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Agricultural Labor in Midwestern United States specialty cropping systems

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Agricultural labor in Midwestern United States specialty cropping systems

by

Anna L. Johnson

A thesis submitted to the graduate faculty
in partial fulfillment of the requirements for the degree of
MASTER OF SCIENCE

Co-Majors: Sociology; Sustainable Agriculture

Program of Study Committee:
Lois Wright Morton, Major Professor
Carmen Bain
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Iowa State University

Ames, Iowa

2016

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DEDICATION

For my grandparents, Theodore Keifer Nace and Lovina Anne Kelley Nace.

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ABSTRACT

Midwest specialty crop production is highly dependent on its workers, many of whom are immigrants. Growers are contending with changes in the composition and size of the farm worker labor force due in part to shifts in immigration patterns. They are also facing changes in weather patterns due to climate change. This research addresses how growers can manage the labor needs of their operations through these shifts. First, a vulnerability framework is applied to interviews with Michigan specialty crop growers on their experiences with variability of labor and weather in their specialty crop systems. This study finds that growers are impacted by and react to the changes in weather and the labor workforce in a variety of ways, such as implementing various strategies to make their operation more attractive to workers as well as reducing the number of workers that their operation needs. These findings confirm the need for considering specialty crop growers and workers when studying both immigration policy and climate change. The second study examines the factors that impact farm worker job tenure, or the length of time that a worker stays with a particular employer, by analyzing data from the National Agricultural Workers Survey. The study finds that certain characteristics of workers and employers impact the length of job tenure, but that certain community characteristics and workers' legal status do not influence the length of job tenure. The implications from this are that there are some factors that growers can control to make their operations more attractive for workers, such as the payment of bonuses, but that other important factors are somewhat outside of their control, such as offering increased year-round employment in operations that have distinct seasonal labor needs.

CHAPTER 1

INTRODUCTION TO AGRICULTURAL LABOR IN THE MIDWEST

Although agricultural production in the United States has become increasingly mechanized, specialty crop production - generally, that of fruits and vegetables - is still dependent on human labor for many tasks. Many farm worker jobs are undesirable: they are often temporary and require strenuous physical exertion for low pay (Oliveira et al. 1993). Domestic workers are generally unwilling to fill these positions, and specialty crop growers have relied on immigrant workers for several decades (Burawoy 1976; Mercier 2014); currently, the majority of immigrant farm workers in the United States are from Mexico (Mercier 2014). Growers are facing increasing difficulties in hiring workers to meet the needs of their operations. One of the most frequently cited reasons is that immigration policy makes it difficult to hire immigrant workers reliably and legally (Mercier 2014).

Some recent literature on labor in United States specialty crop production has addressed growers' perspectives. In Holmes' (2014) ethnographic study of farm workers in Washington, he interviews growers and managers about their work and roles on the farm in addition to spending time with workers. Maldonado (2009) also interviewed tree fruit and vegetable growers in Washington state in order to discern how growers conceptualize the role and importance of the race of their employees. However, literature addressing growers' roles in Midwestern specialty cropping systems is sparse. This study aims to begin to fill this gap by exploring how Midwestern specialty crop growers are continuing to manage their operations when labor is scarce due to changes in the labor work force. Although specialty crops are defined in United States law as "fruits and

vegetables, tree nuts, dried fruits, and horticulture and nursery crops (including floriculture)” (7 US Code 1621), the focus of this thesis is primarily on the fruit and vegetable sectors of specialty crop production.

Thesis Organization

This thesis is organized into four chapters. This first chapter contains context regarding the political economy of specialty crop production and descriptions of chapters two and three of the thesis. Chapters two and three are two separate studies, and are formatted as stand-alone journal articles. These mixed methods studies investigate growers’ perspectives on shifts in agricultural labor scarcity in Midwestern production systems. The first study, in chapter 2, examines how variable weather related to climate change is impacting labor in specialty cropping systems. The second study, in chapter 3, investigates the factors contributing to longstanding worker-employer relationships. The fourth chapter of this thesis contains concluding thoughts, and is followed by illustrative quotes from interviews with workers in Appendix B and elaboration on the methodology used in Appendices A and C.

Political Economy of Midwest Specialty Crop Production

A political economy framework provides a useful tool for understanding the broader political, social, and economic landscape that specialty crop producers operate within. Political economy refers to the ways that the economy, the state, and social relationships influence each other (Lobao 2014). Lobao and Meyer (2001) elaborate: sociologists often apply a Marxian political economy framework in agricultural analysis,

which holds that market competition is socially constructed in ways that benefit large capital interests. Two major aspects of the political economy are particularly important in the Midwest specialty crop landscape: the role of immigration policy in specialty crop agriculture and general trends regarding changes in farm size and the structure of specialty crop markets. Each of these is discussed below.

Immigration and skill level in farm work

An important segment of the political economy in which specialty crop growers operate is the nature of the labor workforce on which they rely. This section explores the impacts that immigration patterns and worker skill levels have on the agricultural labor workforce.

Immigrants from Mexico are the largest group of farm workers today (see Table 1.1), and the percentage of United States farm workers who are from Mexico has indeed been declining since 2000, when it was at 79 percent (Carroll, Georges, and Saltz 2011). This seems to be a reflection of a broader trend: Mexican immigrants have constituted the largest group of immigrants for several years, but the number of immigrants returning to Mexico has recently become greater than the number immigrating into the United States from Mexico (Pew Research Center 2015).

Table 1.1: Farm worker country of origin, 2008-2012

Source: National Agricultural Workers Survey

Country of Origin	Percent
USA and Puerto Rico	26%
Mexico	67%
Other countries (Central America, South America, the Caribbean, South East Asia, Pacific Islands, Asia, Other)	7%

The Pew Research Center (2015) gives a few potential reasons for this dip in net immigration from Mexico. Immigrants reported greater difficulty in finding jobs in the United States following the economic recession. Increased security on the United States-Mexico border deters unauthorized immigrants from crossing. Finally, the United States government has increased the deportations of undocumented immigrants. While there are no data on whether the total number of people willing to engage in farm work is shrinking, since the majority of farm workers are Mexican immigrants, shifts in immigration patterns are likely to be impacting the base of farm workers.

In addition to the impacts from immigration patterns, the skill sets and characteristics of the existing farm worker labor force impact whether growers are able to hire the workers they need. As noted previously, the physical toll, variable work schedule and low pay make farm employment undesirable; hence the reliance on hiring immigrants from countries where earning power is lower than in the United States (Calvin and Martin 2010). But although farm work is often characterized as unskilled labor, there are different levels of skill required for different tasks. Picking apples requires different skills from trimming wine grapevines, and even repetitive harvest jobs require skill and endurance in order to bring in a quality crop (Holmes 2013; Wells 1996). There is also some evidence that the immigrants who move to work in rural areas are more likely to come from rural backgrounds themselves (Farmer and Moon 2009), suggesting that at least some farm workers may already possess skills and knowledge that are useful and desirable in farm work. While there are strong historical and structural reasons for why certain groups are hired into farm work that are not related to individual skill, farm workers' skills are a key part of specialty crop production systems.

The United States Midwest has distinctive agricultural labor patterns. Unlike other regions that produce large quantities of specialty crops, the Midwest is considered a “new destination” for immigrants because immigrant populations were historically concentrated in other areas of the country (Durand, Massey, and Capoferro 2005). However, specialty crop production has been established in the Midwest for over a century and has employed immigrants for several decades (Durand et al. 2005; Rudy et al. 2008). Given its unique history of receiving immigrants as compared to other areas such as the Southwest, Midwest agricultural labor patterns are somewhat different from those in the rest of the country. This thesis focuses on the Midwest region in order to better understand these dynamics.

Role of farm size and markets in specialty crop production

One of the important changes in the agricultural landscape that has impacted specialty crop production is shifts in farm size. Across the United States, the number of both very small farms and very large farms has been increasing, in all sectors including specialty crops. MacDonald et al. (2013) document this shift and give possible reasons for it including changes in technology, farm specialization, and government policy (MacDonald et al. 2013). They also note that larger farms seem to achieve greater efficiencies in production, although their calculations do not take into account growers’ use of contract services and therefore may overstate the economic efficiencies of large operations. A political economy framework provides a more structural explanation for why the number of large and small farms has grown while the number of mid-size farms has shrunk. Political economy holds that the interests of large capital as well as policies

that encourage international trade and low-cost food all foster the expansion of large farms (Lobao and Meyer 2001). These trends are clearly evident in United States specialty crop production, where 72 percent of specialty crop production takes place today on farms over 1,000 acres (USDA 2015).

Table 1.2: Farm Size of top producing Michigan counties by crop type

Top five counties in total sales by category	All agricultural production		Specialty crop Production			
	Average size of farm (acres)	Median size of farm (acres)	Sales (\$1,000)	Acres	Farms	Acres per farm
<i>Sales in Fruit, Tree Nuts</i>						
Kent	136	40	27,136	12,162	126	97
Berrien	147	40	15,626	13,181	294	45
Leelanau	120	72	14,196	16,262	250	65
Oceana	210	72	12,080	15,873	109	146
Ottawa	137	40	11,709	4,599	59	78
Michigan	191	60	133,091	110,163	2,394	46
<i>Sales in Berries</i>						
Van Buren	157	50	50,534	8,761	236	37
Ottawa	137	40	33,827	6,318	113	56
Allegan	194	45	14,078	2,786	82	34
Muskegon	144	40	11,210	1,596	35	46
Berrien	147	40	4,200	1,227	114	11
Michigan	191	60	124,043	23,389	1,444	16
<i>Sales in Vegetables (including melons, potatoes, sweet potatoes)</i>						
Montcalm	211	67	58,213	20,524	76	270
Berrien	147	40	39,862	8,448	145	58
St. Joseph	229	60	34,461	10,842	57	190
Monroe	188	42	34,375	8,459	86	98
Van Buren	157	50	28,671	7,242	98	74
Michigan	191	60	462,726	158,661	2,980	53

There is some indication that these patterns are present in the Midwest. Table 1.2 demonstrates how the average size of farms is far larger than the median size of farms in

several counties in Michigan, which is the highest value producer of specialty crops in the Midwest. In addition, the acres in specialty crops per farm is greater than the county median farm size. These patterns suggest that the trends in farm size and market shifts are present in Midwest specialty crop production as they are in other areas of the country.

As farm size in the United States expanded, so did agricultural markets. Larger farms are best suited to sell into large domestic and international markets (Lobao and Meyer 2001), and specialty crop exports have increased in the United States since 1990 particularly due to the passage of foreign-trade agreements (Johnson 2012). Midwest specialty crop growers therefore compete in international trade as well as with other domestic producers: for example, Washington and Michigan are both top producers of apples while Maine and Michigan are top producers of blueberries (Lynch and Coleman 2010; USDA Economic Research Service 2013). While trends in farm size and market changes are not the direct subject of this research, outlining them provides important context for this research, which is described below.

Overview of Chapter 2: Climate Change and Agricultural Labor

In addition to facing pressure from changes in the agricultural workforce and agricultural markets, Midwest growers also face pressures and challenges due to the weather and climate change patterns in the Midwest. Here, “weather” refers to the state of the atmosphere on a brief time scale, while “climate” refers to weather patterns over a long time scale (thirty years or more) (NOAA 2016). While changes in climate are impacting the Midwest as a region, growers experience and manage in response to weather on a daily basis. Both terms are used throughout this thesis. The weather impacts

on the Midwest from climate change are unique: summer warming in the Midwest has not particularly increased, creating a ‘warming hole’ (Arritt 2016). Winter and nighttime temperatures have been increasing (Pryor et al. 2014) which expands both winter hardiness zones as well as potential pressures from crop pests and diseases (USDA-ARS 2012; Walthall et al. 2012).

One of the major threats from climate change to Midwest specialty crops is that early spring warming can cause perennial crops to break dormancy before the threat of frost has passed, which can critically damage crops (Andresen, Hilberg, and Kunkel 2012; Hatfield and Takle 2014; Hatfield 2012). Other threats to specialty crop agriculture include increased intensity of precipitation events and decreased solar radiation (Walthall et al. 2012).

The literature acknowledges that these changes in weather patterns will impact agricultural production (Melillo et al. 2014; Walthall et al. 2012). Evidence is provided by Johnson and Morton (2015) that specialty crop growers and researchers are concerned about the impacts to labor needs. They found that growers and researchers rated their concern about the change of timing of labor needs on average as a 3.7, or “highly important,” on a 5-point Likert scale.¹ But there is not clear understanding in the literature of how growers are managing the ways that these changes impact the patterns of their labor needs, particularly in light of the changes in the agricultural workforce.

This chapter employs a vulnerability framework (Adger 2006; Smit and Wandel 2006) to data collected from interviews with growers in Michigan in order to understand the ways in which weather and labor interact in specialty crop production in the Midwest.

¹ Likert Scale was as follows: 1 = Not at all important; 2 = A little important; 3 = Moderately Important; 4 = Highly Important; 5 = Extremely important.

The vulnerability framework consists of the elements of exposure, sensitivity, and adaptive capacity. It is a well-established framework that is useful to apply in studying the various impacts – environmental, social, economic – of climate change on a community. Because the environmental, social, and economic impacts of climate change are complex and varied, describing the vulnerability of a community is an important first step in preparing for future impacts from climate change (Smit and Wandel 2006). But the Midwest specialty crop industry is often ignored in the climate change literature due to the dominance of row crop agriculture in the region. For example, Arbuckle, Morton, and Hobbs (2013) as well as Stuart, Schewe, and McDermott (2012) explore the implications of climate change for Midwest agricultural producers, but they focus on row crop agriculture. This chapter seeks to expand this scholarship into the realm of specialty crop production.

Overview of Chapter 3: Job Tenure in Agricultural Labor

Growers and other Midwest employers who rely on immigrant labor have reported increased difficulty in finding enough workers to hire at times that are critical for their operations. Given these changes in the agricultural workforce, growers may need to increase efforts to both attract and retain workers. Growers incur various expenses in managing labor such as the cost of wages, providing housing, and in the management time and expense they spend in recruiting and training. In addition, growers can have narrow windows when their need for labor is critical, and if they cannot employ enough workers during critical production windows they can face costs through crop losses. Growers can manage this risk through increasing their efforts to attract and retain

workers. This chapter examines farm worker job tenure in an effort to discern the factors that influence whether a farm worker returns to or stays with their employer from year to year. The chapter draws on data from the National Agricultural Workers Survey to address this question.

Job tenure is influenced by the characteristics of the worker, the employer, and the broader socio-political context. The concepts of human and social capital are used to measure the characteristics of workers that make them more or less employable, both in and out of farm work. In order to better understand how workers' employment situations impact their job tenure, the broad category of "contexts of reception" is used to map the characteristics of their jobs and employers, the communities where they work, and the broader socio-political context of immigration policy, and how these factors also influence the length of job tenure. Given Midwest growers' increasing interest in retaining workers, this research is expected to lend some insight into the most significant factors that predict longer job tenures for farm workers.

CHAPTER 2

GROWERS' VULNERABILITY TO WEATHER AND LABOR IN MIDWEST
SPECIALTY CROP PRODUCTION

Prospective journal: HortScience

Written and researched by Anna Johnson. Unpublished.

Introduction

Specialty crop producers in the Midwest have always had to contend with variability in weather, labor, markets, and other aspects of production. However, there is evidence that new pressures are developing for them in certain areas. Specifically, climate change is increasing weather variability in the Midwest, causing higher winter temperatures and more intense rainfall events (Arritt 2016) which can impact specialty crop production and yields (Walthall et al. 2012). Here, “weather” refers to the state of the atmosphere on a short time scale, while “climate” refers to weather patterns on a long time scale of thirty years or more (NOAA 2016). While there is research on how climate change is expected to impact crop production and how adaptation is needed (Walthall et al. 2012), there is little understanding of how weather changes influence the labor dynamics of agriculture. Midwest specialty crop agriculture, along with dairy production and meat processing, relies on an immigrant workforce that is increasingly difficult to legally and reliably employ due to current immigration policies (Mercier 2014). These changes in weather and labor present major challenges in Midwest specialty crop management, but the combined impact on specialty crop producers has not yet been investigated or described.

A vulnerability framework is well-suited for examining situations where environmental, social, and economic forces are impacting a community or area. The three

elements of vulnerability are exposure, sensitivity, and adaptive capacity – respectively, an event, the degree of impact from the event, and actions taken in response (Adger 2006). This approach is particularly useful in climate change research because the insight it provides into a community’s ability to adapt allows for planning for future stressors under climate change (Smit and Wandel 2006). However, one of the difficulties of analyzing vulnerability is that it is generally context specific, and different communities may react to similar stresses in different ways (Smit and Wandel 2006). Accurately characterizing a community’s vulnerability depends on consulting with the community (Smit and Wandel 2006).

This exploratory, qualitative study applies a vulnerability framework to investigate the dynamics that Midwest specialty crop growers are experiencing as they manage under increasing weather variability and changes in their labor workforce. Such knowledge can assist the community in strengthening its adaptive capacity as well as inform policy makers about the needs of specialty crop growers. Although this framework is developed to apply to entire communities (Smit and Wandel 2006), here it is applied to the experiences of specialty crop growers as a group.

Overview of Midwest specialty crop agriculture

The term “specialty crop” encompasses a great diversity of both plants and cropping systems. It is defined in United States law as “fruits and vegetables, tree nuts, dried fruits, and horticulture and nursery crops (including floriculture)” (7 US Code 1621). Given the breadth of this category, specialty crops have distinctly different growth patterns in all stages of development. They can be loosely grouped as annuals and perennials: crops that reach maturity in one harvest season versus crops that take several

years to reach harvest maturity. Specialty crops also have a significant range of soil conditions, water availability, temperature, and other weather conditions that are ideal for their growth and development. They are therefore each sensitive in different ways to weather extremes (Walthall et al. 2012).

Appropriate management practices for specialty crops depend on the growth habit of the plant and the durability of the crop. Many fruits bruise easily and require a great deal of hand labor to harvest, particularly if they are channeled into fresh markets. Other specialty crops, such as dry beans or fruits and vegetables destined for processing can be managed by machine from planting to shipping.

Specialty crops generally produce a higher crop value per acre compared to grain crops and hay production. Table 2.1 shows that in 2012, the United States produced over \$57 billion in sales of specialty crops from around 14 million acres of land, a ratio of approximately \$4,112 in sales per acre in specialty crop production. By contrast, for all agricultural production (including specialty crops, grain crops, and livestock) the ratio of sales per acre was only \$432 per acre. As shown in Table 2.1, California dominates United States specialty crop production in number of farms, number of acres in production, and values of sales. Thirteen of California's top twenty commodities produced between 2012-2014 were specialty crops (CDFA 2015). Table 2.1 also shows that the major specialty crop producing regions are in very different parts of the country: the West Coast, Texas, Florida, and the Great Lakes region which includes Michigan and New York.

Table 2.1: Top states in specialty crop production, 2012

(1) For value calculation, “specialty crops” includes vegetables, melons, potatoes, sweet potatoes, fruits, tree nuts, berries, nursery, greenhouse, floriculture, sod, cut Christmas trees, short rotation woody crops, and maple syrup.

(2) This is the market value of all agricultural products sold, including sales of both crops and livestock. Source: (USDA 2015; USDA 2012)

	Specialty Crops			Total Agricultural Production		
	Farms	Land in specialty crops (acres)	Total value of sales of select specialty crops (\$1,000) ¹	Farms	Land in farms (acres)	Market value of agricultural products sold (\$1,000) ²
California	45,646	4,338,625	26,516,823	77,857	25,569,001	42,627,472
Florida	14,483	957,991	4,916,570	47,740	9,548,342	7,701,532
Michigan	9,731	552,962	1,480,775	52,194	9,948,564	8,678,050
New York	9,416	290,232	1,105,419	35,537	7,183,576	5,415,125
Oregon	9,319	488,082	1,873,605	35,439	16,301,578	4,883,674
Pennsylvania	9,913	147,055	1,270,406	59,309	7,704,444	7,400,781
Texas	10,987	428,334	1,740,711	248,809	130,153,438	25,375,581
Washington	10,074	1,012,658	4,347,628	37,249	14,748,107	9,120,749
United States	244,974	14,004,762	57,650,871	2,109,303	914,527,657	394,644,481

Table 2.2 shows agricultural characteristics of the Midwestern states. Of these, Michigan is the largest producer of specialty crops. Because Michigan is downwind from the Great Lakes, it experiences weather that is cloudier, wetter, and more moderate than in other areas of the Midwest; falls and winters are warmer while springs and summers are cooler (Andresen et al. 2012). This contributes to the volume and value of Michigan specialty crop production: the state has the highest value, the greatest number of farms, and the largest number of acres in specialty crop production in the Midwest (USDA 2015). It also produces the second greatest diversity of specialty crops nationally (Mercier 2014). Michigan produces over 50 different kinds of vegetables, over seventeen different fruits and tree nuts, and over eight different kinds of berries (USDA 2012). In 2010, Michigan was also the top producer nationally of several crops, including

cultivated blueberries, tart cherries, cucumbers for pickling, several bedding plants, and both black and cranberry dry beans (MDARD 2011). Michigan is therefore an ideal setting to investigate Midwest specialty crop production.

Table 2.2: Select characteristics of Midwest specialty crop production

Source: (USDA 2012)

- (1) Cropland includes harvested cropland, other pasture and grazing land that could have been used for crops, cropland on which all crops failed or were abandoned, cropland in cultivated summer fallow, and cropland idle or used for cover crops, soil improvement but not harvested, pastured, or grazed.

	Total value of sales of select specialty crops (\$1,000)	Farms that produce specialty crops	Acres in specialty crops	Hired Farm Labor, workers (all agriculture)	Total cropland (acres) ¹
Michigan	1,480,775	9,731	552,962	83,451	7,669,071
Wisconsin	990,863	7,214	367,253	79,590	9,910,991
Minnesota	640,351	5,075	415,541	81,666	21,597,136
Ohio	605,887	3,258	54,092	64,589	10,748,553
Illinois	472,003	3,254	106,556	63,985	23,752,778
Indiana	228,576	2,935	63,252	46,590	12,590,633
Missouri	178,160	6,169	75,782	56,543	15,259,319
Iowa	123,393	2,295	18,931	79,838	26,256,347
Total Midwest	4,720,008	39,931	1,654,369	556,252	127,784,828

Impacts from climate change on Midwest specialty crop production

Climate change research has revealed a great deal about the impacts of climate change on agriculture, the shifts in regional weather patterns, and the specific impacts for different types of cropping systems. First, climate change research shows that climate change is currently affecting agriculture in several ways and is expected to continue to impact production through the next century (Melillo et al. 2014). These changes and impacts to crop production are complicated and varied. Rising temperatures can increase plant growth and extend growing seasons, but also increase plants' risk of heat stress and

decrease water holdings in the soil (Melillo et al. 2014; Walthall et al. 2012). Warmer air can also carry more water vapor, which then increases the intensity of precipitation events. But rather than increasing the amount of water available for plant growth, intense rainfall events generally create more intense runoff and degrade soil through erosion (Walthall et al. 2012). Finally, the rise in temperature expands the areas where diseases, pests, and weeds can overwinter, which increases their pressures on crops (Walthall et al. 2012).

Climate change research has also revealed that climate change impacts are expected to vary by region. Unlike other regions of the country, summer warming in the Midwest has not particularly increased (Arritt 2016). Instead, in the Midwest the fastest temperatures to increase have been the winter and nighttime temperatures (Pryor et al. 2014). Warmer winters are expanding the winter hardiness zones for vegetation (USDA-ARS 2012). The Midwest has also seen an increase in total annual precipitation, with that increase coming primarily in the form of heavier springtime rainfall (Hatfield 2012). Finally, although summer temperatures have not increased, summer humidity has, which can increase the risk of spreading crop diseases (Arritt 2016).

The impacts from climate change to specialty crops are considered in terms of their impacts to the groups of annual and perennial crops. Annual specialty crops, such as tomatoes and potatoes that have life cycles of less than one year, are expected to be considerably impacted by temperature changes (Walthall et al. 2012). Other anticipated stresses to annual specialty crops under climate change include both increased water deficits and increased water excesses (depending on the region in question), more extreme weather events that damage crops, decreased solar radiation from overcast

conditions, and interactions between these stressors that exacerbate the negative impacts (i.e., heat combined with humidity can decrease yields) (Walthall et al. 2012).

