COMPARATIVE ANALYSIS OF RISK PROPENSITY, RISK PERCEPTIONS, AND CROP PRODUCTION METHODS OF SOUTH AMERICA AND THE UNITED STATES

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COMPARATIVE ANALYSIS OF RISK PROPENSITY,

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METHODS OF SOUTH AMERICA AND

THE UNITED STATES

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Growing up working on our family farming operation, the value of hard work and compassion were instilled in me at a very early age. I wish to thank my father for helping to instill this work ethic within me. I wish to thank my mother for giving me her sense of compassion towards others. I would also like to thank my step-father for the numerous lessons he has taught me. I am truly blessed to have these great people in my life.

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"I can do all things through Christ who strengthens me." Philippians 4:13

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Abstract: The purpose of this paper was to review the various, unique risk management styles and practices utilized by farmers in Northwestern Peru. Specific focus was given to better understanding risk propensity and tolerance of farmers in this area. Farmers were given a survey containing basic questions that would reflect their personal levels of risk tolerance as well as share information about their farming operation. Focus was additional placed on analyzing risk perceptions or farmer perceived risk. Perceived risk was broken into three separate sub-categories for further analysis. Risk propensity findings showed that there is a relationship between age, risk tolerance, and profitability per hectare. Findings on risk perceptions or perceived risk showed that farmers evaluate different factors prior to making management decisions, however the factors evaluated by farmers are likely to be different or have different levels of importance in each area. Crop production methods were segmented into six areas: pre-plant, vegetative management, harvest, post-harvest, timeframe, and risk management. Findings for the analysis showed that farmers base their management practices largely off of cultural factors or pre-existing knowledge. Due to this, unless farmers are introduced and educated to new agricultural technology to utilize, they will likely maintain their existing growing and farming practices. Technology plays a significant role in influencing farmer risk propensity and as farmers utilize higher levels of technology, they will often have varying levels of risk propensity. A similar linkage exists with age and risk tolerance.

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CHAPTER I

INTRODUCTION

1.1 Background

The opportunity to travel internationally and work with farmers is a truly once in a lifetime opportunity, especially for an Iowan farm boy. With the help of funding provided by the Don and Cathey Humphrey's long-term travel grant and guidance of Regent's Professor and Master's of International Agriculture Program - Director, Dr. Shida Henneberry, an opportunity was actualized. The process began by meeting with individuals who were well experienced with this region of Northwestern Peru, Ed Gallegos and Jay Albright, and gather what I could from their experiences. Albright and Gallegos had dedicated both their time and money to helping improve the quality of life for people in this area, especially farmers, and were interested in providing direction for my proposed internship. A committee of Albright, Gallegos, and others who were familiar with the area was assembled and created numerous proposed improvements for the Piura region. The Piura region contained many farmers and a plan was created to work to improve management style, which in turn would increase profitability. The plan featured an in-depth planning process and the hope that farmers could gain maximum benefit from forming a farmer's cooperative. During my time in Peru, the main focus was to work towards creation of a cooperative and share with farmers the benefits, such as: being able to purchase inputs of seed, chemical, and fertilizer for a lower price per unit. Depending on the level of adoption and success, other benefits were that farmers would be able to sell their crops together in local markets or reach new export markets to receive a higher price than if the crops were sold by small operations.

Preparation for this required a high level of proficiency in speaking Spanish and an understanding of Peruvian legal structure in order to better navigate any obstacles that may arise. Following arrival in Peru, the utilization of grapevine networking was incredibly important in order to better understand the more specific terms of the local culture. In the initial first two weeks of cultural submersion, with the help of a local lawyer and economist, the necessary steps to form a cooperative were significantly clarified. The lawyer provided additional insight on the Peruvian legal system and explained government structure, level of efficiency, and future steps necessary for future framework of the cooperative. The economist had worked closely with different groups to create cooperatives and traveled frequently. Due to his limited schedule, there was little free time and he was briefly able to share his insights for what additional resources were needed in order to begin forming a farmer cooperative. He was also so kind as to share various documents that helped provide instruction and further explain the technical process of forming a cooperative.

With these new focuses in the front of my mind, I worked each day to secure additional perspective from the farmers in the area on forming a cooperative. During interactions with farmers their thoughts and perspective on future crops such as new higher yielding varieties of corn and fruit production such as table grapes and papaya, were revealed. They were largely opposed to these new production methods, however, interested in learning more. Farmers were given a survey and answered basic personal questions and about their respected operation. In addition to more basic questions, farmers were also asked unique probing questions which eluded to their level of risk tolerance as well as how they handle risk.

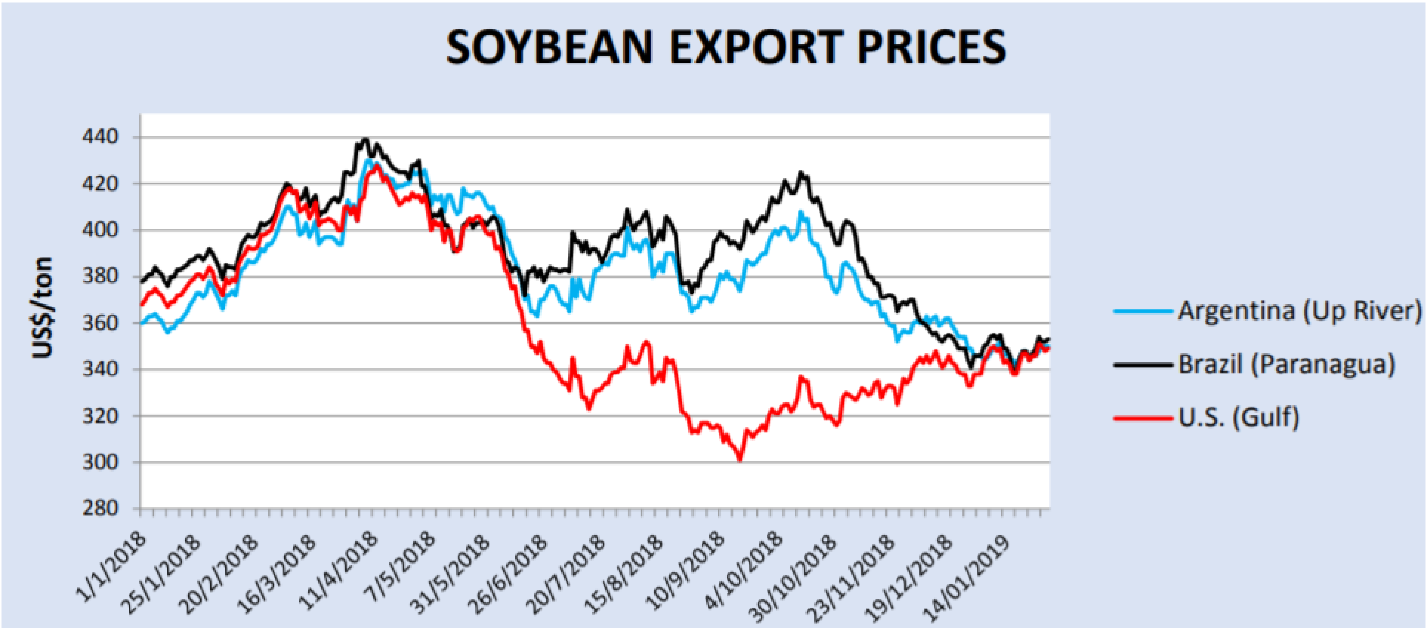
After conducting multiple farmer interviews, there was enough information to form a trend that reflected an interest in increased corn production in the area. Through collaboration with a local seed dealer an opportunity was created and tests were planned to introduce a new higher yielding corn variety to the local farmers. Understanding that farmers often need to learn through doing, it was soon realized that the best way to showcase this newer variety was through securing a field or two and planting these newer varieties. After evaluating all of the options present, it was decided that a formal meeting was necessary with the President of a local micro-loan program called, Familia A Familia.

Familia A Familia is a program that works with a large and well-known church in the area, Santisimo Sacrament Parish. The micro-loan program regularly offered low interest loans to farmers in the area. If farmers were unable to pay back their loan amount it was not uncommon for the church to rent their land from them and hire the farmers to perform labor in exchange for debt forgiveness. During the discussion it was brought up that there were several farmers who had difficulty in repaying their loan amounts and would have land eligible to be rented by the church. Shortly thereafter, the idea of planting a new high yielding corn variety was introduced and the President was very in favor of it. After receiving approval, it was time to move forward with arranging the purchase of fertilizer, seed, and other inputs necessary to produce a high yielding crop. After purchasing all of the supplies necessary, with help of the local agricultural engineer and colleague, Alex Jost, we calculated the appropriate fertilizer rates necessary to meet the crop micro-nutrient needs and applied the granular fertilizer to the soil prior to the field being flood irrigated. Once the field was then flood irrigated it would then be lightly disked in order to be ready for the seed to be planted shortly after. Unfortunately, the corn was planted shortly after my international experience, however, the crop is doing well and farmers in the area are grateful for the additional information they were able to gather from the experimental newer varieties.

Looking at the bigger picture of there are many factors that are evaluated prior to planting in South America, with climate being one of the most critical factors across the region, dependence on water is another factor that largely dictates what crops will be planted when and where. According to Riveros Salcedo (2019), areas in Northwestern Peru will receive on average only 150 millimeters (5.91 inches) of rainfall annually; whereas other areas near the Andes would receive over 710 millimeters annually (28 inches) and mirror the normal precipitation of Cordoba, Argentina (743 millimeters/29.25 inches) or certain parts of Brazil (Rainfall in Cordoba, 2019).

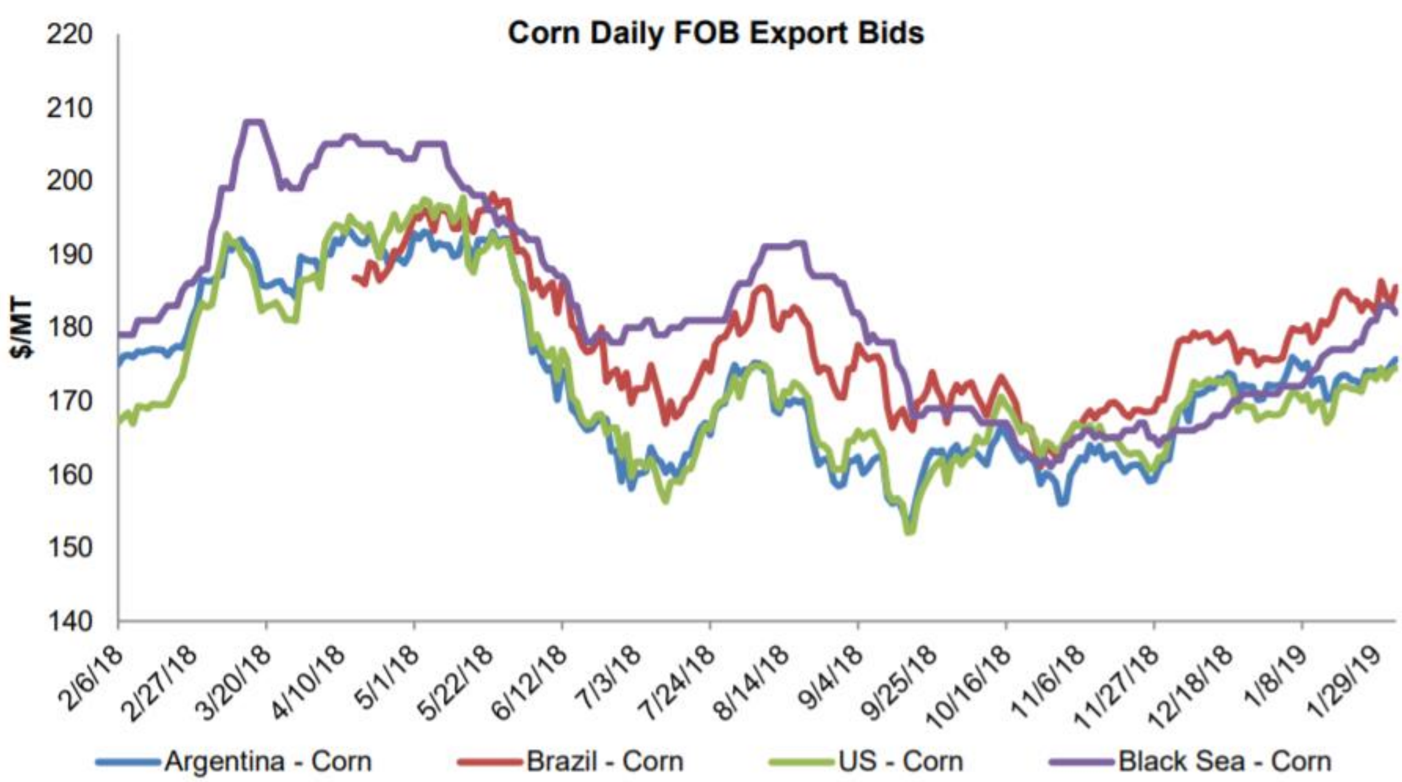
Apart from these climatic factors that are evaluated, there is also another set of factors that farmers evaluate prior to planting, market prices. Figures 1.1 and 1.2 are examples of corn and soybean freight onboard export bids for Argentina, Brazil, United States, and the Black Sea region. Relating the price information to Peruvian farmers, with the current approximate price of Peruvian corn ranging from 30S/ to 50S/ per quintal, this would convert to approximately 179.66$/ton to 299.43$/ton.

Figure 1.1 Soybean Export Prices in Port



Source: United States Department of Agriculture, Foreign Agricultural Services, 2019

Figure 1.2 Daily Freight-On Board Export Bids in Port



Source: United States Department of Agriculture, Foreign Agricultural Services, 2019

These are examples of developed markets; export FOB bids are published through the USDA's Foreign Agriculture Service (FAS) Reports or other various reports for only major exporting markets. Few countries with developing markets have price information be released because of the lack of infrastructural development in the market, lack of production, lack of demand, or other factors that ultimately prevent these emerging markets from receiving the attention necessary to be recognized as a supplier for more than local demand.

According to Minot and Vargas, 2007, countries where marketing techniques are not highly utilized or encouraged result in farmers marketing their grain when prices have been past the seasonal high. Looking at the United States, the grain marketing period occurs primarily during the harvest season, this is consistent with Argentina, Brazil, and Peru as well, for most commodities that have not been priced in advance. Carter, 2012, references that there are several different tools that can be utilized to secure a price in advance and reveals that the option of pricing grain and other agricultural commodities is a true advantage that can only occur with two main things:

1) a developed market that can forecast an expected price, and
2) a written contract between buyer and seller that is legally notarized and enforceable.

With both of these present, farmers in the United States are able to take advantage of guaranteeing themselves an expected harvest price by marketing their grain or commodity in advance. These guarantees are known as forward contracts and require that farmers deliver a specified amount of the commodity within a specified timeframe; in exchange, the buyer will pay the agreed upon amount on the specified amount of commodity. Farmers in South American may not have the opportunity to take advantage of similar agreements, as use of contract agreements, even when notarized are not always honored by the purchaser. This in turn leaves the farmer open to much of the price risk that will be incurred during the growing season. For most areas, it is common that the expected price, which given a normal year of production, is typically at its lowest point during harvest. Therefore, by purchasers backing out of agreements to purchase the commodity, it significantly hurts the farmer's bottom line, as it reduces the expected revenue. With the use of forwarding contracting and other futures and options, the United States has emerged as a world leader in price risk mitigation. Looking at developing regions in South America, there is very little that farmers can do to mitigate risk, especially price risk that farmers may experience during the growing and harvesting seasons.

