PERCEPTIONS AND ATTITUDES OF SMALLHOLDER FARMERS IN NORTH CENTRAL FLORIDA REGARDING THE POTENTIAL USEFULNESS OF SEASONAL CLIMATE FORECASTS

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Introduction

Weather and climate influence society and the economy. In addition, year-to-year variations in the timing, intensity, and duration of seasonal precipitation and extreme temperatures have large impacts on people and the physical landscape. Seasonal climate forecasts provide probabilistic monthly or seasonal climate predictions for the forthcoming year, sometimes longer. (O'Brien et al., 1999). Of the many factors that contribute to climate variation, the El Niño Southern Oscillation (ENSO) has been described as one of the most important determinants of year-to-year climatic variability and severe impact around the globe (Cane, 2000).

In the southeastern United States, oscillations of the Pacific Ocean surface temperature above normal (El Niño) and below normal (La Niña) are a major contributing factor of seasonal climate variation. As Breuer et al. (1999) reported, "El Niño typically brings more rainfall and cooler temperatures to Florida in the fall and winter, while La Niña brings a warmer and much drier than normal fall and winter." The understanding of ENSO and its use for forecasting has advanced in recent years (Neelin et al., 1998), especially after the El Niño event of 1982-83. In the southeastern United States the effect of ENSO is observed to be stronger in the south than the north, and stronger in winter-spring than in summer-fall (O'Brien et al., 1999).

Seasonal climate forecasts have only recently been available to the American public. Advances in knowledge of sea surface temperatures (SSTs) have made it possible for climatologists and meteorologists to predict the climate of the upcoming months or season with a modest degree of certainty and provide such information on an operational basis (Mason et al., 2000). Knowledge of seasonal climatic forecasts allows farmers and other users of climate information to develop seasonal management strategies leading to potential improvements in productivity. Although the full potential is yet to be realized, seasonal climate forecasts have shown promise in determining planting dates, irrigation needs, crop types, fertilization, and planting varieties. Expected market conditions, pests and diseases, and the need for farm insurance for upcoming seasons can all be estimated using seasonal forecast (O'Brien et al., 1999).

Groups such as the International Research Institute for Climate Prediction (IRI) and the National Oceanic and Atmospheric Administration (NOAA) provide seasonal climate forecasts for many regions of the world. The Southeast Climate Consortium (SECC) provides seasonal climate forecasts and decision tools based on seasonal forecasts for the States of Alabama, Florida, and Georgia. This information, hosted at [http://AgClimate.org] goes beyond other climate forecasts that predict only three categories: below normal, normal, or above normal conditions. In addition to this normalcy index, the SECC provides farmers with risk assessment indices for three crops: peanut, potato, and tomato.

The science of climate forecasting is still young and more needs to be understood about SST, ENSO, and other factors that affect climate variability. The present level of accuracy (skill) is high in some regions, where the potential applications are considerable. Farmers that use climate forecasts might reduce their exposure to risks associated with climate variability (O'Brien et al., 1999). The purpose of this study was to ascertain the perceptions of small-scale

north Florida farmers, many of whom sell at local weekly farmers' markets, concerning the potential usefulness of seasonal climate forecasts.

Location

The climate of north-central Florida represents a transition between the warm temperate climate of the southeastern coastal plain and the subtropical climate of peninsular Florida. There are four clearly defined seasons, with most rainfall occurring in the summer months. Winters are generally mild, with at least several nights of freezing temperatures. Summers are warm and humid with thunderstorms occurring at a predictable time almost every afternoon. The landscape has been shaped by the presence of a layer of porous limestone lying close to the land surface, which results in the formation of sinkholes, springs, and caverns. Layers of sand and clay cover the limestone, and the land supports a diverse mosaic of forest and wetland ecosystems.

At the time of first European contact, the people now called Timucua were growing maize, beans and squash as staple crops. Wild plants such as red coontie (*Zamia floridana*) and white coontie and (*Smilax smallii*) also formed an important part of the people's diet.