Although perennial crops are vulnerable in similar ways, they are also vulnerable in the off-season when annual crops are not in production. One of the most commonly identified threats to Midwest specialty crops is that early warm temperatures can cause perennial crops to break dormancy before the threat of frost has ended (Andresen et al. 2012; Hatfield and Takle 2014; Hatfield 2012). In addition to changes in temperature impacting their growth cycles, perennial specialty crops are also vulnerable to changes in water availability, decreased solar radiation, and shifts in ranges of diseases and insects (Walthall et al. 2012). Finally, carbon dioxide is a limiting growth factor for some perennial species, so increases in atmospheric carbon dioxide may increase their growth, although this crop growth may be offset by the other impacts from climate change (Walthall et al. 2012).

Labor in specialty crop production

In order to investigate how growers can maintain a reliable workforce through shifts in immigration and weather, an understanding of the structure of labor in specialty crop production is needed. This section provides a larger context of the relationship between growers and workers, while Table 2.3 demonstrates which states employ the most number of workers in specialty cropping systems and in agriculture overall.

First, growers have more social and economic advantages than their workers: not only are they the employers, but farm workers as a group are historically marginalized (Allen 2004; Holmes 2013; Wells 1996), face health risks through their jobs (Carolan

2012; Farquhar et al. 2008; Harrison 2004) and have historically had few legal protections (Burawoy 1976).

Farm worker jobs – treated here as those involved in planting, pruning and harvesting as well as seasonal post-harvest packing and processing – are and have been characterized by strenuous physical requirements, short tenure, and low pay (Oliveira et al. 1993). These jobs tend to go to populations with few other employment options, primarily immigrant groups (Burawoy 1976). It has historically benefitted growers to leverage their relative advantages and advocate for immigration and labor policies that foster large populations of potential workers, which then helps to drive down their labor costs. An example of this is the creation of the guestworker *bracero* program in 1941 (Wells 1996). This program was instituted when large growers were experiencing labor shortages due to potential workers leaving to fight in World War II. The growers advocated for the creation of a guestworker program that would allow them to hire foreign workers at low cost (Wells 1996). The access to cheap labor did lower costs for growers, but it also depressed wages for domestic workers (Mooney and Majka 1995), and there was very little unionization and legal protections for workers during the time of the program (Wells 1996). The program continued long after the war was over, and was finally ended due to concerns with the welfare of domestic workers as well as increased mechanization causing a decline in the demand for workers (Oliveira et al. 1993). In this case, the framing of “worker shortages” masked growers’ greater concern for lowering their production costs over enhancing worker welfare.

While many things about the specialty crop industry have changed since that time, farm workers are still a highly marginalized population. Today, one of the major ways in

which farm workers are marginalized is through their immigration status: undocumented workers make up nearly half of farm workers in the United States in 2009 (Carroll et al. 2011). As such, they are particularly vulnerable to deportation, have almost no legal protections, and can face harassment in the communities where they work and live (Holmes 2013; Park and Pellow 2011; Wells 1996). Full understanding of today’s “labor shortages” requires acknowledgement of the extent to which this sector relies on undocumented workers and the ways in which that group is marginalized.

Table 2.3: Top five states that employ workers in specialty crops, 2012

Source: USDA Census, 2012

	Specialty Crop Farms		All Farms	
	Farms	Workers	Farms	Workers
California	24,003	414,564	33,955	465,422
Florida	6,085	81,058	13,291	107,192
Michigan	4,496	52,134	13,620	83,451
Oregon	4,411	76,947	10,768	99,305
Washington	5,464	230,645	11,746	256,036
United States	105,423	1,351,219	566,469	2,736,417

These dynamics are present in Midwest specialty crop production. While the Midwest is sometimes considered a “new” destination for immigrants (Durand et al. 2005), several Midwest industries rely on immigrant workers, many of whom are undocumented. These include the dairy and meat processing industries as well as specialty crop production (Mercier 2014). Today, these sectors are all struggling to hire the number of workers that their operations need (Mercier 2014). A variety of factors seem to be at work in creating the current labor shortage, all of them related to the sectors’ dependence on immigrant workers: increased border security, decreased immigration into the United States, the reluctance of domestic workers to take these jobs,

and the inherent complications of using today's guestworker program, called H-2A (Mercier 2014; Pew Research Center 2015).

This research examines growers' strategies with managing labor through their experiences of worker shortages. The history of the relative advantages and disadvantages that growers and workers have had provides important framing for understanding growers' current vulnerability to worker shortages. The framework of vulnerability described below is a method to approach this issue.

Mechanisms of vulnerability

Midwest specialty crop growers are contending with increased difficulty in managing through changes in both weather and labor. Describing the interaction of these two dynamics requires a theoretical framework that can encompass both the biophysical nature of weather and the social and economic nature of labor. Vulnerability studies fill this role and are designed to investigate how systems react to such complex influences. Climate change has been a major impetus in the growth of this scholarship as climate change is expected to impact environmental and social systems in complex ways, and understanding and preparing for these impacts requires a similarly complex theoretical framework (McLaughlin and Dietz 2008).

The components of vulnerability are exposure, sensitivity, and adaptive capacity (Adger 2006; Smit and Wandel 2006; Walthall et al. 2012). Exposure is defined as the nature and degree to which a system experiences environmental or socio-political stress. Sensitivity is described as the degree to which a system is modified or affected by perturbations. Adaptive capacity is the ability of a system to evolve in order to

accommodate environmental hazards or policy change and to expand the range of variability with which it can cope (Adger 2006).

Given the diverse natures of weather and labor, examples of how labor and weather vulnerability manifest in specialty crop systems are very different. For example, a weather exposure might be cold temperatures in the spring; sensitivity might be the extent of crop damage from those cold temperatures, and adaptive capacity could be a grower's ability to protect crops from those low temperatures and damage. Labor vulnerability would exhibit very different exposure, sensitivity, and adaptive capacity. For growers managing with a workforce increasingly in flux, an exposure might be having several employees quit within a short period of time; a sensitivity could be the cost to the business in work not completed and the time and expense of recruiting and training new employees; and an adaptive capacity might be efforts a grower takes to encourage workers to not quit.

One complexity in applying the vulnerability framework is that interacting exposures create new sensitivity (Smit and Wandel 2006). An illustrative example is as follows: weather conditions might encourage a crop to mature to harvest earlier than workers are scheduled to begin harvest, and a grower might then shift their hiring schedules to account for it. In this situation, the exposures would be the change in weather as well as the characteristics of the workforce that cause workers to not be available for work earlier than scheduled. The sensitivity that the grower would experience might be in both the cost of any crop left in the field as well as the cost of their time spent reacting and adjusting to the situation. Their adaptive capacity could be

the actions they take to hire replacement workers and to prevent a similar situation from happening again.

Although these three elements of vulnerability are well established, specific consensus on the mechanisms of vulnerability has not been achieved due to the varied nature of the social, political, economic, and environmental systems in question and the influences visited upon them (Smit and Wandel 2006). However, describing the vulnerability of a locality or system using empirically obtained data from the community can assist in developing and enhancing its adaptive capacity (Smit and Wandel 2006).

Methods

Michigan is the ideal state in the United States Midwest to investigate the connection between weather and labor within specialty crop production because it is the Midwest state with both the highest level of sales from specialty crop production and the largest number of agricultural workers (Table 2.2). Within Michigan, Southwest Michigan has a long and diverse history of specialty crop production that continues today (Rudy et al. 2008). The region's robust capability to support specialty crop production has created a demand for agricultural labor. The six counties listed in Table 2.4 are the top employers of agricultural workers in Michigan, and they are all located in Southwest Michigan (Rudy et al. (2008) defines this region to include the counties of Allegan, Barry, Berrien, Branch, Calhoun , Cass, Clinton, Eaton , Hillsdale, Ingham, Ionia , Jackson, Kalamazoo, Kent, Ottawa, St. Joseph, Van Buren). Other regions in Michigan also produce a great deal of specialty crops – Montcalm County in Central Michigan has the most acres in vegetables while Leelenau County in Northern Michigan has the most

acres in orchards. But given that Southwest Michigan has both a great deal of production of specialty crops and a high reliance on agricultural labor, it is well-positioned to reveal important perspectives about interactions between weather and labor in specialty crop production.

In order to inductively identify emerging themes in how growers are experiencing and reacting to changes in both weather and labor, interviews were selected as the most appropriate method of gathering data because of their ability to capture detail and nuance (Neuman 1994; Rubin and Rubin 1995). The author conducted interviews with five specialty crop producers in the Southwest Michigan area during June 2015. All of the producers raise fruit and/or vegetable crops. Given the limitations on the number of interviews that could be conducted, producers in the nursery industry were not included. Interviewees were identified through snowball sampling, and all but one interview was done in-person and on-farm during work hours. One interview was conducted over the phone after a visit to the farm. The in-person interviews were audio-recorded and later transcribed. The phone interview was transcribed during the interview, and as such the transcription included limited paraphrasing. The interviews were conducted in English. The interviews were semi-structured, and topics included impacts of weather on interviewees' operations and the labor needs of their farm. Interview protocols and informed consent documentation were approved prior to administration by the Iowa State University Institutional Review Board (IRB) #14-453 (See Appendix A, which includes interview questions).

Table 2.4: Michigan counties that employ the most agricultural workers

Note: These six counties in Southwest Michigan employ the highest numbers of agricultural workers compared to all counties Michigan. The full list of counties in Southwest Michigan also includes Barry, Branch, Calhoun, Cass, Clinton, Eaton, Hillsdale, Ingham, Ionia, Jackson, and St. Joseph (Rudy et al. 2008).

(D) USDA did not release this data because the small number of responses could allow observers to estimate an individual growers' information.

Southwest Michigan Counties	Vegetables harvested for sale			Land in orchards		
	Acres	Farms	Sales (\$1,000)	Acres	Farms	Sales (\$1,000)
Allegan	5,239	85	18,360	1,619	59	15,199
Berrien	8,448	145	39,862	13,217	296	19,825
Kalamazoo	1,910	52	3,314	642	33	(D)
Kent	2,397	86	7,936	12,174	128	27,747
Ottawa	3,444	97	14,075	4,648	62	45,536
Van Buren	7,242	98	28,671	9,480	158	60,033
Total Michigan	158,661	2,980	462,726	111,372	2,502	257,133
Total US	4,492,086	72,045	16,851,235	5,199,729	106,488	25,869,700
Southwest Michigan Counties	Hired farm labor			Total		
	\$1,000 payroll	Farms	Workers	Acres	Farms	Sales (\$1,000)
Allegan	53,713	405	3,866	223,343	1,162	194,085
Berrien	31,100	404	4,682	126,096	959	145,902
Kalamazoo	35,511	233	2,948	112,853	598	194,521
Kent	35,745	362	3,179	120,547	888	180,389
Ottawa	71,147	465	7,278	138,148	1,194	300,308
Van Buren	32,899	418	6,183	125,089	981	161,414
Total Michigan	744,744	13,620	83,451	7,669,071	44,668	5,506,437
Total US	26,986,669	566,469	2,736,417	389,690,414	1,551,654	212,397,074

The interviews were coded for vulnerability related to weather, vulnerability related to labor, and vulnerability related to the intersection of weather and labor. For each of these three categories, examples of exposure, sensitivity, and adaptive capacity were identified, ultimately yielding nine coding categories. "Exposures" were identified

as an event, such as a weather event like a frost, or a labor event like several employees quitting unexpectedly. Examples of “sensitivity” consisted of descriptions of what the resulting impact of that exposure was for growers such as whether crops were affected, or whether they were able to continue the work with fewer employees. Finally, examples of “adaptive capacity” were identified as growers’ responses to these events. One researcher did the initial coding and then worked with a second researcher to reconcile the coding of themes and quotes.

Five interviews are the basis for this analysis, but insights from ten other interviews with farm workers as well as other field experiences are referenced in the following discussion when they provide clarifying detail. The ten interviews with farm workers were also audio-recorded and transcribed. Most were in Spanish and conducted with the assistance of an interpreter. Questions were about workers’ experiences in farm work (see Appendix A for interview questions and Appendix B for select quotes from these interviews).

The researcher also attended three Michigan growers’ meetings (a vegetable meeting on March 18; two apple meetings on June 3 and 4, 2015) and one specialty crop conference held in Michigan (December 9-11, 2014). Finally, the researcher conducted several informational interviews, both in phone and in person, with growers and extension agents in preparation for these interviews. Field notes from these experiences are referenced where applicable.

A caveat regarding the methodology should be identified before exploring these findings. The interviews were conducted during a busy summer week, and it seems likely that only growers who feel positively about their relationships with their workers would

consent to spending time during a busy season to be interviewed about the potentially sensitive topic of labor. Thus there may be inherent bias in the findings.

Findings

The growers interviewed represented a range of farm types and sizes in Southwest Michigan. The specialty crops that they raise fall into four general categories: annual vegetables, tree fruits, berries, and grapes (both juice and wine). Several also raise row crops like corn or soy. Because only five interviews were conducted, providing the specific profile of crops for each farm might compromise the confidentiality of the interviews, and so that information is not included. Farm size ranged from around 100 acres to over 1,000. All were family businesses, some having been in operation for over 100 years. Most had some sort of postharvest processing facility on-farm, and those that did not had relationships with such facilities relatively close-by. The operations that primarily rely on field production provided housing to their workers. Each operation employs seasonal workers, and most also employ labor year-round. The smaller operations had around two dozen employees while the larger operations had over 50.

These farms sell fruits and vegetables to diverse markets, including processors, wholesale markets, and direct markets. Generally, the type of market that a grower sells to depends on both the goals of the grower as well as the type of crop. Some crops are generally sold to processors, such as tart cherries and juice grapes, and growers receive a set and inelastic price for these. Other crops are sold fresh, such as peaches, table apples, and many vegetables. The growers talked about crop quality, market supply, and “middleman” brokers impacting the prices that they get. Some of their crops go to

multiple markets. Apples can either be sold fresh or go to processors; growers can receive a higher price for fresh but if crop quality is low then they can be sold to processors. In addition, during other conversations outside of these interviews, several contacts discussed the roles of various crop-specific organizations in Michigan. Some of these organizations pool grower fees to conduct marketing campaigns for a particular crop, while others collect fees to fund research on improved management practices for a particular crop. However, the growers in these interviews did not discuss the impact that these organizations have on their work in great detail.

The interviewees discussed many issues they face pertaining to both weather and labor. Vulnerability, as represented by the major themes of exposure, sensitivity, and adaptive capacity, was clear for each grower with regards to weather and labor. Specific aspects of exposure, sensitivity, and adaptive capacity were fairly common across multiple interviews, while other experiences were only evident in one or two interviews. However, clear connections between weather and labor emerged, as discussed below.

Weather and labor vulnerability are first explored independently below, followed by the ways that they intersect. Since growers generally discussed an event and its impact together, exposure and sensitivity are discussed in tandem for both weather and labor. Next, ways in which weather vulnerability impacts labor vulnerability are presented, followed by evidence for how combined weather and labor exposures can create new sensitivities. Finally, findings on growers' adaptive capacities in these situations are reported for weather, labor, and their combined effects.

Exposure and sensitivity with weather

Given the diversity of crops that the interviewed growers produced, it is no surprise that they described a variety of weather exposures and sensitivities. For example, one of the vegetable producers discussed the difficulty of getting plants in the ground during a wet spring and how the ongoing impacts of that delay were felt throughout the season. Another example is the exposure of a cold winter damaging grape vines, while the exposure of summer storms damaged fruit trees which then made them vulnerable to disease. Several of the tree fruit producers described their experiences during spring of 2012, when the weather was warm for several days in the early spring and was followed by freezing events. They each reported significant damage to their tree fruit crops that year (apples, peaches, cherries). In the below quotes, examples of exposure are underlined, while examples of sensitivity are in italics.

This quote is an example of exposure and sensitivity that a vegetable grower experienced:

“Well, last year, I mean, *we were late planting*, yeah, so being a very wet spring, *it was difficult to get everything we needed in the ground.*” INTERVIEW 1

Multiple growers discussed weather exposure and sensitivity with their tree fruit orchards and grape vine plantings:

“[One year] we had a bad summer storm...destroyed a lot of trees. With storms like that in our summer, the *trees become susceptible to fire blight, bacterial infections*. It’s not just the storm, it’s the aftermath of the storm.” INTERVIEW 15

“We got a terrible winter again, and so *we had dead vines*.” INTERVIEW 13

Finally, a couple of growers described the impact of the 2012 spring on their tree fruit crops:

“I remember like it was yesterday...2012 we had...early warm temperatures, first part of March; *everything popped out real quick, and then they all froze.*”

INTERVIEW 2

“[In 2012] it turned 85 degrees in March, and so everything bloomed on St. Patrick’s day...And that was 85 for a week, which is unusual. Normally, you’ll have 85 for a day; you might have a day of 70, but we had it for a week. *It pushed everything out—it was amazing to see things in full bloom and actually small fruit.* Then the end of April it froze, a couple of hard nights, and killed them.”

INTERVIEW 13

Labor exposure and sensitivity.

Before exploring the patterns of labor exposure and sensitivity that growers described, some description of their patterns of labor is needed. First, all the growers confirmed that some crops and systems require a large amount of labor for a short period of time, such as apple and wine grape harvests, while other crops that are mechanically harvested require comparatively little labor. Second, several growers mentioned that the seasonal demands of other farms in the region create an incentive for workers to quit to take other jobs. Finally, a couple of growers that conduct post-harvest processing on their operations mentioned that the daily variation in the number of work hours offered in post-harvest processing raises difficulties in both hiring and retaining workers. One grower elaborated:

“We had a ton of people come through...in big groups...that really needed the job right away, and we couldn’t give it to them, and then they moved on.... Then we had a couple manic weeks, and we had people quit [because] they didn’t want all those hours [of processing work]....” INTERVIEW 1

In addition to describing their dynamics of labor employment, growers discussed particular labor exposures that are becoming increasingly severe. These included higher worker turnover, decreasing worker return rates to their farm from year to year, fewer

people available to hire overall, and the increasing cost of labor. The implied sensitivity to these exposures is increased costs in both money and management time, but since this research design did not include gathering growers' financial information, their sensitivities are implied rather than quantified. The major non-financial sensitivity that they identified was that it is increasingly difficult to backfill positions as turnover escalates. The below quotes demonstrate some of these concerns; again, exposure is underlined while sensitivity is italicized. For some, the sensitivity of increased difficulty in managing is implied.

"...for every job, we had to hire [about] two people...We just had an incredible amount of turnover and just had a hard time keeping spots filled....it was very difficult last year." INTERVIEW 1

"We used to have 75, 80 percent of the same people return year after year after year, and about 2010, 2011, that started decreasing...And then in 2012 when we had the freeze and there was no fruit around here, we saw it decrease some more...Just nobody's showing up...I mean, 2012, we were probably down to 60 percent return, and then in 2013, 50 percent, and we had the biggest turnover we ever had. We probably sent out [many] *W-2s* because people would come for one or two weeks and say, 'Well, we're moving on somewhere else.'"*

INTERVIEW 6

**Actual number removed to protect identity.*

A couple of growers gave their opinions on why they are having increasing difficulties in hiring the number of people that their operations need, particularly at critical times. Two growers mentioned the importance of cell phones, which allow workers to quickly communicate with each other about where the highest wages can be earned. Immigration policy and increased national border security were also mentioned by a couple interviewees as important factors in shrinking the available workforce and exacerbating their hiring difficulties.

As mentioned in the Methods section, several interviews were conducted with workers as well. One of these interviewees, a foreman, also noted that their employer was experiencing increasing difficulty in hiring workers, and described the reasons behind it as related to the difficulty and cost of crossing the border from Mexico:

“A few years now it’s been hard to find help. Every year we get less and less people, it’s because many went back to Mexico to see their families, and they can’t return. And before, many came across, but now it doesn’t happen. That’s why we need people, yeah. It’s difficult to do a job like this without people. And in Mexico a lot of people want to come, because it’s really hard over there because of the drugs. But if you cross it’s hard because they take money from them to cross. And lots of people don’t want to come, because it’s real hard to cross the border. I think it’s made it more difficult for the whole country. Everyone wants laborers, people, and there isn’t... Every year it’s harder.”
WORKER INTERVIEW 7

Further excerpts from worker interviews can be found in Appendix B.

Another grower identified the rising cost of labor as an exposure, although they did not elaborate on the actual financial impact to their operation:

“...Wages are becoming more competitive, and most of the [workers’] housing is included at or below...my cost.” INTERVIEW 13

Finally, one grower acknowledged the challenge of finding labor in a general sense, but reported that it was currently not a problem in their operation:

“It can be a challenge finding workers when you need it, but I haven’t really had an issue. So I don’t know. Like I said, my guys got connections, and I don’t really care where they come from, as long as I get them.” INTERVIEW 2

This experience might be linked to certain characteristics of this growers’ operation. The greatest number of workers that this grower reported needing at a given time was only a couple dozen, and this interviewee reported years-long relationships with their employees. In contrast with this quote, this grower did report some difficulty hiring

workers in 2013, which is discussed in the next section. Overall, the majority of exposures that growers experienced were in their abilities to hire the number of people that their operation needed.

Intersection of weather and labor: exposure and sensitivity

When considering labor or weather vulnerability, identifying the exposure or sensitivity is fairly straightforward. A weather event can have a mild or severe impact on crops: sensitivity is determined both by the event and the characteristics of the cropping system. With labor vulnerability, a shrinking workforce can expose a grower to an increased difficulty of hiring workers, and their sensitivity to this is determined by how dependent their operation is on being able to hire that number of workers at a particular time.

But in analyzing the interactions of both of weather and labor vulnerability, the interactions of different exposures may influence sensitivity differently. In other words, a grower may be more sensitive to the combination of a difficult weather event and a changing workforce than they would have been to either exposure individually. Below is a description of how growers described weather impacting labor on their farms, followed by an exploration of evidence for double exposure with weather and labor.

First, the interviewees identified several exposures and sensitivities in the ways in which weather influences labor dynamics on their operation. They discussed vulnerability in both day-to-day and multi-year settings. In daily operations, a couple of growers named rain as impacting harvest schedules, which in turn impacts their workers' activities. One example pertained to processing: rain can limit the amount of harvest and

therefore post-harvest processing work that needs to be done. One grower identified a particular sensitivity where workers would sometimes quit when this meant that there was less work for them; workers also revealed in their interviews that in some cropping systems there is no work and no pay for them on rainy days.

One grower described how weather impacts labor over the arc of the growing season. Rainy conditions had prevented the spring application of chemical thinners with fruit trees, which meant that fruit thinning had to be done later in the season by hand, creating an additional task for workers. Another grower mentioned that an early spring could bring an early berry crop, which might come in before enough migrant workers had arrived to pick it.

