Journal of Human Sciences and Extension

Volume 8 | Number 2 Article 8

6-30-2020

Recommendations for Early Phases of Engaging Communities in Climate Change Adaptation

Richard R. Plate
University of Central Florida, richard.plate@ucf.edu

Martha C. Monroe
University of Florida

Claire Friedrichsen
University of Florida

Alison W. Bowers
Virginia Tech

Willandia A. Chaves
Princeton University

Recommended Citation

Plate, R. R., Monroe, M. C., Friedrichsen, C., Bowers, A. W., & Chaves, W. A. (2020). Recommendations for Early Phases of Engaging Communities in Climate Change Adaptation. *Journal of Human Sciences and Extension, 8*(2), 8. https://doi.org/10.54718/XYGW8706

Recommendations for Early Phases of Engaging Communities in Climate Change Adaptation

Acknowledgments

This activity is part of eeWORKS, a project of theNorth American Association for Environmental Education. It was funded by the Pine Integrated Network: Education, Mitigation and Adaptation Project (PINEMAP), a Coordinated Agricultural Project funded by the USDA National Institute of Food and Agriculture(Grant number 2011-68002-30185); the Renewable Resource Extension Act (Award number NI18RREAFXXXG020); and McIntyre-Stennis formula funds (Award number NI18MSCFRXXXG011) to the University of Florida

Recommendations for Engaging Communities in Climate Change Adaptation 136

Recommendations for Early Phases of Engaging Communities in Climate Change Adaptation

Richard R. Plate
University of Central Florida

Martha C. Monroe
Claire Friedrichsen
University of Florida

Alison W. Bowers
Virginia Tech

Willandia A. Chaves
Princeton University

Communities across the globe have begun planning for and adapting to climate change. Cooperative Extension Service professionals are in a unique position to use the resources available to them to facilitate climate change adaptation in their communities. Adaptation planning is a local activity that must be context specific. However, general recommendations can be made to help facilitate the planning process. In this study, we conducted a systematic review of research about climate change adaptation in communities to explore ideas that contribute to successful adaptation-planning communication. We identified and reviewed 50 peer-reviewed articles that described various outreach efforts to engage communities in planning for adaptation across a range of contexts and settings. Five themes emerged addressing how to facilitate early stages of the climate change adaptation process: establishing positive initial engagement, incorporating participatory methods, using tools to facilitate understanding, addressing trust and uncertainty, and maximizing limited time. Based on the review and emergent themes, we offer practical recommendations for educators and Cooperative Extension Service professionals as they engage communities in climate change adaptation.

Keywords: climate change, adaptation, community, outreach, systematic review, public engagement, Extension

Direct correspondence to Richard R. Plate at richard.plate@ucf.edu

Journal of Human Sciences and Extension Volume 8, Number 2, 2020

Recommendations for Engaging Communities in Climate Change Adaptation 137

Introduction

Global climate change since the mid-20th century has been driven by anthropogenic activity (IPCC, 2014b; Oreskes, 2004). Observable changes include an average global temperature increase of .85°C from 1880 to 2012, warming oceans, increased precipitation in the northern hemisphere, increased extreme weather events, ocean acidification due to increased CO_2 absorption, decreased global crop yields, loss of polar snow and ice cover, and global sea rise (IPCC, 2014b; Walsh et al., 2014). Global average temperature is expected to be between 2.5°C and 7.8°C warmer by 2100 without mitigation efforts (IPCC, 2014b). The environmental and subsequent social impacts of global climate change are expected to significantly impact coastal communities, rain-dependent agriculture, accessible groundwater, marine fisheries, and the ranges of pests and pathogens. Increases in storm events, wildfires, and floods could affect both developed and developing nations (IPCC, 2014b).

Early communication and education about climate change focused on mitigation, i.e., interventions to decrease sources and increase the sinks of greenhouse gases (IPCC, 2014a). In the 2000s, policymakers, practitioners, funders, and researchers began to more heavily promote adaptation efforts as it became clear that climate changes were already being felt, particularly in vulnerable regions and sectors of the world (Grothmann & Patt, 2005; McNamara & Buggy, 2017). These impacts involve changes to ecosystems services (Harley et al., 2006), agricultural systems (Wiebe et al., 2015), and a host of threats to coastal areas due to sea level rise or storm events (Nguyen et al., 2016). Human enterprises and communities have begun to adapt to changing conditions (Adger et al., 2005; Grothmann & Patt, 2005). Climate change adaptation refers to strategies in response to actual or expected climate changes that aim to reduce vulnerability to or accrue benefits from climate change (IPCC, 2014a). Adaptation is fundamentally different from mitigation because adaptation involves accepting that climate change is happening and that humanity will live in a world affected by climate change; focuses on tangible problems and solutions; can have immediate benefits, such as improved infrastructure; does not involve agreeing on the cause of climate change; and therefore, has not been as politicized (Moser, 2014). Planned climate change adaptation is a process involving three identified phases (Moser & Ekstrom, 2010):

- an understanding phase that involves identifying, defining, and learning more about the specific problems at hand;
- a planning phase that involves identifying and assessing options for action; and
- a management phase in which chosen courses of action are implemented, monitored, and evaluated.

International, national, and regional organizations have created adaptation plans, a process usually driven by top-down decisions and analysis. Some of these top-down approaches are necessary to align resources, technology, and implementation with national and international

Journal of Human Sciences and Extension Volume 8, Number 2, 2020

Recommendations for Engaging Communities in Climate Change Adaptation 138

planning, but there are also shortcomings, primarily due to developing action plans on too large a scale, especially when climate impacts vary greatly based on local circumstances (Adger et al., 2005). Community-based adaptations to climate change use a bottom-up approach to craft adaptations that might be more suitable for implementation, community by community (McNamara & Buggy, 2017). Engaging the whole community or specific stakeholders within a local community can increase support, feasibility, and relevance (Smit & Wandel, 2006). Community typically refers to a geographic location, but it can also refer to groups who share expertise, such as natural resource managers, tourism operators, emergency planners, or rural farmers (Wenger, n.d.). These experts may also be part of the local geographic community. Such community-based programs have become more common to address vulnerabilities to climate change in rural and urban settings (Ayers & Forsyth, 2009; Mannke, 2011; Murphy et al., 2016).

The goal of involving communities in adaptation creates an important role for local educators and Cooperative Extension Service (CES) professionals to facilitate information exchange and guide a process that enables a community to understand potential problems, evaluate future risks, identify reasonable options, and sustain appropriate behaviors in response to changing environmental conditions (Moser & Ekstom, 2010). Previous work with U.S. Cooperative Extension agents has been driven by helping vulnerable audiences better understand climate change and what they can do to reduce their risk. Adaptation is a topic of interest to Extension professionals and key audiences (e.g., planners, farmers, and foresters), with some audiences being more receptive to hearing about adaptation than mitigation (Boby et al., 2016; Bowers et al., 2016; Diehl et al., 2016, 2017; Hibbs et al., 2014; Jones & Lenart, 2014). As people learn more about adaptation requirements, they may become more supportive of mitigation efforts (Adger, 2003; Evans et al., 2014).

This study builds on documented priorities of adaptation-related education programs by offering educators and agents suggestions for helping communities identify and plan for feasible adaptations to climate change (i.e., the first two stages of Moser & Ekstom's (2010) adaptation process). We conducted a systematic review of the literature to identify, review, and synthesize research studies that explored how educators and communicators have facilitated community engagement for climate change adaptation planning.

Methods

A systematic review uses standardized and explicit methods to identify, screen, and analyze research studies relevant to a chosen topic (Gough et al., 2017). Our review process was guided by systematic review steps and protocols presented in Cooper (2010) and Gough et al. (2017) and from lessons we learned when conducting a previous systematic review of our experience (Monroe et al., 2019).

Journal of Human Sciences and Extension Volume 8, Number 2, 2020

Recommendations for Engaging Communities in Climate Change Adaptation 139

We used academic databases to locate research about climate change adaptation and local communities. We chose the EBSCOhost database, as it searches across multiple databases, including educational research databases (e.g., Education Full Text) and environmental research databases (e.g., GreenFile). Based on preliminary search results, we selected the following set of search terms: global warming or climate change, and adaptation and community. To further constrain the search, we used an additional set of search terms to identify research focused on community outreach with adults: extension, informal education, adult, stakeholders, or outreach.

We ran the search in the EBSCO database in August 2016 using access provided through the University of Florida's library website. The EBSCOhost database identified sources that had the specified search terms in the following fields: abstract, author, subject, keyword, and title. The initial search yielded 306 unique citation records that were exported to Zotero, a bibliographic management research tool that facilitated the vetting process.

To identify relevant search results, we conducted multiple rounds of review. In the first round of review, two team members read the abstract for each citation record and applied a set of decision rules to determine relevance. The decision rules were:

1. Is adaptation to climate change/global warming a focus of the article?
   Yes – Go to #2.
   No – Exclude.

2. Is youth (ages 0-18) the target audience or focus of the article?
   Yes – Exclude.
   No – Go to #3.

3. Is some form of audience engagement described, implemented, or evaluated?
   Yes – Include.
   No – Exclude.

If two team members did not agree on exclusion/inclusion, a third member reviewed the abstract and cast the deciding vote. In a few cases, when the third reviewer was still unsure, a fourth reviewer from the study team would perform a cursory reading of the entire article to determine its relevance. In this initial round, 217 records were excluded from further review, as they did not involve some level of engagement of adult audiences with adaptation to climate change. Excluded articles might have described research studies about stakeholder perspectives without engaging them, or climate change adaptation may simply have not been the focus of the study.