Breaking risk down into different areas that can be analyzed: risk propensity and risk perceptions (or perceived risk), serve as two main areas of emphasis that can help better explain how farmers will react under certain conditions when risk affiliated factors are present.

Section 1.2 Introduction to Risk Propensity

The IGI Global definition of risk propensity is the extent to which a person is willing to take a chance with respect to possible loss (IGI Global, 2019). Persons who are "risk averse" have a low risk propensity; people who are "risk takers" have a high-risk propensity. By understanding this definition of risk propensity, we can better understand what someone, a group of people, a community of people, region, state, or even country may be likely to do when faced with a high level of risk.

Looking at risk perception, which is similar to perceived risk, is defined as beliefs about potential harm or the possibility of a loss. It is a subjective judgment that people make about the characteristics and severity of a risk (Springer Link, 2019). Perceived risk has several components, those being perceived likelihood, perceived susceptibility, and perceived severity (Darker, 2013). These three areas are the main factors that play a large role in the decision making for most farmers and will dictate what action, or lack therefore of, will occur. In this paper there will be several comparisons and light contrasts of Peru, which features low levels of technology adaption in agriculture, Argentina and Brazil, moderate to high levels of technology adaption in agriculture, and the United States, a high level of technology in agriculture.

For purpose of this section, the phrase, technology adaption, recognizes and takes into consideration that all farmers within these respected countries will not utilize agricultural technology equally, rather that there are varying levels of technology available for agricultural use.

The variances across the individual and average levels of technology usage will be significant and most profound in certain areas that utilize little technology compared to areas that are technology driver. Northwestern Peru, compared to other more technologically developed areas in South America, show that there are significant differences in the amounts of technologies utilized. Farmers may not always have access to technology and may utilize very little technologies while others are much more technologically advanced. Given these significant differences in technology utilization, it is not uncommon for that the producers who utilize more technology to manage price and yield risk, have a higher risk tolerance due to the fact that these technologies are being utilized. When price risk management tools are available for farmers to utilize, as a whole, these groups of farmers are more likely to have a higher level of risk propensity due to the fact that they are able to access and utilize more information, especially price information. This additional access to information helps farmers in these areas to ensure that they can be more informed when making a management decision based on this additional information. In a similar sense when there are specific perceived risks, it is expected they will vary from farmer to farmer and region to region. If there is a strong opportunity for farmers to take advantage of technology present, they will likely do so; this will result in a reduction in perceived risk and ultimately increase their risk propensity, resulting in more confidence during the decision-making process and higher expected levels of return.

1.3 Introduction to Risk Perception and Perceived Risk

Shifting to the different components within perceived risk: perceived likelihood, perceived susceptibility, and perceived severity, each is uniquely defined and looks at its own specific portion of perceived risk.

Perceived likelihood considers the likelihood of a particular event occurring. Perceived likelihood for most farmers varies significantly and perceptions formed are based off of many different factors. Farmers may observe an upcoming weather event and see it as a significant indicator of a set of particular conditions, whereas, another farmer may view it as just the opposite.

Perceived susceptibility considers that, if an event were to occur, how would the object, crop, or profit be impacted by whatever factor that changes the original: value, yield, or amount, etc. Looking at perceived susceptibility with specific focus to agriculture, there are specific factors that farmers evaluate when analyzing their crop's susceptibility to factors that will impact yield and profitability.

Lastly, perceived severity is the degree of damage that is expected to occur. It is the final component of perceived risk and level of severity can vary significantly, largely based off of the previous factors of perceived likelihood and perceived susceptibility.

Examples of how these three components are taken into consideration by farmers vary by management style, however, it is expected that there will be some form of risk protection utilized by farmers in attempts to protect yield and value.

The factors that could impact yield during any given crop year are: temperature, rainfall, storm events, consisting of hail and wind damage, insects, disease, and weed pressure. These factors all can impact yield significantly during the growing season, however, most farmers in the analyzed areas plan accordingly to ensure that their crop's risk exposure and likelihood of becoming susceptible is as low as possible. Of the six factors listed above, it is commonly seen that these factors will be factors that farmers take into consideration prior to making a management decision with a focus on risk management. In addition to yield risk, there is a fair amount of price risk as well; in developing markets it is common that forward contracts are not in place. This means that there is no way to guarantee a set amount of grain for a guaranteed price, this leaves farmers open to all of the price risk that may occur. Even in markets that are more developed, there is a strong likelihood that prices prior to planting will be higher than the expected harvest price. Alternatively, there is a chance that crop yields will be less than expected and a belief that market prices could increase exists. It is often because of this belief that there is much grain that remains unsold until it reaches the farmers end destination. Due to the fact that farmers do not price all of their harvested grain in advance there is a high level of high risk that exists even in countries that feature more developed markets and financial risk management tools available.

It is often the case that farmers will focus on yield and price risk, for example farmers who believe their crop will be highly susceptible to insect damage during the growing season will likely purchase a variety of crop that has specific traits to help combat insects, spray an insecticide on their crop, or perhaps do both. By utilizing these management practices, farmers are protecting their crop's yield potential by eliminating possible negative impacts caused by insects. In addition, it is common for farmers across South America and the United States to spray their crops with various types of herbicide, insecticide, and fungicide.

1.4 Introduction to Crop Production Methods

The final the section focuses on crop production methods utilized in the different analyzed countries, it can be said that in order to truly understand a farmer's risk management strategy, one of the most important factors you can look at are the crop production practices and methods behind their operation. By having a complete understanding of one's production methods, it is easier to identify areas in which the respected farmers can work to improve their operation, ultimately helping them become more profitable.

Crop production methods are forms of management of an operation consisting primarily of: pre-planting, vegetative management, harvest, and post-harvest before repeating for the following crop. Of these four different segments, there is not one that is more important than the others, however, the individual processes that overlap across over these periods are perhaps most important. These consist of nutrient management, risk management, and marketing. These vary significantly from country to country and sometimes vary significantly based on an inter-regional basis.

By breaking the crop year into four different and unique stages we are better able to discuss the variations that occur from country to country and even across the equator. To begin to summarize the findings of the paper; many of the factors that farmers evaluate have overlapping characteristics, or perhaps are even the same. Factors that are evaluated prior to plating, during growth, during harvest, and following may not be given the same level of importance in each respected country, however, overall are all very important.

Looking at the pre-plant strategies utilized in Peruvian agriculture, from my experiences in working with farmers in the Northwestern part of the country, where canals provide the majority of water, as the average rainfall amount is approximately five inches, not nearly enough to sustain adequate crop growth and development. The preparation of the canals is one of the first things can farmers must to in order to prepare their field prior to planting. Farmers must remove all excessive vegetative matter than has grown in the canal floor and sidewalls since last flooding. Once the main canal is clear of this debris, the water outlets, which release water to the fields must also be cleared so that farmers will be able to receive the water they purchase. Once the canals and outlets are prepared, farmers have a tractor with a disk come to their field to remove excess weeds, the operator is usually paid a custom-hire rate and following this tillage the farmer then applies fertilizer to his field. Fertilizer is usually broadcast applied by hand unless farmers in other areas have access to a hand-crank spreader or other larger mechanical spreader. Applying fertilizer by hand is often less accurate than applying fertilizer mechanically, however, mechanical application cost is usually significantly higher. Depending on which crop will be planted (corn, cowpea, rice, or other) the fertilizer will be applied first and then shortly later the crop, usually rice, will be hand seeded. Following fertilizer application, the field will be flooded and then sealed off from the canal. The flooded field will have water standing in it for several days, this gives the fertilizer plenty of time to break down and be absorbed into the field. Once the water is absorbed and the field is dry enough to plant farmers will have the field disked again and then shortly there-after, usually within the same day, the field will be planted to its respective crop. Seeding rates vary from crop to crop and farmer to farmer; seeding rates for lower yielding varieties of corn is around 30,000 plants per hectare, whereas higher yielding varieties will typically plant between 80,000 – 90,000 plants per hectare, this is similar to most American planting populations. Farmers will usually seed around 0.75 bushels to 1.50 bushels per hectare of rice seed, and around 80,000 – 100,000 plants per hectare for cowpea. During planting, it is common for additional fertilizer to be applied or even placed next to the seed by the planter next to the seeded furrow.

Management practice varies from crop to crop; however, it is common for most farmers following planting to watch for the presence of pests such as weeds and insects to arise before implementing various control methods. Depending on the level of weed pressure, it is not uncommon to see farmers in their fields with shovels or machetes eliminating the weeds. In cases of extreme weed pressure, farmers will purchase herbicides and spray their fields with the use of a backpack style sprayer. Once insects are found in the fields, insecticide is placed in a small plastic container with an opening for the insects to enter into, insects will usually enter these containers because an attractant added to the solution and will help reduce the pest pressure. It is also not uncommon for farmers to spray insecticide with use of a backpack style sprayer. Following planting, farmers often return to their fields to apply additional fertilizer to help crops reach their full potential. This practice is most common with corn and is less common with crops such as rice or cowpeas. Due to the fact that they cannot rely on consistent rainfall, farmers must flood irrigate their fields during the growing season to ensure that crops receive the moisture necessary to reach full potential. Farmers often flood irrigate their crops on average three to five times during the growing season.

Harvest methods vary from crop to crop; however, a majority of harvest is done by hand. Rice is perhaps the only crop that can be mechanically harvested. Harvest for corn and cowpeas, is done entirely by hand. Once the commodity is removed from the plant it must then be processed further to form the final product which will be sold or refined further. Rice is harvested and the grain must then be run through a mill to remove the hull. Corn goes through a somewhat similar process, as once the ear of corn is removed from the stalk, it is placed to dry in the sun and then shelled out with the use of a corn sheller. For cowpeas, the entire plant is removed from the soil and then piled. Once the entire field is harvested the farmer will place the piles on a tarp and then with wooden sticks begin manually opening the bean pods by using the stick as a separator. Crops are often harvested at a moisture level that is above the recommended storage moisture. This is done to reduce the potential harvest loss that could occur from harvesting crops at a lesser moisture. Once crops are harvested, they are then spread directly onto a tarp and given approximately ten days with direct exposure of the sun.

Following harvest, remaining crop residue is eliminated through biological control, burning of rice stubble and remaining cowpea plants that are piled. Standing corn stalks are removed from the fields and are fed to different animal herds and act as a cheaper form of feed. Following harvest there is very little tillage done until is fertilizer ready to be applied for the following crop. The average period between crops is approximately two and a half months, this period of letting the land lay fallow is thought to be one of the best ways for farmers to let the soil rest. Once crops are harvested, it is common for them to be stored for up to several months before they are sold.

With the unique crop rotation of anywhere from two to four crops being able to be planted within this area, management styles, and crop approaches may vary significantly. Fields will be fertilized and then be flood irrigated around mid-January, once the water recedes the field is then tilled and planted approximately one month later in mid-February. Following emergence of the crop, additional fertilizers may be applied following planting, depending on crop. Crops such as cowpeas have an approximate three-month growing cycle from planting to harvest, corn has an approximate four-month growing cycle and rice an approximate growing cycle of five-months. During the growing season farmers will apply herbicides and insecticides to control pests that may emerge in their fields. Following application of chemicals and pesticides, farmers will usually apply different forms of foliar fertilizers or granular based fertilizers that provide additional nitrogen and other nutrients crops need during growth. Following application, crops continue to grow and mature, management styles are usually more relaxed at this point. Harvest of crops occurs in late May for cowpeas, mid-late June for corn, and then mid-July for rice. Following harvest, crops are given time to lay idle and farmers will then begin preparing their fields for the next crop to be planted. Depending on crops planted, it is common to see double cropping as a regular technique utilized by farmers.

Risk management strategies are more difficult to prepare in areas that farmers cannot receive information that correctly reflects the likelihood of them being exposed to various risk factors. Farmers work to understand the local market price through use of an agricultural engineer who communicates semi-frequently with local commodity buyers such as vendors of animal feed products, local processors who purchase raw commodity products and use them an ingredients and other buyers. Crops can be stored for an extended period of time; however, it is common to have problems with crop storage as storage areas are often not fully enclosed and allow pests such as insects and rodents to cause small amounts of grain damage. Farmers utilize various risk management strategies such as having multiple crops in their rotation, which gives them more flexibility in being able to plant the crop that will provide them with the highest profitability. Farmers also utilize some form of risk management by applying various chemicals and fertilizers to ensure their crops can produce a larger yield. Farmers in the Northwestern Peru have few opportunities to take advantage of financial tools such as any form of crop coverage that would guarantee them a yield or price assurance such as forward contracting their crop with a buyer in advance.

1.5 Purpose and Objectives

The purpose of this study was to elicit information related to the production practices of farmers in Northwestern region of Peru as well as their perceptions of risk related to production, price, and profitability. From these, my objectives were:

1. Summarize survey responses of Northwestern Peru farmers
2. Determine which factors influence risk perceptions

CHAPTER II

LITERATURE REVIEW

This chapter references previous studies composed of: (1) general farmer risk propensity and tolerance and (2) risk perceptions or perceived risks that influence the decision- making process. This literature will offer motivation for this study. In addition, it will provide an understanding of the relationship between farmer risk propensity and how different factors influence their decision-making process.

2.1 Risk Propensity and Tolerance

Over time as technology has increased there have been shifts in the risk propensity of farmers. Farmers base their decisions off of exogenous variables and external factors that will likely impact their expected yield at some point during the growing season. The factors that farmers most specifically analyze are largely based off of their unique demographic area. Oladele (2005) states that the investigation by social scientists have found that farmers' behavior during the decision-making process will largely be influenced by demographic variables, technology characteristics, information sources, knowledge, awareness, attitude, and group influence affect adoption behavior.

One tool that farmers in the United States often take advantage of is crop insurance. Crop insurance is a tool that allows farmers to guarantee themselves a minimum yield or minimum revenue. It is accessible to all farmers and subsidized by the United States Department of Agriculture. Crop insurance is a risk management tool that helps to protect either yield or revenue for a specific commodity. (Risk Management Agency, 2019) There are several types of coverage available for purchase as multi-peril crop insurance, perhaps the most popular in the central Cornbelt being Revenue Protection (RP) and Yield Protection (YP). Yield protection insures the crop based off of an average yield, which is adjusted for increase in yields and trait technology with the help of additional endorsements that can added to the policy. (Risk Management Agency, 2019) A spring price is set during the month of February from futures contract price for the month of December for corn and November for soybeans. Revenue protection works in the exact same way, however, there is an additional price added into during the month of October looking again at futures prices for the same contract months of the same year.

If the price increases from the spring to fall, under a Revenue Protection policy, farmers would receive the price difference and be paid out the difference as a result. Yield Protection will only trigger an indemnity, pay a loss, if there is a yield shortfall; Revenue Protection on the other hand will pay if a yield shortfall or general revenue shortfall were to occur.

Assuming this holds true for a majority of farmers across different geographic regions it is possible to see varying levels of adoption of various technologies given similar level of technology exposure in the same country or state. Oladele (2005) found that adoption studies in Africa, Asia, and Europe have identified farm and technology specific factors, institutional, policy variables, and environmental factors to explain the patterns and intensity of adoption.