But the most commonly mentioned exposures regarding weather and labor were those where the growers also experienced greatest sensitivity through partial or full crop failure. Growers described far lower labor needs for harvest during these seasons, although they still needed some workers for the maintenance of perennial trees and vines. One grower expressed sensitivity to such crop failure as a significant cost:

“...You hit a year like last year where those plants still have to be maintained, even though they don’t have a crop, so you might spend the [money on labor costs] with zero coming in... we lost \$65,000 by having that crop.” INTERVIEW 13

Growers had a great deal to say about the impact of weather on both their labor needs and the workers themselves during the growing seasons of 2012. A couple growers described the impact on their workers during this time:

“The guys got jobs doing other stuff at other farms, picking vegetables mostly, so they were able to keep employed...but I mean there was still enough work for me to do and keep busy and one other guy, and we did have to maintain the orchards somewhat, just so we could get a crop in 2013.” INTERVIEW 2

“As the owner, we endured the storm, but it was hardest on my employees, particularly the seasonal ones, and hard on the cooperative and the seasonal employees there. It was a tough situation for the whole industry.” INTERVIEW 15

They also described how some workers left the Midwest that year:

“The other half [of our crew]... went to Colorado to work on a peach farm, others found construction work in Florida.” INTERVIEW 15

“Yeah, 2012 was a little bit different, because a lot of people left the area, and they drove to Washington where they could harvest apples out there, and then they got reestablished there, and I don’t think a lot of them came back—they stayed there, and then they just work up and down the West Coast.” INTERVIEW 2

The findings up to this point demonstrate that 1) growers experience separate vulnerability regarding weather and labor and 2) weather impacts on-farm tasks. But is there evidence that weather and labor exposures combine to create new sensitivities? Given that there is some evidence that workers left Michigan altogether after 2012, and the earlier evidence of increasing difficulty in hiring workers, it seems likely that a double exposure of adverse weather in 2012 coupled with a changing workforce could create additional labor sensitivity during 2013. In short, the adverse weather and resulting lack of jobs in 2012 might have further impacted growers’ existing difficulties in hiring workers in 2013. The evidence for a compounded sensitivity in 2013 follows:

“[in 2013] It was tight [finding workers]...we [had full crops in several things]—oh, my goodness.” INTERVIEW 2

“I don’t think I really lost anybody in [2013] – you lose a family here or there, you pick up a family here or there – it wasn’t devastating for me – I know for others it definitely was.” INTERVIEW 15

Another grower described their low worker return rate in 2013 but did not seem to think that the 2012 weather was the primary cause. This is an expanded version of an earlier quote:

“And then in 2012 when we had the freeze and there was no fruit around here, we saw [our return rate] decrease some more...But on the other hand...[people in other regions have] been saying, man, they’re running out of people coming, they need to use the H-2A program... Just nobody’s showing up. And I’m like, well, our migrant stream from Florida has never really been an issue, but it started showing up as an issue in 2013....” INTERVIEW 6

Finally, one grower specifically identified apples as a crop that consistently requires the greatest number of people for a short period – about six weeks – and when questioned about hiring being tighter in 2013, that person cited troubles for apple growers but not their operation. There is therefore some evidence from these interviews that there was compounded sensitivity in 2013 resulting from the weather and labor dynamics of 2012, particularly for certain crops, but there was not unanimous agreement on this point.

Growers’ adaptive capacity regarding weather and labor

The third aspect of vulnerability is adaptive capacity. Growers demonstrated a diversity of adaptive capacities. Some are reactions to their exposure and sensitivity to particular weather events. Some are long-term responses to the variability of weather and their dependency on labor. Finally, some growers described specific exposures and sensitivities to which they could not adapt, all of which are described below.

Adaptive capacity to weather

There were several adaptive capacities that growers described as actions that they can take in response to adverse weather. Some of these were short-term, within-season actions: if storm damage leaves them vulnerable to disease, they can apply pesticides. If they expect harsh weather at the end of April, they plant later the following year to avoid the damage it can cause. Some actions were long-term investments in infrastructure, such as installing frost fans and sprinklers to help prevent frost damage to tree fruits, or installing irrigation to avoid adverse impacts from drought. However, these efforts are not always fail-safe. For example, at one of the growers' meetings that the researcher attended, it was revealed that frost fans can compound damage to crops if there are not appropriate temperature conditions. Finally, some weather impacts are so damaging that the plants were wiped out:

“I’m out right now actually calculating how many vines are dead for a government program that might offer some money towards replanting...TAP, Tree Assistance Program...I’m almost done with the three blocks that are hit the worst; and everything else I’ll just do on my own....Some blocks... by block and variety—you know, it won’t be what it was. I don’t know as it will ever be what it was three years ago.” INTERVIEW 13

In this case, the adaptive capacity available to the grower was to file for government payments to replace some of these perennial plantings and replace the rest out of pocket.

One notable finding related to the adaptive capacity to weather was that multiple growers volunteered their thoughts on the variability of weather:

“I’m really not a climate change believer, I can tell you that....It isn’t all of a sudden we’re starting to see this trend or anything. I mean, we watch the weather. We watch the weather trends, and we know that we’re going to try to start planting the 5th of May, and we know that we could have a frost, a late fall freeze by the 20th of September ‘til the 20th of October, anywhere in there. Once you get past the 20th of September, it’s fair game...” INTERVIEW 6

“...it’s just once every 15 years you’re going to take a whopping. And those are long-held patterns...I don’t deny climate change, but you have to realize there was always a lot of random, rollercoaster involved to begin with.” INTERVIEW 13

This suggests that growers feel that there are some exposures that they cannot plan for and that they simply must endure.

Adaptive capacity with labor

Growers had a great deal to say about how they strategize around the labor demands for their farm. A major theme that emerged was that growers have many strategies in place to attract workers. They mentioned increasing pay or paying above average wages. One grower reimburses migrant workers’ travel costs from Florida, while another allowed employees to store their belongings on the farm during the winter when they work in Florida. As demonstrated by an earlier quote, in 2012 one grower let their employees continue to live in the housing on their farm while they worked elsewhere; another grower mentioned opening their employee housing before their season had fully started to attract workers to their operation.

The growers also had a great deal to say about their relationships with their employees. In day-to-day management, several of them described the importance of showing respect to employees:

“Being a cheerleader and motivator is part of what I do. It’s important to develop relationships with [employees].” INTERVIEW 15

“I was always taught that you treat your employees like you would want to be treated, so that’s how I treat mine...So if you treat them well, they treat you well—I feel that way, personally, that they will do that...It doesn’t matter what color they are or what background they have. They’re all humans—they just want to be treated like humans and not dogs...I’ve got some friends that are farmers,

and they yell at their employees and cuss at them, and that's not right to do that. And I don't know why anybody would want to work for that person, so I don't know, it bothers me. So I just treat them the best that I can, and they treat me good." INTERVIEW 2

"Yeah, money isn't everything, okay. And the families we've had around here and stuff, if they have a sick kid or they need to do something, your family's more important than what you're doing here....And there's some places they go, people holler and this and that. Why? If something's going wrong, just take a deep breath and smile, and okay, let's do it different next time—you know, those kind of things." INTERVIEW 6

Some of the interviewees also discussed the differences between hiring workers who are traveling with their families and workers who are traveling alone. Providing housing to families as opposed to single workers costs more to growers, but some growers still described a preference for hiring families:

"We've always focused on catering to families, we believe that the family structure is the backbone of America... we try to supply above average housing, you have to have bigger units with more space for families, but the benefits of that in our opinion is you get a steadier workforce. With single guys, they're more transient, and families are less transient, they like coming back to the same place. You have to have proper housing for their kids. That's why we focus on hiring families, we enjoy the family structure. We believe it alleviates other issues, including drinking. Some of the families have worked for us 20 years..." INTERVIEW 15

"I'm used to having married people. So we've had bad experiences in the past with single guys, because they like to drink and party and usually come out hung over in the mornings." INTERVIEW 2

Even growers whose employees live off-site can have a preference for hiring people within a family unit:

"A lot of them are like a mother and daughter or something; that's pretty common. And that's actually desirable, too, because then you're sharing a vehicle... she's not going to bring her daughter in here if she doesn't show up every day—although that's not always the case...." INTERVIEW 1

A couple of the growers discussed what it meant to have children living on their farm:

“We certainly appreciate and allow the older kids in a family to develop a work ethic, that’s important when you’re going to hire families. We enjoy the husband-wife relationship when working together, and we enjoy having the older children work for us too.” INTERVIEW 15

“...the families that were here back in the 80s and 90s that came, they’re starting to get older, the kids are older, they’re moving on, they’re becoming...teachers, doctors, lawyers—we’ve had them all through here. We’ve seen kids graduate...It’s been a lot of fun.” INTERVIEW 6

Hiring workers and their families was important to several of the growers interviewed, not only because they have experienced family groups to be more reliable as employees, but also because they value supporting workers’ families.

Growers also discussed several ways in which their management decisions are aimed at making sure that they are able to employ the full number of workers that their operation needs at the critical times. For example, several growers were reducing the number of workers that their operation needs. One grower is trying to arrange the operations on their farm to increase the number of year-round jobs and reduce the number of seasonal jobs to avoid the risk of seasonal workers not returning from year to year. (Perennial crops need winter management much more than annual crops do, so this is not an option for every grower.) Another grower, similarly, shifted which crops they grew in order to shift their high labor times to later in the growing season, and stated that the purpose of having several variable crops was to provide jobs through the duration of the growing season. A third grower discussed how their decision to not expand production was determined by their labor needs:

“So we know what we can do and what we can’t do. And I try not to push that envelope too much, because I can always grow and get bigger. I have had those opportunities and turned it all down, because I just don’t have the people to do it and do it well....Because if I fail because I don’t have the people, then why did I

even bother doing it in the first place...I know what my limits are.”

INTERVIEW 2

Another explained the importance of efficient cropping systems in attracting workers:

“We’re always trying to come up with creative ways to make labor more efficient, from the type of trees we plant to how we manage them...A picker can spend 30 percent of his time climbing up ladders, that’s why we’ve gone to shorter trees, higher density production. That’s one of the things that helps get people back, when they see you’re investing in things that will make their jobs easier. We’re constantly planning, constantly planning.” [this quote refers to apple production; the interview number is not given to protect the interviewer’s identity]

Several growers acknowledged the importance of producing in a specialty crop region and how that influenced their ability to hire workers. When they have a big job to do and could put a few extra people to work, they sometimes call their grower neighbors to find out whether they can spare a couple of workers for the day. Sometimes other businesses in the region can offer jobs to seasonal employees in the off-season, which provides incentives for farm workers to stay in the region from year-to-year.

A final aspect of managing workers that the interviewees discussed was the methods through which they hire workers. One interviewee appreciates the immediacy of responses from advertising jobs online. Several also shared their thoughts on the H-2A program, a Federal program that allows United States employers to hire foreign workers for a limited period of time. Growers noted that there is growing demand for the program because it can guarantee labor for growers, but they were generally wary of it because of the expense, the level of paperwork required, and struggles with ensuring that they were approved to hire workers at the critical time for their operations.² The use of farm labor contractors – intermediaries who employ work crews and transport them to growers’

² The interviewees’ use of the program is not discussed since it was not used widely in Michigan at the time of these interviews.

operations as needed – was not discussed, although the 2012 USDA Agricultural Census data show that contract labor is not absent from Michigan: 92 farms in the state reported relying on contract labor exclusively, employing 1,136 workers in this way.

However, growers also described ways in which they do not, or cannot, adapt to the exposures and vulnerabilities of labor. Sometimes adaptive capacity consisted of no action: one grower mentioned that if it is not a critical time in the season, they do not always backfill when an employee quits and instead prefer to “stretch payroll” with their remaining employees. But other growers did not always have adaptive capacities to turn to when they experienced the exposure of high turnover. One grower described their labor shortage in 2013 and said that several jobs were simply done later than usual. Another described the difficulty of matching the timing of their labor needs with workers’ need for employment:

“...you can’t really hire early because if people don’t have the work, they’re going to look for something else...the timing is everything.” INTERVIEW 1

Essentially, while the interviewees demonstrated extensive adaptive capacities for both their weather and labor vulnerabilities, they were also forthcoming about the limitations of those adaptive capacities.

One point which ties all of these concepts together – weather, labor; exposure, sensitivity, adaptive capacity – was in growers’ description of the role of diversity in their production systems. One grower cited difficulties in managing complex diversified systems, but generally the growers identified two major benefits of diversity: they can stagger high labor times throughout a season, and if one crop is hit by adverse weather, there are more likely to be alternate crops that make it through. Thus diversity is an adaptive capacity itself and can shield growers from different kinds of exposures.

Discussion

Although these interviews were limited in number, they do allow for greater understanding of specialty crop production systems in Michigan. To better understand the various pressures that growers face, what follows is first a discussion the vulnerability framework and findings, an elaboration on the importance of farm worker skill, and finally an exploration of the political economy of specialty crops and how it impacts the findings of this research.

Application of the vulnerability framework

The vulnerability framework is very useful in understanding how growers manage through variable weather and changes in labor. The distinctions of the different aspects of vulnerability are contested in some literature (McLaughlin and Dietz 2008; Molnar 2010), and in this study the categories of exposure, sensitivity, and adaptive capacity often overlapped. One trend in these interviews was that growers generally only revealed exposures to which they were sensitive. For example, growers were forthcoming about the types of weather that were harmful, but did not reveal much about the types of weather that were beneficial. In addition, growers' accounts of events often encapsulated exposure, sensitivity, and adaptive capacity together in one thought. Finally, as Lobao and Meyer (2001) discuss, agency, or individual decision-making, plays an important role when analyzing agricultural systems at the individual level. The element of adaptive capacity within the vulnerability framework provides an essential tool for labeling and describing that agency.

The growers had a great deal to say about reducing their weather vulnerability. Exposure and sensitivity varied by crop, but consistent with the literature, tree fruits were described as particularly sensitive to the exposure of spring frosts, while other crops were described as sensitive to a variety of other weather exposures at other times. The interviewees also exhibited a wide range of adaptive capacities for dealing with weather exposures (Hatfield and Takle 2014). This study is not extensive enough to allow for conclusions regarding specialty crop growers' ability to adapt to climate change, but it does demonstrate the important finding that interviewees consider weather variability and the risks to their crops to be an inherent part of their production systems. Since climate change outreach efforts with farmers in other areas of agriculture must take climate change denial into account (Arbuckle et al. 2015) this may be an important and useful finding for future outreach efforts to specialty crop growers.

Given that these interviews included the sensitive topic of labor and they were conducted during a busy time for growers, these data are potentially biased because growers who have generally positive stories regarding their farm workers may be more likely to consent to being interviewed under such circumstances. Therefore, the finding that these growers made efforts to support their workers may be indicative of the bias of the sample rather than illustrative of common grower practices.

But even with its limitations, this study revealed a great deal about the dynamics of agricultural labor on the farm scale. In this study, the concept of "labor vulnerability" was defined as growers experiencing difficulty hiring workers (encompassing exposure and sensitivity) as well as the management decisions they made in response (adaptive capacity). This vulnerability framework informs the kinds of exposures they experience,

such as increasing turnover, workers quitting, and wages increasing. While specific sensitivities were not quantifiable, examples of sensitivity were identified: the difficulty of losing workers at the peak of the season, or of backfilling behind several workers who quit after short tenures. Finally, a great many examples of adaptive capacity to labor exposures and sensitivities were revealed, ranging from fostering personal relationships with workers to paying higher wages.

While the interviews did not reveal extensive detail on the impact of weather on growers' labor needs, there were indications that weather has the greatest impact on labor for the most labor-intensive crops. For example, the weather in 2012 created vulnerability for growers as the tree fruit crop was severely damaged, the number of seasonal jobs plummeted, and some workers left the area. Some of the growers did experience increased labor vulnerability in 2013, which suggests that weather can impact labor vulnerability from year to year, and indeed exacerbate existing labor vulnerability. Other weather exposures impacted growers differently, changing the tasks that needed to be completed or the schedule of work for the season. Given the extent to which specialty crop production is dependent on human labor and the increased weather variability that is expected under climate change, this will be an important intersection to continue to monitor in the future.

Conclusion

This research provides important perspective on how the intersections of weather and labor vulnerability impact Michigan specialty crop farms. These farms are unique in the Midwest for both their crop diversity and for the high number of farm workers they

employ, which leaves them particularly vulnerable to both the influences of climate change and of changes in the labor workforce. Future research on the impacts of climate change on agriculture in the United States would do well to continue to incorporate a sociological perspective in examining how changes in the industry are impacting workers as well as how workforce dynamics are impacting the industry.

These findings demonstrate that labor is an important issue for growers and that variable weather exposure can exacerbate growers' difficulties with labor. However, this study is limited in that it only accounts for growers' point of view, and only a small number of growers. In order to take a robust approach towards climate change adaptation in specialty crop production, related research will need to be done with the workers as well in order to determine the level to which weather impacts their lives and how or whether it influences or exacerbates the struggles they are already facing.

One important finding from this research that has implications for grower outreach is that growers see their operations under constant risk due to weather variability, with or without climate change. Since more extreme weather events are expected in the Midwest under climate change, climate adaptation efforts for growers in this area may not need to be explicitly linked to climate change. In addition, while increasing weather variability may pose a threat to their production systems (as in 2012 with Michigan tree fruit production) the normalcy of weather variability that was demonstrated during these interviews might prove an asset as growers adapt their production systems to increased variability.

Limitations to this Research

There were a few limitations to this research. First, its qualitative, inductive, and exploratory nature as well as the small number of interviews do not allow for broad conclusions. In addition, while the growers interviewed produce a wide variety of crops, asparagus growers were noticeably absent. Because asparagus harvest has a high demand for labor in the spring, the perspectives of asparagus growers will be important to include in future research. Future research might chose to examine growers of a few specific crops, particularly those with short periods of high labor demand, in order to more closely examine how these dynamics work.

One of the important contributions that sociology can make to climate change adaptation work is from its robust body of scholarship on inequalities (Carmin et al. 2015; Harlan et al. 2015). As discussed earlier, while growers are negatively impacted by changes in weather and the work force, as a group growers have far more advantages than farm workers do. An important next step in this research effort will be to examine how the shifts in weather and immigration policy are impacting the workers. This research provides some evidence that farm workers suffer from weather variability when jobs are shortened or eliminated. There was also evidence here that growers are giving thought to how to attract and retain their workers. Future research on impacts to workers should take all of these issues into account.

Despite its limitations, this study demonstrated that when growers experience labor vulnerability, they have a variety of adaptive capacities to turn to that can mitigate some of the impact. In particular, several growers discussed hiring the same workers year after year in their seasonal positions and how that contributed to stability in their work

force. In order to better understand these relationships, the following chapter explores the issue of farm worker job tenure.

References

- 7 US Code 1621. 2014. *Congressional Declaration of Purpose; Use of Existing Facilities; Cooperation with States*. United States.
- Adger, W. Neil. 2006. "Vulnerability." *Global Environmental Change* 16(3):268–81.
- Allen, Patricia. 2004. "Reflections on Ideologies in Alternative Agrifood Movements." Pp. 115–42 in *Together at the Table: Sustainability and Sustenance in the American Agrifood System*. University Park, Pennsylvania: Pennsylvania State University Press.
- Andresen, Jeff, Steve Hilberg, and Ken Kunkel. 2012. *Historical Climate and Climate Trends in the Midwestern USA*. edited by J. Winkler, J. Andresen, J. Hatfield, D. Bidwell, and D. Brown.
- Arbuckle, J. G., L. W. Morton, and J. Hobbs. 2015. "Understanding Farmer Perspectives on Climate Change Adaptation and Mitigation: The Roles of Trust in Sources of Climate Information, Climate Change Beliefs, and Perceived Risk." *Environment and Behavior* 47(2):205–34.
- Arritt, Ray. 2016. *Climate Change in the Corn Belt. CSCAP-0193-2016*. Ames, Iowa.
- Burawoy, Michael. 1976. "The Functions and Reproduction of Migrant Labor : Comparative Material from Southern Africa and the United States The Functions and Reproduction of Migrant Labor : Comparative Material from Southern Africa and the United States1." *American Journal of Sociology* 81(5):1050–87.
- California Department of Food and Agriculture. 2015. "California Agricultural Statistics Review, 2014-2015." 1–126. Retrieved (<https://www.cdfa.ca.gov/statistics/PDFs/2015Report.pdf>).
- Carmin, JoAnn et al. 2015. "Adaptation to Climate Change." Pp. 164–98 in *Climate Change and Society: Sociological Perspectives*, edited by Riley E. Dunlap and Robert Brulle. Oxford University Press.
- Carolan, Michael. 2012. *The Sociology of Food and Agriculture*. Oxon: Routledge.
- Carroll, Daniel, Annie Georges, and Russell Saltz. 2011. "Changing Characteristics of US Farm Workers: 21 Years of Findings from the National Agricultural Workers Survey." *Immigration Reform and Agriculture Conference*. Retrieved January 1, 2015 (<https://migrationfiles.ucdavis.edu/uploads/cf/files/2011-may/carroll-changing-characteristics.pdf>).

- Durand, Jorge, Douglas S. Massey, and Chiara Capoferro. 2005. "The New Geography of Mexican Immigration." Pp. 1–22 in *New Destinations*, edited by Víctor Zúñiga and Rubén Hernández-León. New York: Russell Sage Foundation.
- Farquhar, Stephanie, Nargess Shadbeh, Julie Samples, Santiago Ventura, and Nancy Goff. 2008. "Occupational Conditions and Well-Being of Indigenous Farmworkers." *American Journal of Public Health* 98(11):1956–59.
- Harlan, Sharon L. et al. 2015. "Climate Justice and Inequality." in *Climate Change and Society: Sociological Perspectives*, edited by R. E. Dunlap and R. Brulle. Oxford University Press.
- Harrison, Jill. 2004. "Invisible People, Invisible Places: Connecting Air Pollution and Pesticide Drift in California." Pp. 288–304 in *Smoke and Mirrors*, edited by E Melanie DuPuis. New York: New York University Press.
- Hatfield, J. and G. Takle. 2014. "Chapter 6: Agriculture." *Climate Change Impacts in the United States: The Third National Climate Assessment* 150–74.
- Hatfield, Jerry. 2012. *Agriculture in the Midwest*. edited by J. Winkler, J. Andresen, J. Hatfield, D. Bidwell, and D. Brown.
- Holmes, Seth H. 2013. *Fresh Fruit, Broken Bodies*. Berkeley: University of California Press.
- McLaughlin, Paul and Thomas Dietz. 2008. "Structure, Agency and Environment: Toward an Integrated Perspective on Vulnerability." *Global Environmental Change* 18(1):99–111.
- MDARD, Michigan Department of Agriculture and Rural Development. 2011. *Michigan Agricultural Statistics 2010 - 2011*.
- Melillo, Jerry M., T. C. Richmond, Gary W. Yohe, and (Eds.). 2014. *Highlights of Climate Change Impacts in the United States: The Third National Climate Assessment*.
- Mercier, Stephanie. 2014. *Employing Agriculture : How the Midwest Farm and Food Sector Relies on Immigrant Labor*. Chicago.
- Mooney, Patrick H. and Theo J. Majka. 1995. "The United Farmworkers Era." Pp. 150–83 in *Farmers' and Farm Workers' Movements: Social Protest in American Agriculture*. New York: Twayne Publishers.
- National Oceanic and Atmospheric Administration (NOAA). 2016. "How Is Weather Different from Climate?" 1–8. Retrieved January 1, 2016 (<http://www.noaa.gov/what's-difference-between-climate-and-weather>).

- Neuman, W. 1994. *Social Research Methods: Qualitative and Quantitative Approaches*. 2nd ed. Needham Heights, MA: Allyn and Bacon.
- Oliveira, V., A. Effland, J. Runyan, and S. Hamm. 1993. *Hired Farm Labor Use on Fruit, Vegetable, and Horticultural Specialty Farms*.
- Park, Lisa Sun-Hee and David Pellow. 2011. *The Slums of Aspen: Immigrants vs the Environment in America's Eden*. NYU Press.
- Pew Research Center. 2015. *More Mexicans Leaving Than Coming to the U.S.* Washington, D.C.
- Pryor, Sara C. et al. 2014. *Synthesis of the Third National Climate Assessment for the Great Lakes Region*.
- Rubin, H. and I. Rubin. 1995. *Qualitative Interviewing: The Art of Hearing Data*. Thousand Oaks, CA: Sage.
- Rudy, Alan P. et al. 2008. "The Political Ecology of Southwest Michigan Agriculture, 1837-2000." Pp. 152–205 in *Agrarian Landscapes in Transition: Comparisons of Long-Term Ecological and Cultural Change*, edited by Charles L. Redman and David R. Foster. Oxford: Oxford University Press.
- Smit, Barry and Johanna Wandel. 2006. "Adaptation, Adaptive Capacity and Vulnerability." *Global Environmental Change* 16(3):282–92.
- United States Department of Agriculture. 2012. *U.S. Census of Agriculture, 2012*.
- United States Department of Agriculture Agricultural Research Service. 2012. "USDA Plant Hardiness Zone Map." Retrieved March 16, 2016 (<http://planthardiness.ars.usda.gov>).
- United States Department of Agriculture National Agricultural Statistics Service (USDA-NASS). 2015. *2012 Census of Agriculture: Specialty Crops*.
- Walthall, C. L. et al. 2012. *Climate Change and Agriculture in the United States: Effects and Adaptation*. Washington, D.C.
- Wells, Miriam J. 1996. *Strawberry Fields: Politics, Class, and Work in California Agriculture*. Ithaca and London: Cornell University Press.

