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# Alaska Native Responses to Climate Change: The Role of Community Values in Housing Adaptation

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## ABSTRACT

The Arctic is experiencing intensified impacts from climate change, resulting in unprecedented rates of change, especially for Indigenous communities. Alaska Natives are experiencing transformations in housing, food security, economic stability, and cultural practices as a result of the biophysical changes such as thawing permafrost and coastal erosion. In response, communities are prioritizing adaptation. Although Indigenous communities have been adapting for hundreds of years, adaptation strategies, or actions that seek to moderate harm through the adjustment to actual or expected climate change effects, are not well documented. Housing adaptation strategies are especially understudied, which include any adaptation strategy that is in response to or in preparation for a biophysical change affecting housing. Housing adaptation strategies in response to climate change are primarily focused on physical dimensions (e.g., retrofitting homes, constructing sea wall). Nevertheless, adaptations to changes in biophysical systems are closely interlinked to sociocultural systems, which are often neglected in adaptation discourse. Analyzing existing strategies through the lens of community values captures the sociocultural aspects of adaptation and is critical for sustainable adaptation. This paper presents a research design that addresses these gaps in adaptation discourse by asking: *How are community values represented in housing adaptation strategies in response to climate change?* This research will employ interviews, focus groups, and observations in partnership with two Alaska Native communities in Oscarville, Alaska and Point Lay, Alaska using community based participatory research methods (CBPR). Understanding the role of community values in housing adaptation is essential for developing sustainable adaptation plans, engineering designs, and future research studies. Further, employing CBPR methodologies in the context of adaptation, grounds identified strategies and resulting plans in community experience. As a result, future findings will not only contribute to the intellectual understanding of adaptation processes and theory, but also facilitate actions in response to climate change.

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## **KEYWORDS**

Housing, Adaptation strategies, Values, Climate Change, Community based participatory research

## **INTRODUCTION**

The Arctic is warming at twice the rate of the global average, resulting in biophysical, sociological, economic, and political changes (Clement et al. 2013; Cochran et al. 2013; Keil and Knecht 2017; Keskitalo 2009). It is home to diverse groups of Indigenous Peoples that each have their own distinct cultures and economies and that are spiritually connected to the environment and land. Arctic Indigenous communities are typically isolated and considered exceptionally susceptible to climate change impacts due to their dynamic relationship with the environment and land, high hazards associated with their location (e.g., shorelines), political and economic marginalization, and existing social, health, and poverty disparities (Ford, Pearce, Duerden, Furgal, & Smit, 2010; Galloway Mclean, 2009). Communities are experiencing loss and changes of housing as a result of the biophysical changes including thawing permafrost, coastal erosion, and sea level rise (Ford et al. 2014).

Houses in the Arctic were not designed to withstand unfrozen soils or cyclic transitions between frozen and thawed states, driven by changing climate conditions (Couture et al. 2002; Johannessen et al. 2004). In addition to foundation impacts, thawing soils and increased rainfall depth and intensities leads to increased soil erosion susceptibility localized flooding (Fortier et al. 2008). Consequently, significant structural failures to residential structures are occurring, in many cases leading to uninhabitable dwellings (Bronen 2010; Instanes et al. 2005). Alaska government officials have already classified 31 Alaska Native communities as having imminent flooding and erosion threats, with 12 of the communities choosing to partially or entirely relocate (GAO 2009). Biophysical changes have major implications for community wellbeing that intersect with existing social, cultural, economic, and political stressors, such as the housing crisis (Anisimov et al. 2007; Ford et al. 2010). Alaska Natives' housing conditions are significantly less developed and more overcrowded than the average Alaskan household, leading to increased risks from poorer ventilation and indoor air quality (Pindus et al. 2017). Further, research has demonstrated that living conditions among Alaska natives have directly affected well-being, physical health (e.g., respiratory illness) and mental health (e.g., depression) (Lauster and Tester 2010).