For the remaining 89 records, two team members reviewed each full document and confirmed if it was indeed relevant to our study. We performed this second round of review using the same decision tree used in the first round. A further 36 articles were excluded. Another two articles were eliminated when we could not locate full-text versions. After all rounds of review, 51

Journal of Human Sciences and Extension Volume 8, Number 2, 2020

articles were identified as candidates for analysis. Two team members coded each article for categories such as study context, location, purpose, and recommendations. During analysis, an additional article was eliminated from the final sample as we determined it did not involve community engagement, leaving 50 articles for review.

Analysis of these 50 articles was an iterative process. Two team members summarized each article, identifying key points and lessons learned that would be relevant to practitioners. The results from these analyses were collected into a single table, which was used to guide discussion among the team members about recurring threads (e.g., concepts, points, and lessons). Team members then worked individually to synthesize insights from studies along particular threads and met again to discuss findings. Through an iterative process of individual work, group discussions, and revisions, the key insights were organized into emergent themes related to community engagement with adaptation.

Results

The results of the review are organized into two sections: (1) description of the reviewed studies and (2) themes about adaptation planning communication. The description of the reviewed studies section gives an overview of the study settings, contexts, communication tools, and processes reported on in each study. This section suggests what is currently being explored in research about community adaptation.

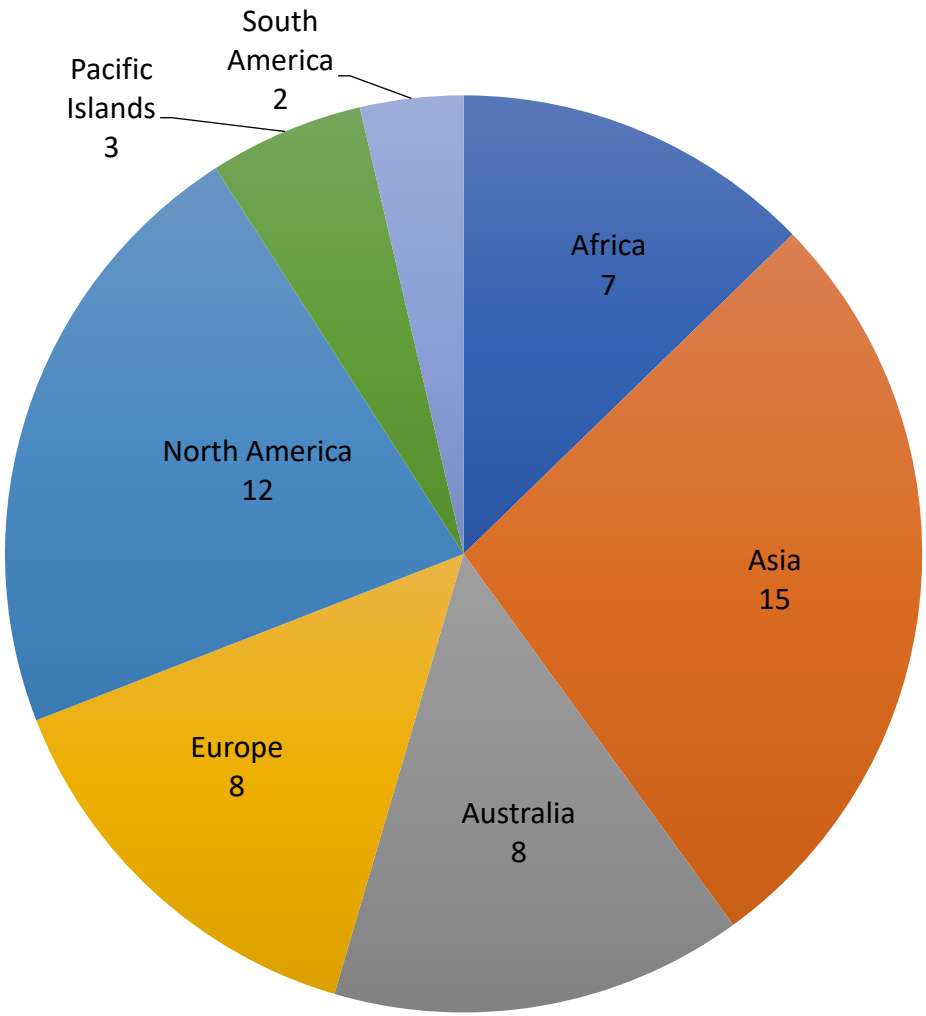
The second section of the results, themes about adaptation planning communication, presents themes from our qualitative analysis of what can be learned about adaptation communication from these papers. The set of themes is not presented here as a necessary theoretical construct but rather as a useful tool for making sense of recurring insights that came from the 50 articles regarding effective community engagement strategies for climate change adaptation programs. In addition, the studies included in this review focused almost exclusively on the understanding and planning phases of adaptation, with little reporting of the management phase (Moser & Ekstrom, 2010). Possible implications of this focus are included in the discussion section of this article.

Description of Reviewed Studies

The reviewed studies were from across the globe, with the greatest number coming from Asia (see Figure 1). Five studies (Jost et al., 2016; Park et al., 2012; Serrao-Neumann et al., 2013; Wongbusarakum et al., 2015; Wright et al., 2014) involved research in multiple regions and are counted more than once in the data presented in Figure 1. At the country level, Australia had the most studies (n = 8), followed by Canada (n = 6) and the continental United States (n = 5).

Recommendations for Engaging Communities in Climate Change Adaptation 141

Figure 1. Geographic Location of Studies



The reviewed studies examined adaptation in a variety of contexts (see Table 1 in the Appendix). Many studies focused on natural resource management in general (e.g., Bardsley & Sweeney, 2010; Cross et al., 2013; Girvetz et al., 2014; Lukasiewicz et al., 2016) or on a specific natural resource such as water (e.g., Bormann et al., 2012; Hasse & Weingaertner, 2016) or forests (e.g., André & Jonsson, 2015; Galicia et al., 2015). Agriculture was also a common context that included studies focused on row crops (e.g., Bartels et al., 2013), subsistence farming (Chaudhury et al., 2016), and ranchers and rangelands (Christmann et al., 2015). A handful of studies examined specific, local contexts, such as surf lifesaving clubs (Richards et al., 2016), public health risks (Bell et al., 2015), and tsunami disaster planning (Henly-Shepard et al., 2015).

A number of researchers appeared to have designed their study around some recognized vulnerability to climate change. Many studies highlighted coastal and island communities (e.g.,

Journal of Human Sciences and Extension Volume 8, Number 2, 2020

Butler et al., 2014, 2015; Cone et al., 2013; Jude, 2008; Mamauag et al., 2013). Some studies emphasized work with rural communities (e.g., Dwamena et al., 2011; Jost et al., 2016; Park et al., 2012) or urban populations (e.g., Dempsey & Fisher, 2005; Eames et al., 2013; Sheppard et al., 2011). A few studies looked at special geographic characteristics that increased vulnerability to climate change, including remote arctic regions (Pearce et al., 2012), glaciated mountains (Byers et al., 2014), and ecologically sensitive areas (e.g., Ross et al., 2015).

In addition to context, Table 1 presents the type of engagement associated with each study, the adaptation phases addressed based on Moser and Ekstrom's (2010) framework for the process of planned adaptation, and each of the identified themes discussed in our results. Almost all of the studies described the implementation of workshops, although a handful of studies also reported on other types of engagement, such as focus groups and meetings. Most studies emphasized the understanding or planning phases, with fewer studies describing some aspect of the management phase.

Adaptation Planning Communication Themes

We identified the following five themes about communicating adaptation planning with communities. Studies with specific information on strategies that appear to improve communication are highlighted under each theme.

Theme 1: Establishing Positive Initial Engagement. Having positive initial engagement with the community is an important first step in creating successful community adaptation planning. To establish initial engagement with stakeholders, the researchers in our reviewed studies focused on selection of participants and incorporating appropriate entry activities. Both of these steps are described below.

Multiple studies observed that engaging stakeholders during the adaptation planning process begins with identifying the right participants. Characteristics that described the "right" participants varied to some degree, but typically included a combination of knowledge, expertise, leadership, or representation of a particular social group. Eames et al. (2013) focused on disciplinary expertise when identifying participants, and Matthews et al. (2008) acknowledged a bias toward practical land management in their decision-making stakeholders. Andersson et al. (2013) focused on "Extension champions"—farmers who had a pre-existing, positive relationship with CES professionals and were viewed as leaders in their community.

Many authors wanted to achieve a diversity of participants. Bhave et al. (2013) placed high importance on including stakeholders from state-, district-, and community-level scales of interest. Langsdale et al. (2009) similarly advocated for a "diverse and balanced representation" (p. 377) of stakeholders. Lemieux et al. (2014) aimed for a "heterogeneous cross-section" (p. 127) representing eleven different sectors. Several studies emphasized the importance of

Recommendations for Engaging Communities in Climate Change Adaptation 143

including both formal and informal leaders (Bardsley & Rogers, 2011; Butler et al., 2014; Matthews et al., 2008).

Identifying participants was often achieved through some combination of researcher and stakeholder input. Langsdale et al. (2009) used the researchers' personal networks to identify participants. Ross et al. (2015) described a carefully designed process for selecting and inviting workshop participants that involved stakeholder analysis, Internet searches, and networking to identify representatives from key local sectors and organizations. A more open strategy of snowball sampling to solicit suggestions for stakeholders had the benefit of keeping the selection process transparent and inclusive and helped to establish active participants in the process (Chaudhury et al., 2016). André and Jonsson (2015) described a similar process in which an initial group of stakeholders was asked to identify other potential participants. A few studies used a process that opened participation to the public by sending out mass invitations through key informants (e.g., extension professionals) or stakeholder organizations (Andersson et al., 2012; Bartels et al., 2013), but this was less common.