In addition to the aforementioned factors, Rao and Rao (1996) found a positive and significant association between age, farming experience, training received, socioeconomic status, cropping intensity, aspiration, economic motivation, innovativeness, information source utilization, information source, agent credibility and adoption.

When these factors are combined, they can provide additional insight as to the rationale or light explanation why farmers make the decisions they do. Through these different factors and conditions aligning, the end result that is seen is the decision made. One area that is of particular interest in this review is the impact of technology on farmer's decisions. Assuming that farmers in a specific area all have access to the same technology and certain groups choose not to adopt the technology, what is the difference in risk propensity or tolerance on average between these two groups? Voh (1982) provides insight and analysis showing that the socio-economic status of farmers is positively and strongly related to adoption of different technologies; which impact farmers' tolerance. Farmers who have higher levels of wealth may be more confident during a period where higher levels of risk are present, this may be due to the fact that they are less worried on the probability of facing a total crop failure.

This was reinforced by Thomas (2014) as farmers who have considerably less income or wealth and must rely more on the use of traditional growing practices tend to be less likely to adopt newer technology and have significantly different levels of risk tolerance.

Menapace, Colson and Raffaelli (2012) show, by way of electronic survey, that farmers who have less technology have lower levels of risk tolerance as a whole. In addition, farmers who have less technology also link differing likelihoods of risk occurrence. The framework provided recognizes that in many risky settings, primarily caused by weather risk, individuals do not know the probability of uncertain events occurring, and thus make decisions based upon subjective beliefs which may not necessarily correspond with true probabilities (Menapace, Colson and Raffaelli, 2012). Alternatively, these authors found that those farmers who serve as a farmer representative in a cooperative, and are therefore more frequently confronted with a variety of management and marketing problems, tend to perceive a lower weather risk. (Menapace, Colson and Raffaelli, 2012)

In production agriculture, it is common for farmers to make a majority of their decisions based largely off of their expected market price or expected weather conditions. Farmers who have access to technology and accurate market information will likely make less of their decision based on weather or climatic events and more so on expected price. For many farmers, previous experiences will largely influence the likelihood of occurrence for future events. This is one of the main reasons as to why farmers regardless of region, after having experienced a significant yield or price reduction, resulting in loss of revenue, will often purchase or adopt technology to ensure that future likelihood of loss is reduced.

2.2 Risk Perceptions

The perception of agricultural risk can be a significant influencing factor during the growing season. Farmers must take into consideration many factors prior to making their ultimate decision. Due to the fact that the different factors that need to be analyzed continue to increase, it is difficult for many farmers to appropriately wade through all of the various risk perceptions. According to Minot and Hill, farmers who hold onto their crop and store it can face more risk than farmers who sell their grain shortly after harvest. They show that there are different types of risk present to farmers who store their grain for extended periods of time, especially if the storage areas are not well secured and can result in spoilage due to inadequate storage conditions. Apart from a price decline during storage, farmers also must contend with other risks during the growing season. Minot and Hill suggest that the highest likelihood of risk occurrence is presented to farmers through weather events and market volatility during the crop growing season. Of these two areas that generate the highest levels of perceived risk or risk perceptions, weather is likely the factor that creates the most uncertainty for many farmers (Minot and Hill, 2007) .

Darker (2013) defined areas in which risk perceptions should be considered for thorough analysis. She broke risk perceptions into three separate, but dependent, categories: 1) perceived likelihood, 2) perceived susceptibility, 3) perceived severity. Each component relies on the previous component to have a minimum degree of occurrence in order for the following to be true. Meaning, without a slight likelihood of occurrence, there would be no possible way to approximate the potential perceived susceptibility. The same goes for perceived severity, without a chance of the threat being present, the factor being impacted would have a very low level of perceived severity.

If we cross these two areas of thought we will see that there is an area that allows many different climatic and weather-based events to be analyzed. Climatic events focus on longer term outlooks such as expected shifts in weather patterns, for example, global warming. Whereas, weather events are more specific to a shorter period of time or more relating to the seasonality of a particular weather pattern. Mase and Prokopy (2013) show that weather patterns influenced by more prominent weather events such as El Nino Southern Oscillation (ENSO) based seasonal climate forecasts (SCFs) tend to cause greater impacts, both positive and negative on cropland, than other more seasonal smaller weather events. These specific weather events influence farmer decisions during the growing season, however, especially prior to the growing season in many areas. According to Osbahr et al. (2010), the annual variance and severity in weather pattern swings can result in excessive moisture or extreme drought. When conditions such as these align prior to farmers having a crop planted, it is not uncommon for farmers to change crop type or maturity in order to better accommodate the new growing conditions. Farmers must be flexible and highly adaptable in-order to make these various changes work. If farmers are successful, they will be rewarded and with a significantly higher yield than other farmers who were unable to adapt their crop to be better prepared for the conditions faced during the growing season.

With risk management being of significant importance for many farmers, the focus of some is more so on risk aversion, as through application or utilization of various agricultural products, farmers may feel that they are averting a major portion of the risk that may be present during the growing season. Farmers will largely make risk aversion decisions in an attempt to protect their crop from exogenous factors that will likely impact yield, market price, or total revenue. (Menapace, Colson, and Raffaelli, 2013)

Farmers in areas with developing markets and limited technology, face different parameters around their crop production practice and are less likely to make changes in production method due to many limiting factors. Osbahr et al. (2010) suggests that these limiting factors are experienced mainly by the poor or smallholder famers, however this is not necessarily the case, as Mase and Prokopy (2013) state that their findings show that farmers in certain areas are reluctant to adopt new technologies even when there is enough capital to invest present.

It is not uncommon for various cultural factors to influence adoption of a new crop or technology that will likely enhance the overall yield capability. These factors likely influence management practice and it is not uncommon for farmers to struggle with applying an appropriate amount of risk protection on their crops during the growing season. Riley and Anderson (2009), stated that it is not uncommon for farmers to over or under-estimate the expected price of their crops in the fall. Even more so, it is not uncommon for farmers to under estimate the amount of price risk that their crops will experience during the growing season. Riley and Anderson (2009) focus on price risk and susceptibility of incurring a loss through price decrease.

Connecting both price and yield risks faced during the growing season, that there are many ways in which farmers can reduce their risk exposure in the field. Farmers can in areas with more advanced markets can take advantage of forward pricing their grain sales, guaranteeing a set price when they deliver their grain to the buyer. Farmers in areas with developing markets may not have this opportunity due to limited demand in the region, which restricts farmers with regard to being able to market their crops. Farmers in these situations face higher levels of risk according to Crane et al. (2009) and would prefer to see lower yields and higher prices as opposed to higher yields and lower prices. Crane et al. (2009) also notes that through the analysis of farming, when viewed as skilled performance - which integrates practical knowledge, technologies, information, social networks, and normative values - rather than as mechanical deployment of technical solutions has profound implications for climate applications and decision support systems for agriculture.

Dana and Gilbert (2008) focus on how farmers are able to manage agriculture price risk in developing countries. Their findings are show that there are many factors that can contribute to price risk. These factors usually are related to political instability, adverse weather or growing conditions, or can be supply and demand driven.

When combined these factors are the driving force behind price risk and will ultimately dictate current and future prices. Darker (2013) defines perceived likelihood as the probability that one will be harmed by the hazard. This ties in well with what Crane et al. (2009) suggest that probabilities are a main way that climatologists set up a model in order to predict the likelihood of occurrence. This information is similar to what is suggested of Osbahr et al. (2010) as they state there has been consistent changing probability of risk and intensity of rainfall events from the 1960s to the present. With this increased likelihood of risk; there is an increased perceived susceptibility.

According to Mase and Prokopy (2013) with an increased level of exposure, the level of vulnerability increases. Farmers often face a significant level of vulnerability during the growing season and must make decisions based on their expectations in order to reduce that risk. Arbuckle, Morton and Hobbs (2015) recognize through adaptation there is an overall reduction in the levels of risk and susceptibility of risk. With this reduction in risk, farmers are given an improved chance of being profitable during the growing season.

Once crops grow through the perceived likelihood and perceived susceptibility phases, they then reach the stage of perceived severity, which is described as the extent of harm a hazard would cause (Darker, 2013). The degrees and ranges of severity can be significant as pointed out by Arbuckle, Morton and Hobbs (2015). For example, the severity on crops that have a high drought tolerance would perhaps not be as high if the same crops experienced a flood during the growing season. This is reinforced by Osbahr et al. (2010) and also takes into consideration impacts on crop nutrient uptake. Osbahr et al. (2010) summarizes that farmer perceptions lead the way for risk being the difference in expectation versus reality. Arbuckle, Morton and Hobbs (2015), provides additional support to this focus and reflects that through adoption of new technologies farmers are better able to reduce their overall operational risk.

2.3 Crop Production Methods

No research exists that directly compares South American crop production methods alongside methods utilized in the United States, however a there are a number of studies that have examined different crop methods in the focus areas. As a whole, the number of different crops that can be produced in the United States and South America is substantial. The variance in being able to reach various yields seems to be the main factor that separates these agricultural world powers. In the 1970s the United States began utilizing more advanced plant breeding techniques with hopes to see genetic improvement. Hall and Richards (2013) suggest that the genetic improvement in yield potential for corn hybrids has far exceeded the improvement of other grains. van Wart et al. (2012) suggest that with increased corn production there has been an increase in overall yields in other crops as well. Though some of these factors are largely driven by the various factors that largely influence crop yield, weather conditions, a majority is derived by the technology imbedded within the seed according to Oya et al. (2004). Yield variations are significant across different soil types, which is an expected variance, therefore the expected yield is different as well (van Wart et al., 2012). Interestingly enough, if we compare the higher quality soils in South American countries such as Brazil and Argentina to yields within the United States, the variation is more profound for some crops than others. This is not always due to different crop hybrid selection or fertilizer application, according to Sampaio et al. (2004). Often times, soil type will play a factor in dictating the expected crop yield, as variation across soils when combined with differences in weather events are often the factors that cause the greatest variations in yield from area to area. Hall and Richards (2012) provide the link between yield potential and water-limited grain crops. The linkage of these factors further shows that there is a large variation across the major differences in the responsiveness of yield potential for soil type, water requirement, chemical and fertilizer application, and many other factors. van Wart et al. (2012) focus their approach at how it is feasible to double crop yields in order to feed the growing population of the world, perhaps the issue lays within the viewpoints addressed by Sampaio et al. (2004) of fertilizer efficiencies and having farmers working to ensure that inputs are utilized to their fullest extent. As agriculture technologies within crops is continually pushed forward the end result of being able to see higher yields will greatly benefit many across the United States and South America.

2.4 Chapter Summary

This chapter presented research that found multiple factors that impact farmers' yield and price risk. In addition, this chapter reinforced that farmers have varying levels risk tolerance. This chapter also outlined the research on farmer risk perceptions with respect to both price risk and yield risk. No literature exists that examines crop production methods in both South America and the United States, however there was enough information present to analyze technologies utilized in current crop production methods.

CHAPTER III

METHODS AND DATA

Section 3.1 Purpose

To address the objectives of this study, a survey was constructed that featured questions which helped reveal basic information about the farmers as well as their operation. The survey utilized a variation of both open and closed set of probing questions that were formatted to provoke a deeper level of response for open ended questions and very pinpoint or direct responses for questions that were close ended. Questions that were focused to be more open ended often allowed respondents to respond with their perceived or recognized value, example: profit per hectare for rice. In other portions of the survey closed ended questions limited answers to concise answers. The survey featured questions on: average yield for crops grown, average profit for crops grown, risk propensity and tolerance, farmer collection of market information, factors evaluated prior to cultivation of crops, and then lastly, if a hypothetical product was introduced into the market and could guarantee an improved yield, how much would they be willing to pay for this product. The survey is provided in Appendix A. Table 3.1 provides a summary of the responses for demographic and close-ended questions.

Table 3.1 Summary of Descriptive Statistics

	Summary Descriptive Statistics			
	Average	Standard Deviation	Minimum	Maximum
Age	58.03	13.47	28.00	81.00
Hectares Farmed	2.23	1.11	0.40	6.00
Risk Tolerance	6.10	2.13	0.00	10.00
Corn Profitability	200.00	595.82	-1200.00	1000.00
Corn Yield	4594.78	2326.21	1610.00	8000.00
Cowpea Profitability	1404.55	815.70	0.00	4000.00
Cowpea Yield	2213.48	641.62	644.00	3680.00
Rice Profitability	954.55	879.22	-1000.00	3000.00
Rice Yield	7759.12	2278.60	3000.00	12500.00

The survey was originally produced in English and then translated into Spanish with the help of Ms. Melissa Pacherres. As a result of translation, the survey underwent slight revisions and was then printed and distributed during farmer interactions.

In total there were forty-three Peruvian farmers, most of which were members of Familia A Familia, a micro-loan program previously discussed. Out of all of the surveys distributed to the Peruvian farmers, three could not have been used as the farmer did not indicate or fill out of all the information necessary.

Section 3.2 Cultural Differences

All farmers gave varying responses, results from the specific areas reflected overall differences in crops grown, average yield, and profitability per acre. These factors that are different not only represent the differences in management practices from country to country, but as well as differences in areas that utilize technology and those areas that do not. The farmer information focused less on growing practices, as it was assumed that many of the farmers utilize similar growing practices. There were varying levels of differences in yield, these factors are more common caused by differences in amounts of fertilizer applied or soil quality.

There was a degree in initial difficulty in adjusting the interview to be more correctly worded in Spanish. After making slight adjustments to the initial survey, the end result was much more well written and seemed to be more professionally prepared.

At first, some of the farmers did not understand, as they knew this was not possible in Peru. It was then explained that financial tools and products such as this existed and were frequently utilized in other parts of the world. The idea of being able to guarantee a predetermined revenue per hectare was a new concept to many of the farmers. In all, the farmers were interested in learning more about these different types of products.

Provided in Appendix A, is the questionnaire in English for reference, the wording used in it is slightly different than how the Spanish version was worded, the phrases do not always translate perfectly from English to Spanish and vice versa. Of all of the questions, the most interesting question to many of the respondents, was the question that looked identify a potential price point for farmer's willingness to pay for a crop insurance product that would be very similar to what we currently utilize in the United States for a majority of our risk management practices.

Section 3.3 Methodology

From objective two, the factors that influence risk perceptions are analyzed using ordinary test squares (OLS) regression. The following model was estimated:

$$(3.1)\ RT_i = \alpha + \beta_1 Age_i + \beta_2 CNP_i + \beta_3 CPP_i + \beta_4 RP_i + e_i$$

Where *RT* is risk tolerance as assess from the survey for each farmer, i. *Age* was each farmer's reported age. *CNP* was corn profitability, *CPP* was cowpea profitability, *RP* was rice profitability as reported by each farmer, i. Initial hypotheses with respect to the beta coefficients are:

$$\beta_1 < 0, \beta_2 > 0, \beta_3 > 0, and\ \beta_4 > 0$$

It is expected that risk tolerance will decrease as age increases, while the profitability of each crop is expected to positively influence risk tolerance.