Europeans used the native peoples' land and labor to increase the scale of production in order to support the growing numbers of colonists at St. Augustine and other ports on the coast. A combination of disease and warfare led to the extinction of the aboriginal tribes of Florida and are reduction in agricultural production. Aside from scattered cattle ranches, there was little formal agriculture practiced in north-central Florida until the arrival of the Seminoles in the mid-Eighteenth century. These people practiced subsistence agriculture much like the Timucua. Only after the Seminoles had been driven into the swamps of south Florida did European settlers develop large-scale permanent settlements in the interior of north-central Florida.

During the mid-nineteenth century, cotton became an important export crop in the region and cattle ranged across the landscape in large numbers. After the Civil War, cotton became less important and livestock and citrus became the primary export crops. The relatively cold winters of north-central Florida made large-scale citrus production more practical further south. The vast pine forests of north and north-central Florida provided a source of turpentine, which became one of the most important industries in the southeast. After World War Two, old growth forests had been depleted and the importance of the "Naval Stores" industry waned. Pine trees became important for paper production and the forests were replaced by high-density tree farms.

In the latter half of the twentieth century, crops like watermelon, bell pepper, and peanut became important to the local economy. Smaller farms produced blueberry and muscadine grape, and more recently various horticultural and ornamental crops for sale in weekly farmers' markets. The production of plants for use in commercial horticulture is also a relatively recent phenomenon in north-central Florida. Organic farming has emerged as an important trend in small-scale agriculture in the twenty-first century. These smallholder farmers, many of whom market on a weekly basis at local farmers' markets, were the farmers interviewed for this study.

Target audience and methods

The team used the *Sondeo* methodology developed at, the Instituto de Ciencia y Tecnología Agrícola (ICTA) in Guatemala (Hildebrand, 1981). A *Sondeo* is a multidisciplinary methodology for conversation-based rapid assessment. Multidisciplinary teams include a natural scientist and a social scientist for each interview.

Sondeos are performed without taking notes during the discussion to engender an informal atmosphere and to allow flexibility of topics discussed. Further, the informal nature of the discussion provides freedom to explore the specific concerns of the farmer. The team directs the conversation to elicit the desired information, but does not follow a rigid line of questioning nor impose a formal agenda on the interaction beyond a broad area of interest, in this case, the potential use of climate forecasts. Through conversation and experience drawn from multiple scientific perspectives, the *Sondeo* team obtains diverse data with significant input from informants.

Following each interview team members individually write their notes. Team members then discuss their notes to ascertain validity and inclusiveness, and to elicit additional information that may have been overlooked by individually written notes. After each round of conversations, teams are reorganized to provide a variety of group dynamics throughout the study. The final *Sondeo* report integrates the results of all conversations and the sharing and processing of information among team members. Owing to the conversational nature of the *Sondeo*, it is not quantitative because all informants are not necessarily asked the same questions during the conversations.

This study of farmers in the north-central Florida area was designed to elicit the attitudes and perceptions regarding potential usefulness of seasonal climate forecasts. *Sondeos* focused on small farmers, or "smallholders." This was accomplished through opportunistic interviewing at both farms and farmers' markets. There is a difference between an on-farm interview and an interview at a farmers' market: on-farm conversations tend to take more time, thus allowing greater depth in conversation, whereas market interviews tend to allow a greater number of farmers to be interviewed. Each method of contacting with farmers presents advantages and disadvantages. We managed time carefully so that the team members were able to have sufficient conversation time with each farmer, regardless of the chosen method.

Three teams first conducted transects of the local area to ascertain the natural and cultural context of the study region. Conversations with farmers were subsequently conducted by groups of three students over a two-week period. A total of 15 farmers participated. Some conversations were conducted consecutively with notes taken after multiple conversations, as compared to the standard method of taking notes after each conversation. This modified method was time efficient at the farmer's markets and provided increased exposure to farmers within a time-limited study. Because discussions at farmers' markets were shorter in duration than on-farm discussions, impacts should be negligible. The teams then met as a complete group to share and process the information from the conversations. This final meeting provided a higher-level aggregation and analysis of information and of local trends in farmer perceptions and attitudes regarding the usefulness of climate forecasting.

