

Transformative Learning through the Development of a Competency-Based Climate Education Program for U.S. County Extension Agents

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Abstract: County agents in the United States need the necessary training and tools to communicate the complexities and provide solutions related to changing weather and climate patterns. Farmers, ranchers and forest owners have questions related to the impact of weather and climate on their production and ecosystems. To address this gap in knowledge and capacity, the Office of the Southern Regional Extension Forester contracted with the USDA Office of the Chief Economist to develop the nationally based Climate Learning Network (climatelearning.net). The goal of this online network is to develop climate literate extension professionals through online education, training, mentoring and networking. A series of competency development meetings were facilitated by a professional firm to determine competencies needed by today's county extension educator. These competencies were then incorporated into the planned electronic learning (e-Learning) platform at climatelearning.net. The learning modules were developed from webinars and other resources and are housed on the Climate Learning Network's website. Experts from around the country were invited to prepare and present webinars on a number of key topics ranging from introductory lessons to more involved lessons concerning adaptation and mitigation of agriculture and silviculture systems. The CLN is currently in its 3rd year of operation and seeks to provide an opportunity for all county agents in the country to improve their understanding and ability to answer climate and weather-based questions from their constituents. More importantly, the CLN seeks to empower agents to develop active programs in the area of climate and weather science.

Key words: Climate education, competency-based education, e-Learning, eXtension, forestry Extension, Extension agent

Introduction

The Extension System (ES) in the United States has a long and storied history of helping people help themselves. Slogans such as "Putting Knowledge" to work from the University of Georgia's Extension Service, and "Solutions to Your Life" at the University of Florida, summarize the goal of transfer of technology and information for solving farmers, ranchers, forest owners, societal and others' issues. The ES in the United States is composed of over 70 university services at both the 1862 and 1890 (historically black land grant colleges) systems. These university-coordinated systems consist of state-level administrators and faculty specialists, who work closely with university-based researchers and county/local based county agents. There are approximately 3000 county-based agriculture and natural resource agents in the 50 states of the US. These agents provide a number of educational programs for their stakeholders and also spend a considerable amount of time providing answers to individual questions, either via email, phone call or through personal face-to-face visits. While the System has, no doubt provided valuable economic, production, social and environmental information to these stakeholders, it has been difficult and challenging to measure the actual impact in many cases. In addition, the situation surrounding production and management of goods and services from today's agricultural, ranching and forestry systems involves many additional considerations.

In addition to providing research-based knowledge and information relating to improving the basic production aspects of various goods and services, today's Extensionist must be knowledgeable in environmental, policy, social and economic considerations. To be affective, today's Extensionist must also be competent in several core areas and also be knowledgeable with regard to effective ways for reaching the appropriate numbers and types of stakeholder groups that he or she is responsible for (Brodeur, et. al., 2011). One area in particular that Extension professionals are expanding their programming in is climate change.

Climate Change Education in the Extension Service

The topic of climate change has presented itself as one of the most challenging programming areas in the 100-plus year history of the North American Extension movement. While the basic context of the situation is fairly straightforward (our weather patterns and climate are changing at historically rapid and unprecedented rates), the reasons for, and the implications of, climate change are hotly debated and poorly understood. Add to this the challenge of understanding and communicating the vulnerability and resilience of various agricultural, range and forest systems to climate and weather, and the Extensionist becomes overwhelmed with information and data.

In early 2012, the USDA National Institute of Food and Agriculture (NIFA), through their Agriculture and Food Initiative (AFRI), provided funds to various universities who were successful in developing proposals related to major food and forest systems throughout the country. These Coordinated Agricultural Programs (CAP) were designed to integrate research, Extension and education across large swaths of physical land and involved multiple disciplines to solve big problems in key crop and fiber commodities. One project in particular, the PINEMAP project focused on increasing the resiliency and ability of loblolly pine (*Pinus Taeda*) to grow and produce in a system with possible reduced rainfall, increased CO₂, and elevated temperatures. This project, and several others at the time provided resources and expertise to engage and educate county Extension agents and others in training to understand climate change science and develop strategies to overcome barriers for effective stakeholder involvement when discussing climate and weather.

