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Subjectivity and Social Positions Shape Habitability in the Context of Environmental Change: A Qualitative Case Study in Northern Ghana

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Abstract

The loss of habitable land is increasingly recognized in climate risk assessments, mainly stemming from material approaches based on concepts of loss and damage. While this generalizes people's experience of environmental change and habitability, the lived realities of environmental change impacts are not homogeneous within one place. Adaptation measures building on such homogenous notions of habitability run risk to not only reproduce but also to increase existing inequalities. Contrasting that, the perception of habitability differs between individuals and is thus subject to multiple claims of truth. Our work aims to add to a more nuanced conceptualization of the habitability concept by showing the socially differentiated perceptions of habitability in a given place. We build our work on a qualitative field study in rural Northern Ghana, drawing on an intersectional understanding of habitability. Our results show how the intersection of gender, age, socio-economic status, and household composition translates into social practices that shape a socially differentiated experience of perceived habitability in places exposed to environmental change. This perception is further influenced by the connectivity of places, as well as by very personal notions of habitability related to changes in social networks and aspects of place attachment. Contrasting material and non-context based understandings of habitability, we conclude that the habitability of a place exposed to environmental change is subjective, characterized through an actor's position within a social-ecological system. Understanding this position as embedded in space and time, it is the interplay of various social categories and the social practices emerging from them that shape an actor's position, and perceived habitability. Understanding this, and consequently avoiding generalizing assessments and statements about habitability, is crucial to implementing policies that enable empowering change, rather than reproducing existing inequalities through climate change adaptation. Those affected by environmental change need to be included when defining habitability.

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1. Introduction

The loss of habitable land is increasingly recognized in climate risk assessments (Horton et al., 2021; Intergovernmental Panel on Climate Change [IPCC], 2022). The majority of works studying the loss of habitable land do so in a dichotomous manner, with little focus on both local context and individual place perception. Analyses are hereby often designed through top-down models, defining habitability based on either single or multiple material, particularly environmental, parameters only (Duvat et al., 2021; Kulp & Strauss, 2019; Storlazzi et al., 2015; Xu et al., 2020). Contrasting these approaches, the actual lived experience of environmental change as well as the perception of places is highly individual, even for people within the same physical location and exposed to the same environmental hazards (Djoudi et al., 2016; Kaijser & Kronsell, 2014). The reasons behind this social differentiation and the observed subjectivity go far beyond environmental factors (Antwi-Agyei & Nyantakyi-Frimpong, 2021; Owusu et al., 2019). They include macro-level factors such as economic entanglements (Nyantakyi-Frimpong & Bezner-Kerr, 2015), meso-level factors such as political structures around local water distribution (Segnestam, 2017), and micro-level factors. The latter include aspects of place attachment (Adams & Adger, 2013; Devine-Wright, 2013), subjective conceptions of well-being (Farbotko & Campbell, 2022), the social position, and the related social practices (Erwin et al., 2021; Kaijser & Kronsell, 2014; Nyantakyi-Frimpong, 2020). Recent works point out how, for instance, being perceived as female translates into gendered social practices that shape both the impact of, and the perception of environmental change (Owusu et al., 2019; Segnestam, 2017; Van Praag et al., 2022). Studies show how other social categories such as ethnicity, marital status, religion, or socio-economic status distinguish the socially differentiated experiences of environmental change (Nyantakyi-Frimpong, 2020; Van Aelst & Holvoet, 2016). Adding to that, social categories such as age and socio-economic status can also play primary roles in characterizing the socially differentiated impact of environmental change (Antwi-Agyei et al., 2015).

Even though the notion of habitability is increasingly used, it has yet to be subjected to critical discussion and extensive definition (Borderon et al., 2023; Farbotko & Campbell, 2022). Besides the clear evidence on the socially differentiated impacts of environmental change and the essential role that social structures and practices play hereby, conceptualizations of habitability in the context of environmental change tend to fall short in integrating the social dimension of the physical space that they analyze. Contextualization in line with local realities remains scarce (see Janoth et al., 2024 for a recent example). To our best knowledge, the majority of current approaches to habitability neither extensively incorporate material components beyond environmental parameters, nor do they integrate non-material parameters, acknowledging that habitability can be both subjective and open to multiple claims of truth (Farbotko & Campbell, 2022; Horton et al., 2021). In summary, there is a knowledge gap between conceptualizing habitability in places exposed to environmental change and the actual experience of environmental change. We address this knowledge gap in this paper.

Building on a qualitative study in rural Northern Ghana, we aim to add to the emerging debate on the habitability of places exposed to environmental change, by elaborating how understanding a social-ecological system's socially constructed sphere is crucial for capturing habitability. We argue that the habitability of a place exposed to environmental change is subjective, characterized through actors' socially differentiated positions within a social-ecological system. Understanding these positions as embedded in space and time, it is the interplay of various social categories and social practices that shapes this position and thereby impacts an actor's perceived habitability. The empirical evidence we present illustrates how the intersection of gender, age, socio-economic status, and household composition transfers to social practices that shape the perception of habitability under the exposure of environmental change. These social practices are strongly linked to the capacity to adapt to environmental change both within and outside of agriculture, the ability to access resources through space and time, and living up to societal expectations. Understanding how social practices and structures are both culturally constructed and subject to change can help in informing socially nuanced adaptation measures to climate change—and thus fully integrate the heterogeneous needs of individuals within a given place (Kaijser & Kronsell, 2014; Lawson

et al., 2020). This would contribute to equitable and just social-ecological transitions and thereby avoid the reproduction and reinforcement of social inequalities in the light of environmental change (Segnestam, 2018; Vigil, 2021b). The remainder of the paper is structured as follows: we first delineate the current debate on habitability and secondly illustrate how we conceptualize habitability. We then describe our methodology before moving to the results section. We close this paper by discussing our results, followed by a conclusion.

2. Habitability and Environmental Change

Habitability has been an established concept in earth sciences and astrophysics for long (Cockell et al., 2022; Langmuir & Broecker, 2012). With the increasing recognition of the limits of adaptation to climate change (Adger, Dessai, et al., 2009; Dow et al., 2013; IPCC, 2022), it has recently gained attention in climate studies (see e.g., Borderon et al., 2023; Farbotko, 2023; Farbotko & Campbell, 2022; HABITABLE, 2023; Horton et al., 2021; Janoth et al., 2024; O'Byrne, 2023; Stege, 2018; Sterly, 2023; Vigil, 2021a; Vinke, 2022). Although the concept of habitability is not completely new to social sciences (see e.g., Gunderson, 1970; Jacobson, 1988; Mahdavi, 1998; Storlazzi et al., 2015 for early approaches), there is little critical discussion on the subject (Farbotko & Campbell, 2022; Borderon et al., 2023). As further illustrated in our theoretical framework in chapter 3, the emerging debate on habitability relates to a range of related and already established concepts in climate studies (Borderon et al., 2023; Sterly et al., 2024). To avoid redundancy in chapters 2 and 3, we introduce some of the arguments in this debate only in chapter 3.

A range of recent habitability studies aligns with a natural sciences-based approach from earth sciences and define habitability solely on the basis of environmental parameters (Storlazzi et al., 2015, 2018; Xu et al., 2020). These works assess habitability in the context of environmental change through the linkages of populations to single or multiple changes in the environment, such as the impacts of sea level rise, soil moisture changes, or extreme heat (Horton et al., 2021; Kulp & Strauss, 2019; Storlazzi et al., 2015). For instance, Xu et al. (2020) predict that between one to three billion people will live in unhabitable climatic conditions within the next 50 years. They base this primarily on the physical locality where people live, assuming a homogenous impact of climate change. Contrasting these findings, still also based on environmental parameters only, Kench et al. (2018) and McLean and Kench (2015) argue that geomorphological changes leading to an increase in land area may actually counterpart sea level rise induced loss of land in some areas. Working towards a multidimensional understanding of habitability, the IPCC has been using the term habitability in its recent reports more extensively as compared to previous reports (IPCC, 2018; IPCC, 2022; Nurse et al., 2014). They define habitability as "the ability of a place to support human life by providing protection from hazards which challenge human survival, and by assuring adequate space, food and freshwater" (IPCC, 2022, p. 2911). The IPCC focuses on environmental thresholds and environmental drivers of habitability change, such as temperature and precipitation, but recognizes that both climatic and non-climatic factors can reduce habitability in a context-specific way, and that these drivers of risk can also combine. Other recent publications have broadened the scope of habitability to include these non-climatic factors, for example, through integrating economic conditions, institutional conditions, and cultural dynamics (Åbo Akademi University, 2023; Duvat et al., 2021). Duvat et al. (2021) expand on environmentally based definitions within a large body of research on atoll habitability by introducing a conceptual framework along five pillars of habitability. These pillars are clustered into water and food security, built environment, economic dimension, and consequences of changing environmental parameters (Duvat et al., 2021). Another glance of their work is widening the understanding of habitability along a differentiation of rural and urban areas. They also acknowledge the role of socio-economic drivers of habitability change, such as cultural or political dynamics, but intentionally neglect them in their final conceptualization.

These so called top-down works illustrated in the previous paragraph hold a set of advantages, such as providing spatial comparability, being able to identify large-scale trends, and highlighting regions at risk. They thus build an important entry point for studying habitability (Horton et al., 2021). Yet, these assessments are limited as they miss local bio-geophysical conditions that cannot be measured with global models. They also fall short to integrate population specific components such as socio-economic status and health, and they do not address context-specific aspects such as local adaptation or individual perceptions of places. Due to little integration of peo-

ple-centric analysis, individual notions of habitability are fully neglected (Farbotko & Campbell, 2022; Horton et al., 2021). This links to Kemp et al. (2022) and Kemp (2023) who argue that the focus of habitability assessments is placed upon the wrong factors: environmental conditions are overstated, in comparison to the social dimension of habitability. Kemp (2023) thereby highlights the importance of understanding how society can deal with climate risks while maintaining physical habitability, arguing that places can become socially inhabitable even if they are still physically habitable.

Addressing the shortcomings of top-down approaches, local knowledge such as stakeholder knowledge and local solutions should be integrated in habitability assessments (Farbotko & Campbell, 2022; Horton et al., 2021). Top-down and bottom-up approaches can complement one another. The strength of bottom-up approaches is to capture small scale differences and changes in the environment and the social sphere (Janoth et al., 2024). Horton et al. (2021) propose a more nuanced understanding of habitability as they link the environmental conditions of a place with context specific aspects of human health, livelihoods, and sustainability. For instance, they show how people have a differentiated resistance to heat, depending on their health, and how this alters their personal thresholds in withstanding extreme temperatures that potentially threaten habitability. They further expand this example showing how air conditioning could help some, but not all in dealing with extreme heat. Building on this line of argumentation, Wrathall et al. (2023) propose to focus the definition of habitability on human safety, resilient livelihoods, and the capacity to adapt. Both Horton et al. (2021) and Wrathall et al. (2023) argue how policy choices play an essential role in shaping habitability. A major novelty of these two works is their framing of habitability as a choice that populations make together. Adding to that, Gemenne et al. (2021) and Gavonel (2023) link habitability to the concept of social tipping points (McLeman, 2018; Milkoreit et al., 2018) and embed the populations of interest within their respective social-ecological systems (Colding & Barthel, 2019; Folke et al., 2016; Partelow, 2018; Young et al., 2006). They further point to the importance of individual indicators such as age, household factors such as wealth, and village related factors such as physical location when analyzing habitability (Gavonel, 2023).