Findings

Market

Relative to other factors, markets play a large role in farm management decisions. After all, most farmers in north-central Florida produce crops for sale rather than for home consumption. In some cases a farmer makes few decisions beyond whether or not to enter into production of a particular crop: decisions on variety, planting date, and harvest date are prescribed by the buyer. One way to differentiate farmers would be to categorize them based upon their frequency of interaction with the market. Truck farmers may visit local markets twice weekly throughout the growing season to sell their vegetables. In contrast, some single-crop producers make only one sale per year. The relative importance of each market transaction differs for producers across this continuum. Farmers with few market interactions are more dependent on buyer specifications and may therefore have less flexibility in crop management, even though these production systems may be best served by implementing changes based upon climate forecasts.

The contribution of farm production to total household income is another important consideration. Flexibility in farm management for farmers that rely completely upon farm-based production to earn a living may differ from those for whom farm income supplements an off-farm primary income source. Changes in farmer perceptions and willingness to incorporate seasonal climate forecasts across this continuum may not be obvious; those who perceive climate forecasting as potentially beneficial, but unreliable, will have to assess aversion to risk and the potential costs of being wrong. It may be that those who depend less on farm production for income will be those most willing to modify their management based on climate predictions, even if their production systems are not as likely to benefit from the climate modeling as others.

The sensitivity of a particular production system to seasonal climate variation in both the short- and long-term is also an important factor in determining farmers' perceptions and willingness to incorporate climate-based forecasts into their management systems.

The culture of the region affects how market, income, and production system combine to influence farmers' attitudes toward climate forecasts. Many farmers are older and many farms have been in operation for generations. Current management practices are an evolving product of experience and cultural conditions that have emerged in response to socio-economic factors over generations. What a farmer's neighbor is doing can play an important role in what the farmer chooses to do. The following section addresses sources of information utilized by farmers in this survey, and provides valuable insight into who the neighbors are and what they might be saying about farm management.

Sources of information on climate and weather

Farmers reported that they use of a wide variety of information sources for local weather and seasonal climate variation. Many of the farmers stated that they listen to local weather

reports on TV or radio and that these reports are frequently inaccurate and are not dependable sources of information. Two farmers mentioned using the Internet to obtain weather reports, specifically from the U.S. Weather Service and the Florida Automated Weather Network (FAWN).

Some farmers mentioned that they rely on extension agents for information on a variety of farm-related questions, from weather and climate to the use of fertilizers and agrochemicals. Generally, farmers who worked with extension agents trusted the individual and believed that the agent was more reliable than other sources of data. Input suppliers were also cited as a source of climate information.

Many farmers seem to rely on their own experiences, those of their neighbors, and traditional folk wisdom to make year to year decisions regarding climate and appropriate planting times and varieties. Several cited the *Farmers' Almanac* as an important source of information; one suggested that the *AgClimate* website would probably offer little more than the *Almanac*.

Many farmers plant according to the phase of the moon. Several explanations for this were offered. Some believe that insect behavior is related to phase of the moon and pest problems can be avoided by planting at the correct phase. Another farmer stated that moisture is pulled to the soil surface at certain times in the lunar cycle, in the same way as tidal cycles.

Several other bits of folk wisdom were given during the discussions. One farmer plants his spring crops as soon as it is warm enough to comfortably sleep naked. This same farmer mentioned the signs of the zodiac, and "planting on the twins," or during the Gemini zodiac period, as suggested by the *Farmers' Almanac*. Another farmer has a problem with cranes over-wintering in his fields because they eat young plants, especially corn. He said that he delays planting until the cranes have migrated.

While farmers cite many potential sources of information on climate and weather, many of them seemed more attuned to market pressures and competition with regard to decision making. Some communicate directly with buyers and plant in order to have a well-timed harvest for demand. Others regularly plant small amounts of a wide variety of crops, in some cases weekly, in order to ensure consistent a supply for the local farmers' market. Many farmers stated they do not actively seek data on seasonal climate conditions as part of their decision making because their market is relatively fixed and because they have already built risk management strategies into their farming systems as a result of years of experience.

Vegetable producers

Vegetable producers have developed cultural practices that enable them to buffer prevailing negative external effects. They stagger planting dates to ensure a steady production and thus remain in business despite the impacts of market limitations, weather effects, and consumer preferences. Farmers do not operate in isolation. Farmers delimited market zones in south and north Florida, Georgia, and extending to North Carolina. They note the importance of taking advantage of the market window in particular zones. Market windows determine the

amount of time that farmers can economically package and ship produce. During this time, either trucks or trains with packing capacity pick up their produce and transport it to market. However, these trucks may not reach a farmer if the same crop is produced 100 miles closer to the market. Nonetheless, consistent supply for local markets remains an important priority for vegetable farmers.

