Investing in Farmland or Farmers?
An Investigation of the Decline of Mid-Sized Agricultural Operations in Ohio

By: Phillip Moore
Arizona State University: School of Sustainability MA program
Committee: Dr. Nalini Chhetri, Dr. Bryan Leonard, Dr. Milan Shrestha

Abstract :
Day-to-day decision makers on agricultural operations play a key role in maintaining both a sustainable and food secure agricultural society. This population, also defined as Principal Producers by the 2017 USDA Agricultural Census Report, has witnessed a significant decline in recent years, raising many questions surrounding why farmers are retiring faster than they can be replaced. To look closely at this phenomenon, this study focuses on the State of Ohio to hear first-hand from producers what they need to be successful through a series of semi-structured interviews. This study also maps recent changes in variables that define this issue from 2007-2017 using QGIS and USDA Agricultural Census data. The findings from this study show the recent decline of mid-sized agricultural operations and provide evidence linking declining rates of principal producer populations with specific features consistent with industrial agriculture. These findings are specific to the State of Ohio, but also raise much larger questions about which populations are experiencing more rapid rates of farm exit, and what implications these trends have for food security on a broader scale.

Introduction:

According to the USDA Agricultural Census, between the years 2007 – 2017 the U.S. witnessed a 7.4% decline in principal producers, a term used to describe day-to-day decision makers on agricultural operations (USDA, 2017). This trend isn't so much an irregularity as it is a representation of a phenomenon occurring across the globe; principal producers are disappearing from agricultural society faster than they can be replaced (World Bank, 2019). This study both recognizes and explores the importance of new entry sustainable principal producers, and further investigates what this population needs to do to successfully replace retiring principal producers. Using a mixed-methods approach my study looks closely at this phenomenon in the United States and specifically the case of the state of Ohio through two different lenses. First, I investigate relative changes in variables linked to principal producer populations through the creation of a series of maps using USDA Agricultural Census data. Second, to better understand what both these populations value I analyze results from a dozen semi-structured interviews with principal producers. Together these results paint a more detailed picture of agricultural society in Ohio and provide evidence of how principal producer populations have been changing on a national level.

The motivation for this study began with the USDA Agricultural Census report showing that between 2012 and 2017, only the largest and smallest types of operations grew in numbers (USDA, 2017). This finding reinforced the claim throughout the literature suggesting that two types of operations are going to persist in future agricultural systems, large scale production models, and small scale direct to consumer models (Park et al., 2014). Production based operations are often run by high business IQ producers who prioritize high yields, and the expansion of their acreage or operating space. Direct to consumer producers do more with less space, as their market advantage comes from local convince, and supplying nice products that might be harder to acquire. The success of both of these models has been evident in recent years, as yields continue to increase on a large scale and local food movements like the farm-to-table model have rooted themselves across all fifty states.

What's been less evident during the rise of the smallest and largest producers, is the loss of the mid-sized producers in-between. The rapid exit of this population of producers that have intimate knowledge of their methods and environment is surely damaging to the knowledge base of agricultural society as a whole if it's not passed down correctly. Historically this type of

knowledge has been passed down to the children of producers, however in 2020, the occupation of producer has become less appealing to the next generation, especially for immediate family as it's common that a retiring producer will want a better life for their children than the hard one they've experienced on the farm. This reality coupled with the rapid decline of mid-sized farm operators, causes one to wonder what our future agricultural system will look like, and how secure it will be without an abundant population of seasoned mid-sized principal producers.

The following study aims to explore the national trend of principal producer decline, specifically amongst the mid–sized operations, to see if these trends exist in Ohio, and to furthermore investigate on a more detailed level how specific variables or production types relate to changes that occurred over the decade 2007 – 2017.

Scope and Definitions:

This study recognizes the importance of new entry sustainable principal producers, by first unpacking the term. USDA describes the term *'producer'* as a person involved in making decisions on any farm classified by the North American Industry Classification System (USDA, 2017). The NAICS extends the reach of the operations by producers to include: greenhouses, nurseries, fruit & vegetable farms, livestock & ranch establishments, and more (USDA, 2017). The term '*principal producers*' captures the population of day-to-day decision makers on agricultural operations. This population was defined as *'primary operator,'* in the 2007 Agricultural Census, but translates to principal producer, as this population was defined in the 2017 Agricultural Census Report as respondents who answered that they were a primary operator or senior partner during the data collection process (USDA, 2017). In 2012, the Census was also expanded to include up to four operators including spouses or children of the Primary Operator. USDA & NASS, 2007). To ensure the 2007 and 2017 datasets were comparable, the value for 2007 principal producer was comprised of the top four operators captured by the 2007 Agricultural Census Report's operator demographics study (USDA NASS, 2007).

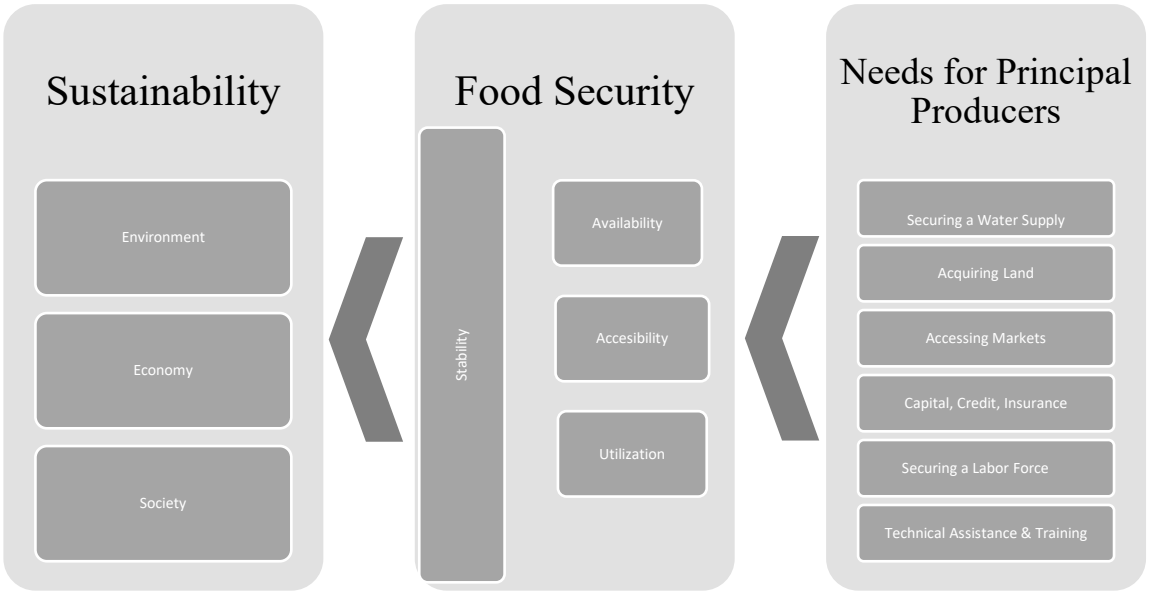
The term '*new entrant*' also needs defining, as this population does not just consist of young farmhands, but a variety of ages and demographics. In fact, the most recent USDA Agricultural Census showed that the average age of new and beginning farmers is 46 years old (USDA, 2017). For this study, new entrants are defined as a person who is interested in producing an agricultural product but has yet to establish a career in this domain yet (Carlisle et al., 2019).

