Risk Perception and Needs: Defining Extension's Climate Change Adaptation Role[1]

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*Many Extension professionals are unsure of the best approach to educate clients about climate adaptation. This fact sheet identifies differences in risk perception as a basis for addressing climate adaptation needs. It is the third in an Extension series and builds upon concepts covered in "*Challenges in Communicating Climate Change to Extension Audiences*" and "*Strategies for Communicating Climate Change to Extension Audiences*."*

Climate variability threatens the productivity, profitability, and, potentially, the viability of traditional agriculture, livestock and forestry operations, and existing community infrastructure. Our clientele may be united in seeking solutions to offset risk, even though they differ in their views on the causes of climate variability. Addressing audiences' needs is the first step to successfully increase resilience or adopt new methods for minimizing loss, reducing temperature stress, and diversifying management to avoid catastrophic crop, feed, livestock or capital loss. Perhaps more than ever, Extension professionals will be the conduit for sharing research with farmers, communities, and forest landowners on climate adaptation strategies and actions. This foray into adaptive changes on a grander scale may demand heightened use of facilitation and communication skill sets to assist farm and forest decision-making and dissemination (James, Estwick, and Bryant 2014).

After the challenge of communicating climate change, the biggest obstacle to climate adaptation programming is understanding audience perceptions of risk. Risk perception can be the common denominator for addressing appropriate adaptation programming. This discussion will begin with an overview of risk, then move to unique client needs and broader audience concerns.

Risk Perception

Most Americans do not perceive climate change as a threat to their well-being. This moderate perception of risk constrains the likelihood of political, economic, and social actions (Leiserowitz 2006). According to Epstein, people process information when perceiving risk in two parallel "modes" or systems: 1) rational and 2) experiential (Epstein 1994). The two informational processing systems are contrasted below (Table 1.)

Table 1. Contrasting two dominant risk-information processing modes.

RATIONAL	EXPERIENTIAL
Factually based	Emotionally driven
Analytical	Holistic
Logical	Affective
Deliberative	Intuitive
Communicated as:	**Communicated as:**
Symbols	Images
Words	Metaphors
Numbers	Narratives

1. This document is FOR335, one of a series of the School of Forest Resources and Conservation, UF/IFAS Extension. Original publication date April 2016. Visit the EDIS website at http://edis.ifas.ufl.edu.

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The relevance of this table is twofold. As Extension professionals, we are most comfortable in the rational mode—conveying science or research results in an effort to transfer new knowledge and better practices with numbers and words. However, in the case of climate adaptation, we are more likely to move individuals to action by adopting an educational approach based on imagery, case studies, and stories--one designed to appeal to the emotions and build experience as well as provide information. Stated more succinctly, "experientially derived knowledge is often more compelling and more likely to influence behavior than is abstract knowledge" (Epstein 1994, page 711).

The experiential approach will seem straightforward in regions of the country where clientele have already begun to experience climate variability in the form of longer growing seasons, higher temperatures, and deviations in average precipitation. It will seem less straightforward in regions where climate variability is less pronounced. Fortunately, our goal is to prompt climate adaptation actions, rather than change audience mental models or belief systems regarding political or religious views. In order to accomplish our adaptive mission, we will have to draw on historical success with innovation adoption (Rogers 2003). We will need to use our existing communication networks, trusted expert delivery, opinion leaders, and the five diffusion stages—knowledge, persuasion, decision, implementation, and confirmation (Rogers 2003)—to explore and critique new strategies to reduce their risk.

More important, perhaps, is the likelihood that not just Extension professionals but all stakeholders should be experimenting locally to find appropriate adaptive solutions. Our clientele will be searching for answers that are harmonious with their operational philosophies. Our role as change agents will be to encourage and support this experimentation, and then communicate solutions among producers (Westley et al. 2011). Researchers will be working to prove the scientific worth of local solutions that bubble up from producers. This wholesale change of the traditional "top-down" land-grant delivery system is illustrated in the organic farming movement, where researchers are bringing scientific legitimacy to locally derived management in cooperation with innovative growers—often after the local techniques are established or proven. In essence, the roles of researcher and farmer, rancher, and forest landowner will be reversed.

Below are examples of five Extension audiences and general trends for Extension programs that may be useful to those audiences.

Farmers are keenly aware of weather patterns and trends because their profitability depends on a successful harvest. Farmers are acutely aware of changing weather patterns, yet may not attribute changes in the Earth's atmosphere to human activities. So, begin farm adaptation programming with observations of changes in flowering times, migration, or weather to encourage discussion and explore potential actions farmers can take to avoid risk.