In response to these stressors and shocks, communities are prioritizing adaptation. Adaptation seeks to moderate harm or exploit beneficial opportunities through the adjustment to actual or expected climate and its effects (IPCC 2014). Adaptation strategies in the Arctic are not well documented or understood, especially in the context of housing since climate impacts on the built environment have intensified in the past decade (Ford et al., 2009). Housing adaptation strategies are especially understudied, which include any

adaptation strategy that is in response to or in preparation for a biophysical change affecting housing (e.g., embankment erosion, flooding, permafrost thawing). Housing adaptation strategies in response to a climate change are primarily discussed as a technical or physical concept, focusing on physical adaptations such as modifying the construction of homes, modification of building codes, and construction of sea walls identified by researchers (O'Brien and Wolf 2010). Adaptation to changes in biophysical systems needs to be closely interlinked to sociocultural systems or representative of local culture, priorities, and values (Adger et al. 2013; Wolf 2011). Understanding existing strategies through the lens of community values captures the sociocultural aspects of adaptation (Reid et al. 2014) which are often neglected in adaptation discourse (Adger et al. 2013; O'Brien and Wolf 2010). This research aims to address these gaps by identifying existing housing adaptation strategies and community values and their role in adaptation strategies for housing. To achieve these goals this research asks: *How are community values represented in housing adaptation strategies in response to climate change?*

To answer this question, field researchers will need to work closely with communities. Contextual research concerning Indigenous communities must be done *with* Indigenous peoples from the community (Ford & Pearce, 2012). Many approaches to research with Indigenous communities have not treated the research process as an exchange and co-creation of knowledge, leaving many Alaska Native communities with little understanding of the data collected and how it was presented (Ford & Pearce, 2012; Lewis & Boyd, 2012). A research approach that explicitly acknowledges the need for partnership throughout the process and has been used with Alaska Natives is community based participatory research (CBPR), which conducts research as an equal partnership between community members, organizational representatives, and researchers (Ford and Pearce 2012; Israel et al. 2010; Lewis and Boyd 2012; Mohatt et al. 2004). This paper presents the research design that will employ CBPR and qualitative methods including interviews, focus groups, and observations. The research conducted will be in partnership with two Alaska Native communities in Oscarville, AK and Point Lay, AK and data collection will take place from May 2019-August 2019. The two communities were selected based on their exposure to a range of housing risks and their existing relationships with the Cold Climate Housing Research Center (CCHRC). The CCHRC is a nonprofit organization that works closely with communities to develop energy-efficient and cost-efficient building technologies in circumpolar regions. Participants will include local stakeholders such as community members, Elders, tribal councils, local tribal authorities, and representatives from organizations involved in matters related to housing and climate impacts such as erosion, flooding, and permafrost thawing.

## **CLIMATE CHANGE HOUSING ADAPTATION**

Climate change adaptation aims to reduce adverse consequences of climate change and to enhance positive impacts through private action and public measures, including behavioral, institutional, and technological adjustments (IPCC 2014). As the impacts of climate change have become increasingly evident and felt across populations, adaptation

has become prevalent in climate change discourse. Due to the relatively recent development in climate change agendas and literature, how adaptation strategies are discussed is primarily framed around physical and technical vulnerabilities (Adger et al. 2013). As a result, climate change adaptation literature has focused on biophysical risk assessments and cost analysis of general adaptation strategies, which are often disconnected from sociocultural contexts across communities and regions (Ford & Berrang-Ford, 2011). Housing adaptation discourse is even further limited in scope and depth. Within literature, including reports on climate change and literature reviews concerning adaptation, there is limited information concerning housing adaptation (Ford & Berrang-Ford, 2011; Instanes et al., 2005; Larsen & Fondahl, 2014; Stockholm Environment Institute & Stockholm Resilience Centre, 2013). When discussed, housing adaptations are primarily based on biophysical risks, technical modifications, and cost of adaptation strategies.