Sustainability & Food Security:

Simply defining principal producers does little to relay their importance to agricultural society. The following aims to frame this population's impact as important components of both sustainability and food security. To understand the importance of principal producers and their relationship to sustainability, it's often easy to analyze this population in regard to the three pillars of sustainability, the economy, environment, and society (Purvis et al., 2019). Environmentally, new entry sustainable principal producers help cut pollution & biodiversity loss (Lee & van Sice, 2011). Socially, new sustainable principal producers help preserve traditional varietals and low input production methods (Rijal, 2010). Finally, in terms of the economy, new sustainable principal producers are needed to combat the continued deterioration of the rural economy, where nearly a quarter of children live in poverty (USDA, 2019).

While agricultural production has increased by 170% from 1948–2015, it is generally accepted that production alone is not enough to ensure food security. In fact, food security is still

an issue today, as over 11% of US households were food insecure at some point in 2018 (Ericksen, 2018). The ideas surrounding food security shifted after 1970 to prioritize more than just the production and availability of food, eventually shedding light on access and distributional inequities, and finally incorporating our nutritional utilization of food (Maxwell, 2001). These ideas eventually culminated at the 2009 World Summit on Food Security as the four pillars of food security: access, availability, utilization, and stability (Grainger, 2010). The pillars conceptualizing food security is reminiscent of the pillars for sustainability, and before long research emerged that drew lines between the two frameworks questioning if one can exist without the other (Berry et al., 2015). Berry et.al used the three pillars of sustainability and the four pillars of food security as a framework to guide the scope of his analysis. To further narrow the focus of this study, six need categories for new entry sustainable principal producers were also incorporated into the framework for this study. The identification of these needs come from (Carlisle et al., 2019) where the authors look closely at barriers new producers face in: *acquiring land, accessing markets, securing a water supply, securing a labor force, accessing capital, credit, & Insurance, and accessing technical assistance & training* (Carlisle et al., 2019). [Framework 1] below visually represents how the study is investigating the needs of new entry sustainable principal producers to both understand why they are failing to keep up with retiring principal producers, and what this means for sustainability and food security on a broader scale.



Framework 1: The conceptual framework depicting the relationship between the pillars of sustainability, food security and the needs for new entry sustainable principal producer (Berry et al., 2015).

Rationale for the choice of Ohio:

This research examines the needs of new entry sustainable principal producers in relation to the 7.4% decline in principal producers over the past decade (USDA, 2017). While the 7.4% decline represents a national trend, this research aims to take a more detailed look at a single state as a representative case study. The state of Ohio was chosen for a number of reasons, the first being a comparable trend of declining principal producer populations, where Ohio's 8.2% closely relates to the national 7.4% (USDA, 2017). Secondly the justification for Ohio is supported by the

number of farms incorporated in the study, where Ohio had the fourth most farms as of 2018 (Shahbandeh, 2018). Finally, as the author of this paper, my previous employment as a farmer in the state of Ohio provided access to a network of producers to be incorporated in the study.

Mixed Methodology:

To investigate the declining population of principal producers in Ohio, this research used a mixed methods approach with both quantitative and qualitative analyses. While this study only investigates a limited time period (between 2007 and 2017), a more complete consideration of large-scale patterns and processes was important to incorporate into the analysis to ensure robustness of the study. This study relied on both peer reviewed literature, and gray literature including stories from interview subjects to compile a relevant background section, however many important events may still be missing. The data was largely derived from what was available from the USDA Agricultural Census Reports, and which events were relative to the six need categories for new sustainable principal producers (Carlisle et al., 2019).

The quantitative analysis was based around reviewing publicly available data from both the 2007 & 2017 USDA Agricultural Census reports. While the Census is collected every 5 years, the ten-year window was selected to give a wider view of change in agricultural society while still maintaining a manageable dataset. In addition, data collected in this window show that beyond five years the number of farmers operating on a farm decline more rapidly, indicating that to more accurately capture this phenomenon the analysis needs to include the years where it is distinctly more challenging to hang onto a farm (Carlisle et al., 2019). Outside of a purely descriptive statistical analysis, some of the data from the 2007 & 2017 Agricultural Census report is represented at the beginning of each section through maps of Ohio's 88 counties. This study will also use run a series of OLS regressions to better understand the significance of variables surrounding the observed changes to principal producer populations.

The qualitative analysis section contains the results of a series of 12 semi-structured interviews with Ohio producers. The questions for the interviews were based around the six needs for new sustainable principal producers previously identified (Carlisle et al., 2019). The answers to the interview questions were coded on a scale of 1–10 to better understand which needs for new sustainable principal producers were most valued by Ohio producers. The scores from the interviews were added up to give each need category an average score and included in the analysis. The interviews also provided a multitude of narratives to better paint the picture of what has been changing for members of agrarian society in recent years. The combination of these approaches provided a more comprehensive dataset to analyze why principal producer populations are on the decline across the state of Ohio.

Background:

At the beginning of the 20th Century author Charles William Burkett described Ohio's agricultural history as "quiet with ever-increasing steps of progress" (Burkett, 1900). For Burkett, these steps of progress could be a reference to the successful draining of the State's Black Swamp for more productive cropland in the late 1800s (Kaatz, 1955). Burkett could also be referring to the budding corn and wheat belts that were well on their way to replacing the Northwestern Quarter of the State where the swamp once reigned. Many more steps of progress followed as farm production increased throughout the early century thanks to advancements in mechanized power.

The 1950s marked a significant step of progress as the green revolution was defined by the promise of increased production due to: mechanized farm equipment, higher yielding seed varieties, and chemical pesticides and fertilizers. This progress did not come at a cost however, as Secretary of Agriculture Earl Butz's call for farmers to, "get big or get out," put pressure on farm families to either adopt higher yielding commodity seeds and invest in expensive machines, or sell their farmland entirely (Berry, 1977). The high upfront costs of this transition for many farmers led to a number of loans being taken out for seeds, chemicals, and machinery. Loans for expanding agricultural operations at this time were widely considered to be a safe investment, however by the beginning of the 1980s a trade embargo, rapidly declining land values, and the raising of interest rates due to inflation sparked crisis in agricultural society, so much that national farm debt doubled between 1978–1984 (White, 2012).