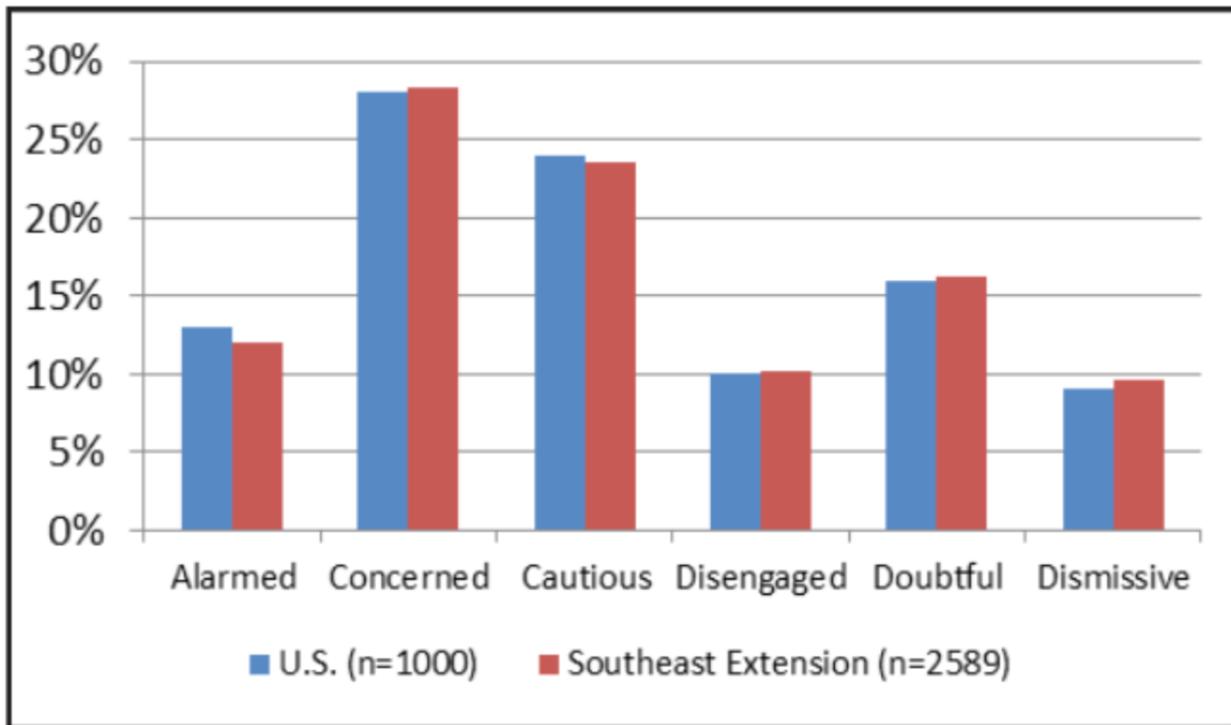
Several challenges presented themselves to a core group of Extension specialists and others involved in these large USDA integrated projects. To address these challenges, these projects allowed for more strategic planning and development of education and training programs. To begin, basic needs assessments were conducted amongst county Extension agents. This included questions about current behavior, knowledge and understanding of climate and weather science history, concerns and options. The needs assessments were conducted for both county Extension agents and, in the case of PINEMAP, professional foresters in both the public and private sector. The results of these assessments then provided the baseline for the development of professional and in-service training. One assessment in particular, focused on southern Extension professionals. Wojcik, et.al., (2014) received survey responses from close to 2,600 Extension professionals in the southeastern United States. The researchers utilized many questions similar to the national survey "Six Americas of Climate Change" (Leiserowitz, et. al, 2010). This survey is a George Mason University study performed regularly that measures the level of concern and alarm among Americans; including 'alarmed', 'concerned', 'cautious', 'disengaged', 'doubtful', and 'dismissive'. The researchers found that the Extension Professionals studied exhibited a pattern that was very similar to those represented in the general public from the national study; that is, there were very similar percentages of respondents

between Extension professionals and those in the general public (Figure 1), adopted from Wocjik, et. al. (2014).

With this information in hand, professionals on the PINEMAP project surveyed another key audience, the professional foresters who will in turn work with the thousands of landowners in the Southern United States who own forest land, and in particular, loblolly pine plantations. These owners control over 12.4 million hectares and contribute to a \$30 billion annual industry. It was hypothesized that this group would both benefit from any knowledge and information they can obtain on affective pine management in the face climate change, and be critical decision makers on behalf of the forest owners regarding their landholdings.

In this study, the researchers electronically surveyed over 6,000 professional foresters in all 13 southern states, and received approximately 1,700 responses. The purpose of the study was to gather information related to current understanding and continuing education needs as they relate to forest management in the face of climate change and catastrophic weather events. In addition, the researchers were interested in the forester's perspectives with respect to whether and why our climate is changing in what appears to be an abnormal fashion.