Housing adaptation strategies in this context include any adaptation strategy that is in response to or in preparation for a biophysical change (e.g., embankment erosion, flooding, permafrost thawing, etc.) that impacts people's homes. Studies that specifically address housing adaptation have focused on potential adaptation strategies such as alteration of housing designs, construction standards, and land zoning (Hamin and Gurran 2009; Ren et al. 2011; Roders et al. 2013). These strategies have been compiled into a wide range of reports to guide future housing designs to provide design choices that are proactively addressing expected impacts such as increased energy usage, increased ground instability, and higher intensity storms (e.g., increased rainfall, wind speeds, temperature, and flooding) (Harker et al. 2012; Roders et al. 2013). These reports list general design alterations, such as considerations for ventilation, and are not based on community-level experiences. As a result, there is a dearth of knowledge concerning housing adaptation strategies, especially for strategies that are currently enacted at a community level.

The other primary focus of housing adaptation literature is a risk-cost-benefit analysis of strategies (Bjarnadottir et al. 2011; Stewart 2013; Stewart and Deng 2015). These studies are a part of the decision process for choosing when and what types of adaptation strategies should be integrated into housing-related policies and engineering design standards (Stewart and Deng 2015). A study in Australia analyzed potential housing adaptation strategies based on cost and ability to maintain total energy consumption and greenhouse gas emissions (Ren et al. 2011). This study only looked at strategies based on building energy simulations informed by climate change prediction models and did not critically reflect on the feasibility of implementation of strategies beyond technical and economic factors. Similarly, a study in Canada analyzed the costs of potential adaptations for housing foundations in response to climate change impacts, such as permafrost thawing (Hoeve et al. 2006). Although this study analyzed adaptations to existing stressors, only technical and economic factors were considered. While these risk-cost-benefit based understandings

of housing adaptation strategies provide important mechanisms for informing large scale policy changes, they are based on generalized adaptations and are removed from the sociocultural context of different communities and people groups. Adaptation strategies in response to biophysical risks are context specific and have costs and benefits that are rooted in sociocultural systems. This gap has been previously recognized through conceptual literature concerning climate change adaptation in general (Berrang-Ford et al. 2011; Neil Adger et al. 2013; Wolf 2011). A set of case studies with two Aboriginal Australian communities aimed to support community-based adaptation by analyzing adaptive capacities based on physical and social dimensions, such as individual skills and social networks (Race et al. 2016). While some studies address aspects of the larger gap of understanding sociocultural dimensions of adaptation (e.g., adaptive capacity), there is a lack of knowledge concerning the sociocultural dimensions specific to housing adaptation strategies. Overall, housing adaptation strategies are analyzed without reference to the dynamic sociocultural aspects of communities that are expected to enact these strategies.

Adaptation literature has developed with the progression of experienced impacts of climate change. Climate change planning has transitioned from focusing primarily on mitigation strategies to a bilateral approach involving both mitigation and adaptation strategies. The predicted impacts of climate change are now a reality for an increasing number of communities, especially those in small island states and the Arctic. As communities respond to intensified impacts, there is an increasing need and an opportunity to understand how communities are adapting to housing impacts from climate change. Currently, there is a significant lack of understanding of community-level housing adaptation strategies and the role of unique sociocultural characteristics of communities.

## **INDIGENOUS COMMUNITY VALUES AND ADAPTATION**

There are growing concerns for the way that adaptation strategies and plans are chosen and developed, especially in the context of Indigenous communities. Indigenous community values are rooted in different knowledge bodies (i.e., Indigenous and local) than the knowledge that informs Western theory. Assumptions made in Western-based adaptation frameworks carry their unique assumptions that may be inconsistent with community values (Boyle and Dowlatabadi 2011). Based on this difference in understanding, adaptation programs implemented by non-Indigenous people risk adversely affect Indigenous Peoples' livelihoods' and rights to lands and natural resources (Nakashima et al. 2012). In response, previous work recommends designing and implementing strategies with community-based practitioners and knowledge holders (Cohen 2011) through approaches that respect community values and address cultural differences in decision-making (Boyle and Dowlatabadi 2011). While theoretical literature concerning sociocultural dimensions of adaptation is growing (Adger et al. 2013; Wolf 2011), there are a limited number of ethnographic studies. A study with the Gitga'at Nation in British Columbia took a values-focused approach to identify risks and creating adaptation plans with communities. Community values identified were used to capture the sociocultural