CHAPTER IV

RESULTS

Section 4.1 Peruvian Farmer Survey Findings

While in Peru, surveys were distributed to farmers and forty-three responses were collected. These responses yielded a wide variety of information and helped to provide a clearer understanding of how Peruvian farmers make decisions. The average age of the sample population from the Peruvian farmer survey was 58.51 years old and a majority of the sample owned land in San Miguel Section 2 and San Jacinto Section 1 which are located within the Region of Piura and Province of Piura (see Figure 4.1 and 4.2). With the majority owning land, 82.5% of the farmers farmed only the land they owned, 7.5% farmed the landed they owned and rented land, 5% rented all of the land they farmed, 2.5% freely rented the land from family members and also rented, lastly, the remaining 2.5% of farmers freely rented from their family members.

Figure 4.1: Regions of Peru

Source: GeoCurrents, 2019

Figure 4.2 Region of Piura - Provinces

Source: Lo Mejor Para Tu Peru, 2019

Average operation size varied greatly, with the largest operation size being 6.0 hectares and the smallest being 0.4 hectares. Note to reader: operation size included all owned, rented, and freely used from family member land. On average, the farmers who owned land and also rented land had larger operations than those who only owned land, only rented, only freely rented the land from family members, or the others who freely rented the land from family or rented land. Across the entire sample population, the average operation was 2.23 hectares or approximately 5.50 acres.

When further examining farmer risk tolerance against age and profitability by crop following equation (3.1), the multi-variable regression values suggest that correlation exists as found in the adjusted R square value of 0.0962 (Table 4.1). The overall significance of the regression was low, partially due to the limited number of responses as well as the limited number of variables used to reflect impact on the dependent variable of risk tolerance. Age was found to negatively and significantly influence risk tolerance. For each year older a respondent in Northwestern Peru aged, their risk tolerance declined by 0.0511 on a scale from zero to ten. Corn and cowpea profitability had the expected signs but were not statistically greater than zero. Rice profitability was found to negatively and statistically influence risk tolerance, which is opposite of the hypothesis from chapter three.

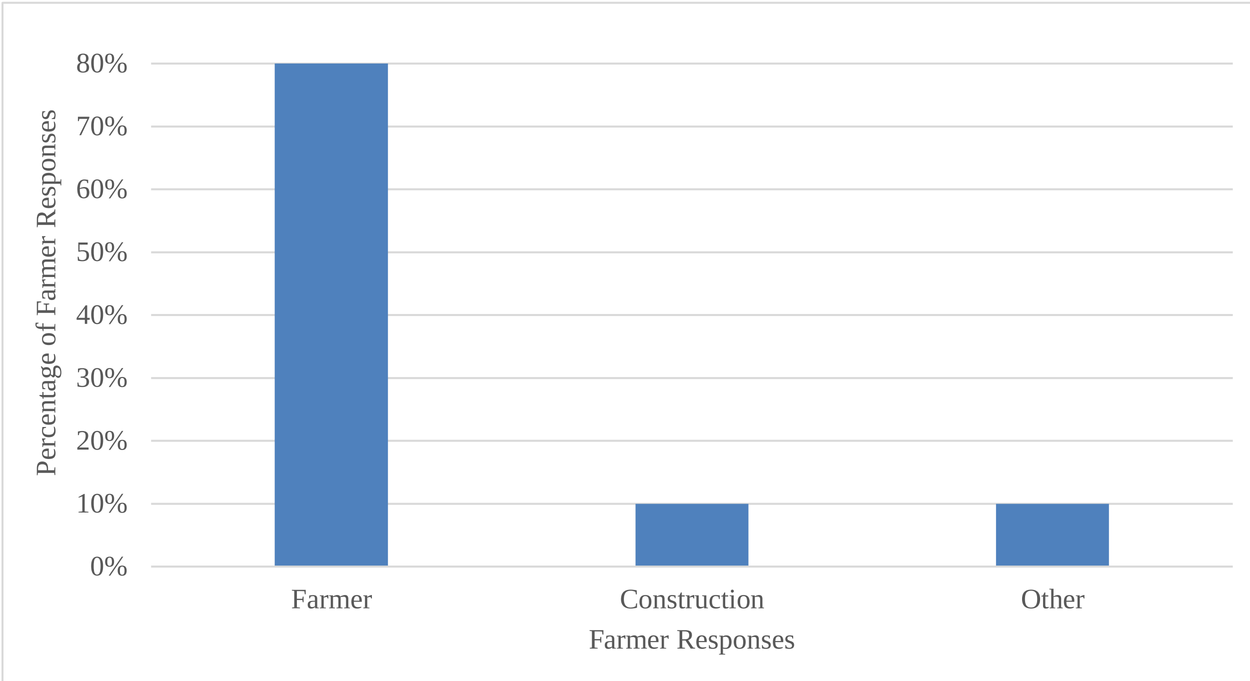
Table 4.1 Risk Tolerance Relationship to Age and Crop Profitability

Dependent Variable:	Risk Tolerance		
Adjusted R Square	0.0962		
Observations	40		
Independent Variables:	*Coefficients*	*Standard Error*	*t Stat*
Intercept	9.3299***	1.47335	6.33245
Age	-0.0511***	0.02484	-2.06017
Corn Profitability	0.0002	0.00126	0.15946
Cowpea Profitability	0.00014	0.00029	0.48520
Rice Profitability	-0.006**	0.00039	-1.40266

Note: '***' indicates significance at the 1% level, '**' indicates significance at the 5% level, based on one-tailed t tests.

A majority of the farmers (80%) worked exclusively as farmers and had no other day jobs or sources of revenue. The remaining 20% had various occupations from practicing carpentry, operating various machinery, working in the grape factory, or working construction. On average, farmers who also worked construction farmed less land than those who had other professionals along with farming.

Figure 4.3 Peruvian Farmer Professional Careers



Looking at the relationship between animal husbandry on farmers, it was interesting to see the wide diversity in species that farmers often shared space around their home. A majority of farmers had livestock of some variety, 72.5% of surveyed farmers, with the majority tending to favor poultry, sheep, or a variation of multiple species. With 25% of surveyed farmers having only chickens or turkeys (poultry), it was interesting to see how even with very little space to house their flocks, they still made room in small areas outside of, or even sometimes inside of their homes. Many of the other farmers who also had livestock tended to favor sheep, perhaps because they are easily herdable and can graze their fields. From the other varieties of livestock ownership, it was noticeable that many of the farmers favored having multiple species, with 17.5% owning at least three different species. In addition, pigs were also fairly popular and were often owned in conjunction with other species, but very seldom by themselves (5% of farmers owned pigs and no other livestock). To conclude the focus on animal husbandry, diversification is very important to the Peruvian farmer as it allows them to have many different species on hand at any given time and this greater selection is perhaps the cultural preference.

With large swings in the price of commodities in recent years, crops that were once favored, such as wheat, cotton, and rice have been slowly worked out of the traditional rotation and more non-traditional crops such as cowpeas and yellow dent #2 corn have made their way into the market. These crops have emerged as the new preferred crops and will likely be grown in the future.

According to agricultural engineer, Roger Morante, due to a recent large importation of rice into Lima, the local price of rice had been significantly suppressed. Based on this, it may be expected that rice margins for the 2019, and succeeding crops years will be narrow (Morante, 2019). Historically, there has been a great amount of diversification in the farmers' lifetime of planting and thus is not uncommon for farmers plant more than two varieties of crop. Currently, 47.5% of the sample population plants only two types of crops: rice and cowpeas. Despite rice and cowpeas being the most popular planting rotation, 20% of respondents utilize a three-crop rotation of cowpeas, corn, and rice to keep their operation's crop rotation diverse. Interestingly enough, following the three-crop rotation's popularity, a single crop rotation of exclusively cowpeas which made up 15%, was followed by 10% of farmers who grew exclusively rice. The remaining farmers surveyed represented 5% that planted both corn and rice, and 2.5% cowpeas and corn only. No farmers exclusively grew corn.

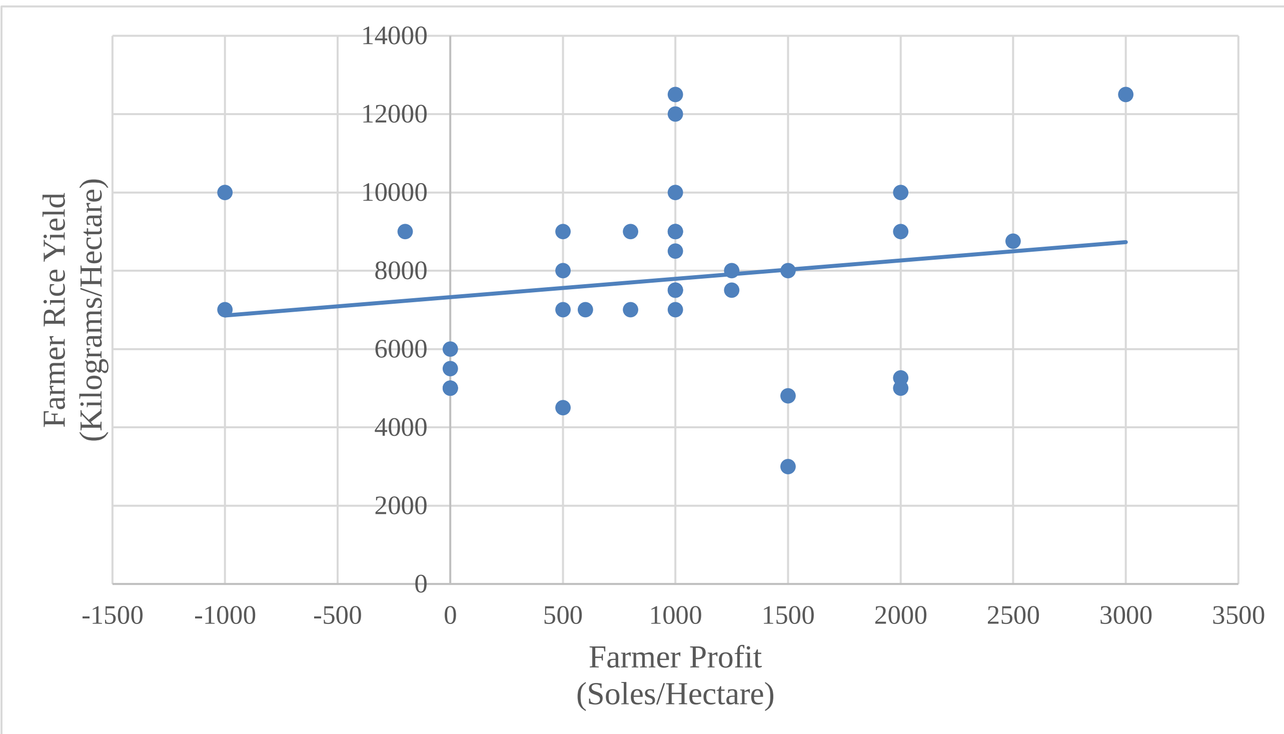
The farmers that utilized a two-crop rotation, which included corn, represented farming practices that were moderately profitable and a planting rotation that would leave more vegetative material behind following harvest. While these numbers were surprising to see, as in the future there should be hope that a higher percentage of farmers will be planting more than one type of crop and planting crops that will likely help them to be profitable. Even as these two crop rotations that will continue to feature rice in them are less than ideal due to narrow margins, these are better to see as opposed to rotations that feature exclusively rice.

Section 4.2 Peruvian Rice Production

Shifting to the profitability per hectare for the farmers, there was a wide range across farmers. The range for rice production was S/4000 (-1,000S/ to 3,000S/), which given the reported small size of operations. Perhaps, the yield and pricing information reveals the underlying realities with most of the farmers in the micro-loan program face on a daily basis of having only limited production information. The average profitability per rice operation was around 954.55S/ per hectare. This converts to approximately 117.10$ per acre, which is the average across all farmers who produced rice, owned, rent, and freely used land from their family.

Yields ranged from 3000 kilograms per hectare to 12,500 kilograms per hectare. The average yield across the farmers who planted rice was 7759.12 kilograms per hectare of approximately 153.57 bushels per acre. Note: one bushel is equal to 45 pounds of rough rice. The wide range of yield may be attributed to different: production methods, management, seed selection, weed and insect control practice, or soil type. Associating profitability and yield, Figure 4.4 it is shown that there is a positive correlation between yield and profitability.

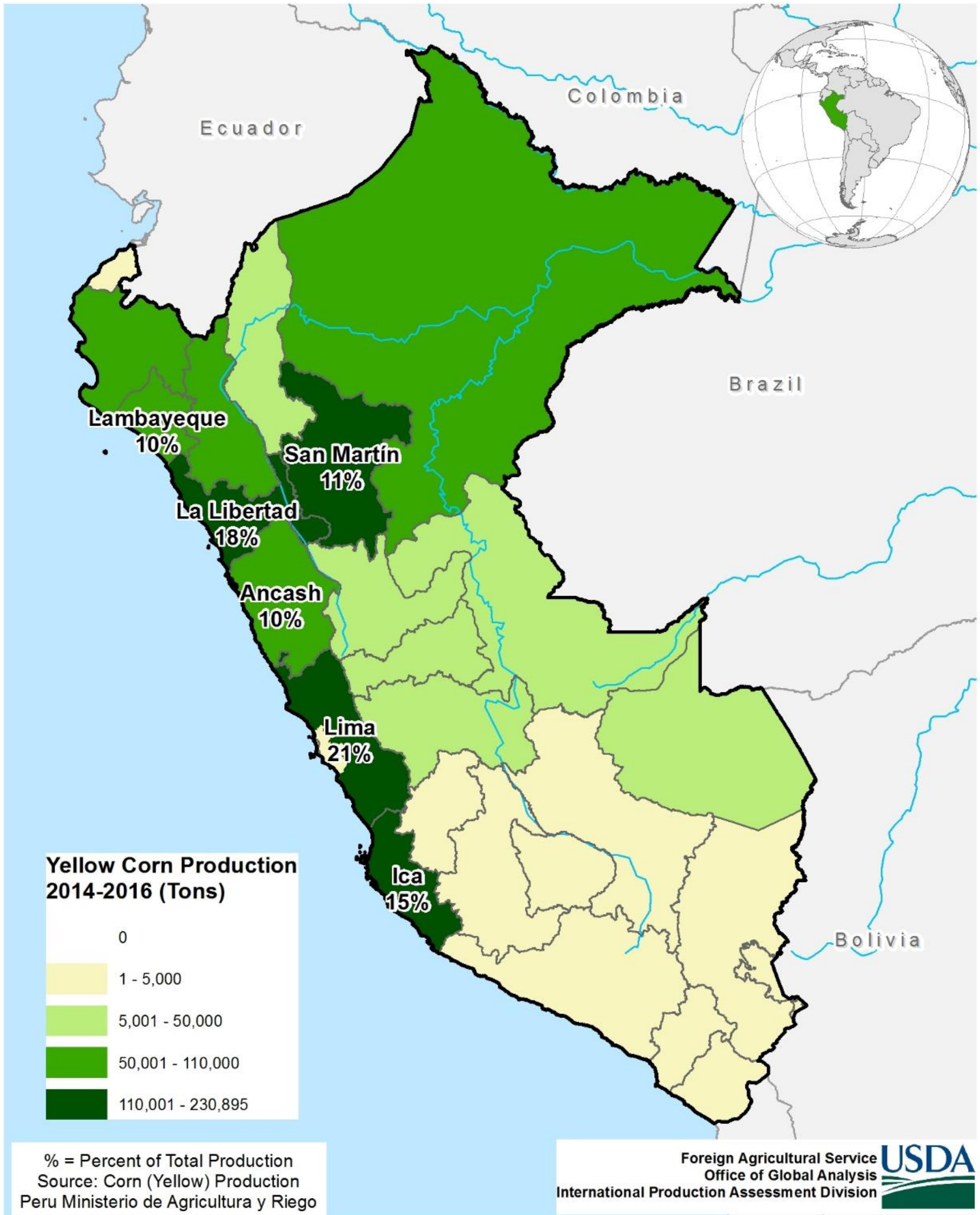
Figure 4.4: Rice Relationship of Profitability to Yield



Section 4.3 Peruvian Corn Production:

Looking at the profitability of corn, with only a limited number of surveyed farmers producing corn in the area of Northwestern Peru it was initially difficult to have an adequate number of responses to form a strong conclusion. The country of Peru does not have high enough annual production in order to be recognized by the United States Department of Agriculture during their monthly World Agriculture Supply and Demand Estimate report. Even so, Peruvian corn imports have been steadily growing since 2015, as imports were then recorded at 2.741 million metric tons in 2015, 2.985 million metric tons in 2016, 3.269 million metric tons in 2017, and 3.402 million metric tons in 2018 (Peru Corn Imports, 2019). Agricultural engineer, Roger Morante, expressed through his workings with farmers in the region, he has seen demand for corn has remain strong across the country and farmers are becoming more and more familiar with how to achieve higher yields (Morante, 2019). A majority of farmers surveyed planted a less costly and lower yielding variety known as Marginal. The farmer sentiment of this particular variety was that the yield was substantially lower than other varieties, however more preferred due to its lesser cost. All but two of the farmers surveyed planted this particular variety, largely because of its lower cost. The farmers who planted varieties with higher yield potential reported that their average corn yields were around 8,000 kilograms per hectare, whereas as the farmers who planted Marginal, reported average yields of 1,610 to 5,000 kilograms per hectare. Table 4.2 indicates that a majority of corn production that occurs for yellow dent #2 in Peru occurs near the coast. Farmers across this western region of Peru can face many of the same problems during the growing season.

