Chapter 03

Seasonal Climate Forecasts and Agricultural Risk Management: The social lives of applied climate technologies

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1. Introduction

There are two aspects to any technological or scientific innovation. First, there is a material aspect, the physical object itself, be it a plastic rain gauge or computer program designed for coupled atmospheric modeling. Research on the material side of technology addresses the ways that it functions technically and its relationship with the physical world. However, technological and scientific innovations also all have a social side. The social aspect of technologies encompasses the ways that people relate to the technology and the ways that it is constituted by, integrated into and sometimes even transformative of social relationships and social structures (Jasanoff 2004; Woolgar 1996).

Since the 1980’s, advances in climatology have significantly increased the quality of seasonal climate forecasts based on the El Niño Southern Oscillation (ENSO) cycle in many parts of the world (Hansen et al. 1998; Patt et al. 2008; Selvaraju 2003). Because ENSO variability affects many different economic sectors – such as power utilities (Changnon et al. 1995), water resource management (Pulwarty and Redmond 1997), fisheries (Broad et al. 2002) and agriculture (Meinke et al. 2006) – much effort has been put into developing
ENSO-based decision support tools. But refinement of forecasting science and technology has not consistently translated into broad use of the resulting information in decision-making. In order to realize societal benefits of seasonal climate forecasting technologies, they must work their way into end-users’ information stream and decision-making processes, linking social and technical aspects of the system.

In the context of a project developing climate applications, climatologists research the biophysical phenomena and contribute to the creation of technologies themselves (in this case climate models, forecasts, and agronomic models based on climate variability), social scientists examine social systems and management behaviors, and the ways that climate-based technologies interact with them. Social science research is useful in theorizing the nature of the relationships between technological and social change, but it also has practical applications when it is conducted in collaboration with the developers of technology. The research presented here illustrates 1. the social dimensions of climate information tools in the context of agricultural risk management in southern Georgia (US), and 2. how social science can contribute to the creation of technologies that are better suited the end-users’ needs and to the realization of the societal benefits of climate sciences.

Terms: Holism

Holism is the idea that a system is best understood by analyzing the way it functions as a whole, rather than breaking it down and analyzing its component parts separately. Holism is a hallmark of anthropology as a discipline, which seeks to analyze interactions and processes involved in all aspects of human cultural and ecological systems.
2. Methods and Data

Stemming from the above observations, the primary objective of our research was to examine the potentials and constraints for farmers’ use of probabilistic seasonal climate forecasts as risk-management tools. In order to understand the “social life” of climate forecasts and provide useful feedback to forecast developers, we adopted a holistic approach to understanding farmers’ decision-making processes. This meant that instead of examining individual management decisions in isolation, we sought to understand how those decisions relate to the broader socio-cultural contexts in which they are embedded. The benefit of the holistic approach is that it can lead to a better understanding of how seasonal climate forecasts are understood from farmers’ perspectives. It addresses not just how climate forecasts can affect individual decision-making, but how their use as information inputs is situated in, and may influence, broader social relations that constitute the agricultural system.

In order to address these objectives, during the winter of 2007, we conducted semi-structured interviews with 38 farmers in 21 counties across southern Georgia (Figure 1), where the ENSO signal is most significant. The semi-structured interviews centered on the relationship between agricultural risk management and climate variability, with an eye toward potential

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1 The informants for this research came from a variety of rural productions systems, including row crops, cattle ranching, fruit and vegetable production, pine production, swine production, etc. However, for the purposes of this paper, we will use the label “farmers” to refer to all of these rural producers and natural resource managers.
applications for seasonal climate forecasts. At the beginning of the interview, we introduced the technical aspects of the SECC’s forecasts, such as the ENSO phenomenon, the geographic scope, probabilistic representation, etc.. Through the course of the interviews, farmers discussed how climate variability related to non-climate factors in decision-making. Furthermore, we sought to understand how farmers situated agricultural management practices within farmers’ overall livelihood strategies. The interviews ranged in length, from 45 minutes to two hours, depending on farmers’ time constraints and their inclination to talk at length.