Figure 1. Extension Respondents Represent All of the Six Americas.



Source Adams, et. al., (2015)

http://www.pinemap.org/publications/researchsummaries/extension/Six_Americas.pdf

More than 60% of foresters answering the survey felt that the climate was changing but differed on what they think the causes are. Thirty four percent were unsure, or believed that there isn't enough evidence one way or another to make a statement. Six percent unequivocally felt that the climate was not changing. Of the 60% who felt the climate was changing, 23% felt that the climate change was human deduced (14% of all foresters), 20% felt that it was a human/natural

combined cause (12% of all foresters), 35% felt it was all natural causation (21% of all foresters), and 23% felt unsure why (14% of all foresters) (Figure 1).

Additional results centered around knowledge levels and interest in learning more about climate science and climate change. Only 25% of the respondents felt that they were moderately or very knowledgeable about these topics, while 41% were not or slightly knowledgeable and 34% were somewhat knowledgeable. Thirty two percent were moderately or very interested in learning more about the topics, 37% were not or slightly interested, and 31% were somewhat interested.(Figure 1).

These results, along with specific requests for certain training on specific forest management topics helped shape the proposed Extension agent and professional forester training. While the general training for Extension agents was to be necessarily broad, it was agreed that the agents who were interested in becoming proficient in climate and weather sciences would need some basic competencies. In late 2015, the Southern Regional Extension Forestry office based at the University of Georgia was awarded a grant to develop an online competency-based educational program augmented by interaction with mentors, field-based representatives, partners and stakeholders. This effort would work in tandem with similar educational activities aimed at professional foresters through a series of on-line based webinars, and presentations at workshops and field days.

Developing Competency-Based Learning for Extension Professionals

One area that has received attention is Competency-Based (CBE) and Learner Oriented (LOE) Education. These concepts are decades-old concepts but are being updated and reintroduced to the Extension and education world with new tools and technologies that are available via software enhancements and the Internet. The process by which a set of knowledge attributes, skills, and abilities are combined to form competencies can be much more effectively undertaken, delivered and assessed now than ever before. Through online relational database software and spreadsheets and online document sharing and videoconferencing, processes that may take months can now be completed in a matter of days. Incorporating the competencies and tagging them to actual educational events that are provided through e-learning software packages such as Moodle have also made tailoring education to individual learning desires and needs is more of a reality now more than ever before. Involving stakeholders in the process, and ensuring that professional development will lead to transformational learning and on-the-ground improvements but these efforts will still however require much more than desktop computing.

eXtension, a ten-year old initiative undertaken by the USDA National Institute of Food and Agriculture, along with the 1890 and 1862 university-system has been at the forefront of using electronic technology to close the gap between research and knowledge at the county level. Through a series of “Communities of Practice (COP)”, topical experts from throughout the country collaborate and network as a committee to develop materials and online resources for county agents to use. In addition to a robust website with the equivalent of electronic factsheets organized from a ‘question’ perspective, these COP’s work together to develop other resources including Moodle® courses, webinars, FAQ’s, and an ‘Ask an Expert’ system that has the potential to engage the entire 15,000 member Extension System.

eXtension has recently taken on the role of being an ‘innovator’ laboratory. In this capacity, eXtension partners and staff work collaboratively to develop online tools and technologies that are cutting edge and have the potential to have huge impacts. These ‘sea changes’ can be

brought about by a new educational or even field technology and can be followed up with a competency-based approach to professional development.

One of these areas of work has been in climate change and climate science. eXtension partners and stakeholders have shown a need for a sound, scientifically-proven, and learner-oriented system for providing competency-based training to field Extension agents. The timing for this need and the availability of these technologies matched perfectly. The team of specialists who have been working across major climate projects throughout the country were very interested in developing online training for local agents. In this manner, the goal was to empower local agents to become Climate Literate Extension Professionals, or ProCLE for short. Through this process the educators desired to improve the validity, efficiency and effectiveness of agents working in climate change education. By participating, the agents find out the skills, abilities and knowledge they currently possess in this area, and the skills, abilities and knowledge they need to possess to become a ProCLE. Through eXtension, the successful candidate who can pass the tests and assessments will receive certificates and electronic badges that signify successful completion of training (Figures 2 and 3).

Figure 2. Badges available upon completion of each ProCLE module.



Figure 3. Close up of badges showing the competency area where badges can be earned.