In response to the 1980s Farm Crisis, a number of significant policies were enacted in the following years. The Federal Crop Insurance Act was created as an attempt to cover losses for farmers and remove risk for large scale producers (Pasour and Rucker, 2005). The 1990s also introduced the direct payment program and the rise of numerous global trade milestones like the North American Free Trade Agreement. As mass producers of corn, wheat, and soy, the new export opportunities and subsidy support greatly benefitted some Ohio Producers, however others found it more difficult to isolate themselves from the prices set by multinational companies (Carlisle et al., 2019). The corn belt continued to produce for the state until the 2012 North American Drought wiped out a quarter of the Belt's annual crop (Ortiz-Bobea et al., 2018). Literature suggests that the impact of the drought along with widespread criticism of the direct payment program led to the USDA to update its subsidy support system to insurance-based programs through the 2014 Farm Bill (Bruckner, 2016). The new subsidy programs Agricultural Risk Coverage (ARC) & Price Loss Coverage (PLC) supports farmers by covering their costs when revenue falls below a certain threshold (close to 86% of their historical yield) or if the price for a commodity falls below a predetermined level (O'Donoghue et al., 2016). These programs effectively reduced the risk of growing products covered under ARC & PLC; however, the distribution of these coverages continues to be disproportionately concentrated amongst the highest grossing operations in Ohio and across the Nation (Bekkerman et al., 2018, EWG, 2019). In addition, the value of these policies has become bid into land prices, further exacerbating the rate of concentration in rural society, and effectively building a stronger barrier for new entry sustainable producers. Each of the events touched on above relate to the six need categories for new entry sustainable principal producers. Throughout the following discussion sections, these events will be also factored into the analysis to better understand some of the changes being investigated.

Methods Detailed:

Upon close investigation, the challenge for new entry sustainable principal producers becomes clearer when one recognizes that the easiest way for this population to succeed currently is to grow as large as possible and specialize in a limited number of products covered by insurance. This pathway, in many ways, is antithetical to the core ethics of sustainable production, and does little to incentivize soil stewardship, diversified production, and the prioritization of supplying healthy and nutritious food (Guthman, 2000). Recognizing the disconnect between the values of new entry sustainable principal producers and the type of producer the current system tends to support is an important starting point for this study.

To better understand the challenges new entry sustainable principal producers face, the following sections will investigate in more depth how specific changes in agricultural society over the past decade relate to the observed trend of declining principal producers. Visual mapping of similar trends for this study was created in QGIS to analyze specific changes in principal producer populations. Each section will investigate USDA Agricultural Census data relating to one of the six needs for new entry sustainable principal producers (Carlisle et al., 2019). The pairing of need categories and specific datasets from both the 2007 & 2017 USDA Agricultural Census Reports are outlined in the Table 1 below:

Need Category	**USDA data for Ohio's 88 Counties [2007 & 2017]**
1.) Acquiring land	1.) change in $/per acre of agricultural land
2.) Access to Markets	2.) change in average net income per operation
3.) Securing a Water Supply	3.) change in the number of farms with irrigation
4.) Securing a Labor Force	4.) change in the number of hired workers
5.) Accessing Capital, Credit, & Insurance	5.) change in total acres with crop insurance
6.) Accessing Technical Assistance	6.) change in the value of machinery on the average farm in the county in $/per operation

Table 1: Need categories for new entry sustainable principal producers derived from the USDA Agricultural Census Reports of 88 counties in Ohio in 2007 & 2017

Each map will be compared to a map depicting the change in principal producer populations throughout Ohio between 2007- 2017. To begin, Figure 1 was created in QGIS to analyze where specific changes in principal producer populations occurred. The map below shows the percent change in principal producers from 2007 to 2017.

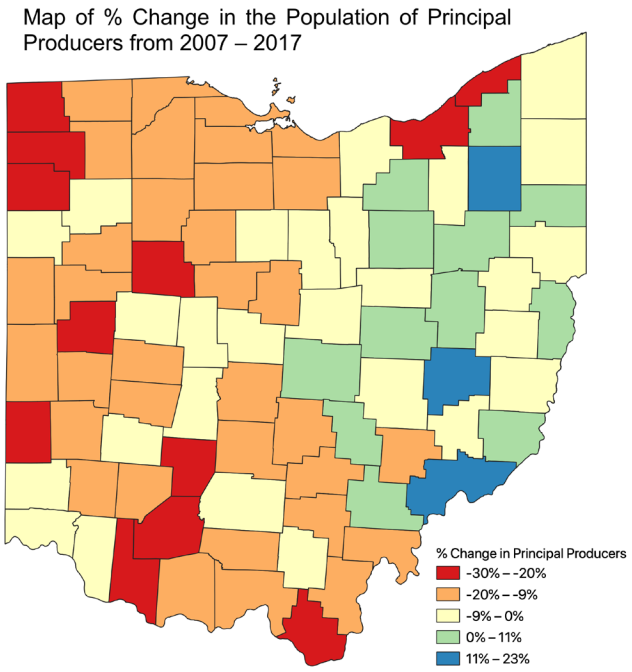


Figure 1: Percent change in Principal Producers
Data source: USDA Agricultural Census Report 2007 & 2017

Initial review, of the pattern represented in this map generates a number of questions, mostly revolving around the notion that the western half of Ohio and shows exclusively higher rates of farm exit while the eastern half show the opposite. The significant correlation initially made when this map was constructed was in regard to the spread of declining principal producer populations over the western half of the state, and the spread of the nation's corn, wheat, and soy belts over a similar territory (USDA, 2017). The counties included in these regions are typically home to operations that produce these crops at a larger scale, and thus share some defining characteristics in terms of acreage, equipment, and investments required. In addition, it is important to initially recognize that the western half of the state has more farmland in total, as the average operation west of Franklin County has over 70 more acres than a county on the eastern side (USDA, 2007 & 2017). The existence of this split in the state in terms of acreage of commodity crops, farm size, and principal producer populations will be a pattern that is examined throughout the next six discussion sections.

The following sections investigate recent changes in six elements that determine a new entry sustainable principal producer's success, but also look to provide evidence that specific types of operations may be at a greater risk of accelerated farm exit than others. This is important to understand if new entry sustainable principal producer populations are seen as a critical element of food security.

Results:

The results of the following sections provide evidence relating declining rates of principal producer populations with specific features consistent with industrial agriculture. Mapping USDA Agricultural Census data from 2007 to 2017 identifies the Western and specifically Northwestern Regions of Ohio as having the most significant rates of declining principal

producer populations. This trend runs parallel to equally significant surges in insured acres and funds spent on agricultural machinery in these regions over the course of the decade.

The results from the semi-structured targeted interviews show that all of the needs are fairly consistently valued amongst principal producers, with the exception of accessing insurance. By investigating insurance policies further, an array of priorities are identified amongst producers highlighting the challenge of providing widely accessible risk coverage in today's agricultural society. One of the surprising results from this study was the level of growth experienced by the smallest producers, especially in recent years. Although this study identifies numerous barriers from increased land prices to exclusion from crop insurance, operations between 1-9 acres saw the most consistent growth across the decade, show that new farmers are successfully entering the system as of late.