Figure 4.5 Peru Yellow Dent #2 Corn Production



Source: United States Department of Agriculture, 2016 (image)

Peru Agricultural and Irrigation Ministry (data)

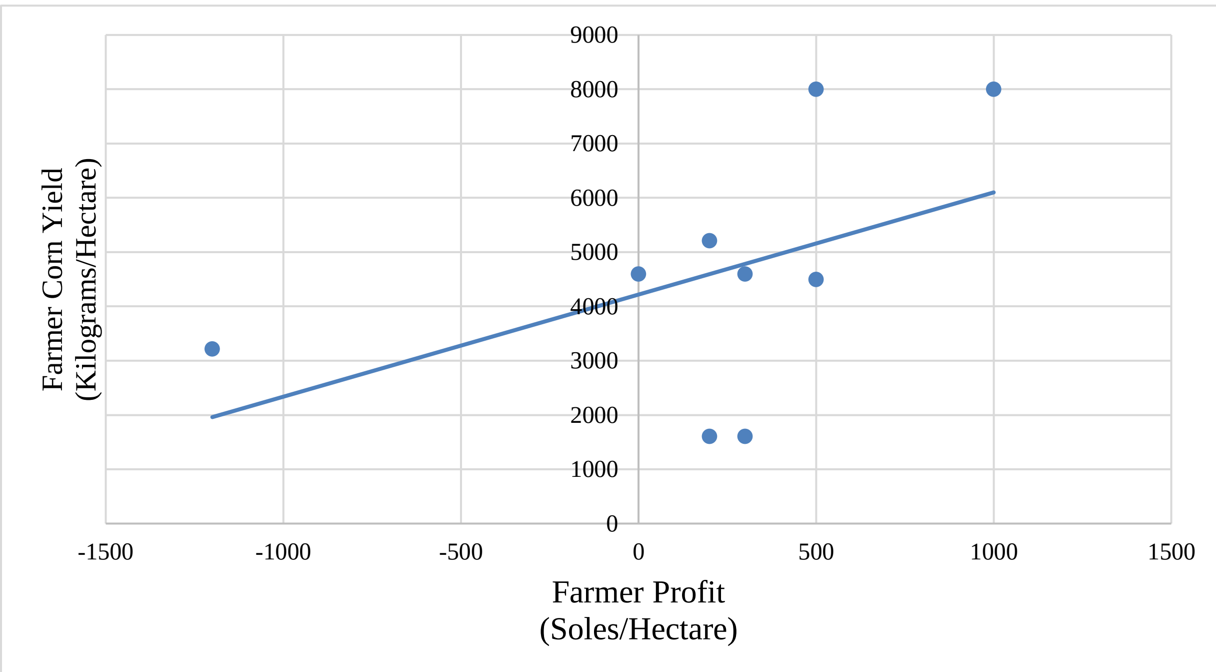
Many farmers in the area had only limited experiences with planting higher yielding varieties of corn. The Peruvian currency is the sol, expressed as S/ and seen as soles throughout the paper. The range in profitability was, 2,700 soles, soles being the Peruvian currency, and reported values were from -1,200 soles to 1,500 soles. The average profit per hectare across all of the farmers who planted corn was 330 soles (Table 3.1); which converts to approximately 40.48 dollars per acre. This per acre average is across all farmers who produced corn, owned, rent, and freely used land from their family.

Farmer responses for corn yields, similar to rice, had a large range per hectare as yields ranged was from 1,610 kilograms to 8,000 kilograms per hectare (Table 3.1). As previously stated, with a majority of these farmers planting a less costly variety of seed, often the average yield will be low. After an in-depth conversation with a group of farmers, I found that the Marginal variety seed only costs around 50 soles per bag, whereas the higher cost varieties such as Dow or Dekalb cost around 600 soles per bag. However, provide traits and genetics that typically increase yields. Based on these conversations the average yield of the marginal variety was approximately 3,500 kilograms per hectare.

The average yield for all varieties, which featured two high yielding varieties in the survey was 4,594.78 kilograms per hectare or 71.57 bushels per acre. Farmers reported that higher yielding varieties of corn such as the Dow and Dekalb varieties can produce yields in excess of 7,360 kilograms per hectare, or 117.06 bushels per acre. Note to readers, one bushel is equal to 56 pounds.

Even with less farmer information, the majority of farmers observed an increase in profitability with an increase in average yield. Figure 4.6 shows a slightly positive correlation between average yield and profitability. As average yield increases, profitability tends to do so, as well. This is attributed to the fact that there are less options in corn production methods. Most farmers need to flood irrigate their fields at least three times following the initial flooding, which is done prior to planting. A majority of farmers, if not all, in the area will pay to have their crop planted with a pneumatic planter, which allows for more consistent seed placement and seed spacing than hand planting.

Figure 4.6: Corn Relationship of Profitability to Yield



A majority of farmers apply some form of fertilizer, insecticide, or herbicide during the crop's life; this is done to increase or maintain expected yield potential. Lastly, all farmers will harvest the crop by hand; farmers will either pay to have harvest done this way by a "harvesting crew" usually comprised of other farmers and workers in the area, or perhaps do a majority of the work themselves with the help of family members. The variations over the course of the plant life cycle can add up in cost very quickly. Roger Morante provided his estimated cost per hectare to vary from 3,500 soles to 6,000 soles per hectare varying based off of specific management decisions (Morante, 2019). Collectively, each unique decision can result in an increased cost of corn production.

With these costs in place, it is worth noting that the average price per quintal varies throughout the growing season. Through conversations not covered from the survey it was evident that prices vary throughout the growing season. Due to the limited production in the area it is not uncommon to see the price range from 35 soles to 55 soles per quintal. This price information was recorded directly from farmers and should be considered primary information. In addition, as there have been few studies conducted on corn price information in this region of Peru, there is very little information readily available. These amounts convert to approximately 5.87 dollars per bushel to 9.22 dollars per bushel. From spring to harvest, the price typically peaks near 55 soles per quintal and then fall to around 35 soles per quintal, this is a price movement of 36.36% during the season.

Section 4.4 Peruvian Cowpea Production

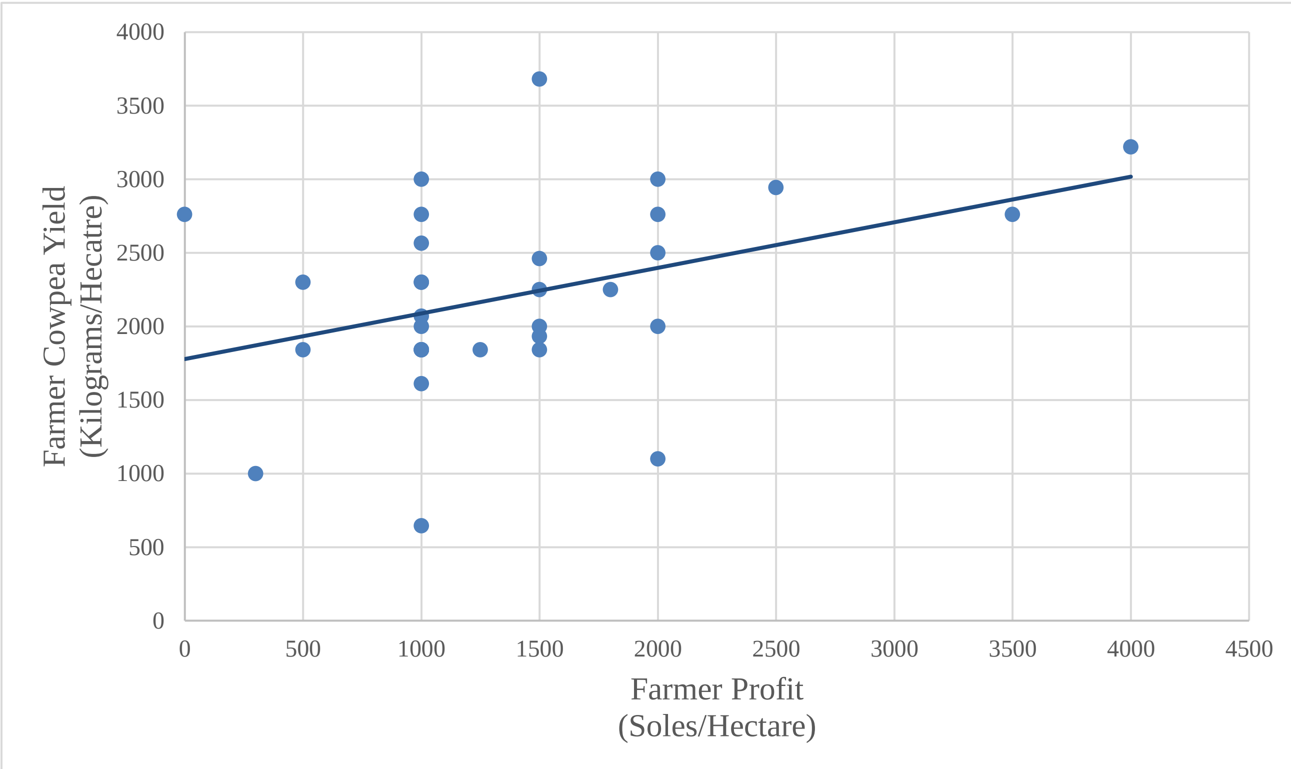
Cowpeas or better known to the Peruvians as frijol are the crop that has the greatest immediate return on investment of any crop currently planted. Cowpeas were introduced by agricultural engineer Roger Morante only a few years ago as an alternative crop to cotton and wheat. Farmers were initially attracted to growing this crop because of the low costs of production.

Looking at the range in profitability, results show that profits were from 0 soles to 4,000 soles per hectare (Table 3.1). This range in profitability is similar to that of rice, however, the minimum profit earned was 0 soles per hectare. Cowpeas were the only crop that farmers reporter non-negative profits. The average profitability across all of the farmers surveyed who planted cowpeas was 1,380.88 soles per hectare, which converts to 169.41dollars per acre. This per acre average is across all farmers who produced cowpeas, owned, rent, and freely used land from their family.

Table 3.1 shows all of the crop farmers who participated in the survey produce, cow peas, have the smallest yield range. Yields ranging from 644 kilograms per hectare to 3,220 kilograms per hectare were recorded, resulting in an average yield of 2213.48 kilograms per hectare. As previously stated, this yield range was only 2,576 kilograms per hectare or approximately 38.24 bushel per acre variance.

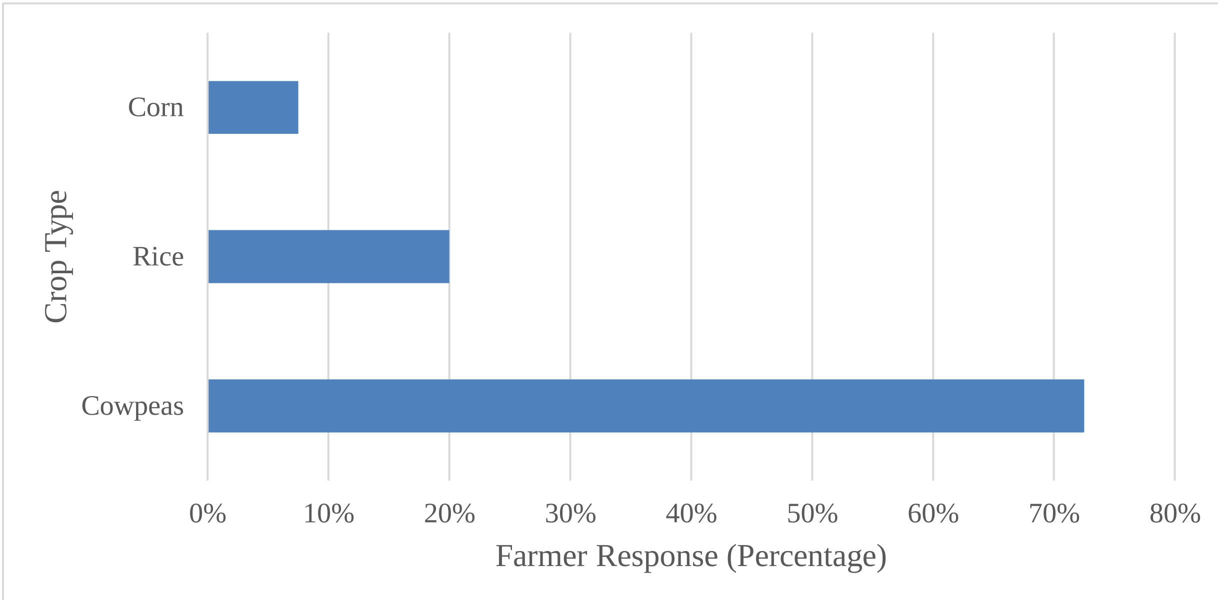
Figure 4.7 depicts the relationship between profitability and average yield for cowpeas. There is a positive linkage between yield increases and profitability and of all crops grown by farmers, cowpeas have the strongest correlation with an increase in average yield to an average increase in profitability.

