis Obispo, CA. 2009.
B.S. Biology	*Cornell University*, Ithaca, NY. 2003.
A.S. Biology	*Jamestown Community College*, Jamestown, NY. 2000.

RESEARCH

Graduate Student Researcher – *Basic Needs Eval. Team, University of California, Santa Barbara,* Santa Barbara, CA.
My research as part of the basic needs evaluation team is as follows: In Spring quarter of 2020, I completed all aspects of a qualitative study to determine how student's food situations were changing in response to the highly dynamic COVID-19 situation. The findings of the study are currently being written up for publication. Second, and also in the spring of 2020, I designed a quantitative survey to be released to the UCSB undergraduate student body to better assess the influence of the pandemic on student food security. The survey was not released due to survey fatigue concerns but will possibly be released in winter quarter, 2021. Third, I'm currently drafting a paper examining differential feelings of stigma of marginalized and un-marginalized groups upon receiving UCSB basic needs services with an expected publication date of Winter quarter 2021 (Present).

Doctoral Dissertation – *Geography Department, University of California, Santa Barbara,* Santa Barbara, CA.
My dissertation research focuses on combining nationally representative secondary data with data that I collected in four peri-urban communities in Peten, Guatemala to better understand how the country is developing and if development is improving household well-being. In the first paper, I examine if and how household occupation profiles are changing over time in Guatemala and what household characteristics associate with the most prevalent occupation profile. The second paper determines if food insecurity associates with household occupation profile and the third paper uses mixed methods field work data to quantify food insecurity using two metrics in four peri-urban communities in Peten, determine if food security associates with occupation portfolio in these communities, and compares the two food security metrics. (Present)

Master's Thesis – *Biology Department, California Polytechnic State University,* San Luis Obispo, CA
Designed and implemented experiments examining the effects of the presence of dissolved organic matter on the development and morphology of marine invertebrate larvae. Analyzed data and presented results of study in both written and oral formats. (1/10)

Biological Science Technician – *United States Geological Survey*, Boise, ID
Led a field team in the collection of data for a project examining the role of fire on stream ecology. Identified aquatic insect larvae. Managed and analyzed data. (6/08 – 3/09, 40hrs/wk)

Field Volunteer - *California Polytechnic State University*, San Luis Obispo, CA
Caught, tagged, weighed, and measured fish for a study monitoring fish populations inside marine protected areas. (9/07 - 10/07, 10hrs/wk)

Field Assistant - *California Polytechnic State University*, San Luis Obispo, CA
Sampled for amphibians, fish, and macro-invertebrates for a project examining the role of different fire regimes on stream ecological processes in Payette National Forest, Idaho. (8/07, 50hrs/wk)

Field Assistant - *Cornell University*, Guanare, Venezuela
Took part in all aspects of implementing an experiment examining the effects of a detrivorous fish on the ecosystem processes of a remote tropical stream. (1/02 - 3/02, 60hrs/wk)

Research Assistant - *Cornell University*, Ithaca, NY

Identified and counted algae for an experiment examining the effects of fish density on algal community composition in tropical streams. (9/01 - 12/01, 10hrs/wk)

CONTRIBUTED PRESENTATIONS

Hodges, C.J., Sweeney, S. April, 2019. Changing livelihoods in the peri-urban zone of the central area of Peten, Guatemala. Conference of Latin American Geographers. San Jose, Costa Rica. Presentation. (04/2018)

Hodges, C.J., Sweeney, S. May, 2018. Maize persists despite declining agricultural livelihoods in Guatemala. American Association of Geographers. Washington, DC. Poster. (05/2019)

Hodges, C.J., Adams, N.J., and Dean E.Wendt. 2006. Dissolved organic matter (DOM) reduces ultra-violet radiation (UVR) induced cleavage delay in embryos of the purple sea urchin, *Strongylocentrotus purpuratus*. Western Society of Naturalists. Redland, Washington. (11/2006)

Hodges, C.J. and Dean E. Wendt. 2007. Does dissolved organic matter influence the timing of early embryonic development of the purple sea urchin, *Strongylocentrotus purpuratus*? Society of Integrative and Comparative Biology. Phoenix, Arizona. (1/2007)

TEACHING EXPERIENCE

Teaching Assistant – University of California Santa Barbara, Santa Barbara, CA
GEOG 3A Oceans and Atmosphere
GEOG 8 Global Climate Change
GEOG 3B Land, Water, and Life
GEOG 20 Geography of Surfing
GEOG 5 People, Place and Environment
GEOG 172 Intermediate Geographical Data Analysis
GEOG 12 Maps and Spatial Reasoning
GEOG 104 Physical Geography of the World's Oceans

Lecturer - *California Polytechnic State University,* San Luis Obispo, CA
BIO 325 General Ecology Lecture and Lab – Developed and presented BIO 325 lecture and lab for major students in the Biological Sciences Department.
BIO 227 Wildlife Conservation Biology Lecture – Continued to teach BIO 227 as mentioned below. (9/12 – 6/13, 40hrs/wk)

Part-Time Lecturer- *California Polytechnic State University,* San Luis Obispo, CA
BIO 227 Wildlife Conservation Biology Lecture - Developed and presented lectures for BIO 227, a non-majors biology course introducing students to all aspects of modern day conservation biology.
Lab Sections-In addition to the lecture mentioned above continued to teach biology labs. (3/11-9/12, 35hrs/wk)

Teacher – *Geumjeong SLP*, Busan, South Korea.
Taught English to Korean kindergarten to elementary aged students at a private school in Korea. (2/10-3/11, 40hrs/wk)

Graduate Student Teaching Associate – *Biological Sciences Department, California Polytechnic State University.* Presented lab lectures, created test questions, and graded all lab assignments and tests for each lab. Lab lectures were created for several classes (Bio 113, Bio 153, Bio 111, and Bio 162).
BIO 162 - Biology of Form and Function (Winter Quarter and Spring Quarter 2008)
BIO 263 – Ecology and Evolution Lab. (Fall Quarter 2007)
BIO 160 – Diversity of Life Lab. (Fall Quarter 2007)
BIO 111 – General Biology Lab. (Fall, Spring, and Winter Quarters of 2006 and 2007)
BIO 153 – Biology of Animals Lab. (Fall Quarters of 2004 and 2005)
BIO 113 – Animal Diversity and Ecology Lab. (Spring 2005, Winter 2004)

Tutor - *Jamestown High School*, Jamestown, NY.
Taught science, and other subjects as needed, to at-risk high school students in an in-house tutoring program. (12/03-6/04, 30hrs/wk)

WORK EXPERIENCE

Construction Volunteer - *FEMA*, Chuuk, Micronesia
Led small group of local people and volunteers in construction of temporary shelters being built in response to 2002 mudslides. (5/03 – 6/03, 50hrs/wk)

Assistant Island Engineer - *Shoals Marine Lab*, Appledore Island, M.E.
Basis mechanical repair, electrical wiring and plumbing. Dove (scuba) to collect specimens and to service intake and outfall lines. (4/02 – 8/02, 40hrs/wk)

Deck Hand - *Shoals Marine Lab*, Appledore Island, M.E.
Operated and maintained a variety of water going vessels for purposes including fishing and passenger transport. (5/01 – 8/01, 40hrs/wk)

PROFESSIONAL SERVICE

Graduate Student Assembly Member, *UCSB Graduate Student Association*
Notify graduate students in the Geography Department about events while transmitting ideas and issues from the graduate students to the GSA. Voting in official GSA matters, including appointment of new Executive Officers, approving ballot language for elections, and deciding a course of action during critical events. (Academic Years 2013-2014, 2015-2016)

Graduate Student Representative, *Cal Poly Graduate Coordination Committee*
Involved in reviewing graduate applications and selection of graduate candidates. Organized graduate student meetings. (Academic Year 2005-2006)

Graduate Student Representative, *Cal Poly Student Fee Committee*
Assisted in distribution of ~400,000 dollars annually within the Biological Sciences Department. Reviewed student and faculty proposal requests for student fee funds. (Academic Years 2004-2005, 2006-2007)

JOURNAL PEER REVIEWS

Have served as a peer reviewer for the following journals:
Journal of Latin American Geography

AWARDS and FUNDING RECEIVED

Borlaug Fellowhship, $17,250 (2016)
National Geographic Research and Exploration Grant, $20,000 (2015)
Graduate Student Research and Travel Grant, UCSB, Broom Center, $1000 (2018)
Graduate Student Research and Travel Grant, UCSB, Broom Center, $2000 (2017)
Graduate Student Research and Travel Grant, UCSB, Broom Center, $1800 (2016)
Graduate Student Research and Travel Grant, UCSB, Broom Center, $1800 (2015)
Leal Anne Kerry Mertes Scholarship, UCSB Geography Department, $2308 (2015)
Outstanding Contribution to Graduate Study Award, CalPoly (2005-2006)
College Based Fees Research Travel Award, Biological Sciences Department, CalPoly, $800 (2006) and $700 (2007)

ABTRACT

Development, livelihoods and food security in Guatemala: Using primary and secondary data to better understand household well-being.

by Corbin James Hodges

Traditional development perspectives follow the modernization paradigm and international development research has largely focused on urban and rural spaces as distinct entities. Recently however, the academic community has recognized the necessity of understanding how households in the developing world utilize different types of spaces to make a living, but little research has explicitly addressed this. This dissertation helps to fill this gap by using mixed-methods research in Guatemala to determine how household occupations are changing over time for both rural and urban households, and whether this change is improving household well-being.

Analysis of both secondary data and data originally collected by the author are utilized to address research questions. Three time points of nationally representative survey data from Guatemala (2006, 2011, and 2015) are used in chapter two to determine if the prevalence of households in different occupation types - operating their own farm, working as paid agricultural labor, or working outside of agriculture - are changing over time. In chapter three, the 2015 nationally representative survey data is used to determine if household occupation type (as classified in chapter two) associates with food insecurity. Last, in chapter four, household survey data collected in four peri-urban communities in the department of Peten, Guatemala are used to expand understanding of how occupation type impacts food insecurity. Instead of classifying jobs into three occupation types, working outside of agriculture is split into two occupation types

based on the location of work, either urban or rural, creating four occupation types to include in statistical models examining associates of food insecurity.

The results of the dissertation highlight development trajectories in Guatemala. Results from chapter two indicate that working as paid agricultural labor is increasing in prevalence in Guatemala while neither the prevalence of own-farm operation or working outside of agriculture are changing over time. Results from chapter three suggest that households working as paid agricultural labor are the most likely to be food insecure, followed by households working outside of agriculture, and last, by households operating their own farm. Last, results from chapter four (field work data) suggest that households working in urban areas are the most food insecure and that there are no differences in food insecurity between households that operate their own farm, work as paid agricultural labor, or work outside of agriculture in the rural space.

In conclusion, despite following the neoliberal economic model of many developed countries, household well-being in Guatemala, at least as measured by food insecurity status, is not improving. Within rural areas, more and more households are relying on paid agricultural work, but this type of work is associated with the greatest likelihood of food insecurity. Furthermore, while the share of the country's population living in urban areas is increasing, working in urban areas isn't associated with better food security, suggesting that this aspect of the development modernization paradigm is not holding true. It seems that subsistence agriculture (own-account farming) creates the greatest amount of food security for households in Guatemala, yet it receives little support from the Guatemalan government. In light of these findings, it may benefit household well-being in Guatemala if governmental and non-governmental organizations increase support for agricultural laborers. While more research is needed to verify mechanisms to do so, raising minimum pay, limiting the maximum number of hours in the work day, and enforcing these standards may benefit individuals and households in rural and peri-urban communities.

Table of Contents

Chapter One: Introduction

Development is a multifaceted concept that includes both how societies change over time and the process by which societies attempt to direct this change, making any simple definition contestable (i.e. Willis, 2014), but commonalities tend to include that development is a long term process of structural societal transformation and that if directed, development should benefit the well-being of people. Early ideas of development largely built on observation of economic change in western societies (Global North countries) (i.e. Rostow, 1960) and led to the formation of the 'modernization paradigm', which stipulates that countries should increase agricultural production, urbanize and industrialize as they move through five stages of development, which starts with a traditional stage and ends in the modern stage, the latter of which is marked as a period of high mass consumption. This idea of development was quickly contested by post-structuralism generally and Marxist geographies specifically, with the latter arguing that the 'modernization paradigm' relies on the constant acquisition of new resources and new markets, which inevitably leads to exploitation and the accumulation of wealth (dependency theory) (i.e. Booth, 1985). Furthermore, post-structuralism in and of itself recognizes the importance of diversity – of people, places, and cultures – and argues that no one type of development is the correct type for every situation and that the objectives of development vary widely (i.e. Mohan, 1997). For example, many Andean indigenous communities believe that successful development must account for the protection of nature (Andolina et al., 2009) and the government of Bhutan structures policy on holistic improvement rather than economic growth (Brooks, 2013). Despite the contested nature of development, the United Nations has created a series of development goals and annually quantifies metrics purporting to measure these goals

(United Nations, 2020) in an effort to track how nations, regions, and the World are changing over time. These goals include improving education and reducing hunger and poverty, with the acknowledgement that the latter has been successfully accomplished in developed nations when people have stable and good-paying jobs. This dissertation examines the trajectory of development in Guatemala by determining if the percentage of households working in different occupation types is changing over time and then determines if occupation influences household well-being, as measured by food insecurity.

Mentioned previously, urbanization is considered a strong part of the modernism paradigm and is assumed to increase as land consolidation in rural areas creates larger farms and these farms mechanize, reducing the need for labor. With concurrent declines in subsistence farming and little labor needed in rural areas, the labor force slowly moves to urban spaces to assume formal positions in the labor force. In 2007, the world became a majority urban place for the first time and Central America (CA) was part of this change. 59% of the population of CA lives in urban spaces and it's estimated that 70% will live in cities in the next decade (Maria et al., 2017). As urban areas grow in spatial extent and in population, it's hoped that good-paying jobs will be created so that both city natives and internal immigrants from the countryside are able to easily find work that meets their livelihood needs.

While much international development effort, both in programming and in research, originally focused on rural areas, long considered to be the least developed areas of the World, with the population shift has come a greater focus on urban areas and the welfare of inhabitants there in. Furthermore, while development paradigms both in policy and in research have largely focused on either rural spaces or urban spaces, this is now recognized

as a false dichotomy (Lerner et al., 2013) and there have been calls to conduct research on urban-rural linkages (i.e. Tacoli, 1998; Tacoli, 2003) and peri-urban spaces, or, spaces that were previously considered rural but have been functionally and/ or physically incorporated into urban areas (Simon, 2008). The concept of livelihood diversification emphasizes the diverse ways that households meet their needs and while the study of the topic originated in rural communities (Ellis, 1998; Ellis, 2000), it is highly applicable to household livelihoods everywhere (Scoones, 2009). While households in truly rural spaces may combine traditional agriculture with a multitude of off-farm income generating activities, such as working for pay on a neighbor's farm or operating a small *tienda* within the residents rural village, households in peri-urban communities may be able to work in the urban center in occupations that are not available in rural settings.

This research contributes to the understanding of peri-urban spaces and the connections between urban and rural in several different ways including through the simple inclusion of both urban and rural households in analysis. Many studies only include urban households or rural households but this limits the scope of understanding that can be developed from the results. Furthermore, defining which households are urban and rural is not clear cut, and more arbitrary designations can lead to the removal of much pertinent data. Last, the field work portion of this dissertation is conducted in four communities that are unambiguously peri-urban. Each of the four communities is surrounded by agricultural fields and/or unbuilt-up space but, as the results will show, a large percentage of households work in the nearby urban center.

No matter where people live, a relatively uncontested development goal is to eliminate hunger and improve food security. Defined as "when all people, at all times have

physical and economic access to sufficient, safe, and nutritious food to meet their dietary needs and food preferences for an active and health life" (1996 Word Food Summit), food security strongly associates with hunger and undernutrition (Reinhard and Fanzo, 2014) but it can be assessed quickly and cheaply using multiple metrics. Furthermore, while morphological characteristics that occur from long-term undernutrition are relatively easy to quantify, they do not necessarily arise from current household conditions. Food insecurity can be assessed across any time frame and matched with household characteristics of that time frame. Last, despite its common usage in the literature and its acceptance as a measure that provides valuable information about the real-world development objective of ending hunger, food insecurity metrics don't necessarily agree with one another in the relatively few studies where multiple metrics are used. Metrics may be different in how they classify households (i.e. what level of food insecurity) and/or they may actually differ in how they rank households food insecurity status (Maxwell et al., 2014). Recognizing the limitations of any individual metric and wanting to develop a better understanding of how two commonly used metrics compare, this study assesses food insecurity in four peri-urban communities in the department of Petén, Guatemala. The location of these communities is important because there is some evidence that the location of households (rural or urban) impact how they respond to FI metrics (Tuholske et al, 2019) and this dissertation examines this by determining the degree of association between the two metrics for households engaged in the urban center and households that are not.

All of the research conducted in this dissertation is based on data collected in Guatemala, which provides an excellent setting to study development. The country is the second poorest in the Western hemisphere, it has poor food insecurity outcomes, and it has

experienced much structural change in the last several decades. Changes include the ending of a 30 year civil-war, neo-liberal restructuring of the economy and massive international trade deals (NAFTA and CAFTA-DR), large scale internal and external migration, and large amounts of narco-trafficking and the activities associated with such as narco-ranching (DeVine et al. 2018), and land constraints imposed on traditional agriculture through many of the above in addition to population increase. Furthermore, Guatemala is urbanizing at the greatest rate in Central America, making it an excellent place to study the influence of livelihoods on household well-being. Last, though the results are not directly generalizable to Central America, Guatemala has many similarities to other Latin America countries and this research can inform situations there as well.

Within Guatemala, the department of Petén is unique because it represents approximately one-third of the countries land mass but contains just one-fifteenth of the country's population. The department was the last area of the country to be pulled into the modern world and there are still disputes with Belize over the placement of the eastern border of the department. Considered a frontier environment up until the previous decade, the department's population has increased approximately 40 times in a 70 year period – from a population of 25,000 in the middle part of the 20th century to one million people today. This population growth was fueled by the building of roads increasing access to the area, land limitations in much of the rest of the country and land availability in the department, and people fleeing the violence of the civil war. Furthermore, the first part of the 21st century saw the formation of the Maya Biosphere Reserve, which was created at least in part in response to rapid deforestation. The reserve covers about one-third of the department and has different zones corresponding with different uses. Today, there is little available land and during the

time that this fieldwork was conducted, squatter households were still settling on, and at times being forcefully evicted from, park lands. Last, with a large natural resource base the urban areas have grown large concurrently with overall population growth. The urban area studied in this dissertation now holds approximately 100,000 people in what not too long ago was considered something of a back-water.

With many changes occurring over the past several decades, this dissertation attempts to address three major research questions: 1) How is Guatemala developing and is this benefitting household well-being? 2) How does livelihood associate with food insecurity? and 3) How do different food security metrics compare? Following this chapter, the dissertation is broken into four other chapters, the first three of which are original empirical work and the last of which is an overall summary and conclusion. In the next several paragraphs, brief introductions are provided of each chapter.

Chapter two uses three time points (2006, 2011, and 2015) of nationally representative data from Guatemala to determine how the country is developing based on quantification of change in household livelihood activity, specifically, type of work. All household work activities are first classified into one of three groups; operating their own farm, working for pay on a farm, or working outside of agriculture and the percentages of households working in each type are presented for each time point. These results suggest that the percentage of households working in agriculture labor is increasing over time while the percentage of households operating their own farm or working outside of agriculture are not increasing and may actually be decreasing over time. Furthermore, the percentage of households diversifying across the job types classified here are not increasing over time. From a development perspective this is not necessarily what modernists would expect to

happen, where an urbanizing society should have more and more households utilizing urban (non-agriculture) jobs to sustain themselves. However, from a structuralism perspective recognizing the diversity of development in different places, the second half of this chapter asks if the observed development, namely the increase in percentage of households working for pay on other people's farms, is leading to positive outcomes for household well-being. Using a logistic regression model using working as agriculture labor as the dependent, binomial variable and several households characteristics as the independent variables, the analysis shows that households working in agricultural labor are poorer, less educated, and more likely to be indigenous than households not working in agriculture labor. This is a troubling finding as it suggest that the job type that is increasing in prevalence in the population is not associated with positive outcomes for household well-being.

Next, chapter three of the dissertation continues the examination of the relationship between household characteristics and well-being by assessing if and how food insecurity associates with household's occupation portfolio (the combination of job types that a household engages with) using the 2015 nationally representative data that was used as the third time point in the previous chapter. Here, modernist development perspectives suggest that households working in non-agriculture occupations should have better food insecurity than their more agrarian counterparts while the results from the first chapter makes one hope that households that are working as agriculture labor are more food secure. Results contradict both of the above presuppositions. Household operating their own farm either as a sole job-type or combined with working outside of agriculture are the least likely to be food insecure, and households working in agriculture labor are the most likely to be food insecure, no matter if they work only in that job type or combine that job type with any other. Once again,

these are troubling findings because there is a mismatch between the job type that is increasing in prevalence in the population and household well-being.

