Background paper: The habitability concept in the field of population-environment studies: relevance and research implications

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Introduction:

Based on current reports on the growing dynamics and impacts of the climate crisis (UNEP 2022, Armstrong McKay et al. 2022, IPCC 2022, Romanello et al. 2022, Steel et al. 2022), it is increasingly clear that there are limits to adaptation to climate change: humanity faces permanent and crisis-related changes. This raises the question of whether declining habitability due to climate change and environmental degradation will lead to widespread forced migration. So far, there is little empirical evidence of sustained mass movements due to climate change now or in the recent past. However, given expected loss and damage over the course of this century, together with increasing inequality, vulnerability and demographic change, it seems likely that in many regions at least parts of the population will not be able to sustain their livelihoods or even survive in the long term.

It is therefore not surprising that the concept of 'habitability', hitherto mainly known in astrophysics (e.g. Langmuir and Broecker 2012), is increasingly finding its way into climate studies and the geosciences (e.g. Horton et al. 2021; Farbotko and Campbell 2022). The debate on the short- and long-term habitability or uninhabitability of places as a consequence of environmental change and degradation is not entirely new (e.g. Storlazzi et al. 2015), but so far, the concept is not well elaborated, and its added value to existing concepts is unclear.

In this PERN cyberseminar we want to discuss the relevance and implications of the concept of habitability in the field of population-environment research through the following key aspects:

(1) The environmental aspects of habitability, and how to go beyond environmental determinism and the pitfalls of "carrying capacity"

The idea of "habitability" in the sense of the suitability of a place to support human life and livelihoods, is linked to ideas of "carrying capacity". Carrying capacity, defined as the ability of ecosystems to support human or animal population (Osborn 1953, Ehrlich 1968, Hardin 1968), has been criticised as being rooted in environmental determinism (Sayre 2008). However, it is a widespread notion, and is being currently applied, partly also in quite neo-Malthusian framings (e.g. Fan et al. 2022). Malthusian notions of carrying capacity have on the one hand been challenged by technological innovations and continued growth (e.g. Boserup 1965, Simon 1981). On the other hand, increasingly apparent limits and boundaries for supporting growth and wellbeing, on regional and especially at the global scale (de

Sherbinin et al. 2007), recall the necessity to consider the limited natural basis of human development. If we want to fruitfully incorporate this into thinking of habitability, we need to address the limitations of both environmental, as well as techno-social determinisms. It might for example be necessary to explicitly consider processes on different scales and at different sites, for example when habitability of places is extended or limited with local resources (e.g. gravity based water pumps for irrigation) or with resources from other places (e.g. with diesel pumps).

Discussion questions: *Do we need a new concept that brings together environmental and social realities and their possible future(s)? What is the added value of questioning the population-environment interaction through the concept of habitability? How can environmental determinism be avoided?*

(2) The concept of social-ecological systems dynamics and tipping points, and the assessment of habitability thresholds

The concept of social-ecological systems (SES), and the study of their interactions, dynamics and resilience provides an important basis for a process-oriented understanding of changes of habitability, especially aspects of non-linearity, multi-stability, thresholds and tipping points, and feedback loops (e.g. Berkes and Ross 2013). This gives important insights into the dynamic nature and temporal aspects of interacting, local to regional scale geo-ecological and social processes that we need to understand in order to understand changes in SES and habitability. However, social processes and dynamics are based on different operational logics and functioning than ecological (or large scale economic) systems (Adger 2000, Folke et al. 2016). In most SES and resilience approaches, a rather functionalist notion of society dominates, putting an emphasis on the conditioning influence of institutions, norms and values. Large parts of contemporary social theory stress the relevance of inequalities in endowment with resources and power, struggles for differential positioning in social fields, as well as discourses and domination (Olsson et al. 2015).