To complete this effort, Eduworks® (<http://eduworks.com/>), a private sector company with International experience in artificial intelligence, and facilitation of competency and curriculum design, was contracted to work with a small group (6) of Extension climate professionals with over 60 years of combined experience in climate science education and Extension. Eduworks® worked closely with this team to using a novel process which outlined the objectives, coordinated the process by which desired competencies and skills were determined, and developed assessment protocols. EduWorks® also worked behind the scenes to develop new Information Technology solutions to support the process. This included a competency database which was designed to be integrated with the eXtension Moodle® learning management system (LMS) deployment. This database provides the ability to tag eLearning modules and other online content with specific competencies which are then tracked within the LMS. Through a series of web-based meetings, the facilitators and the Extension professionals developed a set of competencies and desired skills and attributes associated with these competencies. They also developed the metrics by which acquisition of these competencies and skills could be measured. Through this methodology, EduWorks® and the Extension team completed the first online, synchronous Design of Competency (DECOMP)® process. The results of this effort are listed in Table 1 and Appendix A.

Table 1.
Core Competencies for the ProCLE initiative.

Competency	Explanation
Integrate climate vulnerability concepts to ANR systems	Be able to describe the 3 components of climate vulnerability. How each component contributes to climate risk, and how to manage each component to reduce risk.
Integrate climate system concepts into extension programming	Be able to describe and apply the interactions among climate system components (e.g. carbon cycle, layers of the atmosphere, water systems, living organisms, etc.) to extension clients and programs.
Demonstrate Human Impact	Demonstrate the impact of human activities on the climate system using scientific evidence.
Mitigation	Understands the role of emissions in climate change and the methods of reduction of heat trapping gasses in the atmosphere (e.g. sequestration, renewable energy, etc.).
Adaptation	Recommends adjustments to ANR systems to moderate harm and capture opportunities in response to actual or expected climate change.
Resilient Management	Identifies configurations of ANR systems that are resilient to changing conditions. Assists in the development of local innovations. Understands adaptive management strategies in agriculture (i.e. whole farm planning).
Climate Policy	Identifies the climate policies that apply to their clientele. A climate literate extension professional understands the policies, agency directives, and politics and their effect on climate solutions.

Communicate climate issues	Present climate issues without challenging beliefs about climate change.
Maintains relevant climate knowledge	Is up to date on the national climate assessment. Follows trends and new discoveries in climate science, attends applicable events (i.e. national conferences, professional development, continuing education, etc.), and reads current media (blogs, communiques, etc.).
Contribute to shared learning	Participates in learning networks to share knowledge with and learn from others (i.e. climate professionals, extension members, clientele, etc.).
Is an Extension Professional	Values research and unbiased delivery of scientific knowledge, continuous improvement, etc. Supports continuous innovation. Provides information grounded in science and supported by experiential knowledge. Is a bi-directional link between the land grant mission/institution and practitioners.

The competencies developed through the DECOMP process were made available to the working group via a simple web interface that was linked to an editable database. A review of the table and Appendix highlights the various competencies, knowledge, skills and attributes that a trained ProCLE will have a command of. These include areas such as proclivity in concepts relating to vulnerability of systems, adaptation concepts, mitigation options, resiliency and resilient management, climate policy, climate communications, and a host of internal skill sets desirable for effective Extension engagement in climate change education.

A subsequent effort to the development of the competencies and skills, was the creation of online learning opportunities for the agent desiring ProCLE certification. This occurred through the creation of the Climate Learning Network (CLN), an online portal developed to provide informational resources on climate change as well as assist county Extension agents and others with online learning and competency-building. Through this effort, the Extension team which had assisted with the ProCLE activity, also assisted with prioritizing webinars on subject matters that would ensure learning and applying the ProCLE competencies. The portal, located at www.climatelearning.net houses resources and educational materials designed to provide the County Extension agent with the tools they need to become certified as a ProCLE agent, and tools and resources they can use for their local audiences and stakeholders.

To provide simple and far-reaching access to useful climate tools for Extension professionals, CLN developers partnered with the USDA Regional Climate Hubs to leverage existing assets. Specifically, CLN collaborated with the Southern Regional Climate Hub (SERCH) to expand their existing ToolShed climate tool database and online interface to include Extension-relevant tools and add Extension metadata too the tools found in the database. An Extension focused deployment of ToolShed was integrated into the CLN web portal and offers Extension specific search options as well as full access to the complete ToolShed database and functionality.