Chapter four of the dissertation looks more in depth at the above concepts through the examination of household characteristics and food insecurity in four traditionally rural communities located close to the urban capital of the department of Petén, Guatemala. Where the previous two chapters utilize secondary data, this chapter uses primary data collected by the author using mixed methods research culminating in 208 household interviews with a statistically representative sample of households in each of the four communities. Much development theory and research focuses on either urban or rural spaces and this study helps to fill this gap by explicitly studying communities that have both rural and urban characteristics. Furthermore, by conducting field work in communities this chapter allows for the explicit comparison of food insecurity between households with different occupation profiles who live in the same place. While chapter three includes region and area (urban or rural) in the analysis, the data do not allow for an explicit apples-to-apples comparison. Thus, the results don't explicitly show that households that operate their own farm and work outside of agriculture have better food security than households around them that have different occupation profiles, but that these households may just be geographically placed together and have some other structural condition that causes them to have better food security outcomes. The field work conducted in this chapter does not have this problem. Furthermore, the field work component of the dissertation determined the location of non-agriculture work (in the urban center or in the rural communities) something that few studies do but which has important implications for development. Modernist development perspectives would predict that households working in the urban space will have better well-

being (or certainly not poorer well-being) than households working in non-agriculture occupations in rural spaces.

Contrary to expectations, results from the field work suggest that households with members working in the urban space are more food insecure than households that only work in the rural space but that this relationship depends on the metric used to quantify food insecurity. Analysis performed with HFIAS data showed a distinct relationship between FI and job type while analysis performed with FCS data did not indicate an association between FI and job type. These results emphasize the necessity of choosing the correct metric for the location in question and point out fruitful grounds for future research.

In chapter 5, the dissertation finishes with a brief summary of results and discussion from each chapter, followed by an overall discussion and conclusions. Last, future research is laid out both for individual chapters and based on the dissertation as a whole.

Chapter Two:

Livelihood change in Guatemala

1. INTRODUCTION

The United Nations Sustainable Development Goals (2030) state the necessity of reducing global poverty and one way to do this is the production of good-paying jobs (https://www.un.org). For example, Rostow's economic growth model suggests that as countries progress through developmental stages livelihoods shift away from agriculture and self-employment towards better paying and more secure jobs (Rostow, 1960). Guatemala has lagged behind other countries in other development trajectories, for example, the demographic transition (Grace and Sweeney, 2013), and is one of the poorest countries in the Western Hemisphere, yet we know little about if and how occupations are changing over time. This research determines whether the relative frequencies of households operating their own farm, working as paid agricultural labor, or working outside of agriculture are changing over time and in accordance with theories of economic development. Furthermore, the research determines which household characteristics associate with the occupation type that is increasing the most frequently in the population to determine if change is likely to improve household well-being in the future.

Globally, there are approximately 570 million farms of which 500 million are family owned and 479 million are small sized (2 hectares or less) (Lowder et al., 2016). Of the small-farms, the overwhelming majority are still practicing subsistence agriculture, where the majority of harvest is consumed at home rather than sold. Furthermore, in developing countries 75% of the poor continue to depend on subsistence agriculture either directly or

indirectly for their livelihood. Despite this, rural livelihood transition, wherein households with traditional rural occupations switch into occupations that are considered more modern, is occurring almost ubiquitously (Bhandari, 2013). For small-holder farmers, development may include farm commercialization, livelihood diversification, or farm exit. In the latter situation, a household stops farming all together (Brooks et al., 2009). For rural households working as paid agricultural labor, their rural livelihood transition may involve a shift into working for pay outside of agriculture or operating their own business in either the formal or informal economies.

While modernistic development paradigms suggest that modernization will improve household well-being, rural livelihood transition may be advantageous or disadvantageous to household well-being depending on both the structural characteristics that the household is immersed in (region, country, department, and municipality) and the characteristics of the household itself, often conceptualized as the five types of capital that household's possess. (Bebbington, 1999). The combination of these largely determine whether a households is seeking new types of jobs as survival strategies, where they are looking for something else just to continue to meet their needs, or an accumulation strategy, where they see a good opportunity elsewhere and capitalize on it to increase their asset base (Ellis, 2000). For example, a household that operates a successful farm and is able to save money each year may choose to start working in the non-agricultural sector as well because they see an opportunity to make more money and further improve their household's lot in life. Versus a household who is forced to sell their farm to cover the costs of a medical emergency and are forced to look for low remuneration non-agriculture work to continue to meet their basic needs.

In Guatemala, numerous co-related events have occurred over the past half-century, all of which have altered the structure within which households make livelihood decisions. First, four and a half decades of civil war (from 1960 to 1996) dramatically altered rural life. Rural people were often forced into model villages (concentrated settlements) and their movements were heavily restricted. This limited the time farmers spent in their fields thereby decreasing farm productivity. Furthermore, violence in western Guatemala led to large scale internal migration, often into the more tropical lowlands. Steinberg and Taylor (2002) hypothesize that rapid migration (or escape) led to important ritual and maize cultivation items being left behind and that seed varieties brought to the lowlands were not well-adapted to the hot, humid climate of farming households' new environment. Last, the agriculture knowledge that households brought with them was probably not well-suited to growing maize in the different climate.

Second, international aid agencies and the Guatemalan government encouraged use of high yield-corn varieties (Carey, 2009) in the hope of decreasing demands for social reforms. This led to dependence on chemical inputs, thereby decreasing the independence of small-holder maize producers (Carey, 2009). Though yields in the short-term may have increased, these corn varieties weren't especially well-suited to environmental conditions and quickly led to soil degradation with resultant long-term decreases in yields.

At the same time, in exchange for debt relief, international financial institutions guaranteed relief if markets were liberalized. Large increases in debt (due to military expenditures and corruption) in the 1980's and 1990's caused the government to look for ways to increase foreign-exchange reserves and the government pushed for more export-oriented agriculture (Escoto and Marroquin 1992), which was also the trend in development

philosophy among international development agencies at the time. Farmers were encouraged to grow crops to exploit the countries comparative advantage of low cost, abundant labor and a tropical climate. Labor intensive crops such as tropical fruits and "winter crops", or crops that are commonly grown in North America but can't grow there during the winter months, were proposed as a way for farmers to make better income. Additionally, in seeking relief from debt, structural adjustment programs by the World Bank and International Monetary Fund required government price controls on agricultural products to cease in favor of market-determined pricing and previously closed markets were required to be open to imports.

Additionally, multiple factors are acting to cause land consolidation. Large scale cattle ranches require vast swaths of land to feed their herds as Guatemalan ranchers primarily use extensive grass-fed techniques (one cow per hectare). Many Guatemalan farmers embraced cattle culture and aspire to be ranchers someday but the economic viability of cattle for small-holder farmers is debatable (Grandia, 2009). Herd sizes smaller than ~45 may not be economically viable. Additionally, the high incidence of narco-ranching (Devine et al, 2018), whereby people involved in the drug trade use ranching to launder money, misrepresents to small-holders the potential benefits of this livelihood strategy and undercuts legitimate cattle operations.

More recent international trade agreements may have hurt maize farmers. The Dominican Republic Central America Free Trade Agreement (DR-CAFTA) was put into place in 2007 and may have increased imports of corn from the United States. As with the liberalization programs of the 1990's, this may be problematic for small-holder Guatemalan farmers because they are forced to compete with the heavily subsidized US corn producers.

US corn producers receive on average $28,000 of direct subsidies annually (Alonso-Fradejas and Gauster 2006).

Also on the international front, land consolidation by transnational industrial agricultural enterprises has limited land availability for small-holder farmers. For example, palm oil is now the number one crop in areal extent grown in Guatemala. Similarly, large area ecological reserves have led to land limitations in different parts of the country (Grandia 2006)

Lastly, generational desires are changing. Cell phone connectivity has increased to the point where even the most remote locations of the country have areas with reception and ideation of normal living standards is changing. Few youngsters growing up in agricultural households want to stay in farming and there is large scale migration to urban areas. Furthermore, 10% of the Guatemalan population lives in the United States and it's very common to hear rural Guatemalans, especially the young people, state that migrating to the Unites States as their primary goal (Hodges 2017, 2018, 2019, personal communication). Guatemala City and other urban areas don't produce enough good jobs to be desirable to many while the risks of going to the US are high but so are the rewards.

The two major purposes of this paper are as follows: 1) to determine the percentages of households in different job types and different occupation profiles and if these are changing over time and 2) to determine the household characteristics that associate with the job type that is becoming the most prevalent in the population. To do this, we examine the percentages of households working in three different job types (non-agriculture based occupations, own-farm operation, and paid agricultural labor) at three time points (2006, 2011, and 2015) to examine Guatemala's development trajectories from 2006 to 2015.

Research questions are as follows: 1) What percentages of households work in different job types (own-farm operation, paid agricultural labor, non-agriculture) in Guatemala and are these changing over time? 2) What is the prevalence of different household occupation profiles in Guatemala and are these changing over time? 3) Which household characteristics are associated with working as paid agricultural labor, the job type that is increasing in prevalence in the population?

2. METHODS

2.1 Data sources

This research uses secondary data from the 2006, 2011, and 2014 *Encuesta Nacional de Condiciones de Vida* (ENCOVI) performed by the *Instituto Nacional de Estaditica* (INE) of the Guatemalan government (www.ine.gob.gt) (Figure 1). The ENCOVI surveys are based on the Living Standard Measurements Survey (LSMS) produced and deployed by the World Bank (www.worldbank.org/en/programs/lsms) in multiple countries across the globe, including in Guatemala. Data produced by the survey is representative at the national and regional levels and across rural and urban areas. Surveys were conducted with 11,536 to 13,686 households and 54,823 to 68,739 individuals at each time point (Figure 1). The sampling frames are based on stratified two-stage cluster designs where primary sampling units are census blocks and secondary sampling units are a sample of households chosen from each of the selected primary sampling units. The survey instruments are approximately 60 pages in length and contain hundreds of questions; some of which are asked of the household generally and some of which are asked of every individual in the household. Data

from multiple question sets within the survey were used in analysis but the question set on occupations was the most important for this study.

Figure 1. Data information.

Data Sources	Year	Individuals	Households
Guatemala National Institute of Statistics, National Survey of Living Conditions	2006	37,772	7,276
Guatemala National Institute of Statistics, National Survey of Living Conditions	2011	68,739	13,686
Guatemala National Institute of Statistics, National Survey of Living Conditions	2014	54,823	11,536

2.2 Job type and occupation profile classifications

The occupation question sets in the surveys include approximately 100 questions which include questions about the specific job roll of the individual, the primary purpose of the company that the person worked for (if not themselves), and whether the individual worked for themselves, a family member, or someone else. Questions were asked of each individual over the age of six and if an individual worked more than one occupation, questions were asked about the two most important jobs. This study uses the above three questions to classify individual's jobs into three job types. Jobs where individuals worked on their own farm or on the family farm without pay were classified as "own-farm operation", jobs that involve working for pay on another person's farm were classified as "agricultural labor" and jobs that do not involve the person working on a farm (neither their own or someone else's) were classified as "non-agriculture" work. The latter category is broad as it contains all jobs outside of agriculture, including self-employment.

Using this information, household occupation portfolios were then created by aggregating individual job information to the household level. For example, if individual one of household "A" worked in "own-farm operation" and individual two of household "A"

worked in “non-agriculture”, then household “A” was determined to have an occupation portfolio of “own-farm operation and non-agriculture work”. This aggregation yielded seven different household occupation portfolios as outlined below:

1) Own-farm operation only: households that only work on their own farm

2) Ag labor only: households that only work for pay on other people’s farms

3) Non-ag only: households that only work outside of agriculture

4) Own-farm operation and Ag-labor: households that work both on their own farm and on other people’s farms

5) Own-farm operation and Non-ag: Households that work on their own farm and outside of agriculture

6) Ag labor and Non-ag: Households that work on other people’s farms and outside of agriculture

7) Own-farm operation, Ag labor, and Non-ag: households that work in each occupation type

Note that occupation portfolios may contain just one job type, two job types, or three job types as classified here.

2.3 Descriptive statistics and T-tests

Once job types and household occupation portfolios were determined, the percentage of households working in the three different job types and the percentages of households with the seven different occupation profiles were calculated for each time point. T-tests were then used to determine if the percentages of households working in each of the three job types changed from 2006 to 2011 and from 2011 to 2014 and if the percentage of households with

different occupation profiles were statistically different from 2006 to 2011 and from 2011 to 2014. The results of the t-tests are not shown in tables because almost without exception, differences in percentages between years were found to be significant, and this is attributable to the large sample size.

2.4 Logistic Regression Model

With results from the t-tests suggesting that the job type increasing the most in the household population is paid agricultural labor, a logistic regression model was used to determine which household characteristics associate with a household working as paid agricultural labor versus not working as paid agricultural labor, with this being the binomial (0/1) dependent variable. The logistic formula is stated in terms of the probability that $Y = 1$, which is P. The probability that Y is 0 is 1 - P. The *ln* symbol refers to a natural logarithm and $a + bX$ is the equation for the regression line.

$$\ln\left(\frac{P}{1-P}\right) = a + bX$$

Multiple independent variables were used in the analysis and each variable fits into one of three categories as follows: 1) household characteristics, 2) head of household (*jefe* in Spanish) characteristics, and 3) geographic characteristics. Household characteristics included ethnicity, number of people in the household, and the percent of household members that are dependents. Head of household characteristics include education level, gender, and age. Last, geographic characteristics include region in which the household is located and whether the households is located in an urban or rural area. Guatemala is commonly divided into 8 regions based on topographic and human characteristics as described below (Figure 1):

- Region 1: *Metropolitana*. Guatemala City Metropolitan Area. The largest urban center in Guatemala and the nation's capital.

- Region 2: *Norte*. Alta Verapaz and Baja Verapaz. Traditionally an area with a very large indigenous population.

- Region 3: *Nororiental*. El Progreso, Zacapa, Izabal, and Chuiqimula.

- Region 4: *Suroriental*. Jalapa, Jutiapa, and Santa Rosa. This región contains a smaller strip of the fertile Pacific lowlands than either región 1 or región 5 and more of the mountainous terrain that

- Region 5: *Central*. Chimaltenango, Sacatepequez, and Escuintla. Located largely on the Pacific flatlands this area has experienced relatively recent growth of industrialized agriculture.

- Region 6: *Suroccidental*. San Marcos, Quetzaltenango, Totonicapan, Solola, Suchitepequez, Retalhuleu. This region contains the most industrial agriculture operations in the country with large mechanized and irrigated farms.

- Region 7: *Noroccidental*. Huehuetenango and Quiche.

- Region 8: *Petén*. The last region of Guatemala to be developed; it is the most rural and containing 1/3 of the country's land mass and 1/15 of the country's population.

Figure 1. Map of regions of Guatemala and map of Guatemala topography.

In addition to region, the data also designate the households as being in a rural or urban location. Urban and rural designations in Guatemala are largely made based on population size. Villages with more than 2000 people and with more than 51% of residences containing electricity and running water inside of the house are designated as urban while smaller villages with fewer services are designated as rural. Last, it is worth pointing out that in Guatemala most rural agrarian households are not located on the land that they farm but are located in nuclear settlements (villages/communities) and travel daily to the family farm. But, despite the relatively high densities in rural villages, there are few services or other urban characteristics.

3. RESULTS

3.1 Household demographic info

Information on household size, number of working aged people in the household, and number of people working in the household are important for understanding changes in occupation profiles over time. These data show that the mean household size (number of

people per household) declined slightly from 2006 to 2014 (4.90 in 2006 and 4.77 in 2014) and the median household size decreased from 5 individuals in 2006 to 4 individuals in 2014 (Table 1). While the household size appears to have declined, the number of working aged people per household remained approximately the same with around four people over the age of six per household (Table 2). Last, the mean number of individuals working per household was approximately two and appears to be constant over time (2.06, 1.98, and 1.97 in 2006, 2011, and 2014, respectively) (Table 3). Looking at the distributional characteristics of this variable, 37% of households have one person working, 29% of households have two people working, 34% of households have three or more people working, averaged over the three time points and these percentages do not appear to be increasing or decreasing over time (Table 4). In summary, while household size seems to be decreasing neither the number of working aged individuals nor the number of people working appear to be changing over time.

Table 1. Number of individuals per household (N = 7,276, 13,686, and 11,536 for 2006, 2011, and 2014 data, respectively).

	2006	2011	2014
Mean	6.1	5.9	5.9
Stand. Dev.	2.7	2.7	2.6
Median	6.0	6.0	5.0
Range	1 to 21	1 to 20	1 to 20

Table 2. Number of working aged individuals per household (older than six years) (N = 7,276, 13,686, and 11,536 for 2006, 2011, and 2014 data, respectively).

	2006	2011	2014
Mean	4.0	4.1	4.0
Stand. Dev.	2.1	2.1	2.0
Median	4.0	4.0	4.0
Range	1 to 15	1 to 20	1 to 20

Table 3. Number of people working per household (N = 7,276, 13,686, and 11,536 for 2006, 2011, and 2014 data, respectively).

	2006	2011	2014
Mean	2.1	2.0	2.0
Stand. Dev.	1.4	1.4	1.3
Median	2.0	2.0	2.0
Range	0 to 12	0 to 12	0 to 11

3.2 Own-ag, other-Ag, non-ag percentages

Understanding the commonality of job types that households work is important for targeting interventions to help households in need and knowing if and how the prevalence's of these job types are changing over time is necessary for understanding Guatemala's development trajectories. Results show that 75.07% of working households participate in non-agriculture occupations while 47.13% of households participate in agriculture-based occupations, averaged over the three time points. Contrary to expectations, there is little evidence that the percent of households participating in agriculture is decreasing over time or that the percent of households working in non-ag is increasing over time. In fact, household participation in agriculture may have increased from 2006 to 2011 while the percentage of households working in non-agriculture may actually be decreasing over time (Table 4).

Table 4. Percent of working households in each major job type (N = 7,276, 13,686, and 11,536 for 2006, 2011, and 2014 data, respectively).

	2006	2011	2014	Mean
Non-agriculture	77.4	74.2	73.6	75.1
Agriculture	45.3	48.3	47.8	47.1

Looking at the percentages of households that work only in non-agriculture, only in agriculture, or in both non-agriculture and agriculture, a little more than a fifth of households diversify livelihood activities by working both in agriculture and non-agriculture jobs. Furthermore, a little over half of households (52.87%) only work in non-ag and about a quarter of households only work in agriculture (24.93%). Another way of looking at this is to consider only rural households (those working

Table 5. The percent of working households working in agriculture, non-agriculture jobs or both (N = 7,276, 13,686, and 11,536 for 2006, 2011, and 2014 data, respectively).

	2006	2011	2014	Mean
Non-agriculture only	54.7	51.7	52.2	52.9
Agriculture only	22.6	25.8	26.4	24.9
Both non-ag and agriculture	22.7	22.5	21.3	22.2

in ag) and we find that a little less than a half also work in non-agriculture based occupations. Contrary to expectations, the percent of households working in both agriculture and non-agriculture based occupations is not increasing over time and if anything, may be decreasing slightly across years (22.74%, 22.51%, and 21.35% in 2006, 2011, and 2014 respectively). There is not a clear trend in change over time for households only working in non-ag but it does appear that the percentage of households only working in agriculture is actually increasing over time (22.56% in 2006, 25.79% in 2011, and 26.43% in 2014) (Table 5).

In regards to individual job types, the data show that 75.1% of households work outside of agriculture, 36.67% of households operate their own farms, and 24.25% of households work on other people's farms. While the percentage of households working on their own farm may or working outside of agriculture may be decreasing slightly over time, the strongest signal in the data shows that percentage of households working as paid agricultural labor is increasing over time with18.90%, 25.81%, and 28.03% of households working in this job type in 2006, 2011, and 2014, respectively) (Tables 6). Furthermore, if we consider only households engaged with agriculture, either own farm operation or agricultural labor, the percentage working on other people's farms increased from 33% in 2006 to 44.61% in 2014.

Table 6. Percent of working households involved with each job type (N = 7,276, 13,686, and 11,536 for 2006, 2011, and 2014, respectively).

	2006	2011	2014	Mean
Non-agriculture	77.4	74.2	73.6	75.1
Own farm	37.7	37.6	34.8	36.7
Agricultural labor	18.9	25.8	28.0	24.2

3.3 Occupation portfolio percentages

Building on job type information, the percentages of households in each of the seven occupation profiles were determined to better understand how households combine different job types to form livelihoods. Averaged over the three time points, the most prevalent

occupation portfolio is working only in non-agriculture jobs (mean = 52.87%), followed by households that both operate their own farm and work in non-agriculture jobs (mean = 13.45%). The next two most common occupation portfolios are similarly prevalent in the population with 9.44% of households only operating their own farm and 9.53% of households operating their own farm and working as agricultural labor (Table 7).