Figure 4.7: Cowpea Relationship of Profitability to Yield



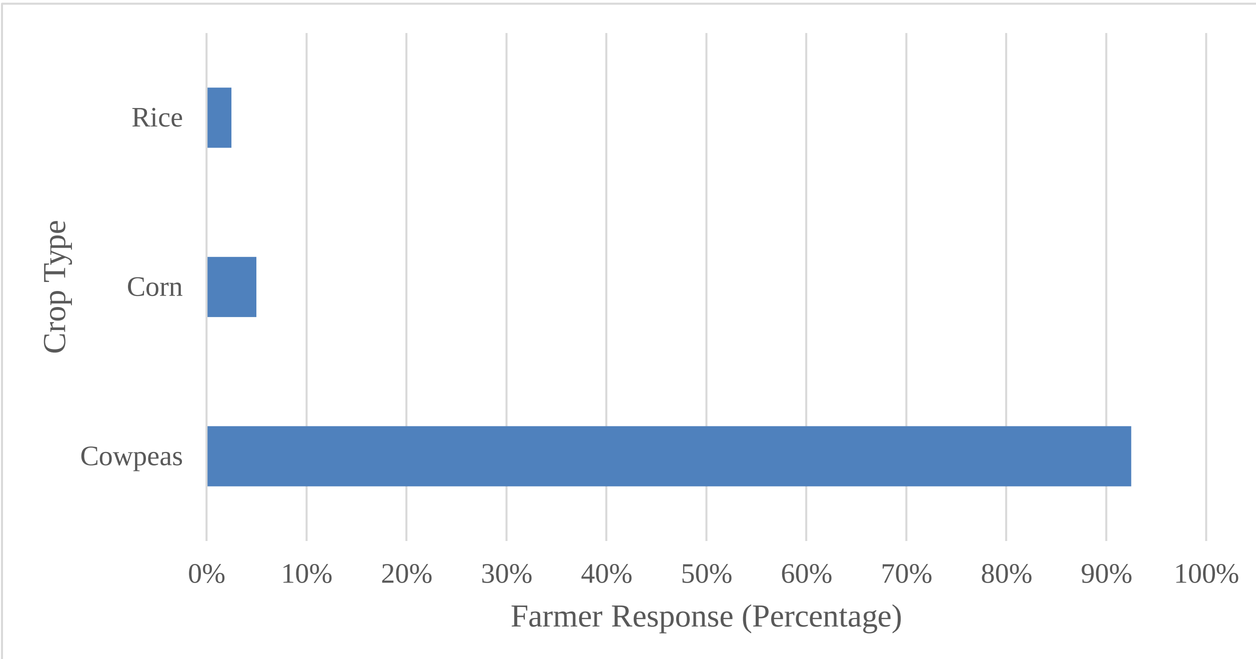
Shifting focus to a different cultural preference of which crop is preferred by Peruvian farmers it should be noted that through conversations with many farmers in the area, there has been a large shift in preference rice to cowpeas. As many farmers in this area have very little, they prefer to produce crops that are profitable crop or least costly crop to produce. For many of the Peruvian farmers the most profitable crop to produce was cowpeas, with 72.5% of survey respondents indicating this outcome. Many of the survey respondents who do not currently grow cowpeas, reported that they are planning to begin growing them and plan to transition from mainly rice production and incorporate cowpeas in their rotation. Rice is viewed as a reliable crop by many as 20% responded that it is their most profitable crop to produce.

Figure 4.8: Most Profitable Crop to Produce



With the focus of most profitable crop already being covered, looking at the least costly crop to produce. Farmers in this area of Peru have overcome much adversity in the past and now, as a result, look to produce the crop that is least costly to produce. Farmers fear that if they produce a costlier crop, that they may not be able to repay their debts and may lose their land. Figure 4.9 reports that 92.5% of all farmers surveyed responded that the least costly crop for them to produce were cow peas. With this being said, there were two farmers (5% of respondents) who reported corn to be their least costly crop to produce, and then one farmer (2.5% of respondents) who reported rice to be their least costly crop to produce.

Figure 4.9: Least Costly Crop to Produce



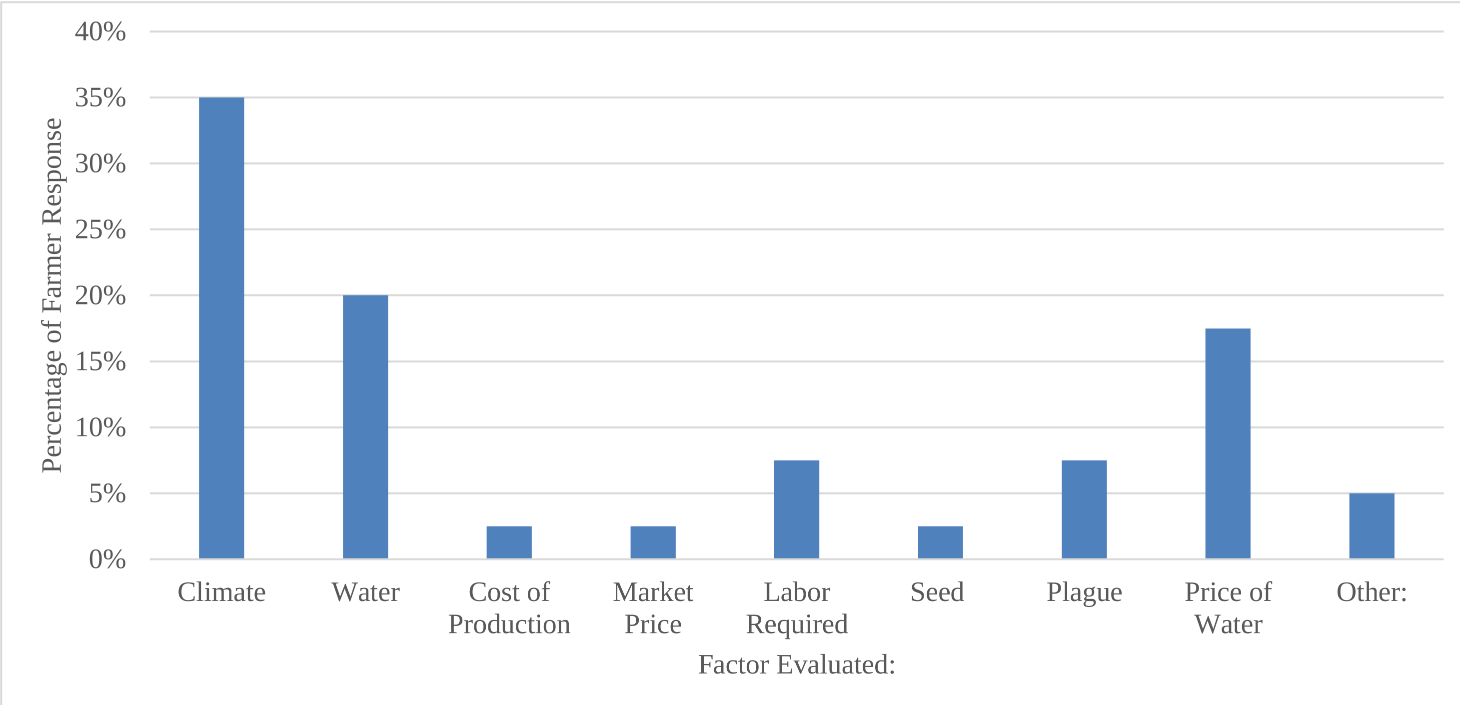
To summarize the findings from the Peruvian farmer interviews, it can be concluded that profitability and average yield are not always strongly correlated, however as average yield increases profitability generally tends to do the same. In addition, there is evidence to support that farmers tend to favor planting crops that are either most profitable or least costly for them to produce.

Section 4.5 Peruvian Factor Evaluated

When the question of, what factors do you evaluate prior to planting was posed, the most common first response was climate (35% of respondent's first answer), followed then by related to water (20% of respondent's first answer), and then the cost of water (17.5% of respondent's first answer) and getting it from the main irrigation canal to their fields. Farmers responded with which three factors were most important to their decision-making process and interestingly the second response by farmers still featured climate as the most popular answer with 30% of the second response, followed then by “Other” which varied responses that focused on everything from cost of labor required, use of equipment, and many other factors. For the third response by most farmers, with 20%, seed, pertaining to seed cost was tied with “Other” for most common answer; coming in third for the third most commonly responded answer was market price, which occupied 17.5% of third answer responses.

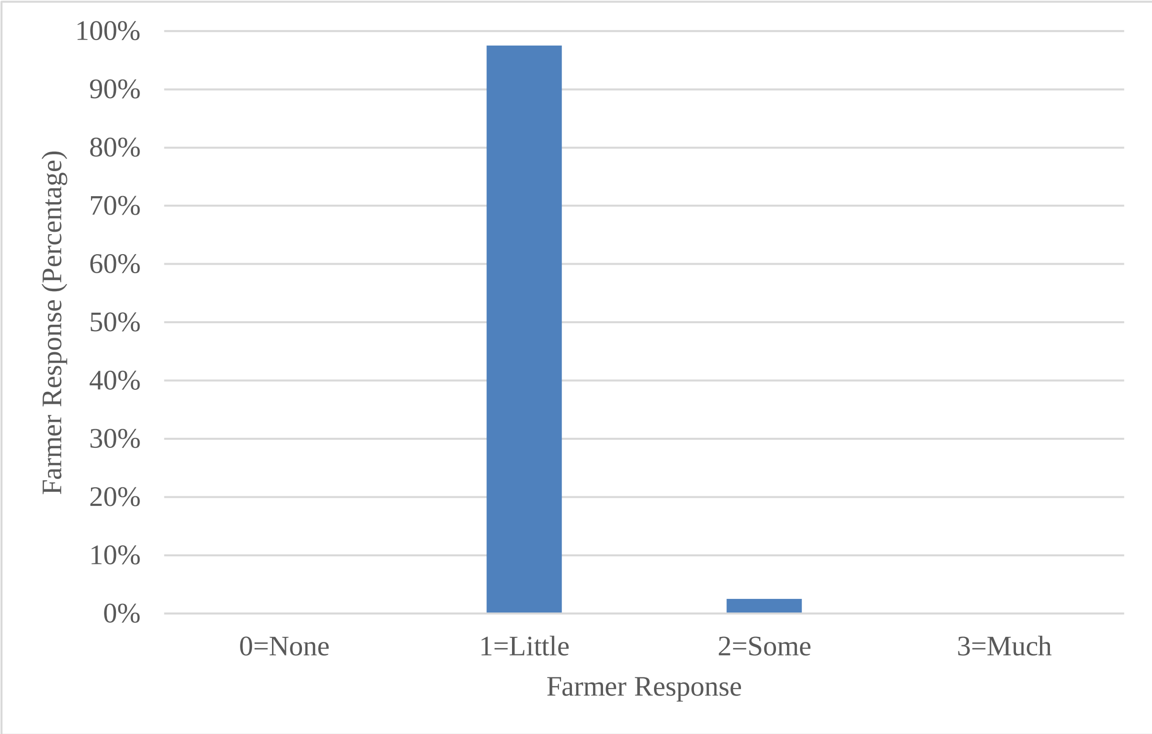
While the responses varied, climate was the most important factor evaluated. Climate plays an important role in influencing the decision-making process of all farmers interviewed. The predicted climate dictates which crop a farmer plants and when it will be planted during the season. As previously stated, the survey of farmer information provided more than adequate information to suggest that farmers in areas that have limited amounts of technology, including the technology necessary to gather current price information on products that they produce, struggle to know the price that they may be able to sell their products at until the day they go and speak with the agricultural engineer or the buyer directly themselves. The current selling process is fairly time consuming, especially in areas where farmers may only have a mule or moto-bike as their main form of transportation.

Figure 4.10: Peruvian Farmer Primary Factor Evaluated Prior to Planting



With these factors in mind, it is perhaps less surprising to see that out of 40 different Peruvian farmers surveyed, 97.5% responded that they receive little information about the market price on the crops they grow or new advancements in crop or agricultural technology, this is reflected in Figure 4.11. The responses for the question were defined by respondents; many of the farmers in the area relied heavily on oral communication or learning of price through the grapevine. As a result, many responded that they receive little information, however, there was one respondent who was a relative of a local agricultural engineer and felt that he received more information than "little" and reported he received some market information but not "much". Many farmers who have more developed markets such as farmers in the United States and other South American countries have been able to either call into a local cooperative or processing plant and ask for the daily bid of a particular crop, then make a management decision to either sell or hold their crop.

Figure 4.11: Peruvian Farmer Knowledge of Market Price or Advancements in



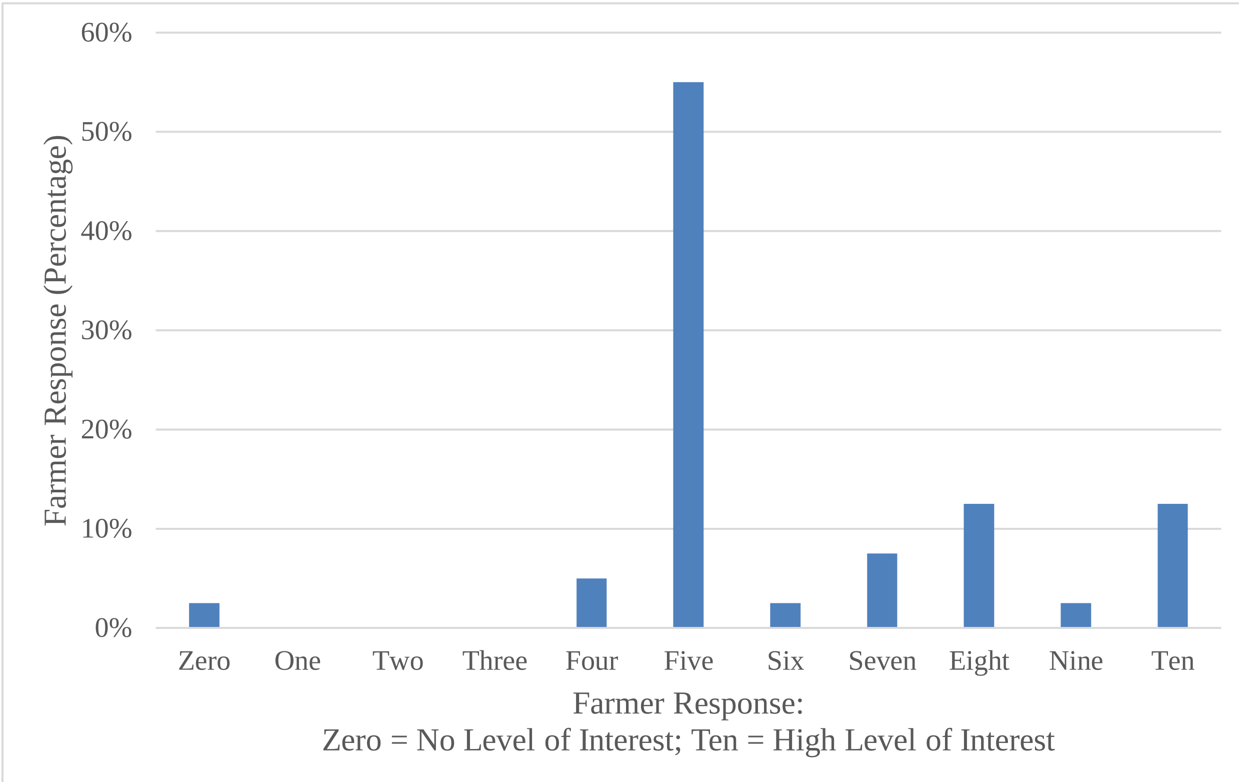
Agriculture

Interestingly enough, many of the farmers do have cell phones, however, many farmers are too old to be seriously interested in learning how to use them, and are often used as a tool for people to contact them. During the data collection process, it appeared that farmers were able to use their phone as needed and were able to make calls, however, the majority of farmers did not have the information necessary to contact the grain buyer directly. It is because of this lack of technology and connection that many Peruvian farmers market their grain at whatever price the market happens to be at when they are needing money to pay their bills or perhaps prepare for the upcoming crop.