3. Theoretical Framework

In the light of these recent conceptual advancements on habitability, this work understands habitability from a people-centered social-ecological perspective (Biggs et al., 2021; Colding & Barthel, 2019; Folke et al., 2016), including insights from the field of intersectionality studies (Crenshaw, 1991; Djoudi et al., 2016; Kaijser & Kronsell, 2014; Mahler et al., 2015; Nightingale, 2011; Resurrección et al., 2015). We understand the positioning of actors and the social categories and practices that this is linked to in a sense of Bourdieu's theory of social practice (Bourdieu, 1990; Maton, 2012; Power, 1999). Our framework further builds on concepts such as place utility (Adams & Adger, 2013; Wolpert, 1965), ecosystems services (Chee, 2004; Ellis et al., 2019), nature's contribution to people (Díaz et al., 2018; Wiederkehr et al., 2019), loss and damage (McNamara & Jackson, 2019; Mechler et al., 2020), and the social limits of adaptation (Adger, Dessai, et al., 2009; Dow et al., 2013)

We define habitability in line with the working definition by Sterly et al. (2024, p. 4) as "the emergent property of a place to afford people to pursue a healthy, meaningful and dignified life." Following Sterly et al.'s (2024) conceptualization, it is neither solely the physically nor solely the socially constituted elements that determine habitability but rather their multidimensional interaction. The habitability of a place is thus constructed and reproduced over space and time as the result of the wider political ecology and political economy that the social-ecological system is embedded in (Sterly et al., 2024). We frame habitability as socially differentiated. Respective thresholds are along a continuum from optimal to not at all livable (Borderon et al., 2023; Farbotko, 2023; Farbotko & Campbell, 2022; Gavonel, 2023; Sterly et al., 2024). The evaluation of how habitable a place is along this continuum "emerges from people's lived experiences, perceptions and discourses of and about the material and immaterial properties of a place" (Sterly et al., 2024, p. 3).

Building on Farbotko and Campbell (2022), and Kitara et al. (2021), we argue that the populations of interest should define their own concept of habitability, including respective thresholds. However, little is known on the ways in which habitability is culturally and socially practiced (Farbotko, 2023; Janoth et al., 2024). Relating to O'Byrne (2023), we extend rather descriptive framings of the material dimen-

sions of habitability by arguing for a normative conceptualization that centralizes the freedom of choice. O'Byrne (2023) builds that conceptualization on Amartya Sen's understanding of freedom and capabilities (De Haas, 2021; Sen, 1999). Through that, he supports the idea that habitability can be subject to multiple claims of truth (Farbotko & Campbell, 2022; O'Byrne, 2023). Going also beyond a descriptive approach, Farbotko and Campbell (2022) acknowledge how this stems from differences in worldviews. This conclusion emphasizes the culturally and socially embedded experiencing of habitability and calls for the integration of local belief systems and cultural practices, including aspects of spirituality and place attachment (Janoth et al., 2024).

Potential indicators interplaying to shape an individual's habitability perception thus include, but are not limited to, livelihood activities and notions of place-attachment, wellbeing, and valued objectives (Adams, 2016; Devine-Wright, 2013; Sterly et al., 2024). Moreover, the habitability of a social-ecological system is dynamic, with the drivers of habitability change being context specific, socially differentiated, and of multidimensional nature. These drivers of habitability change can occur from micro- to macro-level. They can play out as external factors, inter alia through political, environmental, or economic drivers, but also as very internal factors such as changes in individual needs (Sterly et al., 2024). As habitability is along the intersection of nature and culture, so are the effects of environmental hazards (Hoffmann & Oliver-Smith, 2002).

Lastly, relating to the importance of space, we embed habitability into broader notions of political ecology, acknowledging how teleconnections between places also contribute to habitability (Borderon et al., 2023; Sterly, 2023; Sterly et al., 2024). These teleconnections link to biophysical processes, economic entanglements as well as to the mobility of goods, information, and persons (Adger, Eakin, et al., 2009). Going beyond the integration of local adaptation measures, including teleconnections between places, argues that places and livelihoods are linked (Porst & Sakdapolrak, 2020; Rockenbauch et al., 2019; Sakdapolrak et al., 2016), for example, through remittances, socio-cultural practices, and government subsidies (Janoth et al., 2024; Sterly, 2023).

To position individuals within a social-ecological system over space and time, one must look at the social categories and social practices shaping that position (Lykke, 2009; Osborne, 2015). Social categories interact with each other and thus do not describe homogenous groups but rather individuals with multiple, overlaying social categories (Arora-Jonsson, 2011; Kaijser & Kronsell, 2014). Further, social categories translate into informal and formal norms and values within societies that condition social practices (Segnestam, 2018; Vigil, 2021b). Social practices refer to an individual's actions and behaviors, which "result from the relations between one's dispositions (habitus) and one's position in a field (capital) within the current state of play of that social arena (field)" (Maton, 2012, p. 51). Just as social categories, social practices are dynamic and fluid (Segnestam, 2018). They reflect the workings of power, including the unequal division of labor, the rights to resources, participation and decision-making, and the differentiation whose knowledge is relevant for discourses and decisions (Segnestam, 2018; Vigil, 2021b). Social position and practices condition the different capacities of individuals to control their own situation and to respond to changes in the social-ecological system they live in, including environmental changes (Segnestam, 2018; Vigil, 2021b). Understanding the role of social practices serves to understand how individuals experience the very same climatic stressor differently, based on their position in a social-ecological system (Djoudi et al., 2016; Kaijser & Kronsell, 2014).

4. Material and Methods

4.1 Research Site

The case study is located in the rural savannah area of the Northern Region, Ghana. Landscapes are shaped by a rainy and a dry season. Most people practice small-scale farming. Other activities include retailing, food vending, being a pickup driver, and sand winning. The standards of living are low in comparison to Ghana's national average (Mensah et al., 2020). Social practices in the area are characterized by a patriarchate structure and a hierarchic system, mainly along gender, age, and social-economic status. The local understanding of gender is binary and equals sex. Women are responsible for care work and men for managing the household. Though agricultural activity is dominated by men, women increasingly engage with it. Resources, particularly land and livestock, are also traditionally controlled by men. It is elder men who take decisions on village level—including the decision on who actively participates in these decisions.

While the knowledge of married women is actively recognized at the household level, its recognition at the village level and beyond remains selective.

The village has been growing constantly in population and in spatial extent during the past 20 years. Within that period, electricity, improved sanitation, boreholes, a health-care facility, a junior high school, and an asphalted road were introduced. Yet, not everyone profits from these developments to the same degree, as using some of them requires financial capital that some cannot afford. In addition, the growth in population contributes to water shortages and land scarcity. The increasing pressure on land leads to decreasing soil fertility, as traditional field rotation patterns are constrained, and as farmers extensively use chemical fertilizer. This decrease in soil fertility, as well as an increase in erratic rainfall, has been named as the most impactful environmental change to the village during our fieldwork. Common coping mechanisms are livestock sales, savings spending, or remittances. Livelihood diversification is an established adaptation measure. People further adapt to soil fertility decline through fertilizer use and crop rotation. Varying crop planning time, and planting different crops, is an adaptation mechanism to increasingly erratic rainfall.

4.2 Methodological Approach

Our methodological approach builds on a social constructivist perspective, with a specific emphasis on gender and social equity (Segnestam, 2018; Vigil, 2021b; Vigil et al., 2019). We implemented it through six weeks of qualitative field work in Northern Ghana in July and August of 2022. With this, we aimed to assess habitability from an emic perspective and through a people centered approach (Farbotko & Campbell, 2022; Horton et al., 2021; Sterly et al., 2024; Vigil, 2021b), and to consider both intersectionality and subjectivity in the analysis of environmental change (Elmhirst et al., 2015; Kaijser & Kronsell, 2014). A focus on perceptions, norms, and values helps to unravel relevant social practices. The research site was selected for our analysis as it is exposed to environmental change, and as previous research in the area suggests also a considerable social differentiation in experiences of environmental change (Nyantakyi-Frimpong, 2020; Nyantakyi-Frimpong & Bezner-Kerr, 2015).

There is no standardized set of methods for an intersectional and multidimensional assessment of habitability. We thus use a tailored mixed-methods approach to meet our objective within the given context (Fehrenbacher & Patel, 2020; Kaijser & Kronsell, 2014; Segnestam, 2018; Vigil, 2021b). With the support of two local research assistants, we conducted two focus group discussions, two transect walks, four key informant interviews with individuals from the village, four expert interviews with individuals from outside the village, and 27 semi-structured, individual interviews. Two of the semi-structured interviews were stopped half-way. This happened after we asked the interviewees if we should stop the interviews as we noticed their dissatisfaction with the situation. The expert interviews served to get a contextual overview on the social practices, and their recent development, as well as on recent changes in the environment within the region. The key informant interviews, the transect walks, and the first focus group discussion specified this information on village level. These three methods also captured recent changes within the village and outlined the collective narratives on habitability changes, including underlying drivers for habitability change. By collective narrative, we refer to the village level narrative on habitability, acknowledging how this is influenced by factors that go beyond the physical location of the community. The second focus group discussion accounted for a deeper understanding of social practices, in particular how they impact the experience of environmental change. The semi-structured interviews than completed our data collection through providing nuanced insights into the subjective habitability perceptions of individuals, including information on the reasons underlying a potential social differentiation (Vigil, 2021b). We accounted for differing views on short-term and long-term changes by embedding some of our interview questions around seasonal views, for example, referring to rainy or dry season and referring to harvesting and planting season, and by referring to different presidential periods as points of reference. Most importantly, we were able to derive a nuanced understanding inductively from the interviews, based on temporal references such as "when our first child was born," "when I first moved to this village," and "when I was a bachelor."