Despite market restrictions, farmers indicated that they counter the effects of bad weather, such as frost, by staggering planting dates. Diversification of crops within farms seemed to be a security measure as well. These farmers indicated that the more diverse the crops planted in any particular season, the higher the likelihood of consistent production.

Most vegetable producers irrigate their crops.. Producers identified irrigation as an important means to reduce the frost injury.

Some farmers said that a climate forecast could help them position better their crops within the landscape of their planting fields. For example, during a cold and dry period, farmers would plant their crops along low-lying areas.

Cattle

According to one small farmer among those interviewed who produced cattle, seasonal climate forecasts would be most useful to producers whose income depends solely upon cattle production because climate affects harvests and prices. In general, however, interest in seasonal climate forecasts was limited as cattle growth does not depend directly on weather conditions. Production decisions depend instead on market conditions.

Cattle feed mainly on planted, fertilized rye grass pasture. Brahma bulls were introduced to the herd in the recent past so that cattle could better use fodder in the woods during poor pasture years. Because rye grass is a cool climate plant, both planting and harvesting dates are sensitive to climate variation. When the farmer expects high levels of rain he is less likely both to fertilize and to cut hay. However, 2005 was the first year he could remember not fertilizing and not getting a first cutting. The operation cannot afford to retain the normal herd size because of the missed hay harvest. Consequently, the farmer will sell cattle at a lower weight and lower price. The decision to forego fertilization and the initial cutting was based upon advice from a fertilizer dealer regarding the probability of hurricanes striking Florida's coast.

In general, the farmer relies upon management information provided by local weather reports, county extension agents, mail-order publications (e.g. *Cattlemen*), and prayer. Confidence in the extension agents is high; whereas confidence in the weather service is low. Confidence in seasonal climate forecasts might increase if they are consistent with information the farmer obtains from other, more familiar, sources. Only then would climate forecasts become a factor in farm management decisions.

Orchards

Orchards are lands used principally for cultivating tree fruits and nuts. In addition to food production, orchards can be managed for recreation or aesthetic value. Commonly, orchards are highly controlled and intensively managed. Florida's subtropical climate is suitable for the culture of many fruit and nut trees; however, the trees require the application of several agricultural inputs. Sustainability and profitability are not always correlated in these systems. Nevertheless, some of the more difficult crops to grow, such as southern high-bush blueberries, can be extremely profitable under the right circumstances. In contrast, muscadine grape production is highly sustainable but offers low profitability and market potential. In order to decide what species or cultivar to use, farmers account for the specific characteristics of the site. The adaptability of a given species is region specific.

One major cause of fruit crop loss is freezing temperatures during late winter or early spring, during flowering and early fruit development. Damage during this critical developmental period may cause rapid loss of flowers and fruits, or injure fruits; either of which can be devastating. Variety selection, adequate site selection and preparation, pruning, flooding, and overhead irrigation are practices that are used to mitigate freeze damage.

Conclusions

For the small farmers interviewed, the practices that could be introduced in their farming systems by incorporating seasonal climate forecasts may not significantly differ from those that are already part of the existing management strategies. Consequently, the potential benefits of using seasonal climate forecasts to capitalize on or mitigate climate effects are relatively low for both vegetable and orchard production systems as compared with row crops and livestock (Figure 1).