aspects of adaptation (Reid et al. 2014). This approach responded to the need for contextual adaptation strategies that are representative of local culture and priorities (Adger et al. 2013; Wolf 2011). As a result, a comprehensive adaptation plan was developed for the Gitga'at Nation. As the discourse around sociocultural dimensions of adaptation develops, there is still a lack of studies concerning adaptation strategies that have been enacted instead of just planned. Further, adaptation plans formed are wide in scope and therefore limited in detail, with housing-related adaptation strategies remaining general when mentioned.

## **RESEARCH PLAN METHODS AND METHODOLOGY**

### **CONTEXT**

As the impacts of climate change create unprecedented stressors for local communities, existing stressors such as the housing crisis are further heightened. Alaska Natives' housing conditions are significantly less developed and more overcrowded than the average Alaskan household, leading to increased risks from poorer ventilation and indoor air quality (Pindus et al. 2017). The multifaceted nature of the stressors impacting housing resiliency (e.g., limited housing, poor design, flooding, erosion) emphasizes the critical need to understand housing adaptation strategies using approaches that integrate local and Indigenous knowledge and sociocultural dimensions into the research methodology (e.g., CBPR, values-based approach).

Oscarville is a small Yup'ik community located in rural southwest Alaska, in the Yukon–Kuskokwim Delta. Like many Alaska Native communities, they are deeply tied to their cultural practices, to the land spiritually and culturally, and they rely on many natural resources and wildlife for food and cultural practices. The area is considered at high risk for experiencing impacts of climate change including severe storms, flooding, erosion, and permafrost thawing (CCHRC 2017). The residential housing and community buildings are situated several feet (meters) from the Kuskokwim River, along the Kuiggayagaq Slough. The CCHRC completed an Alaska Housing Assessment Report in 2017 that identified the Yukon–Kuskokwim Delta as the most at risk area concerning housing in the State of Alaska. This is due to multiple factors, such as preexisting conditions including inadequate sanitation, isolated location, overcrowding in homes, and health among other risks. Housing in Oscarville is limited and considered to be inadequate for residents (CCHRC 2017). The existing conditions are further impacted by melting permafrost, concerns for flooding, erosion, wind storms, and heavy rain. In response, the need for new housing standards and adaptations to foundations is expected. Melting permafrost has led to structural damage to the buildings including windows, doors, floors, and stairs which creates physical safety hazards for residents. While all homes in Oscarville are impacted by melting permafrost, the impacts and adaptations need for each home are dependent on the pre-existing conditions of homes, based on the way it was built, age, the number of residents, and location (CCHRC 2017).

Point Lay, AK is a small Iñupiat community located on the rural northwest coast of Alaska (NSB 2017). The Kasugeluk Lagoon separates the community from the ocean. Similar to Oscarville, AK and many Alaska Native communities, Point Lay is at risk for severe impacts from climate change. Major risks for the community include permafrost melt, sea level rise, embankment erosion, subsidence, and flooding. In 2016, the community’s reservoir unexpectedly drained into the Kokolik River due to melting permafrost, which had previously served as a barrier between the lake and river (Waldholz 2017). This sudden change significantly impacted the community’s availability of fresh water. Beyond the impacts of climate change, existing housing conditions are similar to Oscarville, AK with limited housing availability and overcrowding (NSB 2017).