Accounting for intersectionality implies sampling for heterogenous groups (Segnestam, 2018; Vigil, 2021b). We thus applied purposive sampling in our study (Creswell & Plano Clark, 2017; Vigil, 2021b). This sup-

ports building a sample frame that includes a diverse range of participants with regard to age, socio-economic status, and gender on the one hand, and a differentiated experience of environmental change on the other hand. Hereby, women were in focus of the sample to capture the differentiated habitability perceptions within different women groups, as literature points at the necessity to capture the differences between heterogenous sub-groups of women (Djoudi et al., 2016; Kaijser & Kronsell, 2014). We shortlisted social categories based on their relevance for both everyday life and the experience of environmental change, as capturing all social categories connected to a single person would potentially result in an infinite level of detail (Warner et al., 2008). To elaborate on both femininities and masculinities, as well as to account for intra-household differences in habitability perceptions, several couples of husbands and wives were interviewed. Besides that, we also interviewed a set of men without considering the perspective of their wife/wives in case they were married. One of the focus group discussions was held with women only to mitigate power inequalities (Vigil, 2021b). For this very same reason, the individual interviews were held with the participant alone whenever possible (Vigil, 2021b). The participants for key informant interviews were selected based on their broad knowledge about the village.

The participants of the individual interviews were between 20 and 75 years old. In the 27 semi-structured interviews, 21 of the interviewees were women and six were men. All interviews were held in the local language Dagbani. The two research assistants interpreted to English during the interviews, to enable the researchers to react to answers. Interviews were taped and the English translations were transcribed (Flick, 2017; Temple & Young, 2004). The data was analyzed through a Qualitative Content Analysis (Mayring, 2014) in MAXQDA (VERBI Software, 2021). The lead author anonymized, digitalized, and subsequently coded the transcripts thematically based on both deductive and inductive coding (Mayring, 2014; Zhang & Wildermuth, 2005). The initial codebook was created based on the research design, including relevant literature, and on insights gained from the field work period. The codes and particularly their descriptions and the respective decision rules were then iteratively revised whilst coding the first part of the transcripts (Zhang & Wildermuth, 2005), and further codes were added inductively from the material. This process ensured the capturing of local perceptions of environmental change (De Longueville et al., 2020; Van Praag et al., 2022). This approach further helps to include individual and context-based exposure to environmental change based on local perception (De Longueville et al., 2020; Horton et al., 2021).

5. Results

This chapter's overarching structure is deducted through our methodological approach: we captured habitability perceptions, their short- and long-term dynamics, and the drivers of habitability (change). We then focused on the particular roles of environmental change and social practices for shaping habitability. Subchapter 5.1 outlines *how* habitability in the research area is subjective and socially differentiated. Subchapter 5.2 unravels *why* habitability is socially differentiated.

5.1 Perceived Habitability in the Context of Environmental Change

5.1.1 Habitability Perceptions are Subjective and Socially Differentiated

The perceptions of habitability were clearly subjective and varied widely among individuals, and that could be traced back to individual, valued objectives. Seven individuals explained high habitability, nine individuals framed habitability as satisfactory or neutral, and nine individuals indicated low habitability. This contrasts the rather positive habitability perception obtained from the collective narrative within the key-informant interviews, the transect walks, and the focus group discussions. Those with medium to high socio-economic status, education, medium age, supporting social networks, and diversified livelihoods *tended* to express higher habitability in comparison to those with low socio-economic status, little to no education, high age, constraining household compositions, and non-diversified livelihoods. The role of gender has to be strongly embedded into the intersection of these other social categories. Individuals who expressed a high degree of habitability linked this thus to their livelihood situations, the coverage of their basic needs, high place attachment, and social as well as cultural relationships to and within the village. This is illustrated by the fact that many participants expressed pride in being born in the village, and as many could not imagine living elsewhere in the

long term. In contrast, those who perceived a low habitability, linked this to livelihood struggles, food insecurity, and to a lower place attachment. For instance, some of the women who migrated to the village within the past five years for marriage, expressed discomfort due to food insecurity, and little attachment to the place. While livelihoods, place attachment, and social relations were commonly named indicators for well-being, very individual factors included the health of children, which is particularly relevant for mothers of young children, and cultural practices and rituals, which were particularly relevant for elderly men.

5.1.2 Perceived Habitability is Dynamic, and Drivers of Change are Multidimensional

Adding to the subjectivity and social differentiation explained above, habitability is perceived as changing and dynamic, in both short- and long-term. The perceived direction of change, as well as the way how people explain these changes are also subjective and socially differentiated. The narratives captured in the focus group discussions, the transect walks, and the key informant interviews indicated a steady increase in habitability over the past 20 years. Contrasting this, the semi-structured interviews with individuals showed that habitability was perceived to have changed in both positive (eight individuals) and negative (15 individuals) directions in the same period. Positive changes tended to have happened in particular for those individuals with medium to high socio-economic status, with stable livelihoods, in combination with both a suitable working age and the formation of a nuclear family. Negative changes were reported by those with vulnerable livelihoods and medium to low socio-economic status, depending strongly on agriculture and having little access to coping and adaptation. Here, it is particularly the aged who report decreases in habitability. These particular individuals related this to their decreasing health condition, the death of their partners, and to less physical capacity for practicing their livelihoods. We did not observe a gendered pattern here as it was rather the intersection of various social categories and translocal livelihoods on household level that navigated the direction of change in habitability perceptions. Two individuals indicated no changes in habitability in the past 20 years. Development initiatives have increased the village's status within the region, which is in general positively associated with the perceived habitability. Participants reported that having a large number of in-migrants shows them and others that their village is a desirable place to live in. Access to healthcare, markets, sanitation facilities, and education had improved, and electricity had allowed the diversification of livelihoods and brought everyday advantages such as being able to charge phones or using grinding mills. Drivers constraining but not reversing this increase in habitability on village level included price rises for food and agriculture inputs, cultural changes, and environmental change. Negative cultural changes, often framed as the "introduction of modernity," were reported through the occurrence of misbehavior such as alcohol abuse, lowered respect towards the elders, and unmarried sex. These cultural changes further included the decline of traditional practices such as traditional dances or worshipping practices, as the following example from one of the focus group discussions shows:

> The local dances decreased a lot in the last 20 years, and the modern dance is not for us. Now there is a lot of improper dressing. For ladies, you can even see their underwear or they wear miniskirts, and for the boys the underwear also shows constantly. (focus group discussion 1)

On the individual level, increases in perceived habitability were associated with the establishment of households through businesses or agricultural activities, and from the formation of nuclear families. One married couple we interviewed separately from each other reported that they had no land 20 years ago when they had just newly migrated to the village. The husband had been increasing their land since then, supported by his wife's financial capital, while the wife had established a tailoring business. This tailoring business was, for instance, only possible as the village had access to electricity. Both stated that the birth of their children in the past 20 years further increased their wellbeing. Contrasting, not everyone profits from the developments mentioned above, as using some of these facilities requires financial capital that some do not have, and as the population growth leads to land scarcity and to decreased soil fertility. Others attribute a perceived decrease in habitability to their age, which makes them feel weak, or to the death of a close relative. One woman told us how her wellbeing has decreased rapidly since her husband died, and that she did not have the strength to follow the life she desired. The semi-structured interviews further illustrated very explicitly how habitability was dynamic also on the short term, particularly through agri-environmental seasonality. Those primarily depending

on agriculture for their livelihoods perceived habitability during and after harvest (which is in the late rainy season and during parts of the dry season) as higher than during the planting season, as food security usually decreases in the time of planting (which is in the early rainy season). The village was described as flourishing in that time of the year: "The harvest season is better. If everyone is harvesting, they feel comfortable, they admire the world. People even have some spare groundnut for you and the whole village seems happy" (Amin[1], semi-structured interview). Those building also on livelihoods outside of agriculture partially reported increased habitability in the dry season, as they have higher sales in that time of the year.

5.1.3 The Influence of Environmental Change on Habitability is Socially Differentiated and Subjective

The impact of environmental change on habitability is mediated by socio-economic systems, and is manifesting socially differentiated. As indicated above, environmental change did influence, but not limit the perceived increase in habitability within the broader collective narrative. On the individual level, all but one of the participants reported that they recognized environmental changes over the past 20 years. Of those, 21 reported an increase in erratic rainfall patterns, which includes not only droughts and floods but also a less predictable offset of the rainy season, 22 reported a decrease in soil fertility and nine reported either soil acidification or increases in weed. Regarding habitability perceptions, environmental change had negative effects on 21 individuals, and neutral to very little effects on five individuals. The resulting livelihood constraints decreased food security, access to health services, and education for some individuals, particularly for those with low socio-economic status and livelihoods based primarily on agriculture, little social capital, and high age. Having to cater for young children exacerbated this. Coping and adaptation happened along a continuum in relation to the desired outcomes: Those indicating no or little influence of environmental change on habitability explained that they were still being able to maintain their livelihoods, cover their needs, and hence to maintain their wellbeing. This is particularly true for those individuals with relatively high financial or physical capital, diversified livelihoods (supported by having certain skills), supporting family networks they can rely on (e.g., through remittances), adult children (they do not have to cater for but that can support them), and high place attachment (as this creates an acceptance of the place disregarding its material components). Environmental change thus played a subordinate role for their perceived changes of habitability. For few participants, very personal matters offset the effects of environmental change and development related changes. This is particularly true in relation to changes in health conditions, for example, through aging, and changes in social relations, for example, through the death of a close relative. Exemplary for this group, but exceptional for the collective narrative, one middle-aged farming woman told us, although she struggled with decreased soil fertility, that she perceived the place as highly habitable, as it was solely due to the newly built hospital that she could maintain her essential survival. In contrast, three women told us how the death of their respective husbands, in combination with their own decreasing health conditions due to their aging, decreased habitability. The majority of individuals indicating a decrease in overall habitability due to environmental change reported that they could not deal with the impacts of environmental change in a way that was satisfactory to them. As one man (Amin) of low socio-economic status, high age, with young children, and no education, stated, the decreasing soil fertility limited his harvest and thus constrained him from sending his children to school. Another man (Wunam), having very similar social characteristics as Amin, told us that while he did welcome the introduction of electricity and the health center as a positive development, he personally cannot make use of it, as the following quote illustrates:

> If I am sick and they need to take me to [nearby city], I need a good road. If I am sick, I will need electricity to charge it [a phone]. But you need to have a phone for this. If you do not have a good livelihood, you cannot [have a phone]. How can I buy a phone? How can I pay health bills? The things [positive developments] are there, but I cannot use them. (Wunam, semi-structured interview)

He accounts habitability as low due to his age, decreasing soil fertility, and the formation of a nuclear family, as we will show in sub-chapter 5.2. For him, the negative impacts of environmental change outweighed the positive impacts of development interventions. One woman, whom we asked to weigh the changes in soil fertility against the development projects, illustrates

that it is not the development but rather the environment that maintains her wellbeing: "You cannot joke with anything that has to do with the stomach. The survival comes from the farm. The light cannot help you to survive. We depend on our farming output for that" (Safia, semi-structured interview).