Looking at trends over time, the percent of households working only in non-agriculture occupations may be decreasing over time. In terms of agricultural households that only work on their own farm or only work on other people's farms, these data show that the percentage of households only working on their own farm is declining slightly over time while the percentage of households that only work on other people's farms is increasing over time. Last, it's worth noting that every occupation portfolio that includes paid agricultural labor is increasing in prevalence with the exception of households that work in each of the three job types (Table 7).

Table 7. Percent of working households in each occupation profile (N = 7,276, 13,686, and 11,536 for 2006, 2011, and 2014, respectively).

Occupation Profiles	2006	2011	2014	Mean
Non-agriculture	54.7	51.7	52.2	52.9
Own farm	11.1	9.6	7.6	9.4
Agricultural labor	3.9	6.2	7.7	6.0
Non-ag/ Own farm	15.3	12.9	12.1	13.4
Own farm/ Ag labor	7.6	10.0	11.0	9.5
Non-ag/ Ag labor	3.7	4.5	5.2	4.5
Non-ag/ Own farm/ Ag labor	3.7	5.1	4.0	4.3

3.4 Logistic regression model

Results of the logistic regression model confirm that working as paid agricultural labor is increasing in prevalence in the population and that it is doing so while all other variables are accounted for. The odds of a household working in paid agricultural labor are

1.83 time greater in 2014 than in 2006 and 1.59 times greater in 2011 than in 2006. Next, poverty and work in paid agricultural labor associate with one another. Households that are extremely poor are 4.35 time more likely to work in paid agricultural labor than are households that don't work in this job type. Additionally, with every additional level of education that a *jefe* achieves, they have much lower odds of working as paid agricultural labor. Last, households with younger *jefes* are more likely to work in paid agricultural labor (Table 8).

Table 8. Logistic regression results of the association between year (and other independent variables) and the binomial dependent variable, household works in paid agricultural labor (0/1) (N = 32,498).

Independent Variables	Coefficient	Std. Error	T-value	Odds Ratio	P-value
Intercept	-6.46	0.27	-23.93	0.00	0.00
Hours worked	-0.10	0.01	-13.80	0.90	0.00
Number of jobs	0.35	0.01	26.60	1.42	0.00
ETHNICITY					
Indigenous	-0.25	0.03	-7.56	0.78	0.00
reference: Non-indigenous					
EDUCATION					
None	3.10	0.25	12.46	22.20	0.00
Primaria	2.57	0.25	10.39	13.11	0.00
Basico	1.75	0.25	6.89	5.77	0.00
Diversificado	0.84	0.26	3.19	2.31	0.00
reference: Post-divers.					
AGE					
under 25	0.87	0.07	12.56	2.38	0.00
25 to 34	0.63	0.05	12.33	1.87	0.00
35 to 44	0.41	0.05	8.13	1.50	0.00
45 to 54	0.20	0.05	3.70	1.22	0.00
55 to 64	0.13	0.06	2.23	1.14	0.03
reference: 65 and older					
GENDER HHH					
Female head of household	-0.81	0.04	-20.70	0.44	0.00
reference: male head of HH					
POVERTY STATUS					
Extremely Poor	1.47	0.04	33.84	4.35	0.00
Poor	0.98	0.03	30.16	2.67	0.00
reference: not poor					
Number of people					
Dependency Ratio	-0.09	0.01	-12.30	0.92	0.00

AREA					
Rural location	0.70	0.03	21.94	2.01	0.00
reference: Urban location					
REGION					
Region 2	1.32	0.11	11.94	3.74	0.00
Region 3	0.98	0.10	9.47	2.66	0.00
Region 4	1.15	0.11	10.88	3.14	0.00
Region 5	1.55	0.10	15.14	4.71	0.00
Region 6	1.24	0.10	12.23	3.45	0.00
Region 7	1.27	0.11	11.62	3.55	0.00
Region 8	1.07	0.12	9.05	2.91	0.00
reference: Region 1					
YEAR					
2014	0.60	0.03	17.51	1.83	0.00
2011	0.46	0.03	14.15	1.59	0.00
reference: 2006					

4. DISCUSSION

Guatemala ranks low on the United Nations Development Programs development index, has poor food security outcomes, and 10% of the population lives in the United States largely due to poor economic opportunities in the country. Therefore, understanding the relative abundances of jobs types and household occupation portfolios and whether the ones that are increasing in prevalence are improving household well-being is essential for creating effective policy solutions to advance development in the country. Guatemala has a strong agrarian tradition so while this research included information on non-agriculture based jobs, it grouped all non-ag jobs together while splitting agriculture jobs into own-account farming and paid agricultural labor to better understand how rural livelihoods are changing over time.

At the broadest level of classification, this work suggests that the relative percentages of households working in non-agriculture versus agriculture (either own-account or paid labor) is not shifting towards non-agricultural work, contrary to expectations. There are many putative reasons for this but it appears that the development of Guatemala's economy is

proceeding very slowly through the stages of the economic transition model. For rural households, it's likely that urban jobs are difficult to find and that they lack the social networks to find work outside of their communities.

When households are categorized to include those that are involved with both non-agriculture and agriculture, results show that diversification across these sectors is high especially for households that are involved with agriculture. While 30% of households that work in non-agriculture occupations are also work in agriculture, almost two-thirds of households that work in agriculture also work in non-agriculture. Contrary to expectations however, the percent of households in both sectors is not increasing over time. This lack of increasing diversification may be because the percent of rural households working in non-ag is already high and for rural households that are not diversified in this way, there is little opportunity to do so. This is probable for households in more remote locations where there is little economic development outside of the primary sector.

While agriculture continues to remain important, these results suggest that how households engage with agriculture is changing. The percentage of households working for pay on other people's farms is increasing as an absolute percentage within the population (~ 50%), it's increasing as a sole job type utilized by a household within the population (increase by 49%), it's increasing in importance as a job type that is combined with other job types to create a diversified occupation portfolio within the population (increase by 33%), and last, for households engaged in agriculture, the relative share working on other people's farms versus on their own farms increased by almost 33% from 2006 to 2014. Though further research is needed to validate and explain this trend, it seems likely that households located in rural areas are running out of land to farm and that there aren't many opportunities for

them to work outside of agriculture. With little land and few options outside of the primary sector, households have little choice but to work for pay on other people's farms. Though some of this work may be on neighboring family farms, much is likely to be on large scale, industrial farms which is ironic as the development of these farms are a reason that small-holders have land limitations in the first place. For some households, having the option to work for pay in agriculture is probably a great opportunity. If they can continue working their own farm adding this job type will allow the household to have cash which is a rare situation for subsistence farmers and is temporally limited (they only receive cash once or twice a year when they harvest and sell crops).

Last, operating a family farm remains an important part of household livelihood diversification. Whereas few households combine working in non-agriculture with working for pay on a farm (4.50%), twice as many households combine working their own farm with work for pay on other people's farms and about three times as many combine own-account farming with work in non-agriculture based occupations. It's likely that working on one's own farm allows for scheduling flexibility such that household members doing so are able to work other jobs. Though not presented in this paper, other research using the same datasets but looking at individual level work shows that individuals that work in non-agriculture almost never work for pay on farms (and vice versa) but that it's not uncommon for individuals working on their own farm to also work either in non-agriculture or for pay on a farm. This is important because it suggest that for households with only one person working, the main way to diversify is to run their own farm.

With evidence suggesting that the share of households working as paid agricultural labor are increasing in the population, understanding what characteristics they have is

important for determining if they have improving well-beings. The data show that households that work for pay on farms are poorer, younger, and less likely to be indigenous than households working in other job types. Addressing the former, the direction of association between poverty status and working for pay on another person's farm is not certain and may actually be bidirectional. It's plausible that households with fewer assets and less land (more poor) are less likely to have land to pass on to offspring such that these offspring are more likely to need to work for pay on other people's farms. Once working on other people's farms, they are unlikely to be able to purchase land of their own as this type of work is not well remunerated, often insecure, and potentially exploitative in nature (long hours, few breaks, etc). If this is the case, then transition to a more developed economy is replicating poverty with little advantage for the rural poor.

In addition to having lower socioeconomic status, households working for pay on other people's farms are younger than households that are have their own farm. This age difference may exist due to household life cycle or because young people simply have a lesser resource base available to them. In the former situation, young adults leave the house to start their own household, they work for pay on other people's farms, and later in life they either purchase their own land or inherit family land to start their own farm operation. In the latter scenario, land is limited for a variety of reasons and there isn't enough land for young people to have their own farms. Last, it's possible that working for pay on other people's farms is more desirable to young folk than is operating their own farm.

Next, households with less education are more likely to work for pay on other people's farms than they are to work in other job types, which matched with the poverty gap suggests that households with the lowest socioeconomic status are the most likely to work for

pay on other people's farms. If real, this is disconcerting because it suggests generational transmission of poverty. The least educated *Jefes* probably are the least educated because they grew up in the poorest households and as adults they are the most likely to be working for pay on other people's farms probably because their parents didn't have enough land to bequeath to them. Last, the utility of this relationship between education and own farm work versus agriculture labor is questionable as the mean education level of households engaged in any type of agriculture is 2.88 years with mean education years varying from a high of 3.58 years to a low of 2.14 years. It's questionable whether the extra year of education will have a real-world impact on job opportunities.

Last, indigenous households are 16.75% less likely than non-indigenous households to work for pay on other people's farms and this result begs the question of to what degree indigenous households are choosing to not work for pay on other people's farms or if they are not able to work on other people's farms because of prejudice. Furthermore, the indigenous are thought to be very tied to their land which may mean that they are choosing to maintain their own farms and to not work for other people. However, the indigenous in Guatemala have also been historically marginalized and they may be discriminated against when farms are hiring labor.

5. CONCLUSION

With agricultural labor increasing as a livelihood strategy in the population, it may improve household well-being in Guatemala if GO's and NGO's better support individuals and households pursing this type of work. Though more research is needed to verify the efficacy of the following types of support, requiring higher pay for agricultural laborers,

reducing the maximum number of hours that agricultural laborers can work, and enforcing the above may improve rural livelihoods, especially of those with less capital. It's not uncommon for agricultural laborers in Guatemala to be paid the equivalent of 5 USD per day and to work 10 to 12 hours per day.

Future research will fill in the gaps in this study by quantifying jobs worked across the span of a year. There are seasonal aspects to work, especially in agriculture production, so it's possible that the research presented above misses some livelihood activities. Furthermore, additional research will look in depth at individual jobs to better understand how households diversify livelihood activities. For example, households may primarily diversify through one individual working multiple jobs or through multiple individuals working one job. Determining the extent of each is important for the development of effective policy solutions to better help households meet their labor goals. Additionally, future research will determine why individuals and households are working for pay on other people's farms. To what extent are households doing so by choice (i.e. due to pull factors) versus out of necessity (i.e. due to push factors). Finally, more work needs to be conducted to better understand how working for pay on other people's farms impacts household well-being relative to other occupation types.

Chapter Three:

Household livelihoods and well-being in Guatemala: Evidence that subsistence agriculture plays a key role in household food security.

1. INTRODUCTION

1.1 Background

As countries pass through normal development trajectories, the share of gross national product (GNP) generated by agriculture decreases while the share of GNP generated by non-agricultural activities increases (FAO, 2008). This implies that over time a greater percentage of households will rely on non-agricultural activities to meet their needs which will include both households shifting out of agriculture all together or households adding work in non-agriculture activities while continuing to operate their own farm. In theory, these development changes lead to greater household well-being: greater educational achievement, improved health outcomes, and better food security. The last, which has been a focus of developmental agencies for decades, is also the focus of this paper. This research determines if and how household livelihood activities, as measured by the type of work that households are involved in, associates with food insecurity.

The United Nations 2030 Sustainable Development Goals provide a pathway to the eradication of hunger as did their predecessor, the 2015 Millennium Development goals (https://www.un.org/sustainabledevelopment), but over 820 million people across the World remain hungry today. Furthermore, while world hunger was on the decline in the latter part of the 20th century and the first decade of the 21st century, in the last five years this improvement has increased and in several regions, including Central America, hunger has

increased (FAO, IFAD, UNICEF, WFP and WHO, 2019). While the causes of hunger are multifaceted, complex, and driven by events at multiple scales (i.e. individual, household, community, state, nation, region, international) the way a household earns a living, its livelihood, may impact hunger.

A livelihood is the way in which an individual or household secures what they need (and want) to sustain their lives. The sustainable livelihoods framework is a tool to model livelihoods in an all-encompassing manner. Generally used to study poverty, livelihood analysis grew out of Sen's work on entitlements and deprivations of households (Sen, 1981) and today livelihood analysis includes the components in the following diagram borrowed from Scoones (1998) (Figure 1). The well-being of a household (livelihood outcomes including food security, poverty, and educational attainment) depends on the livelihood activities that a household is involved with (jobs), the livelihood resources that a households possesses (including five types of assets or capitals), the institutions and organizations that structure the environment in which a household exists (Bebbington, 1999), and last, the larger scale contexts and conditions that households have little control over but which can impact their lives such as climate, politics, history and international trade agreements (Scoones, 1998 and 2009; Bebbington, 1999). This paper focuses on the aspect of livelihood analysis over which a household has the most control, the livelihood activities (work activities) that they perform and determines if livelihood activities impact household food security.

Food security is commonly defined as "when all people, at all times, have physical and economic access to sufficient, safe and nutritious food to meet their dietary needs and food preferences for an active and healthy life" (1996 World Food Summit) and is critical for

a multitude of reasons. Food security is encoded within Article 25 of the Universal Declaration of Human Rights (1948), it's necessary to improve economic capacity (a well-fed population is more productive than an underfed one), and it's necessary for political and social stability. For example, when food prices rose in 2008-2009 it triggered riots across the globe (Berazeva and Lee, 2013). Most importantly, food security is strongly related to human health. Hunger and food security go hand-in-hand and over time these conditions can lead to undernourishment. If experienced for long periods of time, undernourishment may cause chronic malnutrition (Reinhard and Fanzo, 2014) leading to stunting (low height for age), wasting (low weight for height), or underweight (low weight for age) morphologies (WHO, 2018). Furthermore, undernutrition can cause developmental delays in children, make people more prone to disease, cause swollen and bleeding gums, and lead to dizziness and fatigue. While undernutrition is difficult to quantify[1] and morphological outcomes are not temporally aligned with current household conditions (how current occupation impacts long term conditions), food security can be assessed quickly and cheaply using multiple metrics. Despite its importance, food security remains elusive in many parts of the world with approximately two billion people currently experiencing moderate or severe food insecurity.

One potential way for households to minimize food insecurity is to diversify their livelihoods. Formerly defined as "the process by which rural families construct a diverse portfolio of activities and social support capabilities in order to survive and to improve their standards of living" (Ellis 1998), research show that in many impoverished areas of the world households maintain themselves by piecing together a variety of activities (Bailey and Pomeroy, 1996) and they do so either to survive or thrive. For some households, new work

[1] Measuring undernutrition requires detailed information about the type and amount of food consumed each day, typically gathered using a food diary.

activities may be added just to keep the household afloat. For others, the household might be doing quite well and they add new work activities to thrive or accumulate resources (Ellis, 2000). In either case, it's likely that diversification hedges against risk and is beneficial for livelihood security (Ellis, 2000).

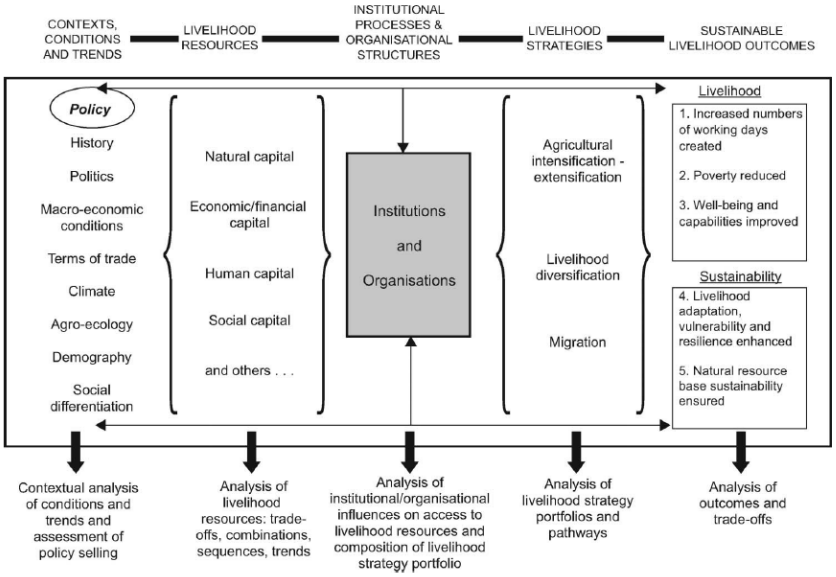

Figure 1. The livelihood analysis framework used to study poverty (Scoones, 1998).

Whatever the case, improvements in communication and transportation infrastructure have probably increased the ease and lowered the cost (reduced the entry barriers) for households to diversify their livelihoods. For rural households, growth of urban areas may improve connectivity to urban centers which may in turn benefit rural household's well-being through the acquisition of for-pay jobs. Conversely, for urban households, greater connectivity to rural spaces may allow the household to operate their own farm or receive food support from rural family and friends, especially in times of need (Zezza and Tasciotti, 2010).

This study is different from the above and thus makes novel contributions to the

literature by using survey data that is nationally representative of all households (both rural and urban) to assess if and how food security is associated with household livelihood occupation portfolio while controlling for multiple known food security correlates, including poverty status. The following research questions are addressed: 1) Is household food security associated with household occupation portfolio? 2) Is household food security associated with geographic characteristics, and 3) Is geographic location or occupation portfolio more important in understanding variation in household food security? By answering the above questions this study aims to contribute to the literature on food security in developing countries determining if the primary resource base for most households, occupation, influences food security outcomes. In doing so, this research will help to inform policy in Guatemala on the areas and households most in need of food support.

1.2 Urban Agriculture and Rural Non-Farm Income: Linked but Separate Literatures

Recent work suggests that the urban-rural dichotomy is artificial and that in most modern societies, households utilize a variety of livelihood activities that don't necessarily correspond to urban or rural definitions (Lerner and Eakin, 2011). Despite this, the majority of past development research has focused either on urban spaces or rural spaces so here, this research is contextualized using two distinct literatures; the field of urban agriculture (UA) and the field of rural non-farm income. As the names imply, the two fields of study examine different populations (urban vs rural) but both sets of literature compare households that include the uncommon activity for the geographic area in question to households that don't. For example, the urban agriculture literature looks at urban households who engage in agriculture, the uncommon activity for an urban space, and compares some aspect of their

food security to urban households that do not engage in agriculture. Similarly, the rural non-farm income literature compares rural households that work for wages off of their farms, the uncommon activity, to rural households that only operate their own farms.

Starting with the urban agriculture field, a recent literature review of the impacts of urban agriculture on food security report three key findings summarized from 35 peer-reviewed journal articles (Poulsen et al., 2015). First, urban agriculture is primarily used to meet subsistence needs and when agricultural products are sold to generate income, it's usually in small amounts. Second, urban agriculture can provide households with specific types of foods that would not otherwise be accessible to them. Last, UA may provide economic and social benefits for women as well as facilitating their contribution to household food availability. In a large empirical paper prior Zezza and Tasciotti (2010) used national level data from 15 developing or transition countries, including Guatemala, to assess if urban agriculture is associated with caloric availability and found that households practicing urban agriculture had higher calorie consumption of dairy and staple products. Last, in more recent work in Kenya, Omondi et al. (2017) show that urban households growing crops have better food security than their urban counterparts that do not do agriculture.

The literature on the impacts of rural non-farm income on food security is mixed with some studies showing a positive influence and others showing no effect or a negative influence. Sharma and Chandrasekhar (2016) examined three groups of households within rural areas in India and determined that households with a commuter working in an urban area had better dietary diversity outcomes. Another study performed in India found that nonfarm income decreased the likelihood of farming households being nutritionally insecure

as quantified by diet quality, or the percentage of food calories coming from staples over the previous 30 days (D'Souza et al., 2020). Research in Africa demonstrates that non-farm work improves income and food security in 150 rural households in Northern Ghana, the later quantified by whether a household's food stock declined during critical periods of food shortages over a one year period (Owusu et al., 2011). Gebremedhin and Swinton (2001), working in Ethiopia, found that households with off-farm work were less likely to participate in food-for-work programs than were farming households without off-farm work. In Central American, Ruben and Van Den Berg (2001) found that Honduran farm households have greater food consumption if involved in non-farm activities. Last, in Eastern Asia Duong and Thanh (2020) found that off-farm employment was positively associated with both food diversity indices and food consumption value.

However, multiple studies have found that off-farm income sources may have adverse effects on food security outcomes as off-farm work may replace labor towards on-farm activities. Chang and Mishra (2008) determined that off-farm work does impact food security but that the direction of the impact depends on whom is working off the farm. When the owner works off-farm food expenditures are higher but when the spouse of the owner works off farm food expenditures are less. Mabuza, Ortmann, Wale, & Mutenje (2016) working in rural Swaziland determined that off-farm-income-dependent households had either lower food security or the same food security as their on-farm-income-dependent household counterparts. Lastly, Pfeiffer, López-Feldman, & Taylor (2009) found a negative relationship between non-farm income and calorie consumption in rural Mexican households. This study recognizes that the distinction between rural and urban may be obsolete in the real world and therefore includes all households (both urban and rural) in analysis to provide a fuller

understanding of how livelihood activities influence food security.