Following participant selection, starting the adaptation planning with appropriate entry activities helped simplify the complexity and, if necessary, diffused the politicization of climate change. Appropriate entry activities that engaged instead of silencing participants included discussing recent extreme weather concerns and vulnerabilities and presenting local and context specific data. Bartels et al. (2013) successfully established long-term stakeholder participation in part by organizing initial workshops around timeline stories and seasonal climatic concerns related to natural variation in weather patterns rather than discussing climate change with farmers. Subsequent workshops expanded this discussion to include adaptation measures associated with climate change. Several studies reported initiating discussions in the context of vulnerabilities (Jost et al., 2016; Mamauag et al., 2013; Park et al., 2012; Piya et al. 2013). Using an approach similar to Bartels et al. (2012), Galicia et al. (2015) focused on present vulnerabilities associated with land-use policies before identifying vulnerabilities with stakeholders coupled with scientific predictions of future climate variability.

Several studies stressed the importance of beginning with risk-related, local-scale data that are directly relevant to stakeholders. Examples of local-scale data included stakeholder exposure to bushfires under drying climatic conditions (Preston et al., 2009) and estimated probabilities of winter wildfires, lower winter agricultural yields, dam breaks, and lack of household water (Andersson et al., 2013). Several studies in coastal areas focused on flooding and coastal erosion due to sea level rise (Dempsey & Fisher, 2005; Licuanan et al., 2015; Wadey et al., 2015). Encouraging stakeholders to provide their own experiences in the context of the local data often helped stakeholders engage in discussions from the beginning (e.g., Bartels et al., 2013; Bell et al. 2015; Girvetz et al., 2014).

Journal of Human Sciences and Extension Volume 8, Number 2, 2020

Recommendations for Engaging Communities in Climate Change Adaptation 144

Theme 2: Supporting Engagement Using a Participatory Approach. Once initial engagement was achieved, authors of reviewed studies often described employing participatory and collaborative strategies to support direct interaction with stakeholders, tap into local knowledge and expertise, and support social learning. In this study, we use the term "participatory approach" to describe methods designed to encourage active participation of stakeholders in decision-making and action-taking (Few et al., 2007). For example, Ross et al. (2015) created a series of climate roundtables with diverse community members and government organizations in Australia to build collective efficacy for adaptation planning. Their detailed analysis of what was intended, what happened, and what worked suggests region-wide planning can be tackled with a series of community meetings. Influence diagrams, a type of systems concept map, helped groups understand multiple pathways of impacts and consequences (Ross et al. 2015). Bartels et al. (2013) reversed conventional roles of specialists and stakeholders, with farmers taking the primary role in initial discussions while specialists took the role of listeners. After a workshop creating a timeline of past climate events, pairs of one stakeholder and one Extension specialist described a specific adaptation strategy to the group, including potential risks and benefits, given their experiences.

Researchers often described a desire to not only initiate stakeholder involvement in adaptation planning but also to support stakeholder participation in a way that led to meaningful, continued involvement. Time spent building personal connections among stakeholders can increase the likelihood that stakeholders will continue to participate in the process of adaptation planning (Andersson et al., 2013). To build local capacity and begin an adaptation program in Canada, Picketts et al. (2012) divided community planners and leaders into small groups with each group, including representatives from different sectors. Group work enabled more individuals to participate in discussions, with up to five priority impacts presented to the full group for discussion. Engagement remained high throughout the workshop, and participants continued to engage in climate adaptation efforts even after the workshop was over. Tschakert et al. (2014) worked with stakeholders over 3.5 years through 15 different activities. For example, strategies such as community theatre, walking journeys, and risk mapping supplemented environmental monitoring, scenario building, and anticipatory capacity assessments to help participants envision and work toward the future. Iterative learning strategies were essential to identifying practical adaptive strategies that enabled participants to overcome feelings of helplessness.

In addition to encouraging sustained stakeholder involvement, researchers used participatory methods as a way to tap into local knowledge and experience. Combinations of scientists and stakeholders helped bridge bottom-up and top-down efforts to plan adaptation strategies (Christmann et al., 2015; Matthews et al., 2008), with strategies to facilitate communication being essential. In India, stakeholders from different education and socioeconomic backgrounds were interviewed separately to ensure representation of all perspectives (Bhave et al. 2013). Even so, facilitator intervention was needed to draw out reluctant voices. Strategies such as a "problem web-solution web" brainstorming tool enabled a group to map climate-related

Journal of Human Sciences and Extension Volume 8, Number 2, 2020

Recommendations for Engaging Communities in Climate Change Adaptation 145

vulnerability aspects and adaptive measures, which then generated discussion among those with broader experience. Frazier et al. (2010) assembled different community leaders and asked them to work in groups (e.g., emergency preparedness, planning) and then report out to others for a facilitated discussion. These concurrent focus groups allowed experts to contribute their knowledge to a multi-perspective planning discussion. Bardsley and Sweeney (2010) found that applied and participatory GIS modeling projects had difficulty due to the perception among stakeholders of a lack of quality data and uncertainty of the models. However, in one case, participants (apple growers) felt that the program successfully combined technical and local knowledge by using a stepwise approach involving a series of workshops and technical development.

Finally, researchers sometimes reported using participatory methods to encourage social learning, which occurs when stakeholders learn from and build stronger connections with each other (Reed et al., 2010). In groups of experts and citizens, social learning means both groups contribute their perspectives and gain information through interaction. To support social learning, Matthews et al. (2008) found discussions among scientists and agricultural decision-makers were essential to create a shared understanding of climate projections and reasonable adaptations. Working in Scotland, they explored how to present complex, downscaled climate change projections. Complex graphs required interpretation, interaction with researchers, and questions from participants to best convey the information, which led to opportunities for dialogue and learning. Christmann et al. (2015) described how interviews and surveys of stakeholders in Uzbekistan prior to workshops enabled organizers to build on participants' perceptions and create drawings and symbols that could be blended with climate data. Participant reflections indicated the process enabled them to see individual weather events as part of a larger climatic trend, coordinate efforts across the rangelands, and discuss longer-term strategies. Henly-Shepard et al. (2015) reported on iterative participatory modeling workshops in Hawaii that engaged members of the community in disaster planning. Fuzzy-logic cognitive mapping and scenario modeling enabled the group to challenge their original beliefs and generate more adequate ideas of their vulnerability in the future.

Theme 3: Using Tools to Facilitate Understanding. Tools, defined in this study as formal, structured methods that can be replicated, often proved to be a useful part of community adaptation planning. Tools allowed participants to collectively gain a better understanding of the impact of climate change, gather more information on possible effects, better define the problem that will occur in their specific context due to climate change, and develop and then assess various adaption options. Tools were used to build a common understanding of current and future impacts of climate change and possible adaptation scenarios.

Several studies showcased the importance of tools that used visualization to facilitate the process of gathering and using adaptation relevant information. Wadey et al. (2015) held public viewings of a film showing simulated coastal flooding scenarios. They reported increased

Journal of Human Sciences and Extension Volume 8, Number 2, 2020

engagement and concern regarding sea level rise among those who viewed the fly-through simulations. Researchers frequently used various forms of maps and mapping exercises. Bell et al. (2015) used time-series, granular data to develop local, overlaid maps that showed both historical and projected climatic changes. Preston et al. (2009) provided participants with multiple maps showing vulnerability to climate impacts as well as the individual components included in vulnerability scores (e.g., bushfire exposure, climate sensitivity, and adaptive capacity). Several researchers reported on web-based maps. Dempsey and Fisher (2005) described a web-based tool that allowed stakeholders to access geographical information about climate change impact and land-use change. Lieske (2015) described a tool that allowed stakeholders to move around a digital map, toggle between different layers of data (e.g., flood level projections, social vulnerability index), and add their own map features.

Recognizing the value of acknowledging and prioritizing each stakeholder's own knowledge and experience, researchers used historical timelines, sketches, and other figures to integrate scientific data with information provided by stakeholders. Andersson et al. (2013), Bartels et al. (2013), and Dwamena et al. (2011) reported successful use of timelines to elicit stakeholder knowledge and increase understanding of broad-scale climatic trends. To ensure participation from stakeholders with limited formal education, Girvetz et al. (2014), Tschaakert et al. (2014), and Christmann et al. (2015) engaged participants in developing figures that combined scientific data with participants' sketches and symbols. Some studies reported using participatory mapping exercises as a tool for producing visualizations that integrate biophysical data with stakeholder knowledge. Dwamena et al. (2011) reported on the use of large three-dimensional regional maps onto which participants used post-it notes and push-pins to overlay their own "spatial memories" of community vulnerabilities, resources, and activities. This collectively produced, three-dimensional model was reported as an effective tool for generating a common understanding of the problem among stakeholders and improving future coordination of the efforts of various organizations active in the region.

In some cases, researchers used tools to facilitate stakeholder participation in vulnerability assessment. A participatory vulnerability assessment tool called Integrated Coastal Sensitivity, Exposure, and Adaptive Capacity for Climate Change (I-C-SEA Change) was developed to help non-experts in the tropical Indo-Pacific understand vulnerabilities associated with coastal ecosystems (Licuanan et al., 2015). Participants were able to combine their knowledge and experience with data related to erosion and marine flooding. Similarly, Vulnerability Assessment Tool for Understanding Resilience of Fisheries (VA-TURF) is a vulnerability assessment developed for fishers to assess coastal fisheries, reef ecosystems, and socioeconomics in tropical fisheries in the Pacific (Mamauag et al., 2013). Both tools led to the empowerment of community members to evaluate their own vulnerability and move toward adaptation.