Acquiring Land

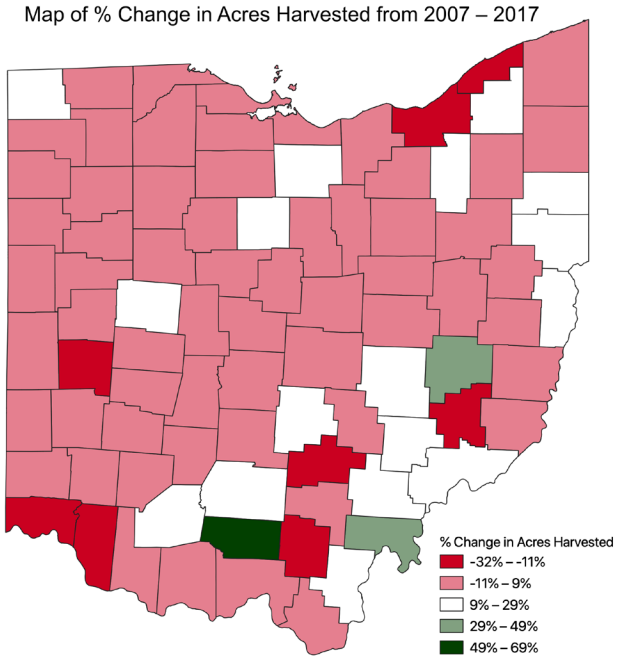


Figure 2: Percent change in acres harvested.
Data source: USDA Agricultural Census Report 2007 & 2017

To understand the importance of acquiring land for a new entry sustainable principal producer, the following section was organized to investigate if there was a possible correlation between declining principal producer populations and changes in acres harvested. Figure 2 provides little evidence of a significant split between the eastern and western sides of the state but does show widespread declines in acres harvested across nearly three quarters of the state as a whole.
To investigate further, this study looked closely at USDA Agricultural Census data categorizing operations by their size to identify if any specific types of operations are dropping off at a higher rate. Interpretation of these results are inherently challenging as it is difficult to track if a small operation is growing, or if a large operation is selling off pieces of its property. With this variable in mind the results show that mid-sized operations, between 50-499 acres experienced a nearly 20% decline over ten years (USDA, 2007 & 2017). Interestingly enough the smallest operations (1-9 acres & 10-49 acres) and the largest operations (2000+acres) experienced growth

in their numbers (USDA, 2007 & 2017) (Brown & Zulaf, 2019). This trend is consistent with national data confirming that in today's agricultural society, the operations that are successfully entering, surviving, and growing their operations exist at opposite ends of the size spectrum (USDA, 2012 & 2017). The success of the largest operators reinforces patterns of farm consolidation that date back to the green revolution. The level of growth experienced by the smallest operations, particularly the 1-9-acre operations where there's been a more than 30% increase over the decade, is one of the surprising results from this section (Brown & Zulaf, 2019). While interviews with representatives from small scale operations identified the recent optimism surrounding local, transparent, niche businesses as a possible driver of this trend, one of the major categories of new producers that went largely unacknowledged by this study were producers for subsistence production instead of the market. Over half of respondents interviewed in this study began their agricultural operation as a practice purely for subsistence production instead of market. This points to a common motivation amongst new entry principal producers, in that they prioritize their autonomy and ability to provide for themselves and their loved ones.

Accessing Markets

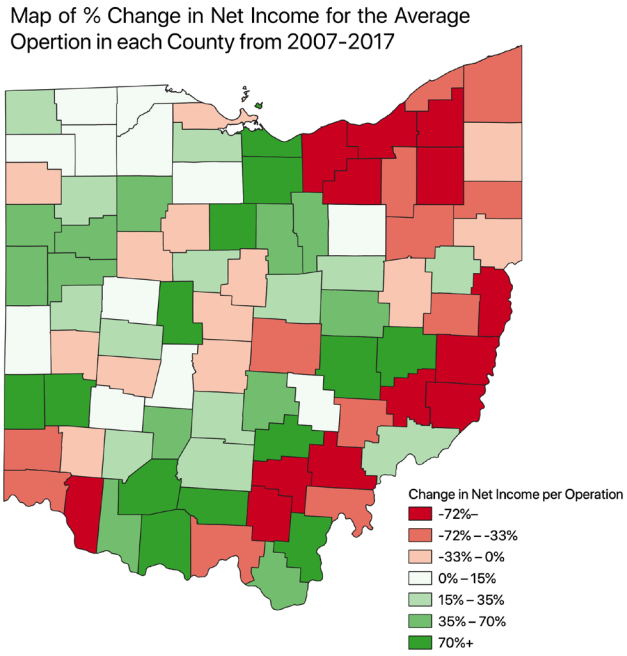


Figure 3: Percent change in net income for the average operation per county.
Data source: USDA Agricultural Census Report 2007 & 2017

To understand the importance of accessing markets for a new entry sustainable principal producer, the following section was organized to investigate changes in net income for the average operation per county. Investigating individual operations and their proximity to markets was considered for this study, however in the end, tracking net income proved to be a useful tool in understanding which counties were full of agricultural enterprises successfully engaging their markets, and which were experiencing widespread losses.

Cursory examination shows a split of countries in Figure 3 and appears to be present for this trend. However, it is important to keep in mind the range of factors that determine an operations net income, especially when you're looking at the average operation per county.

Counties with large urban environment like Cuyahoga and Brown and even regions like Appalachia in the southeastern corner of the State are easy to identify by their large declines in average net income. This, in many ways, is expected given the documented challenges of urban agriculture and producers living in low income regions of rural society (Mougeot, 2000; Stevens & Mallet, 2019). In the northeastern corner of the state another significant pattern shows up in the collection of counties that experienced the least changes in their net income over the decade (counties designated by the color white). The clustering of this level of income stability is not experienced anywhere else in the state and raises questions about the financial risk experienced by the operations in these counties over the decade. The stability is particularly interesting in light of the Nation's Corn Belt being heavily concentrated across these counties and the fact that this region was impacted by the 2012-13 North American Drought.

Securing a Water Supply

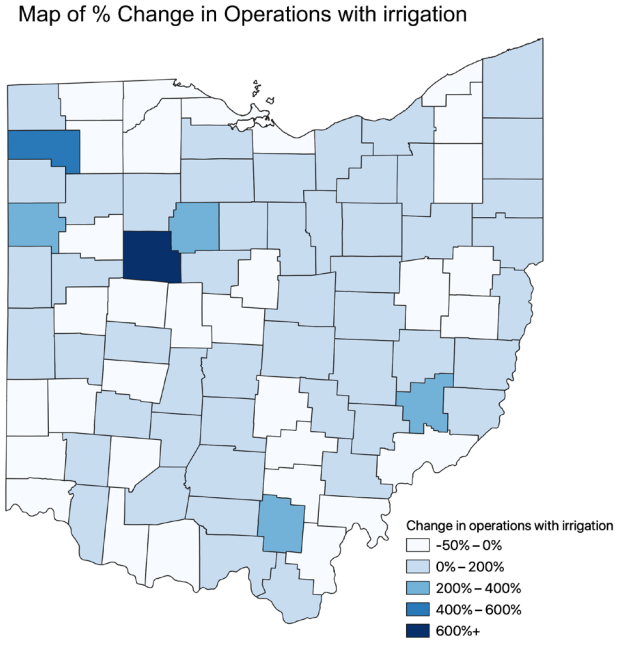


Figure 4: Percent change in operations with irrigation
Data source: USDA Agricultural Census Report 2007 & 2017

To understand the importance of securing a water supply for a new entry sustainable principal producer, the following section was organized to investigate percent changes in operations with irrigation. Finding a suitable dataset to investigate changes in water use by agricultural operations was difficult to compile in the time frame available for this study. Tracking changes in operations adopting irrigation was chosen due to its availability in the USDA Agricultural Census reports.