Programs and Products

Through additional resources provided by the Office of the Chief Economist (OCE) at the USDA, a series of webinars were developed on various topics of interest and use to county Extension agents. These webinars also contain valuable core competencies as outlined by the DECOMP process. Webinar titles to date include the following:

1. Climate Science 101 for Extension Professionals
2. Communicating Climate Change Impacts & Options to a Disbelieving Audience
3. A Fair and Balanced Look at Climate Variability, Change & Impacts Across the Southeastern United States
4. Agricultural Adaptation Practices
5. Stories from the Field
6. Resilient Pine Management
7. Integrating Climate Change In Extension Programming

These webinars, between 50 and 60 minutes in length were designed for live and archived viewing via the SREF administered climatewebinars.net webinar portal. These assets were also leveraged as the basis for the creation of the primary CLN Climate Literacy Certification e-Learning modules. The e-Learning modules utilized the basic webinar information and expanded the efficacy of these products by creating a venue whereby competencies and learning could be tested in a persistent and interactive manner. To develop these modules, a project manager with working knowledge of the DECOMP process and results worked closely with a software engineer with experience in e-Learning software. Additional members of this development team included web programmers and graphic designers. This process, Webinar Based e-Learning Development (WebBED), utilized custom designed templates in Adobe Captivate e-Learning design software. This template and webinar synergy provided a rapid method for the design and deployment of the interactive e-Learning modules. The e-Learning modules utilized high-quality web-based recordings of each of the webinars and created an online course with assessment exercises intermixed throughout each video. Continuation through the videos is contingent upon scoring a passing grade of 75% or better. Upon completion of each webinar and the entire series, the participant receives confirmation of completion, an electronic badge and a certificate of completion. In this manner, the webinars and modules can be viewed by anyone who may have an interest, but for those who wish to attain ProCLE status, they must be viewed from the e-Learning portal and quizzes must be passed.

Conclusion

With limited resources, processes such as these offer the opportunity to streamline fairly involved and complex topics such as climate change. The process is straightforward, engages experts and can be accomplished in a short amount of time. The level of expertise required for the various tasks is not in consequential however and specific skills are necessary to facilitate the process, to develop the competencies, and to create the online presence for training. In addition, the engagement of stakeholders and the creation of a student learning network for shared learning and discussion are two additional programming areas that require time, effort and resources. Investigators are reviewing opportunities to bring this training to the next level and have written grants to obtain funding. To date, funding has not been made available.

Appendix A:

Integrate climate vulnerability concepts to ANR systems

- Apply exposure knowledge.
- Apply adaptive capacity knowledge.
- Apply sensitivity knowledge.
- Recommend actions to reduce exposure.
- Recommend actions to increase adaptive capacity.
- Recommend actions to reduce sensitivity.
- Communicate vulnerability in terms of risk management to clients.
- Relate climate vulnerability recommendations to client needs.
- A proCLE will know the 3 components of climate vulnerability.
- A proCLE will know the collective and independent contributions of capacity, exposure, and sensitivity to risk management.

Integrate climate system concepts into extension programming

- Apply climate system concepts to extension programming.
- Communicate climate system concepts to clients.
- A proCLE will know the difference between weather and climate and their models.
- A proCLE will know how biogeochemical cycles influence the climate system.
- A proCLE will know climate science fundamentals.
- A proCLE will know how humans drive climate change.
- A proCLE will know how climate system components interact with ANR systems.

Demonstrate Human Impact

- Communicate scientific evidence for human impact to extension clients.
- A proCLE will know how human activities drive climate change.
- A proCLE will know how human influenced climate change affects ANR systems.
- A proCLE will know how human activities can positively affect climate change.
- A proCLE will favor a solution-based approach to climate challenges.

Mitigation

- Identify actions that provide multiple benefits to ANR systems and society as a whole while reducing heat trapping gasses in the atmosphere.
- Evaluate potential mitigation actions in the context of local conditions.
- Recommend actions to reduce heat trapping gasses in the atmosphere.
- Communicate multiple benefits of mitigation.
- Identify mitigation opportunities for extension clients.
- Communicate mitigation opportunities to extension clients.
- A proCLE will know how local ANR systems contribute to or offset emissions of heat trapping gases.
- A proCLE will know ANR best practices for reducing heat trapping gases in the atmosphere.
- A proCLE will know how to identify sinks and sources of heat trapping gasses in local ANR systems.