A separate set of tools was used to help stakeholders visualize future climate impacts and adaptation scenarios, facilitating the development and assessment of adaptation options. Preston

Recommendations for Engaging Communities in Climate Change Adaptation 147

et al. (2009) guided participants through a cognitive mapping process using simulation software (Vensim) to produce a collective map that showed agreed-upon links between drivers, outcomes, and management options allowing stakeholders to assess various adaptation options. Langsdale et al. (2009) used a similar modeling program (Stella) to help workshop participants visualize future scenarios and the impacts that management steps may have on those scenarios. Mapping exercises were again helpful when assessing adaptation options. Frazier et al. (2010) began with a GIS map that combined storm surge and sea level rise projections with data regarding social and economic development to facilitate discussion about county planning in business development, emergency management, and infrastructure. Similarly, Jude (2008) created visualizations of future coastlines to help managers and the public select a management plan and reported on the advantages and disadvantages of computer visualizations as a public education tool. Sheppard et al. (2011) combined maps, photographs, diagrams, and storylines to develop computer simulations to facilitate stakeholder discussions about a wide range of future scenarios in workshops. Participants in these workshops reported a clearer understanding of local and global connections in climate impacts and responses.

Theme 4: Addressing Trust and Uncertainty. Lack of trust and uncertainty are underlying difficulties with climate change and adaptation planning. The studies we reviewed revealed strategies to deal with building trust and the uncertainty inherent with a changing climate. In some studies, the process of building trust began during initial engagement, as successfully engaging stakeholders requires stakeholders to perceive the host institution to be credible and trustworthy. Dempsey and Fisher (2005) suggested that perceived credibility "has more to do with qualities and credentials of the source than with the scientific quality of the information" (p. 1506) and based their own presentations on IPCC data. Matthews et al. (2008) report that tables of raw data were viewed as more credible and more salient than summaries for their audience of decision-makers. Moreover, they saw managing participant expectations (i.e., establishing a context in which stakeholders acknowledge the inherent uncertainty in climate impacts and view their own and scientific knowledge as partial) as a key aspect of maintaining credibility.

Researchers suggested that using local data, relevant contexts, and clear language were most helpful in developing trust with participants. Bormann et al. (2012) found that participants trusted local knowledge more than scientific knowledge and opted to use a relatively short time horizon for their discussions, which minimized uncertainty but unfortunately led to adaptation recommendations that maintained the status quo. Stott and Huq (2013) suggested that information that is too complex and abstract to understand is as ineffective as information that is too basic or oversimplified. Information that has "technical terms and external concepts" (p. 385) may not connect with people and can create barriers to involvement. A balance between complexity and simplification should create information that is appropriately translated to the audience. Andersson et al. (2013) found that active engagement of agricultural extension agents and their rapport with small farmers led to higher participation and more workshops attended by the small farmers than other groups. Personable facilitators who are knowledgeable of climate

Journal of Human Sciences and Extension Volume 8, Number 2, 2020

change are essential, as the lack of scientific knowledge could become a barrier to effective communication with stakeholders (Stott & Huq, 2014).

Finally, researchers reported using a variety of tools to address trust and uncertainty during the engagement process. For instance, Butler et al. (2014), Luque et al. (2013), and Cross et al. (2013) reported having workshop participants identify and prioritize "no-regret" actions that would be useful in addressing climate change impacts but also in improving quality of life in the context of any future climate scenarios (i.e., reducing poverty, improving housing). Bardsley and Rogers (2011) used a tool, The Adaptation Challenge, to engage participants in learning, building trust, and addressing uncertainty as they used local knowledge to adapt climate projections. Using future scenarios, participants were able to consider contingency plans in the face of significant variance (Cross et al., 2013). Andersson et al. (2013) described participant-produced matrices in which breakout groups quantitatively identified the severity and likelihood of climate-related problems identified earlier in the workshop. Lemieux et al. (2014) used a Policy Delphi approach, which they viewed as well-suited for situations with "significant uncertainty" and in which "exact knowledge" and "historical precedent" are not available (p. 128). The Policy Delphi process focused on participant responses to a survey developed from participant input during earlier stages of the workshop (e.g., pre-workshop online survey, breakout sessions).

Theme 5: Maximizing Limited Time. Successful community adaption planning takes time (Bardsley & Sweeney, 2010; Cone et al., 2013), as it requires stakeholders to acquire new skills and mental models to understand the impacts of climate change, the context of the adaption, and realistic adaption options. Repeated interaction and concerted effort to create personal relationships with participants can increase return rate in future adaptation planning activities (Andersson et al., 2013) and allow participants to build trust in the host institution, facilitators, and process (Bartels et al., 2013). Matthews et al. (2008) suggested an iterative process "rather than one-off contact with stakeholders" (p. 71) was important to their social-learning approach. Langsdale et al. (2009) found that during their participatory watershed modeling, it was important to engage participants for 40 to 60 hours in the participatory process before they built trust in the model. Yet, researchers in our sample struggled with getting stakeholders to commit the necessary time. Picketts et al. (2014) cited time as the biggest drawback to participation, explaining they limited their program to a one-day workshop because many invitees indicated they could not commit to more than one day. Langsdale et al. (2009) reported poor attendance by elected officials due to their inability to commit to the five-workshop program. Andersson et al. (2013) noted the importance of avoiding busy times of the year for their stakeholders (e.g., planting and harvesting).

Authors of reviewed studies offered several guidelines to maximize the limited time available for planning and interaction with stakeholders. In many cases, researchers disseminated information about climate change prior to holding a workshop. Cross et al. (2013) provided participants with

access to pre-workshop webinars that took the place of introductory presentations that would have been a part of the workshop. Before one community-based adaptation workshop, participants received documents describing historic climate trends and information about climate variability and future projections (Picketts et al., 2012).

At the beginning of engagement, establishing clear, agreed-upon program foci and objectives helped keep discussions on track and increased stakeholder satisfaction with the outcomes (Andersson et al., 2013; Byers et al., 2014; Langsdale et al., 2009). Cross et al. (2013) had participants complete pre-workshop surveys to identify features (e.g., natural fire regime) to focus the adaptive-planning exercises. Similarly, Cone et al. (2013) used information from experts and a combination of results from pre-workshop surveys and interviews to develop a causal map as a starting point for workshop discussions. Girvetz et al. (2014) developed a vulnerability assessment prior to workshops based on existing literature and input from a subset of local experts and stakeholders. This assessment became a starting point for participants to amend and supplement with their own observations during the workshops. As part of a series of workshops, Cross et al. (2013) provided participants in later workshops with a draft conceptual model created in prior workshops upon which the participants could build.

Additional Thoughts About the Adaptation Planning Communication Themes

Since most of the papers in our review explore the Understanding and Planning phases of community adaptation work, these five themes are most useful to organizers and Extension professionals who are introducing and teaching about climate adaptations to their communities. The themes are not independent of each other and have interesting overlaps. Establishing a positive and engaging relationship and maintaining that atmosphere throughout the activity helps to increase trust and explain relevant uncertainty (our theme four). This is also likely to facilitate participatory methods that enable all stakeholders to engage (our theme two). Similarly, those participatory methods may help increase understanding and trust, but they are also likely to take time, creating a tension between our themes two and five.

Discussion and Conclusions

As climate change impacts are felt in the most vulnerable regions of the planet, community-based processes to identify and implement adaptations to climate change are a critical step to increasing resilience. Both the factors that affect and define vulnerability and the strategies used to implement change are deeply steeped in social contexts. Participatory approaches that reflect and adapt to the local community are nearly universal. They can be designed to enhance social learning, build social capital, and increase community capacity to create change. Cone et al. (2013) emphasize the importance of putting "scientists, communicators, and publics into dialogue about what they know, what it means, and how to put it to work…, using group processes and visible thinking routines" (p. 357). McNamara and Buggy (2017) noted that the long-term success of these approaches is dependent upon a parallel process of institutionalizing,

mainstreaming, and upscaling community-based adaptions. The very facilitators, educators, and Extension agents who are helping guide these processes are a likely source of networking and leadership in this regard. These professions include an approach to program development and formative evaluation that may enable them to engage in the type of experimentation, action research, and iterative learning that is needed to navigate this new territory (Reed et al., 2015).

Extension agents and educators who are part of a broader network are also well-positioned to address the critical crosscutting barriers that affect each step of the adaptation process: leadership, resources, communication and information, and values and beliefs (Moser & Ekstrom, 2010). Skilled leaders (including those in each community) can facilitate engaging processes that respect stakeholders; elicit participation; and maintain transparent, creative, and relevant activities. Resources such as expertise, information, and time may be more available than funding and technology in some regions and stand a greater chance of becoming available with the commitment of an institutional network than an individual community. Communication and information are essential at every phase of the process, both within the community and between the community and decision-makers at larger scales. Values and beliefs held by each participant affect their perceptions, their engagement, and the outcome of the process (Moser & Ekstrom, 2010). Educators and Extension agents are likely to bring an understanding of these concerns and training to overcome these barriers.

In the context of three phases of adaptation programs, we see the five themes identified in this study as applying to multiple phases in different ways. For example, theme three, "using tools to facilitate understanding," includes tools for improving stakeholder understanding of the challenges presented by past climate impacts (Understanding Phase) as well as understanding of likely future impacts (Planning Phase). Similarly, theme four, "addressing trust and uncertainty," includes techniques to build and maintain trust in leaders of the adaptation process, in scientific insights regarding past and future climate impacts, and in other stakeholders. Again, these techniques begin in the first stages of the process and continue throughout. In this way, we believe that the insights gleaned from the studies reviewed help to flesh out for practitioners the theoretical framework provided by Moser and Ekstom (2010).