Moreover, environmental change also impacts habitability through influencing social relations and cultural practices, as the following quote shows:

> Environmental change has a negative impact on me. It also affects my social relations. When you are invited to a ceremony, you are expected to bring a gift. We cannot go because we cannot afford this. This leads to others coming to your own ceremonies less. My social status decreases and I like it less in the village. I do not like walking around here anymore. Overall, it is not comfortable for me here and now. (Salwa, semi-structured interview)

Another man reported that, although he still harvested enough to maintain himself and his family, his harvest had decreased to a degree that he could give out less to others—which he indicated as essential for his wellbeing:

> Because I now give out less, I do not enjoy the place as much anymore as 20 years ago. I do not have the money anymore to give things out to others. The soil fertility declined. … Now the food harvest has declined sharply. (Razak, semi-structured interview)

5.2 Social Practices and Habitability Perceptions

The clusters that structure this subchapter were inductively drawn from the field data. They are clustered along different forms of climate change adaptation practices. Table 1 illustrates these clusters, as well as the most relevant social practices and social

Table 1 The Social Practices Behind Socially Differentiated Habitability Perceptions

Cluster	*Social practices*	*Differentiated mechanisms were observed along…*
Livelihood diversification	Labor division	…time capacities to operate a business, do paid labor, or to migrate. Differentiated outcomes are particularly driven by differences in care work, implying great importance of gendered power inequality.
	Access to and control over resources	…the access to financial, human, and social capital to diversify, operate a business, do paid labor, or to migrate. Differentiated outcomes are particularly implemented along gender, socio-economic status, age, and education.
	Participation and decision making	…the degree of agency for making decisions to operate a business, do paid labor, or to migrate. This is strongly linked to gender related power differences.
Coping and adaptation within agriculture	Labor division	…time capacities to invest into agriculture. This strongly links to gender-based differences in care work responsibilities.
	Access to and control over resources	…the usage of fertilizer, the access to machinery, being able to sell livestock, having knowledge on crop rotation, employing paid labor, having individual physical strength, and being able to access sufficient amounts of land. This widens to being able to build on experience around agricultural practices. Differences were particularly strong along the intersection of socio-economic status, gender, and age.
Resource usage and accumulation across space and through time	Access to and control over resources	…spatial aspects such as the accessibility of fertilizer from other places, the usage of remittances, and the ownership of land elsewhere. Temporal aspects link to land access based on family entanglements, and to accumulating knowledge in the past.
Intra-household composition	Access to and control over resources	…the number, age, and gender of children within a family. Young female children were reported by some to be an additional burden as they need increased supervision. Male adolescent children contrast this by being valued as labor force. Others reported that simply having a family meant pressure they were not able to handle through their ongoing livelihood. Differences are observed particularly along socio-economic status, gender, and education. That said, men and women reported, intra- and inter-gender wise, strongly diverging perspectives in relation to their household's wellbeing.

categories relating to them. An initial version of the most relevant social practices and social categories was deducted before the fieldwork by orienting on overarching power relations that guided our methodological approach (Segnestam, 2018; Vigil, 2021b). They were adapted throughout the data analysis. The last column lists some of the mechanisms where these socially differentiated practices influence outcomes related to individuals' habitability perceptions. We thereby focus on the practices, categories, and examples that proved most essential after data analysis. It is important to note at this point that this section means to show tendencies rather than fully representative generalizations of reality. The interlinkages between the intersections of specific social categories and the related social practices are not to be interpreted as straight-forward. This is of particular importance for both gender and age, as these categories are strongly depending on translocal livelihood entanglements on household level. The following paragraphs provide nuanced insights on Table 1.

5.2.1 Livelihood Diversification Influences Habitability

The capacity to draw on non-agricultural livelihood activities influences how environmental change impacts habitability perceptions, especially with regard to seasonal changes of habitability. In general, non-agricultural activities contributed to secure and improved or constant wellbeing, by stabilizing and diversifying livelihoods, and making them less subject to environmental variation, particularly with regard to seasonality effects, and changes. Education, age, gender, and socio-economic status mediate this mechanism. Specialized education, suitable working age, being a man, and a medium to high-socio economic status tend to be factors that increase the capacity to mitigate the impact of environmental change on habitability. Education, including skills outside of formal education, increases individuals' ability to work outside of agriculture. These skills included tailoring, retailing, cooking, and welding. Among better educated village members, it is the young and the middle-aged people rather than the aged ones who draw on diversified livelihoods. Some elderly women engaged in shea butter processing but indicated that their physical strength constrained them. In addition to education and being of a suitable working age, opening and operating a business, for example, requires financial capital, motivation, and time, all of which are not equally accessible to everyone. Due to care work responsibilities, women were often constrained from investing additional time in livelihoods. Moreover, married women could not migrate or open a business without their husband's permission. Several interviewees reported that they were able to mitigate the impacts of environmental change on their livelihoods by operating a business, drawing on special skills and financial savings from their nuclear and extended families. The example of Jemila, who, supported by her husband, opened a retailing store after years of fluctuating harvests, illustrates this interplay between education, gender, age, and socio-economic status:

> Habitability is now higher than in the past 20 years. Back than I did not even have coins to go to the grinding mill. With my income from the store I am now able to do so. There is nothing that really bothers me at the moment as I have a good business. The other developments have influenced my habitability in a positive way. Environmental change had minimal impacts. Yet, if my colleagues are on the farm and if I was too, I would not have been happy. I can see that they have bad harvest sometimes now. (Jemila, semi-structured interview)

5.2.2 Coping and Adapting Within Agriculture Influence Habitability

Also, the ability to cope and adapt to environmental stresses *within* agriculture influences the impact of environmental change on perceived habitability. This ability links to agricultural practices such as using fertilizer, or following crop rotation, but also depends on having sufficient land. Socio-economic status, age, gender, education, and household composition are factors that mediate this mechanism**.** Again, high socio-economic status, being of suitable working age, and being a man tended to result in rather positive outcomes, alongside supportive household compositions and having education on agriculture. Broadly speaking, gender and socio-economic status strongly influence how much land and livestock one owns and controls, as mostly men inherit these from their families. Moreover, women tended to have less time to invest into agricultural activities due to obligations for care work. Adding to that, women reported having less knowledge on adapting to environmental change than men, as they felt less experienced in agricultural practices. This can also be traced back to their care work duties. Women thus often relied on

their husband's capabilities to cope and adapt. High socio-economic status enables a person to also use land of others to increase land for cultivation. Someone's socio-economic status further influenced their ability to access agricultural inputs such as fertilizers, machinery, or modified seeds, in a timely manner as well as in sufficient quality and quantity. Applying adaptation measures such as crop rotation and planting larger tracts of land required either individual physical strength, the in-kind help of other household members, or being able to hire laborers. Physical strength was reported to decrease with age. While one man told us how he uses his strength to follow crop rotation and explained how this helps in maintaining soil fertility, other elderly men told us that they could not do crop rotation due to their limited strength. These men further illustrated that although they would have had enough land to cultivate without crop rotation, their physical strength hinders them. They could also not draw on other family members or hire labor. The following example of a married couple illustrates the interlinkages between gender, socio-economic status, age, and household composition just described:

> Man can cultivate a lot of acres and thus environmental change impacts them less. If you have less land like a woman, the impact of a bad harvest will be more. Even when you only get half [of the usual harvest] as a man, you will still have a lot of harvest. The man farm more because they have enough money. If I had more money and would go to my village, I would get more land there. Here not though, as there is not enough fertile land left to farm on. I would have gone to look for even more cash and work if I did not have to do care work. Owning more land would help. I could do more farming. It is because I am a woman and I cannot take care of it. He [the husband] has nothing to do and can straight to the farm. That is why mostly men own the land. I have to bath the kids and by the time I get to the farm it is 12 o'clock. And I cannot invest as much time as a man. Men have nothing to do in the house. They have more time and this helps them with cultivating more land. (Sara, semi-structured interview)

The interview with a male farmer completes this example:

> Even when the agricultural officers come and tell me we should do crop rotation, I am not strong enough as I am old. They show us if you do one acre, apply fertilizer two times, you can get 15 bags of maize from it, but I cannot afford the fertilizer as input. (Wunam, semi-structured interview)

5.2.3 Resource Usage and Accumulation Across Space and Through Time Influences Habitability

Being able to access and control resources not just within the village but also through connections to other places also mediates how environmental change impacts habitability. Important examples for such resources included fertilizer, remittances, and agricultural land. This is again differentiated along socio-economic status, gender, migration status, and household composition. Particularly, building on a migration history embedded in a supportive household of high socio-economic status, turned out to have positive effects in mitigating the impact of environmental change on habitability. If fertilizer, for example, was not available within the village, some would get it delivered from the nearest city, using their social relations and financial means. Access to financial capital and goods from outside the village is dependent on the entanglement of social status, migration and translocal linkages, and household composition, as the following quote shows:

> To cope with droughts, I went to my brothers and got money from them during drought. … I also got Cola from my brothers and sold them. It is cheaper to get in the Ashanti region where my brothers live. With that money, I re-established myself for the next farming seasons. (Jemila, semi-structured interview)

Several participants also drew on physical resources, notably land, outside the village to ensure their livelihoods. However, among the persons interviewed, it was only men who had land in other places that they were able to control. One man, who was a member of the local aristocracy in another village, still owned a lot of land in that place that he could cultivate. Contrasting to that, other men who were former members of the local aristocracy within the research village now struggle to access their land, as this quote explains:

> My husband is a prince. He came from another village when his father became chief here six years ago. This means that his father's actual land is in

> another village. The new chief here then was able to simply take the land [in the research village] here to use. My husband than had to move out of the palace [when a new chief was elected] as it was another family's turn. (Salwa, semi-structured interview).

In addition to financial remittances—both regular and in times of need—and the access to inputs and additional resources, also the inflow of knowledge and skills related to migration played a role. Several women mentioned how growing up with other women of their family in other places, often in cities of Ghana's Southern part, taught them the special skills that they used to diversify their livelihoods away from agriculture. Lastly, using migration as a strategy to access resources from other places was intended by several women, but forbidden by their husbands.