1.3 Guatemala

Guatemala is an excellent country in which to study food security and livelihood diversification because it has poor food security outcomes and rapid societal changes are increasing the potential for livelihood diversification. Urbanization, pressures on small-holder farmers, and migration are just a few of the processes rapidly transforming Guatemalan society. Guatemala has the lowest percentage of urban residents (52%) in Central America but it has the greatest rate of urban population growth at ~ 3.4%, annually (Maria et al., 2017). With the growth of urban areas, there may be increasing opportunities for households to diversify. Migration from Guatemala to the United States has long been an important component of the Guatemalan economy and this continues today. Approximately 1 in 10 Guatemalans live in the United States and 2019 remittances made up 13.89% of GDP at 10.65 billion dollars (USD)(World Bank, 2020). While migration is costly, risky, and has potential negative impacts to both the migrant and the family that stays behind, this is certainly an opportunity for households to increase or gain income and to do so in a highly diversified manner. Lastly, the framework within which small-holder farmers operate is increasingly challenging making farming a more difficult and less desirous occupation to provide for a family. With population growth, land consolidation, international trade policy, soil degradation, and little government investment in small-holder agriculture, many households are finding it necessary to leave agriculture or combine working their own farm with other livelihood options. Furthermore, land distribution in the largely agrarian country has always been highly iniquitous and is probably increasingly so today as multinational

corporations acquire land for global products such as palm oil and narco-traffickers acquire large tracts of land with which to launder money through cattle ranching (Grandia, 2009; Grandia 2013).

Guatemala ranks consistently low in different development indices including those that quantify hunger and food security. In 2019, the United Nations Development Program (UNDP) ranked Guatemala 126 out of 189 countries on the Human Development Index (HDI) and 59.39% of the population lives below the poverty line (2018) (UNDP, 2019). Of the population of approximately 15 million people, 2.8 million people are severely food insecure and 4.6 million people are moderately food insecure; the largest absolute number of people experiencing food insecurity in C.A. (FAO, 2014). Lastly, Guatemala has both the highest percentage (46.7%) and highest absolute number of children under 5 who are stunted (900,000) of all Latin America and Caribbean countries (FAO, 2014). These numbers are so poor that they rank Guatemala as one of the worst countries in the world in terms of childhood stunting. In parallel to this and in tandem with tendencies throughout the world where the indigenous are more food insecure and hungry (Lemke and Delormier, 2017), indigenous Guatemalan children younger than five years old are twice as likely to be stunted as their non-indigenous peers (Fukuda-Parr 2016).

2. METHODS

This research uses secondary data from the 20*14 Encuesta Nacional de Condiciones de Vida* (ENCOVI) performed by *the Instituto Nacional de Estaditica* (INE) of the Guatemalan government (www.ine.gob.gt). The ENCOVI survey is based on the Living Standard Measurements Survey (LSMS) produced and deployed by the World Bank in

multiple countries across the globe (World Bank, 2020), including in Guatemala in 2000, 2006, 2011, and 2014. Data produced by the survey is representative at the national and regional levels and was conducted with approximately 11,536 households and 55,000 individuals throughout the year of 2014. The survey instruments are approximately 60 pages in length and contain hundreds of questions; some of which are asked of the household generally and some of which are asked of every individual in the household. Data from multiple question sets within the survey were used in analysis but two question sets were of particular importance for this study; the food security and occupation modules.

2.1 Food Security

The dependent variable in this study, household food security status, was quantified using the *Escala Latinoamericana y Caribeña de Seguridad Alimentaria* (ELCSA) which was first developed by the Food and Agricultural Organization of the United Nations (FAO, 2012). As the name implies, the survey instrument was developed to better assess household food security in Latin America and the Caribbean and is closely based the on the Household Food Insecurity Experience Scale (HFIES), another food security measure developed by FAO and used throughout the world.

The ELCSA instrument asks a series of 15 questions to evaluate many different components of food security. For example, the first question asks if there has been worry and anxiety in the household due to lack of resources to acquire food. Several questions then about diversity of food types/items consumed, and the last several questions ask if the household has consumed less food than they would like. Furthermore, the first eight questions ask about adult members of the households and the household generally and the

second eight questions ask a similar set of questions about household members under the age of 18. All questions have binary responses and to determine a household's food security status, affirmative responses are summed and this number is compared to a predetermined scale which relates the ELCSA score to food security status. As households without children are asked a smaller number of question than households with children, there are different scales by household type. For households without children, zero (0) affirmative responses designates a household that's food secure, a score equal to 1- 3 corresponds to a household with "mild food insecurity", a score of 4 to 6 corresponds to a household with "moderate food insecurity" and a household with a score of 7 to 8 corresponds to a households with "severe food insecurity". For households with children, a zero score also corresponds to a household that is "food secure", a score of 1-5 corresponds to a household with "mild food insecurity", a score of 6 to 10 corresponds to a household with "moderate food insecurity" and a score of 11 to 15 corresponds to a household with "severe food insecurity". The food security variable used as the outcome variable in this analysis is therefore ordinal with four levels.

2.2 Occupation Profile

The next major set of variables used in this study came from the ENCOVI question set asking households about occupations. Whereas the ELCSA was asked of the household generally, the occupation questions were asked about each individual (over the age of 6) in the household. If the individual worked more than one occupation, questions were asked about the first two occupations. Consisting of approximately 100 questions, the module includes questions about the specific job roll of the individual, the primary purpose of the

company that the person worked for (if not themselves), and whether the individual worked for themselves, a family member, or someone else.

This study used the above three questions to classify individual jobs into three job types, as follows. First, a job where an individual worked on their own farm or on the family farm without pay was classified as "own-farm operation". Second, a job where a person worked on someone else's farm for pay was classified as "paid agricultural labor". Last, a job that did not involve the person working on a farm was classified as "non-agriculture work". This latter category is broad as it includes all jobs outside of agriculture, whether self-employed or employed by another, and in all sectors of the economy. Once each individual job was classified, they were aggregated to the household level. For example, if individual one of household "a" operated their own farm and individual 2 of household "a" worked in "non-agriculture", then household one has an occupation profile of "own farm operation and non-agriculture work". This aggregation yields seven different household occupation portfolios as outlined below:

1) Own-farm operation only: households that only work on their own farm

2) Ag labor only: households that only work for pay on other people's farms

3) Non-ag only: households that only work outside of agriculture

4) Own-farm operation and Ag labor: households that work both on their own farm and on other people's farms

5) Own-farm operation and Non-ag: Households that work on their own farm and outside of agriculture

6) Ag labor and Non-ag: Households that work on other people's farms and outside of agriculture

7) Own-farm operation, Ag labor, and Non-ag: households that work in each occupation type

In the analysis, occupation portfolio is used as a nominal independent variable with seven levels; one level corresponding to each occupation portfolio. Because occupation portfolios do not include information on the number of people working in each occupation type or the number of hours worked in each occupation type, the total number of jobs worked by the household and the total number of hours worked by the household are included in analysis as two separate continuous variables.

2.3 Geographic Characteristics

hile household occupation portfolio is the primary independent variable of interest, we also sought to better understand and control for how geographic characteristics are associated with household food security. To do this region and area (urban/rural) location of the household was included in analysis. Guatemala is commonly divided into 8 regions based on topographic and human characteristics as described below (see Fgure 1):

- Region 1: *Metropolitana*. Guatemala City Metropolitan Area. The largest urban center in Guatemala and the nation's capital.
- Region 2: *Norte*. Alta Verapaz and Baja Verapaz. Traditionally an area with a very large indigenous population.
- Region 3: *Nororiental*. El Progreso, Zacapa, Izabal, and Chuiqimula.
- Region 4: *Suroriental*. Jalapa, Jutiapa, and Santa Rosa. This región contains a smaller strip of the fertile Pacific lowlands than either región 1 or región 5 and more of the mountainous terrain that

- Region 5: *Central*. Chimaltenango, Sacatepequez, and Escuintla. Located largely on the Pacific flatlands this area has experienced relatively recent growth of industrialized agriculture.

- Region 6: *Suroccidental*. San Marcos, Quetzaltenango, Totonicapan, Solola, Suchitepequez, Retalhuleu. This region contains the most industrial agriculture operations in the country with large mechanized and irrigated farms.

- Region 7: *Noroccidental*. Huehuetenango and Quiche.

- Region 8: *Petén*. The last region of Guatemala to be developed; it is the most rural containing 1/3 of the country's land mass and 1/15 of the country's population.

Figure 2. Map of regions of Guatemala and map of topography of Guatemala.

In addition to including the regional location of households, analysis also includes whether a household is located in an area designated as urban or rural by the Guatemalan government. Urban and rural designations in Guatemala are largely made based on population size. Villages with more than 2000 people and with more than 51% of residences containing electricity and running water inside of the house are designated as urban while

smaller villages with fewer services are designated as rural. Also, most rural agrarian households are not located on the land that their farm is on, but instead are located in nuclear settlements (villages/communities). Though some households may be isolated, few are.

In addition to the above independent variable, several demographic variables were included in the analysis including ethnicity, age of household head, gender of household head, number of people in the household, education level of household head, and the percent of household members that are dependents. Of special interest here is ethnicity as the indigenous are often reported to have higher child malnutrition than their ladino counterparts.

2.4 Ordinal logistic regression

n ordinal logistic regression (OLR) model was used in analysis to determine if the independent variables, especially occupation portfolio, associate with household food insecurity. OOLR was used because the response variable (Y) has ordered categories/levels (J) and the model assesses the log odds (logit) of the cumulative probability that Y is less than or equal to a specific category of J given the independent variables. Mathematically, this is represented as,

$$\log\left(\frac{P(Y \leq j)}{P(Y > j}\right) = \beta_j - \eta_1 x_1 - \ldots - \eta_p n_p$$

It is commonplace to exponentiate the coefficients (β, η) to create odds ratios for ease of interpretation. In the analysis done here, the household food security rating is the dependent variable (Y) with 4 categories (J) ordered as follows: not food insecure < mild food insecurity < moderate food insecurity < severe food in insecurity. When an odds ratio is greater than one for a given independent variable (i.e X_1), for example 1.5, this indicates that

for every one unit increase in X_1, the odds of a household being more food insecure rather than less food insecure increases by 50% (1.5 times).

Because the model deals with the cumulative probability, the concept of more food insecure rather than less food insecure can be defined in multiple ways. For example, this can mean that a household is more likely to be severely food insecure rather than moderately, mildly, or not food insecure. It can also mean that a household is more likely to be either severely or moderately food insecure rather than mildly food insecure or not food insecure. Lastly, it can mean that a household is more likely to be severely, moderately, or mildly food insecure rather than not food insecure.

3. RESULTS

3.1 Individual ELCSA questions and ELCSA categorizations

We begin the results section by looking at the percentage of all households that responded affirmatively to the first eight questions in the ELCSA question module (Table 1). The first ELCSA question is the most subjective in that it doesn't ask about an actual state but instead asks whether the household was worried about not having enough food to eat in the past three months. 71.32% of all households responded affirmatively to the question and as expected this is the question with the highest percentage of affirmative responses. For most people, worry precedes actual food limitation (ELCSA Q1). The second questions asks whether the household ran out of food because of a lack of money or other resources and 28.34% of households responded affirmatively (ELCSA Q2). The third and fourth questions both ask about dietary diversity rather than limitations to total food access. 54.42% of households were unable to eat healthy and nutritious food (ELCSA Q3) while 55.70% of

households ate only a few kinds of foods because of a lack of money or other resources (ELCSA Q4). Questions 5 through 8 all ask about households not eating as much as they should with questions differing based on how households did not consume enough food. 20.28% of households had to skip a meal (ELCSA Q5) while 36.77% of households ate less than they thought they should because of a lack of money or other resources (ELCSA Q6). Lastly, the questions addressing the most severe food limitations indicate that 19.14% of households were hungry but did not eat (ELCSA Q7) and 12.19% of households went without eating for a whole day because of a lack of money or other resources (ELCSA Q8)(Table 1).

Table 1. The percent of households responding affirmatively to individual ELCSA food security questions for households with children, households without children, and for all households.

ELCSA QUESTION #	Questions	Households with children (N = 8,885)	Households without children (N = 2,641)	All households (N = 11,536)
	Questions about adults			
1	Worried that food will run out?	74.5	60.5	71.3
2	Had no food in the house?	30.3	21.7	28.3
3	Not had healthy food?	58.4	41.6	54.6
4	Had a limited variety of food?	56.2	40.1	52.5
5	Skipped a meal?	19.3	14.1	18.1
6	Ate less than they should?	37.1	24.4	34.2
7	Felt hungry because of a lack of food?	19.4	13.6	18.1
8	Eat only once a day or not at all?	11.5	9.4	11.1
	Questions about children			
10	Not have healthy food?	50.5	NA	NA
11	Have a limited variety of food?	48.9	NA	NA
12	Skip a meal?	12.9	NA	NA
13	Eat less than they should?	27.6	NA	NA
14	Receive less food than they should?	24.8	NA	NA
15	Feel hungry because of a lack of food?	10.6	NA	NA
16	Eat only once a day or not at all?	6.9	NA	NA

The Latin American and Caribbean Food Security Scale (ELCSA) groups households

into four different categories of food insecurity and this nationally representative sample shows that over three quarters of households (77.43%) report some level of food insecurity in Guatemala (Table 2). More importantly, about 37% of all households are classified as moderately to severely food insecure. This percentage increases to 40% for households with children and decreases to 27% for households without children.

Table 2. The percent and cumulative percent of all households, households without children, and households with children with different levels of food security (N = 11,536).

	HHs with children		HHs without children		All households	
Food Security Level	Percent	Cum. Percent	Percent	Cum. Percent	Percent	Cum. Percent
Severe Food Insecurity	12.8	12.8	9.47	9.47	12.04	12.04
Moderate Food Insecurity	26.97	39.77	18.15	27.62	24.95	36.99
Mild Food Insecurity	41.04	80.81	38.4	66.02	40.44	77.43
Food Secure	19.18	NA	33.99	NA	22.57	NA

3.2 Occupation portfolios

The occupation portfolios utilized by the largest percent of households in the study population is working only in non-agriculture based occupations (49.29%). This is followed by two occupation portfolios with similar prevalence's. Households that work both on their own farms and in non-agriculture based occupations are 11.42% of the population while households that work both on their own farm and on other people's farms are 10.42% of the population. Next are two occupation portfolios which consist of only one job type each. Households that only work on other people's farms are 7.31% of the population and households that only work on their own farm are 7.22% of the population. Last, the two least common occupation portfolios are

Table 3. The percent of households with each occupation portfolio (N = 11,536).

Occupation portfolio	Percent
Non-agriculture	49.3
Own farm, Non-ag	11.4
Own farm, Ag labor	10.4
Ag labor	7.3
Own farm	7.2
Non-ag, Ag labor	4.9
Own farm, Ag labor, Non-ag	3.8

households that work both in non-ag occupations and on their own farm (4.94%) and households that work in all three job types (3.78%) (Table 3).

3.3 Food security level by household occupation portfolio

Based on the descriptive statistics (percentages), food insecurity level appears to vary with household occupation portfolio and household occupation portfolios naturally sort into four food insecurity groups (Table 4). The most food insecure group consists of households with just one occupation portfolio, those that work both on other people's farms and on their own farms and they are more food insecure, by far, than households with every other occupation portfolio. Of these households, only 8.33% are food secure, the lowest percentage of all portfolios, and almost 70% are moderately to severely food insecure. The group with the second greatest amount of food insecurity includes households with three different occupation portfolios: 1) households that work on other people's farms and in non-agriculture occupations, 2) households that work only on other people's farms, and 3) households that work in each of the three job types classified in this study. The percentages of households with these occupation portfolios that are food secure are in the low double digits (13.02%, 12.72%, and 10.05%, respectively) and though the percentages of households with mild, moderate, and severe food insecurity varies slightly between occupation portfolios, they have more similar food insecurity levels to one another than they do to other households. The third group consists of households with two occupation portfolios; 1) households that only work on their own farm and 2) households that work on their own farm and in non-agriculture occupations. 18.44% of the former and 16.92% of the latter are food secure while only 21.45% of the former and 17.06% of the latter are severely food insecure.

These households have the third greatest amount of food insecurity or conversely, the second best food security outcomes. Last, the households with the least amount of food insecurity are the households that only work in non-agriculture based occupations. 30.07% of these households are food secure and only 9.28% are severely food insecure (Table 4).

Table 4. The percent of households in each food insecurity (FI) level by occupation profile (N = 11,536).

	Secure	Mild FI	Moderate FI	Severe FI	Total
Non-agriculture	30.1	41.9	18.8	9.3	100.0
Own farm, Non-ag	16.9	46.6	27.4	9.2	100.0
Own farm, Ag labor	8.3	32.7	39.4	19.5	100.0
Ag labor	12.7	39.7	28.9	18.7	100.0
Own farm	18.4	37.0	32.9	11.7	100.0
Non-ag, Ag labor	13.0	35.9	30.6	20.5	100.0
Own farm, Ag labor, Non-ag	10.1	39.7	37.1	13.2	100.0

3.4 Ordinal logistic regression (OLR)

Household occupation portfolio

ccupation portfolio was included in the model as a factor variable and the level with the lowest ELCSA score, working both on one's own farm and in non-agriculture, was set as the reference level (Table 5). Results show that there are four groups of occupation portfolios that have statistically significant different food insecurity levels from one another. The first group contains just one occupation portfolio, "Non-ag, Other- ag", which has odds of being more food insecure (rather than less food insecure) 1.80 times greater than that of households with the occupation profile “own-farm, non-ag' ($p < 0.001$). Households working in non-ag, ag labor" also have significantly greater odds of being more food insecure relative to all other occupation profiles (Table 5).

The second group of occupation profiles contains households working in “own-farm, ag labor" and just "ag labor”. The odds of these two occupation profiles being more food

insecure are 1.53 and 1.51 times that of households working the "own-farm, non-ag" occupation portfolio, respectively (p=0.00, p=0.00). The third group of occupation profiles includes households working in all three occupation types and households only working in non-agriculture occupations. The odds of households working in all three job types (own-farm, ag labor and, non-ag) being more food insecure rather than less food insecure is 1.28 times that of households working in the "own-farm, non-ag" reference group. For households only working in non-agriculture, the odds that they are more food insecure is 1.28 times that of households in the reference group.

The fourth group contains the two occupation profiles with the best food security outcomes. Households working only on their own farms and the reference level, households working both on their own farms and in non-agriculture jobss, have the lowest odds of being more food insecure compared to all other occupation profiles.

Two other variables about occupations were included in analysis. The first, number of hours worked per week, was statistically significant. For every additional twenty hours worked, the odds of a household being more likely to be food insecure decrease by 3%. Contrary to this, for the variable "number of jobs worked", the odds of being more food insecure increase 1.05 times for each additional job worked by the household (Table 5).

Household characteristics

Analysis included three different household characteristics: poverty status (extremely poor, poor, not poor), number of people in the household, and the percentage of dependents in the household. As was expected, poverty status was a statistically significantly associate of food insecurity. For poor households, the odds of being more food insecure (rather than less

food insecure) are 1.93 times greater than that of non-poor households. The discrepancy was greater between extremely poor households and non-poor households with the odds of an extremely poor household being more food insecure 2.95 times greater than that of non-poor households. Furthermore, when comparing extremely poor households to poor households, the former are much more likely to be more food insecure (Table 5).

In addition to poverty status, both the total number of people in the household and the percentage of household members that are dependents appear to influence food insecurity. The number of people in the household is statistically significant but has a small effect size, with each additional person in the household increasing the odds of being more food insecure by 0.4% ($p = 0.06$). Lastly, mirroring results from the descriptive statistics where households with children were generally more food insecure than their childless counterparts, the percent of household members that are less than 7 years old or greater than 65 years old is associated with food insecurity and the effect size is greater than that for the number of household members. For every ten percent increase in number of dependents, the odds of a household being food insecure rather than less food insecure increase by 6% ($p=0.00$) (Table 5).

Characteristics of household head

Four demographic characteristics of the household head were included in the analysis: 1) ethnicity (indigenous vs. non-indigenous), 2) education (level achieved), 3) age and 4) sex (male or female). The first, ethnicity, was not found to be a statistically significant associate of food insecurity, but the latter three were. For each additional level of school attended, the odds of a household being more food insecure decreased on average by approximately 106%, with some variation between different levels. When comparing

households with no formal education to households with some college, *post-diversificado,* , the former are 5.25 times more likely to be food insecure. Age of the household head is associated with the household's food insecurity but the effect size is small. The odds of a household being more food insecure rather than less food insecure are greatest for households in the four youngest age categories. Lastly, female headed households have odds of being more food insecure 1.29 times greater than that of male headed households (Table 5).