A cursory examination of Figure 4 offers little evidence of a split dividing the eastern and western counties. Over half of the counties in the State experienced an increase in operations with irrigation. The northwestern region once again catches the eye as it is home to four counties that saw more than a 200% increase in the number of operations that use irrigation. The high rates in this region relative to other regions throughout the State show that operators in the

northwest valued irrigation technology during this decade. This line of reasoning would once again make sense given the high concentration of corn and the estimated 22% statewide decline of corn yields despite a 13.4% increase in planted acreage from 2011 to 2012 due to the drought (Fuch et al., 2015). Literature suggests that warming conditions will continue to plague Midwestern commodity crop supplies, causing reason to believe that the drought may have been a wakeup call for producers who were hit hardest by and are consequently looking to prepare for a similar event in the future by investing in irrigation (Ortiz-Bobea et al., 2018).

When talking to producers about the 2012-13 North American Drought, many insisted that their operations were not as significantly impacted from water scarcity due to the fact that 2011 was the wettest year on record for the State. Producers even went as far as to say that while the warming conditions have been a challenge over the past decade, the year of the drought and a few other select years in the decade were harder on farmers due to extreme weather events, most commonly mentioned rain. After further investigating reports manufactured by the National Drought Mitigation Center, the findings from the interview process were confirmed as the most damaging event to occur for crop producers over the decade was the 2012 derecho on June 29th and the subsequent violent thunderstorms three days later. The combined impact of these weather events inflicted an estimated $1 billion dollars in damages across the State and is still today considered to be the third costliest insurance disaster in the State's history (Fuch et al., 2015).

Securing a Labor Force

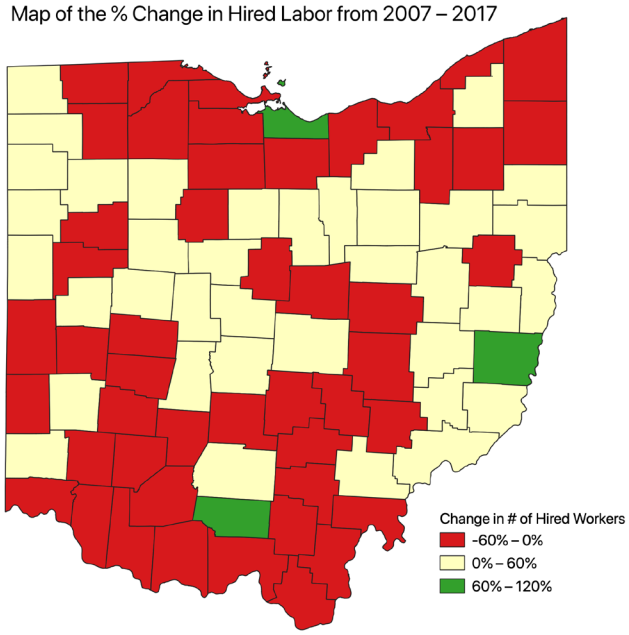


Figure 5: Percent change in the number of hired labor
Data source: USDA Agricultural Census Report 2007 & 2017

To understand the importance of securing a labor force for a new entry sustainable principal producer, the following section investigated changes in the population of hired laborers. When doing any study looking closely at hired work on U.S. agricultural operations it is important to recognize the presence of undocumented workers. While the USDA Agricultural Census is a critical tool for this analysis, its database does not capture the existence of undocumented workers, a significant drawback given that almost half (49%) of the hired labor in U.S.

Agriculture comes from undocumented workers (O'Brien et al., 2014). This challenge makes it hard to fully evaluate the map of Ohio given the chance that the current official data may only reveal incomplete evidence. It is also important to recognize that the national average may be skewed by states such as California and Texas that are massive producers and are geographically located close to the international borders. Still literature suggests that significant undocumented labor forces exist well and away from borders in most every state, especially in the agricultural fields (Grey, 2013).

A cursory examination of Figure 5 shows the split in the state does not seem apparent in terms of an east/west divide. There does seem to be significantly more counties that are experiencing declines in hired farm labor, however these results are far from conclusive given the reality that some counties may show declines in total hired labor where there is actually just a switch in dependence from documented to undocumented workers. While this scenario may exist only on few if any operations, the overall trend of declining hired agricultural employment has been a constant for much of the last century as advancements in chemistry, genetic engineering, and mechanization have strived to produce more with less labor (Berry, 1977). The increases in the nation's dependence on a foreign workforce is also a signal of the scarcity of hired labors for agricultural operations. The USDA witnessed H-2A visas, which grant foreign workers temporary access to the country to work as agricultural workers, quintuple from 2005 to 2018, equating to around 108,000 full year positions today (Wiener-Bronner, 2020). While this influx of temporary foreign workers on one hand might push domestic hired laborers out through competition, under closer examination, 75% of interview subjects included in this study would welcome skilled laborers and see them as essential to their operation, supporting the observation that hired work on agricultural operations still widely exist today. One of the most consistent themes in the literature as well as when talking to farmers is the challenges of recruiting American workers over the past decade, as many believe people do not want to do the physical work anymore.

Accessing Capital, Credit, and Insurance

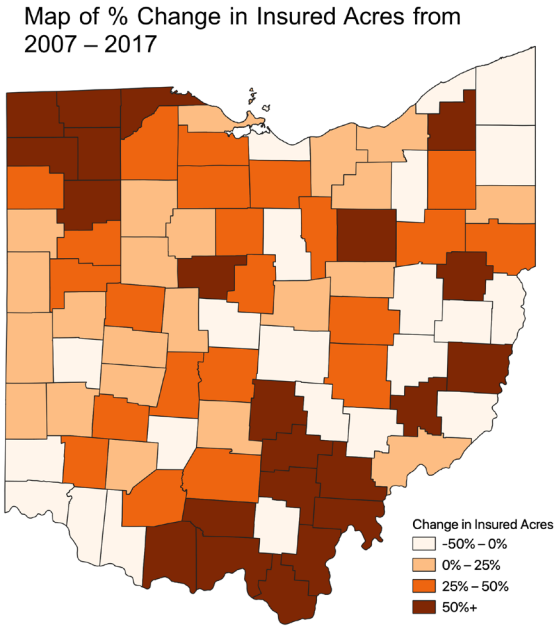


Figure 6: Percent change in insured acres
Data source: USDA Agricultural Census Report 2007 & 2017

To investigate the importance of accessing capital, credit, and insurance for a new entry sustainable principal producer, the following section investigates changes in acres insured during the 2007–2017 time frame. Changes in insured acres was chosen for this section due to the availability of this data category in both USDA Agricultural Census Reports, and partly due to the challenges of compiling a dataset to measure changes in capital and credit amongst individual operations. Literature also suggests that tracking insured acres over the past decade may be significant due to the recent changes in the national agricultural subsidy support system, especially in terms of crop insurance (Bruckner, 2016).