Discussion questions: *Defining habitability means being able to measure habitability thresholds and tipping points: Are we equipped to do this? What does it imply empirically to study the habitability of a place or a socio-ecological system? Can we establish thresholds that underline that the system under study is or will no longer be habitable? Can we anticipate habitability thresholds in ways that prevent loss of life from disasters? Are there tipping points in social systems that may actually precede tipping points of habitability in physical systems?*

(3) Thinking habitability through place connectivity and translocal livelihoods

It is apparent that habitability thresholds are fluid and place and people specific, moreover, as the process of globalization has progressed (Gallagher 2009), places and livelihoods are increasingly spatially interconnected, implying that thinking in terms of translocal livelihoods (i.e. Sakdapolrak et al. 2016, Adger et al. 2002) could make more sense than measuring only the *in-situ* habitability of a place. Conceptualizing habitability thus means considering teleconnections and adopting a relational perspective, seeing places as connected across scales and space – a place might be linked through structures and flows with other places, but also with entities on national or global levels (Massey 2005). A typical example would be the remittances sent by migrants from the capital city that enable households to stay in places of origin despite increasingly severe climate risks (Sakdapolrak et al.

forthcoming). Governments have strong roles in influencing the habitability of specific places, in order to improve territorial control or to safeguard resource sufficiency, for example by providing resources and infrastructure for irrigating desert areas or mining places in the Arctic. Adger et al. (2009) identify three *mechanisms* of tele-connectivity: biophysical linkages and feedbacks; economic market linkages; and flows of resources, people, and information. On the other side, immobility is not only problematic when people are unable to move away from existential risks and are "trapped" (Zickgraf 2018), but also when they cannot make use of migration or connectivity for coping with and buffering risks.

Discussion questions: *How to take into consideration teleconnections when defining and measuring habitability (and avoid similar shortcomings to that of the notion of carrying capacity)? How to make use of existing research on the connected and translocal character of livelihoods, populations and places?*

(4) The idea of climate justice, inhabitability and social difference

Habitability is closely related with questions of climate justice, and this applies across scales from the global to the local: the impacts of climate change are unevenly distributed on a global scale: climate change disproportionately affects countries and societies that are already more vulnerable (IPCC 2022), but have in many cases contributed little in terms of historical emissions (Meyer and Roser 2010). Within countries, the heterogenous distribution of effects of climate change and the capacities to deal with them is creating challenges of justice and responsibility (Mathur et al. 2014). But also on the local level, the ability to deal with climate risks and the vulnerability of households and individuals are not equally spread. Therefore, habitability is not the same for everyone, but instead is distributed unequally along multiple intersecting axes of difference even on micro-level. In addition, the question also arises who has the right to decide on the (in)habitability of places, and with which consequences for people on the local level. These multi-scale differentiation of vulnerability and thus also how, and for whom, habitability "plays out" on these scales, require a consideration of the concepts of (in)habitability, vulnerability, and climate justice also on smaller social level.

Discussion questions: *Who gets to decide when habitability thresholds have been reached? Should governments have the right to decide areas that are restricted for development or slated for resettlement? How can local community views be incorporated? What does the loss of habitability mean for local populations – and especially the most vulnerable, who may lack the means to adapt or migrate? What does this mean with regard to multi-level climate justice?*

(5) The emergence of literature on catastrophic climate change scenarios and existential risks, limits to adaptation, and the need for managed retreat

The argument of intolerable thresholds of climatic conditions for human beings (such as temperatures or rising water levels) that could reshape settlement patterns is being debated in the literature. While 1% of the Earth's space is considered uninhabitable due to extreme climatic conditions in 2020, researchers estimate that by 2070 this proportion could reach 20% if greenhouse gas emissions are not reduced (Xu et al. 2020). Despite the general capacity to adapt to changes, socioeconomic systems may face limits to adaptation when dangerous thresholds in vital biophysical, sociocultural, or economic

systems are crossed (Dow et al. 2013). Limits to adaptation determined by social, economic and cultural factors – sometimes coined as "soft adaptation limits" – can potentially be overcome and transformed (Dow et al 2013). "Hard adaptation limits", on the other hand, arise when the human or ecosystems cannot adjust to new climate regimes leading to unavoidable and potentially irreversible impacts (Roy et al. 2018). Recent literature points out that existential risks are still poorly framed, defined, and analyzed in the scientific literature (Kemp et al. 2022; Huggel et al. 2022) and engaging with the concept of habitability could help grapple with this challenge of better understanding catastrophic climate change. Thinking about (in)habitability also means to consider the actions that can be taken when and where the limits of adaptation *in situ* are reached, such as organized retreat (Haasnoot et al. 2021) or resettlement (Oliver-Smith and de Sherbinin 2014). According to Ajibade and Siders (2022), states and communities across the globe have embarked on planned relocation, resettlement or managed retreat.

Discussion questions: *Would conceptualisation and operationalising habitability contribute to research on catastrophic scenarios, adaptation limits and existential risks? What does this mean in terms of the debate on adaptation strategies, when adaptation limits are reached?*

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