5.2.4 Intra-Household Composition Influences Habitability

Societal expectations building on norms and values connected to gender, household composition, and age influence habitability perceptions when exposed to environmental change. For instance, femininities link to care work. Women reported on their children's wellbeing more often than men did, when relating to the impacts of environmental change on habitability. Contrastingly, some women indicated only little responsibility for their husbands' wellbeing, as the following example shows:

> When I am affected by environmental change it will be a burden on my man. He has to feed me. It is his problem when the harvest is low. When I get something [e.g., income], I decide what to do with it. If I am not able to come out with something from the farm, my man has to bear for it. (Sara, semi-structured interview)

The quote above shows further how notions of masculinity come with the norm to sustain the needs of the whole household. Some men felt their perceived habitability decreasing, as they could not fulfil this expectation. They reported that in times before they had to sustain their wives, children, and other family members, they would feel better, as they were only responsible for themselves—a state that many enjoyed relatively. These gendered differences are further influenced by age. Older persons, particularly women, were taken care of by their children or their children's husbands. Adding to that, having male children was reported to indicate higher livelihood security for aging parents. However, this also meant that elderly women were partly constrained in their livelihoods, as their male children forbid them to continue working themselves. Lastly, while having young children, particularly girls, was reported to place additional burdens on individuals, older children, particularly boys, were seen as relieving pressure and contributing to their parents' perceived habitability. Young girls put additional responsibility on mothers as they need more supervision, while boys can be left more on their own. The quote below illustrates how gender, household composition (here: the age and gender of her children), and age interplay. Salwa's case is further complicated, as the husband's second wife was not married long enough so that they would allow her to cook for the family. This meant increased care work for Salwa:

> I do not consider migration because of the children. Me being here with the children is better than money and me not being here. … Yes, if the children were older I could develop a business and would be less busy with the mother role. I would be a head porter. All the children are female. You have to take care of them totally until they are responsible because else someone takes them otherwise. This is different with male kids. Female kids mean more work. Yes, it is a problem to give birth to only females because they are in the end the property of other houses. They will marry and your investment gets lost. It will thus get difficult when we as parents get old and do not have male kids. We pray for a male child. There is nothing we can do to prepare for environmental change happening again. (Salwa, semi-structured interview)

One man reported that his perceived habitability has declined, compared to the time when he was unmarried, because he had to take care of his family by now. Interplaying with that, his harvest had decreased through a combination of soil fertility decline, increased soil acidity, erratic rainfall, not having the financial capacities to invest into fertilizer, and decreasing bodily strength as a result of aging, so he could not apply crop rotation or cultivate more land. Although he valued the development changes within the village, he couldn't make use of them, as his livelihood was constrained for the above reasons. He perceived the place as little habitable:

> Habitability has changed. It has changed in a declining way. Initially, when I was a bachelor, I could harvest more. I had nobody to feed and nobody was dependent on me. I could just life my live. After I married and [my wife] gave birth to children, the people I have to take care of now are many. (Wunam, semi-structured interview)

6. Discussion

This paper aims to contribute to closing the knowledge gap between top-down habitability assessments and lived experiences of place perception and environmental change. The qualitative fieldwork in Northern Ghana showed socially differentiated trends of perceived habitability, and different mechanisms that were behind these changes. Overall, perceived habitability is not static, and was reported to have changed over both short-term and long-term periods. In collective narratives, the perceived habitability has generally increased in the village, however on household and individual level, the changes were much more variegated, including also perceived decline. Factors that contributed to increases in perceived habitability were the stability and diversification of livelihoods, namely the ability to adapt agricultural practices, and to engage in non-agricultural activities; migration and outside connectivity including the transfer of finances, goods, and knowledge; and the development interventions and infrastructure improvements such as access to healthcare, markets, sanitation facilities, education, and electricity. Factors that were associated with a decline in perceived habitability were economic factors such as increasing prices of food, agricultural inputs, and commodities; environmental change such as declining rainfall and soil fertility; increasing population and resulting land scarcity; and cultural change such as loss of traditions and intergenerational respect.

It is important to note that the causal influences of these factors were strongly mediated by the intersecting configurations of education, age, gender, household composition, and socio-economic status. These mediating effects were often of such an extent that the same mechanism had positive influences on perceived habitability for one household or individual, but negative for another, depending on the relevant individual categories. These social categories intersect and shape social position and practices, and thus set the conditions for individuals' and households' capacities to draw on diversified livelihood activities, to cope and adapt within agriculture, to access and control resources from other places, and to meet societal expectations.

The subjective nature of habitability perceptions can be interpreted through different views on well-being, place attachment, and place perception (Adams & Adger, 2013; Jones & Boyd, 2011). The seasonal nature of habitability links to seasonality effects in livelihoods and food security as central indicators of wellbeing (Abu et al., 2014). The socially differentiated impact of environmental change on habitability can be interpreted via the unequal impact of environmental change on individual well-being. This is driven by different levels of vulnerability and different forms of value judgement (Kaijser & Kronsell, 2014). This social differentiation is further explained through the role of social practices in coping with and adapting to environmental change (Erwin et al., 2021). We also observed differences in habitability perceptions within households, which we relate to intra-household power dynamics (Nyantakyi-Frimpong, 2020) and to the role of socially differentiated socio-cultural roles, expectations, and practices (Janoth et al., 2024). These subjective aspects ultimately make habitability subject to multiple claims of truth (Farbotko & Campbell, 2022).

The results further indicate a considerable dependency of women on their male household members in shaping their perceived habitability, as consistent with other analyses with other analyses of patriarchal structures (Lawson et al., 2020; Nyantakyi-Frimpong, 2020). Moreover, looking at the case of Salwa, we see how gender inequalities can be even reinforced through social practices under the influence of environmental change (Segnestam, 2017). Lastly, the importance of space and time in shaping individual habitability perceptions relates to the role of migration and connectivity for shaping livelihoods and wellbeing (Janoth et al., 2024; Sakdapolrak et al., 2016), as well as for place perceptions (Adams & Adger, 2013; Devine-Wright, 2013).

Finding that habitability is socially differentiated and also depending on factors beyond the environmental dimension, we contrast previous works that build their conclusions exclusively on either single or multiple environmental parameters (Duvat et al., 2021; Storlazzi et al., 2018). We thus align with research that calls for the integration of material factors

other than environmental ones (Farbotko & Campbell, 2022; Horton et al., 2021). We support the importance of acknowledging the social dimensions of habitability (Janoth et al., 2024; Kemp, 2023), particularly with regard to social differentiation (Sterly, 2023). Rather than seeing habitability as dichotomous and static (Storlazzi et al., 2018), we underline that perceptions and thresholds are both dynamic and continuous (Borderon et al., 2023). We thereby support the view that habitability cannot be generalized but has important subjective dimensions (Farbotko, 2023). This subjectivity further emphasizes how habitability is relational and extends beyond material parameters, for example, through the role of cultural practices (Farbotko & Campbell, 2022; Janoth et al., 2024), which underlines the importance of an emic perspective in assessing habitability (Farbotko, 2023; Sterly et al., 2024). Addressing debates on top-down versus bottom-up approaches, our research follows Horton et al. (2021), arguing for a people-centered habitability research through a combination of both approaches. Lastly, we contradict that decreases in habitability directly link to migration, as suggested previously (Storlazzi et al., 2018). As we illustrate, migration can also lead to decreasing habitability, but these linkages are not straight forward, and special caution should be taken when studying the complex and often multi-directional interplays between environmental change, migration, and changes of habitability (Adger et al., 2021; Mortreux et al., 2023). The role of the connectivity of places needs to be captured in several directions when assessing habitability, with migration being a consequence of habitability decline, but also an important contributing factor for shaping habitability (Borderon et al., 2023; Janoth et al., 2024).

Our work suggests that integrating aspects of (feminist) political ecology (Elmhirst et al., 2015; Lykke, 2009; Mahler et al., 2015; Resurrección et al., 2015) and translocality (Brickell & Datta, 2011; Greiner & Sakdapolrak, 2013; Sakdapolrak et al., 2016) bear great potential for addition to a grounded conceptualization of habitability (Vigil, 2021a). This implies that habitability assessments integrate aspects of intersectionality. We thereby call for acknowledging and problematizing that social categories are culturally constructed and dynamic—and thus possible to be changed (Djoudi et al., 2016; Kaijser & Kronsell, 2014). A feminist political ecology perspective ensures, for instance, the analysis of gender as a result of social practices and discourses rather than as a synonym of sex (Segnestam, 2018; Vigil, 2021b). The coherent intersectional lens enables to entangle why and how people's perceived habitability is impacted by environmental change—rather than solely describing *that* they are impacted (Vigil, 2021a). A translocal perspective helps to integrate the connectivity of places beyond physical aspects of mobility (Brickell & Datta, 2011; Sheller & Urry, 2006), for example, through embedding intersectional aspects in multiple places (Mahler et al., 2015). It can further help to overcome a (too) narrow conceptualization of the habitability-migration nexus, with a focus on outmigration and displacement, as environmental change can actually contribute to immobility (Adger et al., 2021; Zickgraf, 2021), and migration can also contribute to increasing or stabilizing habitability. Lastly, local knowledge and cultural practices, including aspects such as spirituality, should be integrated in conceptualizing habitability, to avoid skewed conclusions stemming from Western perspectives only (Farbotko & Campbell, 2022; Janoth et al., 2024). Hereby, researchers must ensure epistemological plurality to avoid reproducing the development of thresholds based on top-down understandings of habitability, rooted in Western perspectives. For policymakers, our results imply a framing of habitability as strongly related to human agency and choice from micro- to meso-level (O'Byrne, 2023; Wrathall et al., 2023), rather than understanding habitability as based on environmental determinisms. Policy can influence habitability (Wrathall et al., 2023)—and the populations affected by these policies should be integrated in defining their own habitability as well as related adaptation measures (Farbotko & Campbell, 2022; Kitara et al., 2021; Kofe, 2021).

Our paper shows how habitability research builds on, but also widens and combines, a range of already established concepts within research on global environmental change. We align with criticism on the notion of carrying capacity (Fan et al., 2022; Sayre, 2008) by taking a holistic and interdisciplinary approach to studying habitability that avoids environmental determinism (Sterly et al., 2024). Adding to that, the habitability concept as outlined in our work addresses calls for overcoming the lack of people-centered approaches in socio-ecological systems thinking (Colding & Barthel, 2019; Vigil, 2021b). The integration of non-material factors hereby links to nature's contribution to people (Díaz et al., 2018; Sterly et al., 2024; Wiederkehr et al., 2019). Loss and damage (IPCC, 2022; Warner & Van Der Geest, 2013) feeds into our understanding of habitability as it points at the

social differentiation inherent to the impacts of environmental change. It further links to understanding habitability through human agency (Wrathall et al., 2023). Both of these links also hold true for the limits of adaptation to climate change (Adger, Dessai, et al., 2009; Dow et al., 2013). Concluding, we acknowledge that the usefulness of habitability as a novel concept in social sciences has yet not come to a closure (Borderon et al., 2023). Yet, the current scientific debate along the usage of habitability narratives in politics pinpoints a strong need of building conceptual bridges between social sciences and natural sciences.