Limitations

The selection of search terms used in this study limited results, and we certainly missed papers that were relevant but lacked the exact words we used. Additionally, the peer-reviewed literature tends to promote research findings, such that case descriptions of successful community-based adaptation projects are either not reported or are used to illustrate a research question and may not be captured in the abstracts. Finally, our search process did not include non-peer-reviewed literature, which is a likely source of project reports that detail community-based climate change adaptation efforts. Particularly with the recent grant-funded activity through international and

Recommendations for Engaging Communities in Climate Change Adaptation 151

development non-governmental organizations (NGOs), some innovative strategies have been missed by our reliance on the peer-reviewed literature.

Recommendations for Engaging Communities in Climate Change Adaptation

Based on the systematic review of the 50 identified articles and the five themes that emerged about community adaptation planning, we suggest the following recommendations for Extension professionals and other educators and communicators working with communities to address climate change adaptation:

- Taking time to identify all key stakeholders prior to the beginning of the process increases the likelihood of broad adoption of actions and plans.
- Placing stakeholder knowledge and perspectives at the center of the discussion from the beginning of the planning process can increase participation and receptiveness to scientific input regarding climate change.
- Using the many tools that are available to foster communication between stakeholders about complex topics and processes from low tech physical maps and push-pins (Dwamena et al., 2011) to high tech computer simulation (Langsdale et al., 2009; Pearce et al., 2012).
- Visualizing both the risks of climate change and the outcomes of potential adaptation strategies can be challenging for participants. Simulation tools can be supplemented by facilitated discussions and other social learning techniques that help stakeholders consider new ideas.
- Using scenario-building exercises that combine input from stakeholders and scientists to guide planning in the face of inherent uncertainty involved in future, local-scale climate impacts. This can involve modifying projections with local data (Pearce et al., 2012), building on scenarios with local knowledge of historic adaptations to climate variation (Bhave et al., 2013), and ranking and prioritizing options based on feasibility (Frazier et al., 2010).
- Establishing the practical and local implications of climate change impacts; and fostering personal, long-term relationships among participants. Mistrust is a major barrier that can be addressed by engaging stakeholders in a process to surface their knowledge and making it a central part of the discussions.
- Incorporating stakeholder responsibilities into the scheduling of workshops; and structuring workshops such that progress made during one workshop can provide a foundation for the next workshop even with significant stakeholder turnover (Cross et al., 2013). Time constraints represent another major barrier that can be addressed by developing materials and activities to prepare participants for workshop discussions.
- Building the trust and coordination between individual and institutional stakeholders that is necessary to manage the inherent uncertainty involved requires long-term commitment. Adaptation is a process that takes place over time, not in a single event.

Journal of Human Sciences and Extension Volume 8, Number 2, 2020

Note that only three of the 50 articles included in this review report on the management phase of adaptation. Therefore, the recommendations for practitioners provided above are related to the understanding and planning phases of adaptation (Moser & Ekstrom, 2010). While it is reasonable to assume that increased success in the early stages of community adaptation would increase the likelihood of success in the management phase, more evaluations of the management of community-based climate change adaptation programs are needed to explore how steps taken during the early phases of adaptation can enhance or impede successful management of climate change adaptations. While our focus here is on recommendations for practitioners, there is a clear need for more research on the ability of these programs to bring about effective community adaptations to climate change.

References

Adger, W. N. (2003). Social capital, collective action, and adaptation to climate change. *Economic Geography*, *79*(4), 387–404. https://doi.org/10.1111/j.1944-8287.2003.tb00220.x

Adger, W. N., Arnell, N. W., & Tompkins, E. L. (2005). Successful adaptation to climate change across scales. *Global Environmental Change*, *15*(2), 77–86. https://doi.org/10.1016/j.gloenvcha.2004.12.005

Andersson, L., Wilk, J., Graham, L. P., & Warburton, M. (2013). Design and test of a model-assisted participatory process for the formulation of a local climate adaptation plan. *Climate & Development*, *5*(3), 217–228. https://doi.org/10.1080/17565529.2013.812955

André, K., & Jonsson, C. A. (2015). Science-practice interactions linked to climate adaptation in two contexts: Municipal planning and forestry in Sweden. *Journal of Environmental Planning & Management*, *58*(2), 297–314. https://doi.org/10.1080/09640568.2013.854717

Ayers, J., & Forsyth, T. (2009). Community-based adaptation to climate change. *Environment: Science and Policy for Sustainable Development*, *51*(4), 22–31. https://doi.org/10.3200/ENV.51.4.22-31

Bardsley, D. K., & Rogers, G. P. (2011). Prioritizing engagement for sustainable adaptation to climate change: An example from natural resource management in South Australia. *Society & Natural Resources*, *24*(1), 1–17. https://doi.org/10.1080/08941920802287163

Bardsley, D. K., & Sweeney, S. M. (2010). Guiding climate change adaptation within vulnerable natural resource management systems. *Environmental Management*, *45*(5), 1127–1141. https://doi.org/10.1007/s00267-010-9487-1

Bartels, W-L., Furman, C., Diehl, D., Royce, F., Dourte, D., Ortiz, B., Zierden, D. F., Irani, T. A., Fraisse, C. W., & Jones, J. (2013). Warming up to climate change: A participatory approach to engaging with agricultural stakeholders in the Southeast US. *Regional Environmental Change*, *13*, 45–55. https://doi.org/10.1007/s10113-012-0371-9

Recommendations for Engaging Communities in Climate Change Adaptation 153

Bell, E. J., Turner, P., Meinke, H., & Holbrook, N. J. (2015). Developing rural community health risk assessments for climate change: A Tasmanian pilot study. *Rural & Remote Health*, *15*(3), 1–15. http://www.rrh.org.au/journal/article/3174

Bhave, A., Mishra, A., & Groot, A. (2013). Sub-basin scale characterization of climate change vulnerability, impacts and adaptation in an Indian River basin. *Regional Environmental Change*, *13*(5), 1087–1098. https://doi.org/10.1007/s10113-013-0416-8

Boby, L., Hubbard, W., Megalos, M., & Morris, H. L. C. (2016). Southern foresters' perceptions of climate change: Implications for educational program development. *Journal of Extension*, *54*(6), Article v54-6rb3. https://www.joe.org/joe/2016december/rb3.php

Bormann, H., Ahlhorn, F., & Klenke, T. (2012). Adaptation of water management to regional climate change in a coastal region – Hydrological change vs. community perception and strategies. *Journal of Hydrology*, *454–455*, 64–75. https://doi.org/10.1016/j.jhydrol.2012.05.063

Bowers, A. W., Monroe, M. C., & Adams, D. C. (2016). Climate change communication insights from Cooperative Extension professionals in the US Southern states: Finding common ground. *Environmental Communication*, *10*(5), 656–670. https://doi.org/10.1080/17524032.2016.1176947

Butler, J. R. A., Suadnya, W., Puspadi, K., Sutaryono, Y., Wise, R. M., Skewes, T. D., Kirono, D., Bohensky, E. L., Handayani, T., Habibi, P., Kisman, M., Suharto, I., Supartarningsih, S., Ripalsi, A., Fachry, A., Yanuartati, Y., Abbas, G., Duggan, K., & Ash, A. (2014). Framing the application of adaptation pathways for rural livelihoods and global change in eastern Indonesian islands. *Global Environmental Change, Part A: Human & Policy Dimensions*, *28*, 368–382. https://doi.org/10.1016/j.gloenvcha.2013.12.004

Butler, J. R. A., Wise, R. M., Skewes, T. D., Bohensky, E. L., Peterson, N., Suadnya, W., Yanuartati, Y., Handayani, T., Habibi, P., Puspadi, K., Bou, N., Vaghelo, D., & Rochester, W. (2015). Integrating top-down and bottom-up adaptation planning to build adaptive capacity: A structured learning approach. *Coastal Management*, *43*(4), 346–364. https://doi.org/10.1080/08920753.2015.1046802

Byers, A. C., McKinney, D. C., Thakali, S., & Somos-Valenzuela, M. (2014). Promoting science-based, community-driven approaches to climate change adaptation in glaciated mountain ranges: HiMAP. *Geography*, *99*(3), 143–152.

Chaudhury, A., Helfgott, A., Thornton, T., & Sova, C. (2016). Participatory adaptation planning and costing. Applications in agricultural adaptation in western Kenya. *Mitigation & Adaptation Strategies for Global Change*, *21*(3), 301–322. https://doi.org/10.1007/s11027-014-9600-5

Christmann, S., Aw-Hassan, A., Rajabov, T., & Rabbimov, A. (2015). Collective action for common rangelands improvement: A climate change adaptation strategy in Uzbekistan. *Society & Natural Resources*, *28*(3), 280–295. https://doi.org/10.1080/08941920.2014.933927

Journal of Human Sciences and Extension Volume 8, Number 2, 2020

Recommendations for Engaging Communities in Climate Change Adaptation 154

Cone, J., Rowe, S., Borberg, J., Stancioff, E., Doore, B., & Grant, K. (2013). Reframing engagement methods for climate change adaptation. *Coastal Management*, *41*(4), 345–360. https://doi.org/10.1080/08920753.2013.803926

Cooper, H. M. (2010). *Research synthesis and meta-analysis: A step-by-step approach* (4th ed.). Sage.