Geographic characteristics

Two geographic characteristics were included in analysis: 1) region and 2) location (urban or rural). Region is a statistically significant associate of food insecurity and the effect size is large. For example, the region with the lowest odds of being more food insecure rather than less food insecure (region 6) is 86% less likely to be more food insecure than the region with the greatest odds of being more food insecure (region 4). Five groups of regions emerge as being statistically different from one another in terms of food insecurity outcomes. Region 6 is in its own group and has the lowest odds of being food insecure. Regions 1, 5, and 7 are in the second group and have the second lowest odds of being food insecure. The third group contains regions 3 and 8 and the fourth group contains region 8 again in addition to region 2. Region 8 has similar odds of being food insecure as regions 2 and 3 while region 2 has greater odds of being insecure than does region 3. The last group, group 5, contains just region 4 which has greater odds than all other regions of being more food insecure rather than less food insecure. Finally, we look at household location. Defined as either being

located in a rural or urban location these results show that households in a rural location have odds of being more food insecure 1.07 times greater than that of urban households (Table 5).

Table 5. Ordinal logistic regression model results of independent variables associated with food security (N = 11,536)

Independent Variables		Coefficient	Std. Error	T-value	Odds Ratio	P-value
HH OCCUPATION PORTFOLIO	Non-ag, Ag labor	0.61	0.09	6.75	1.84	0.00
	Own farm, Ag labor	0.46	0.07	6.27	1.59	0.00
	Ag labor	0.46	0.08	5.74	1.59	0.00
	Own farm, Ag labor, Non-ag	0.27	0.10	2.74	1.31	0.00
	Non-ag	0.20	0.06	3.09	1.22	0.00
	Own farm reference: Own farm, Non-ag	0.09	0.08	1.13	1.10	0.13
	Hours worked	-0.03	0.01	-2.77	0.97	0.00
	Number of jobs	0.06	0.02	2.68	1.06	0.00
ETHNICITY	Indigenous reference: Non-indigenous	0.06	0.05	1.22	1.06	0.11
EDUCATION	None	1.66	0.11	14.48	5.25	0.00
	Primaria	1.40	0.11	12.99	4.06	0.00
	Basico	1.14	0.12	9.58	3.12	0.00
	Diversificado reference: Post-divers.	0.60	0.11	5.31	1.83	0.00
AGE	under 25	0.37	0.10	3.72	1.45	0.00
	25 to 34	0.39	0.07	5.52	1.47	0.00
	35 to 44	0.34	0.07	4.84	1.40	0.00
	45 to 54	0.40	0.07	5.37	1.50	0.00
	55 to 64 reference: 65 and older	0.26	0.08	3.34	1.30	0.00
GENDER HHH	Female head of household reference: male head of HH	0.26	0.05	5.35	1.30	0.00
POVERTY STATUS	Extremely Poor	1.13	0.07	17.12	3.10	0.00
	Poor reference: not poor	0.66	0.05	14.14	1.94	0.00
	Number of people	-0.02	0.01	-1.56	0.98	0.06
	Dependency Ratio	0.06	0.01	5.83	1.06	0.00
AREA	Rural location reference: Urban location	0.07	0.04	1.66	1.07	0.05
REGION	Region 4	0.52	0.08	6.32	1.68	0.00
	Region 2	0.37	0.10	3.71	1.44	0.00
	Region 8	0.26	0.10	2.47	1.29	0.01

Region 3	0.18	0.08	2.26	1.20	0.01
Region 5	0.07	0.08	0.98	1.08	0.16
Region 7	0.08	0.09	0.86	1.09	0.19
reference: Region 1					
Region 6	-0.17	0.08	-2.23	0.85	0.01

4. DISCUSSION

Drawing from the sustainable livelihoods literature (Chambers and Conway, 1992; Bebbington, 1999; Scoones, 1998) this study assesses the influence of livelihood strategy, in particular, household occupation portfolio (composed of three different job types), on food insecurity status as quantified by the Latin American and Caribbean Food Security Scale (ELCSA) using a representative sample of households from the Guatemalan population. In addition to assessing occupation related variables, the normal suite of household characteristics are included in analyses as well as two geographic variables. The latter are included to better understand the interplay of occupation and location in determining food insecurity in Guatemala. Recognizing the connectivity of urban and rural spaces and the somewhat arbitrary designations of urban or rural, data for all households, both those designated as rural and urban, are included in analysis.

Results show that household occupation portfolio is strongly associated with food insecurity above and beyond the normal suite of variables that influence food insecurity (including poverty status, education level and geographic location) and that the influence of occupation profile on food insecurity is somewhat different when looking at the univariate results versus the multivariate results.

The clearest signal in the data is that households working for pay on other people's farms, whether as the only job type in the household or combined with other job types, are

the households most likely to be food insecure. Of the seven household occupation portfolios classified in this study, the four with the greatest likelihood of food insecurity include working on other people's farms and this is observed in both the univariate and multivariate results. Putative reasons for this association include that working for pay on other people's farms pays much less than work for pay outside of agriculture and that working in agriculture may be more insecure (temporary) than non-agriculture work (Hodges and Sweeney, unpublished data). It's also likely that working for pay on other people's farms tends to be more of a survival strategy rather that a strategy that allows a household to thrive and accumulate wealth. For many rural individuals faced with land loss or land constraints, there are few jobs outside of agriculture due to undeveloped local economies and because they live far away from urban areas. Furthermore, it's probable that rural households are only going to work on other people's farms if they don't have enough land to work on their own farm. The high food insecurity of households working on other people's farms is problematic for household well-being in Guatemala because past research suggests that the percent of households relying on this type of work for their livelihoods is likely increasing in the population (Hodges and Sweeney, unpublished data). In Guatemala currently, approximately 26% of households are working on other people's farms (ENCOVI, 2014).

Compared to working for pay on other people's farms, households that have their own farm are generally less likely to be food insecure and this was observed in both the univariate and multivariate case. Whereas households with occupation portfolios that include working on other farms are in the bottom four ranks of food insecurity, households with occupation portfolios that include working on their own farm rank in the 1st, 2nd, 4th and 6th positions. Furthermore, when we eliminate the occupation portfolios that include both

working on their own farm and working on other people's farms we find that households working on their own farms are ranked 1st and 2nd while households working on other people's farms are ranked 5th and 7th. This strongly suggests that households who have their own farm have better food security (less likely to be food insecure) than households that work for pay on other people's farms. Lastly, we observe a wide range of food insecurity outcomes for households working on their own farms (1st, 2nd, 4th and 6th positions) and this is probably due to the size and quality of landholdings. Households holding larger areas of land and/or higher quality land generally have better food security outcomes. For example, it's likely that households that only work on their own farms have more land or land that is of better quality than households that work both on their own farms and work on other people's farms.

The association between non-agriculture work and food insecurity in this study is complicated for two reasons. First, households only working in non-agriculture activities have different food insecurity ranks in the univariate case than in the multivariate case and second, the food insecurity ranks of occupation portfolios containing non-ag job types are diffuse. In the latter, occupation portfolios that include the non-ag job type are ranked 1st, 3rd, 4th and 7th in food insecurity out of the seven occupation portfolios. Potential reasons for the diffuse ranks include the wide variety of jobs classified in this rather generic category. For example, it includes households working for other people in permanent, professional positions as well as day-labor work and households that work for themselves (run their own business). Also, it's possible that the real-world type of non-agriculture job is associated strongly with the other job types used here (own-ag, ag labor). For example, low-pay, temporary, part-time non-ag jobs may be prevalent amongst households that also work on

other people's farms while higher paying, permanent non-agriculture jobs may be prevalent with households that work on their own farms.

The second interesting aspect of the non-ag results is that households only working in non-agriculture activities have the least likelihood of food insecurity in the univariate case but are ranked third in food insecurity in the ordinal logistic regression model. There are multiple causes for this disparity. First, households that only work in non-agriculture don't have the ability to maintain a portion of their harvest for emergencies and are also subject to the whims of others. Though not analyzed here, most non-ag jobs in Guatemala are non-contractual and short term. Furthermore, these households may be the most truly urban households in the sample limiting their ability to gain sustenance from "forest products". In other words, in times of strife these households are less able to gather natural products such as fruits and vegetables that grow wildly to sustain themselves.

In addition to the above, the ELCSA metric used in this study to quantify food insecurity asks a series of subjective questions and it's possible that how subjects respond is influenced not only by their food access situations but also by past and current experience. For example, households only engaged in non-agriculture based activities have more education and greater SES on average than households with other occupation portfolios and may have different food standards. A rural household that consumes "maize" and "frijol" every day of the week may feel that their diet has excellent diversity and respond negatively to ELCSA questions while an urban household consuming the same diet may think that their diet is not nutritiously adequate and respond affirmatively to ELCSA questions.

Last, the discrepancy between the univariate data and the multivariate case may be due to a positive association between a household only working in non-ag and other variables

that associate negatively with food insecurity. For example, households that only work in non-ag have more education and are less likely to be extremely poor than households with other occupation profiles, both characteristics that make a household less likely to be food insecure.

In addition to household occupation portfolio, the analysis and results include information about the total number of hours worked by the household and the total number of jobs being worked by the household. Results show that households that work more hours have better food security outcomes while those that work a greater number of jobs are more likely to be food insecure. These results suggest that households tend to work more jobs as a survival strategy rather than as an accumulation strategy and that fewer, better quality jobs may improve a household's well-being.

Though the analysis presented above was not constrained only to urban or rural households, the results have implications for the urban agriculture and rural non-farm economy literatures. Fitting the results into the rural non-farm economy literature we find that off-farm work for income does influence food insecurity of farming households but that the type of non-farm employment is important. Farming households that have off-farm income from non-agriculture activities are less likely to be food insecure while farming households that have off-farm income from working on other people's farms are more likely to be food insecure. This may be because working on other people's farms pays less than working non-agriculture jobs and it may be because households with smaller farms are more likely to work on other people's farms than they are to work outside of agriculture. This difference may help to explain why the literature on rural non-farm employment is mixed when it comes to food security outcomes. Numerous studies suggest that farm households

that work non-farm jobs have better food security outcomes than farm households that do not (Duong and Thahn, 2020) but other studies suggest that pulling labor off the family farm can actually result in worse food security outcomes (Chang and Mishra, 2008). This study may shed light on this disparity in that if non-farm income comes from low paying work on other people's farms it may be a better strategy for households to maintain that labor on their own farm.

When looking at these results from the perspective of urban agriculture we find that households that work on their own farms and in non-agriculture may have better food security than households that only work in non-agriculture. In this manner, this study suggests that urban households have better food security outcomes when conducting their own farming. Furthermore, separate analyses (that are not included here) were performed for rural households and for urban households and results of these were consistent with the results from the presented statistical model.

The geographic characteristics used in the analysis include region of residence and urban/rural location. Households in regions 2, 3, 4, 6, and 8 have significantly higher chances of food insecurity than do households in regions 1 (predominantly Guatemala City metropolitan area) and household in rural areas experience significantly greater food insecurity than households in urban areas. The reason for this may be that the rural and urban designations used (as set by the Guatemala government) can be quite arbitrary wherein urban areas don't necessarily have more urban characteristics than rural areas. Having said this, households in designated rural areas are shown to have poorer food security outcomes relative to households in urban areas suggesting that interventions should be targeted to rural communities. This is not a surprising result.

5. CONCLUSION

With results from chapter two showing that the percent of households with an individual working in paid agricultural labor are increasing in the population and results from this chapter suggesting that these households are more likely to experience food insecurity, it may be necessary for governmental and non-governmental organizations to improve conditions for agricultural workers in order to improve household well-being in the country. Though this research doesn't examine mechanisms by which for-pay agricultural laborers may effectively be supported by institutions, higher pay and workplace protections to prevent exploitation are likely to be good starting points. At the national level, agriculture laborers are paid much less than laborers working in non-agriculture occupations and agricultural workers often work longer hours than they are paid for. Furthermore, many agricultural laborers work in potentially dangerous conditions, for example, spraying agricultural chemicals without wearing personal protective equipment. Higher pay and better work-place conditions might benefit laborers and their households.

Chapter Four:

Jobs and food security in the peri-urban zone of Petén, Guatemala: Daily work commuting to the urban center associates with poor food security outcomes.

1. INTRODUCTION

The United Nations 2030 Sustainable Development Goals (goals 2 and 3) focus on eliminating hunger as did their predecessor, the 2015 Millennium Development Goals (goal 1), but despite these initiatives, approximately 870 million people across the globe consume fewer calories than they need (FAO, 2012). Throughout the decades of effort to reduce world hunger, society has been changing rapidly with one change a shift in location of population. The World became a majority urban place for the first time in 2007 (UN, 2009) and though rates vary by country and region, all world regions are urbanizing. With shift in population to cities, understanding how hunger varies across different types of space (urban, rural and peri-urban) and how connections between different types of space influence hunger is essential for improving individual and household's well-being today and into the future.

With advances in communication and transportation technologies increasing the connectedness between places (i.e. Tacoli, 1998, 2003), including between urban centers and their outlying rural areas, understanding if and how these flows impact household well-being is essential. Peri-urban spaces are an appropriate place to study connectivity because they exist at the boundary of rural and urban spaces and are likely to experience the pros and cons of flows between. While rural and urban spaces are traditionally defined and tend to have relatively clear delineations, peri-urban zones have both urban and rural features (Aberra and King, 2005) and are created when formerly rural areas are physically and/or functionally

incorporated into nearby urban spaces (Awitia, 2004). Physical incorporation is the expansion of built-up (urban) space closer to, adjacent to, or around the previously rural area while functional incorporation is the connection of processes and linkages formerly contained within the urban space, out into the newly created peri-urban zone. Examples of these linkages include the expansion of urban government to include the rural space, the flow of pollution from urban areas into rural areas (for example,polluted water from an upstream city passing through a downstream rural village) and a special focus of this study, the movement of individuals between their rural villages and nearby urban centers. Last, with urbanization occurring throughout the World, peri-urban zones will grow in population size and geographic extent necessitating better understanding of how they function in order to improve conditions as they transition from their rural/ agrarian pasts to their urban futures.

As a basic need, adequate food is essential to well-being and underpins many other aspects of a secure life. While hunger is difficult to quantity and caloric assessment of individuals and households is time consuming and cost prohibitive, multiple metrics have been developed to assess food security, commonly defined as follows from the 1996 World Food Summit. “Food security is achieved when all people, at all times, have physical and economic access to sufficient, safe, and nutritious food to meet their dietary needs and food preferences for an active and healthy life”. Food security is critical for a multitude of reasons. It’s encoded within Article 25 of the Universal Declaration of Human Rights (1948), it's necessary to improve economic capacity (a well-fed population is more productive than an underfed one), and it’s necessary for political and social stability. As an example of the latter, food riots across the globe were triggered in 2008-2009 when food prices rose. Despite its importance, food security remains elusive in many parts of the world.

Household food security in peri-urban communities may be influenced (for better or worse) through connections to nearby urban centers. Food security may be improved if urban centers provide new and/or better work opportunities, a wider diversity of food,lower food prices on previously hard to find items, or through the introduction of new ideas and the most current knowledge on healthy eating. Negative food security outcomes may arise if greater connectivity to the urban center causes rural households to lose their land (i.e. through land speculation, conversion of public land to private land, etc.) or if greater connectivity leads to increased costs of living. Despite the many ways that connectivity may alter food security, few studies explicitly examine food security in peri-urban settings.

Central America is urbanizing at the second greatest rate of any region in the World and while 59% of Central Americans live in urban spaces, it's estimated that 70% will live in cities within the next several decades (Maria et al., 2017). Among Central America nations, Guatemala has the lowest percentage of urban residents (52%) but the greatest rate of urban population growth at ~ 3.4%, annually. At the same time, Guatemala has poor development outcomes. The United Nations Development Program (UNDP) ranked Guatemala 126 out of 189 countries on the Human Development Index (HDI) in 2019 and 59.39% of the population lives below the poverty line (2018) (HDR 2019). With 2.6 million people undernourished, 2.8 million severely food insecure, and 4.6 million moderately food insecure, Guatemala has the largest absolute number of people experiencing food insecurity in C.A. Last, of reported CA countries, Guatemala has both the highest percentage (46.7%) and highest absolute number of children under 5 who arestunted (900,000). This is also the greatest rate of child stunting in all of Latin America and the Caribbean (FAO, 2014)). With poor development outcomes and rapid societal change, Guatemala is an excellent country to

develop a better understanding of how hunger varies across different types of space (i.e. urban, rural, and peri-urban) and how connections between different types of space influence household well-being.

Numerous case studies have examined food security within Guatemala across different conditions. Lopez-Ridaura et al. (2019) examined different types of farming households in the Western Highlands of Guatemala and found that diversified maize-based, coffee-based, and specialized coffee farm households were more food secure than households that specialized in maize production (N = 4,790, only looked at houses that had agriculture activity). In another study conducted in the Western Highlands (Chilasco), food security was assessed between two groups of farmers: those growing broccoli for export and those growing only maize and bean (traditional crops). They found that broccoli growers earned significantly higher incomes than traditional farmers but the two groups did not differ in food security measures (Methot and Bennet, 2018) (N=52). Milan and Ruano (2013) used mixed methods research in Cabrican (Western Highlands) and conducted 136 household surveys identifying food insecure households and determining how households respond to food insecurity. They found that 78% of households had experienced food scarcity in the past 10 years and that they responded to food scarcity through a variety of methods including increasing output of food production, selling livestock, reducing food consumption, reducing expenditures and diversifying activities (and also ask for remittances from migrants abroad). In one of the few studies looking at the impacts of urban-rural linkages on food security, mixed-methods research conducted in Solola (Western Highlands) with 50 mainly indigenous Maya at a marketplace found that urban-rural linkages have mixed effects on household well-being with some negative effects on food security (INESAD, 2013). Last, the

one study found explicitly examining food security in Petén focused on the southern half of the department and examined the impacts of oil palm development on food security (Hervas and Isakson, 2020). This study found that while the few households employed by the palm oil plantation had better food security outcomes, the decrease in local staple production probably decreased food security for other households in the area. In summary, Guatemala food security studies have largely had a different geographic focus than this study: namely, the Western Highlands. Furthermore, most of the food security studies we found look at differences in food security across different types of agriculture with few if any explicitly examining food security in peri-urban areas or between households that work or don't work in nearby large urban centers. Lastly, where there has been quite a bit of research done in Petén, almost all of it focuses on truly rural areas and/or communities that are associated in some way with the Maya Biosphere Reserve (i.e. Shriar, 2002). This research is unique in that it studies peri-urban communities that are still strongly dependent on agriculture but are potentially transitioning to more urban based livelihoods.

This study contributes to filling these gaps by examining food security in four peri-urban communities in Guatemala and determining if households with urban workers have different food security outcomes than households without urban workers. The following research questions are addressed:

1) Using two common food security metrics, what is the frequency of food insecurity in these communities?

2) Does type and location of work, especiallyworking in the urban center, impact food insecurity?

Study site

The department of Petén is in the northernmost department of Guatemala and is bordered by Mexico to the North and West and Belize to the East. The department comprises about one-third of the countries territory and was the last area of the nation to be developed. With a total population of ~25,000 through the middle of the twentieth century (Schwartz, 1990), the functional incorporation of the department began in the 1950s when the government began to construct roads, manage natural resources and partition land; the latter primarily to elites and military officials (Schwartz, 1990). Furthermore, because of growing population pressures on land outside of the department, in-migration of largely Q'eqchi Mayans originating from Alta Verapaz and southern Petén began in earnest in the 1950's (Adams, 1965). In the 1960's, the civil war, continued landlessness, and a newly built road from Alta Verapaz (the department to the South) facilitated stepwise migration into Petén (Adams, 1965). In the next decade, the construction of a road from Guatemala City to Petén and the passing of a law encouraging settlement of subsistence farmers led to a peak in migration of a more equal proportion of both indigenous and Ladino immigrants (Schroten, 1987).

Towards the end of the 1980's and throughout the 1990's conservation efforts intensified in Petén and became a more important agent of change (Suter, 2012). In the 1990's the international conservation community and Guatemalan conservationists formed the Maya Biosphere Reserve (Nations, 2006; (Sever, 1999)) to attempt to slow the rapid rate of deforestation. The reserve covers most of the northern half of the department and was designed with different zones intended for different levels of human use and thus different levels of environmental protection (CONAP, 1992). The formation and continued existence

of the reserve has been controversial at both local and national levels because it limits land available to small-holder farmers. Settlers continue to migrate into the reserve and forced evictions have occurred in the past several years.

By the first decade of the 21st century, the frontier of Petén was closed and the department that was originally viewed as a pressure release for the landless and poor throughout the nation had no more available land. Furthermore, with narco-ranching on the rise (Grandia, 2006; 2013), increases in large industrial agricultural operations, (for example, massive palm oil plantations), and rampant land speculation, holding onto land became difficult for many small-holder agriculturalists throughout the department.

Today, Petén has around1 million people and while the department has traditionally been thought of as a rural, its rapid increase in population hasn't just been in rural areas. Bustling urban centers have grown with increases in agricultural production and numerous migrants now come to the area for the opportunities the urban centers provide. Furthermore, as generational attitudes change, young people from rural households in the department migrate to the city for a chance to improve their lot in life. With these changes comes the need to better understand food security outcomes in urban spaces and how household livelihoods impact food security.