A limitation of this study lays in the complexity of habitability perceptions and related aspects that shape habitability from micro- to meso-scale. We captured very subjective habitability perceptions, rather than illustrating a complete habitability assessment under the inclusion of factors such as global economic entanglements or greater regional politics. Thus, place connectivity receives little explicit integration. However, we place a particular focus on the impacts of migration throughout our work. Moreover, we aimed to put this subjectivity, together with nuanced small-scale changes in the natural environment, into focus through our bottom-up approach on habitability (Horton et al., 2021). Furthermore, we capture the heterogeneity of the population through a limited, yet carefully selected set of social categories rather than including all social categories that an individual can be identified with. This latter approach generalizes populations to a certain degree, which can in turn disregard local and micro-level complexity and might hinder the contestation of power (Kaijser & Kronsell, 2014). However, when doing intersectional studies and assessments under conditions of limited resources, one has to choose which social categories to include and which to exclude to avoid an infinite level of detail. We ensured this balance through iterating the social categories of interest throughout our fieldwork (Kaijser & Kronsell, 2014; Vigil, 2021b). Finally, we did not aim to generalize people's habitability perceptions, but rather emphasized their heterogeneity in relation to environmental change (as suggested by Nyantakyi-Frimpong, 2020).

7. Conclusion

This paper shows how habitability in places exposed to environmental change is subjective and relational. We further conclude, in strong contrast to assessments with little integration of local context and individual notions, that habitability is socially differentiated and dynamic on a microscale. This means that even though environmental stresses might be spread homogeneously in one region, their impact on habitability will not be uniform. As we aimed to reduce the gap between recent approaches to habitability and the actual, local experience of environmental change, our work underlines the need to emphasize the social dimension of a social-ecological system when analyzing the impact of environmental change on habitability. Recognizing that deconstructing the impact of environmental change is not novel, we hereby align with well-established research from social sciences, calling for a more nuanced and situated understanding of global environmental change from a socio-ecological perspective, including a cross-spatial focus on the role of power and post-colonial structures (see for instance Adger, 2010; Djoudi et al., 2016; Siddiqi, 2022; Sultana, 2022).

This "assessment gap" can contribute to scientific conclusions and, in consequence, to policies and climate change adaptation measures that generalize people's habitability perceptions and needs in inaccurate and unjustified ways (Farbotko & Campbell, 2022; Horton et al., 2021). Climate change adaptation measures might thus run risk to not only reproduce, but even to increase existing inequalities and hence vulnerabilities (Bezner Kerr et al., 2022; Farbotko & Campbell, 2022). In consequence, the population of interest's scope for agency in defining their own concept of habitability and in taking necessary action is decreased (Farbotko & Campbell, 2022). For instance, Bordner et al. (2020) show that alarmist narratives around habitability loss can create reluctance among donors to provide financial assistance for development and in-situ adaptation. Adding to that, narratives of habitability losses are also linked to social tipping points, human migration, and notions of climate refugees (Storlazzi et al., 2018; Wrathall et al., 2023). Contrasting, there is yet little evidence for a large movement of people away from areas strongly exposed to climate change (Borderon et al., 2019; Mortreux et al., 2023). Rather, some of these areas even experience increasing immobility when experiencing environmental change (Adger et al., 2021). Research should thereby go beyond material aspects, meaning the extension to non-material factors such as place attachment, cultural practices, and valued objectives. We further call to include the role of place-connectivity and time when assessing habitability. Approaches

that feed from (feminist) political ecology and from translocality research can help in addressing these aspects. Our results imply that policy makers and other relevant actors must understand habitability under the influence of environmental change in a socially nuanced way that contrasts environmental determinism and narratives of mass migration. Finally, geography as a very broad discipline bears great potential to sharpen coherent narratives around habitability. In particular, geography can address the limited understanding of place connectivity in habitability research. Yet, we strongly support new directions of interdisciplinary collaboration that push towards pluralistic narratives, knowledge diversity, increased recognition of socio-cultural factors, and action-oriented research (Farbotko & Campbell, 2022; Janoth et al., 2024; Schipper et al., 2021).

This paper adds to the current debate on habitability in several ways: i) we show how habitability is socially differentiated by integrating aspects of intersectionality; ii) we capture habitability beyond its material aspects by examining subjective and relational aspects; iii) we assess the role of space and time by showing how translocal networks as well as past events such as childhood education matter for the perception of habitability; iv) we include not just parameters that are directly linked to climate change but also those environmental changes that are more strongly linked to local and short-term anthropogenic effects, in this case soil fertility decrease. In conclusion, we widen existing empirical works on habitability that focus on environmental parameters only through the integration of other material and non-material aspects and add to recent theoretical works on habitability within social sciences via empirical evidence.

Note

[1]All names of interview partners are pseudonymized.

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References

Åbo Akademi University. (2023). *Introduction. The Habitability Handbook—An assessment tool for viable communities*. https://www.abo.fi/en/centre-for-lifelong-learning/habitability/habitability-handbook/

Abu, M., Codjoe, S. N. A., & Sward, J. (2014). Climate change and internal migration intentions in the forest-savannah transition zone of Ghana. *Population and Environment*, *35*(4), 341–364. https://doi.org/10.1007/s11111-013-0191-y

Adams, H. (2016). Why populations persist: Mobility, place attachment and climate change. *Population and Environment*, *37*(4), 429–448. https://doi.org/10.1007/s11111-015-0246-3

Adams, H., & Adger, W. N. (2013). The contribution of ecosystem services to place utility as a determinant of migration decision-making. *Environmental Research Letters*, *8*(1), 015006. https://doi.org/10.1088/1748-9326/8/1/015006

Adger, W. N. (2010). Social capital, collective action, and adaptation to climate change. In M. Voss (Ed.), *Der Klimawandel* (pp. 327–345). VS Verlag für Sozialwissenschaften. https://doi.org/10.1007/978-3-531-92258-4_19

Adger, W. N., De Campos, R. S., Codjoe, S. N. A., Siddiqui, T., Hazra, S., Das, S., Adams, H., Gavonel, M. F., Mortreux, C., & Abu, M. (2021). Perceived environmental risks and insecurity reduce future migration intentions in hazardous migration source areas. *One Earth*, *4*(1), 146–157. https://doi.org/10.1016/j.oneear.2020.12.009

Adger, W. N., Dessai, S., Goulden, M., Hulme, M., Lorenzoni, I., Nelson, D. R., Naess, L. O., Wolf, J., & Wreford, A. (2009). Are there social limits to adaptation to climate change? *Climatic Change*, *93*(3–4), 335–354. https://doi.org/10.1007/s10584-008-9520-z

Adger, W. N., Eakin, H., & Winkels, A. (2009). Nested and teleconnected vulnerabilities to environmental change. *Frontiers in Ecology and the Environment*, *7*(3), 150–157. https://doi.org/10.1890/070148

Antwi-Agyei, P., Dougill, A. J., & Stringer, L. C. (2015). Barriers to climate change adaptation: Evidence from northeast Ghana in the context of a systematic literature review. *Climate and Development*, *7*(4), 297–309. https://doi.org/10.1080/17565529.2014.951013

Antwi-Agyei, P., & Nyantakyi-Frimpong, H. (2021). Evidence of climate change coping and adaptation practices by smallholder farmers in Northern Ghana. *Sustainability*,

13(3), 1308. https://doi.org/10.3390/su13031308

Arora-Jonsson, S. (2011). Virtue and vulnerability: Discourses on women, gender and climate change. *Global Environmental Change*, *21*(2), 744–751. https://doi.org/10.1016/j.gloenvcha.2011.01.005

Bezner Kerr, R., Naess, L. O., Allen-O'Neil, B., Totin, E., Nyantakyi-Frimpong, H., Risvoll, C., Rivera Ferre, M. G., López-i-Gelats, F., & Eriksen, S. (2022). Interplays between changing biophysical and social dynamics under climate change: Implications for limits to sustainable adaptation in food systems. *Global Change Biology*, *28*(11), 3580–3604. https://doi.org/10.1111/gcb.16124

Biggs, R., de Vos, A., Preiser, R., Clements, H., Maciejewski, K., & Schlüter, M. (2021). *The Routledge handbook of research methods for social-ecological systems*. Routledge.

Borderon, M., Sakdapolrak, P., Muttarak, R., Kebede, E., Pagogna, R., & Sporer, E. (2019). Migration influenced by environmental change in Africa: A systematic review of empirical evidence. *Demographic Research*, *41*, 491–544. https://doi.org/10.4054/DemRes.2019.41.18

Borderon, M., Sterly, H., Sakdapolrak, P., De Sherbinin, A., Adamo, S., Gemenne, F., Zickgraf, C., & Horton, R. M. (2023). *Background Paper: The concept of habitability in the field of population-environment studies: Relevance and research implications*.

Bordner, A. S., Ferguson, C. E., & Ortolano, L. (2020). Colonial dynamics limit climate adaptation in Oceania: Perspectives from the Marshall Islands. *Global Environmental Change*, *61*, 102054. https://doi.org/10.1016/j.gloenvcha.2020.102054

Bourdieu, P. (1990). *The logic of practice*.

Brickell, K., & Datta, A. (2011). *Translocal geographies: Spaces, places, connections*. Farnham.

Chee, Y. E. (2004). An ecological perspective on the valuation of ecosystem services. *Biological Conservation*, *120*(4), 549–565. https://doi.org/10.1016/j.biocon.2004.03.028

Cockell, C. S., Samuels, T., & Stevens, A. H. (2022). Habitability Is binary, but it is used by astrobiologists to encompass continuous ecological questions. *Astrobiology*, *22*(1), 7–13. https://doi.org/10.1089/ast.2021.0038

Colding, J., & Barthel, S. (2019). Exploring the social-ecological systems discourse 20 years later. *Ecology and Society*, *24*(1), art2. https://doi.org/10.5751/ES-10598-240102

Crenshaw, K. (1991). Mapping the margins: Intersectionality, identity politics and violence against women of color. *Standford Law Review*, *43*(6), 1241–1299.

Creswell, J. W., & Plano Clark, V. L. (2017). *Designing and conducting mixed methods research*. Sage.