With regard to risk propensity, when faced with a potential of adapting or utilizing a new crop or technology the average response was 'five' on a scale from zero to ten. The specific question posed to farmers was: On the scale, indicate how comfortable you would feel with the use of a new crop or a new technology, with the risk of winning or losing a lot of money, assuming an equal probability of both.

By assuming an equal probability of both, farmers were essentially taking into consideration that the crop would either do well or fail to be profitable at all. The scale was numbered from zero through ten, with zero meaning that they would not be interested, five was moderately interested, and ten was very interested in adopting a new crop or technology to have a chance at earning them much more revenue per hectare. Out of all of the respondents, there were only five responses below a score of five, with two of them being a four, and one respondent marking zero, Figure 4.12 shows farmer response. The most common response was that of a five, with twenty-two of the respondents indicating that they would be moderately interested in learning more about this technology or crop and then utilizing it in their operation. There were five respondents who answered with a ten and the remaining responses ranged from six through nine. The results reveal an average score for this particular question of a 6.1 out of 10. This score indicates that farmers were interested in learning more about different crops and new technologies that can help them to be more profitable.

Figure 4.12: Peruvian Farmer Response: Risk Tolerance



Section 4.6 Peruvian Farmer Willingness to Pay

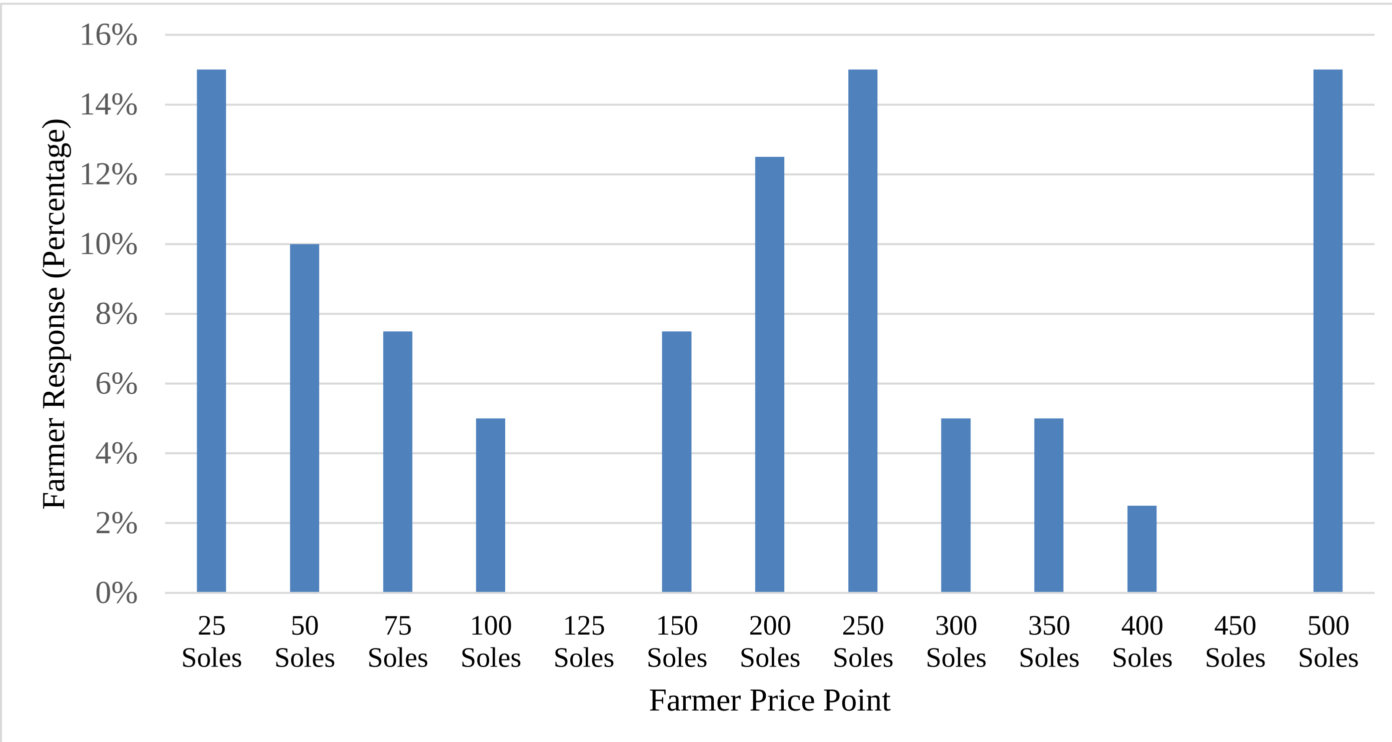
While drafting the survey, the need to include a question assessing a fair corn yield was agreed upon to be used to establish a base line. Through discussions with agricultural engineer Roger Morante, we established an amount of 7,360 kilograms per hectare to be a “good” yield for farmers who would plant the high yielding corn variety. The amount 7,360 kilograms is equal to 160 quintals.

When farmers in Peru were initially asked about their willingness to pay for an insurance product that would guarantee them a set amount of revenue per hectare, many were unsure of what was the actual question was. Through further explanation and clarification, farmers became more understanding of the question and were able to answer with ease. In some survey responses received, Peruvian farmers were reluctant to believe that such a thing existed in the United States and could not imagine that it would work or be paid for by the government. Other farmers had no issue understanding that farmers in other parts of the world could be guaranteed a certain amount of grain, regardless if there was a physical product produced.

Farmers we given 15 different possible price points to pick from with the highest amount to be paid per hectare being 500 soles and the lowest being zero soles.

There were three price points that stood out from the farmer's responses, as they all received 15% (6) of the vote for price farmers were willing to pay to guarantee themselves a "good" yield (Figure 4.13). These amounts were the maximum, 500 soles, the middle, 250 soles, and the minimum 25 soles. Other answers that met or exceeded 10% of respondents, were 50 soles per hectare (10%), 12.5% of respondents selecting 200 soles. The average price that farmers were willing to pay per hectare for a yield guarantee of a good yield of 7,360 kilograms per hectare was 210.63 soles. This amount converted from soles per hectare to dollars per acre is 25.61 dollars, which is around the cost of an 85% Optional Unit (OU), Revenue Protection (RP) policy for most corn farmers in Central Iowa.

Figure 4.13: Peruvian Farmer Willingness to Pay for Corn Yield Guarantee of 7,360kg/ha:

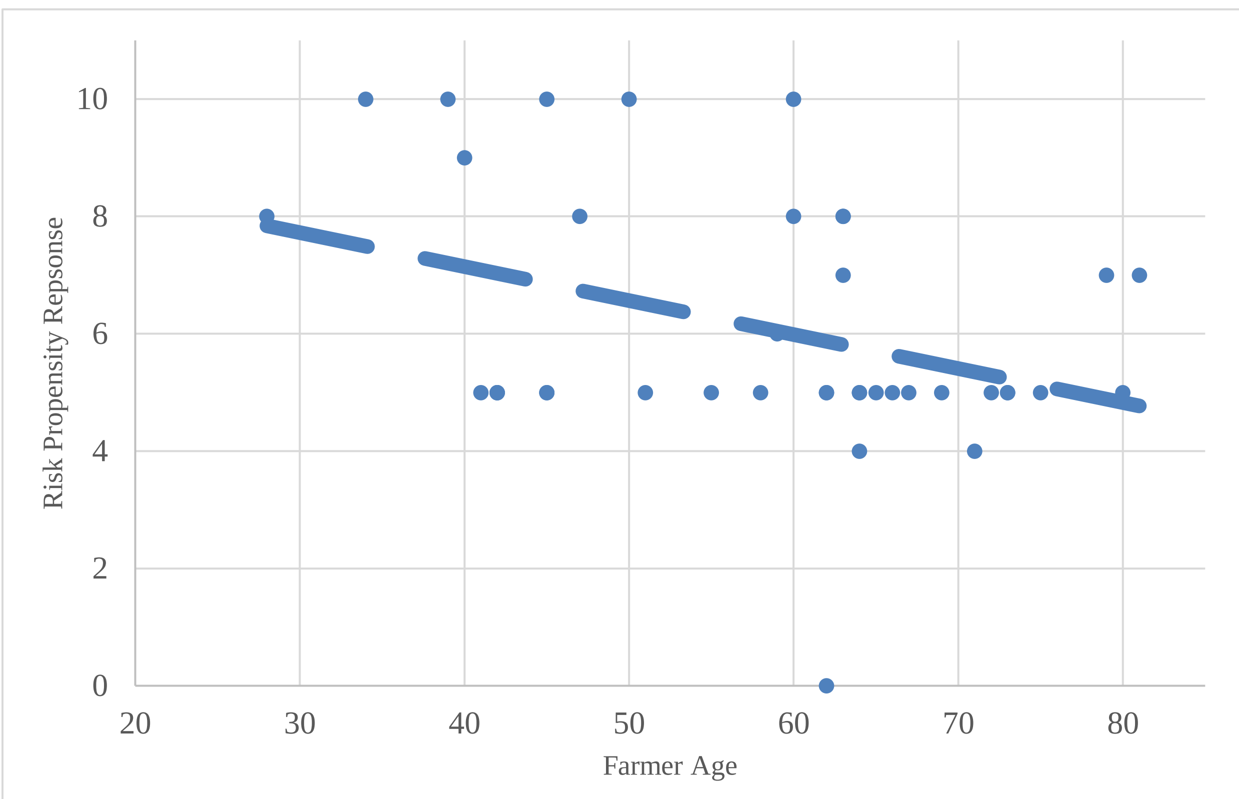


Section 4.7 Peruvian Farmer Risk Perceptions and Perceived Risks

Two of the farmers who operated differently than the other local farmers, as they were the only two who planted the high yielding corn varieties, reveal that their respective scores for risk propensity were seven and nine. These scores were higher than many, while these scores cannot directly reflect the farmer's profitability, it does reflect the level in which farmers who have access to better technology, expressed in the form of financial capacity to purchase higher yielding seed, will be more likely to have a high perceived likelihood for seeing a positive or beneficial result as compared to those who do not have the financial capacity to afford such technologies.

Age as a factor that influences overall outlook on being successful and impact the perceived likelihood, does not provide evidence for these two individuals, as their ages were respectively, 40 and 79. The classical thought that as farmers age, they become more risk averse certainly has not shown to be as perfect as the correlation that many would have initially thought that it would have. Figure 4.14 shows that there is a relationship between age and overall response when asked about their risk propensity. Interestingly enough, farmers with less technology or more limited technology appeared to respond with lower scores on the graph than farmers with more access to different technologies did.

Figure 4.14: Peruvian Farmer Age Plotted Against Risk Propensity



CHAPTER V

SUMMARY, CONCLUSIONS, AND IMPLICATIONS

Section 5.1 Summary of Farmer Findings

From my time and experiences in Peru, it became clear that often times, risk management decisions were made with little knowledge of the current market and were more often focused on what weather conditions were present and what type of weather events were expected. After visiting with more and more of the farmers, it was interesting to see that decisions were largely made by the “gut feeling” of the farmer, which was usually a guess in itself as what the upcoming year’s weather would be.

Through analyzing various information and having interactions with Peruvian farmers it is clearer to see that farmers evaluate different factors prior to making a management-based decision. The differences in factors evaluated come from the value of importance farmers assign the factors faced, which can sometimes be due to the use of different technologies utilized by these farmers. Over time, the presence of technology utilized by farmers in the United States and South America has shifted which factors are perceived to be most impactful during the decision-making process.

Through talks with farmers that have access to technology and utilize these resources their factors evaluated are different than those not utilizing said technologies. The ability to easily check commodity price information has provide great benefit and is an advantage for farmers in areas with well-developed markets and limited technological opportunities present. Areas that have farmers who can access market pricing almost immediately tend to show that market price information weighs in more heavily than the concern of weather in deciding which crops to plant. This is nearly the opposite of most farmers in Northwestern Peru, who focus more on evaluating factors as: climate, water availability, and water cost over factors such as market price.

Section 5.2 Peruvian End User Search

With the limited market information available to most farmers it can be very difficult to budget and make important management decisions for the upcoming crop that will be planted without knowing which crop would be most favorable to produce. A majority of the Peruvian farmer price information comes directly from the agricultural engineer who works with the farmers or farmer group directly to market their crops. With the limited number of processors or end users of unrefined agricultural products, products such as: rice, corn, cowpeas and other goods have to be milled, shelled, or processed to the point where they can be sold directly to consumer.

The process for finding buyers consisted of the agricultural engineer visiting various stores in neighboring towns and gathering farmer information of total amount of grain in storage and would then be recorded for each individual farmer or farmer group. Once the agricultural engineer had collected all of this information he would travel to nearby cities and discuss with stores that sell: animal feed, seed, general consumer goods, grocery chains, and many other stores that would perhaps be interested in purchasing the final product and then sell directly to consumers.

During my time in Peru this process became more recognizable as an art, since buyer and seller would need to come together and agree on a price. This seems very straight forward, however, the actual negotiation process for corn and rice can be very rigorous. Given the complexity of this process that Peruvian farmers utilized during the buyer search, it would not be surprising to see similar grain marketing techniques that are used in neighboring South American countries of Bolivia, Ecuador, Colombia, Venezuela and other portions of Brazil and Argentina become more widespread in small segregated areas where certain crops are produced and sold within a very close proximity.

Section 5.3 Summary of Risk Propensity

All in all, risk propensity is very difficult to measure, while in Peru, it was encouraging to see that farmers work to reduce their operational risk in many different ways. The variations from farmer to farmer are significant with risk propensity. The results from the survey have shown that some farmers are much more risk tolerant than others. Farmer survey information has shown that when farmers have less availability to technology, they will make their management decisions based off giving different factors importance while still using a majority of the same factors as most farmers in the world. Looking at Peru and other parts of South America we can see that this is the case, especially when compared to their South American counterparts in Brazil and Argentina.

Farmers in these areas are likely to utilize various tools to help in their yield risk management and reduce their overall yield risk. Looking at additional risk management tools available to farmers, if a yield insurance product were in place, farmers would consider investing in the product at the desire coverage level. The level of coverage and willingness to pay would vary from farmer to farmer as people have a varying level of willingness to purchase an intangible product such as this.

Farmers frequently evaluate different factors prior to planting their crops; factors such as expected climate and weather conditions, market pricing, costs that will affect total production expense, capital required and other factors. These factors are similar to factors that farmers all across the world must also evaluate prior to planting their crop, however, the difference in which factors are most important significantly varies due to the differences in technology available and the lack of technology that is utilized.