In the 2014 Farm Bill two new types of coverage were introduced for producers, Agricultural Risk Coverage (ARC) & Price Loss Coverage (PLC). These programs cover a portion of a farmer's losses when crop revenue falls below historical production averages, or if the price for a commodity falls below a pre-established level (O'Donoghue et al., 2016). These programs incentivize producers to expand their operation's acreage by reducing the risk of planting covered crops and ensuring them 86% of what they've historically earned, or a previously established amount based on the market, even if their crop fails or the price drops. This value was in turn bid into the price of land, causing the average cost of farmland to increase by 175% during this period (USDA 2007, 2017). Ohio producers responded with an increase of over 1.5 million insured acres over the decade.

A cursory examination of Figure 6 shows some evidence of a split in the state, where there appears to be a higher concentration of insured acres on the western side. The clustering of counties that had significant increases in insured acres are mostly centered around the Northwestern and Southcentral regions. When comparing the volume of new acres that were insured over the decade instead of the percent change, the northwestern region stands out as this region was home to an increase of over a half a million acres, or roughly one third of the new acres insured over the decade (USDA, 2007 & 2017). The concentration of insured acreage in this region begins to shed light on the previously identified levels of income stability observed in the northwest in Figure 3. The correlation between these two maps provides some evidence that counties with high levels of insured acres also experience less fluctuation in average net income. An additional finding of interest in the literature showed that this region was also home to a recent spike in foreign owned farmland. Paulding county alone, located in the Northwest on the Ohio-Indiana border is home to 41,000 acres of foreign owned farmland (Wilde, 2019). Ohio lacks any regulations concerning foreign purchases of farmland unlike some of its bordering states, which has led to a number of countries investing, most notably Germany, where investors have purchased over 71,000 acres of farmland across Ohio today (Wilde, 2019). Foreigners are not the only ones purchasing up agricultural land as nationally there has been an observed 14% increase in farmland owned by non-farmers in the past three decades (Zhang, W., A. Plastina, and W. Sawadgo, 2018). When you factor in the changes that have been made to crop insurance systems and the witnessed stability that ensued in the Northwest despite the damages caused by the drought and derecho during this time period, it starts to make sense that purchasing and funding an insured agricultural production has recently become a safe investment.

The widely recognized concern of increasing levels of farmland being owned by non-farmers is the disconnect from the land that is likely to exist as enrollment in crop insurance does not necessitate any form of environmental standard (O'Donoghue et al., 2016). While the common

belief is that non-farmers or foreign investors are bad neighbors or stewards of the land, literature suggests that in Ohio many German clients have established excellent reputations as gracious landlords, often allowing aging producers to live on their farms even after the land has been sold off (Wilde, 2019).

Technical Assistance & Training

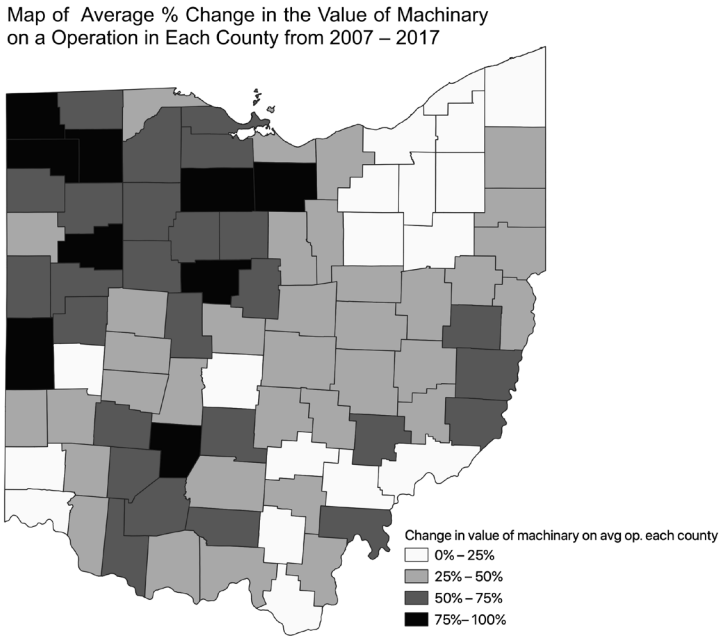


Figure 7: Percent change in average value of farm machinery per county
Data source: USDA Agricultural Census Report 2007 & 2017

To investigate the importance of technical assistance and training for a new entry sustainable principal producer, the following section investigates changes in the total value of machinery on the average operation in each county. A similar challenge arose for investigating this section as interviews with principal producers revealed that this population mostly relies on themselves or their local network for technical assistance and training. Tracking changes in this domain was difficult to do on a state-wide scale, so this section was organized around investigating which counties were investing more in equipment and machinery. A cursory examination of Figure 7 offers some evidence that a split in the state exists, as the Western side of Ohio experiences greater average increases in agricultural machinery. This conclusion's significance is diluted by the previously identified concentration of larger operations on the Western Half of the State. There is also once again a significant concentration in the Northwestern region, a result somewhat expected given what we know about the region in terms of the type of agriculture practiced and the necessity of high value equipment to produce at a large scale. Nonetheless one of the key findings from this study relates to the continued significance of the Northwest corner where we've previously identified significant levels of income stability, surges in insured acres, and now increases in farm machinery.

<u>Quantitative Analysis:</u>

The visual analysis from the mapping process presents an interesting view of agricultural society in Ohio over the past decade. By investigating the changes these maps represent and comparing them to the declining rate of principal producers, this study provides visual evidence linking declining principal producer populations to a number of trends represented in this study. Specifically, this study provided evidence correlating declining principal producer rates with increases in insured acreage, average value of farm machinery, and in some respects increases or stability in average net income. While the justification for these results are detailed in each discussion section, a further statistical analysis was used to frame the findings with more precision.

Regression Table 1 presents the results of a number of regressions relating the percentage change in principal producer populations (classified in this dataset as FRR "Farmer Replacement Rate") to the six variables used for this study, also represented in [Table 1]. Each of the variables included listed percentage changes from 2007 to 2017. Columns #1 through #6 present the results of six seperate regressions, one focused on each of the six need categories. Column 7 includes all the variables in a single model so that we can discuss conditional correlations between farmer replacement rate and each need category, holding constant the other variables.