**DATA COLLECTION THEORETICAL APPROACH**

There is an increased recognition for the need for contextual adaptation strategies that are representative of local culture and priorities (Adger et al. 2013; Wolf 2011). This research aims to understand existing strategies through the lens of community values to capture the sociocultural aspects of adaptation (Reid et al. 2014). Further, this research will adopt a CBPR approach, which will invite communities to participate in the study throughout the research process, including research methods, data collection, and results (Lewis and Boyd 2012). The research team will work closely with the CCHRC to connect with the Elders and tribal councils and discuss preliminary methods being considered to obtain initial views and openness of the communities to the proposed methods. Participants will include local stakeholders such as community members, Elders, tribal councils, local tribal authorities, and representatives from organizations involved in matters related to housing and climate impacts such as erosion, flooding, and permafrost thawing. Individuals from each category of participants will be interviewed, and in-community focus groups will be held that will be open to any community member over the age of 18. Interviews will focus on identifying community values and housing adaptation strategies, while focus groups will aim to reach a collective understanding of community values and their connection to housing adaptation. The research timeline (see Table 1) and methodology sections below provide further details concerning CBPR practices.

Table 1. Timeline for Research Tasks and Corresponding CBPR Practices

Research Task	Oscarville, AK		Point Lay, AK		CBPR Practices
	May '19	Jun '19	Jul '19	Aug '19	
Initial Research Plan Review with Community	X		X		Review research question and methodology with community representatives
Conduct interviews with stakeholders	X	X	X	X	Review interview questions with community representatives
Conduct observations in community	X	X	X	X	Review key observations with community representatives



Conduct focus group in the community	X		X	Collaborative and iterative approach to consensus building in the focal group
Analyze interviews, observations and focus group transcripts	X	X	X	Co-analysis with community member through dual coding to validate results and coding framework

### INTERVIEWS WITH STAKEHOLDERS

Semi-structured interviews will be conducted with local stakeholders such as community members, Elders, tribal councils, local tribal authorities, and representatives from other organizations involved in matters related to housing and climate impacts. Interviews will last approximately one hour and be conducted in English in a location where they feel most comfortable (e.g., in their homes, tribal office, etc.). Interview participants will initially be identified through personal interaction with contacts made through the University of Anchorage and the CCHRC, who work closely with Alaska Native communities. After initial interviews, a combination of door-to-door sampling and snowball sampling will be used to connect with local stakeholders. Interviews with community members will aim to achieve a balanced gender, age, and socioeconomic representation. Aligning with research protocol, this research aims to conduct 50 interviews within each community or until theoretical saturation is reached (i.e., when no new themes or topics are mentioned in a subsequent interview) to ensure that conclusions are representative of the community as a whole. The approach of snowball sampling allows for data collection that is limited by either the willingness of participants or until theoretical saturation is reached (Palinkas et al. 2015). The context and exploratory nature of this research are best enacted through techniques that allow for data collection to be guided by both community connections and not limited to the researcher’s understanding of community dynamics.

During the interviews, respondents will be asked questions concerning housing adaptation such as: *“Have you noticed any changes to your house? What did the first response to these changes look like? How have these changes impacted your life? What changes have you made in response to these impacts?”* In addition, they will be asked questions concerning community values, with an emphasis on housing, such as: *“What does housing mean to you?”* and *“What aspects of housing are most important to you?”* CBPR methodologies will be used during this stage by reviewing interview questions with community members and representatives. The interviews will be recorded with the consent of the participant and transcribed verbatim.