CHAPTER 3

THE ROLE OF HUMAN AND SOCIAL CAPITAL AND CONTEXS OF RECEPTION
ON FARM WORKER JOB TENURE

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Anna Johnson conducted the research and wrote this manuscript. Dr. Emily Berg provided expert assistance with the statistical work.

Introduction

Many specialty crop growers in the United States Midwest are facing increasing difficulty in hiring the workers that their operation needs (Johnson and Morton 2015; Mercier 2014). This sector relies on immigrant labor, primarily from Mexico (Calvin and Martin 2010; Mercier 2014); reasons behind these hiring difficulties include increased security at the United States-Mexico border, decreased immigration rates into the United States, and the inherent complications of using today's guestworker program, called H-2A (Jensen 2014; Jordan 2015; Mercier 2014; Pew Research Center 2015). Given this shift in the farm worker labor force, growers have increased incentive to retain their current workers. This research examines several characteristics of both farm workers and their situations of employment in order to determine which factors contribute to longer job tenure for farm workers. Farm worker job tenure is defined as the length of time that a farm worker stays in employment with a particular employer, either by returning from one growing season to the next or by holding continuous employment.

Job tenure, as opposed to income or other factors involved in farm worker employment, is a labor characteristic well-suited to examine short and long-term relationships between farm workers and employers. This investigation uses a theoretical

framework that allows for examining the characteristics of both workers and their employment situations that might impact job tenure. First, the concepts of human and social capital are applied to analyze the characteristics of workers that impact their employability (Aguilera 2003; Kandel et al. 2011) In addition, the broad category of “contexts of reception” is used to map the characteristics of farm worker jobs, the communities where they work, and the broader socio-political context of immigration policy (Kandel et al. 2011).

Below is a discussion of the relationship between specialty crop production and immigrant workers, followed by a more detailed description of the factors that influence job tenure. This is followed by discussion of the National Agricultural Worker Survey and how it is applied here to understand farm worker job tenure. Finally, the findings are revealed and their meaning and implications are described in the discussion and conclusion sections.

Specialty crop production and immigrant workers

Throughout the United States, farm worker jobs in specialty crops are often characterized by their short duration, strenuous physical requirements, and low pay (Oliveira et al. 1993).³ However, depending on the crop and task, there is some variation in the structure and desirability of farm worker jobs. For example, a job harvesting apples may only last a month or two, while a job maintaining wine grapevines might require work throughout the year. Short-term jobs are generally considered the least desirable,

³ Specialty crops encompass a wide variety of crops; the term is defined in United States law as “fruits and vegetables, tree nuts, dried fruits, and horticulture and nursery crops (including floriculture)” (7 US Code 1621).

and farm workers who work in short-term jobs may look for several over the course of the year. Farm worker jobs also vary in their physical demands – for example, pruning fruit trees in the spring might be less strenuous than harvesting many pounds of tomatoes during summer heat. A body of literature also documents a number of negative health impacts that can come from farmwork (Crowley and Ebert 2014; Farquhar et al. 2008). According to the Bureau of Labor Statistics (2014), in 2014 the sector of agriculture, forestry, fishing, and hunting had the highest fatal work injury rate of any other sector: 25.6 per 100,000.

The specialty crop industry relies on a landless wage labor work force primarily made up of immigrants to perform this strenuous and sometimes dangerous labor (Pfeffer 1983). Immigrant farm workers come to work in the United States for higher wages than they could earn in their home country (Calvin and Martin 2010). Most immigrants who take the undesirable job of farmwork do so because they do not have more desirable options available to them (Jensen 2014).

As a group, farm workers face a variety of challenges. Nearly 50 percent of farm workers do not have legal status in the United States, and these undocumented workers are disadvantaged in a variety of ways. They are vulnerable to deportation, have little legal recourse when they are being treated unfairly by employers, and can face harassment in the communities they work and live in (Holmes 2013; Park and Pellow 2011; Wells 1996). As an example, sentiment against undocumented immigrants was so strong in California in 1994 that the state tried to ban undocumented immigrants from accessing health care, education, and welfare benefits (Durand et al. 2005).

In addition to the difficulties that come with being undocumented, many farm workers face other difficulties. One is language barriers. Individuals' other identities can marginalize them even further. For example, women who work in farm work can face sexual harassment on the job that their male counterparts do not experience (Wells 2013). Indigenous Mexican people, who are marginalized among Latino Mexicans, can be doubly marginalized among Mexican immigrants when they emigrate to the United States (Holmes 2013).

Because farmwork is physically difficult work that receives low pay, few people who work in farmwork stay in farm work for very long. Instead, many immigrant farm workers transition out after a few years. Milard and Chapa (2001) describe how Latino immigrants who settled in the Midwest invariably left farmwork for other food processing or light industry jobs, using agricultural work as a stepping-stone of employment for many Mexican immigrants who came to the Midwest in the 1980's and 1990's. Other scholars have confirmed this pattern. Wells (2013) found a similar preference among farm workers in southeast California, who preferred to exit farmwork if possible because of its low pay and seasonal nature. Specialty crop growers therefore rely on a continually rotating supply of new immigrant seasonal farm workers to meet their labor needs (Griffith 2011; Wells 2013).

However, immigration patterns are shifting and this workforce is changing (Jensen 2014; Jordan 2015; Pew Research Center 2015). Growers in the Midwest are facing increasing difficulty in hiring workers as a result (Mercier 2014), and there is increased interest among these growers to change their recruiting practices (Dudek 2016). The following section explores the utility of examining farm worker job tenure to better

understand the relationship between farm workers and their employers and shed greater light on this concern.

Farm worker job tenure

This research examines farm worker job tenure, or the length of time that an employee works for a particular employer. Given the general undesirability of farm work described above, most farm workers are expected to have relatively low job tenures with their employers, but this is not true for all farm workers. This research hypothesizes that when farm workers have longer job tenures with a particular employer, additional factors are at play that create a relatively more positive situation. Because job tenure can be ended either by a worker's decision to leave or an employer's decision to terminate, it is also a useful proxy for examining the various factors that farm workers and employers negotiate in an employment situation. But these dynamics are complex: for example, as described above, farm workers generally face difficult working conditions, so even the best situation for an individual is likely to still have difficulties given the general undesirability of farm work. In addition, the more "employable" an individual is, the lower the likelihood that they return to a particular employer because they are better able to move and find a more desirable position (Aguilera 2003). Several factors are therefore expected to influence whether an individual returns to a particular employer from year to year, as described below.

Farm workers' capitals and contexts

The factors that influence farm worker job tenure are expected to fall into two categories: characteristics of the worker, grouped here under “human and social capital,” and characteristics of their job and life situations, explored here as “contexts of reception.” The following section elaborates on these concepts and is succeeded by the hypotheses for this research and the hypothesis tests conducted using data from the National Agricultural Worker Survey.

Human and social capital

A human capital framework refers to characteristics that make an individual more or less appealing to an employer. “Higher levels” of human capital correspond with increased earning potential. Aguilera's (2003) research investigates these dynamics for Latino immigrants, and found that increases in human capital corresponded with workers leaving a job more quickly, presumably to go to a better job. Kandel et al. (2011) similarly found that higher human capital – such as more education, more United States experience, and other factors - corresponded with full-time, year-round employment among Latino immigrants.

The concepts used here to study an individual farm worker's human capital correspond to this approach and include education, experience, and English ability. Higher education, increased skills, and increased English ability are all generally expected to correspond with an increase in human capital (Aguilera 2003; Kandel et al. 2011). But farmwork requires relatively low levels of human capital, which is why it employs immigrants with few other employment options. Therefore, farm workers with

higher levels of human capital would be expected to have shorter job tenures because they would be better able to find more appealing employment elsewhere. A further complication is that while the majority of farmwork does not require highly skilled workers, some farmwork positions do require greater skill than others. Therefore, more highly skilled farm workers are expected to have longer job tenures in farm work.

In addition to examining human capital, this research will also investigate the impacts of social capital on farm worker job tenure.⁴ Here, social capital is considered to be the relationships that an individual holds and the advantages that those relationships offer. Aguilera and Massey (2003) explore the many ways in which immigrants' social capital can influence their employment. For example, an employer may be more likely to trust a farm worker if they were referred through a personal connection. Or a robust social network can increase the number of jobs that an individual learns about, which enables them to more easily find the most desirable employment available. Given this range of influences on employment, social capital can impact job tenure in opposing ways. First, a strong social network can assist an individual in a job search (Aguilera and Massey 2003), so for a farm worker seeking to move out of farm work, or even to move to different employment within agriculture, the strength of their social network might decrease their job tenure. However, when an individual is referred to an employer through a personal contact, it can create a sense of obligation for both parties (Aguilera 2003), thereby potentially increasing their job tenure. This research will investigate which of these impacts social capital has on farm worker job tenure.

⁴ The consideration by Kandel et al (2011) of immigrants' social networks is a simplification of the broader concept of social capital, which is generally considered distinct from human capital. However, for this research, social networks are the primary element of social capital analyzed, so human and social capital are considered together.

Finally, Aguilera (2003) notes that while there may be differences in immigrants' relative levels of human capital, Latino immigrants generally have fairly low levels of human capital overall, and they may face additional difficulties in finding secure employment due to their race, gender, or the segregation of occupations. These factors that influence whole groups of immigrant farm workers point to the need for examination of the structural influences on farm worker employment.

Contexts of reception

In addition to their investigations of Latino immigrants' human capital, Kandel et al. (2011) also explore a variety of macro-level contexts that impact immigrants. These range from farm-level structures to national policies. For example, Kandel et al. (2011) explore the influence of the characteristics of the employer on farm workers, specifically citing that some employers have preferences for hiring people of a particular race, ethnicity, or gender (see Maldonado (2009) for a discussion of the racialization of farm workers). This research modifies the approach of Kandel et al. (2011) to examine three different concepts of macro-level context and their potential impact on farm worker job tenure. These three concepts are employer context, community context, and immigration policy context.

The employer context represents the conditions of farm worker jobs conditions that employers control, and depending on the characteristics of the job they can either be attractive to workers or not. Higher pay is a clear incentive to stay with an employer. Year-round jobs are also more desirable than seasonal ones, so a year-round job would be expected to be associated with longer job tenure than a temporary job (Kandel et al.

2011). In addition, many growers provide housing for their seasonal workforce, but the quality of the housing that an employee lives in impacts their quality of life (Farquhar et al. 2008; Michigan Civil Rights Commission 2010). The condition of an employer's farm worker housing might also impact a farm worker's job tenure.

The second context of interest to be examined here is the availability of community resources for farm workers. Many scholars have highlighted problems with farm workers' lack of access to adequate health care, attributing it to various causes such as inadequate local infrastructure, the transient nature of migrant work, and finally general prejudice on the part of the permanent community (Holmes 2013; Poss and Pierce 2003). Farm workers can also struggle with a lack of access to childcare and schools for their children. A farm worker might therefore choose, if they are able, to stay in or return to a job in a setting where these resources are more readily available to themselves and their families.

The final context to be considered is national immigration policy. Probably the biggest single factor impacting the lives of farm workers and their families is an individual's documentation status. As described above, documentation status dramatically affects an individual's ability to live, work, and move freely in the United States. Documented status might be associated with shorter job tenure as an individual has greater freedom to move within the United States. Undocumented status can impact job tenure in different ways. Sometimes undocumented workers build long-term working relationships with employers and stay with a grower for several years (Wells 1996), but as a marginalized group they may only have access to the least desirable and most temporary jobs and growers may have lower incentive to re-hire them from year to year.

Although documentation status may have varying impacts on job tenure, given that a large portion of farm workers are undocumented, this is an essential factor to include in this analysis.

Hypotheses

Both human/social capital and contexts of reception can positively or negatively impact the dependent variable of this study, length of job tenure. Table 3.1 below explains how these dynamics are expected to interact. For example, increases in human/social capital could both increase and decrease job tenure: a farm worker might be more likely to stay with an employer if they have human/social capital characteristics that make them a desirable employee, but those same characteristics might make them more likely to leave for a more desirable job. This is shown in the column headings of Table 3.1 below: high levels of human/social capital that is useful for farmwork and lower levels of human/social capital are both expected to have an inverse relationship on job tenure, while levels of human/social capital that are useful in farmwork are expected to be positively associated with job tenure. Under contexts of reception, the characteristics that create a more supportive environment for farm workers are expected to be positively associated with job tenure, while those that are less supportive are expected to be negatively associated with job tenure. These hypotheses can be expressed as follows:

H1a: Variables that represent increases in human/social capital that is valuable outside of farm work will be associated with shorter in job tenure.

H1b: Variables that represent increases in human/social capital that is valuable for farm work will be associated with longer in job tenure.

H1c: Variables that represent lower levels of human/social capital will be associated with shorter job tenure.

H2: Contexts of reception that are supportive for farm workers will be associated with longer job tenure, and contexts that are less supportive will be associated with shorter job tenure.

Table 3.3 and Table 3.4 in the following section provide more detail as to which specific variables are expected to have positive or negative associations with job tenure.

Table 3.1: Hypotheses of influence of human/social capital and contexts of reception on farm worker job tenure

		Human and Social Capital		
Contexts of Reception		Human and social capital more useful for non-farmwork (-)	Human and social capital more useful for farmwork (+)	Less human and social capital overall (-)
	More supportive (+)	Don't stay in farmwork	Stay in farm work, longer job tenure	Stay in farm work, shorter job tenure
	Less supportive (-)	Don't stay in farmwork	Stay in farm work, shorter job tenure	Stay in farm work, shorter job tenure

Additional factors not considered

There are many factors that might affect an immigrant's job tenure in farm work that have not been covered here. The first is general prejudice that immigrants might encounter when moving through the communities where they work. Even though Latino immigrants have been settling in the United States for many years, Jiménez (2008) theorizes that the racial boundaries distinguishing Latinos as a unique group are reified by the ongoing influx of new Latino immigrants. Latino farm workers can therefore face native prejudice, which, if it is particularly harmful to them, may influence their decision to stay in a particular community or with a particular employer.

In addition, the economic and employment structure of an agricultural region might also play a role in job tenure and farm worker retention. For example, an employer might be more attractive to seasonal farm workers if the employer's neighbors offer jobs in the alternate season. While these dynamics are not explored in this research, the proposed framework is expected to be quite informative about many factors that influence farm workers' job tenure.

Survey Design and Methods

This study explores farm worker job tenure using survey responses from the National Agricultural Workers Survey (NAWS). The NAWS was conducted annually between 1989 and 2012 by the U.S. Department of Labor (DOL), surveying over 50,000 farm workers during this time period. In an effort to randomly survey farm workers while accounting for variation in farm worker activity, the NAWS sampling design is stratified both by region and by agricultural season. The seasonal interview cycles are conducted in February, June, and October. In each cycle, a sample is constructed from six levels of selection: region, Farm Labor Areas (single county or groups of counties), county, Zip Code region, employer, and finally respondent. DOL allocates at least 1,500 interviews per year across the different strata, proportional to the farm labor expenditures of a given Farm Labor Area (United States Department of Labor 2015). Once an area has been selected, DOL contacts farm employers in that area to ask whether they will consent to administration of the survey on their farms. When DOL interviewers visit the farms they randomly select farm workers to create a sampling frame. In 2009, 66 percent of farm employers contacted agreed to have the DOL interviewers visit their farms, and 92

percent of approached workers agreed to be interviewed (see Appendix C). Further information on the survey methodology can be found here:

<http://www.doleta.gov/agworker/naws.cfm#s-regions> and in Appendix C.

This research focuses on the responses of farm workers from the Midwest region. The NAWS is a publically available dataset, and in order to preserve the anonymity of the respondents and their employers, the lowest level of geographic detail that DOL reports in the public-use data set is six geographic regions for the entire country. The Midwest region to be considered here includes responses from Illinois, Indiana, Ohio, Iowa, Kansas, Missouri, Michigan, Minnesota, Nebraska, North Dakota, South Dakota, and Wisconsin. DOL advises that regional analyses use at least four years' worth of data; responses from 2009-2012 will be analyzed here.

The initial subset of NAWS data from the Midwest from 2009-2012 included 750 cases, unweighted. Several cases were dropped for the following reasons. First, one respondent reported their age as 14 and their length of job tenure as 11 years; this is assumed to be an error and this case was dropped. In addition, certain variables from the NAWS questionnaire allowed a participant to answer "don't know"; in some cases these responses were re-coded as NA's (see Table 3.2). Finally, the NAWS dataset contains a sprinkling of item nonresponses. When the final suite of variables for the model was selected, all cases containing at least one NA response to the variables of interest were dropped. The final dataframe included 601 cases unweighted, which corresponds to N = 1,329 weighted.

The NAWS public dataset includes both variables straight from the NAWS questionnaire (U.S. Department of Labor Employment and Training Administration

2013) as well as created summary and analytic variables (United States Department of Labor 2015). The public access dataset also includes an aggregate sampling weight variable that allows for national level analysis despite differences in sample sizes by strata. DOL also provided separately⁵ a file with fifty replicate weights for variance estimation constructed using Fay's method of balanced repeated replication with a tuning parameter of $\rho = 0.5$ (Judkins 1990). Once the final suite of variables was chosen and the data subset identified, R software was used to generate a generalized linear model, and both the estimation weights and the replicate weights were incorporated so that the results reflect the impact of the complex survey design.

Dependent variable

The dependent variable used in this model is job tenure, or the number of years that an employee has worked at the operation where they were interviewed. A worker did not have to be employed year-round in order to be considered employed for multiple years: for each respondent, one day of employment with the current employer was counted as one year. Because farm work is generally a stepping-stone occupation for immigrants (Milard and Chapa 2001), these data are understandably highly skewed right, with over half of participants reporting their job tenure with their current employer as two years or less, although the mean response was 5.5 years (see Table 3.3). The log of this variable is used in this analysis.

⁵ Daniel Carroll, email correspondence, October 15, 2015. Trish Hernandez, email and mail correspondence, October 26, 2015.

Independent variables

Several variables are examined for their impact on job tenure. They fall into the categories of human/social capital; contexts of reception including employment characteristics, community resources, and immigration policy; and finally controls, all described below. Table 3.3 has descriptive characteristics of the continuous and integer variables; Table 3.4 has descriptive statistics for categorical variables. The predicted signs of the model coefficient for each variable are included as well in Tables 3.3 and 3.4.

Human and social capital variables

These variables correspond to different characteristics that impact an individual farm worker's ability to secure a particular job and their ability to stay in or return to it (for year-round or seasonal workers, respectively). The NAWS contains a great deal of information that can inform upon an individual's employability both in and out of farm work.

As is shown in Table 3.1, an increase in human and social capital is predicted to influence an individual's job tenure in a few ways. Either it can give them access to better jobs outside of farm work, which is expected to decrease their job tenure, or give access to better jobs within farm work, which is expected to increase their job tenure.

Three variables are expected to predict an individual's ability to secure a more desirable job within farm work: years of experience in farm work in the United States (logged), the years they expect to continue in farm work, and the type of farm work that they are doing (levels are 'pre-harvest,' 'harvest,' 'post-harvest,' and 'semi-skilled'). Generally, greater levels of skill and experience are expected to predict longer job tenures

because those individuals are more likely to be able to access more desirable farm jobs. More years of farm work experience is therefore expected to predict longer job tenure. It is assumed here that farm workers who expect to stay in farm work will in fact stay in farm work, and that this response will also predict longer job tenures. Finally, harvest tasks are the most common in farm worker jobs (Oliveira et al. 1993), and are considered here as the most commonly available skill, so the ability to secure a non-harvest job is conceptualized as an indicator of additional skill and/or an ongoing relationship with the employer. Therefore, individuals in non-harvest jobs are expected to demonstrate longer job tenures.

The variables that are expected to predict whether an individual can more easily find employment outside of farm work are: their education level, their English fluency, the number of years of experience that they have working outside of farm work (logged), and whether they feel they are able to get a job outside of farm work within a month (0 = no, 1 = yes, 7 = 'don't know'). Education is measured by the highest grade completed in school (ranging from 0 = 'no school' to 16 = 'four years of college'). Individuals' responses to their ability to speak English are also used here (1 = not at all, 2 = a little, 3 = somewhat, 4 = well). For all of these variables, values that represent greater human capital (more education, greater English fluency, ability to get a non-farm work job, non-farm work experience) are expected to predict shorter job tenures because individuals with these traits will be better able to secure more desirable, non-farm work employment.

Finally, two measures of social capital are included here. The first is how the individual originally found their current farm job. The most frequent response was that they were "referred by a relative/friend/work mate." If the pattern of greater social

capital predicting shortened job tenure for Latino citizens that Aguilera (2003) observed holds for the farm workers in this study, we can expect that an individual whose social ties helped them find their current employment may be better able to find more attractive work outside of farm work and therefore have a shorter job tenure.

The other measure of social capital used pertains to family situation. The experience of a farm worker who is accompanied by their family is somewhat different from one who is not. An unaccompanied farm worker is more mobile and therefore more able to change jobs as necessary, while a farm worker who lives and/or travels with their family is less mobile, and might be more inclined to settle in an area or return to a job from year to year if they find an opportunity to do so. In addition, some farm worker families have established long-term relationships with farmer employers, and multiple members of their family work with that employer, which is expected to increase in their job tenure with a particular employer. Therefore, whether the respondent is accompanied or not is used to measure their family situation (0 = unaccompanied, 1 = accompanied); accompanied farm workers are expected to have longer job tenures.

Context of reception – employment

The farm structure and work opportunities available with a particular employer are expected to influence a farm worker's job tenure. Two variables on wages are used: type of wages (piece, hourly, combination) and whether an employer pays a bonus or not in addition to wages. Piece work is expected to be less appealing and therefore associated with shorter job tenure: it is often more physically taxing because an individual's pay is

dependent on the volume of crop they can pick. The responses of hourly payment and salaried employment as well as receipt of bonus are expected to increase job tenure.

Having several employers and short, temporary jobs during the year is less secure and undesirable for farm workers, and might be an indication that a farm worker will not return to that employer in subsequent years. Two variables are used to measure this concept. The first is whether a farm worker is employed seasonally or year-round, and the second is the number of employers that the farm worker reported during the previous year. The more secure situations - year-round employment and one or few employers – are expected to predict longer job tenure.

Context of reception – community resources

Two measures are used as indicators of a community's receptiveness to farm workers and whether the farm worker can obtain the services they need. The best indicators in the NAWS for this pertain to access to healthcare: whether or not a farm worker has used United States health care in the last two years (0 = no, 1 = yes), and the number of difficulties they encountered in obtaining that health care. This latter variable was created from the summed responses of several yes/no questions about difficulties that a farm worker has faced in obtaining health care; the most often reported difficulty was "too expensive," but others included problems with transportation, clinic hours, and language barriers. The Cronbach alpha value for this health care measure is 0.98. Increased access to community resources, as indicated by few to no difficulties in obtaining health care, is expected to predict increases in job tenure.

Context of reception – immigration policy

United States immigration policy has an enormous impact on immigrants' lives, and since many farm workers are immigrants, it is expected that their legal status will influence their job tenure as well. In the NAWS, legal status is measured in four categories. Since this study is most concerned with whether or not an individual is vulnerable to deportation, the three categories of "citizen," "green card," and "other work authorization" were combined into a single category of "legal presence," while "unauthorized" was left as a single category. Being unauthorized is expected to predict shorter job tenures than having legal status because unauthorized farm workers are less safe, stable, and secure in the United States. The NAWS does not survey workers employed via the H-2A temporary guestworker program, so the experiences of those workers are not included in this analysis.

Controls

Certain variables are included as control variables, although predictions can be made about whether they will influence a farm workers' job tenure. First, two measures of income are included: an individual's total income and their family's income, each adjusted for inflation to 2012 levels using the Consumer Price Index (U.S. Department of Labor, Bureau of Labor Statistics). The income variables are included as controls rather than as part of one of the theoretical constructs because although income and job tenure are related, income is not an indicator of human capital, social capital, nor any of the contexts of reception. However, increases in personal income are generally expected to indicate more desirable employment and should predict increases in job tenure, while

increases in family income might indicate that other family members have found employment more lucrative than farm work and the individual might leave their current position. It is important to note that although increased income might be expected to relate to job desirability, farm workers may have several jobs throughout the year and their reported income may not be entirely dependent on the employer about whom they are reporting.