Adaptation

- Identify adjustments that moderate harm and capture opportunities while providing multiple benefits to ANR systems and society as a whole.
- Evaluate potential adaptation opportunities in the context of local conditions
- Recommend actions that moderate harm and capture opportunities in response to actual or expected climate change in local ANR systems.
- Communicate multiple benefits of adaptation
- Identify adaptation opportunities for extension clients
- Communicate adaptation opportunities to extension clients
- A proCLE will know how technology, natural, human, social, and financial resources contribute to adaptive capacity.
- A proCLE will know how local ANR systems contribute to or degrade adaptive capacity.
- A proCLE will know how to evaluate the adaptive capacity of local ANR systems.
- A proCLE will know best practices for enhancing the adaptive capacity of local ANR systems.

Resilient Management

- Identify adaptations that enhance the resilience of local ANR systems.
- Evaluate adaptations that enhance the resilience of local ANR systems.
- Recommend adaptations that enhance the resilience of local ANR systems to extension clients.
- Communicate adaptations that enhance the resilience of local ANR systems to extension clients.
- Educate extension clients about adaptations that enhance the resilience of local ANR systems.
- A proCLE will know adaptive management strategies for ANR systems.
- A proCLE will know how changing conditions affect local ANR systems.
- A proCLE will know resilient design principles for ANR systems.
- A proCLE will know basic agroecology concepts (i.e. farming system processes, nutrient and water cycles, pest suppression, etc.).

Climate Policy

- Recognize barriers and opportunities for extensions clients created by international, national, and state climate change policies.
- Deliver information about climate change barriers and opportunities to extension clients.
- Communicate how climate change policies affect ANR systems.
- Recognize impact of key decision makers on climate change policy.
- A proCLE will know how federal, state, and local climate policy effect their clients.
- A proCLE will know where to find the federal, state, and local climate policy analysis and interpretation for local ANR systems.
- A proCLE will know USDA building blocks for Climate smart ANR (Voluntary and incentive based, Focused on multiple economic and environmental benefits, Meets producer needs, Cooperative and focused on building partnerships, Assess progress and measure success).

Communicate climate issues

- Apply best communication practices with extension clients (i.e. ELFLAND, PIE, etc.).
- Identify needs, beliefs, and values of client audience.
- Establish trusted communication and commonality with extension clients.
- Identify potentially challenging messages before delivering to client audience.
- Prepare climate issue resources prior to client communication.
- A proCLE will know best practices for communicating science based information about controversial subjects.
- A proCLE will know the climate beliefs of their clients.
- A proCLE will know the vocabulary of climate science communication.

Maintains relevant climate knowledge

- Understand peer reviewed resources for current climate information.
- Participate in science-based climate related education events.
- Understand current consensus in climate science.
- Understand the national climate assessment as it relates to local ANR systems.
- Follow key climate change issues in public discourse as it relates to local ANR systems.
- A proCLE will favor continuous learning and personal development.
- A proCLE will know where to find the latest climate related ANR scientific information that applies to their client needs.
- A proCLE will know the National Climate Assessment as it applies to their client needs.
- A proCLE will know media (blogs, communiques, etc.) as they apply to their client needs.

Contribute to shared learning

- Participate in climate-related networks (i.e. CLN, SECC, CFW, etc.).
- Establish purposeful two-way communication with peers, clients, and partners.
- Disseminate successful client, partner, and peer adaptations and innovations.
- Incorporate shared knowledge into extension programs.
- A proCLE will believe in the benefits of engagement with peers, clients, and partners.
- A proCLE will respect the knowledge of peers, clients, and partners.
- A proCLE will value sharing knowledge via publication and other forms of dissemination.
- A proCLE will value building a network of peers, clients, and partners.
- A proCLE will value multiple forms of knowledge held by peers, clients, and partners.

Is an Extension Profession

- Demonstrates capabilities of extension professionals.
- Develops innovation and communication channels to support future ANR success.
- Demonstrates respect for diverse values and beliefs.
- Selects most applicable education method (technological, in-person, etc).
- The Climate Literate will know how to identify funding sources to support ANR programs.
- The Climate Literate will know funding sources to support ANR programs.
- The Climate Literate will know partner expertise and resources.
- The Climate Literate will know their local ANR systems.

- The Climate Literate will believe that any audience can be approached.
- The Climate Literate will respect local knowledge, attitudes, beliefs, and values.
- The Climate Literate will know the extension program and its goals.
- The Climate Literate will know the teaching tools and technologies available.

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