Cross, M. S., McCarthy, P. D., Garfin, G., Gori, D., & Enquist, C. A. F. (2013). Accelerating adaptation of natural resource management to address climate change. *Conservation Biology*, *27*(1), 4–13. https://doi.org/10.1111/j.1523-1739.2012.01954.x

Dempsey, R., & Fisher, A. (2005). Consortium for Atlantic Regional Assessment: Information tools for community adaptation to changes in climate or land use. *Risk Analysis: An International Journal*, *25*(6), 1495–1509. https://doi.org/10.1111/j.1539-6924.2005.00695.x

Diehl, D. C., Garcia, E. P., Sloan, N. L., Dourte, D. R., Galindo-Gonzalez, S., & Fraisse, C. W. (2016). From resistance to receptiveness: Farmer willingness to participate in Extension discussions about climate variability and climate change. *Journal of Human Sciences and Extension*, *4*(3), 61–74. https://www.jhseonline.com/article/view/759/657

Diehl, D. C., Sloan, N. L., Garcia, E. P., Galindo-Gonzalez, S., Dourte, D. R., & Fraisse, C. W. (2017). Climate-related risks and management issues facing agriculture in the Southeast: Interviews with Extension professionals. *Journal of Extension*, *55*(1), Article v55-1a2. https://www.joe.org/joe/2017february/a2.php

Dwamena, E., Banaynal, R., & Kemausuor, F. (2011). Participatory three dimensional model mapping (P3DM): Expanding rural horizons and decision making for food security planning, climate change adaptation and flood risk reduction in Ghana. *Research Journal of Agricultural Science*, *43*(4), 186–195. https://www.rjas.ro/paper_detail/1365

Eames, M., Dixon, T., May, T., & Hunt, M. (2013). City futures: Exploring urban retrofit and sustainable transitions. *Building Research & Information*, *41*(5), 504–516. https://doi.org/10.1080/09613218.2013.805063

Evans, L., Milfont, T. L., & Lawrence, J. (2014). Considering local adaptation increases willingness to mitigate. *Global Environmental Change*, *25*, 69–75. https://doi.org/10.1016/j.gloenvcha.2013.12.013

Few, R., Brown, K., & Tompkins, E. L. (2007). Public participation and climate change adaptation: Avoiding the illusion of inclusion. *Climate Policy*, *7*(1), 46–59. https://doi.org/10.1080/14693062.2007.9685637

Frazier, T. G., Wood, N., & Yarnal, B. (2010). Stakeholder perspectives on land-use strategies for adapting to climate-change-enhanced coastal hazards: Sarasota, Florida. *Applied Geography*, *30*(4), 506–517. https://doi.org/10.1016/j.apgeog.2010.05.007

Galicia, L., Gómez-Mendoza, L., & Magaña, V. (2015). Climate change impacts and adaptation strategies in temperate forests in Central Mexico: A participatory approach. *Mitigation & Adaptation Strategies for Global Change*, *20*(1), 21–42. https://doi.org/10.1007/s11027-013-9477-8

Journal of Human Sciences and Extension Volume 8, Number 2, 2020

Recommendations for Engaging Communities in Climate Change Adaptation 155

Girvetz, E., Gray, E., Tear, T., & Brown, M. (2014). Bridging climate science to adaptation action in data sparse Tanzania. *Environmental Conservation*, *41*(2), 229–238. https://doi.org/10.1017/S0376892914000010

Gough, D., Oliver, S., & Thomas, J. (2017). *An introduction to systematic reviews* (2nd ed.). Sage.

Grothmann, T., & Patt, A. (2005). Adaptive capacity and human cognition: The process of individual adaptation to climate change. *Global Environmental Change*, *15*(3), 199–213. https://doi.org/10.1016/j.gloenvcha.2005.01.002

Harley, C. D., Randall Hughes, A., Hultgren, K. M., Miner, B. G., Sorte, C. J., Thornber, C.S., Rodriguez, L. F., Tomanek, L., & Williams, S. L. (2006). The impacts of climate change in coastal marine systems. *Ecology Letters*, *9*(2), 228–241. https://doi.org/10.1111/j.1461-0248.2005.00871.x

Hasse, J. U., & Weingaertner, D. E. (2016). From vision to action: Roadmapping as a strategic method and tool to implement climate change adaptation - the example of the roadmap 'water sensitive urban design 2020.' *Water Science & Technology*, *73*(9), 2251–2259. https://doi.org/10.2166/wst.2016.065

Henly-Shepard, S., Gray, S. A., & Cox, L. J. (2015). The use of participatory modeling to promote social learning and facilitate community disaster planning. *Environmental Science & Policy*, *45*, 109–122. https://doi.org/10.1016/j.envsci.2014.10.004

Hibbs, A. C., Kahl, D., PytlikZillig, L. M., Champion, B., Abdel-Monem, T., Steffensmeier, T., Rice, C. W., & Hubbard, K. (2014). Agricultural producer perceptions of climate change and climate education needs for the central Great Plains. *Journal of Extension*, *52*(3), Article v52-3a2. https://www.joe.org/joe/2014june/a2.php

IPCC. (2014a). *Climate change 2014: Impacts, adaptation, and vulnerability. Part B: Regional aspects. Contribution of Working Group II to the fifth assessment report of the Intergovernmental Panel on Climate Change*. http://www.ipcc.ch/report/ar5/wg2/

IPCC. (2014b). *Climate change 2014: Synthesis report. Contribution of Working Groups I, II and III to the fifth assessment report of the Intergovernmental Panel on Climate Change.* http://www.ipcc.ch/pdf/assessment-report/ar5/syr/AR5_SYR_FINAL_All_Topics .pdf

Jones, C., & Lenart, M. (2014). Forestry professionals and Extension educators vs. climate change: Implications for Cooperative Extension programming. *Journal of Extension*, *52*(3), Article v52-3a1. https://www.joe.org/joe/2014june/a1.php

Jost, C., Kyazze, F., Naab, J., Neelormi, S., Kinyangi, J., Zougmore, R. P., Bhatta, G., Chaudhury, M., Tapio-Bistrom, M., Nelson, S., & Kristjanson, P. (2016). Understanding gender dimensions of agriculture and climate change in smallholder farming communities. *Climate & Development*, *8*(2), 133–144. https://doi.org/10.1080/17565529.2015.1050978

Journal of Human Sciences and Extension Volume 8, Number 2, 2020

Recommendations for Engaging Communities in Climate Change Adaptation 156

Jude, S. (2008). Investigating the potential role of visualization techniques in participatory coastal management. *Coastal Management*, *36*(4), 331–349. https://doi.org/10.1080/08920750802266346

Langsdale, S. M., Beall, A., Carmichael, J., Cohen, S. J., Forster, C. B., & Neale, T. (2009). Exploring the implications of climate change on water resources through participatory modeling: Case study of the Okanagan Basin, British Columbia. *Journal of Water Resources Planning & Management*, *135*(5), 373–381. https://doi.org/10.1061/(ASCE)0733-9496(2009)135:5(373)

Lemieux, C. J., Gray, P. A., Douglas, A. G., Nielsen, G., & Pearson, D. (2014). From science to policy: The making of a watershed-scale climate change adaptation strategy. *Environmental Science & Policy*, *42*, 123–137. https://doi.org/10.1016/j.envsci.2014.06.004

Licuanan, W. Y., Samson, M. S., Mamauag, S. S., David, L. T., Rosario, R. B., Quibilan, M. C. C., Siringan, F., Sta. Maria, M. Y. Y., España, N. B., Villanoy, C. L., Geronimo, R. C., Cabrera, O. C., Martinez, R. J. S., & Aliño, P. M. (2015). I-C-SEA Change: A participatory tool for rapid assessment of vulnerability of tropical coastal communities to climate change impacts. *AMBIO - A Journal of the Human Environment*, *44*(8), 718–736. https://doi.org/10.1007/s13280-015-0652-x

Lieske, D. J. (2015). Coping with climate change: The role of spatial decision support tools in facilitating community adaptation. *Environmental Modelling & Software*, *68*, 98–109. https://doi.org/10.1016/j.envsoft.2015.02.005

Lukasiewicz, A., Pittock, J., & Finlayson, M. (2016). Institutional challenges of adopting ecosystem-based adaptation to climate change. *Regional Environmental Change*, *16*(2), 487–499. https://doi.org/10.1007/s10113-015-0765-6

Luque, A., Edwards, G. A. S., & Lalande, C. (2013). The local governance of climate change: New tools to respond to old limitations in Esmeraldas, Ecuador. *Local Environment*, *18*(6), 738–751. https://doi.org/10.1080/13549839.2012.716414

Mamauag, S. S., Aliño, P. M., Marinez, R. J. S., Muallil, R. N., Doctor, M. V. A., Dizon, E. C., Geronimo, R. C., Panga, F. M., & Cabral, R. B. (2013). A framework for vulnerability assessment of coastal fisheries ecosystems to climate change — Tool for understanding resilience of fisheries [VA-TURF]. *Fisheries Research*, *147*, 381–393. https://doi.org/10.1016/j.fishres.2013.07.007

Mannke, F. (2011). Key themes of local adaptation to climate change: Results from mapping community-based initiatives in Africa. In W. L. Filho (Ed.), *Experiences of climate change adaptation in Africa* (pp. 17–32). Springer.