Forests at Risk

1. Rising temperatures, drought, and fires may lead to forests becoming a weaker sink or a net carbon source by 2100, and as soon as 2030 in some US regions (USDA 2012, IPCC AR5 2014).
2. Pervasive droughts, fire, and insect outbreaks put mitigation benefits of the forests at risk (IPCC AR5 2014).
3. Forest disturbances and climate extremes will effect carbon balance—some forest ecosystems already responding (IPCC AR5 2014).
4. In North America, growing seasons are lengthening, causing an increase in carbon intake through photosynthesis (Serakos et al. 2014).
5. In North America, increased growing season will cause a northward shift of the geographic ranges of many species, affecting landscapes and habitats (Serakos et al. 2014, Prasad et al. 2007).
6. Droughts and precipitation increases will likely alter the range of species at the forest's ecological edge (Serakos et al. 2014).
7. Projections of 24 and 38 million acres of forests will likely be converted to other uses between 1997 and 2060, with more than half of the forecasted forest losses in the South, and more than 90 percent to occur in the eastern United States (Wear 2011).

Changes in atmospheric carbon dioxide, temperature, and precipitation patterns will affect agricultural productivity in some areas of the nation more than others (Walthall et al. 2012). Some regions and crops will be "winners," whereas others may experience climate problems. Fortunately, there are low-cost, lower-risk management changes that farmers can make to respond to changing projections, including changing their planting times, using a seed source from a different latitude, choosing new varieties, and altering irrigation regimes. Changing climatic conditions are already impacting the ranges of weed and pest species, making some crops more vulnerable at their ecological margins. Farmers will understand the need to adapt their management plans to combat new weeds, even if they disagree that climate changes are the cause of the new weed threats. Encouraging farmers to experiment on a small scale may generate an experiential basis for local farming suggestions and successes. Research from local universities combined with peer solutions may be more helpful than national guidelines.

Agriculture in the United States has historically been most successful when dynamic and adaptive: changing to capitalize on emergent markets, vagaries of weather, and fluctuating input and market prices. While the climate has been relatively stable over the last 100 years, increased climate variability will prompt flexibility, adaptation, farmer ingenuity, and marketing prowess. Capturing and sharing success stories and examples of other useful solutions will be important; building a network of farmers willing to share their ideas and outcomes could be a critical Extension role for the future.

A small sample of projections for crop farmers follows: (James, Estwick, and Bryant 2014)

- A shift in climate and agricultural zones toward the poles.
- A boost in agricultural productivity due to increased carbon dioxide in the atmosphere.
- Pronounced droughts and floods due to changing climatic conditions.
- Rising temperatures, which are expected to bring heat waves, melting glaciers, and ice sheets; and rising sea levels with major consequences for global food security.
- Numerous weeds, pests, and diseases thriving under warmer temperatures, wetter climates, and increased CO_2 levels.
- An increase in heat waves, which could negatively affect the livestock industry and eventually increase livestock susceptibility to disease, reduce fertility, and reduce milk production.
- Drought-related significant reduction in quality of available pastures for livestock grazing and threaten pasture and feed supplies.

Understanding Farmer Acceptance of Adaptive Options

Extension agents have always understood that producers will adopt the practices agents recommend only if those practices are socially acceptable in the producers' communities. By understanding farmers' acceptance of adaptive techniques, educators can focus efforts on actions most likely to be deployed. For instance, a recent survey of Southeastern farmers showed that conservation tillage, high-residue cover crops, nitrogen management strategies, and web-based "Agroclimate" decision-making tools were significantly more likely to be deployed by farmers than three other techniques suggested by specialists and technology transfer agents (sod-based rotation, variable-rate irrigation, and micro irrigation) (Bartels et al. 2012).

Ranchers are invested in their livestock. In some regions, temperature stress on livestock and poultry is a concern (Walthall et al. 2012). Climate change will affect US rangeland vegetation growth and distribution through temperature and precipitation variability. Climate extremes, drought, and climate-induced livestock stress will be distributed asymmetrically. According to the USDA's "Animal Agriculture in a Changing Climate" project (http://animalagclimatechange.org/), expected climate challenges to livestock operations include increased diseases and pests, greater livestock stress, extreme weather and storm events, drought, and market uncertainty. Uncertainty abounds within the agriculture sector, and topics for further research include regional climate variability, vegetation dynamics, and complicated interactions and feedbacks related to temperature and precipitation variability (USDA 2016).