### FOCUS GROUPS

Focus groups are especially useful for studying housing adaptation strategies as the sociocultural dimensions require a deep understanding of community values and dynamics. Focus groups facilitate this deep understanding by leveraging group discussions

and dynamics that stimulate memories and more detailed responses (Leydens et al. 2004; Spradley 2016). Focus groups will be open to everyone and aim to include diverse participants in terms of their socio-economic status, gender, age, and profession to allow sufficient representation of community experience (Cutter 2011). There will be one focus group session in each community that introduces the goals of the project and creates an open space for dialogue concerning climate-related impacts on housing and how people have responded. At the beginning of the focus group, moderators will describe the goals of the study, rules of the session, and confidentiality requirements per Institutional Review Board guidelines. Data will be recorded using audiotapes, board notes, and observer notes to increase the reliability of the collected data. CBPR methodology is utilized in this stage through a collaborative and iterative approach to consensus building within the focus groups. The focus groups will have two stages including (1) housing adaptation strategies identification and confirmation; (2) values identification and confirmation. Participants will be asked discussion-based questions concerning community values with an emphasis on housing, through the lens of “what is important to us.” Questions will start broad and be narrowed as the discussion progresses and participants and facilitators reach points of consensus. Housing adaptation discussions will take place in small break out groups to encourage participation.

## **OBSERVATIONS**

This research relies on community observation to improve cultural understanding, help interpret the interview content, show patterns that interview participants have become blind to, record behaviors, triangulate findings, and identify opportunities for further questioning in interviews (Merriam and Tisdell 2016). Observations compliment data collected in interviews and focus groups by providing opportunities for data collection during informal interactions within the community. Observations are recorded as field notes, during focus groups, and through community produced materials (e.g., drawing, maps, etc.) that will be collected when applicable. Including observations within the methodology enables in-field researchers to adapt to the needs of the communities and engage appropriately within the communities. Based on an observation framework by Creswell and Poth (2018), the level of engagement of the field-researcher spans the spectrum of full observer to full participant. Full observer takes place in scenarios where participation is inappropriate (e.g., community meetings, cultural activities, etc.), while full participant takes place in scenarios deemed appropriate such as focus groups or adaptation activities. Determining whether participation or observation is appropriate is extremely contextual and based on the community and local culture. As a result, field researchers will ask permission to determine the appropriate form of data collection. Areas of observation include but are not limited to, community meetings, important social areas (such as town squares, recreation areas, etc.), and areas impacted by erosion, permafrost thawing, and flooding. These observations conducted will focus on biophysical impacts to housing (e.g., flooding, erosion, etc.), who is most affected by impacts (e.g., age, gender, etc.), who is most involved in housing discussions and actions (e.g., age, gender, etc.), and

housing adaptation strategies implemented (e.g. differences in home construction or location). CBPR methodologies will be utilized during this stage by discussing key observations with community members when appropriate.

#### **DATA ANALYSIS**

NVivo software will be used to manage and organize data analysis. Data analysis will include coding of interviews, focus groups, and observations regarding community values, housing adaptation strategies, and the relationship between the two. Open coding will be used initially by freely coding all observed connections within the collected data to the initial research question. Axial coding is then used to group codes into emerging categories and themes, once interpretations are made and an understanding of the underlying meaning of the data starts solidifying (Merriam and Tisdell 2016). To increase data analysis reliability transcriptions will be coded by two researchers (Munoz and Bangdiwala 1997), one from our research team and another from the local communities and will include verification of similar codes, chronologies, and conclusions. Recruiting a community member will help validate the results and bring local knowledge to the coding framework. Further, community engagement and feedback is an essential component of the reliability of data collection. Post-data collection will primarily be done through member checks which verifies completed transcripts with participants to ensure information is appropriately interpreted and portrayed. This will primarily be done by sharing the coding framework with participants and creating space and time for open feedback and reflection.

#### **RELIABILITY IN DATA COLLECTION AND ANALYSIS**

Reliability in data collection will be developed by spending 2-3 months immersed in the community and through strong community engagement throughout the research process. Further, triangulation of interviews for each stakeholder type, focus groups, observations and analysis of any collected artifacts will be critical in ensuring reliability. It is also critical to understand the limitations in data collection and analysis as a foreigner to Alaska Native communities who carry different assumptions and understandings of the world. This research will be completed in partnership with the community and will heavily rely on the development of trust and understanding between the field researcher and community participants. Visiting with the Elders, their families, and communities will be crucial to establishing rapport and trust with the community leaders and help them open up and share. This process of rapport building will take place on the individual participant level, through the community level (Lewis and Boyd 2012). Participating in community events to increase meaningful interaction time will build trust between the research team and the community (Lewis and Boyd 2012). This approach will deepen the researcher's understanding of culture and community dynamics, which increases the researcher's capacity to analyze observations and better understand differences in limitations.