The research was conducted close to the geographic center of Peten where the urban center is comprised of three cities that are adjacent to one another: Flores, Santa Elena, and San Benito. Flores, the department capital, is located on an island in *Lago Peten Itza* and the island is connected to the shoreline of the lake and the city of Santa Elena by a ~1/4 mile long causeway. Flores has a population of ~2,000 people and in addition to being the department capital, it's the tourist hub of the area. Most of the guided trips to the numerous

Mayan ruins in the region (i.e. Tikal, El Mirador) originate from Flores and the city and lake themselves draws many national and international tourists. Work for the government and in tourism are abundant on the island.

Santa Elena is located along the southern shoreline of *Lago Peten Itza* and has a population of ~ 25,000 people. The department's airport is located in Santa Elena as is a Burger King, McDonalds, Taco Bell, numerous local shops and a super market. The city also contains a traditional market and at least two separate bus stations. There are many opportunities to work in retail and services.

Located to the west of Santa Elena and along the shoreline of the lake lies San Benito. San Benito is the municipality capital of the department of San Benito and has a population of approximately 75,000 people. While Flores and Santa Elena are the older and more established cities in the region, San Benito has the most build-able space and captures many of the migrants to the area. Containing numerous retail and service businesses along the main roads, much of San Benito is comprised of residences in an approximation of suburban sprawl. Relative to Flores and Santa Elena, San Benito is considered much less safe and local people largely avoid going there after dark.

The four study communities were chosen for inclusion in the study because they are close enough to the urban center to make daily commuting feasible yet are varying distances and travel times to the urban center. Furthermore, all of the communities have *ejido* lands as the primary natural resource base. Santa Cruz is located within the municipality of San Francisco and is the closest community to the urban center both in terms of travel time and geographic distance. Located approximately 8.05 kilometers from the San Benito traffic circle, buses run through every 10 to 15 minutes and the road is paved the entire distance.

With a population of 431 people, the community is the second smallest community in the study. The second closest community to the urban centeris San Antonio, which is located in the municipality of San Benito. Located approximately 10.02 kilometers from the San Benito traffic circle, most of the route is on a reasonably well-maintained dirt road. Travel time between the city and San Antonio is 30 to 35 minutes, around twice as much time as is required to travel from Santa Cruz to the city. San Antonio is the largest community in the study with a population of 1478 people. Last, San Antonio was founded by Chicle extractors in the middle of the 1900s and is probably the oldest community of the four. The third most connected community in the study is Purushila, within the municipality of Santa Ana. It's located approximately 12.5 kilometers from the main Santa Elena bus station, 7.3 kilometers of which are on dirt roads. Bus transport is much less frequent than in the aforementioned two communities with only several buses per day moving people between the community and the urban center. However, the buses are timed to enable day workers to commute to and from the city. Motorcycle travel time is approximately 25 minutes. Purushila used to be located along the main travel route between Flores, Santa Elena and Guatemala City (the southern route out of the department) but then the road parallel and to the east was paved displacing the majority of through traffic. Though agriculture is the traditional livelihood of Purushila residents, the displacement of through traffic did reduce business at local *tiendas*. The fourth community, La Pita, is located in the municipality of Santa Ana and is the furthest from the urban center at 28.8 kilometers,, 4.15 kilometers of which are on a dirt road. The dirt road leads to the main road connecting the urban center to other parts of Guatemala including Guatemala City. Bus transport from the community itself is infrequent but if

residents walk to the main road, they can flag down one of the many micro-buses passing through. Motorcycle travel time to the urban center is ~45 minutes.

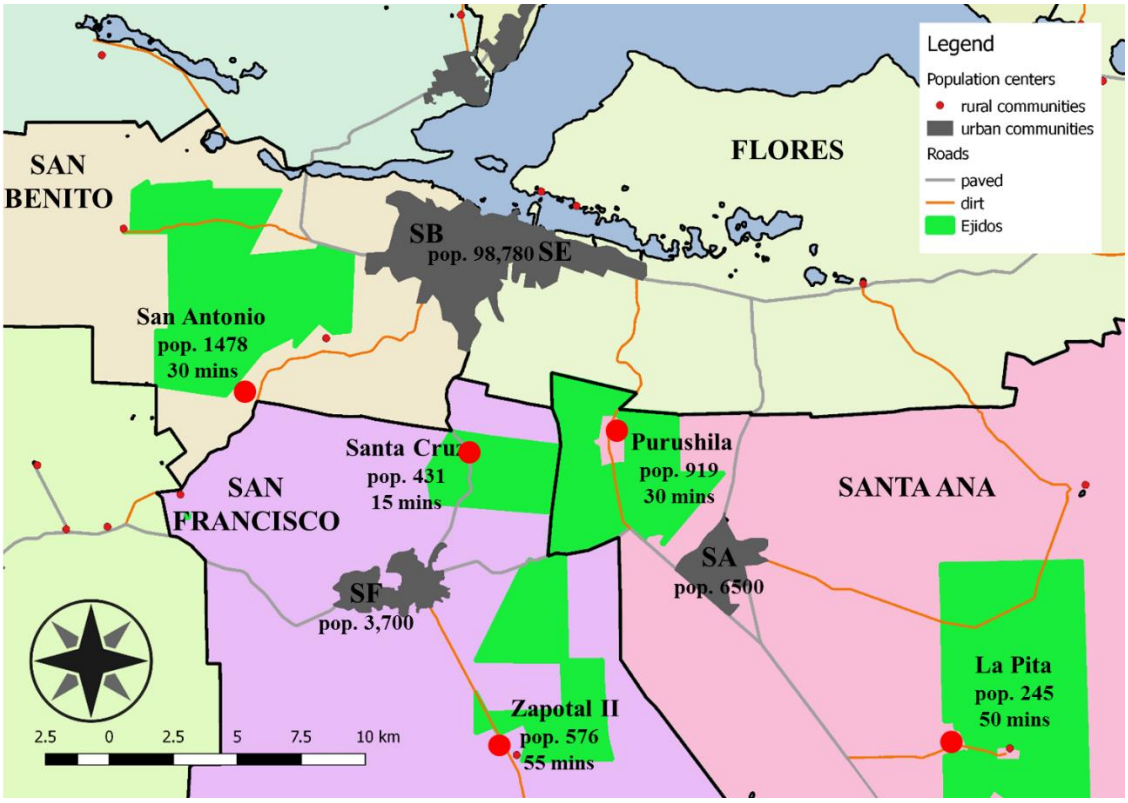

Figure 1. Map of study area and communities.

Each of the study communities is largelysurrounded by *ejido* land. The *ejidos* are public lands that have traditionally been managed by the municipality governments. Community members are given annual contracts to plots of *ejido* land and usually pay around the equivalent of 30 USD/ per hectare/ per year. The contracts are renewable on an annual basis and the previous year's contract holder is generally awarded the same contract for the next year. At times however, municipalities sell off *ejido* lands to private buyers, thereby removing the land from the communalpool. This is problematic for residences of the study communities as the *ejido* lands make up the vast majority of available land. Furthermore, when these lands are sold off, it's often to people from outside of the area. Because of the

socially and politically sensitive nature of the *ejido* lands in these municipalities, it's difficult to obtain reliable information about them. Few of the village leaders I spoke with had reliable information on the extent of the *ejido* lands around them. At municipality offices, asking about *ejido* land received a mixed reception due to the controversyaround their selling/privatization.

2. METHODS

This field work started in November of 2017 and concluded in July of 2018. Mixed methods research was used and work began with informal/ethnographic interviews and finishied with household surveys. The first set of interviews were conducted with leaders in the seven municipalities that converge around *Lago Peten Itza*. From these interviews, a general sense of context was developed for the area and pertinent information was gathered including population data for nearby communities. Written permission was obtained from the *alcalde* of each municipality to conduct surveys within their respective municipalities. From available information, four communities were chosen for inclusion in the study and after receiving permission from community *alcalde's* semi-structured interviews were conducted with community leaders.

Once study communities were selected,random samples representing ~30% of households from each community were drawn. To select households randomly, every structure in satellite images (Google Earth) of communities were labeled with a number and a random number generator was then used to select the aforementioned percentage of households. Several days were spent in the communities prior to conducting the surveys to ensure that residences were not missing from the satellite photos. Furthermore, if a selected structure

was found to not be a residential unit while conducting surveys (a rare occurrence), the closest residential unit (in geographic space) was selected for inclusion..

Surveys were conducted in person and in the first contact with the household, a surveyor approached the house, described why they were there, and then conducted the survey with the male head of house (*jefe*). In most cases, the survey was conducted at that time but if it wasn't, the surveyor would work with the household to determine a time for the team to return. In almost all cases, the male household head was interviewed but in a few cases the female head of household was surveyed (for example, after multiple return visits to the household without the *jefe* being present). Consent to conduct surveys was received at the beginning of each survey and survey team members then read each question to the person being surveyed and recorded their responses on paper forms. The average time to conduct surveys was around one hour and response rate was over 95%. Of the few households that declined to participate, there seemed to be little commonality. For example, one declining household had a painted, concrete-block house indicating higher socioeconomic status while another had a small wood-board house with multiple possessions common to subsistence farmers spread throughout the yard.

Surveys consisted of ~ 300 questions and included demographic questions as well as questions about education, immigration/emigration, remittances, food security, dietary diversity and livelihood activities (jobs/ occupations). The questions of interest for this study, primarily the food security and livelihood activities question modules, were largely taken from previously conducted surveys. Much of the livelihood activity question set was taken either from World Bank, Living Standard Measurement Surveys (LSMS) or Demographic Health Surveys (DHS). Food security was quantified using questions sets identified below.

The household food insecurity access scale (HFIAS) is a survey instrument developed by USAID that has been used (and validated) in different developing countries (i.e. Frongillo and Nanama, 2003 ; Coates etal. 2003). As the name implies, the instrument focuses on the "access" portion of food security and is comprised of nine questions (Figure 1). These questions ask about worry of not having enough food, the ability of the household to eat the kinds of food that they prefer, and last, whether the household had to eat less food than they would like (USAID, 2007) (Figure 1). Each question is asked about the previous four weeks and if a household responds yes to a question, they are then asked the frequency with which they experienced that condition. Frequency answers are constrained to: 1 = Rarely (once or twice in the past four weeks), 2- Sometimes (three to ten times in the past four weeks), or 3 - Often (more than ten times in the past four weeks). In addition to examining responses to individual question, two different metrics can be quantified from this data. The first is the household food insecurity access scale (HFIAS) score and the second is Household Access Food Insecurity Prevalence (HFIAP). The first metric, HFIAS, is calculated by summing the responses to each of the questions, with responses to each question ranging from zero (did not experience the condition) to 3 (experienced the condition more than ten times). HFIAS scores range from 0 to 27 and the higher the score the more food insecure the household. While HFIAS score is a continuous variable, the second metric, HFIAP, is a categorical variable and it places households intofour food security categories: 1) food secure, 2) mildly food insecure, 3) moderately food insecure, and 4) severely food insecure, depending on HFIAS score (Figure 2).

No.	Occurrence Questions
1.	In the past four weeks, did you worry that your household would not have enough food?
2.	In the past four weeks, were you or any household member not able to eat the kinds of foods you preferred because of a lack of resources?
3.	In the past four weeks, did you or any household member have to eat a limited variety of foods due to a lack of resources?
4.	In the past four weeks, did you or any household member have to eat some foods that you really did not want to eat because of a lack of resources to obtain other types of food?
5.	In the past four weeks, did you or any household member have to eat a smaller meal than you felt you needed because there was not enough food?
6.	In the past four weeks, did you or any household member have to eat fewer meals in a day because there was not enough food?
7.	In the past four weeks, was there ever no food to eat of any kind in your household because of lack of resources to get food?
8.	In the past four weeks, did you or any household member go to sleep at night hungry because there was not enough food?
9.	In the past four weeks, did you or any household member go a whole day and night without eating anything because there was not enough food?

Figure 1. Household food insecurity access scale questions.

		Frequency question	Frequency		
			Rarely	Sometimes	Often
		1a	0 - 1	2	3
Food secure		2a	4	5	6
		3a	7	9	10
Mildly food insecure		4a	8	11	12
		5a	13	14	17
Moderate food insecure		6a	15	16	18
		7a	19	20	21
Severely food insecure		8a	22	23	24
		9a	25	26	27

(image from: https://www.icco-cooperation.org/en/blogs/effectively-assessing-household-food-security-status/)

Figure 2. Household food insecurity access scale assignment scheme of categorical food insecurity levels.

The second major food insecurity question module used in this study is the World Food Programs (WFP) Standard Food Consumption Score (FCS) questionnaire which asks households the number of times that they've eaten food from each of eight different food groups in the past seven days (WFP, 2008). To calculate FCS , the frequency with which a

household consumes each food group is multiplied by a weight representing the relative caloric content of items in that group. For example, the weight for the meat/fish group is 4 while the weight for the staples group is 2. The products are then summedto determine the FCS, a measure of household food insecurity. Similar to the categorization of HFIAS to produce HFIAP, FCS has a standardized categorization system as follows. Households with FCS's less than 23 are designated as food secure, households with FCS scores of 22 to 35 are placed in the borderline food insecurity level, while households with FCS's greater than 35 have acceptable food security. In this study, we use FCS as a continuous variable to be better able to differentiate between households with different characteristics.

The results of this study are presented in four sections. The first section presents the descriptive statistics (means, medians, ranges, and percentages) for all of the dependent and independent variables used in analyses (Tables 1 and 2). The second section presents the results generated using the HFIAS data. The percentages of affirmative responses to individual HFIAS questions are described for all households, households with urban workers, and households without urban workers (Table 3).The percentages of households with zero HFIAS scores (Table 4) and the mean and median HFIAS values (Table 5) are presented for all households, households with urban workers, and households without urban workers. Next, a zero-inflated negative binomial regression model (ZINB) is used to determine which household characteristics associate with HFIAS. A ZINB model is used because over 30% of households have HFIAS values of zero (Table 6). ZINB models return two sets of coefficients: 1) count model coefficients which reflect association between household characteristics and non-zero HFIAS values and 2) zero inflation model coefficients which reflect the association between HOUSEHOLD characteristics and whether the HFIAS value

is zero or not zero, similar to a logistic regression. Last with the HFIAS data, a logistic regression model is used to determine which household characteristics associate with a household being severely food insecure (Table 8). Though this model is partially replicative of the ZINB model, it's included because from a practical stand point, households with severe food insecurity are the most important to target with interventions.

The third section presents the results of the food consumption score data. The mean and median number of days per week that all households, households with urban workers, and households without urban workers consume each of the eight food groups is presented (Table 9). Then, the mean and median FCS's are presented for all households, households with urban workers, and households without urban workers (Table 10). Next, the number of households that fall into each FCS food insecurity category (poor, borderline, acceptable) are determined (Table 11). Last, two statistical analyses were performed. In the first, ordinary least squares regression is used to determine which household characteristics associate with FCS and in the second logistic regression is used to determine which household characteristics associate with households with lowest 20% of FCS scores (the most food insecure households). Note that unlike with the HFIAP data where ~20% of households fall into the severe food insecure category according to the metrics classification system, with the FCS data NO households fall into the poor food security category so analysis was simply performed on the households with the 20% lowest FCS's. The bottom fifth of households were designated as severely food insecure (1's) and the top four fifths of households were designated as food secure (0's) in analysis. Even though this binary split results in a relative measure of food insecurity, rather than the absolute measure used for HFIAS, we think there

is value in assessing which households are most food insecure within the sample population and, moreover, that this does accord with real deprivation.

The fourth section compares HFIAS and FCS. The two are dramatically different types of food insecurity metrics as the former is based on the interviewee's subjective interpretations of their access to food while the latter is based on quantification of the number of days in a week that food items in each of eight food groups are consumed by the household. As such, it's important to understand if and how these two metrics differ when both are quantified for the same households. Three methods are used to compare HFIAS to FCS. In the first, the percentage of households that fall into the HFIAP categories (severe food insecurity, moderate food insecurity, mild food insecurity, food secure) are compared to the percentages of households that fall into FCS categories (poor food security, borderline food security, acceptable food security) (Table 14). Next, the number of households that fall into the severe food insecurity HFIAS category are compared to the number of households that fall into the 20% of households with the lowest FCS scores to determine how closely the two metrics match up just for the households with the worst food insecurity (Table 15). Last, a ZINB model was used with HFIAS as the dependent variable and FCS as the independent variable to determine the extent of the association between the two. Like the two ZINB models discussed above, this ZINB model outputs count model coefficients and zero inflation model coefficients to account for the large number of observations (households) that have zero HFIAS scores.

3. RESULTS

3.1 Descriptive statistics

In study communities, the large majority of households were working in the previous 12 months and the most common job type was working on one's own farm (growing crops and/or animal husbandry). With 55.45% of households working on their own farm, these peri-urban communities are maintaining their rural livelihoods. However, the functional incorporation into the urban space is observed with 26.07% of households working in the urban center, making this the second most common job type. Third, 19.91% of households are working for pay on another person's farm and fourth, 18.96% of households work in non-agriculture within their own communities. On average, households worked 1.63 jobs in the previous 12 months (Table 1).

Table 1. Descriptive statistics for categorical independent variables (N = 208).

Variable	N	%
COMMUNITY		
San Antonio	81	38.39
Santa Cruz	39	18.48
La Pita	33	15.64
Purushila	58	27.49
ETHNICITY		
Indigenous	41	20.10
Non-Indigenous	163	79.90
OCCUPATION VARIABLES		
Works own farm (0/1)	117	55.45
Works on other's farm (0/1)	42	19.91
Works in non-urban non-ag (0/1)	40	18.96
Works in urban center (0/1)	55	26.07
DEMOGRAPHIC VARIABLES		
Receives remittances (0/1)	25	11.90

In study communities, the average age of the household head was 44 years, and the mean number of people per household was 4.74. The mean number of years of schooling was 4.55 which corresponds to having completed the first three to four years of *basico* (the U.S. equivalent of elementary school). Of 25 potential assets, households possessed 9.90 assets with households

Table 2. Descriptive statistics for continuous independent variables (N = 208).

Variable	Mean	Median	Range
Assets	9.90	10	2 to 25
Number of HH members	4.74	5.00	1 to 12
Number of jobs	1.63	1.00	0 to 6
Mean HH education	4.55	4.5	0 to 13.5
Age of Jefe	45.49	44	18 to 45

owning as few as 2 or as many as 25. Furthermore, twenty-five of the 211 sampled households (11.90%) received remittances in the previous 12 months. Last, 20.10% of households identified as indigenous (Table 2).

3.2 Household food insecurity access scale (HFIAS)

3.2.A HFIAS Individual Questions

The HFIAS is determined from household's responses to nine questions and these results show that greater percentages of households respond affirmatively to the questions asked earlier in the survey instrument. This is intuitive as the questions progress from asking about more mild forms of insecurity to more severe forms of food insecurity. Fifty percent of all households responded that they worried about not having enough food to eat (question 1), 33 to 47% of all households responded affirmatively to questions about the types of foods consumed (questions 2, 3 and 4), around 26.5% of households ate smaller or fewer meals (questions 5 and 6) while 9, 12, and 17% of households did not eat for a day, went to sleep hungry, or ran out of food completely (questions 7, 8, and 9)(Table 3).

Comparing households with urban workers to households without urban workers, results indicate that households with urban workers respond affirmatively to all questions in greater frequency than do households without urban workers (with the exception of question four). This indicates that households with urban workers are more food insecure. Of the eight questions in which a greater percentage of urban households responded affirmatively, the greatest percentage differences between sub-populations are in questions one, eight, and nine. Relative to households without urban workers, approximately 30% more household with urban workers worried about not having enough food to eat (question 1) and around 50%

more indicated that they went to sleep hungry or did not eat for a day (questions 8 and 9)(Table 3).

Table 3. The percentage of responses of all households, households with urban workers, and households without urban workers to each HFIAS question (N = 180).

	All households				Households with urban workers				Households without urban workers			
HFIAS questions	Yes	1 to 3 times	4 to 10 times	more than 10 times	Yes	1 to 3 times	4 to 10 times	more than 10 times	Yes	1 to 3 times	4 to 10 times	more than 10 times
1. Worry not enough food to eat?	50	14	21	15	62	18	30	14	46	12	18	16
2. Lack of preferred foods to eat?	44	16	19	9	46	16	22	8	44	15	18	10
3. Eat limited variety of foods?	47	13	23	11	50	16	24	10	46	12	22	12
4. Eat foods you did not want to?	33	11	13	9	28	12	8	8	35	10	15	9
5. Eat smaller meals?	28	8	14	6	32	16	12	4	26	5	15	7
6. Eat fewer meals?	25	9	11	4	26	18	6	2	25	6	13	5
7. No food in household?	17	8	6	2	18	14	4	0	16	6	7	3
8. Went to sleep hungry?	12	6	4	2	16	12	4	0	11	3	5	3
9. Not eat for a day?	9	6	3	1	12	8	4	0	8	5	2	2

** The percentages in each cell were rounded to the nearest whole number to ease interpretation of the table.*

3.2.B HFIAS Zeros, Means, and Medians

Households with urban workers are slightly less likely to have HFIAS values of zeros relative to households without urban workers though the difference is not large (36.90% vs 38.76%) (Table 4) and when comparing the mean and median HFIAS values for households with urban workers to households without urban workers, a similar pattern is observed (Table 5). Households with urban workers have greater mean and median HFIAS values (4.96 and 4, respectively) than do households without urban workers (4.86 and 2, respectively) and the difference in means between the two groups is very small while the difference in medians is quite large. Comparing within group means and medians and reflecting on between group distributions and standard deviations, the households without urban workers have greater skew towards lower HFIAS values but a few households with very high HFIAS values creating a relatively large gap between a high mean (4.86) and a low median (2).