Another control variable is migrant type, which includes the categories of “settled,” “follow-the-crop,” “shuttle,” and “newcomer.” NAWS defines these categories as follows. An additional category in the dataset, “migrant,” includes all workers who traveled more than 75 miles during a 12 month period to obtain a farm job, while “settled” includes those who do not fit the migrant category. “Migrant” has two sub-groups: “shuttle,” or those who stay within a 75 mile radius of their job location and do not do farm work in their home region, and “follow-the-crop” migrants who travel to several farm locations within the United States for work. “Newcomers” are defined as having been in the country less than a year when they were interviewed (Carroll, Samardick, and Bernard 2005). The “settled” category is expected to predict increases in job tenure as compared to the other categories because settled individuals have a geographic incentive to return to the same employer from year to year. Similarly, for the variable of birth country, farm workers who were born in the United States are expected to be more settled than those born outside of the United States, and to therefore have longer job tenures.

Indigenous identity is also included as a control. Holmes (2013) provides an extensive exploration of the additional difficulties that indigenous migrant workers can

face as compared to Latino migrant workers. Because of these additional difficulties, indigenous identity is expected to predict a decrease in job tenure. Gender is also included as a control for similar reasons; since women are more likely to be marginalized in farm worker positions, they are expected to have shorter job tenures than men. Age is included as a control and is logged. Finally, since tasks and seasons vary by crop, a variable is used to denote the segment of the specialty crop industry where the farm worker is employed (field crops, fruits and nuts, horticulture, vegetables, and misc/mult). Since these categories are already aggregated, no predictions are made as to their impact on job tenure.

Race and ethnicity are not used as controls. Although farm workers are often racialized by their employers and employment communities (Holmes 2013; Maldonado 2009), the U.S. Department of Labor acknowledges issues with the validity of the race and ethnicity variables in the NAWS. First, the Department of Labor notes that ethnicity labels can be arbitrary as they are based on cultural heritage, nationality, and racial background. In addition, race categories can be difficult for foreign workers to understand if the way that race is understood in the United States is different from how it is understood in their home countries (Carroll et al. 2005). Given these difficulties, these variables were left out of the final model.

Finally, although the differences between grower and labor contractor employers are important in other areas of the country and for many farm workers (Balderrama and Molina II 2009), they are not considered here. While the NAWS contains information about growers and labor contractors, virtually none of the respondents in this subset of NAWS data reported working for a farm labor contractor, indicating that labor

contractors had little impact in the Midwest specialty crop industry during this time period. (This may indicate a weakness of the dataset: the U.S. Department of Agriculture 2012 Agricultural Census shows that for the states included in this dataset, 282 farms rely on contract labor exclusively and employ 1,964 workers in this way (USDA 2012)).

NAWS also does not have robust data on farm worker housing, so while it may be an important factor in understanding the employer context, this study does not analyze the impact of farm worker housing conditions on job tenure.

Table 3.2. Variable recoding and adjustments* (table continued on next page)

*Note that the original NAWS codebook contains more levels for several variables than are reported here or in Table 3.4. For example, additional options for birth country include South America and the Caribbean. However, no respondents in this subset of NAWS data reported their birth country as either of those places. In this and similar cases, those additional levels for which there were no responses are left off this table.

** Adjusted for inflation using the Consumer Price Index Calculator from the U.S. Bureau of Labor Statistics.

Variable	Change
<i>Human capital</i>	
How long do you expect to continue doing farm work in the U.S.A.?	This variable was recoded to equalize the intervals between the categories. Responses were re-coded to the mean of the range of the category they indicated. "Other" was recoded as "NA."
<i>Social Capital</i>	
Found this job through:	Categories with small numbers of cases recoded: "Recruited by farm labor contractor/his foreman," "Referred by the employment service," "Referred by the welfare office," "Referred by labor union," and "Other" were re-coded as a single level.
<i>Contexts of Reception: Employment</i>	
Method of payment	The smallest category "combination hourly-piece" is combined with the largest related category, "by the hour."
Do you work for this employer on a seasonal basis or year round?	"Seasonal" and "Don't know" recoded as a single level.

Table 3.2 continued

Aside from your wages, do you receive any other money bonus from the grower or labor contractor?	“No” and “don’t know” recoded as a single level.
<i>Contexts of Reception: Community resources</i>	
Index of difficulties faced when getting health care in the U.S.	NAWS includes ten yes-no questions about whether the respondent encountered certain difficulties in accessing health care in the U.S. Each was coded 0 = no and 1 = yes. This index was created by summing all of the participants’ responses for these ten questions. The Standardized Cronbach alpha for this index is 0.98.
<i>Contexts of Reception: Immigration Policy</i>	
Current Legal Status	“Citizen,” “Green Card,” and “Other work authorization” categories were re-coded as a single level, “Legal Status.”
<i>Controls</i>	
Family’s total income last year in U.S.A. thousand dollars (U.S.A. earners only)?**	This variable was re-coded to equalize the intervals between the categories by converting each score to the upper limit of each income category (new range: 0 to 45). Adjusted for inflation to 2012 levels. “Don’t know” was recoded as “NA”.
Your total income last year in U.S.A. thousand dollars (U.S.A. earners only)?**	This variable was re-coded to equalize the intervals between the categories by converting each score to the upper limit of each income category (new range: 0 to 45). Adjusted for inflation to 2012 levels. “Don’t know” was recoded as “NA”.
Birth country	Several original categories had only a few cases. Large category “USA” combined with small category “Puerto Rico.” Remaining small categories, “Central America” and “Asia” were combined with “Other” category.

Table 3.3. Descriptive statistics of continuous variables

Weighted N: 1,329. Unweighted N: 601. Weighted values shown. Standard Errors in Parentheses.

“+/-“ indicate the predicted direction of influence on the dependent variable.

Variable	Mean	Std. Dev.	Min	Max	Predicted Direction
<i>Dependent Variable</i>					
Number of years working for this employer	5.494 (0.767)	6.653 (0.735)	1	47	
<i>Human Capital</i>					
Highest Grade Completed in School	9.099 (0.871)	4.251 (0.270)	0	16	-
Years working in farm work in the U.S.	10.276 (1.450)	9.410 (0.564)	1	64	+
Years working in non-farm work in the U.S.	5.663 (0.381)	6.713 (0.506)	0	43	-
Ability to speak English	2.838 (2.837)	1.218 (0.073)	1	4	-
Years expect to continue in U.S. farmwork	5.132 (0.170)	1.695 (0.125)	0.5	6.0	+
<i>Context of Reception: Employment</i>					
Number of Employers reported	1.129 (0.037)	0.420 (0.058)	1	5	-
<i>Context of Reception: Community resources</i>					
Number of Difficulties Reported in Obtaining Health Care	0.420 (0.082)	0.680 (0.063)	0	3	-
<i>Controls</i>					
Age	35.840 (1.927)	13.680 (0.908)	14	80	+
Individual income in previous year (thousand \$, adjusted to 2012 levels)	23.158 (1.070)	14.554 (0.647)	0	48.159	+
Family income in previous year (thousand \$, adjusted to 2012 levels)	27.472 (1.668)	14.134 (0.951)	0	48.159	-

Table 3.4. Descriptive statistics of categorical variables (table continued on next page)

Weighted N: 1,329. Unweighted N: 601. Weighted values shown.

Levels used as reference values in model are denoted with (ref). “+/-“ indicate the predicted direction of influence on the dependent variable.

Variable	Proportion	Predicted Direction
<i>Human Capital</i>		
Could get a U.S. non-farm job within a month		
Yes (ref)	532 (40%)	
No	535 (40%)	+
Don't know	262 (20%)	+
Task		
Harvest (ref)	221 (17%)	
Pre-harvest	621 (47%)	+
Post-harvest	216 (16%)	+
Semi-skilled	270 (20%)	+
<i>Social Capital</i>		
Found this job through:		
Referred by relative/ friend/work mate (ref)	891 (67%)	
Applied on own	340 (26%)	-
Recruited by grower/ foreman	29 (2%)	-
Other	69 (5%)	-
Live with family member		
Accompanied (ref)	809 (61%)	
Unaccompanied	520 (39%)	-
<i>Context of Reception: Employment</i>		
Method of payment		
By hour or hour & piece (ref)	1267 (95%)	
Piece	16 (1%)	-
Salary	47 (4%)	+
Employment seasonality		
Year-round (ref)	564 (42%)	
Seasonal/don't know	766 (58%)	-
Receive bonus?		
No/don't know (ref)	951 (72%)	
Yes	378 (28%)	+
<i>Context of reception: Community resources</i>		
Used U.S. health care in last two years		
No (ref)	494 (37%)	
Yes	835 (63%)	+

Table 3.4 continued

<i>Contexts of Reception: Immigration Policy</i>		
Legal Status		
Citizen/Green Card/Other Work Auth. (ref)	738 (55.5%)	
Unauthorized	591 (44.5%)	-
<i>Controls</i>		
Migrant type		
Settled (ref)	999 (75%)	
Follow the Crop	47 (4%)	-
Shuttle	274 (21%)	-
Newcomer	9 (1%)	-
Birth Country		
U.S. (ref)	562 (42%)	
Mexico	716 (54%)	-
Other	51 (4%)	-
Gender		
Male (ref)	911 (69%)	
Female	418 (31%)	-
Indigenous identity		
No (ref)	1224 (92%)	
Yes	106 (8%)	-
Crop		
Field Crops (ref)	212 (16%)	
Fruits & nuts	259 (20%)	
Horticulture	601 (45%)	
Vegetables	245 (18%)	
Misc/mult	12 (1%)	

Findings

The descriptive statistics shown in Table 3.3 and Table 3.4 reveal a great deal about these data. First, the dependent variable has a wide spread – the maximum number of years to have worked with an employer was 47. As noted previously, this variable is also skewed right: while the mean number of years to have worked for an employer in the Midwest is over five years, the median (not shown in table) was two.

A great deal is revealed about the independent variables as well. With the variables that measure human and social capital, the average of the highest grade the respondent completed was grade nine, out of a possible sixteen. Respondents had a wide range of years of experience in farm work: there were averages of 10 years working in farm work in the U.S. and 5.6 years in non-farm work in the U.S., with maxima of 64 and 43 years, respectively. The average years that farm workers expected to stay in farm work was five years; since the maximum possible answer in the NAWS is “over five years” and is treated here as six years, the real average may be higher than five years. The average ability to speak English was nearly three, coded as “somewhat” well in the NAWS (the maximum of four represents the ability to speak English “well”). Forty percent of respondents felt confident that they could get a non-farm job within a month. Although harvest is generally considered the task that requires the most workers, the most common response for task was pre-harvest at 47 percent, much larger than the national percentage of 27 percent for 2007-2009 (Carroll et al. 2011); additional research may be needed to explain how and why tasks vary by region. The variables that measure social capital revealed that the majority of respondents (67 percent) found their current farm job through their social network, and are also accompanied by family (61 percent).

In the variables under contexts of reception, the average number of employers that a farm worker had worked for was just over one with a maximum of five. The average number of difficulties in obtaining health care was 0.4 with a maximum of three. The majority of respondents are paid by the hour or by a combination of hour and piece work (95 percent), do not receive bonuses or do not know whether they will (72 percent) and

hold seasonal positions or do not know whether their position will be seasonal (58 percent). Over half had legal documentation status (56 percent).

Finally, with the control variables, the average age was 36 with a range from 14 to 80. Average individual income was over \$23,000 with a maximum of over \$48,000 and a minimum of zero; average family income was over \$27,000 with the same range. Both of these averages are far below \$54,300, the estimated median income for the Midwest during 2013 (DeNavas-Walt, Proctor, and U.S. Census Bureau 2015). The majority of respondents reported being settled (75 percent), having been born in Mexico (54 percent), being male (69 percent), and not having an indigenous identity (92 percent). The majority of respondents also reported working in specialty crops: 45 percent in horticulture, 20 percent in fruits and nuts, and 18 percent in vegetables.

A generalized linear model was calculated with these data and is shown in Table 3.5. The F-statistic and the R^2 both support the use of this model. The F-statistic shows that model is statistically significant to the 0.01 level and the R^2 of 0.624 shows that the model explains 62 percent of the variance in job tenure. Because the dependent variable in this model is logged, the direction of the coefficients of the model and whether they are significant provide the most salient information to interpret.

Human and social capital

Of the human and social capital variables studied, several variables were found to be significant predictors of the log of years of job tenure. First, the model indicates that as the years that an individual works in farm work increases, so does the years of job tenure, with all other variables held constant. But as the years working in non-farm work increases, the years of job tenure decreases, with all other variables held constant.

Theoretically, this makes sense: as an individual spends more time out of farm work, they cannot also simultaneously be working for a farm employer.

Table 3.5. Predictors of log of years working with current employer (table continued on next page)

*Significant to the 0.05 level. **Significant to the 0.01 level.

¹Some respondents reported zero years for this variable; since the log of zero is undefined, the value of all cases was increased by one year in order to calculate the log.

Weighted N: 1,329.

Unweighted N: 601.

$R^2 = 0.624$

F = 3.050602

dfnum = 36

dfden = 66

p-value = 4.22E-05

Variable	β	SE	p-value
Intercept	-0.892	0.659	0.175
<i>Human Capital</i>			
Highest Grade Completed in School	-0.010	0.020	0.618
Log of years working in farm work in the U.S.	0.447	0.052	0.000**
Log (years working in non-farm work in the U.S. + 1) ¹	-0.230	0.078	0.003**
Able to get a U.S. non-farm job within a month (ref: yes)			
No	0.081	0.119	0.500
Don't know	-0.089	0.151	0.555
Years expect to continue in U.S. farmwork	0.027	0.028	0.336
Ability to speak English	0.063	0.047	0.180
Task (ref: harvest)			
Pre-harvest	0.395	0.123	0.001**
Post-harvest	0.153	0.144	0.286
Semi-skilled	0.477	0.089	0.000**
<i>Social Capital</i>			
Found this job through: (ref: via friend/relative/work mate)			
Applied on own	0.008	0.106	0.937
Recruited by grower/foreman	-0.301	0.564	0.593
Other	0.377	0.334	0.259
Unaccompanied (ref: accompanied)	-0.198	0.084	0.018*
<i>Contexts of Reception: Employment</i>			
Method of payment (ref: hour, comb. hour-piece)			
Piece	0.178	0.310	0.567
Salary	0.047	0.172	0.784
Paid Bonus (ref: not)	0.338	0.116	0.004**
Number of Employers reported	-0.052	0.158	0.741
Employed in this job seasonally (ref: year-round)	-0.311	0.113	0.006**

Table 3.5 continued

<i>Context of Reception: Community Resources</i>			
Used U.S. health care in the last two years (ref: didn't)	0.083	0.133	0.532
Number of Difficulties Reported in Obtaining Health Care	-0.117	0.084	0.164
<i>Context of Reception: Immigration Policy</i>			
Legal status: unauthorized (ref: authorized)	0.006	0.090	0.943
<i>Controls</i>			
Individual income in previous year (thousand \$, 2012 level)	0.022	0.007	0.001**
Family income in previous year (thousand \$, 2012 level)	-0.019	0.006	0.001**
Crop (ref: field crops)			
Fruits & nuts	-0.261	0.255	0.306
Horticulture	0.008	0.127	0.950
Vegetables	-0.099	0.149	0.506
Misc/mult	0.187	0.247	0.449
Migrant type (ref: settled)			
Follow the Crop	0.299	0.284	0.292
Shuttle	0.105	0.134	0.433
Newcomer	0.486	0.345	0.158
Indigenous Identity (ref: none)	0.211	0.197	0.284
Birth Country (ref: U.S.)			
Mexico	-0.066	0.201	0.741
Other	-0.324	0.229	0.156
Log of Age	0.355	0.159	0.026*
Gender (ref: male)	0.016	0.154	0.918

This model also shows that two skill levels – pre-harvest and semi-skilled - were significantly different from the reference task, harvest. While all farm work requires skill, some tasks require more training and experience, and harvest is generally considered the task requiring the least skill and training. This finding supports the theory that farm workers who have obtained positions that require more skill tend to stay with that employer longer. It also suggests that the post-harvest category, which was not found to

be a significant predictor of job tenure, does not require the same level of training that pre-harvest and semi-skilled tasks do.

Finally, the model predicts that years of job tenure is expected to be lower for an unaccompanied farm worker as compared to an accompanied farm worker, with all other variables held constant. This supports the idea that a farm worker who is living with or migrating with their family is looking for more stable employment and is more likely to stay with a particular employer from year to year than one who is working and/or migrating alone. This also supports the idea that if employers hire several members of one family, the workers are more likely to stay with that employer.

Contexts of reception and controls

Only two variables representing contexts of reception were found to be significant predictors of job tenure, and both were under the context of employment. These were whether an employee is paid a bonus, and whether they are employed year-round. As expected, receipt of bonus and year-round employment were both predictors of longer job tenure.

Finally, three control variables were significant predictors of job tenure: individual income, family income, and age. Individual income was found to be a positive predictor of job tenure, while family income was a negative predictor. Since age and years of job tenure are closely linked, the fact that age is a significant predictor of job tenure is an indicator of the trustworthiness of these data.

A few variables that were not found to be significant predictors of job tenure are worth mentioning, including some for which the predicted direction of the sign of their

coefficients was different from that in the model. First, hourly work was predicted to be significantly different from piece and salary work, and piece work was expected to correspond with shorter job tenure, with all other factors held constant. However, the overwhelming majority of respondents were paid hourly (see Table 3.4), which may be responsible for both the absence of significance and the positive sign of the coefficient for piece work instead of the negative one predicted.

Discussion

As discussed earlier, the United States agricultural system has relied on an ever-rotating supply of immigrant workers to perform agricultural work for many years (Calvin and Martin 2010; Pfeffer 1983). Growers are experiencing increased difficulty in hiring workers (Mercier 2014), which both puts growers at more of a disadvantage while workers may experience a relative increase in advantage, becoming more able to pursue higher paying work. Indeed, two growers mentioned experiencing higher worker turnover and described how their workers are better able to communicate which employers are paying the highest wages because they now have access to cell phones.⁶

In a situation where farm workers have increasing incentives to leave employment with a particular employer, what are the factors that encourage them to stay? In this study, the human and social capital elements that predicted longer job tenures for farm workers were their own experience in farm work and the presence of their families. This is consistent with findings by Wells (1996) who describes how many mid-size strawberry growers tended to employ workers from two or three families from year to year. While

⁶ Grower interviews, June 2015.

this finding referred to extended families with several adult employees, a Michigan grower described a preference for hiring family units including children because it provides a steadier workforce.⁷

Other, more traditional measures of human capital, such as education and language ability, did not affect farm worker job tenure. This is likely an indication of the characteristics of the alternative jobs that are available to people who work in farm work. For the immigrant farm worker population, the jobs outside of farm work that are available to them may be limited to physically demanding occupations such as construction or service work, where education and English ability may not be requirements. Therefore, their education level and language ability may not have a significant impact on whether they stay in farm work.

While job tenure is not a perfect indicator of farm worker welfare, the finding that increased difficulty in obtaining health care tends to decrease job tenure on average (with all other variables held constant) supports the theory that a community with resources that are supportive of farm workers will be more attractive to them. Supporting these public services for farm workers might lead to lengthening farm workers' job tenures.

The findings regarding the contexts of reception demonstrated that workers stay in year-round employment where they receive higher pay and are performing more skilled jobs, with all other variables held constant. However, it is not necessarily straightforward for growers to develop more year-round positions as a way to attract workers. Certain crops have high labor needs for only short periods during the year. Some growers are already strategizing to create work during the more relaxed season so

⁷ Grower interview, June 2015.

that when the busy season hits they already have the workers that they need.⁸ Although it would be a departure from the traditional model of relying on migrant and seasonal farm workers, creative policies to attract farm workers could encourage regional economic development that creates jobs for farm workers in the off-season.

Migrant type was not a significant predictor of job tenure. This seems to imply that although a settled worker might be more likely to try and work in a specific geographic area, they will not feel obligated to stay with or return to the same employer year after year. Perhaps the knowledge they accumulate about a community while settling provides them better access to more desirable jobs and this shortens their job tenure. This framework is further supported because although none of the three categories of migrant were found to be significant predictors of job tenure, they each did have positive coefficients, indicating that job tenure tends to be higher for migrant status as compared to settled status, all other variables held constant. The corresponding implication is that migrants are more likely to prefer to establish long-term relationships with a single employer that they can return to from year to year, which is consistent with the findings of other scholars (Wells 1996).

In addition, it is notable that legal status is not a significant predictor of job tenure. It is possible that this is due to respondents under-reporting their undocumented status (although note that nearly half of respondents did report themselves to be undocumented). It is also possible that some employers do not investigate their employees' legal status too rigorously, and that therefore a farm worker's legal status does not actually impact their employment.

⁸ Grower interviews, June 2015.

Ultimately, these results demonstrate that although there are several factors at play in determining the length of a farm worker's job tenure, they are not as numerous as originally anticipated. The theoretical categories of human and social capital and context of employment were shown to have the most significant predictors of farm worker job tenure, while community resources and immigration policy were not found to be significant predictors. While not every conceptual category had significant predictors of farm worker job tenure, the fact that the significant predictors were distributed across the conceptual categories of human/social capital as well as the employer context is notable. This supports the basic framework outlined in Table 3.1 that job tenure is dependent not only on an individual's situation but also on the characteristics of the position that they hold.

Finally, there were a number of limitations to this research. Most fundamentally, data on why farm workers change employers would help to inform why farm workers leave a position for better employment. More data on the availability of community resources (NAWS contains virtually no information about farm workers' children's school enrollment) would also have been helpful in determining the influence that a community can have on farm workers' choice to stay with an employer. Finally, a breakout of data by crop rather than crop type would have allowed for more targeted findings regarding specific cropping systems.

Conclusion

This study helps to clarify the roles that human and social capital and contexts of reception play in leading to multi-year employment for farm workers. The findings offer

several implications for future research. First, although examining job tenure reveals a great deal about the situations that encourage long job tenure, it is not an adequate measure for farm worker welfare or employer satisfaction. In order to advance both of these goals, further research that focuses on the contributing factors for each of these, such as farm workers' access to health care and employers' experiences of labor shortages, will be needed. But given the long-standing reliance of growers on immigrant workers and the decrease in immigration rate from Mexico, maintaining and building employer-employee relationships that lead to lengthened job tenures may be an important strategy for growers. Finally, further research into the role that the agricultural region plays in determining both farm workers' choices as well as the availability of seasonal jobs within an area could be incredibly informative.

References

- 7 US Code 1621. 2014. *Congressional Declaration of Purpose; Use of Existing Facilities; Cooperation with States*. United States.
- Aguilera, Michael B. and Douglas S. Massey. 2003. "Social Capital and the Wages of Mexican Migrants: New Hypotheses and Tests." *Social Forces* 82(2):671–701.
- Aguilera, Michael Bernabe. 2003. "The Impact of the Worker: How Social Capital and Human Capital Influence the Job Tenure of Formerly Undocumented Mexican Immigrants." *Sociological Inquiry* 73(1):52–79.
- Balderrama, Rafael and Hilario Molina II. 2009. "How Good Are Networks for Migrant Job Seekers? Ethnographic Evidence from North Carolina Farm Labor." *Sociological Inquiry* 79(2):190–218.
- Bureau of Labor Statistics. 2014. *Number and Rate of Fatal Occupational Injuries by Industry Sector, 2014, All Charts, Census of Fatal Occupational Injuries*.
- Calvin, Linda and Philip Martin. 2010. *The US Produce Industry and Labor: Facing the Future in a Global Economy, ERR-106*.