De Haas, H. (2021). A theory of migration: The aspirations-capabilities framework. *Comparative Migration Studies*, *9*(1), 8. https://doi.org/10.1186/s40878-020-00210-4

De Longueville, F., Ozer, P., Gemenne, F., Henry, S., Mertz, O., & Nielsen, J. Ø. (2020). Comparing climate change perceptions and meteorological data in rural West Africa to improve the understanding of household decisions to migrate. *Climatic Change*, *160*(1), 123–141. https://doi.org/10.1007/s10584-020-02704-7

Devine-Wright, P. (2013). Think global, act local? The relevance of place attachments and place identities in a climate changed world. *Global Environmental Change*, *23*(1), 61–69. https://doi.org/10.1016/j.gloenvcha.2012.08.003

Díaz, S., Pascual, U., Stenseke, M., Martín-López, B., Watson, R. T., Molnár, Z., Hill, R., Chan, K. M. A., Baste, I. A., Brauman, K. A., Polasky, S., Church, A., Lonsdale, M., Larigauderie, A., Leadley, P. W., Van Oudenhoven, A. P. E., Van Der Plaat, F., Schröter, M., Lavorel, S., … Shirayama, Y. (2018). Assessing nature's contributions to people. *Science*, *359*(6373), 270–272. https://doi.org/10.1126/science.aap8826

Djoudi, H., Locatelli, B., Vaast, C., Asher, K., Brockhaus, M., & Basnett Sijapati, B. (2016). Beyond dichotomies: Gender and intersecting inequalities in climate change studies. *Ambio*, *45*(S3), 248–262. https://doi.org/10.1007/s13280-016-0825-2

Dow, K., Berkhout, F., & Preston, B. L. (2013). Limits to adaptation to climate change: A risk approach. *Current Opinion in Environmental Sustainability*, *5*(3–4), 384–391. https://doi.org/10.1016/j.cosust.2013.07.005

Duvat, V. K. E., Magnan, A. K., Perry, C. T., Spencer, T., Bell, J. D., Wabnitz, C. C. C., Webb, A. P., White, I., McInnes, K. L., Gattuso, J., Graham, N. A. J., Nunn, P. D., & Le Cozannet, G. (2021). Risks to future atoll habitability from climate-driven environmental changes. *WIREs Climate Change*, *12*(3), e700. https://doi.org/10.1002/wcc.700

Ellis, E. C., Pascual, U., & Mertz, O. (2019). Ecosystem services and nature's contribution to people: Negotiating diverse values and trade-offs in land systems. *Current Opinion in Environmental Sustainability*, *38*, 86–94. https://doi.org/10.1016/j.cosust.2019.05.001

Elmhirst, R., Darmastuti, A., & Resurreción, B. (2015). Material feminism and multi-local political ecologies: Rethinking gender and nature in Lampung, Indonesia. In R. Lund & P. Doneys (Eds.), *Gender entanglements: Re-visiting gender in rapidly changing Asia* (pp. 177–206). NIAS Press.

Erwin, A., Ma, Z., Popovici, R., Salas O'Brien, E. P., Zanotti, L., Zeballos Zeballos, E., Bauchet, J., Ramirez Calderón, N., & Arce Larrea, G. R. (2021). Intersectionality shapes adaptation to social-ecological change. *World Development*, *138*, 105282. https://doi.org/10.1016/j.worlddev.2020.105282

Fan, J., Liang, B., Liu, H., Wang, Y., Zhao, Y., Zhang, H., Liu, B., & Chen, D. (2022). Impact on local sustainability of the northward expansion of human activities into protected

areas in northern Tibet. *Land Degradation & Development*, *33*(15), 2945–2959. https://doi.org/10.1002/ldr.4366

Farbotko, C. (2023). *Thinking about (unin)habitability through a regionally grounded perspective: The atolls of Oceania*. https://www.populationenvironmentresearch.org/cyberseminars/11007

Farbotko, C., & Campbell, J. (2022). Who defines atoll 'uninhabitability'? *Environmental Science & Policy*, *138*, 182–190. https://doi.org/10.1016/j.envsci.2022.10.001

Fehrenbacher, A. E., & Patel, D. (2020). Translating the theory of intersectionality into quantitative and mixed methods for empirical gender transformative research on health. *Culture, Health & Sexuality*, *22*(sup1), 145–160. https://doi.org/10.1080/13691058.2019.1671494

Flick, U. (2017). *The SAGE handbook of qualitative data collection*. https://doi.org/10.4135/9781526416070

Folke, C., Biggs, R., Norström, A. V., Reyers, B., & Rockström, J. (2016). Social-ecological resilience and biosphere-based sustainability science. *Ecology and Society*, *21*(3), art41. https://doi.org/10.5751/ES-08748-210341

Gavonel, M. F. (2023). *Thinking about habitability through the exploration of thresholds and tipping points in climate migration*. https://www.populationenvironmentresearch.org/cyberseminars/11007

Gemenne, F., Zickgraf, C., Leigh, V., & Castillo Betancourt, T. (2021). *Working definitions of key concepts*. https://habitableproject.org/publication/working-definition-of-key-concepts/

Greiner, C., & Sakdapolrak, P. (2013). Translocality: Concepts, applications and emerging research perspectives. *Geography Compass*, *7*(5), 373–384. https://doi.org/10.1111/gec3.12048

Gunderson, E. K. (1970). *A social systems approach to habitability:* Defense Technical Information Center. https://apps.dtic.mil/sti/pdfs/AD0738698.pdf

HABITABLE. (2023). *HABITABLE Project*. https://habitableproject.org/habitable/

Hoffmann, M., & Oliver-Smith, A. (2002). *Catastrophe & Culture*. School of American Research Press & James Currey Ltd.

Horton, R. M., De Sherbinin, A., Wrathall, D., & Oppenheimer, M. (2021). Assessing human habitability and migration. *Science*, *372*(6548), 1279–1283. https://doi.org/10.1126/science.abi8603

Intergovernmental Panel on Climate Change. (2018). *Global warming of 1.5°C. An IPCC special report on the impacts of global warming of 1.5°C above pre-industrial levels and related global greenhouse gas emission pathways, in the context of strengthening the global response to the threat of climate change, sustainable development, and efforts to eradicate poverty*. Cambridge University Press. https://doi.org/10.1017/9781009157940

Intergovernmental Panel on Climate Change. (2022). *Climate change 2022: Impacts, adaptation, and vulnerability. Contribution of working group II to the sixth assessment report of the Intergovernmental Panel on Climate Change*. Cambridge University Press. https://doi.org/10.1017/9781009325844

Jacobson, J. L. (1988). Environmental refugees: A yardstick of habitability. *Bulletin of Science, Technology & Society*, *8*(3), 257–258. https://doi.org/10.1177/027046768800800304

Janoth, J. N., Abu, M., Sakdapolrak, P., Sterly, H., & Merschroth, S. (2024). The impact of migration on culturally-embedded and subjective perceptions of habitability in a context of environmental change: A case study from Northern Ghana. *ERDKUNDE*, *78*(1), 35–55. https://doi.org/10.3112/erdkunde.2024.01.02

Jones, L., & Boyd, E. (2011). Exploring social barriers to adaptation: Insights from Western Nepal. *Global Environmental Change*, *21*(4), 1262–1274. https://doi.org/10.1016/j.gloenvcha.2011.06.002

Kaijser, A., & Kronsell, A. (2014). Climate change through the lens of intersectionality. *Environmental Politics*, *23*(3), 417–433. https://doi.org/10.1080/09644016.2013.835203

Kemp, L. (2023). *Uninhabitable futures on a habitable earth*. https://www.populationenvironmentresearch.org/cyberseminars/11007

Kemp, L., Xu, C., Depledge, J., Ebi, K. L., Gibbins, G., Kohler, T. A., Rockström, J., Scheffer, M., Schellnhuber, H. J., Steffen, W., & Lenton, T. M. (2022). Climate Endgame: Exploring catastrophic climate change scenarios. *Proceedings of the National Academy of Sciences*, *119*(34), e2108146119. https://doi.org/10.1073/pnas.2108146119

Kench, P. S., Ford, M. R., & Owen, S. D. (2018). Patterns of island change and persistence offer alternate adaptation pathways for atoll nations. *Nature Communications*, *9*(1), 605. https://doi.org/10.1038/s41467-018-02954-1

Kitara, T., Bhagwan, J., Talia, M., Sopoaga, E., Tong, A., Jetnil-Kijiner, K., Tabe, T., Teingiia-Ratite, T., Taloiburi, E., Mosby, Y., Teaiwa, K., Emberson, P., Fry, I., Harris-Rimmer, S., Kofe, S., & Farbotko, C. (2021). *Diaspora-led dialogue: Climate change challenges to the cultural identity and sovereignty of Pacific Atoll nations*. Toda Peace institute.

Kofe, S. (2021). *Tuvalu's Future Now Project: Preparing for climate change in the worst-case scenario*. https://devpolicy.org/tuvalu-preparing-for-climate-change-in-the-worst-case-scenario-20211110

Kulp, S. A., & Strauss, B. H. (2019). New elevation data triple estimates of global vulnerability to sea-level rise and coastal flooding. *Nature Communications*, *10*(1), 4844. https://doi.org/10.1038/s41467-019-12808-z

Langmuir, C. H., & Broecker, W. (2012). *How to build a habit-*

able planet. The story of earth from the big bang to humankind. Princeton University Press.

Lawson, E. T., Alare, R. S., Salifu, A. R. Z., & Thompson-Hall, M. (2020). Dealing with climate change in semi-arid Ghana: Understanding intersectional perceptions and adaptation strategies of women farmers. *GeoJournal*, *85*(2), 439–452. https://doi.org/10.1007/s10708-019-09974-4

Lykke, N. (2009). Non-Innocent intersections of feminism and environmentalism. *Kvinder, Køn & Forskning*, *3–4*. https://doi.org/10.7146/kkf.v0i3-4.27970

Mahdavi, A. (1998). Steps to a general theory of habitability. *Human Ecology Review*, *5*(1), 23–30.

Mahler, S. J., Chaudhuri, M., & Patil, V. (2015). Scaling intersectionality: Advancing feminist analysis of transnational families. *Sex Roles*, *73*(3–4), 100–112. https://doi.org/10.1007/s11199-015-0506-9

Maton, K. (2012). Habitus. In M. J. Grenfell (Ed.), *Pierre Bourdieu: Key concepts* (pp. 48–64). Acumen.

Mayring, P. (2014). *Qualitative content analysis: Theoretical foundation, basic procedures and software solution*. https://nbn-resolving.org/urn:nbn:de:0168-ssoar-395173

McLean, R., & Kench, P. (2015). Destruction or persistence of coral atoll islands in the face of 20th and 21st century sea-level rise? *WIREs Climate Change*, *6*(5), 445–463. https://doi.org/10.1002/wcc.350

McLeman, R. (2018). Thresholds in climate migration. *Population and Environment*, *39*(4), 319–338. https://doi.org/10.1007/s11111-017-0290-2

McNamara, K. E., & Jackson, G. (2019). Loss and damage: A review of the literature and directions for future research. *WIREs Climate Change*, *10*(2), e564. https://doi.org/10.1002/wcc.564

Mechler, R., Singh, C., Ebi, K., Djalante, R., Thomas, A., James, R., Tschakert, P., Wewerinke-Singh, M., Schinko, T., Ley, D., Nalau, J., Bouwer, L. M., Huggel, C., Huq, S., Linnerooth-Bayer, J., Surminski, S., Pinho, P., Jones, R., Boyd, E., & Revi, A. (2020). Loss and damage and limits to adaptation: Recent IPCC insights and implications for climate science and policy. *Sustainability Science*, *15*(4), 1245–1251. https://doi.org/10.1007/s11625-020-00807-9

Mensah, F. B., Agyaho, J. F., Elikplim Kofiniti, R., & Sebu, J. (2020). *Multidimensional poverty—Ghana*. Ghana Statistical Service.