Table 4. The percentages of households with HFIAS's of zero for all households, households with urban workers, and households without urban workers.

All households	Households with urban workers	Households without urban workers
37.99	36.00	38.76

A z-test shows that there is not a significant difference in percentages between households with and without urban workers.

In addition to examining the means and medians for all households, the mean and median values were calculated just for households without zero HFIAS values.In this subset, households with urban workers had similar mean HFIAS values (7.75 versus 7.94) but maintained higher median values (8 versus 6). Furthermore, excluding households with zero HFIAS values, group differences between means and medians show a similar pattern. Households without urban workers have a relatively large gap between a larger mean (7.94) and a smaller median (6) while households with urban workers have a small gap between

mean and median. In summation, when using all of the data, households with urban workers have ~50% greater median HFIAS values and when using data without zero value HFIASs, households with urban workers have ~33% greater HFIAS values (Table 5) than households without urban workers.

Table 5. The mean and median HFIAS values for all households, households with urban workers, and households without urban workers.

Type	All households		Households with urban workers		Households without urban workers	
	mean	median	mean	median	mean	median
Zero-value households included	4.89	2	4.96	4*	4.86	2*
Zero-value households excluded	7.88	7	7.75	8	7.94	6

*T-tests were used to compare means and Mood's tests were used to compare medians between households with and without urban workers. *** , **, and * indicate significant differences of p <0.01, p<0.05, and p<0.10.*

3.2.C HFIAS Zero Inflated Negative Binomial Regression Model

With over 30% of households having an HFIAS score of zero, a zero-inflated negative binomial regression model (ZINB) was used to determine which household characteristics associate with food insecurity (Table 6). Count model results show that different communities have different HFIAS scores with Santa Cruz having the greatest score and Purushila having the lowest score (least food insecurity). Furthermore, indigenous households have scores greater than non-indigenous households. In regards to the independent variable greatest interest in this study, occupation type, results show that households with urban workers is a significant associate of food insecurity. Households with urban workers have HFIAS values greater than households without urban workers. Last for

the count model, every one unit increase in household mean education decreases HFIAS by 0.10 units.

Contrary to the count model results reviewed above, the zero-inflation portion of the model reveals little of interest. The only significant variable is the number of household members which shows that the greater the number of household members the lower the HFIAS values.

Table 6. Zero-inflated negative binomial regression results for HFIAS values.

Independent Variable	Count Model Coefficients	Zero Inflation Model Coefficients
(Intercept)	2.93	0.62
COMMUNITY (Ref. San Antonio)		
Santa Cruz	0.38*	-0.39
La Pita	0.02	0.67
Purushila	-0.06	-0.28
ETHNICITY (Ref. Indigenous)		
Non-Indigenous	-0.35*	-0.61
OCCUPATION VARIABLES		
Works own farm (0/1)	0.13	-0.24
Works on other's farm (0/1)	0.16	-0.40
Works in non-urban non-ag (0/1)	-0.06	-0.92
Works in urban center (0/1)	0.52*	-0.31
DEMOGRAPHIC VARIABLES		
Assets	-0.02	0.01
Receives remittances (0/1)	0.21	0.30
Number of HH members	-0.05	-0.22*
Number of jobs	-0.04	0.32
Mean HH education	-0.1**	-0.07
Age of Jefe	0.00	0.01

*Signif. codes: '*** '0.01, '** 0.05, '* 0.1*

3.2.D HFIAP Individual Question Responses

The household food insecurity experience scale (HFIAP) places households into one of four food security categories based on their HFIAS values (Table 7). According to this categorization, 20.79% of all households in this study are severely food insecure while 24.72%, 14.04%, and 40.45% are moderately food insecure, mildly food insecure or food secure, respectively (Table 7). Comparing these values for households with urban workers to households without urban workers, the former are more likely to be severely and moderately food insecure (22.00 % vs 20.31% and 30.00% vs. 22.66%, respectively) and less likely to be mildly food insecure (10.00% vs 15.63%) or food secure (38.00% vs. 41.41%). These results suggest that households with urban workers are more likely to be food insecure than their counterparts.

Table 7. The number, percent, and cumulative percent of households in each HFIAP category for all households, households with an urban worker, and households without an urban worker.

	All households			Households with urban workers			Households without urban workers		
Category	N	%	Cum. %	N	%	Cum. %	N	%	Cum. %
Severely food insecure	37	20.8	20.8	11	22.0	22.0	26	20.3	20.3
Moderately food insecure	44	24.7	45.5	15	30.0	52.0	29	22.7	43.0
Mildly food insecure	25	14.0	59.6	5	10.0	62.0	20	15.6	58.6
Food secure	72	40.5	NA	19	38.0	NA	53	41.4	NA

Z-tests were used to compare proportions of households in each HFIAP category between households with and without urban workers. No significant differences were found.

3.2.E HFIAP Logistic Regression

In addition to the descriptive statistics comparisons of HFIAP values, logistic regression analysis was used to determine which households characteristics associate with

households that fall into the moderately or severely food insecure categories (Table 8). Results show that households with an individual working in an urban area are more likely to be moderately /severely food insecure relative to households without a worker in an urban center (Table 8). There is also an association between food security and community with households in Santa Cruz the most likely to be moderately or severely food insecure and households in Purushila the least likely to report being food insecure (Table 8). This model, by looking at food security as a binomial variable in a logistic regression model, confirms the results of the previous ZINB model and explicitly focuses on associations between severe food insecurity and household characteristics.

Table 8. Logistic regression results for households being severely food insecure or not severely food insecure according to the HFIAP categorization system

Independent variables	Estimate	std.error	statistic	p.value
(Intercept)	3.70	2.12	1.74	0.08
COMMUNITY (Ref. San Antonio)				
Santa Cruz	0.12	0.76	0.15	0.88
La Pita	-16.40	1648.57	-0.01	0.99
Purushila	-1.02	0.78	-1.31	0.19
ETHNICITY (Ref. Indigenous)				
Non-Indigenous	-1.13	0.70	-1.61	0.11
OCCUPATION VARIABLES				
Works own farm (0/1)	0.43	1.03	0.42	0.68
Works on other's farm (0/1)	0.71	1.18	0.60	0.55
Works in non-urban non-ag (0/1)	1.10	1.13	0.98	0.33
Works in urban center (0/1)	2.92	1.03	2.84	0.00
DEMOGRAPHIC VARIABLES				
Assets	-0.22	0.11	-1.97	0.05
Receives remittances (0/1)	0.33	1.00	0.33	0.74
Number of HH members	0.11	0.19	0.56	0.58
Number of jobs	-0.81	0.53	-1.53	0.13
Mean HH education	-0.37	0.14	-2.72	0.01
Age of Jefe	-0.03	0.03	-1.23	0.22

3.3 FOOD CONSUMPTION SCORE (FCS)

3.3.A FCS Answers to Individual Questions

The data used to determine food consumption score is based on households enumerating the number of days in the last week that they have consumed foods in each of eight different food groups. The results for all households show that lower quality and less costly food groups (i.e. staples, pulses, oils, and sugar) are consumed almost every day of the week while higher quality food groups (i.e. meat, fruit, and milk) are consumed with much less frequency within the study population (Table 9).

Comparing individual food group responses between households with urban workers and households without urban workers, the former consumed every food group more frequently, on average. Furthermore, of the more commonly consumed food groups, the mean differences across household type are very small while in the less frequently consumed food groups, the differences in means are larger. Urban households consume meat 34.07% more days per week, consume milk 31.21% more days per week, and consume fruit 40.26% more days per week on average than do households that do not have urban workers.

Table 9. The mean and median number of days per week that all households, households with urban workers, and households without urban workers consume items in each of the food consumption score food groups.

Food Groups	All households		Households with urban workers		Households without urban workers	
	Mean	Median	Mean	Median	Mean	Median
Staples (ie. maize, rice)	6.9	7	7.00	7	6.87	7
Pulses (i.e. black beans)	6.65	7	6.76	7	6.62	7
Vegetables	3.47	3	3.71	3	3.38	3
Fruit	2.55	2	3.23**	3**	2.30**	1**
Meat (i.e. chicken, beef)	2.94	3	3.62***	3*	2.70***	2*
Milk	1.87	1	2.27	2	1.73	1
Sugar	6.53	7	6.73	7	6.46	7
Oil	6.2	7	6.24	7	6.18	7

*Differences in means and medians were compared across households with and without urban workers using T-tests and Mood's median tests, respectively. *** , **, and * indicate significant differences of p <0.01, p<0.05, and p<0.10.*

Median values follow a similar pattern across household types. For example, households with urban workers consume meat on 50% greater number of days, milk twice as often, and fruit 300% more often than households without urban workers.

3.3.B FCS normal categories

The mean and median FCS scores for all households are 64.37 and 63 respectively. Comparing households with urban workers to households without urban workers, the former have greater mean and median FCS's and the differences are large (difference in means = 9.4, difference in medians = 6) (Table 10).

Table 10. The mean and median Food Consumption Scores for all households, households with urban workers, and households without urban workers.

All households		Households with urban workers		Households without urban workers	
mean	median	mean	median	mean	median
64.37	64	71.2***	67*	61.8***	61*

*Differences in means and medians were compared across households with and without urban workers using T-tests and Mood's median tests, respectively. * **, **, and * indicate significant differences of p <0.01, p<0.05, and p<0.10.*

Similar to the categorization system used with HFIAS data, food consumption scores were used to categorize households into poor food security, borderline food security, or acceptable food security and within this system of classification only three of the households in this study fall into the borderline category (zero are in the poor category).Therest of the households fall into the acceptable food security category. Comparing households with urban workers to those without, one urban household falls into the borderline category while two non-urban households fall into the borderline category (Table 11).

Table 11. The number of all households, households with urban workers, and households without urban workers that fall into each of the three FCS categories (acceptable, borderline, and poor food security).

FCS category	All households		Households with urban workers		Households without urban workers	
	N	%	N	%	N	%
Acceptable	176	98.32	49	98.00	127	98.45
Borderline	3	1.68	1	2.00	2	1.5504
Poor	0	0	0	0.00	0	0

3.3.C FCS OLS model

An ordinary least squares regression model was used to assess associations between household characteristics and food consumption score (FCS) (Table 12). Unlike the ZINB model used to assess association between household characteristics and HFIAS values, this model does NOT indicate that there is an association between food security and occupation type. However, this model suggests that ethnicity is a statistically significant associate of food security with non-indigenous HHs having food consumption scores 9.35 units greater than indigenous households, on average With higher FCS's indicating better food security, these results suggest that indigenous HHs are more food insecure than their non-indigenous counter parts. Additionally, this model suggests that households with more assets have better food security with each additional asset corresponding to an increase in FCS of 1.42 units.

Table 12. Ordinary least squares regression results for the association between independent variables and household Food Consumption Score (FCS (N=208)

Independent variables	Estimate	Std.error	Statistic	P.value
(Intercept)	37.92	8.44	4.50	0.00
COMMUNITY (Ref. San Antonio)				
Santa Cruz	0.47	3.44	0.14	0.89
La Pita	4.15	4.06	1.02	0.31
Purushila	3.03	3.24	0.94	0.35
ETHNICITY (Ref. Indigenous)				
Non-Indigenous	7.74	3.24	2.38	0.02**
OCCUPATION VARIABLES				
Works own farm (0/1)	-2.33	3.60	-0.65	0.52
Works on other's farm (0/1)	3.39	4.09	0.83	0.41
Works in non-urban non-ag (0/1)	-3.30	4.04	-0.82	0.42
Works in urban center (0/1)	3.72	3.77	0.99	0.33
DEMOGRAPHIC VARIABLES				
Assets	1.42	0.35	4.10	0.00***
Receives remittances (0/1)	6.91	4.04	1.71	0.09*
Number of HH members	1.26	0.77	1.64	0.10
Number of jobs	-2.11	1.70	-1.24	0.22
Mean HH education	0.43	0.45	0.96	0.34
Age of Jefe	0.03	0.10	0.35	0.73

3.3.D Food consumption score (FCS) logistic regression

In addition to the OLS regression model, a logistic regression model was used to assess the HH characteristics that associate with households with the lowest FCS scores (households with the most food insecurity). As was found with the ordinary least squares regression model, the type of occupation was not found to impact severe food insecurity (Table 13). However, several other variables were found to be associates. The model shows associations between assets and number of household members and food insecurity. For every additional asset that a household possesses, the odds of a households falling into the

bottom fifth of FCSs decreases by ~ 22% and for every additional household member, the log odds of a household falling into the bottom fifth of FCS scores decreases by ~38%.

Table 13. Logistic regression testing the association between independent variables and households in the bottom quartile of Food Consumption Scores (0/1) (N= 208).

term	estimate	std.error	statistic	p.value
(Intercept)	4.28	1.74	2.46	0.01
COMMUNITY (Ref. San Antonio)				
Santa Cruz	-0.01	0.57	-0.02	0.99
La Pita	-17.52	1221.50	-0.01	0.99
Purushila	-0.50	0.63	-0.78	0.43
ETHNICITY (Ref. Indigenous)				
Non-Indigenous	-0.90	0.57	-1.57	0.12
OCCUPATION VARIABLES				
Works own farm (0/1)	-1.02	0.78	-1.30	0.19
Works on other's farm (0/1)	-0.40	0.83	-0.48	0.63
Works in non-urban non-ag (0/1)	1.05	0.73	1.43	0.15
Works in urban center (0/1)	-1.03	0.85	-1.22	0.22
DEMOGRAPHIC VARIABLES				
Assets	-0.22	0.08	-2.69	0.01
Receives remittances (0/1)	0.18	0.93	0.20	0.84
Number of HH members	-0.38	0.16	-2.38	0.02
Number of jobs	0.34	0.35	0.96	0.34
Mean HH education	-0.03	0.09	-0.29	0.77
Age of Jefe	-0.01	0.02	-0.72	0.47

3.4 Compare HFIAS to FCS

The HFIAS and the FCS scales are dramatically different types of food insecurity metrics as the former is based on the interviewee's subjective interpretations of their access to food while the latter is based on quantification of the number of days in a week that food items in each of eight food groups are consumed by the household. As such, it's important to understand if and how these two metrics differ when both are quantified for the same households. Here, we compare the two metrics in the following ways: 1) Results from the previously discussed ZINB model (HFIAS) and OLS regression model (FCS) are compared, 2) Results from the two logistic regression models are compared, 3)categorical classifications

of food insecurity of the two metrics are compared, and 4) a ZINB regression model using HFIAS as the dependent variable and FCS as the independent variable is run to test for associations between the two

3.4.A Compare HFIAS and FCS categories

Food insecurity classifications were compared for the two metrics and there is little similarity. While direct comparison is not possible because HFIAS uses four categories and FCS uses three categories, the FCS classification system places 98.32% of households in the acceptable category while HFIAS places just 40.45% of households in the food secure category (Table 14). Furthermore, the HFIAP classification determines that 20.79% of the households are severely food insecure while the FCS classification suggest that 0% of households are in the poor food security category..

Table 14. Comparing the number and percent of households in each FCS category to each HFIAP category

FCS			HFIAP categories		
Category	Number	Percent	Category	Number	Percent
Acceptable	176	98.32%	Food secure	72	40.45%
Borderline	3	1.68%	Mild food insecurity	25	14.04%
			Moderate food insecurity	44	24.72%
Poor	0	0.00%	Severe food insecurity	36	20.79%

3.4.B Statistical model results

In addition to comparing the percentages of households categorized as food insecure by each metric, the results of statistical models using HFIAS and FCS as continuous variables are compared and we find similarities and dissimilarities. While both models

indicate that ethnicity influences food insecurity, the model that uses HFIAS indicates an association between occupation type and food insecurity while the FCS models indicates no association between food insecurity and occupation type. Furthermore, whileboth models suggest that the number of household members influences food insecurity, they differ in regards to the association between food insecurity and assets.

Second, comparing the logistic regression models that examine association between independent variables and severely food insecure households, similarities and dissimilarities are also observed. Both the HFIAS and FCS logistic regression models show that assets are negatively associated with severe food insecurity while the HFIAS model additionally suggests that having household members working in an urban area and having lower education associate with severe food insecurity. While these latter two variables are not significant in the FCS OLR model, the number of household members is, with households with more members less likely to be severely food insecure.

3.4.D Zero-inflated negative binomial regression model comparing FCS to HFIAS

In this section, the two metrics are statistically compared using a zero-inflated negative binomial regression model that treats HFIAS as the dependent variable and FCS as the independent variable (Table 15). The zero-inflation portion of the model is not significant but the count model shows a negative association between the two metrics. Furthermore, separate ZINB models were also conducted for households with urban workers and households without urban workers. Similar to the model conducted with all households, these models do not show a significant association for the zero-inflation component but both show an association for the count

model. Both of the count model coefficients are negative and the coefficient for the model run just on the data with households without urban workers is much larger, indicating a stronger association between HFIAS and FCS for households without urban workers than for households with urban workers.

Table 15. Zero inflated negative binomial regression results with HFIAS as dependent variable and FCS as independent variable for all households, households with urban workers, and households without urban workers.

Independent Variable	Count Model Coefficients	Zero Inflation Model Coefficients
All households FCS	- 0.017 ***	0.008
Households with urban workers FCS	- 0.013 *	0.001
Households without urban workers FCS	- 0.021 ***	0.014

** **, **, and * indicate significant differences of p <0.01, p<0.05, and p<0.10.*

4. DISCUSSION

This study used mixed-methods research to collect data, including household surveys (n = 208), in four peri-urban communities in the department of Petén, Guatemala with a primary focus on understanding household food security and its associates. Two well established and validated food security measures, HFIAS and FCS, were calculated for each household in the sample and the results suggest that work location (urban vs peri-urban) and ethnicity impact food insecurity and that the relationship between HFIAS and FCS food security measures is complex. The percentage of food insecure households within study communities varies widely based on the metric used for quantification but the HFIAS data classify 60.55% of all households as food insecure and 20.79% of households as severely food insecure. From this, it's clear that despite a potentially advantageous location allowing for relatively easy access to a rapidly growing urban location, food security remains a real challenge for households in these communities.

Analyses with HFIAS data indicate that ethnicity and job types worked by members of the household associated with food insecurity. For the latter, contrary to expectations, households with urban workers are more food insecure than households without urban workers and this is observed in both the descriptive statistics and multivariate analysis. Households with urban workers are more food insecure even after controlling for other known associates of food security such as number of assets, level of education achieved, and number of people in the household. There are multiple putative explanations for this. First, the majority of urban workers in study communities are employed in temporary jobs, often as day laborers on construction projects.If lucky, workers are hired on to a large project and work for several weeks, but much of the time they work for several days and then are out of work until they can find another project. These periods of unemployment may lead to instability in household income, itself a factor that may increase food insecurity, or may lead to greater feelings of uncertainty, which may increase the likelihood of a household responding affirmatively to HFIAS questions. Second, the cost of transportation between study communities and the urban center are large. With a minimum wage of approximately 80 *Quetzals* (Q) per day (10 USD), and many workers paid substantially less, transportation can consume a significant percentage of income. For example, round trip bus fare between communities and the urban center is a minimum of 10 Q and round-trip transport between the bus station and locations within the city are a minimum of 4 Q. At these prices, public transportation consumes a minimum of 17.5% of daily wage. The price of purchasing a motorcycle and paying for gas costs approximately the same over a several year period. The high cost time-consuming nature of commuting may lead to food insecurity. Third, households working in urban areas may have less knowledge of wild plants and animals that

can be consumed in times of need. Whereas farming household's food insecurity may cycle with the season it's likely that they have more ethnographic knowledge of local edible plants and can use these food sources to survive during the lean times of the year. Last, households with urban workers and households without urban workers may have different notions of diet adequacy and this may influence how they respond to HFIAS questions. For example, question five of the HFIAS survey instrument asks if anyone in the household had to eat a smaller meal than they felt they needed in the past 30 days and the definition of a smaller meal may vary between households with urban workers and households without. Similarly, questions two through four all ask in some way about whether households are eating the foods that they prefer. Here, truly rural households may feel that eating maize and bean every day is a preferred and adequate diet while a household with urban workers, eating an identical diet, may state that they are eating foods that they don't want to eat and that their diet is inadequate.