- Carroll, D., Rm Samardick, and S. Bernard. 2005. *Findings from the National Agricultural Workers Survey (NAWS) 2001–2002: A Demographic and Employment Profile of United States Farm Workers*.
- Carroll, Daniel, Annie Georges, and Russell Saltz. 2011. “Changing Characteristics of US Farm Workers: 21 Years of Findings from the National Agricultural Workers Survey.” *Immigration Reform and Agriculture Conference*. Retrieved January 1, 2015 (<https://migrationfiles.ucdavis.edu/uploads/cf/files/2011-may/carroll-changing-characteristics.pdf>).
- Crowley, Martha and Kim Ebert. 2014. “New Rural Immigrant Destinations: Research for the 2010s.” Pp. 401–20 in *Rural America in a Globalizing World: Problems and Prospects for the 2010s*, edited by Conner Bailey, Leif Jensen, and Elizabeth Ransom. Morgantown: West Virginia University Press.
- DeNavas-Walt, Carmen, Bernadette D. Proctor, and U.S. Census Bureau. 2015. *Current Population Reports, P60-252, Income and Poverty in the United States: 2014*. Washington, D.C.
- Dudek, Tom. 2016. “Potential Sources of Labor : Are These in Your Future Plans ?” *Michigan State University Extension*. Retrieved March 1, 2016 (http://msue.anr.msu.edu/news/potential_sources_of_labor_are_these_in_your_future_plans).
- Durand, Jorge, Douglas S. Massey, and Chiara Capoferro. 2005. “The New Geography of Mexican Immigration.” Pp. 1–22 in *New Destinations*, edited by Victor Zúñiga and Rubén Hernández-León. New York: Russell Sage Foundation.
- Farquhar, Stephanie, Nargess Shadbeh, Julie Samples, Santiago Ventura, and Nancy Goff. 2008. “Occupational Conditions and Well-Being of Indigenous Farmworkers.” *American Journal of Public Health* 98(11):1956–59.
- Griffith, David. 2011. “Labor Recruitment and Immigration in the Eastern North Carolina Food Industry.” *International Journal of Sociology of Agriculture and Food* 19(1):102–18.
- Holmes, Seth H. 2013. *Fresh Fruit, Broken Bodies*. Berkeley: University of California Press.
- Jensen, Eric B. 2014. “Mexican-Born Farmworkers in US Agriculture.” Pp. 69–84 in *Rural America in a Globalizing World: Problems and Prospects for the 2010s*, edited by Conner Bailey, Leif Jensen, and Elizabeth Ransom. Morgantown: West Virginia University Press.
- Jiménez, Tomás R. 2008. “Mexican Immigrant Replenishment and the Continuing Significance of Ethnicity and Race.” *American Journal of Sociology* 113(6):1527–67.

- Johnson, Anna and Lois Wright Morton. 2015. *Midwest Climate and Specialty Crops: Specialty Crop Leader Views and Priorities for Midwest Specialty Crops. Sociology Technical Report 1039.*
- Jordan, Miriam. 2015. "U.S., Mexico Increasingly Competing for Farm Labor." *Wall Street Journal*, January 23.
- Judkins, David R. 1990. "Fay's Method for Variance Estimation." *Journal of Official Statistics* 6(3):223–39.
- Kandel, William, Jamila Henderson, Heather Koball, and Randy Capps. 2011. "Moving Up in Rural America: Economic Attainment of Nonmetro Latino Immigrants." *Rural Sociology* 76(1):101–28.
- Maldonado, Marta Maria. 2009. "'It Is Their Nature to Do Menial Labour': The Racialization of 'Latino/a Workers' by Agricultural Employers." *Ethnic and Racial Studies* 32(6):1017–36.
- Mercier, Stephanie. 2014. *Employing Agriculture : How the Midwest Farm and Food Sector Relies on Immigrant Labor.* Chicago.
- Michigan Civil Rights Commission. 2010. *A Report on the Conditions of Migrant and Seasonal Farmworkers in Michigan.*
- Milard, Ann F. and Jorge Chapa. 2001. *Apple Pie and Enchiladas.* Austin: University of Texas Press.
- Oliveira, V., A. Effland, J. Runyan, and S. Hamm. 1993. *Hired Farm Labor Use on Fruit, Vegetable, and Horticultural Specialty Farms.*
- Park, Lisa Sun-Hee and David Pellow. 2011. *The Slums of Aspen: Immigrants vs the Environment in America's Eden.* NYU Press.
- Pew Research Center. 2015. *More Mexicans Leaving Than Coming to the U.S.* Washington, D.C.
- Pfeffer, Max J. 1983. "Social Origins of Three Systems of Farm Production in the United States." *Rural Sociology* 48(4):540–62.
- Poss, Jane E. and Rebecca Pierce. 2003. "Characteristics of Selected Migrant Farmworkers in West Texas and Southern New Mexico." *Californian Journal of Health Promotion* 1(2):138–47.
- U.S. Department of Labor Employment and Training Administration. 2013. "National Agricultural Workers Survey Codebook for Public Access Data, Cycle 1-73."
- United States Department of Agriculture. 2012. *U.S. Census of Agriculture, 2012.*

United States Department of Labor. 2015. "The National Agricultural Workers Survey." Retrieved October 9, 2015 (<https://www.doleta.gov/agworker/naws.cfm#s-regions>).

United States Department of Labor Bureau of Labor Statistics. 2015. "Consumer Price Index Inflation Calculator." Retrieved October 1, 2015 (http://www.bls.gov/data/inflation_calculator.htm).

Wells, Barbara. 2013. *Daughters and Granddaughters*. New Brunswick: Rutgers University Press.

Wells, Miriam J. 1996. *Strawberry Fields: Politics, Class, and Work in California Agriculture*. Ithaca and London: Cornell University Press.

CHAPTER 4

CONCLUDING THOUGHTS

Specialty crop production systems are a unique segment of agriculture where many tasks, from pruning to harvesting, depend on human labor. Growers in the United States Midwest experience significant challenges in managing their operations when they face increased difficulty in hiring and retaining workers. There is evidence of increasing interest in this topic: Michigan State University Extension recently published an article that listed fifteen strategies growers could take to attract and retain workers that range from improving internal employee management practices to traveling to recruit migrant employees in areas where they spend the winter (Dudek 2016). Understanding the factors that create these challenges with labor management as well as the strategies that growers can take to address them is clearly important for the health of the Midwest specialty crop industry.

This research approached this problem from two angles. Chapter 2 considers how climate change is influencing this system – in particular, how variable weather influences growers' management of and need for workers. Interviews with growers revealed that growers consider weather variability to be an integral part of specialty crop production in the Midwest, and that weather can influence labor demands on both a daily and seasonal time scale. The broader context of immigration policy and patterns are also impacting the farm worker population such that worker turnover is increasing and growers are experiencing increasing difficulty hiring the workers they need for their operations. Various strategies they employ to attract and retain workers included raising wages and building relationships with workers' families. They also talked about changing the

makeup of their operations in order to be less dependent on employees, through reducing the number of jobs they offer and shifting to different crops that require less labor or less seasonal labor. These findings offer valuable insight into understanding the vulnerability of labor systems within specialty crop production under climate change.

Chapter 3 approaches the relationship between growers and employees by examining the factors that impact farm worker job tenure. The factors that were found to be significant predictors of job tenure were years of experience in farm work and in non-farm work; the task that the worker was hired to perform (pre-harvest and semi-skilled workers were more likely than harvest workers to have longer job tenures); and workers who were unaccompanied by family members were less likely than accompanied workers to have longer job tenures. Longer job tenure was also predicted by the payment of a bonus and by year-round employment. Some of these findings have clear implications for growers: paying workers a bonus may help to increase worker retention. However, not every finding provides an obvious recommendation: for example, the seasonality of employment is determined by the structure of a specialty crop operation and the crops that are grown – changing these systems to favor more year-round workers may be more difficult.

Limitations and Future Research

While this methodological approach revealed a great deal about specialty cropping systems and agricultural labor, it had a few limitations. In chapter 2, the findings are limited by the number of interviews as well as the absence of asparagus growers' perspectives. The indications from the field notes were that asparagus and

apples are the two systems that are having the most difficulty finding workers because they have a high demand for many workers for only a short time period. Future research focusing on their perspectives would be illuminating.

In chapter 3, the major limitation is that the NAWS was not continued after 2012. Reinstating this survey, which was conducted between 1989-2012, would allow for continued understanding of farm workers and their lives as well as continue data collection for a valuable dataset. In addition, more place-specific data that could be matched with weather and production patterns would also allow for a more nuanced understanding of how specific weather events impact the labor patterns over time. Without this data, only broad conclusions about regional trends in agricultural labor are possible.

An additional limitation is that this research explores growers' perspectives; future research should address the issues in question from workers' perspectives. The vulnerability framework applied in Chapter 2 is designed to encompass the concerns of entire communities. Without workers' perspectives, the vulnerabilities described here are incomplete.

Finally, future research should also address the utilization of the H-2A guestworker program. The Midwest specialty crop industry has increased interest in this program as a way to manage labor demands over the course of the growing season, but farmworker advocates have concerns about the legal protections for workers hired through the program (Mercier 2014). Investigation of farmworkers' experiences in the program can contribute to a better understanding of its role in specialty crop production.

REFERENCES

- 7 US Code 1621. 2014. *Congressional Declaration of Purpose; Use of Existing Facilities; Cooperation with States*. United States.
- Adger, W. Neil. 2006. "Vulnerability." *Global Environmental Change* 16(3):268–81.
- Andresen, Jeff, Steve Hilberg, and Ken Kunkel. 2012. *Historical Climate and Climate Trends in the Midwestern USA*. edited by J. Winkler, J. Andresen, J. Hatfield, D. Bidwell, and D. Brown.
- Arbuckle, J. G., L. W. Morton, and J. Hobbs. 2015. "Understanding Farmer Perspectives on Climate Change Adaptation and Mitigation: The Roles of Trust in Sources of Climate Information, Climate Change Beliefs, and Perceived Risk." *Environment and Behavior* 47(2):205–34.
- Arritt, Ray. 2016. *Climate Change in the Corn Belt. CSCAP-0193-2016*. Ames, Iowa.
- Burawoy, Michael. 1976. "The Functions and Reproduction of Migrant Labor : Comparative Material from Southern Africa and the United States The Functions and Reproduction of Migrant Labor : Comparative Material from Southern Africa and the United States1." *American Journal of Sociology* 81(5):1050–87.
- Calvin, Linda and Philip Martin. 2010. *The US Produce Industry and Labor: Facing the Future in a Global Economy, ERR-106*.
- Carroll, Daniel, Annie Georges, and Russell Saltz. 2011. "Changing Characteristics of US Farm Workers: 21 Years of Findings from the National Agricultural Workers Survey." *Immigration Reform and Agriculture Conference*. Retrieved January 1, 2015 (<https://migrationfiles.ucdavis.edu/uploads/cf/files/2011-may/carroll-changing-characteristics.pdf>).
- Dudek, Tom. 2016. "Potential Sources of Labor : Are These in Your Future Plans ?" *Michigan State University Extension*. Retrieved March 1, 2016 (http://msue.anr.msu.edu/news/potential_sources_of_labor_are_these_in_your_future_plans).
- Durand, Jorge, Douglas S. Massey, and Chiara Capoferro. 2005. "The New Geography of Mexican Immigration." Pp. 1–22 in *New Destinations*, edited by Víctor Zúñiga and Rubén Hernández-León. New York: Russell Sage Foundation.
- Farmer, Frank L. and Zola K. Moon. 2009. "An Empirical Examination of Characteristics of Mexican Migrants to Metropolitan and Nonmetropolitan Areas of the United States." *Rural Sociology* 74(2):220–40.
- Hatfield, J. and G. Takle. 2014. "Chapter 6: Agriculture." *Climate Change Impacts in the United States: The Third National Climate Assessment* 150–74.

- Hatfield, Jerry. 2012. *Agriculture in the Midwest*. edited by J. Winkler, J. Andresen, J. Hatfield, D. Bidwell, and D. Brown.
- Holmes, Seth H. 2013. *Fresh Fruit, Broken Bodies*. Berkeley: University of California Press.
- Johnson, Anna and Lois Wright Morton. 2015. *Midwest Climate and Specialty Crops: Specialty Crop Leader Views and Priorities for Midwest Specialty Crops. Sociology Technical Report 1039*.
- Johnson, Renée. 2012. "The U. S. Trade Situation for Fruit and Vegetable Products." *Congressional Research Service* 1–17.
- Lobao, Linda. 2014. "Economic Change, Structural Forces, and Rural America: Shifting Fortunes across Communities." Pp. 543–55 in *Rural America in a Globalizing World: Problems and Prospects for the 2010s*, edited by Conner Bailey, Leif Jensen, and Elizabeth Ransom. Morgantown: West Virginia University Press.
- Lobao, Linda and Katherine Meyer. 2001. "The Great Agricultural Transition: Crisis, Change, and Social Consequences of Twentieth Century US Farming." *Annual Review of Sociology* 27:103–24.
- Lynch, Brendan and Jonathan Coleman. 2010. *Apples - Industry and Trade Summary, ITS-04*.
- MacDonald, James M., Penni Korb, and Robert A. Hoppe. 2013. *Farm Size and the Organization of U.S. Crop Farming, ERR-152*.
- Maldonado, Marta Maria. 2009. "'It Is Their Nature to Do Menial Labour': The Racialization of 'Latino/a Workers' by Agricultural Employers." *Ethnic and Racial Studies* 32(6):1017–36.
- Melillo, Jerry M., T. C. Richmond, Gary W. Yohe, and (Eds.). 2014. *Highlights of Climate Change Impacts in the United States: The Third National Climate Assessment*.
- Mercier, Stephanie. 2014. *Employing Agriculture : How the Midwest Farm and Food Sector Relies on Immigrant Labor*. Chicago.
- National Oceanic and Atmospheric Administration (NOAA). 2016. "How Is Weather Different from Climate?" 1–8. Retrieved January 1, 2016 (<http://www.noaa.gov/what's-difference-between-climate-and-weather>).
- Oliveira, V., A. Effland, J. Runyan, and S. Hamm. 1993. *Hired Farm Labor Use on Fruit, Vegetable, and Horticultural Specialty Farms*.
- Pew Research Center. 2015. *More Mexicans Leaving Than Coming to the U.S.* Washington, D.C.

- Pryor, Sara C. et al. 2014. *Synthesis of the Third National Climate Assessment for the Great Lakes Region*.
- Rudy, Alan P. et al. 2008. "The Political Ecology of Southwest Michigan Agriculture, 1837-2000." Pp. 152–205 in *Agrarian Landscapes in Transition: Comparisons of Long-Term Ecological and Cultural Change*, edited by Charles L. Redman and David R. Foster. Oxford: Oxford University Press.
- Smit, Barry and Johanna Wandel. 2006. "Adaptation, Adaptive Capacity and Vulnerability." *Global Environmental Change* 16(3):282–92.
- Stuart, Diana, Rebecca L. Schewe, and Matthew McDermott. 2012. "Responding to Climate Change: Barriers to Reflexive Modernization in U.S. Agriculture." *Organization & Environment* 25(3):308–27.
- United States Department of Agriculture Agricultural Research Service. 2012. "USDA Plant Hardiness Zone Map." Retrieved March 16, 2016 (<http://planthardiness.ars.usda.gov>).
- United States Department of Agriculture National Agricultural Statistics Service (USDA-NASS). 2015. *2012 Census of Agriculture: Specialty Crops*.
- USDA Economic Research Service. 2013. *U.S. Blueberry Industry*.
- Walthall, C. L. et al. 2012. *Climate Change and Agriculture in the United States: Effects and Adaptation*. Washington, D.C.
- Wells, Miriam J. 1996. *Strawberry Fields: Politics, Class, and Work in California Agriculture*. Ithaca and London: Cornell University Press.

APPENDIX A

INSTITUTIONAL REVIEW BOARD FORM

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OF SCIENCE AND TECHNOLOGY

Institutional Review Board
Office for Responsible Research
Vice President for Research
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Date: 5/29/2015
To: Dr. Lois Wright Morton
317C East Hall
From: Office for Responsible Research
Title: Midwest Climate Hub Specialty Crop Project
IRB ID: 14-453

Approval Date: 5/28/2015 **Date for Continuing Review:** 9/24/2015
Submission Type: Modification **Review Type:** Expedited

The project referenced above has received approval from the Institutional Review Board (IRB) at Iowa State University according to the dates shown above. Please refer to the IRB ID number shown above in all correspondence regarding this study.

To ensure compliance with federal regulations (45 CFR 46 & 21 CFR 56), please be sure to:

- **Use only the approved study materials in your research, including the recruitment materials and informed consent documents that have the IRB approval stamp.**
- **Retain signed informed consent documents for 3 years after the close of the study, when documented consent is required.**
- **Obtain IRB approval prior to implementing any changes to the study by submitting a Modification Form for Non-Exempt Research or Amendment for Personnel Changes form, as necessary.**
- **Immediately inform the IRB of (1) all serious and/or unexpected adverse experiences involving risks to subjects or others; and (2) any other unanticipated problems involving risks to subjects or others.**
- **Stop all research activity if IRB approval lapses, unless continuation is necessary to prevent harm to research participants. Research activity can resume once IRB approval is reestablished.**
- **Complete a new continuing review form at least three to four weeks prior to the date for continuing review as noted above to provide sufficient time for the IRB to review and approve continuation of the study. We will send a courtesy reminder as this date approaches.**

Please be aware that IRB approval means that you have met the requirements of federal regulations and ISU policies governing human subjects research. **Approval from other entities may also be needed.** For example, access to data from private records (e.g. student, medical, or employment records, etc.) that are protected by FERPA, HIPAA, or other confidentiality policies requires permission from the holders of those records. Similarly, for research conducted in institutions other than ISU (e.g., schools, other colleges or universities, medical facilities, companies, etc.), investigators must obtain permission from the institution(s) as required by their policies. **IRB approval in no way implies or guarantees that permission from these other entities will be granted.**

Upon completion of the project, please submit a Project Closure Form to the Office for Responsible Research, 1138 Pearson Hall, to officially close the project.

Please don't hesitate to contact us if you have questions or concerns at 515-294-4566 or IRB@iastate.edu.

APPENDIX B

FARM WORKER QUOTES

As described in chapter 2, in addition to the grower interviews, several interviews were conducted with farm workers as well. Although these interviews were not the basis for these analyses, there are several quotes from them that inform both the background and the findings in these papers. Below is a sampling of these quotes, which were all interpreted from Spanish into English.

“But here when the fruit is no good, the owners don’t need people, only [need] a certain amount of people...When there is a lot more [fruit], then they send for more people. And since we know people, we talk to our friends, to our relatives, and we ask them to come... Almost everyone finds work, because the ones that are coming from Florida...we already know where we’re going, most of us. Those that don’t get together with those that do and find work. You know of a place, and we tell them, ‘Let’s go to this place. I know that they need laborers.’” WORKER INTERVIEW 12

“[a couple of other workers] prefer to stay here and than go to the asparagus...a lot of them...needed asparagus pickers...[but] If it’s only going to be two or three weeks... [the workers] want steady work. That’s the problem.” WORKER INTERVIEW 14

“There’s a lot of things that us Hispanics want, but you know that we can’t...Lots of people would love to change to get better documents and to be able to do well, but it’s not possible; it hasn’t been possible. Maybe there’s a chance in the future. In the past, when we get here, I was illegal. I started working ‘73. I wasn’t legal until ‘86, and my children and my wife, they had amnesty in ‘86 when the law passed. And then we were happy, we could go to Mexico, come back, see the family, it’s easier, lots of people were like that. It’s not possible. But let’s see in the future. It’s good for the country, I think. Most of the people are good people, and they want to work, but there is people, too, that are up to no good, and maybe that’s why they think that we’re all the same, but it’s not that way. We’re all different. Some of us want to work, really, just pure work, and we’re happy that way.” WORKER INTERVIEW 7

“Working on the farm is not easy like people thinks. I hear a lot of people today, like how they’ve got discrimination because [most] people that work on the farm is Mexican people, and we feel like they don’t appreciate the work that we do for them. Because actually all day the most vegetables and fruits that they sell around in the stores here, we pick all the fruits, and sometimes they don’t appreciate that...working on the farm is not easy... You know, it hurts my heart, because here we are too many people from other countries, but especially people that they don’t like you, they always talking more about Mexicans ... It’s really hard doing the things. It’s easy to say things. You know how they don’t respect you. But when you do the things in the farm, you learn a lot of things. You learn that everybody is the same, no matter what color you are. We have feelings like everybody. We have heart, we’ve got kids, everything. And we do this, like I said, because we like it, but at least we gotta...appreciate.” WORKER INTERVIEW 5

I feel right now in these years...I feel like they recognizing the labor that we do here. Because they used to... I hear a lot of things in the news about how farmers treat people and everything, and like I say, I feel like it is not fair. It is not fair because, first of all, we know that we eat because they give us work, but they know that if they don’t have nobody to do this work, they don’t got nothing to eat. And I feel right now like that’s nice. That everybody is trying to understand, and everybody, they seeing the difference that we making here, too, and I feel like, wow, they try to pay more attention to what we do and everything. That’s really nice.” WORKER INTERVIEW 5

Yes, Alabama, because of the law...a lot of people are afraid to come there and work there because of the new laws. Georgia is the same, the police is very harsh. They grab people, they report them to immigration, they kick them out, so a lot of people don’t want to come... There’s a lot of states like that, that’s very different. Arizona. The other states that people just don’t like it, the state of Louisiana, too—the people know where not to go. And it’s harder for those states to have people working. People like it when they can work with less problems.... sometimes you get stopped by the police, lots don’t have a license.... Sometimes they have no insurance. Yeah, it’s really on every side, it’s difficult. And those who are lucky, pass. I think it was better, and it was easier, because everybody could have their insurance, they could have their license, they could buy their little car. It was more secure. It was better for everyone. But one day they took your license away, then it becomes more difficult. And people who have to move to find work, they need a car, because more so when they’re moving far away...It’s become difficult, but there’s no way about it, we’ve got to just keep on working hard and see if the laws change.” WORKER INTERVIEW 7

“Some people like to come here, because the boss got new houses, but in other places, no....Like there’s no bathroom—you’ve got to shower outdoors and share communal bathrooms.” WORKER INTERVIEW 9

“[children like attending school in Michigan more than Florida]...because here they help them more than in Florida. And, see, when you come and you’re Mexican and just got here, don’t speak English...here they help her with her grades, and her low grades went up. My daughter says that they help her more here. I tell my husband, “Let’s stay the whole year,” but he’s too afraid of the snow and the weather, the cold.” WORKER INTERVIEW 10

“...We’re coming from far, from Florida—it’s hard. And sometimes we don’t come because...There is a lot of officers. There’s people have no license, and they take the risk to come.” WORKER INTERVIEW 11

“There’s plenty of people that don’t want to come, because it’s pretty far, and there’s years that the work is worthless—there’s not enough fruit. And there’s people that have kids at school, and they don’t want to move. When the kids are at school in Florida...they say that they’re missing too much school. When we get to Florida, they say that the schoolwork here is not acceptable, so many don’t come because of those reasons...” WORKER INTERVIEW 12

“[In Michigan] The teachers are good; they take good care of you, they’re kind. When I first came the first year, they charged me for the kids’ lunch in Florida, and...when I get [to Michigan], the first year the principal was surprised, and he couldn’t believe that they were charging me over there. And he says that there’s no way they should be charging you. He was surprised...when I ask him how much was going to be the kids’ lunch, and he said, “No, there is no charge.” WORKER INTERVIEW 12

“I am grateful that you’ve come to interview me and I’m grateful that you recognize us immigrants. Some, many times we think that we’ve been forgotten by the world.” WORKER INTERVIEW 9

APPENDIX C

NATIONAL AGRICULTURAL WORKERS SURVEY

[1205-0453: The National Agricultural Workers Survey, Part B]

B. Collection of Information Employing Statistical Methods

1. Description of Universe and Sample

a) Universe

Entity	Universe	Sample
Agricultural Region	12	12
Farm Labor Areas	497	90
Farms w/ hired or contract labor	338,373	564
Hired Crop Workers (estimated)	1,400,000	1,500

The universe for the study is the population of field workers active in crop agriculture in the continental United States (U.S.). The National Agricultural Workers Survey (NAWS) will use multi-stage sampling relying on probabilities proportional to size to interview approximately 1,500 randomly selected crop workers in fiscal year (FY) 2012. To achieve this number of interviews, cyclical targets include an oversample of 200 interviews to account for possible non-response.

b) Response Rate

The sampling design, described below, involves obtaining a random selection of employers. In FY 2009, 66 percent of the randomly selected employers (or their surrogates) who employed workers the day they were contacted by interviewers agreed to cooperate in the survey and interviews were conducted on 59 percent of the eligible establishments. As there are no universe lists of workers, the sampling frame of workers is constructed after contact with the employer.