Regression Table 1 *Principal Producer Populations compared to six need categories*

	#1	#2	#3	#4	#5	#6	#7
%Δ AcreHarvst.	0.203**	—	—	—	0.260***	—	0.330**
	(0.083)				(0.085)		(0.093)
%Δ Net Income	—	-0.017**	—	—	—	-0.011**	-0.022**
		(0.005)				(0.055)	(0.008)
%Δ Ops. IRRG	—	—	-0.001	—	—	—	-0.014**
			(0.003)				(0.006)
%Δ Hired Labor	—	—	—	0.092**	—	—	0.064*
				(0.039)			(0.038)
%Δ In. Acres	—	—	—	—	-0.045**	—	-0.030
					(0.021)		(0.023)
%Δ Avg $MECH	—	—	—	—	—	-0.192***.	-0.203***
						(0.046)	(0.050)
%Δ Operations	—	—	0.825***	—	—	—	—
			(0.027)				
R^2	.0653	.0817	.9158	.0489	.0888	.2274	.4778

Note: Standard errors in parenthesis
****/**/* Indicate significance at 1%, 5%, and 10% level*
REG 1: displays the results of an OLS regression run in STATA using USDA Agricultural Census data from 2007 & 2017.

When testing the need categories, each of the variables included for the six need categories tested as significant at either the 1%, 5%, or 10% levels, with the exception of the percent change in operations with irrigation. These findings are somewhat consistent with what could be observed in Figures 1 – 7. While each of the other five need categories provided evidence of a statistically significant relationship, the magnitudes of these changes are not all equal. For example, the change in the average value of machinery on an operation has close to 20 times the effect of the percentage change in hired labor or net income.

Column 7 presents the results of running a regression with all six of the variables chosen to represent each need category. The results of this model show that the estimated effects of each variable were larger when the other variables were controlled for. The changes in hired labor was the lone exception to the phenomenon, as the significance of this variable also slightly decreased when the full model was tested. The drop-off of insured acres as a significant variable is an interesting finding form this model, however column #5 shows that some of that significance might be soaked up by changes in acres harvested, as changes in insured acreage does show up as significant at the 5% level.

By running a series of regressions, we are able to identify the relative significance of each of the variables identified in this study. Regression Table 1 confirms some of the patterns that were visible through the previous figures 1 –7 and provides more precise evidence of the relationship between the changes in these variables and principal producer populations. The next section looks beyond statistics to better understand this topic from Principal Producers firsthand.

Qualitative Analysis:

The qualitative analysis was organized around the semi-structured interview process, in which 12 principal producers answered a series of questions coded for similar answers (questions located in Appendix A. One of the key results from the targeted interview process was a ranking of the needs for new entry sustainable principal producers. A specific set of questions asked participants to provide a score on a Likert scale with 1 (being the lowest) to 10 (being the highest) indicating the level that they value each of the six needs. The scores from the 12 interviews are averaged and displayed in Table 2:

Need Category:	**Average Score: (1-10)**
1.Acquiring Land	8.8
2.Accessing Markets	7.9
3. Securing a Water Supply	8.5
4. Acquiring a Labor Force	8.1
5.Accessing Capital, Credit, Insurance	4.9
6. Technical Assistance & Training	7.1

Table 2: displays the average score from 12 interviews with Principal Producers. Subjects were asked to provide a score from 1 to 10 indicating how important each need category was for them.

While the ranking of the need categories is an interesting finding from this sample, the outlier in this dataset (accessing capital, credit, and insurance) reveals much more. There was a general consensus amongst participants that any new entry to agriculture would benefit from the inheritance of capital like land, equipment, or infrastructure. For those less fortunate, it was also widely agreed that good credit is essential to taking out a loan to cover some of the step startup costs required with any production. When talking about insurance, there was less of a consensus around its importance for smaller operations. Looking back at the interview data the score of 4.9

in this section is mainly a reflection of this category being valued by mostly by just the larger producers. When asked about crop insurance, one small-scale Producer can be quoted saying:

> "I don't know if I'm big enough to qualify for crop insurance, and I'm not sure that it makes sense for my size of operation if I was. It would probably just end up being another cost, rather than good thing for me personally."

Under closer examination of the enrollment process for crop insurance programs ARC & PLC, it is true that operations smaller than 10 acres do not qualify (O'Donoghue et al., 2016). Furthermore, this quote reveals the existence of a perceived financial barrier that prevents small-scale producers from considering insurance even if it was available. These barriers alone mark a massive distinction between the risks faced by large scale producers and those face by small-scale producers. The same farmer who is quoted above revealed throughout the interview process that over the past year, increasingly challenging weather conditions wiped out over 50% of their operations crop. This reality is by no means isolated, as over half of respondents listed some aspect of the weather as the worst and most challenging part of being a producer. One principal producer sums up the risks small-scale operations face explaining that:

> "One bad season can put you under, sometimes financially, but sometimes it's just the mental burden of seeing all your hard work destroyed by something out of your control, like too much rain, or an early frost."

The level of risk faced by the smallest producers is one of the reoccurring findings throughout this research. This study shows that despite the challenges of higher land prices, increasingly frequent extreme weather events, and lesser access to protection from those events, small scale operations (between 1-49 acres) experienced the most growth over the decade, specifically the smallest operations (1-9) where there was a 52% increase between 2012 and 2017 (USDA, 2017 & 2012).

Many factors may have been identified as the cause of this surge, including the USDA's establishment of the Beginning Farmer's and Rancher's Program in 2012. This program created a number of incentives for new and retiring producers, including changes to insurance access for new entry producers. The Federal Crop Insurance Act was expanded under this program to cover a Farmer or Rancher who has no more than 5 years of experience (Williamson, 2014) (USDA, 2014). While adding beginning farmers and ranchers to the Federal Insurance Act expanded the access to this form of coverage, it did not waive the 10-acre restriction necessitating new producers to grow quickly if they want coverage. To receive crop insurance, you also need to produce crops covered by the insurance policies, leaving specialized producers and operations who prioritize varietal diversity less access. The 2014 Farm Bill looked to alleviate this concern by expanding the type of crops covered through the Federal Crop Insurance Act to include a variety of specialty crops. This definition covers 400 agricultural commodities where there are now varying levels of coverage available (Williamson, 2014). While expanded coverage meant less risk for specialized producers, literature suggests that some niche producers opposed specialized coverage due to its effect on the market (i.e. if an insurance policy reduces the risk of producing a specialized product, more farmers will be incentivized to produce specialized products driving down prices and the revenue received by niche operations). This reality sheds

light on how unique the priorities are of different agricultural operations, and how complicated it is to craft effective legislation for everyone.