With less resources available farmers in Peru are forced to utilize more fundamentally sound risk management techniques such as: crop rotation or planting crops that they are familiar with, that help protect their bottom line and keep them in business for another year. Farmers who rely on less sophisticated risk management tools will give themselves additional opportunities to utilize different risk management tools as compared to more developed regions, areas, countries, etc.

With the recent adoption of cowpeas and the very recent introduction of new higher yielding corn varieties, we may see farmers take more risks and plant these new cultivars in hopes of more profit than they have in previous years. Many Peruvian farmers are unwilling to break cultural standards or step away from existing crop rotations because of the fear of social scrutiny, interesting how different things impact farmers risk propensity, is it not?

Section 5.3.1 – Perceived Likelihood

While conducting my survey in Peru, I asked farmers if they felt the market price for rice would improve or if the weather would be more suitable for the crops they were growing. The answers I received varied, however, because of what I believe to be the cultural Peruvian way, farmers were generally optimistic about the future. Farmers were consistent, regardless of what topic I asked them about, that prices would rebound, that insect pressure would be less this year, that the weather conditions would be more ideal, that they will be able to grow more of a crop. When given the chance to elaborate on their perceived likelihood of something favorable happening, almost all of the farmers had a very high value for the positive side of the perceived likelihood.

The farmer surveys administered to farmers in Peru, contained questions that focused on finding which factors farmers evaluate prior to planting their crop and helped to reveal what factors are most important to them. This question directly focused on discovering which factors have the greatest perceived susceptibility and risk exposure to them. This means that the most common answer question response from farmers either in Peru or the United States, could be recognized as one of the main factors that an average farmer would evaluate because their perceived likelihood of being susceptible to the factor was perceived to be high. The results reflect that there are many factors that farmers can evaluate to better understand the areas they have the highest perceived susceptibility and ways that they then can reduce the likelihood of occurrence or impact, or ensure their susceptibility may be lessened through the use of some additional practice or technology.

Section 5.3.2 – Perceived Susceptibility

Farmers in Peru place a high value in limiting susceptibility to weather or climate. Given that farmers in Peru place a high level of importance on understanding the weather's impact on their crops during the growing season, farmers may be more likely to purchase crops that have a higher drought tolerance, purchase crops that require less water, or even purchase more water to be used on their crop.

Looking to better understand the level of susceptibility by each of these farmer groups, the differences in technologies have caused a large difference in the factors evaluated and believed to pose the greatest level of risk to a farmer's crop. Farmers who have access to daily market information are much more likely to be concerned with price risk as compared to farmers who do not have this information readily available to them. Farmers who do not have access to regular market price information will put less focus or importance on the market price and more of a focus on the physical factors that will increase or elevate their crop's yield risk such as insects or other climatic factors.

It is because of this approach that the focus of farmers within these analyzed areas remain the same. Meaning that until farmers in areas with developing markets can utilize a higher level of technology giving them price information more frequently thus potentially changing the order of importance in the factors that they evaluate. A shift in the focus of factors evaluated could result in farmers in areas with developing markets, assuming we would see a developed market emerge, change the importance of market price being taken into consideration prior to planting. Assuming that markets develop and technology utilized by farmers continue to increase, it is possible and likely that countries of these criteria could be more similar in reflecting nearly the same responses as American farmers did with the main focus of factors, they evaluate prior to planting being mainly market price.

In summary, a majority of the factors important to Peruvian farmers were those that impact yield. This is important to note because farmers in various regions in Peru as well as other portions of South America that do not have the ability to receive frequent price information are focused on their management decisions based on factors that they can control and have access to. To conclude, if farmers in areas of developing markets, had access to the same information and technology as farmers in areas with advanced or developed markets and access to technology we would likely see that the factors evaluated prior to planting would be more similar with farmers in areas that have similarly developed markets and utilization of technology.

Section 5.3.3 – Perceived Severity

Looking at perceived severity, it can be very difficult to compare as the ranges of perception are so different from farmer to farmer, however, from the results we can make a few inferences. When looking at a factor that poses a certain degree of risk, such as a rain storm, drought, or price movement in the market, once we accept that an event is occurring, with a perceived likelihood of 100%, we determine that we are highly susceptible perhaps as a result of lack of coverage due to a management decision that underestimated the potential susceptibility or other event, we must then face the severity of this event or risk taking place and deal with it.

The amount of severity is largely based on previous management decisions of the farmer or operator of the land or crop. For example, if a severe drought were to come across the Cornbelt of the United States, if a farmer made the decision not to plant a crop variety or seed with traits that help the plant continue to grow without the presence of moisture, that farmer would have face a significantly higher level of severity than a farmer who did plant such a variety or crop. This is also the case for price risk as well, as farmers who did not forward price or protect the price of future grains or commodities through a various control method.

Perceived severity is often a factor that is communicated prior to a growing season and then actualized during the same season. For example, if there is talk of the Midwestern United States experiencing an El Nino weather pattern, the overall thought from farmers may be that they should plant a variety of corn that matures later in growing season, as El Nino is typically reflective of ideal growing conditions for corn, thus the farmer would be likely to receive a higher yield per acre as a result. If the forecast of an El Nino during the growing season holds true, a farmer who risked planting a later maturing variety of corn will likely be rewarded as they would receive a higher yield per acre than if they had planted an early maturing variety. However, if the communicated thought was wrong and El Nino turned into La Nina, which exhibits less than favorable growing conditions for corn during the growing season, and the farmer planted his crop prior to the shift in news, he would have a high level of perceived severity in the fields where he planted the later maturing variety of corn because of the traits requiring more moisture than an earlier maturing variety.

The ultimate degree of severity is largely based off of which factors occur during the growing season. Farmers across the world face these numerous factors and must carefully evaluate them such as we have in the previous sections discussing perceived likelihood and perceived susceptibility.

Section 5.4 – Crop Production Methods

Relating this all to investment tools that help to control and reduce both yield and price risk, such as fertilizers, pesticides, seed traits or genetics, and crop pricing tools it is not uncommon to see investment in these tools. When there is a strong likelihood of occurrence, a high level of perceived susceptibility, and a high level of perceived severity then farmers will utilize these tools to help reduce the overall expected severity.

Farmers can utilize chemicals such as insecticides, herbicides, fungicides or a combination of these products to help their crops reach their yield potential by removing a portion of the expected risk due to the negative yield impacts caused by external factors. If farmers who face expected yield risk due to various climatic factors, insects, and other external factors did not utilize any tools that act as a form of crop protection available to them, the yield they would expect to receive would vary and would be based largely upon the severity of the crop damage.

Farmers will make crop management decisions with the intention of seeing a positive return on their investment in the form of reduced yield loss as a result. For example, when farmers in North Central Iowa apply fungicide to their crops, this is often done to reduce the yield loss due to various crop diseases that will form which may reduce the yield. This is an example of investment in a yield risk tool resulting in an increase or preservation of yield. Farmers annually experience these type of yield variances posed by various pests and must decide what management practice they should utilize in order to either manage or reduce that risk. Farmers in the areas with emerging or developing markets, like Peru, have the least number of tools available to them to reduce their price risk. Farmers in some of these developing areas may have no access financial or price risk management tools at all.

While administering my survey to the Peruvian farmers my final question was always, hypothetically, how much would you be willing to guarantee a corn yield of 117.06 bushels per acre, a good corn yield for a Peruvian farmer. The average answer converted into US$ was 25.61 dollars per acre, which for many American farmers would be a fair price. This amount of 25.61 dollars per acre and represents the willingness to pay for a guaranteed amount of corn for the farmer, factors such as climate, various pests, and other external factors have no impact as this is the guaranteed amount.

Many of the Peruvian farmers were astounded to hear of this and better understood as a result when I would ask about their willingness to pay for a guarantee, essentially the same type of guarantee we would see under a Yield Protection policy through Multi-Peril Crop Insurance (MPCI).

Referencing the above information, Peruvian farmers on average, with substantially less market information have a strong likelihood of being able to more profitable than American farmers if they were to receive that guarantee of 117.06 bushels per acre by paying 25.61 dollars per acre for the guarantee. A guarantee of this portion would greatly reduce the perceived severity of loss if a yield loss were to occur.

To conclude, there are many different management practices that can help reduce the severity of risk in crops. Farmers in developing market areas could gain immensely from price risk tools. However, until they become available in their respected areas, farmers will continue to manage their yield risk as closely as possible. Without any form of a guarantee, farmers can face the likelihood of encountering losses, due to yield risk and price risk factors. Farmers across the world work to utilize various tools to reduce overall perceived severity of loss, if certain losses were to occur.

Section 5.7 – Conclusions

The previous chapters of this paper have discussed the findings of the research surveys conducted highlighting the individual information of Peruvian farmers. Following the introduction, we then shifted to risk propensity, which is the extent to which a person is willing to take a chance with respect to possible loss. After discussing risk propensity, we shifted to risk perceptions or perceived risk and then lastly, we looked at crop production methods, which compared the crop production methods across the South American countries analyzed and the United States.

While looking at risk propensity, it is important to understand that farmers will all react differently when given a set of factors. Their level of risk propensity is what ultimately dictates how they will react when they encounter risk in either yield or price risk. The findings from the farmer surveys helped us to conclude that farmers who utilize technology will have on average a higher level of risk propensity than farmers who do not.

In addition, farmers in areas that utilize technology in developing areas will have a vastly different outlook on the usage and integration of technology than farmers who have been utilizing said technology. Farmers who utilize differing risk management products that are available to them are much less likely to face risk, or when they do face these risks are more likely to positively respond to them. Additionally, risk propensity can shift for a collective group, however, the necessary conditions must align in order for that to happen. If farmers are able to take advantage of increases in technologies available to them and perhaps increase their level of technology utilization, it is likely that farmers who do this will increase their overall risk propensity, meaning they will be more likely to take on additional risks in the future.

Linking risk propensity to risk tolerance, farmers who purchase or utilize expanded levels of technology, especially at an overall younger age, increases their risk propensity and risk tolerances. It is common for younger individuals or young farmers, to have an increased level of tolerance when it comes to making decisions in the face of risk, especially while they can utilize additional agricultural technologies.

Risk perception, was previously defined as the beliefs about potential harm or the possibility of a loss. It is a subjective judgment that people make about the characteristics and severity of a risk (Springer Link, 2019). Farmers in developing areas often will analyze and evaluate different factors that are driven by climatic events or costs of production. This is especially the case in South America as even farmers in Brazil and

Argentina who have greater access to technology than their peers in other countries will still place a high level of importance on evaluating the expected weather events prior to planting. Farmers in the United States place more importance on price information and utilize more risk management tools that work to mitigate price volatility or risk.

There is a difference in cultural value placed on being able to utilize these intangible price risk management tools which results in many South American farmers not placing as high of level of importance in utilizing things such as future and options to their advantage. With this difference in social culture, it is expected that as a result many farmers will not be as well able to manage their total risks, but rather focus solely on more specific risks. When farmers specialize or focus their risk in areas different areas, rather than from a holistic level, there can be many chances for unmanaged risk to negatively impact their bottom-line. Risk perception was broken down into three main components: perceived likelihood, perceived susceptibility, and perceived severity. Each of these different components plays a unique role in influencing farmer's overall risk perception.

Perceived likelihood is the likelihood of a particular event occurring, the focus of perceived likelihood in this section was perceived likelihood of an event occurring that would impact crop yield. Overall findings from the analyzed areas and graphs helped us to conclude that a linkage exists between farmers who have access to advanced agricultural technology and who are younger. Younger farmers who have the access to utilize technology of some kind, especially advanced agricultural technology, will have a greater risk propensity or more favorable outlook (positive and strong perceived likelihood) of an upcoming agricultural event.

In addition, perceived likelihood varies from risk event to risk event and the influencing factors vary greatly. Price risks and their perceived likelihood of occurrence are driven and influenced by the seasonal supply and demand swings in the commodity markets. Yield risks and their perceived likelihood of occurrence are driven more so by climatic factors such as: precipitation, heat, and other independent weather events. Risk susceptibility is another component of the overall risk farmers must also evaluate. Risk susceptibility is one stage beyond risk likelihood, as when we evaluate the risk susceptibility, there is present and assumes a risk likelihood of 100%.

To conclude this section on perceived susceptibility, the results from the survey of Peruvian farmers reflect that the most common response in the survey for the question focusing on which factors farmers evaluate prior to planting was different. The main factor evaluated by Peruvian farmers directly impacted their yield risk susceptibility. This is important to note because farmers in various regions in Peru as well as other portions of South America that do not have the ability to receive frequent and up to date price information are forced to focus and make their management decisions based on factors that they understand.

If farmers in areas of developing markets, had access to the same information and technology as farmers in areas with advanced or developed markets and access to technology we would likely see that the factors evaluated prior to planting would be more similar with farmers in areas that have similarly developed markets and utilization of technology.

Ultimately, farmers today face severe risk all across the world. Farmers who utilize technology or have it available to them will often times be better prepared to face risk that may arise during the growing season. Without these risk management tools that farmers utilize year to year, there would be many less farmers in the world today.

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APPENDICES

APPENDIX A:

Peruvian Farmer Survey

1. Personal Information:

Name: …………………………………………………… Age: ………

2. Field Data:

Section:………………………………………Sector:……………………………………

The parcel I farm is: (Mark with an X that corresponds)

( ) Property ( ) Rented ( ) Loaned from Family

¿How many hectares do you farm? ……………………………....

3. Agricultural Data:

Do you have another job apart from being a Farmer?

………………………………………………………………………………………………

What crops do you plant?

( ) Rice ( ) Corn ( ) Cowpeas

( ) Others…………………………………………………………………………

¿How much profit do you usually receive per crop?

In rice………………………………………………………………………….

In corn………………………………………………………………………….

In cowpeas…………………………………………………………………….

In others……………………………………………………………………….

Do you have animals?

( ) Cows ( ) Goats ( ) Sheep

( ) Pigs ( ) Turkeys/Chickens ( ) Guinea Pigs

( )
Others……………………………………………………………………………….

Primary Questions:

1. What crop is most profitable to grow?
   a. Rice
   b. Corn
   c. Cowpeas
   d. Other
2. Which crop is least expensive to produce?
   a. Rice
   b. Corn
   c. Cowpeas
   d. Other
3. ¿What is the average yield you receive for each crop?
   a. Rice …………………………………………………………….
   b. Corn …………………………………………………………….
   c. Cowpeas …………………………………………………………….
   d. Other…………………………………………………………….
4. On the scale, indicate how comfortable you would feel with the use of a new crop or a new technology, with the risk of winning or losing a lot of money. Assuming an equal probability of both.

   0-----1------2-----3-----4----5-----6-----7-----8----9-----10

5. Do you obtain much, or Little information about the market Price or advancements in agriculture?

6. What factors do you evaluate before you plant your crops?
   ………………………………………………………………………………………
   ………………………………………………………………………………………
   ………………………………………………………………………………………
   ………………………………………………………………………………………
   ………………………………………………………………………………………
7. Hypothetically, how much would you pay for a guaranteed yield of 7,360 kilos of corn per hectare? Indicate the Price that you would pay below.

   S/500…………………………………….

   S/450…………………………………….

   S/400…………………………………….

S/350 ……………………………………….

S/300……………………………………….

S/250……………………………………….

S/200……………………………………….

S/150……………………………………….

S/125……………………………………….

S/100……………………………………….

S/75………………………………………..

S/50………………………………………..

S/25………………………………………..

S/0…………………………………………

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