Climate changes on US rangelands brought about by drought and extreme storms alter growing seasons. These changes will affect productivity/profitability most notably from the economic costs of disease prevention and adaptations made for heat and drought (like shade, shelter, ventilation, and misting and watering systems). While predictions for northern latitudes seem beneficial with warming and increased precipitation, successful adaptation will involve capturing market advantage, taking advantage of emerging markets within an atmosphere of cost reduction, and making wise risk-avoidance investments. Threats to livestock populations are valuable harbingers of threats to human populations. Disease, heat-related illness and death, allergens, and vector-borne diseases that sicken and kill stock also hurt vulnerable people; thus, future research on climate drivers and confounding factors has great potential benefits not just for animal agriculture sectors but for people, too (National Academy of Science 2011). As always, Extension's ability to link ranch/livestock programming to locally identified risks and target programs effectively to meet audience needs will be key to success. Staying informed and instantaneously alerting producers of

Agriculture on the Edge			
Climate change also affects agriculture and crop yields around the world. With 40% of Earth's land surface occupied by cropland and pastures, a shifting climate may alter agricultural locations, techniques, crop choices, and yields.	IPCC reports predict that climate change will bring drier conditions to already dry areas while bringing more precipitation to temperate and tropical areas.	An increase in atmospheric CO_2 and temperature may improve one crop and harm others. Scientists have shown that an increase in atmospheric CO_2 will improve corn-crop yields because the plants will assimilate more CO_2.	However, an increase in atmospheric CO2 may decrease yields in other grains such as rice and wheat (Serakos et al. 2014).

impending heat waves and other extreme weather will be instrumental as Extension increases trust, becomes a go-to adaptation source and develops future program support and success.

Forests rely upon fewer human inputs than agricultural systems (less irrigation, fertilizer, and pesticide treatment) but grow over a much longer time and therefore will be exposed to future climate variations. Forests may become more stressed by changes in atmospheric carbon dioxide, precipitation, temperature, and nitrogen deposition, but the more significant changes are likely to be due to wildfires, insect pests, disease, erosion, flooding, and drought (Vose, Peterson, and Patel-Weynand 2012). Some areas will be more vulnerable than others. Forest landowners have an opportunity to manage their resources to help mitigate climate change by maximizing carbon sequestered in wood, root, and forest soil. Some producers may opt for carbon management over traditional wood products as carbon markets become established and provide income. Wood products may become more popular where they can replace materials that emit or generate carbon, such as concrete and steel in building construction and fossil fuels in energy production (Perez et al. 2005).

Forest landowners constitute a challenge to interpreting climate change needs because of their diversity in ownership objectives and the scarcity of research. The National Woodland Owner Survey offers a unique insight on the interest and needs of this audience. The 2011–2013 preliminary data from North Carolina suggest the top five "environmental" concerns all have a link to future climate variability. In descending order they are wildfire, insects and disease, wind and ice storms, water pollution, and invasive species (Butler et al. 2014). Forest owners tend a long-term resource that typically requires very little management. This might suggest to forest landowners that there is not much they can do, and they thus may not have not invested much energy to learn about the problem or solutions (Krantz and Monroe 2013).

Interested private landowners who are Extension audiences may be motivated less by income from their forests and more by desire to be a good steward of their forest resources (Krantz 2014). Targeting economic and stewardship objectives can foster management strategies that increase forest resilience and solutions that yield multiple benefits, like maintaining healthy forests to provide habitat for wildlife, to maintain water quality, or to minimize invasive plants or disease. Landowners who are motivated by stewardship of the land may value the results of adaptive climate actions regardless of whether they resist or accept messages about human causes of climate change.

Coastal residents and planners are experiencing sea level rise, extreme weather, coastal storm surge, and flood from extreme events. Risk and vulnerability assessment are often spurred by the local threats, such as devastating storm surges, hurricanes, seasonal high tides, subsidence, and eroding shorelines (Burkett and Davidson 2013). Some decisions—for instance, electing to repair or reinforce infrastructure (transportation systems, water systems, waste treatment facilities, etc.)—are currently expensive, but the priority to plan for disasters is being prompted by visionary decision makers.