All of our interviews with farmers were arranged and facilitated by county agricultural extension agents. The first step of this process was to contact the administrators from extension service and explain the purpose of our project and receive the support. Then, one month prior to the planned fieldwork, we contacted a list of extension agents in a cluster of counties, explaining the overall research project as well as the objectives of our interviews with

![Figure 1 – Study region.](image_url)
farmers. The agents, in turn, contacted some of their farmers and arranged a schedule for the interviews. Our initial intention was to focus on farmers, but we realized that the extension agents themselves also had a wealth of information and could act as intermediaries, clarifying questions to farmers and responses to interviewers. Consequently, we frequently included the agents in the interviews, along with the farmers.

Upon completion of the fieldwork, the research team transcribed the interviews and then analyzed the transcripts using NVIVO, a software designed for the analysis of qualitative data. Our process of text analysis involved coding the transcribed text, using a coding scheme developed by the research team, in order to analyze the recurrent themes in the interviews and understand how they relate to each other. Formal coding of the interview transcripts, which has done by the first author and then reviewed by second author, enabled us to both aggregate and analyze the data in a systematic way.

3. Results

The first step to understanding how farmers might be able to use seasonal climate forecasts is recognizing the key management decisions they make through the course of a growing season, and the calendar for those decisions. Interest in climate forecasts varies by agricultural sector, by farming strategy and by time of the year. For example, row crop farmers are most concerned with onset of spring rains and the quantity and distribution of summer rainfall, fruit and vegetable growers are most interested in the last spring frost/freeze dates, pecan growers want to know about hurricanes during the fall harvest season and pine foresters are most focused on winter rains. Even within the same sector, the
timing of climate information needs varies substantially according to geographic region. In the tomato sector, for example, growers in central Florida need information about probabilities of frost and freezing more than a month earlier than tomato growers in central Georgia.

The information we gathered on farmers’ decision-making calendars across different agricultural sectors in the Southeast highlighted the fact that various users would need updated forecasts virtually every month out of the year. This insight contributed to a shift in how the SECC produced its Climate Outlooks. We had originally been publishing them quarterly, but the realization that our end-users’ collective information needs were effectively constant led the SECC to publish climate outlooks monthly, thus making the information more relevant and timely for end-users.

Farmers identified a variety management decisions with the potential to be influenced by climate forecasts (see Table 1). As demonstrated by research elsewhere (Phillips et al. 2001; Roncoli et al. 2009), interest in seasonal climate forecasts was often focused on capitalizing on favorable conditions rather than minimizing potential negative impacts. For example, during years with ample rainfall, many farmers said they would want to plant more corn, a high-value but high-risk crop, instead of cotton or peanuts. Variety selection is another adaptive response to climate forecasts frequently mentioned by farmers. For example, within a particular crop, some varieties are better adapted to certain conditions. In fact, one of the first recorded instances where SECC forecasts were applied in Georgia has come in the form of variety selection. The 2006 growing season was forecast as having increased probability of lower than average summer rainfall. In Irwin County, Georgia, this

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*Textual analysis is a broad methodological arena, with a wide variety of qualitative and quantitative approaches. We recommend using (Bernard and Ryan 2002) as a good starting reference for understanding textual analysis, but be warned: it isn’t necessarily as simple as it sounds.*
information was passed along to farmers by the extension agent in his weekly column in the local newspaper, along with the suggestion that farmers consider growing a peanut variety that matures more quickly and is more adapted to drought conditions. The agent reported that this suggestion was widely adopted, and that adopters saw better yields than those who stuck with long-season varieties.