Once interviewers have a worker frame, a random sample of workers is chosen. The interviewers, who generally work in pairs, approach workers directly to set up interview appointments in their homes or other agreed-upon locations. In 2008-2009, 92 percent of the approached workers agree to be interviewed.

2. Statistical Methodology

Overview

The goal of the NAWS sampling methodology is to select a nationally representative, random sample of farm workers. The NAWS uses stratified multi-stage sampling to account for seasonal and regional fluctuations in the level of farm employment. The stratification includes three interviewing cycles per year and 12 geographic regions, resulting in 36 time-by-space strata. For each interviewing cycle, NAWS staff draws a random sample of locations within all 12 regions from the universe of 497 Farm Labor Areas (FLAs). FLAs are single or multi-county sampling units which form the primary sampling units (PSUs). Employers within PSUs are the secondary level and workers within employers are the tertiary level of sampling units. The number of interviews

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allocated to each region is based on regional farm worker employment data (number of agricultural hired and contract workers) from USDA's Farm Labor Survey. Similarly, the number of interviews allocated to each FLA is proportional to the number of farm workers employed at that time of the year. The FLA size measure is obtained by multiplying a seasonality estimate, derived primarily from the BLS QCEW, by local farm labor expenditure data, from USDA's Census of Agriculture (CoA). Interview allocation is thus proportional to stratum size.

In each FLA, a simple random sample of agricultural employers is drawn from a universe list compiled mainly from public agency records. NAWS interviewers then contact the sampled employers or farm labor contractors, arrange access to the work site, and draw a random sample of workers at the work site. Thus, the sample includes only farm workers actively employed in crop agriculture at the time of the interview.

Stratification

Interviewing cycles

To account for the seasonality of the agricultural industry, interviews are conducted three times a year in cycles lasting ten to twelve weeks. The cycles start in February, June and October. The number of interviews conducted in each cycle is proportional to the number of agricultural field workers hired at that time of the year. The U.S. Department of Agriculture's (USDA) National Agricultural Statistics Service (NASS) provides the Employment and Training Administration (ETA) with the agricultural employment figures, which come from USDA's Farm Labor Survey (FLS).

Regions

Regional stratification entails defining 12 distinct agricultural regions that are based on USDA's 17 agricultural regions. At the start of the survey in 1988, the 17 regions were collapsed into 12 by combining those regions that were most similar e.g., Mountain I and Mountain II, based on statistical analysis of cropping patterns. In each cycle, all 12 agricultural regions are included in the sample. The number of interviews per region is proportional to the size of the seasonal farm labor force in that region at that time of the year, as determined by the NASS using information obtained from the FLS.

Sampling within Strata

Farm Labor Areas

Each region is comprised of several multi-county sampling units called Farm Labor Areas (FLAs). Originally, the NAWS used USDA Crop Reporting Districts, but experience showed that these units were not homogeneous with respect to farm labor. As a result, using Census of Agriculture data and ETA mappings of seasonal farm labor concentrations, the NAWS staff identified aggregates of counties that had similar farm labor usage patterns and were roughly similar in size. The resulting FLAs also account

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for varying county size across the United States. For example, in the East, a Farm Labor Area may include several counties; in the West, a Farm Labor Area may be composed of a single agriculture-intensive county. FLA size is more homogeneous within region than it is across regions. The approximately 3,000 U.S. counties are reduced to 497 farm labor areas.

Each cycle's FLAs will be drawn from the universe of 497 FLAs. For each cycle, within each region, a sample of FLAs is drawn using probabilities proportional to size. The size measure used is an estimate of the amount of farm labor in the FLA during a particular cycle. In this case, the measure is based on the hired and contract labor expenses from the most recent Census of Agriculture, available at the time of drawing the sample. The CoA labor expenses are adjusted using seasonality estimates which identify the percentage of labor expenses that fall into each of the NAWS cycles: fall, spring and summer.

The seasonality estimates are constructed from Quarterly Census of Employment and Wages (QCEW) data. The estimates are made by aggregating the reported monthly employment for each month included in the corresponding NAWS cycle e.g., June, July, August, and September for the summer cycle. The percentage of employment corresponding to each cycle becomes that FLA's seasonality estimate. In cases where there is insufficient information, state seasonality averages are used.

The total number of FLA visits for the NAWS annual sample is 90. To ensure that an adequate number of FLAs are visited in each region, a minimum of two FLAs are assigned per cycle. Thus 12 regions X 2 FLAs X 3 cycles = 72 FLAs. The remaining 18 FLAs are assigned proportionately using the seasonal FLS data. Sampling FLAs within each region for each cycle is done using PPS sampling, using SAS' PROC SURVEYSELECT. The number of FLAs selected for each region has typically ranged from two to five for each cycle.

Counties

In selecting counties, an iterative sampling procedure is used to ensure an adequate number of counties is selected for each region. In most cases, interviews are completed in the first county and no additional counties are needed. However, because there is tremendous uncertainty about the number of workers in a county, additional counties are occasionally needed to complete the FLA allocation. Counties are selected one at a time without replacement using probabilities proportional to the size of the farm labor expenditures in that county at that time.

The process of selecting a county within a FLA begins with a randomly sorted list of counties within the FLA. A cumulative sum using the size of the seasonal hired and contract labor expenditures is constructed for this list similar to the process described above for FLA selection. When selecting a county, the selection number is the product of a random number selected from the uniform distribution multiplied by the cumulative total of the seasonal hired and contract payroll. The county that includes that number in

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its selection of the cumulative sum is selected.

Example showing selection algorithm for counties within FLAs

County	Seasonal labor expenditures	Cumulative Sum	Selected
A	100,000	100,000	
B	300,000	400,000	
C	800,000	1,200,000	
D	450,000	1,650,000	<=
E	600,000	2,250,000	

Selection

Random number	0.657
Random number * cumulative sum	1,478,250
Selected County	D

As mentioned above, often only one county is needed. Should additional counties be needed in a multi-county FLA, additional counties are pulled one at a time without replacement using the method described above. To be prepared, this is done in advance of interviewing but only implemented if needed.

Each county is marked with and ordered by its selection number (e.g., 1,2,3...)

Interviews begin in the first selected county and, as a county's work force is depleted, interviewing moves to the second randomly selected county on the list and so forth, until all the allocated interviews in that FLA have been completed. In FLAs where farm work is sparse, interviewers may need to travel to several counties to encounter sufficient workers to complete the FLA's allocation.

Zip Code Clusters

The next level of sampling is randomly selecting Zip Code Clusters within each county. Zip Code Clusters divide the county into smaller areas that are based on geographic proximity and the number of employers in the area. Zip Code Clusters are designed to be roughly equal in size. Selection of Zip Code Clusters is done by randomly sorting the lists. Field staff begin by contacting employers in the first cluster and then move down the list following the random order until the FLA allocation is filled or the county's workforce is exhausted. In some large counties, the Zip Code Clusters are also large. In these cases, in order to increase the diversity of the employer sample, the NAWS limits the number of interviews that can be done in one cluster to 10.

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Employers

Within each selected county, employers are selected at random from a list of agricultural employers. The list is compiled from administrative lists of employers in crop agriculture. An important component of the list is employer names in selected North American Industrial Classification Codes that the Bureau of Labor Statistics (BLS) provides directly to the contractor per the terms of an interagency agreement between the ETA and the BLS. Because of uncertainty about the conditions of seasonal farm labor in each location, the number of employers to be interviewed is not known in advance.

Simple random sampling is done at the employer level for several reasons. First, there is no reliable size information before the cycle, so using probabilities proportional to size (PPS) is difficult. Second, simple random sampling results in a greater variety of farm sizes whereas PPS favors larger farms. This increases the probability of including more information on events such as accidents and safety concerns that are considered more likely to occur at small farms.

For each cycle, a simple random sample of employers is selected for the first county on the county roster in each FLA. Once a county is selected, the corresponding employer list is sorted according to geographic order (e.g., zip code) and a random starting point is selected. Lists are geographically sorted to minimize the distance between farms and to increase interviewer efficiency. To ensure that interviewers cover the entire county, the list is sorted randomly and 50 employers are selected. If the interviewer has not filled the interview allocation after visiting those employers, then another pull of 50 employers is sampled, sorted and given to the interviewers. If, during the interviewing process, it becomes necessary to go to a subsequent county on the county roster for a particular FLA, then a random sample of employers for that additional county will be generated.

Workers

The interview allocation at each employer is roughly proportional to the FLA allocation. If the allocation was based on employer size, it would be possible to collect all interviews from a single employer if the FLA allocation was small and the first employer to participate had a large workforce. To ensure that interviews come from two or more employers per FLA, the following algorithm is used.

If the total number of interviews allowed for the county or clusters is:

Less than 25 interviews, the maximum interviews allowed per employer is 5

26-40 interviews, the maximum interviews allowed per employer is 8

41-75 interviews, the maximum interviews allowed per employer is 10

More than 75 interviews, the maximum interviews allowed per employer is 12

If the number of workers is less than the allocation then all workers at that employer are to be interviewed.

On large farms, workers are usually organized into crews consisting of several workers and a supervisor. While crew size can range from a handful to more than 100, crews of 30 or less are most typical. When the number of crews is large, randomly selecting

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workers from each crew would be infeasible for interviewers as well as an imposition on the farm employer. For this reason, on farms with more than one crew, the number of crews to be randomly selected will be determined using probabilities proportional to the square root of size. A chart similar to the one below will be provided to interviewers. Interviewers keep track of the number of crews selected and the size of the crew. Interviewers pro-rate the number of interviews across the selected crews based on the size of the crews. Their instructions for this are included in Appendix B.

Number of crews	Number to select randomly
1 to 2	1
3 to 6	2
7 or more	3

Within each crew, the interviewers follow specific sampling instructions that were designed by a sampling statistician to ensure selection of a random sample of workers at each selected employer. Specifically, if n is the number of interviews for that crew and N is the total number of workers within the crew then interviewers place n marked tags and $N-n$ unmarked tags in a pouch and shuffle them. Workers then draw a tag and those with marked tags are included in the sample. If multiple crews are used, the procedure is completed with each selected crew. These instructions are included in Appendix B

Weighting

The NAWS uses a variety of weighting factors to construct weights for calculating unbiased population estimates:

- Sampling weights are used to calculate unbiased population estimates by assigning each sample member a weight corresponding to the inverse of its probability of selection.
- Non-response factors are used to correct sampling weights for deviations from the sampling plan, such as discrepancies in the number of interviews planned and collected in specific locations.
- Post-sampling adjustment factors are used to adjust the weights given to each interview in order to compute unbiased population estimates from the sample data.

The data used for these weights comes from several sources. The number of workers at the farm on the day of sampling is collected from the employer by the interviewer and is part of the sampling documentation. The number of qualified employers in the county comes from the Employer List universe. The county size information is Census of Agriculture farm labor expenditure data, which has been seasonally adjusted using the BLS QCEW. FLS data are used for the regions and cycles.

As explained below, non-response weights are calculated simultaneously with regional post-sampling adjustment weights.

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Sampling weights

Each worker in the sample has a known probability of selection. Information collected at each stage of sampling is used to construct the sampling weights.

Sampling weights are calculated as the inverse of the probability of being selected:

$$WT_k = 1/\text{prob},$$

where $\text{prob} = \text{workprob} * \text{growprob} * \text{counprob} * \text{flaprob}$,

$$\text{with } \text{workprob} = \frac{\text{number of workers interviewed at the farm location}}{\text{total number of workers at that location}},$$

$$\text{growprob} = \frac{\text{number of growers interviewed in the county}}{\text{total number of qualified growers in that county}},$$

Calculating counprob, the county within FLA weight is more complicated. For example, if one of the sampled counties is larger than another, then its probability of selection should be higher than that of the other. If several counties are selected from a particular region, then the selection probability for a particular county is (1) its probability of selection on the first draw, plus (2) the probability of its selection on the second draw, plus (3) the probability of its selection on the third draw, etc.

For the standard method of sampling several items with probabilities proportional to size, without replacement, closed-form formulas for the exact inclusion probabilities do not exist. However, these probabilities can be calculated exactly using multiple summations. This procedure can be implemented in SAS within PROC IML.

Suppose that the population at a particular sampling stage consists of N objects with sizes s_1, s_2, \dots, s_N , having total size $S = \sum_{j=1}^N s_j$. Let π_j^i be the probability that the j^{th} item is selected on the i^{th} draw. Then for $j = 1, 2, \dots, N$,

$$(1) \quad \pi_j^1 = \frac{s_j}{S},$$

$$(2) \quad \pi_j^2 = \sum_{k=1, k \neq j}^N \frac{s_k}{S} \frac{s_j}{S - s_k},$$

$$(3) \quad \pi_j^3 = \sum_{k=1, k \neq j}^N \sum_{l=1, l \neq k}^N \frac{s_k}{S} \frac{s_l}{S - s_k} \frac{s_j}{S - s_k - s_l},$$

$$(4) \quad \pi_j^4 = \sum_{k=1, k \neq j}^N \sum_{l=1, l \neq k}^N \sum_{m=1, m \neq k, m \neq l}^N \frac{s_k}{S} \frac{s_l}{S - s_k} \frac{s_m}{S - s_k - s_l} \frac{s_j}{S - s_k - s_l - s_m}, \text{ and so forth.}$$

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These i^{th} -draw probabilities each have the property that $\sum_{j=1}^M \pi_j^i = 1$. Finally, the probability that the j^{th} item is included in a sample of size n is $\pi_j = \sum_{i=1}^n \pi_j^i$. These inclusion probabilities have the property that $\sum_{j=1}^M \pi_j = n$.

Both the FLA and county selection probabilities can be calculated exactly using these formulas.

The formula for FLAprob which is the probability that the FLA was selected within the region derives from the systematic probability proportional to size selection process used.

Consider

N is the number of FLAs in the region

s_1 through s_N are the sizes of the FLAs.

S is the sum of the FLA sizes, so $S = \sum_{i=1}^N s_i$.

n is the number of the FLAs to be selected with probabilities proportional to size.

In selecting the FLAs, they were listed in a random order. A column of cumulative FLA sizes was constructed. That is, the cumulative size at the j^{th} FLA will be $S_j = \sum_{i=1}^j s_i$.

A random starting point, k_0 , was chosen between 1 and $k = \frac{S}{n}$. The integers $k_0, k_0 + k, k_0 + 2k, \dots, k_0 + (n-1)k$ can be listed. The j^{th} FLA will be selected if one of these integers falls between $S_{j-1} + 1$ and S_j (where S_0 is interpreted to be 0).

Without loss of generality, consider the first FLA on the randomized list. It will be selected if k_0 lies between 1 and s_1 . Thus, its probability of selection is $\pi_1 = \frac{s_1}{k} = n \frac{s_1}{S}$.

In general, the probability that the j^{th} FLA is selected is $\pi_j = n \frac{s_j}{S}$.

Non-Response Weighting

Non-response corrections adjust for deviations from the sampling design. If, for example, ten interviews should have been collected at a farm but only two interviews were collected, those two interviews could be given five times the weight they would have otherwise received. Thus, each interview's weight needs to be adjusted to represent a certain value in terms of size. Instead of making this adjustment at the farm level, it could be made at any higher level in the sampling plan. For the NAWS this means at the employer list-within-zip code cluster, cluster-within-county, county, county list-within-FLA, FLA, FLA list-within-region, region, or national level.

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By raising the level at which adjustments are made, overall size information is, generally, more reliable. This is due to the statistical effect of averaging, greater year-to-year stability over larger geographic areas, and the lower likelihood of the absence or suppression of data due to confidentiality considerations. On the other hand, lower-level adjustments are more sensitive, if the information used for making the adjustments is reasonably accurate.

For two reasons, the NAWS non-response adjustments are made at the region level. First, the region is the lowest level with enough interview coverage to calculate weights for the size adjustment. All of the 12 NAWS regions are visited in every cycle. If, for some reason, there are too few interviews in a region, the region can be combined with adjacent regions for weighting purposes.

Second, the NAWS uses measures of size provided by the USDA Farm Labor Survey, which are reported by quarter and region. The USDA is the only source of quarterly statistics on levels of farm worker employment. The Census of Agriculture, for instance, collects annual data rather than quarterly and the statistics are published every five years. Thus, by using USDA Farm Labor Survey figures to make the size adjustment, the NAWS can adjust the weights by season and region and construct unbiased population estimates. Non-response adjustments for size, therefore, are made at the region-within-cycle level to create corrected region weights.

Post-sampling weights

Post-sampling weights are used in the NAWS to adjust the relative value of each interview in order for national estimates to be obtained from the sample. There are five post-sampling weights. Two of the weights adjust for unequal probabilities of selection that can only be determined after the interviews are conducted. These include the unequal probabilities of finding part-time versus full-time workers (day weight) and the unequal probabilities of finding seasonal versus year-round workers (seasonal weight). The next three weights (region, cycle, and year) adjust for the relative importance of a region's data, a sampling cycle, and a sampling year. The measures of size used are obtained from the USDA. The region weight, as discussed below, is calculated simultaneously with non-response weighting. The cycle weight and year weight serve slightly different roles in estimation. They allow different cycles and sampling years to be combined for statistical analysis. These weights are also based on USDA measures of size.

It should be noted that the NAWS sampling plan is based on USDA NASS data collected in the year before the interviews. For example, fiscal year 2011 data is used to plan the NAWS 2012 sample. The weights, however, use NASS data from the year during which the interviews were conducted. This corrects for any discrepancies in allocations due to projecting farm worker distributions based on past year data.

Adjustment for days worked per week: the day weight

The day weight adjusts for the probability of finding part-time versus full-time farm

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workers. A part-time worker, who works only two or three days per week, has a lower likelihood of being encountered by the interviewing staff than a worker employed six days per week. Therefore, respondents are weighted inversely proportional to the length of their workweek.

A conservative adjustment for the number of days worked is appropriate to avoid excessively large sampling weights. Field reports indicate that relatively few workers are contacted on Sundays, and a review of the interviews indicated that virtually no workers reported Sunday hours without Saturday hours. Accordingly, workers reporting at least six workdays per week nearly always have a full chance of selection. Thus, any workers reporting at least six days of work per week are treated as having a full chance of selection; adjustments are made only for those workers with less than six days of work per week. The day weight (DWTS) is computed as: $DWTS = 6 / (\text{length of the workweek})$ where “length of the workweek” is the number of days per week the respondent reports working at the time of the interview for the current farm task (if two tasks are reported, the one with more days per week is used). Seven-day workweeks are truncated to six, as explained previously. For the few workers not reporting the number of days, DWTS is assigned a default value of 1.

Adjustment for seasons worked per year: the season weight

The calculation of worker-based weights is complicated by the fact that workers could, in general, be sampled several times a year. Furthermore, neither the USDA, CoA nor the FLS information provide figures that can be used for the annual number of farm workers. The USDA CoA reports the number of directly-hired workers employed on each farm, but does not adjust for the fact that some workers are employed on more than one farm in the census year. In addition, CoA farm worker counts exclude labor-contracted farm workers. Similarly, the FLS is administered quarterly and reports the number of farm workers employed each quarter, so the same worker could be reported in multiple quarters. Because of this repetition of workers across quarters, it would be invalid to derive the total number of persons working in agriculture during the year by summing quarterly figures from the FLS.

As employment information is not available for every worker for each quarter of the year, the only way to avoid double-counting of farm workers is to use the 12-month retrospective work history collected in the NAWS. Specifically, predicting future-period employment is achieved by imposing the assumption that workers who report having worked in a previous season would work in the next corresponding season. For example, a worker sampled in spring 2008 who reported working the previous summer (2007) is assumed to work in the following summer (2008). For some purposes, including the calculation of year-to-year work history changes, this assumption cannot not be used. For purposes such as obtaining demographic descriptions of the worker population, however, this assumption provides satisfactory estimates.

Furthermore, it is assumed that a worker has an equal likelihood of being sampled in each season worked. This assumption is dependent on a balance between the amount of farm work done by the worker in each season and the number of interviews obtained in that

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region for the season. Recall that the NAWS interview allocation is proportional to FLS seasonal agricultural payroll. Thus, the probability of sampling is related to the amount of work performed by individual workers. With these simplifying assumptions, it is possible to calculate a seasonal weight that is simply the inverse of the number of seasons the interviewee did farm work during the previous year.

For the purposes of the NAWS, there are only three seasons per year. An interviewee always performed farm work during the trimester he/she was sampled. From the NAWS interview, it can be determined during which of the two previous trimesters the respondent also did farm work. If the interviewee only worked during the current trimester, the seasonal weight is 1/1 or 1.00. If the interviewee worked during the current trimester and only one of the two prior trimesters, the seasonal weight is 1/2 or 0.50. Finally, if the interviewee worked during the current and both of the prior trimesters, the seasonal weight is 1/3 or 0.33.

This season weight is similar to the day weight in the sense that respondents who spend more time (seasons) working in agriculture have a greater chance of being sampled. Therefore, the weighting has to be inversely proportional to the number of seasons worked in order to account for the unequal sampling probability.

The region weight

The region weight adjusts the relative weight of a region's data in relation to the number of interviews collected in that region. If the number of interviews collected was smaller than the regional allocation in the sampling plan, an adjustment weight greater than one is assigned to each interview in the region, and vice versa. These adjustments ensure that the population estimates are unbiased.

The region weight is based on USDA FLS measures of regional farm employment activity. This is the best source of information available about farm workers. The USDA figures are reported by region and quarter, which allows the weight to be sensitive to seasonal fluctuations.

Correspondence between USDA data and the NAWS sampling cycles

The calculation of the region weight relies on two pieces of information: the USDA regional measures of size and the number of interviews completed in each region. The first step in the process of calculating the region weight is to apportion the USDA quarterly size figures among the three NAWS sampling cycles.

The USDA figures are reported quarterly. NAWS sampling years, however, cover non-overlapping 12-month periods (from September to August), which are divided into three cycles. Accordingly, it is necessary to adjust the USDA figures to fit the NAWS sampling frame by apportioning the four quarters into three cycles.

For example, the number of farm workers in the fall cycle for a region is assumed to be the total number of workers for that region in USDA quarter 1 of the current fiscal year (FY_c) plus one-third the number of workers for that region in USDA quarter 2 of the next

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fiscal year (FY_p). The formula for the winter, spring and summer cycles is constructed similarly.

Determining the NAWS region grouping according to interview coverage

The region weight (within cycle) is calculated as follows for each region j ($1, \dots, n_i$) in cycle i :

$$PWTR_{ij} = \frac{USDA_{ij} / X_{ij}}{\sum_{j=1}^{n_i} (USDA_{ij} / X_{ij})} \times \frac{\sum_{j=1}^{n_i} X_{ij}}{DWTS_{ij}},$$

where $USDA_{ij}$ is the USDA Farm Labor Survey estimate of the number of workers for region j in cycle i , X_{ij} is the sum of the sampling weights for region j in cycle i , $DWTS_{ij}$ is the sum of farm worker day weights for region j in cycle i . Also, $1 \leq DWTS_{ijk} \leq 6$ (where k refers to a farm worker), so that $DWTS_{ij} = X_{ij}$ if all farm workers in region j in cycle i are working full time and $DWTS_{ij} = 6 \times X_{ij}$ if all farm workers are working 1 day only a week in region j in cycle i .

Combining different sampling cycles: the cycle weight

The NAWS combines data from the different sampling cycles (seasons) within the same sampling year in order to generate more observations for statistical analysis. In order to combine cycles it is necessary to adjust for the number of workers represented in each cycle in relation to the number of interviews collected in the cycle. For instance, suppose the NAWS did not do proportional sampling as explained above but rather interviewed the same number of people in all three cycles in the 2007 fiscal year. If the USDA reported more workers for the fall and spring/summer cycles, as compared to the winter cycle, then the interviews in the fall and spring/summer would be worth relatively more in terms of size than the interviews conducted in the winter cycle. Accordingly, the interviews in the winter would have to be down-weighted in relation to the interviews in the other seasons (cycles) before the cycles could be combined.