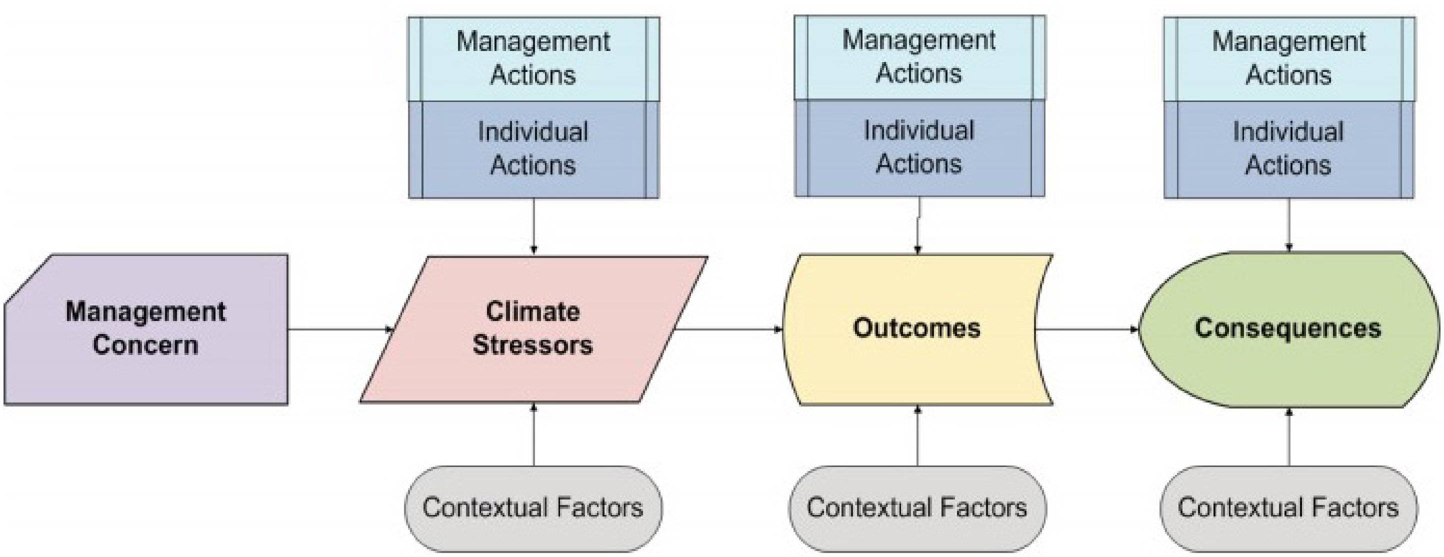

Figure 1. VCAP Vulnerability Diagramming Process for Community Climate Change Stressors (University of South Carolina et al. 2011).

Once a community determines its top-priority threats, whether they are saltwater intrusion to water supplies, flooding and inundation, faltering estuary ecosystems, or compromised waste water treatment systems, Extension can facilitate and lead community efforts to mitigate those threats. One noteworthy Extension effort toward building coastal communities' capacity to adapt to climate change is the Vulnerability and Consequences Adaptation Planning Scenario (VCAPS).

The VCAPS process prompts decision-makers in coastal communities to diagram potential climate stressors, their impacts to the community, and the consequences of those impacts for municipal management. Community managers create their own diagram of locally tailored information about climate change issues, impacts, and potential consequences for coastal communities (VCAPS 2011).

Homeowners and citizens who are not specifically connected to any of the above audiences may wish to be engaged in climate solutions. Their sense of moral responsibility or their interest in maintaining a comfortable world for future generations may fuel this concern. They may wish to mitigate their contribution to greenhouse gas emissions by conserving energy, reducing their reliance on fossil fuels (installing solar panels or water heaters; investing in a hybrid vehicle), reducing their consumption of products in general, relying more on locally produced food and resources, and helping to build a community of concerned and responsible citizens. Extension can support all of these efforts by providing information about local resources and strategies for making decisions about preferred products. The Sustainable Living program, now Living Green (livinggreen.ifas.ufl.edu), offers suggestions for resources, workshops, and strategies for leading groups to consider a variety of options for mitigating climate change, including carpooling, public transit or bike commuting, installing insulation, weather stripping, replacing energy-inefficient appliances, choosing lighter roofing colors in warmer climates, opting for fuel efficiency at next car replacement, and replacing drafty old windows with new, energy-saving models (Apel et al. 2010).

Best Practices for Climate Communication

Once Extension professionals have established themselves as a trusted source of useful adaptation strategies, clients will likely request additional climate background information for decision-making in context. Colleagues from across the United States have noted successful practices that can advance clientele toward climate resilience. Fischhoff (2007) suggests that climate change communication campaigns (4C) are best approached as a team effort (with interdisciplinary focus):

- Climate scientists (know the nature of the risks and potential responses),
- Social and decision scientists (know how to craft useful information to a target audience), and
- Communications professionals (know how to get the information conveyed—reach and frequency—to be noticed and considered by target audience).

For additional insight on successful communication strategies please see the first two factsheets in this series: "Challenges in Communicating Climate Change to Extension Audiences," and "Strategies for Communicating Climate Change to Extension Audiences."

This interdisciplinary approach has been successful with Extension organizations across the United States and is ideally suited for presenting adaptive climate actions that work and "sell" locally where they are proposed.

Summary

The Cooperative Extension Service has a cherished legacy of helping communities and individuals solve problems and reduce risks by providing information and skills. Addressing climate change is the greatest challenge people face today. It will involve many existing and new skills to address pest management, family finance, emergency response, community planning, farm efficiency, and forest resilience. Providing this information in a manner that respects audience values, interests, and concerns will always be critical. Extension agents may wish to engage their audiences in conversations about what concerns them as well as perceived or experiential changes in weather patterns, growing seasons, and the legacy they will leave their children. People do not need to accept anthropogenic climate change to be willing to adapt to current changing conditions. People who care about sustainability, natural resources, and their community do not require economic incentives to make changes in their management practices or their lifestyles. Providing people with the information they need and desire in a manner that makes sense to them is our challenge, now as always.

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