Most farmers are not accustomed to using 90-day climate forecasts as anything more than interesting conversation pieces. Consequently, for them, assessing the potential uses of seasonal climate forecasts was at best an exercise in imagination. Following this discussion, farmers often observed that the information may be interesting, and potentially useful, but “The real question is, how accurate is the forecast?”. Accuracy and reliability of seasonal climate forecasts are the most important questions when farmers consider actively using them to inform management practices. Farmers however are inclined to assess accuracy and reliability using their own standards in contexts of their own

Table 1. Identified management decisions

<table>
<thead>
<tr>
<th>Potential use of climate forecasts</th>
<th>Frequency of mention</th>
</tr>
</thead>
<tbody>
<tr>
<td>Crop selection</td>
<td>23</td>
</tr>
<tr>
<td>Planting timing</td>
<td>16</td>
</tr>
<tr>
<td>Input management</td>
<td>14</td>
</tr>
<tr>
<td>Land management</td>
<td>13</td>
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<tr>
<td>Variety selection</td>
<td>11</td>
</tr>
<tr>
<td>Marketing strategy</td>
<td>8</td>
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<tr>
<td>Harvest timing</td>
<td>4</td>
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<tr>
<td>Insurance strategy</td>
<td>3</td>
</tr>
<tr>
<td>Herd management</td>
<td>2</td>
</tr>
<tr>
<td>Hog lagoon management</td>
<td>1</td>
</tr>
</tbody>
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N=38
operations, rather than by using statistical criteria. This underscored the fact that scientific measurements of accuracy don’t get the final word when it comes to end-users’ assessments of information.

Our interviews indicate that forecasts’ relative degree of certainty compared to other variables is a key factor for farmers when trying to assigning weight to the information. Although climate variability has a significant impact on agricultural production (Legler et al. 1999), a wide variety of non-climatic factors also inform agricultural risk management (see Table 2). While each of these factors is also somewhat uncertain, farmers are inclined to put greater weight on such factors, that have a higher degree of certainty than climate forecasts, when calculating risks and adaptive management responses. The example below, from a farmer who also has a peanut shelling business, illustrates the some of the complex and fuzzy calculations that goes into the seemingly simple decision of whether to grow corn in the upcoming season.

Well, we don’t know where we’re going to fit in with corn yet. That 300 acres of cotton, part of that may be corn. It’ll probably be more like 200 acres cotton and 100 acres corn. I don’t think we’ll replace peanut acres with corn. That’s probably contrary to what a lot of farmers around here are doing. Corn is probably going to replace peanuts. But we’re in the peanut business, first of all, and our insurance guarantee on cotton is not very good, and its real good on corn and peanuts, so from that standpoint we’re leaning toward those two crops, and not as much cotton…. On dry (unirrigated) land, we’ll have some peanuts, some cotton, some corn. Yeah, we’ll plant some dry land corn. We haven’t been growing a lot of corn over the last 10 years. Back when we were growing tobacco, we’d only plant corn around the edges of the tobacco fields as a windbreak to protect the tobacco. [Despite] not having been growing much corn over the last 10 years, we’ve made some really good corn. Our yields are really high, even our dry land yields, so our insurance guarantee is really high, even on dry land, so we may plant some dry land corn. I can afford to take the risk of a drought, because I’ll be protected by federal crop insurance. Some of the soil is heavy for us, Tifton-type soil, about as good as it gets around here.

While climate variability can significantly affect the relative success of corn farming vs. cotton or peanut farming, climate forecasts do not appear to figure
into the farmer’s thinking. Instead, he refers to market conditions, government policies, agronomic history, insurance guarantees, his degree of technological investment, agroecological conditions, household economic situation, and even his social position (as a peanut sheller) as factors that influence his decision-making. All of these issues are seen as having greater relative degrees of certainty than seasonal climate forecasts. Moreover, they are factors that the farmer has a history and habit of considering, so they have a track record within the farmer’s own operation. In order to affect farmers’ risk management behavior, seasonal climate forecasts must fit into this broad array of considerations, they must have a comparable degree of certainty, and they must have an explicit and accessible track record upon which farmers can draw to achieve a comfortable balance of confidence and caution.

Agricultural extension agents repeatedly told us that large-scale, heavily irrigated farmers were not very interested in seasonal climate forecasts as risk management tools. Irrigation serves as a technology that mitigates vulnerability to drought, thus diminishing their interest in adapting to seasonal climate patterns. Consequently, our sample is biased toward mid-range row-crop farmers with limited or no irrigation, who were more likely to use seasonal climate forecasts to their advantage. Therefore, seasonal climate forecasts may be more
likely to benefit smaller and flexible operations, if their owners can successfully access and apply the information in a timely manner.