Matthews, K. B., Rivington, M., Buchan, K., Miller, D., & Bellocchi, G. (2008). Characterising the agro-meteorological implications of climate change scenarios for land management stakeholders. *Climate Research*, *37*(1), 59–75. https://doi.org/10.3354/cr00751

Journal of Human Sciences and Extension Volume 8, Number 2, 2020

Recommendations for Engaging Communities in Climate Change Adaptation 157

McNamara, K. E., & Buggy, L. (2017). Community-based climate change adaptation: A review of academic literature. *Local Environment*, *22*(4), 443–460. https://doi.org/10.1080/13549839.2016.1216954

Monroe, M. C., Plate, R. R., Oxarart, A., Bowers, A., & Chaves, W. A. (2019). Identifying effective climate change education strategies: A systematic review of the research. *Environmental Education Research*, *25*(6), 791–812. https://doi.org/10.1080/13504622.2017.1360842

Moser, S. C. (2014). Communicating adaptation to climate change: The art and science of public engagement when climate change comes home. *Wiley Interdisciplinary Reviews: Climate Change*, *5*(3), 337–358. https://doi.org/10.1002/wcc.276

Moser, S. C., & Ekstrom, J. A. (2010). A framework to diagnose barriers to climate change adaptation. *Proceedings of the National Academy of Sciences of the United States of America*, *107*(51), 22026–22031. https://doi.org/10.1073/pnas.1007887107

Murphy, D., Wyborn, C., Yung, L., Williams, D.R., Cleveland, C., Eby, L., Dobrowski, S., & Towler, E. (2016). Engaging communities and climate change futures with multi-scale, iterative scenario building (MISB) in the western United States. *Human Organization*, *75*(1). https://doi.org/10.17730/0018-7259-75.1.33

Nguyen, T. T., Bonetti, J., Rogers, K., & Woodroffe, C. D. (2016). Indicator-based assessment of climate-change impacts on coasts: A review of concepts, methodological approaches and vulnerability indices. *Ocean & Coastal Management*, *123*, 18–43. https://doi.org/10.1016/j.ocecoaman.2015.11.022

Oreskes, N. (2004). The scientific consensus on climate change. *Science*, *306*(5702), 1686. https://doi.org/10.1126/science.1103618

Park, S., Howden, M., & Crimp, S. (2012). Informing regional level policy development and actions for increased adaptive capacity in rural livelihoods. *Environmental Science & Policy*, *15*(1), 23–37. https://doi.org/10.1016/j.envsci.2011.09.004

Pearce, T., Ford, J., Caron, A., & Kudlak, B. (2012). Climate change adaptation planning in remote, resource-dependent communities: An Arctic example. *Regional Environmental Change*, *12*(4), 825–837. https://doi.org/10.1007/s10113-012-0297-2

Picketts, I. M., Werner, A. T., Murdock, T. Q., Curry, J., Déry, S. J., & Dyer, D. (2012). Planning for climate change adaptation: Lessons learned from a community-based workshop. *Environmental Science & Policy*, *17*, 82–93. https://doi.org/10.1016/j.envsci.2011.12.011

Piya, L., Maharjan, K., & Joshi, N. (2013). Determinants of adaptation practices to climate change by Chepang households in the rural Mid-Hills of Nepal. *Regional Environmental Change*, *13*(2), 437–447. https://doi.org/10.1007/s10113-012-0359-5

Preston, B. L., Brooke, C., Measham, T. G., Smith, T. F., & Gorddard, R. (2009). Igniting change in local government: Lessons learned from a bushfire vulnerability assessment. *Mitigation & Adaptation Strategies for Global Change*, *14*(3), 251–283. https://doi.org/10.1007/s11027-008-9163-4

Journal of Human Sciences and Extension Volume 8, Number 2, 2020

Recommendations for Engaging Communities in Climate Change Adaptation 158

Reed, M. S., Evely, A. C., Cundill, G., Fazey, I., Glass, J., Laing, A., Newig, J., Parrish, B., Prell, C., Raymond, C., & Stringer, L. C. (2010). What is social learning? *Ecology & Society*, *15*(4), 1–10. http://www.ecologyandsociety.org/volXX/issYY/artZZ/

Reed, S. O., Friend, R., Jarvie, J., Henceroth, J., Thinphanga, P., Singh, D., Tran, P., & Sutarto, R. (2015). Resilience projects as experiments: Implementing climate change resilience in Asian cities. *Climate and Development*, *7*(5), 469–480. https://doi.org/10.1080/17565529.2014.989190

Regmi, B., Star, C., & Filho, W. L. (2016). Effectiveness of the Local Adaptation Plan of Action to support climate change adaptation in Nepal. *Mitigation & Adaptation Strategies for Global Change*, *21*(3), 461–478. https://doi.org/10.1007/s11027-014-9610-3

Richards, R. G., Sanò, M., & Sahin, O. (2016). Exploring climate change adaptive capacity of surf life saving in Australia using Bayesian belief networks. *Ocean & Coastal Management*, *120*, 148–159. https://doi.org/10.1016/j.ocecoaman.2015.11.007

Ross, H., Shaw, S., Rissik, D., Cliffe, N., Chapman, S., Hounsell, V., Udy, J., Trinh, N., & Schoeman, J. (2015). A participatory systems approach to understanding climate adaptation needs. *Climatic Change*, *129*(1-2), 27–42. https://doi.org/10.1007/s10584-014-1318-6

Salvini, G., Ligtenberg, A., van Paassen, A., Bregt, A. K., Avitabile, V., & Herold, M. (2016). REDD+ and climate smart agriculture in landscapes: A case study in Vietnam using companion modelling. *Journal of Environmental Management*, *172*, 58–70. https://doi.org/10.1016/j.jenvman.2015.11.060

Serrao-Neumann, S., Di Giulio, G. M., Ferreira, L. C., & Choy, D. L. (2013). Climate change adaptation: Is there a role for intervention research? *Futures*, *53*, 86–97. https://doi.org/10.1016/j.futures.2013.08.002

Sheppard, S. R. J., Shaw, A., Flanders, D., Burch, S., Wiek, A., Carmichael, J., Robinson, J., & Cohen, S. (2011). Future visioning of local climate change: A framework for community engagement and planning with scenarios and visualisation. *Futures*, *43*(4), 400–412. https://doi.org/10.1016/j.futures.2011.01.009

Smit, B., & Wandel, J. (2006). Adaptation, adaptive capacity and vulnerability. *Global Environmental Change*, *16*(3), 282–292. https://doi.org/10.1016/j.gloenvcha.2006.03.008

Stott, C., & Huq, S. (2014). Knowledge flows in climate change adaptation: Exploring friction between scales. *Climate & Development*, *6*(4), 382–387. https://doi.org/10.1080/17565529.2014.951014

Tschakert, P., Dietrich, K., Tamminga, K., Prins, E., Shaffer, J., Liwenga, E., & Asiedu, A. (2014). Learning and envisioning under climatic uncertainty: An African experience. *Environment & Planning A*, *46*(5), 1049–1068. https://doi.org/10.1068/a46257

Vulturius, G., & Swartling, Å. G. (2015). Overcoming social barriers to learning and engagement with climate change adaptation: Experiences with Swedish forestry stakeholders. *Scandinavian Journal of Forest Research*, *30*(3), 217–225. https://doi.org/10.1080/02827581.2014.1002218

Journal of Human Sciences and Extension Volume 8, Number 2, 2020

Recommendations for Engaging Communities in Climate Change Adaptation 159

Wadey, M. P., Cope, S. N., Nicholls, R. J., McHugh, K., Grewcock, G., & Mason, T. (2015). Coastal flood analysis and visualisation for a small town. *Ocean & Coastal Management*, *116*, 237–247. https://doi.org/10.1016/j.ocecoaman.2015.07.028

Walsh, J., Wuebbles, D., Hayhoe, K., Kossin, J., Kunkel, K., Stephens, G., Thorne, P. D., Vose, R. S., Wehner, B., Willis, J., Anderson, D., Doney, S., Feeley, R., Hennon, P. A., Kharin, V., Knutson, T., Landerer, F. W., Lenton, T. M., Kennedy, J. J., & Somerville, R. (2014). Chapter 2: Our changing climate. In J. M. Melillo, T. C. Richmond, & G. W. Yohe (Eds.), *Climate change impacts in the United States: The third national climate assessment* (pp. 19–67). U.S. Global Change Research Program. https://doi.org/10.7930/j0kw5cxt

Wenger, E. (n.d.). *Communities of practice: A brief introduction.* https://scholarsbank.uoregon.edu/xmlui/bitstream/handle/1794/11736/A%20brief%20introduction%20to%20CoP.pdf?sequence%E2%80%B0=%E2%80%B01

Wiebe, K., Lotze-Campen, H., Sands, R., Tabeau, A., van der Mensbrugghe, D., Biewald, A., Bodirsky, B., Islam, S., Kavallari, A., Mason-D'Croz, D., Müller, C., Popp, A., Robertson, R., Robinson, S., van Meijl, H., & Willenbockel, D. (2015). Climate change impacts on agriculture in 2050 under a range of plausible socioeconomic and emissions scenarios. *Environmental Research Letters*, *10*(8), 085010. https://doi.org/10.1088/1748-9326/10/8/085010

Wongbusarakum, S., Gombos, M., Parker, B.-A. A., Courtney, C. A., Atkinson, S., & Kostka, W. (2015). The Local Early Action Planning (LEAP) Tool: Enhancing community-based planning for a changing climate. *Coastal Management*, *43*(4), 383–393. https://doi.org/10.1080/08920753.2015.1046805

Wright, H., Vermeulen, S., Laganda, G., Olupot, M., Ampaire, E., & Jat, M. L. (2014). Farmers, food and climate change: Ensuring community-based adaptation is mainstreamed into agricultural programmes. *Climate & Development*, *6*(4), 318–328. https://doi.org/10.1080/17565529.2014.965654

Richard Plate is a lecturer in Environmental Studies in the Office of Interdisciplinary Studies at the University of Central Florida.