While the HFIAS data classify over 60% of households as food insecure the FCS data classify just 1.65% of households as food insecure. Furthermore**,** while the results from the HFIAS data are straightforward in determining the influence of work location on food insecurity the results from the FCS questionnaire are more complex. The FCS data shows that households with urban workers are less food insecure in the univariate case (higher mean and median FCS values) than households without urban workers but when additional variables are included in analysis, there is not a difference in food insecurity between the two groups. This change is probably because urban households are more likely to have other characteristics that associate negatively with food insecurity such as more assets (5% greater), more workers (20% greater), and greater number of years of education (33% to

50%). Once these are accounted for, there is no difference in FCS between urban working households and their purely rural counterparts.

The discrepancies between HFIAS and FCS found in this study can be explained in several ways and are not unique to this study. For example, Tuholske et al. (2020) found similar differences in their case study in Accra, Ghana, where 70% of sampled households were classified as food insecure using HFIAS data and just 2.10% of households were classified as food insecure using FCS data. These results are similar despite the fact that Accra, Ghana is a large urban area (population 4.2 million) and the sample communities in this study are small (population total ~ 4,000) and primarily rural in nature. Furthermore, the ratio of HFIAS classified food insecure households to FCS classified food insecure households is similar in both studies. The ratio is 33.33 to 1 for this study and 36.69 to 1, for Tuholske et al.'s study in Ghana.

So why the discrepancy between these two metrics? First, the two metrics are fundamentally different because the HFIAS metric is a household's subjective interpretation of their food insecurity while the FCS metric quantifies the number of days that different food groups were consumed in the past week. It's possible that a household that consumes higher calorie (highly weighted) foods in the FCS classification may eat a much lower quantity of all foods, leading to a situation where they have high FCS (not food insecure) but low HFIAS (food insecure). Second, the FCS classification system is probably only effective for areas with extremely severe food insecurity. For example, a household that eats maize and beans seven days a week and consumes just one other food item once per week is considered food secure according to FCS classification. While consuming only maize and beans every day can be a nutritionally adequate diet if the correct amounts of these items are

consumed and the maize is prepared in the correct way, it's unlikely that this diet meets most household's micro and macro nutrient needs. Even if it provides sufficient calories, it's unlikely to provide sufficient nutrients. Last, these two metrics are computed based on questions asked of different time periods. The HFIAS instrument asks about the last 30 days while the FCS instrument asks about the past 7 days and this temporal mismatch may explain some of the differences between the two.

Last, it's worth noting that in addition to job type, both the FCS and HFIAS analyses indicate indigenous households are more likely to be food insecure than their non-indigenous counterparts. This agrees with the results of numerous other case studies but is disappointing because Petén is often considered the "melting-pot" of Guatemala. Clearly, inequality is still prevalent across this divide.

5. CONCLUSIONS

In conclusion, households in the peri-urban zone of central Petén, Guatemala experience high rates of food insecurity similar to most other areas of the country. Within the communities, indigenous households are the most likely to be food insecure and should be targeted for interventions by both governmental and non-governmental organizations. While it appears that households with members working in urban areas are more food insecure than their purely rural counterparts, more research is necessary to determine the validity of this argument. Households that farm or only work in rural spaces may be more hesitant to admit to hunger related questions in an approximation of "rugged individualism" while households that work in urban centers may be more comfortable responding that they struggle to acquire food. Similarly, households with urban workers may have very different food standards than

households that only work in rural spaces and if these standards are higher (quantity and quality), than they may report greater food insecurity via the HFIAS instrument even though they have similar diets. Future work will compare HFIAS for households with similar diets that either have or don't have urban workers to better ascertain if there are difference in how the two groups respond to HFIAS questions and further field research will be conducted to determine if households with urban workers have different food standards than their counter parts.

Chapter 5: Discussion and Conclusions

"The developing world", "the global south", and "the third world" are all terms intended to categorize countries based on development status and while processes and definitions of development are contested, there is general agreement that how societies change over time should improve the well-being of people. One way to do this based on the modernist perspective is through economic development that leads to good-paying jobs with the hope that jobs and other improvements will help to reduce hunger and it's negative effects to human health. This dissertation examines the development trajectory of household occupation profiles in Guatemala and determines if household occupation profile associates with household well-being.

The second chapter of the dissertation examined if the percentages of households operating their own farm, working for pay on another person's farm, or working outside of agriculture changed over the course of a nine year period using nationally representative data from Guatemala. Results indicate that households are continuing to work their own farms, that the percentage of households working outside of agriculture all together is not increasing, and that there are large increases in the percentages of households working for pay on other people's farms. The increase in for-pay agriculture labor is observed both for households only utilizing this job type and for households that combine working in paid agriculture labor with operating their own farm or working in non-agriculture occupations. From a notion of linear and progressive development, we would predict that working as paid agriculture labor will improve household's well-being but this doesn't seem to be the case in Guatemala. Working as agriculture labor generally pays little for long hours and is temporary

in nature. Furthermore, these results show that households working as paid agriculture labor are more likely to be poor and are less educated than their counterparts, further exacerbating concern that this is the most rapidly growing occupation type in the country. However, rather than vilifying paid agriculture labor, it's likely it's rapidly becoming the only type of work available in rural areas. As land availability declines due to population growth and land consolidation - and narco-ranching undercuts legitimate agriculture markets - young rural villagers have little opportunity to continue in subsistence agriculture and are left with the choice of moving away or working for pay on someone else's farm. With results indicating that the percentage of households working outside of agriculture is not increasing, it appears that many rural people are staying in rural places and simply shifting from operating their own farm to working on someone else's.

Building on what was learned in chapter two of the dissertation, chapter three further explored the relationship between work type and household well-being by determining 1) the prevalence of food insecurity of households with different occupation types and 2) the association between food insecurity and occupation profile when other variables were accounted for, using nationally representative date. Food security is defined as "a household having enough to eat of what they want to eat" and is strongly associated with hunger and health outcomes like malnutrition and stunting – each of which has detrimental effects on household's well. Results show that there are clear distinctions in food insecurity across occupation profiles and that households that work as paid agriculture labor, whether or not they combine this with other job types, are the most likely to be food insecure. Contrary to this, households only operating their own farm or combining own-farm operation with work outside of agriculture are the least likely to experience food insecurity. Once again, as was

found in chapter one the job type that is becoming more prevalent in the overall population, and thus much more prevalent in the rural population, is the job type most strongly associated with poor household well-being. These results further the argument that households aren't choosing to work as paid agriculture labor but are being pushed into it because of limited other options. Furthermore, results indicating that households operating their own farm (either solely or in addition to working in non-agriculture) have the best food security outcomes calls into question the current efficacy of non-agriculture work generally and paid labor specifically to adequately replace the well-being provided by the loss of subsistence farming.

Chapter four of the dissertation built on the first two chapters by examining a similar topic, namely, how household occupation portfolio influences food security, and extending the question to determine if households working outside of agriculture were doing so in the nearby urban center or within the rural space. Furthermore, this chapter clarifies concepts from the previous chapter because the data were collected from four peri-urban communities, ensuring that households with different occupation types are comparable because they exist in the same space. Results show that households working in urban areas have greater prevalence of food insecurity and are more likely to be food insecure when all other variables are accounted for. Similar to the above where households working in non-agriculture occupation were found to have middling levels of food security, these results suggest that development in Guatemala is not yet to the point where abandoning the family farm to work in non-agriculture occupations is beneficial to household well-being. However, unlike the previous chapter, these results do not suggest that there is a difference in food insecurity

between households that operate their own farm and households that work as paid agricultural labor, when all other variables are accounted for.

In addition to the above, chapter three also compared two commonly used food metrics, FCS and HFIAS in several different ways. These results suggest that, though the two metrics technically have an association, they provide different conclusions about overall levels of food insecurity in the communities, different information about which households are the most severely food insecure, and different information about which household characteristics associate with food insecurity. These results suggest that researchers need to be cautious when choosing a food insecurity metric and that it's beneficial to use multiple food insecurity metrics when conducting field work.

The research completed in this dissertation brings up five other studies to build on and further extend this body of work. First, all chapters of this dissertation focus on the household level but recent livelihood research objectives have stated the necessity of developing a better understanding of how individual livelihoods compile to create household level occupation portfolios (Scoones, 2015; Scoones 2009). Future research will use the nationally representative datasets used above determine to what extent household level job diversity is created from one individual working multiple jobs versus multiple individuals working at the same time. Furthermore, individual level analysis will indicate which job types can and cannot be worked concurrently by one person, providing important information for on the ground development practitioners as they attempt to guide households in the best ways to meet their needs.

Second, field work needs to be conducted to fully understand why the percentage of people working for pay in agriculture labor is increasing. Viewing this within the context of

the determinants of migration, future research will determine if workers are pulled to this type of work because it is thought to be more remunerative and stable than operating their own farm or are pushed to this type of work because there is simply little land available to farm and few opportunities outside of agriculture. Interview and survey work will be conducted with individuals and households in peri-urban communities to determine work aspirations versus work availability. Young people not currently working (13-18 year olds) and young adults (18 – 23 year olds) from these communities will be included in the sample frame to develop a better understanding of the formers aspirations and the latter's decision making process in selecting their current occupation, if there was any choice at all.

Third**,** there is concern within the development community that neoliberal economic reforms meant to encourage small-holder farmers to grow cash crops rather than subsistence crops may decrease household food security yet there is evidence in the literature for the persistence of growing maize, even where households have other suitable livelihood alternatives (i.e. Lerner et al., 2013, research done in the peri-urban zone of Mexico City). Future research, using the three time points of nationally representative data used in chapter one above, will determine if the percentage of households growing maize is decreasing within the farming population, if the ratio of land area dedicated to growing maize versus land area dedicated to growing other crops is decreasing, and last, if the percentage of maize harvest sold at market (rather than kept for home use) is increasing over time. The latter is important because even if households aren't switching to other crop types they may be shifting from growing maize for subsistence to growing maize for market, which is s significant shift in livelihood strategy.

Fourth, in this dissertation, one classification system was used to classify jobs in the first two chapters (own-ag, other-ag, and non-ag) and a slightly modified version of this was used in chapter three where households working outside of agriculture were split into whether they worked in the urban area or rural area (own-ag, other-ag, non-ag urban and non-ag non-urban) but there are multiple other ways to classify jobs that will increase understanding of development in Guatemala. Future work will determine the extent to which Guatemala is moving from informal economies, where households largely work for themselves (self-employed), to formalized economies where it's more common to work for pay. Change over time will be assessed with the datasets used in the first chapter of the dissertation. Then, the association between occupation portfolios and food insecurity will be assessed using both the 2015 nationally representative data (from chapters one and two above) and the field work data from chapter three, reclassified to emphasize differences between own-account work (self-employment) and formal work.

Fifth, future work will also examine why subjective measures of food security (chapter two: ELCSA, chapter three: HFIAS) do not necessarily match well with objective measures of food security (i.e FCS, chapter four). One hypothesis put forward in this dissertation is that households with different occupation types may have different food standards causing them to respond differently to subjective food security measures despite having similar diets. This will be tested in two ways. First, using the ENCOVI dataset that was used in chapter three, households will be grouped according to diet and then analysis will be conducted to determine what household characteristics associate with food insecurity within dietary groups. Having standardized by diet, the results should provide some understanding of what characteristics of households may cause them to respond differently to

subjective food security measure questions. For example, households working in urban areas or living in urban areas may be found to report greater food insecurity than rural households, despite having the same diet. Field work will also be used to address this questions. While the secondary data work will create generalized understanding, the field work will explicitly ask households with different occupation types what their food preferences are. This work will use both surveys and experiments to develop a better understanding of differential food preference and standards.

In conclusion, it appears that the current changes in society in Guatemala are not necessarily proving beneficial to household well-being, specifically the amount of food insecurity that they experience. The share of the country's population that is living in urban areas is growing, but living in urban areas isn't necessarily associated with better food security outcomes. Similarly, within rural zones, more and more people are working as paid agricultural labor, but this type of work isn't necessarily associated with better food security either. Last, it seems that subsistence agriculture (own-account farming) creates the greatest amount of food security for households within this general categorization system but the literature suggests that this livelihood is becoming more and more difficult to sustain.

References

Aberra, E., King, R., 2005. Additional Knowledge of Livelihoods in the Kumasi Peri-urban Interface (KPUI). Development Planning Unit, University of London, Uk. 65 pp.

Alonso-Fradejas, A., 2012. Land control-grabbing in Guatemala: the political economy of contemporary agrarian change. Canadian Journal of Development Studies / Revue canadienne d'études du développement 33, 509–528.

Bailey, C., Pomeroy, C., 1996. Resource dependency and development options in coastal Southeast Asia. Society & Natural Resources 9, 191–199.

Bebbington, A., 1999. Capitals and Capabilities: A Framework for Analyzing Peasant Viability, Rural Livelihoods and Poverty. World Development 27, 2021–2044.

BHANDARI, P.B., 2013. Rural livelihood change? Household capital, community resources and livelihood transition. J Rural Stud 32, 126–136.

Brooks, J., Cervantes-Godoy, D., Jonasson, E., n.d. 2009. Strategies for smallholders in developing countries: commercialisation, diversification and exit 21.

Brooks, J.S., 2013. Avoiding the Limits to Growth: Gross National Happiness in Bhutan as a Model for Sustainable Development. Sustainability 5, 3640–3664.

Carey, D., 2009a. Guatemala's Green Revolution: Synthetic Fertilizer, Public Health, and Economic Autonomy in the Mayan Highland. Agricultural History 83, 283–322.

Carey, D., 2009b. Guatemala's Green Revolution: Synthetic Fertilizer, Public Health, and Economic Autonomy in the Mayan Highland. Agricultural History 83, 283–322.

de la ELCSA, C.C., 2012. Escala Latinoamericana y Caribeña de Seguridad Alimentaria (ELCSA): Manual de uso y aplicaciones. Roma: FAO.

Ellis, F., 2000. The Determinants of Rural Livelihood Diversification in Developing Countries. Journal of Agricultural Economics 51, 289–302.

Ellis, F., 1998. Household strategies and rural livelihood diversification. The Journal of Development Studies 35, 1–38.

Escoto, J., Marroquin, M., 1992. LA AID en Guatemala: poder y sector empresarial. CRIES: AVANCSO, Managua, Nicaragua.

FAO (Ed.), 2018. Building climate resilience for food security and nutrition, The state of food security and nutrition in the world. FAO, Rome.

FAO (Ed.), 2014. Strengthening the enabling environment for food security and nutrition, The state of food insecurity in the world. FAO, Rome.

FAO (Ed.), 2008. Biofuels: prospects, risks and opportunities, The state of food and agriculture. FAO, Rome.

Fenton, L., others, 2013. Problematizing the effect of rural-urban linkages on food security and malnutrition in Guatemala's Western Highlands. Development Research Working Paper.

Food and Agriculture Organization of the United Nations, 2019. The state of food security and nutrition in the world: safeguarding against economic slowdowns and downturns.

Ford, A., Nigh, R., 2015. Maya Forest Garden: Eight Millennia of Sustainable Cultivation of the Tropical Woodlands (Vol. 6). Left Coast Press.

Fukuda-Parr, S., 2016. From the Millennium Development Goals to the Sustainable Development Goals: shifts in purpose, concept, and politics of global goal setting for development. Gender & Development 24, 43–52.

Gatica-Domínguez, G., Victora, C., Barros, A.J.D., 2019. Ethnic inequalities and trends in stunting prevalence among Guatemalan children: an analysis using national health surveys 1995–2014. Int J Equity Health 18.

Grandia, L., 2013. Road Mapping: Megaprojects and Land Grabs in the Northern Guatemalan Lowlands. Development and Change 44, 233–259.

Grandia, L., 2009. Raw hides: Hegemony and cattle in Guatemala's northern lowlands. Geoforum 40, 720–731. Hervas, A., Isakson, S.R., 2020. Commercial agriculture for food security? The case of oil palm development in northern Guatemala. Food Sec.

Lemke, S., Delormier, T., 2017. Indigenous Peoples' food systems, nutrition, and gender: Conceptual and methodological considerations. Maternal & Child Nutrition 13, e12499.

Lopez-Ridaura, S., Barba-Escoto, L., Reyna, C., Hellin, J., Gerard, B., Wijk, M. van, 2019. Food security and agriculture in the Western Highlands of Guatemala. Food Sec. 11, 817–833.

Lowder, S.K., Skoet, J., Raney, T., 2016. The number, size, and distribution of farms, smallholder farms, and family farms worldwide. World Development 87, 16–29.

Maria, A., Acero, J.L., Aguilera, A.I., Lozano, M.G., 2017. Central America Urbanization Review 203.

Méthot, J., Bennett, E.M., 2018. Reconsidering non-traditional export agriculture and household food security: A case study in rural Guatemala. PLOS ONE 13.

Mohan, G., 1997. Developing differences: post-structuralism & political economy in contemporary development studies. Review of African Political Economy 24, 311–328.

National Institute of Statisticss, 2020. Instituto Nacional de Estadistica Guatemala. URL
Office of the United States Trade Representative, 2020. CAFTA-DR (Dominican Republic-Central America FTA).

Rashed, T., Jürgens, C. (Eds.), 2010a. Remote Sensing of Urban and Suburban Areas, Remote Sensing and Digital Image Processing. Springer Netherlands, Dordrecht.

Reinhardt, K., Fanzo, J., 2014. Addressing Chronic Malnutrition through Multi-Sectoral, Sustainable Approaches: A Review of the Causes and Consequences. Front. Nutr. 1.

Schroten, H., 1987. Internal migration in Guatemala during the period 1976-1981. Notas Poblacion 15, 47–97.

Schwartz, N.B., 2015. Swidden Counts: A Petén, Guatemala, Milpa System Production, Carrying Capacity, and Sustainability in the Southern Maya Lowlands. Journal of Anthropological Research 71, 69.

Schwartz, N.B., 1990. Forest Society: A Social History of Petén, Guatemala, Ethnohistory. University of Pennsylvania Press, USA.

Scoones, I., 2009. Livelihoods perspectives and rural development. The Journal of Peasant Studies 36, 171–196.

Scoones, I., 1998. Sustainable Rural Livelihoods: A Framework for Analysis.

Sen, A., 1981a. Ingredients of famine analysis: availability and entitlements. The Quarterly Journal of Economics 96, 433–464.

Sen, A., 1981b. Public Action and the Quality of Life in Developing Countries*. Oxford Bulletin of Economics and Statistics 43, 287–319.

Sen, A., 1979. Issues in the measurement of poverty. The Scandinavian Journal of Economics 81, 285–307.

Shrestha, S.S., Bhandari, P., 2007. Environmental Security and Labor Migration in Nepal.

Shriar, A.J., 2014. Theory and context in analyzing livelihoods, land use, and land cover: Lessons from Petén, Guatemala. Geoforum 55, 152–163.

Shriar, A.J., 2009. Roads to Poverty Exploring the Impacts of Economic Integration on Socioeconomic Conditions and Land Use in Northern Guatemala. Journal of Planning Education and Research 28, 456–469.

Shriar, A.J., 2002. Food security and land use deforestation in northern Guatemala. Food Policy 27, 395–414.

Simon, D., 2008. Urban Environments: Issues on the Peri-Urban Fringe. Annual Review of Environment and Resources 33, 167–185.

Steinberg, M.K., Taylor, M., 2002a. The Impact of Political Turmoil on Maize Culture and Diversity in Highland Guatemala. Mountain Research and Development 22, 344–351.

Sundberg, J., 2010. Ngo landscapes in the maya biosphere reserve, guatemala. Geographical Review 88, 388–412.

Suter, L., 2012. Land succession and intensification in the agricultural frontier: Sierra del Lacandón National Park, Guatemala.

Tacoli, C., 2003. The links between urban and rural development. Environment and Urbanization 15, 3–12.

Tacoli, C., 1998. Rural-urban interactions: a guide to the literature. Environment & Urbanization 10, 147–166.

United Nations, 2020. Sustainable development goals. URL https://www.un.org/sustainabledevelopment/ (accessed 11.11.20).

United Nations, 2015. We can end poverty. Millennium Development Goals and Beyond. URL https://www.un.org/millenniumgoals/ (accessed 11.11.20).

United Nations, 1948. Universal Declaration of Human Rights [WWW Document]. URL https://www.un.org/en/udhrbook/pdf/udhr_booklet_en_web.pdf (accessed 11.11.20).

United Nations Development Programme, 2019. Human development report 2019: beyond income, beyond averages, beyond today: inequalities in human development in the 21st century.

Weeks, J.R., 2010. Defining Urban Areas, in: Rashed, T., Jürgens, C. (Eds.), Remote Sensing of Urban and Suburban Areas, Remote Sensing and Digital Image Processing. Springer Netherlands, Dordrecht, pp. 33–45.

World Bank, 2020. The Living Standards Measurements Study (LSMS). URL https://www.worldbank.org/en/programs/lsms.

Zezza, A., Tasciotti, L., 2010. Urban agriculture, poverty, and food security: Empirical evidence from a sample of developing countries. Food Policy 35, 265–273.