Limitations:

The unfortunate reality of any study is that there are limitations to any research process. This study would have benefitted form a wider selection of data to incorporate into the analysis. The pairing of the need categories with data sets was limited by what could be obtained solely through the USDA Agricultural Census. Representing each of those need categories more accurately with a more expansive dataset would have allowed for a more robust statistical analysis. In a similar manner, expanding the analysis to incorporate a larger time series would have benefitted this study, allowing the investigation of these changes over multiple decades.

The interview process would have benefitted from a larger sample of Principal Producers. Ideally 25+ participants would have allowed the findings from this part of the study to hold more weight analytically. In total if this study were to be recreated or expanded, it would benefit from a more rigorous sampling to ensure a wide range of producers were represented from a variety of geographical locations. Finally, in tune with the theme of this study, a more thorough investigation of the population of principal producers working on mid-sized operations would have allowed this study to hone-in on the some of the big questions being investigated. Further work on this subject would benefit from an in-depth investigation of how these need categories are prioritized by the Principal Producers exiting the system most rapidly.

Conclusion:

During the targeted interview process I asked 12 different principal producers what they need most to be successful, and somewhat surprisingly I got 12 different responses. This recognition is not meant to explore a dozen more themes, but to show how difficult it is to pin down what principal producers' value and what it is they need to be successful. This paper aimed to examine why principal producers are disappearing across Ohio by investigating the needs of this population through literature, data, and interviews. By mapping relevant changes between 2007 & 2017 using USDA Agricultural Census data, this research provided visual evidence linking declining rates of principal producer populations with specific features consistent with industrial agriculture. Specifically, this study confirmed that the western half of the state, a region exclusively dominated by counties experiencing declines in principal producer populations, was also home to bigger farms, higher yields of commodity crops, and a surges in both crop insurance and the average value of machinery on an agricultural operation over the past decade.

The interview process revealed that on average, smaller producers did not value crop insurance as much as larger producers did, due to a variety of reasons including the exclusion of an enrollment option for operations under 10 acres. A consistent result throughout this study found that despite the barriers of higher land prices, exclusion from crop insurance, and increasingly frequent extreme weather events, producers who operate on farms smaller than 10 acres are still establishing themselves in agricultural society, and rapidly at that, over the past five years. This reality in many ways reflects the national trend of only the largest and smallest operations growing, while mid-sized farms continue to drop out. The challenge of this type of system boils down to the process of crafting effective legislation to meet both the needs of large industrial agricultural operations and small niche operations. This study sheds light on some of the recent efforts made to support both small–and large-scale producers, through the Beginning Farmer and Rancher Program and the USDA crop insurance programs ARC & PLC.

While it is important to recognize progress being made, it is also hard to ignore all that is lost with the continued decline of principal producer populations. Farmland has witnessed widespread prioritization in recent years, with land prices increasing, investment from non-farmers and foreign owners, and incentive structures supporting efforts to expand covered acreage. By observing the decline in principal producer populations, it is hard to blame producers for taking advantage of a favorable market, especially given the reoccurring theme of retiring farm owners struggling to pass down their land to their children. While this widespread trend could be seen as a necessary thinning of least efficient operations of agricultural societies, this population's value extends well beyond its yields. The farm decision makers have their finger on the pulse of our food system, and when you reduce this population, you lose some of the production diversity that is so critical to both sustainability and food security. You also lose the regionally specific information that is earned by principal producers, who admittedly have improved their production process by learning from their mistakes and their environment over the many years they have been operating. These attributes that principal producers provide are not easily measured like increases in yields nor net income, but they are just as important to new entry sustainable principal producers. This reality raises the question of which pathway leads to a more sustainable and food secure system: investing in farmland or farmers?

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Appendix A:

Date:_____ Interviewee Name:_____
Interviewee reference contact info:_____

Introduction Questions:
Tell Me about your farm, profession, or agricultural work?
Why are you interested in agriculture?
Who got you into Agriculture?
Where do you see your farm or the farms you work with in 5 or 10 years?
What's the best part of your job/ what's the worst?
What's your biggest challenge in the agricultural field today?
What's the most important thing a Farmer needs to be successful today?

Conditional Questions:
If you don't own farmland, how do you produce?
If you do produce, how?
What is the biggest barrier keeping you from producing more if desired?
Are there other products that you'd like to produce, is there anything keeping you from producing _____?
Would you like to produce more varieties of what you produce now?
Are there barriers that prevent you from producing certain ways that you'd like to? (Organic certification, chemical free, as an example)
If you are a retiring Producer, who is going to fill your shoes?
Why do you believe farm decision makers are disappearing?

Need #1: Acquiring Land:
How did you acquire the land you farm on? / Where do you produce?
Do you have plans for expansion?
If you're not looking to expand, why not?
What are your plans for your land when you retire from farming?
Are there any new products you are looking to produce?
If you were a new farmer, on a scale from 1 to 10 how important do you think acquiring land is?
1 2 3 4 5 6 7 8 9 10

Need #2: Accessing Markets:
What's the main way you buy or sell fresh produce?
Why do you continue to engage with the agricultural community?
Are there any barriers that prevent you from accessing markets to buy or sell fresh produce?
If you were a new farmer, on a scale from 1 to 10 how important do you think it is to access markets for your products to succeed?
1 2 3 4 5 6 7 8 9 10

Need #3: Securing a Water Supply:
If you produce food, how do you get your water?
Have you always gotten your water this way?
Has this source been reliable?
Does securing a water supply play an important role for your production process? If so please describe
How does cost influence your choices when it comes to water?
If you were a new farmer, on a scale from 1 to 10 how important do you think it is to secure a reliable water supply?
1 2 3 4 5 6 7 8 9 10

Need #4: Securing a Labor Force:
Do you work alone, rely on family & friend labor, or do you have a hired labor force?
How long have you worked this way?
How important to your production is it that you acquire a labor force?
Is the work highly seasonal or are there down times every year?
Do you have off the farm employment in the down times?
If you were a new farmer, on a scale from 1 to 10 how important do you think it is to secure a labor force?
1 2 3 4 5 6 7 8 9 10

Need #5: Accessing Capital, Credit, and Insurance:
Do you enroll in crop insurance of any kind?
Have you ever enrolled in a program with the USDA or FCA?
If so, describe how you feel the program benefitted your production process?
If not, do you feel like there are programs that support producers in your position?
Have you ever taken out a loan for your agricultural business?
If so, Do you feel that it was a good loan? Please describe more if comfortable…
If you were a new farmer, on a scale from 1 to 10 how important do you think it is to access capital, credit, and insurance?
1 2 3 4 5 6 7 8 9 10

Need #6: Accessing Technical Assistance and Training:
When something goes wrong in your production process, how do you fix it?
Is there anyone specifically you rely on for technical assistance?
How did you learn how to do your job to the level you perform it at now?
How would you go about passing on your knowledge?
Do you find it easy to receive agricultural training or assistance?
How would you be most receptive to learning new agricultural information?
If you were a new farmer, on a scale from 1 to 10 how important do you think it is to access technical assistance and training
1 2 3 4 5 6 7 8 9 10