Milkoreit, M., Hodbod, J., Baggio, J., Benessaiah, K., Calderón-Contreras, R., Donges, J. F., Mathias, J.-D., Rocha, J. C., Schoon, M., & Werners, S. E. (2018). Defining tipping points for social-ecological systems scholarship—An interdisciplinary literature review. *Environmental Research Letters*, *13*(3), 033005. https://doi.org/10.1088/1748-9326/aaaa75

Mortreux, C., Jarillo, S., Barnett, J., & Waters, E. (2023). Climate change and migration from atolls? No evidence yet. *Current Opinion in Environmental Sustainability*, *60*, 101234. https://doi.org/10.1016/j.cosust.2022.101234

Nightingale, A. J. (2011). Bounding difference: Intersectionality and the material production of gender, caste, class and environment in Nepal. *Geoforum*, *42*(2), 153–162. https://doi.org/10.1016/j.geoforum.2010.03.004

Nurse, L. A., McLean, R., Agard, J., Briguglio, L. P., Duvat-Magnan, V., Pelesikoti, E., Tompkins, E., & Webb, A. (2014). Small Islands. In V. R. Barros, C. B. Field, D. J. Dokken, M. D. Mastrandrea, K. J. Mach, T. E. Bilir, M. Chatterjee, K. L. Ebi, Y. O. Estrada, R. C. Genova, B. Girma, E. S. Kissel, A. N. Levy, S. MacCracken, P. R. Mastrandrea, & L. L. White (Eds.), *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* (pp. 1613–1654).

Nyantakyi-Frimpong, H. (2020). Unmasking difference: Intersectionality and smallholder farmers' vulnerability to climate extremes in Northern Ghana. *Gender, Place & Culture*, *27*(11), 1536–1554. https://doi.org/10.1080/0966369X.2019.1693344

Nyantakyi-Frimpong, H., & Bezner-Kerr, R. (2015). The relative importance of climate change in the context of multiple stressors in semi-arid Ghana. *Global Environmental Change*, *32*, 40–56. https://doi.org/10.1016/j.gloenvcha.2015.03.003

O'Byrne, D. (2023). *Habitability as capability: Proposing a normative definition of the concept*. https://www.populationenvironmentresearch.org/cyberseminars/11007

Osborne, N. (2015). Intersectionality and kyriarchy: A framework for approaching power and social justice in planning and climate change adaptation. *Planning Theory*, *14*(2), 130–151. https://doi.org/10.1177/1473095213516443

Owusu, M., Nursey-Bray, M., & Rudd, D. (2019). Gendered perception and vulnerability to climate change in urban slum communities in Accra, Ghana. *Regional Environmental Change*, *19*(1), 13–25. https://doi.org/10.1007/s10113-018-1357-z

Partelow, S. (2018). A review of the social-ecological systems framework: Applications, methods, modifications, and challenges. *Ecology and Society*, *23*(4), art36. https://doi.org/10.5751/ES-10594-230436

Porst, L., & Sakdapolrak, P. (2020). Gendered translocal connectedness: Rural–urban migration, remittances, and social resilience in Thailand. *Population, Space and Place*, *26*(4), e2314. https://doi.org/10.1002/psp.2314

Power, E. M. (1999). An introduction to Pierre Bourdieu's key theoretical concepts. *Journal for the Study of Food and Society*, *3*(1), 48–52. https://doi.org/10.2752/152897999786690753

Resurrección, B., Doneys, P., & Lund, R. (2015). Gender

entanglements in gender and development: A call for grounded, multi-dimensional and 'moving' feminisms. In R. Lund, P. Doneys, & B. Resurreción (Eds.), *Gender entanglements: Re-visiting gender in rapidly changing Asia* (pp. 319–328). NIAS Press.

Rockenbauch, T., Sakdapolrak, P., & Sterly, H. (2019). Beyond the local – Exploring the socio-spatial patterns of translocal network capital and its role in household resilience in Northeast Thailand. *Geoforum*, *107*, 154–167. https://doi.org/10.1016/j.geoforum.2019.09.009

Sakdapolrak, P., Naruchaikusol, S., & Ober, K. (2016). *Migration in a changing climate. Towards a translocal social resilience approach*. *DIE ERDE, 147*(2), 81–94. https://doi.org/10.12854/erde-147-6

Sayre, N. (2008). The genesis, history, and limits of carrying capacity. *Annals of the Association of American Geographers*, *98*(1), 120–134.

Schipper, E. L. F., Dubash, N. K., & Mulugetta, Y. (2021). Climate change research and the search for solutions: Rethinking interdisciplinarity. *Climatic Change*, *168*(3–4), 18. https://doi.org/10.1007/s10584-021-03237-3

Segnestam, L. (2017). Gendered experiences of adaptation to drought: Patterns of change in El Sauce, Nicaragua. *Latin American Research Review*, *52*(5), 807–823. https://doi.org/10.25222/larr.220

Segnestam, L. (2018). *Integrating gender and social equity into sustainable development research*. Stockholm Environment Institute. https://www.sei.org/wp-content/uploads/2018/11/181105a-gill-segnestam-gender-guidance-1808h.pdf

Sen, A. (1999). *Development as freedom*. Oxford University Press.

Sheller, M., & Urry, J. (2006). The new mobilities paradigm. *Environment and Planning A: Economy and Space*, *38*(2), 207–226. https://doi.org/10.1068/a37268

Siddiqi, A. (2022). The missing subject: Enabling a postcolonial future for climate conflict research. *Geography Compass*, *16*(5), e12622. https://doi.org/10.1111/gec3.12622

Stege, M. H. N. (2018). Atoll habitability thresholds. In W. Leal Filho & J. Nalau (Eds.), *Limits to Climate Change Adaptation* (pp. 381–399).

Sterly, H. (2023). *Thinking habitability as socially differentiated, and as influenced by tele-connections*. https://www.populationenvironmentresearch.org/cyberseminars/11007

Sterly, H., Borderon, M., Sakdapolrak, P., Adger, W. N., Ayanlade, A., Bah, A., Blocher, J., Blondin, S., Boly, T., Brüning, L., Bunchuay-Peth, S., O'Byrne, D., Safra De Campos, R., Codjoe, S. N. A., Debèeve, F., Detges, A., Franco-Gavonel, M., Hathaway, C., Funke, N., … Zickgraf, C. (2025). Thinking habitabitability for a connected, un-equal and changing world. *Global Environmental Change, 90*, 102953. https://doi.org/10.1016/j.gloenvcha.2024.102953

Storlazzi, C. D., Elias, E. P. L., & Berkowitz, P. (2015). Many atolls may be uninhabitable within decades due to climate change. *Scientific Reports*, *5*(1), 14546. https://doi.org/10.1038/srep14546

Storlazzi, C. D., Gingerich, S. B., Van Dongeren, A., Cheriton, O. M., Swarzenski, P. W., Quataert, E., Voss, C. I., Field, D. W., Annamalai, H., Piniak, G. A., & McCall, R. (2018). Most atolls will be uninhabitable by the mid-21st century because of sea-level rise exacerbating wave-driven flooding. *Science Advances*, *4*(4), eaap9741. https://doi.org/10.1126/sciadv.aap9741

Sultana, F. (2022). The unbearable heaviness of climate coloniality. *Political Geography*, *99*, 102638. https://doi.org/10.1016/j.polgeo.2022.102638

Temple, B., & Young, A. (2004). Qualitative research and translation dilemmas. *Qualitative Research*, *4*(2), 161–178. https://doi.org/10.1177/1468794104044430

Van Aelst, K., & Holvoet, N. (2016). Intersections of gender and marital status in accessing climate change adaptation: Evidence from rural Tanzania. *World Development*, *79*, 40–50. https://doi.org/10.1016/j.worlddev.2015.11.003

Van Praag, L., Lietaer, S., & Michellier, C. (2022). A qualitative study on how perceptions of environmental changes are linked to migration in Morocco, Senegal, and DR Congo. *Human Ecology*, *50*(2), 347–361. https://doi.org/10.1007/s10745-021-00278-1

VERBI Software. (2021). *MAXQDA 2022* [Computer software].

Vigil, S. (2021a). *Feminist political ecology and habitability*. https://habitableproject.org/news/feminist-political-ecology-and-habitability/

Vigil, S. (2021b). *Gender and social equity guidance note for HABITABLE researchers*. HABITABLE project. https://habitableproject.org/publication/gender-analysis-guidance-for-habitable-researchers/

Vigil, S., Pross, C., & Resurrección, B. (2019). *Critical gender analysis guidance note*. https://www.sumernet.org/media/download/orig/1199ef2ed1fdaa7f9b8636154018c2d97ddbda6e.pdf

Vinke, K. (2022). *Sturmnomaden. Wie der Klimawandel uns Menschen die Heimat raubt* [*Storm nomads. How climate change is robbing us humans of our homes*]. DTV.

Warner, K., Dun, O., & Stal, M. (2008). Field observations and empirical research. *Forced Migration Review*, *31*, 13–14. Scopus.

Warner, K., & Van Der Geest, K. (2013). Loss and damage from climate change: Local-level evidence from nine vulnerable countries. *International Journal of Global Warming*, *5*(4), 367–386.

Wiederkehr, C., Schröter, M., Adams, H., Seppelt, R., & Hermans, K. (2019). How does nature contribute to human mobility? A conceptual framework and qualitative analysis. *Ecology and Society*, *24*(4), art31. https://doi.org/10.5751/ES-11318-240431

Wolpert, J. (1965). Behavioral aspects of the decision to migrate. *Papers in Regional Science*, *15*(1), 159–169. https://doi.org/10.1111/j.1435-5597.1965.tb01320.x

Wrathall, D., De Sherbinin, A., Oppenheimer, M., & Horton, R. M. (2023, May 29). *Defining habitability*. https://www.populationenvironmentresearch.org/cyberseminars/11007

Xu, C., Kohler, T. A., Lenton, T. M., Svenning, J.-C., & Scheffer, M. (2020). Future of the human climate niche. *Proceedings of the National Academy of Sciences*, *117*(21), 11350–11355. https://doi.org/10.1073/pnas.1910114117

Young, O. R., Berkhout, F., Gallopin, G. C., Janssen, M. A., Ostrom, E., & Van Der Leeuw, S. (2006). The globalization of socio-ecological systems: An agenda for scientific research. *Global Environmental Change*, *16*(3), 304–316. https://doi.org/10.1016/j.gloenvcha.2006.03.004

Zhang, Y., & Wildermuth, B. (2005). Qualitative analysis of content. *Human Brain Mapping*, *30*(7), 2197–2206. https://doi.org/10.1002/hbm.20661

Zickgraf, C. (2021). Theorizing (im)mobility in the face of environmental change. *Regional Environmental Change*, *21*(4), 126. https://doi.org/10.1007/s10113-021-01839-2