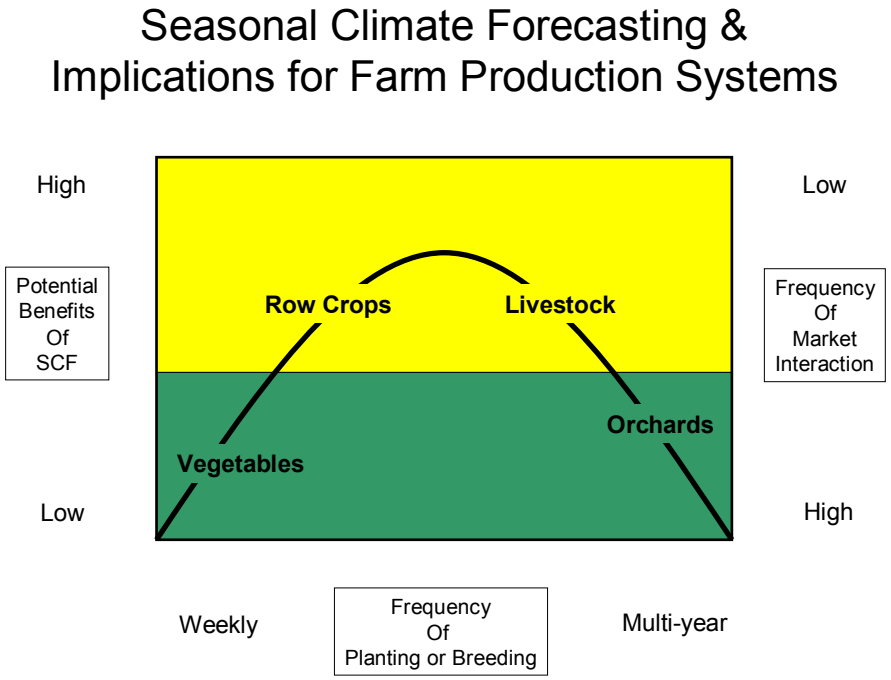
Management for Environmental & Market Factors

Most of the small farmers surveyed already use techniques that reduce environmental risk. Small-scale **vegetable producers** planted different crops and varieties on multiple dates to minimize exposure to severe weather and adverse seasonal climate trends. Similarly, fruit and nut **orchard managers** planted different fruits and varieties to accomplish the same effect, but in a system that permits far less short-term decision-making. The result is that while vegetable farms and orchards differ significantly in their planting flexibility, they both have developed management systems that effectively mitigate environmental risk.

In contrast to vegetable production systems and orchards, **row crop farmers** seldom have more than one opportunity per growing season to affect crop composition. It stands to reason that increased knowledge of the climatic conditions for the coming growing season would be of greatest benefit to those who have the least ability to respond after planting. Likewise,

livestock producers must make pasture management decisions early in the growing season: fertilization and irrigation of pasture can directly affect carrying capacity and individual animal growth. However, unlike row crop systems, livestock producers might use seasonal climate forecasts to help with decisions for several management options: how many head to buy, how many to sell, when to plant or fertilize forage, when to buy hay, and when to first cut forage. While these options may not result in ideal management, they impart a greater flexibility to the production system.

Figure 1:



The high frequency of farmer-market interactions in vegetable and orchard production systems relative to row crop and cattle production systems lessens the potential benefits of using a seasonal climate forecast (Figure 1). The financial success of systems with high frequency of market interaction (i.e. weekly) depends less on the outcome of a single transaction. Row crop and livestock producers, in contrast, typically have only one opportunity to sell their product at the end of the growing or production season. Demand and prices are subject to significant changes outside of what is typically a small window of time. The commodity nature of row crops and livestock also increases the possibility that, through futures markets, overall demand and prices for a region are fixed well in advance of harvest or livestock sales.

Market related events that occur in other growing regions can affect farmer management decisions. Markets in competing production regions might directly or indirectly reflect climate affects on production in those regions. Decisions base on such events are reactions that may be indirectly related to seasonal climate, though the window of opportunity is often too narrow to make any changes to the production system. Nevertheless, one of the benefits related to these out

of region events could be a price differential realized within the region. Consumer demands and expectations drive many planting decisions.

Although we only had the opportunity to interview one farmer from both the row crop and livestock production systems, we conclude that they are potential beneficiaries of a seasonal climate forecast, but that row crop farmers are less likely to be adopters than the livestock producers. Specifically, management options for row crop farmers may be more limited due to prior investments in planting, harvesting, and processing equipment specific to a particular crop or variety, and by the inherent characteristics of the markets including wage differential paid from state to state. We therefore conclude that small livestock producers have the greatest potential to benefit from seasonal climate forecasts, a result supported by a previous *Sondeo* of large livestock producers (Breuer et al., 2000).

Although the farmers use a number of sources of information, due to the trust the farmers expressed in extension agents, we conclude that the Extension service is an important source of information for producers concerning seasonal climate forecasts for those farmers for whom it is appropriate.

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