## **CONCLUSION AND CONTRIBUTIONS**

This paper outlined a methodology to understand and analyze the sociocultural dimensions of housing adaptation strategies through a values-based understanding, which are essential to the development of sustainable adaptation plans and policies. This research challenges conventional approaches to climate change adaptation research by: (1) partnering with communities at every stage of the research process; (2) identifying enacted housing adaptation strategies at a community level; and (3) analyzing the role of community values in housing adaptation strategies. There is a dearth of knowledge concerning housing adaptation strategies enacted at a community level, especially from a values-based approach and in the context of Indigenous communities. While a values-based approach to adaptation has been done with adaptation planning, studies are limited and primarily focus on potential strategies instead of existing strategies. Further, the studies are wide in scope and therefore limited in detail, especially in the context of housing. To address these gaps, we will develop a theory on the relationship between community values and housing adaptation in partnership with communities. While the use of interviews, focus groups, observations, and NVivo coding is commonplace, the content, depth, and commitment to partnership are critical contributions to values-based, community-based, and housing adaptation theories. Future findings will not only contribute to the intellectual understanding of adaptation processes and theory, but also facilitate actions taken by communities, governments, and organizations anticipating and responding to the impacts of climate change.

There remains a gap of knowledge concerning housing adaptation strategies within literature concerning adaptation (Ford et al. 2011; Larsen and Fondahl 2014; SEI-SRC 2013). This is especially true for strategies that are currently enacted at a community level. In response to these gaps, this paper serves as a baseline for understanding enacted housing adaptation strategies at a community level. Understanding housing adaptation strategies at a community-level are essential for multilateral collaboration and aligning long term goals and resources between communities and external agencies. There is also a limited understanding of the sociocultural dimensions of housing adaptation strategies, which is essential for developing contextual adaptation strategies that are representative of local culture and priorities (Adger et al. 2013; Wolf 2011). Understanding the role of community values in housing adaptation is essential for developing sustainable adaptation plans, engineering designs, and future research studies.

Further, employing CBPR methodologies in the context of adaptation will contribute to both theoretical and practical applications of this research by grounding identified strategies and resulting plans and designs in community experience. This approach increases community awareness and engagement with adaptation by stimulating conversation and collaboration through focus groups. Further, it promotes the exchange

and co-creation of knowledge by engaging community members in the data analysis process.

### **RELATION TO GRAND CHALLENGES**

This research responds to grand challenges three (GC3) innovation and growth strategies, four (GC4) system integration, and five (GC5) lifecycle value and governance. It responds to GC3 and GC4 taking a values-based approach to analyzing housing adaptation strategies, which contributes to agile collaboration and systems integration of sociocultural dimensions of climate change adaptation. This approach recognizes that differences in values can inhibit collaboration for sustainable and innovative adaptation and addresses this gap by integrating community values into adaptation analysis. This research highlights the importance of a systems approach when considering adaptation planning and policy design by showing the relationship between physical and sociocultural systems through values. Further, this research responds to GC5 by supporting shared awareness and synchronization between climate change adaptation partners, within communities and between communities and external stakeholders (e.g., non-profits, governments). This research highlights the importance of considering different priorities, cultures and knowledge bodies (e.g., Indigenous and western science) when responding to the impacts of climate change by analyzing the role of values in housing adaptation strategies. By integrating values into adaptation analysis, adaptation planning can be synchronized with community priorities and support sustainable adaptation.

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