The cycle weight is calculated similarly to the region weight, but at the cycle- rather than region- level. The sum of the USDA size for a cycle is divided by the number of interviews in that cycle. The cycle weight (or region weight within year) is calculated as follows for each region j $1, \dots, n_i$, cycle i in year Y :

$$PWTCR_{ij} = \frac{\frac{USDA_{ij} * K_{ij}}{X_{ij}} * \sum_{i,j \in Y} X_{ij}}{\sum_{i,j \in Y} \left(\frac{USDA_{ij} * K_{ij}}{X_{ij}} \right) * SSEADWTS_{ij}}$$

where $SSEADWTS_{ij} = \sum_{k \in (i,j)} DWTS_k * SEASWTS_k$

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$$K_{ij} = \frac{\sum_{k \in (i,j)} DWTS_k * SEASWTS_k}{\sum_{k \in (i,j)} DWTS_k}$$

and

$0.33 \leq SEASWTS_k \leq 1$ (k refers to a farm worker) and $SEASWTS_k = 1$ if the farm worker worked only one cycle during the year, so that if all farm workers for region j in cycle i worked full time and only one cycle in the corresponding year $K_{ij} = 1$ and $SSEADWTS_{ij} = X_{ij}$.

Combining different sampling years: the year weight

The year weight allows different sampling years to be combined for statistical analysis. It follows the same rationale as the cycle weight, but at the sampling-year level. If the same number of interviews are collected in each sampling year, those interviews taking place in years with more farm work activity are weighted more heavily in the combined sample.

Sampling years cannot be combined if the interviews are not comparable in terms of agricultural representation. In an extreme case, suppose that the NAWS budget tripled one of the sampling years, consequently tripling the number of interviews. If the two sampling years were joined without adjustment, the larger sampling year would have an unduly large effect on the results.

To avoid this, the year weight is calculated as a ratio of the total number of farm workers in a sampling year to the number of interviews in that sampling year. The year weight (or region weight related to all years of interviews) is calculated as follow for each region j (1..nij), cycle i (the sum over i,j means all farm workers, all cycles all years):

$$PWTCR_{ij} = \frac{\frac{USDA_{ij} * K_{ij}}{X_{ij}}}{\sum_{i,j} \left(\frac{USDA_{ij} * K_{ij}}{X_{ij}} \right)} * \frac{\sum_{i,j} X_{ij}}{SSEADWTS_{ij}}$$

with the same notations than for the preceding weights.

Obtaining the final weights

Once the individual weight components are calculated, final composite weights are calculated as the product of the day weight, the season weight, and region weight and the sampling weight. The cycle and year are also factored into the composite weights when multiple cycles or sampling years are used. The composite weights are adjusted so the sum of the weights is equal to the total number of interviews at the next higher level of stratification. These adjusted composite weights based on farm workers are then used for calculating the estimated proportion of workers with various attributes.

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The individual observation weights are obtained at the farm worker level:

$$PWTRD_k = PWTR_{j,k \in (j)} * DWTS_k * WT_k$$

This is the weight within cycle; it includes an adjustment for the length of the workweek but no seasonal adjustment.

$$PWTCRD_k = PWTCR_{j,k \in (j)} * DWTS_k * SEASWTS_k * WT_k$$

This is the weight within a year; it includes both the length of the workweek and seasonal adjustment. This weight may be used for the analysis of one particular year of interview.

$$PWTYCRD_k = PWTYCR_{j,k \in (j)} * DWTS_k * SEASWTS_k * WT_k$$

The composite weight (PWTYCRD) is used for almost all NAWS analysis. This weight allows merging several years of analysis together. It is included in the public access dataset.

3. Statistical Reliability

a) Response

Employer response

To maximize employer response, the contractor sends an advance letter to employers and provides them a brochure explaining the survey. The letter is signed by the survey director and includes the names of the interviewers and their contact information. For further information or questions, the letter and brochure direct employers to contact either the survey contractors (JBS International) at a toll free number or the Department of Labor's (DOL) Contracting Officer's Technical Representative (COTR). Employer calls are returned quickly. In addition, and before the start of every interview cycle, JBS provides the COTR a list of scheduled interview trips. The list includes the counties and states where interviews will be conducted, the names of the interviewers who will be visiting the selected counties, and the dates the interviewers will be in the selected counties. The COTR refers to the list whenever he receives an employer call to confirm the interviewers' association with the survey.

Both DOL and the contractor make presentations on the survey and provide survey information, e.g., questionnaires, to officials and organizations that work with agricultural employers. The NAWS has received the endorsement of several employer organizations. This improves the response rate since agricultural employers sometimes call their organization when considering survey participation.

Intensive and frequent interviewer training is also conducted as a means to increase employer response rates. Interviewers are trained in pitching the survey in various situations and, being well versed in the history, purposes, and use of the survey, are able to easily answer any questions or address any concerns an employer might have. In addition, when explaining the purpose of the survey to employers, interviewers clearly

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distinguish the survey from enforcement efforts by the Department of Homeland Security, DOL and other Federal agencies, and assure employers that their information is confidential.

Worker response

The survey's methodology has been adapted to maximize response from this hard-to-survey population. Interviewers pitch workers in English or Spanish, as necessary. All interviewers are bilingual and bicultural. In addition, interviewers make sure that potential respondents know that they are not associated with any enforcement agency, e.g., Immigration and Customs Enforcement. Interviewers explain the survey to workers and obtain their informed consent.

b) Non-response

The \$20 honorarium to farm workers enables the survey to achieve an estimated worker response rate of 92 percent. This high level of response greatly aids in protecting the survey estimates from non-response bias. To reduce employer non-response, interviewers are instructed to make several contact attempts at different times of the day and on different days of the week. Interviewer contact attempts are logged and the logs are monitored for compliance. When necessary, interviewers are instructed to accommodate an employer's preference for scheduling surveys and, if needed, the interviewer can request an extension of the field period.

To measure the effect of employer non-response on the survey's findings, the survey's statistician, project manager, and COTR are exploring the possibility of using the minimal information known about and/or collected from the non-cooperating employers, e.g., primary crop, county, number of workers employed, and quarterly hired farm payroll to generate proxy employer types. If it is possible to construct such proxies, then the demographic characteristics of workers employed on farms of cooperating employers of a particular type will be analyzed to determine if there are significant differences in the key demographic and employment characteristics of workers from participating vs. proxy non-participating employers.

c) Reliability

A probability sampling methodology will be used and estimates of the sampling errors will be calculated from the survey data.

Estimation procedure

1. At the highest level of the sampling design, the region/cycle level, stratified sampling was used. Sampling is then carried out at the lower levels, independently within each stratum.

The following description is excerpted from Obenauf¹:

¹ Obenauf, W. (2003), "An Application of Sampling Theory to a Large Federal Survey," Portland State

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The stratified sampling technique divides the entire population into relatively homogenous groups that are mutually exclusive and exhaustive. Samples are then drawn from each of these groups (strata) by simple random sampling or an alternate method. The entire sample is a compilation of these independent samples from each of the strata. In stratified sampling, an estimate of the population mean can be made for each of the strata.

Estimate of population mean:

$$\bar{y}_x = \frac{\sum_{k=1}^L N_k \bar{y}_k}{N},$$

where N_k is the population size of stratum k and L is the number of strata into which the population is divided.

If a simple random sample is taken within each stratum (recall that other schemes can be used to draw a sample from each of the strata), the following represents an unbiased estimate of the variance of \bar{y}_x :

$$Var(\bar{y}_x) \approx \sum_{k=1}^L \left(\frac{N_k}{N} \right)^2 \frac{s_k^2}{n_k} (1 - f_k).$$

The standard error of the estimator is the square root of this estimated variance, or

$$S.E.(\bar{y}_x) = \sqrt{\sum_{k=1}^L \left(\frac{N_k}{N} \right)^2 \frac{s_k^2}{n_k} (1 - f_k)}.$$

2. At the second stage of the sampling design, within each stratum, counties (or groups of counties) are treated as clusters.

The following description is another excerpt from Obenauf1.

The population is again divided into exhaustive, mutually exclusive subgroups and samples are taken according to this grouping. Once the population has been appropriately divided into clusters, one or more clusters are selected ... to comprise the sample. There are several methods of estimating the population mean for a cluster sample. The method most pertinent to this study is that involving cluster sampling proportional to size (PPS).

With PPS sampling, the probability (z_j) that a cluster j is chosen on a specific draw is

given by $z_j = \frac{M_j}{M}$, where M_j is the size of the j^{th} cluster and M is the population size. An

unbiased estimate of the population total is given by

$$\hat{y}_{pps} = \frac{1}{n} \sum_{j=1}^n \frac{y_j}{z_j} = \frac{M}{n} \sum_{j=1}^n \frac{y_j}{M_j} = M\bar{y},$$

where y_j is the sample total for y in the j^{th} cluster, n is the number of clusters in the sample and \bar{y} represents the average of the cluster means.

To estimate the population mean, this estimate must be divided by M , the population size.

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The variance of the estimator of the population total is given by

$$V(\hat{y}_{ppz}) = \frac{M^2}{n} \left[\sum_{i=1}^N \frac{M_i}{M} \left(\frac{y_i}{M_i} - \bar{y} \right)^2 \right],$$

This is estimated by $V(\hat{y}_{ppz}) \approx \frac{M^2}{n} s_{mean}^2$, where s_{mean}^2 is the sample variance of the $\frac{y_i}{m_j}$ values.

For an estimate of the population mean,

$$\bar{y}_{ppz} = \bar{y} = \frac{1}{n} \sum_{j=1}^n \bar{y}_j = \frac{1}{n} \sum_{j=1}^n \frac{y_j}{m_j} \text{ and } V(\bar{y}_{ppz}) \approx \frac{s_{mean}^2}{n}.$$

In two-stage cluster sampling, the estimated variance of the estimator is then given by an iterative formula:

$$Var(\bar{y}_{clus}) = E_1 [Var_2(\bar{y}_{clus})] + Var_1 [E_2(\bar{y}_{clus})].$$

This iterative formula is then generalized to compute the variance of the estimators in multi-stage sampling schemes with three or more levels. Exact formulas become intractable at this point, and the various statistical software packages rely upon either re-sampling methodology or linear approximations in order to estimate the variances and standard errors of the estimators.

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The following is an excerpt from the SAS documentation for PROC SURVEYMEANS².

The SURVEYMEANS procedure produces estimates of survey population means and totals from sample survey data. The procedure also produces variance estimates, confidence limits, and other descriptive statistics. When computing these estimates, the procedure takes into account the sample design used to select the survey sample. The sample design can be a complex survey sample design with stratification, clustering, and unequal weighting.

PROC SURVEYMEANS uses the Taylor expansion method to estimate sampling errors of estimators based on complex sample designs. This method obtains a linear approximation for the estimator and then uses the variance estimate for this approximation to estimate the variance of the estimate itself (Woodruff 1971, Fuller 1975)^{3,4}.

SAS (e.g., Proc Surveymeans), allows the user to specify the details of the first two stages of a complex sampling plan. In the present case, the stratification and clustering at the first two levels are specified in Proc Surveymeans (strata region; cluster FLA). At the lower levels of the sampling scheme, the design attempts to mimic, as closely as is practical, simple random sampling. The software is not able to calculate exact standard errors, since it presumes true simple random sampling beyond the first two levels. The sampling weights will remedy any differences in selection probabilities, so that the estimators will be unbiased. The standard errors, however, are only approximate; the within-cluster variances at stages beyond the first two are assumed to be negligible.

In the “Surveymeans” procedure, the STRATA, CLUSTER, and WEIGHT statements are used to specify the variables containing the stratum identifiers, the cluster identifiers, and the variable containing the individual weights.

For the NAWS, the STRATA are defined as the cycle/region combinations used for the first level of sampling. The CLUSTER statement contains the primary sampling unit, which is the FLA. The variable for FLA is county_cluster.

The WEIGHT statement references a variable that is for each observation i , the product of both the sampling weight Wt_i and the non-response weight $PWTYCRD_i$. This variable is called `pwtycrd` for historic reasons.

The Surveymeans procedure also allows for a finite population correction. This option is selected using the TOTAL option on the PROC statement. The total statement allows for the inclusion of the total number of PSUs in each strata. SAS then determines the number of PSUs selected per region from the data and then calculates the sampling rate. In cases such as the NAWS where the sampling rate is different for each strata, the TOTAL option includes a reference to a data set that contains information on all the strata and a variable `_TOTAL_` that contains the total number of PSUs in that strata.

² SAS Institute Inc., *SAS/STAT® User's Guide*, Version 8, Cary, NC: SAS Institute Inc., 1999, 61, 3.

³ Woodruff, R. S. (1971), “A Simple Method for Approximating the Variance of a Complicated Estimate,” *Journal of the American Statistical Association*, 66, 411–414.

⁴ Fuller, W. A. (1975), “Regression Analysis for Sample Survey,” *Sankhyā*, 37, Series C, Pt. 3, 117–132.

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We include here sample code for Proc Surveymeans to calculate the standard errors for our key estimator WAGET1.

```
proc surveymeans data=naws.crtddvars total=naws.regioninfo;
strata dmaregn cycle;
cluster county_cluster;
var waget1;
weight pwtycrd;
```

Precision of key estimators

Two of the many variables of interest are FWRDAYS, which is the number of days worked per year by a respondent, and WAGET1, which is the average hourly wage of a respondent.

Based on data collected in 2005, and applying the weights that were revised as part of the 2009 independent evaluation (see below under Statistical Consultation), the 2-standard-error confidence interval for the first variable, FWRDAYS, was 183 ± 8.5 . That is, with approximately 95% confidence, the average number of days annually worked, per person, lies between 174.5 and 191.5. This constitutes a margin of error of $\pm 4.6\%$ of the estimated value.

For the second variable, the average wage (WAGET1), the interval is 7.95 ± 0.21 . With approximately 95% confidence, the average wage lies between \$7.74 and \$8.16. This yields a margin of error of $\pm 2.6\%$ of the estimated value.

There are numerous other variables of interest, whose standard errors vary greatly. These two are offered as examples that show some of the range of possible precisions obtained.

4. Tests

The questionnaire to be used in the survey was developed by the DOL with input from various Federal agencies. Apart from adding the Environmental Protection Agency-sponsored questions on the amount of time per day a workers is engaged in a particular crop and task, and on clothes laundering and personal hygiene practices, the questionnaire will be unchanged from the version that OMB approved in the last submission. The majority of the questions have been used for over twenty years, are well understood by the sampled respondents, and the data they provide are of high quality.

5. Statistical Consultation

The following individuals have been consulted on statistical aspects of the survey design: Stephen Reder and Robert Fountain, Professors, Portland State University, (503) 725-3999 and 503-725-5204; Phillip Martin, Professor, University of California at Davis (916) 752-1530; Jeff Perloff, Professor, University of California at Berkeley (510) 642-

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9574; and John Eltinge, the Bureau of Labor Statistics (BLS) (202) 691-7404.

In 2009, Mathematica Policy Research, Inc. researchers Daniel Kasprzyk, Ph.D., Frank Potter, Ph.D., and Steve Williams ((609) -799-3535) evaluated the equations for the survey's sampling weights and the impact of the weights on key national-level findings.

The data will be collected under contract to the ETA by JBS International, Aguirre Division (650) 373-4900. Analysis of the data will be conducted by Daniel Carroll, ETA (202) 693-2795, and by JBS International, Aguirre Division.

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Appendix B: Contacting and Selecting Farm Workers

A. A FARM WORKER QUALIFIES TO PARTICIPATE IN THE NAWS (ELIGIBLE), IF HE/SHE ...

1. **WORKS IN** any type of crop agriculture in the United States. This includes “crops” produced in nurseries.
2. **WORKS IN** the production of plants or flowers (including work done in nurseries like planting, cultivating, fertilizing, grafting and seeding).
3. has worked in the last 15 days, at least 4 hours per day, for the contacted employer, and meets any of the criteria mentioned above.

B. A WORKER CANNOT PARTICIPATE IN THE NAWS (INELIGIBLE) IF HE or SHE:

1. Was interviewed by NAWS within the last 12 months in the same location.
2. Is an “H-2A worker.” H-2A is a program similar to the “braceros”. An H-2A worker is a foreigner who is in the United States on a temporary work visa to work for a specific agricultural employer or association of agricultural employers for a specific period of time (less than a year). At the end of the period, the worker returns to his/her respective country.
3. Works exclusively with livestock (animals: such as bees, horses, fishes, pigs, cows, etc).
4. Hasn’t worked for the contacted employer at least one day for 4 hours or more in the last 15 days.
5. Does “non-farm work” for the employer (mechanic, sales, office, etc).
6. Is a family member of the employer and doesn’t draw a salary like other farm workers.
7. Is the employer or contractor.
8. Is a sharecropper that makes all operational decisions such as when, where and how to plant, harvest, etc.
9. Works for a packing house or cannery (packing or canning agricultural products) outside of the ranch. **Note:** Workers who are packers or canners can be eligible for the NAWS study if they satisfy the following two requisites:
 - a) the canning or packing plant is adjacent or located on the farm, **AND**
 - b) at least 50 percent of the produce being packed or canned originated from the ranch of the contacted employer.
10. Works for a landscaping company that just sells, installs, maintains or preserve trees or plants; this includes the planting of ornamental plants and placement of sod.

Whenever a worker doesn’t qualify to participate, be gracious and thank him/her for their time and proceed to the next worker.

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C. NUMBER OF INTERVIEWS PER EMPLOYER

The Employer Lists indicates the total number of interviews allocated for your assigned county. **NEVER** can the *total county* allocation be completed by interviewing workers from *one single employer*. If this appears likely to happen, call the office for instructions.

Refer to the table below, and find the number of interviews per employer based on the number of workers at the employer on the day visited

Number of workers	Number of Interviews
1 - 2	1
3 - 6	2
7 to 12	3
13-20	4
21-30	5
31-42	6
43-56	7
57-72	8
73-90	9
91-110	10
111-132	11
133 or more	12

Note: Sample the allocated number of workers at the employer (interviewing those that agree to participate) and if the county allocation is not complete, continue onto the next employer. At the last employer complete the number of interviews allocated to that employer on the chart – EVEN IF YOU EXCEED THE COUNTY ALLOCATION.

D. LOCATING THE WORKERS

Once you get permission from the employer (and you have documented the number of employed workers) ask the employer where you can find the workers. If they are in different locations ask the employer: “how many workers are in each location?” Also ask the employer (or supervisor assigned by employer) for the best time and location to meet with them.

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WORKERS' LOCATIONS

The best time to contact workers

Unless the employer gives you permission to speak with his/her employees during working hours, do not make any contacts or appointments or try to interview the workers during their work hours.

Changing work locations

Once the employer gives you permission to contact the workers, try to complete your contacts and interviews on the same day the employer gave you permission. You should be aware that from day to day it is common to find that workers in the field change location; and new workers can be in the same field on a different day.

The location of the field is not in the assigned county

If the location of the field or operation of the farm is located outside of the designated county, you **cannot interview** those workers. The farm workers must be physically working in the NAWS assigned county for the particular cycle. That is, it is not unusual that the same employer may have farm land and workers in two different counties.

E. HOW TO CHOSE ELIGIBLE WORKERS FOR THE STUDY

Selecting workers located in different areas

If the employer informs you that his employees are distributed over more than one fields/crew (in the same county), do the following. Use the table below to identify the number of crews and then randomly select the crews.

Number of crews	Number to select randomly
1 to 2	1
3 to 6	2
7 or more	3

Once you have selected the crews, use the proportional formula, below, to calculate how many from each field/crew you need to interview. The same proportional formula should be used if you locate workers in different residencies. **For example**, if the workers live in two different labor camps or housing then find out how many live in each dwelling and calculate proportionately how many you should interview from each dwelling.

Proportional selection of workers

When you find that workers are divided into different areas, randomly sampling from each group will be necessary to maintain equal likelihood of selection for everyone. The following formula serves as a guide to calculate the number of

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workers that should be selected when you find that workers are divided into different areas. In this example, there are 3 sampled fields and you are allowed to conduct 12 interviews for this employer.

a	b	c
Number of workers per location	Number of workers per location ÷ Total of workers	%X# total of interviews = 12
Field A = 20	$20 \div 30 = 66.6\%$	$.666 \times 12 = 08$ interviews
Field B = 05	$05 \div 30 = 16.6\%$	$.166 \times 12 = 02$ interviews
Field C = 05	$05 \div 30 = 16.6\%$	$.166 \times 12 = 02$ interviews
Workers total = 30		Total = 12 interviews

Random Selection

As a sample of workers from an employer is needed, the workers are to be chosen at random. All eligible workers of the employer must have an equal chance of being chosen. Everyone has a chance when selecting crews. Then everyone in the selected crews must have an equal chance of selection. The following are the instructions provided to interviewers:

Random Sampling Instructions for NAWS sampled worksites

Before you go to the site, make sure you have:

- A set of tags with colored stickers on them (at least 12 for each site you expect to visit)
- A set of tags with no stickers (at least 50 for each site you expect to visit)
- A bag (or some other dark container to use to hand out the tags, so that workers can pull the tags without seeing what they're getting)
- Sufficient supplies to carry out surveys with the workers that are selected
- A Sampling Tracking Sheet for each site you expect to visit

Once you have gotten permission from the employer to interview, identify the number of workers on site for that day. Record that number in **Line 1** on the Sampling Tracking Sheet.

NOTE-If the number of workers on the site is less than or equal to the cluster, skip the sampling process and ask all workers to complete the interview. Record the number of workers asked to interview on Line 6 of the Sampling Tracking Sheet and the number completing interviews on Line 7. Leave lines 2-5 blank.

NOTE-for any of these approaches, if any sampled workers refuse the interview- **DO NOT REPLACE THEM-** move on to the next employer if additional interviews are needed to complete the cluster allocation.

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Use the chart above to determine the correct number of interviews to be done; this will be the same number of stickered tags to put into the bag: Record the number of stickered tags you put in the bag on **Line 2** on the Sampling Tracking Sheet.

Next, put enough tags without stickers into the bag so that the total number of tags in the bag equals the number of workers at the site. (For example, if there are 20 workers at the site, and you put 5 stickered tags in the bag, then add another 15 tags.) Record the number of unstickered tags you put in the bag on **Line 3** on the Sampling Tracking Sheet.

One interviewer will go around to each worker and have them pull a tag from the bag, while the other speaks to the group.

At the end of the introduction, the speaker will ask everyone to look at their tags, and ask those who have stickers to come up. Record the number of workers who come up to you with stickered tags, who you ask for an interview on **Line 6** on the Sampling Tracking Sheet.

Carry out the interviews and record the completed number of interviews on **Line 7** of the Sampling Tracking Sheet.

Continue, using the same bag, until you've talked to all workers in the group.

When you have time, count the number of tags left in the bag (if any) and record this number on **Line 4** in the Sampling Tracking Sheet. Count the number of stickered tags left in the bag (if any) and record this number in **Line 5** in the Sampling Tracking Sheet.

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Sample Tracking Sheet

County Name _____ Date Visited _____
 Employer/Farm name _____ Employer ID _____
 Allocation (circle 1) 5 8 10 12

Line	Number of:	
1)	Workers (from employer)	
2)	Stickered tags put in bag(s)	
3)	Unstickered tags put in bag(s) (lines 2+3 should equal line 1)	
4)	Tags left in bag(s) at end (after all groups/after all workers have been offered a tag)	
5)	Stickered tags left	
6)	Workers asked for interview ("contacted" in current system)	
7)	Workers completing interview	

Were there more than one crew: ___ YES ___ NO

If yes:

How many crews: _____ How many in each crew (list):

From how many crews did you "randomly" select workers (list):

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REFERENCES

Fuller, W.A. (1975), "Regression Analysis for Sample Survey," *Sankhyā*, 37, Series C, Pt. 3, 117-132.

Obenauf, W. An Application of Sampling Theory to a Large Federal Survey. Portland State University, Department of Mathematics and Statistics. 2003.

SAS Institute Inc., SAS/STAT® User's Guide, Version 8, Cary, NC: SAS Institute Inc., 1999, 61, 3.

Woodruff, R. S. (1971), "A Simple Method for Approximating the Variance of a Complicated Estimate," *Journal of the American Statistical Association*, 66, 411–414.