While a seasonal climate forecast is information that is applied by individual decision-makers, the sum total of these individuals’ decisions can create an aggregate effect in the agricultural system overall, raising a variety of social equity issues. These issues address the question of how benefits are distributed across actors in the agricultural system: Who is most capable of accessing, interpreting, and leveraging forecasts to their competitive advantage? How does one actor’s use of the information impact other actors’ ability to benefit from it? Does the introduction of this new information resource put some people at a competitive disadvantage? (for examples, see Broad et al. 2002; Lemos and Dilling 2007). While our research was not centered on these questions, preliminary findings are indicative of potential for uneven distribution of benefits of seasonal climate forecasts.

However, when considering the potential systemic implications of seasonal climate forecasts, farmers recognize that they will not be the only people to use forecasts. Farmers even expressed concern that climate forecasts could affect profitability negatively because of the ways that they might be used by other actors in the agricultural sector. Reliable seasonal climate forecast would also be used by crop insurers, agricultural lenders, commodity speculators, input vendors and other actors. All of these institutions are affected by climate variability and have significant impact on farmers’ management strategies and profitability. Furthermore, large financial institutions have greater human resources to put toward accessing climate information and a stronger position from which to leverage it.

In both Brazil (Lemos et al. 2002) and Zimbabwe (Phillips et al. 2002), for example, agricultural banks responded to forecasts for increased

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To see the Southeast Climate Consortium’s primary outreach portal for the agricultural community, look up www.agroclimate.org. Feedback is always welcome!
probability of drought by tightening credit. Modeling this process shows that when farmers adopt recommended responses to forecasts, financial performance improves over the long-run, but also exhibits significant interannual volatility (Phillips et al. 2002). In an agricultural system where farmers are already spread thin by heavy debt loads, such extreme volatility has the potential to send many beyond financial viability thresholds. While it is often difficult to fully predict how the benefits of new technologies will be distributed in society, good intentions must be balanced by a consideration of likely systemic effects in order to serve the needs of intended end-users.

One of the key lessons in addressing inequity in access to forecasts is being mindful of how dissemination is conducted (Broad et al. 2002). In recognition of this point, the SECC has diversified its outreach and research activities to reach underserved populations who are often not reached by conventional agricultural extension services, such as African-American and Latino farmers, as well as the growing sector of organic farmers. This effort has centered on partnerships with key boundary organizations that have a history of service and high level of credibility among these populations, such as the Federation of Southern Cooperatives, and the North-South Institute, and Georgia Organics. By focusing more effort on research and outreach among underserved sectors of the agricultural economy, the SECC and partners aim to offset imbalances in the capacity to use and benefit from seasonal climate forecasts.

4. Closing thoughts

The case study discussed in this chapter has shown the importance of understanding the decision-making context into which the climate information tools are introduced, such as the ways that people interact with the information, the non-climate factors that shape decision-making, and the potential systemic affects of various actors’ differential capacity to access, process and apply the information. By using what Morss et al (2005) called an “end to end to end” approach, social science research can be incorporated into the development of climate information systems with the goal creating products that integrate with end-users’ existing material circumstances and information use habits.
Furthermore, recognizing the many other non-climate considerations that shape and constrain risk management facilitates the development of a more realistic assessment of the potential for climate information systems to inform and transform people’s behavior.

Integrating social science research with the development of climate applications should not be seen as a means of convincing the public to use information tools or change their behavior to what scientists deem rational. Instead, the study of the social life of technologies should be seen as a way of changing the way technological development itself is practiced, so that it is more directly linked with end-users’ needs and interests, while considering the broader contexts and practical constraints of their everyday lives. In effect, it is more about changing scientists’ attitudes and behavior in ways that ensure that their work be more relevant and useful to end-users.

5. Acknowledgements

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6. References