Martha Monroe is a Professor focused on environmental education and Extension in the School of Forest Resources and Conservation at the University of Florida.

Claire Friedrichsen is a doctoral candidate in Soil and Water Sciences at the University of Florida. Her focus area is Extension communication related to food security, agricultural development, and soil and water management.

Alison Bowers is a doctoral candidate in Educational Research and Evaluation in the School of Education at Virginia Tech in Blacksburg, Virginia.

Journal of Human Sciences and Extension Volume 8, Number 2, 2020

Recommendations for Engaging Communities in Climate Change Adaptation 160

Willandia Chaves is a Postdoctoral Research Associate in the Program in Science, Technology and Environmental Policy (STEP) in the Woodrow Wilson School of Public & International Affairs at Princeton University. She works at the interface of wildlife ecology and the human dimensions of conservation.

Acknowledgements

This activity is part of eeWORKS, a project of the North American Association for Environmental Education. It was funded by the Pine Integrated Network: Education, Mitigation and Adaptation Project (PINEMAP), a Coordinated Agricultural Project funded by the USDA National Institute of Food and Agriculture (Grant number 2011-68002-30185); the Renewable Resource Extension Act (Award number NI18RREAFXXXG020); and McIntyre-Stennis formula funds (Award number NI18MSCFRXXXG011) to the University of Florida.

Journal of Human Sciences and Extension Volume 8, Number 2, 2020

Appendix

Table 1. Type of Engagement, Adaptation Phase, and Context of the Reviewed Studies (Full citations for the studies are shown in the Reference section of the article.)

Study	Type of Engagement	Adaptation Phase	Themes	Context
Andersson et al., 2013	Workshops	Understanding, planning	1,2,3,4,5	Agriculture, biodiversity, housing, livestock, wildlife, water supply in a river basin in South Africa
André & Jonsson, 2015	Focus groups	Understanding	1,2,3	Municipal planning, rural forestry in Sweden
Bardsley & Rogers, 2011	Presentations, workshops	Understanding, planning	1,2,3,4,5	Natural resource management in urban and peri-urban areas in Australia
Bardsley & Sweeney, 2010	Meetings, presentations, surveys, workshops	Understanding, planning	2,3,4,5	Natural resource management in a Mediterranean climatic region in Australia
Bartels et al., 2013	Workshops, learning network	Understanding, planning, management	1,2,3,4,5	Row crop agriculture in the southeastern U.S.
Bell et al., 2015	Workshops	Understanding, planning	1,2,3	Health concerns in rural communities in Tasmania
Bhave et al., 2013	Workshops	Understanding, planning	1,2	Agriculture, water resources in a river basin in India
Bormann et al., 2012	Meetings, interviews, presentations, focus groups, workshops	Understanding, planning	2,4	Flood control, sea level rise water management in a primarily rural county in Germany
Butler et al., 2014	Focus groups, interviews	Understanding, planning	1,2,4	Adaptation pathways in complex systems emphasizing poverty and development in eastern Indonesian islands
Butler et al., 2015	Workshops	Understanding, planning	1,2,4	Community vulnerability in Indonesia and Papua New Guinea in the Coral Triangle region
Byers et al., 2014	Data collection, field visits by experts, photographs, meetings	Understanding, planning	2,5	Glacier melting, water resources in glaciated mountain regions in Nepal

Recommendations for Engaging Communities in Climate Change Adaptation 162

Study	Type of Engagement	Adaptation Phase	Themes	Context
Chaudhury et al., 2016	Workshops, interviews	Understanding, planning	1,2	Agroforestry in a small farming community in western Kenya
Christmann et al., 2015	Interviews, meetings, workshops	Understanding, planning, management	2,3	Livestock, rangeland degradation, rangeland governance in villages in Uzbekistan
Cone et al., 2013	Interviews, focus groups, surveys, workshops	Understanding, planning	1,2,3,4,5	Coastal issues in at-risk communities in the U.S.
Cross et al., 2013	Interviews, surveys, workshops	Understanding, planning	1,2,3,4,5	Natural resource management of areas under both public and private jurisdictions in the southwestern U.S.
Dempsey & Fisher, 2005	Interactive website, case studies, survey	Understanding	1,3,4	Land use, quality of life related to sea level rise in the eastern U.S.
Dwamena et al., 2011	Workshops	Understanding, planning	3	Flooding, food security, natural resource management, water resources in rural Ghana
Eames et al., 2013	Workshops	Understanding, planning	1,3	Built environment and infrastructure in urban areas in the U.K.
Frazier et al., 2010	Focus groups, participatory mapping, workshops	Understanding, planning	2,3,4,5	Coastal vulnerability in southern U.S.
Galicia et al., 2015	Focus groups, interviews, workshops, working groups	Understanding, planning	1	Forest management in temperate forests in central Mexico
Girvetz et al., 2014	Workshops	Understanding, planning	1,2,3,4,5	Adaptation of rural communities in data-sparse areas of Tanzania
Hasse & Weingaertner, 2016	Roadmap process, meetings	Understanding, planning	2	Urban development, water management in urban areas in western Germany
Henly-Shepard et al., 2015	Participatory modeling workshops	Understanding, planning	1, 2, 3	Coastal islands, disaster (tsunami impacts) planning in the Hawaii islands
Jost et al., 2016	Focus groups, interviews	Planning	1, 2, 3	Small farm agriculture, women farmers in poor, vulnerable areas of Uganda, Ghana, and Bangladesh

Journal of Human Sciences and Extension Volume 8, Number 2, 2020

Recommendations for Engaging Communities in Climate Change Adaptation 163

Study	Type of Engagement	Adaptation Phase	Themes	Context
Jude, 2008	Interviews	Planning	3	Visualization of sea level rise along coastal U.K.
Langsdale et al., 2009	Small group meetings, workshops	Understanding, planning	1,2, 3,5	Water resources in a river basin community in Canada
Lemieux et al., 2014	Survey, meetings, interviews, workshops	Understanding, planning	1,2, 4, 5	Natural resource management in a watershed region in Canada
Licuanan et al., 2015	Workshops	Understanding	1, 2, 3, 5	Impacts of climate change in tropical coastal communities in the Indo-Pacific
Lieske, 2015	Web-based decision support system, workshops	Understanding, planning	3	Urban coastal flooding, sea level rise in eastern Canada
Lukasiewicz et al., 2016	Interviews, workshops	Understanding, planning	3	Ecosystem-based management in a river basin region in Australia
Luque et al., 2013	Public consultations, workshops	Understanding, planning	1,2,4	Poverty and urban planning in Ecuador
Mamauag et al., 2013	Focus groups, workshops	Understanding	1,3	Vulnerability assessment of coastal reef fisheries, indigenous communities in the Philippines
Matthews et al., 2008	Group interviews, focus groups	Understanding	1,2,3,4,5	Agriculture in Scotland
Park et al., 2012	Workshops	Understanding, planning	1,2,3	Rural livelihood vulnerability in Pacific Island countries
Pearce et al., 2012	Meetings, partnerships, consultations, photovoice, workshops	Understanding, planning, management	1,2,3	Adaptation in remote, resource-dependent, Indigenous Arctic community in Canada
Picketts et al., 2012	Focus groups, workshops	Understanding, planning	2,3,5	Community planning and adaptation for fire and flood disasters, water, and transportation in rural Canada
Piya et al., 2013	Household surveys	Understanding	1	Marginalized indigenous populations in Nepal
Preston et al., 2009	Workshops	Understanding	1,3,4	Wildfire vulnerability assessment in urban Australia

Journal of Human Sciences and Extension Volume 8, Number 2, 2020

Recommendations for Engaging Communities in Climate Change Adaptation 164

Study	Type of Engagement	Adaptation Phase	Themes	Context
Regmi, Star, & Filho, 2016	Focus groups, interviews	Management	2	National policies and local planning in Nepal
Richards et al., 2016	Workshops	Understanding, planning	1,2,3	Surf-life saving clubs in coastal Australia
Ross et al., 2015	Participatory climate roundtables	Understanding, planning	1,2,3	Water resources, land-use planning in connected socio-ecological systems in Australia
Salvini et al., 2016	Interviews, role playing game,	Understanding, planning	2,3	Forest conservation, adaptive agriculture, land use in a farming community in central Vietnam
Serrao-Neumann et al., 2013	Focus group meetings, interviews, workshops	Understanding, planning	2	Urban coastal communities in Brazil and Australia
Sheppard et al., 2011	Workshops	Understanding, planning	3	Community engagement and planning in urban communities in Canada
Stott & Huq, 2014	Interviews	Management	4	Knowledge flow across multiple scales in Bangladesh
Tschakert et al., 2014	Interviews, focus groups, small group activities, workshops	Understanding, planning	2,3,4	Change and uncertainty in rural communities in Ghana and Tanzania
Vulturius & Swartling, 2015	Interviews, focus groups	Understanding	2,3	Forest resources in Sweden
Wadey et al., 2015	3D visualization film	Understanding, planning	1,3	Flooding, sea level rise in coastal communities in the U.K.
Wongbusarakum et al., 2015	Outreach materials, workshops	Understanding, planning	2,3	Community-based planning in tropical coastal communities in Micronesia and Coral Triangle
Wright et al., 2014	Interviews, surveys, focus groups	Management	2,3	Agriculture and food security in Bangladesh, Mozambique, Uganda, and India

Journal of Human Sciences and Extension Volume 8, Number 2, 2020