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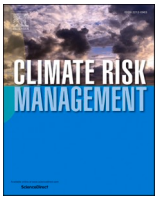

Linking quality of life and climate change adaptation through the use of the macro-adaptation resilience toolkit

Erin Friedman [a], William Solecki [a,*], Tiffany G. Troxler [b], Zachary Paganini [c]

[a] Department of Geography and Environmental Science, City University of New York – Hunter College, New York, NY, United States
[b] Department of Earth and Environment and Sea Level Solutions Center, Institute of Environment, Florida International University, United States
[c] Earth and Environmental Science Program, The Graduate Center, City University of New York, United States

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ABSTRACT

Climate change is affecting the quality of life and well-being of residents of U.S. communities and neighborhoods, posing a critical challenge for municipalities attempting to simultaneously address competing economic interests and public welfare concerns through climate adaptation policies. In response to this tension, this paper presents an innovative decision-making support toolkit — the Macro-Adaptation Resilience Toolkit (MART) — that is designed to explicitly address and overcome emerging tensions associated with community level climate adaptation policy development and ongoing and varied quality of life concerns of residents. In piloting the use of the toolkit in Miami-Dade County, we illustrate how climate adaptation can be situated within broader quality of life discussions with community stakeholders and formulate transformative strategies that could better align climate risk and adaptation and resilience actions with local quality of life issues. Findings from participant dialogues illustrate that socioeconomic inequalities of urbanization, such as gentrification, affect the kinds of climate risks that are considered of most concern to communities. Within this framework, participants formed transformational adaptation strategies that focused on improving quality of life in the long-term via conceptualizing large-scale shifts in the local governance, financing and economic structure thereby re-imaging daily life in the region.

1. Introduction

This paper presents an innovative decision-making support toolkit that is explicitly designed to address and potentially overcome emerging tensions regarding community level climate adaptation policy development and implementation. The tool described as the Macro-Adaptation Resilience Toolkit (MART) is structured to simultaneously empower users to more fully define and link for themselves the connection between climate change risk, adaptation options and their community-level interests and needs. The toolkit is designed to engage directly with the climate adaptation policy development process by creating a new set of inputs that take advantage of and build upon the increasing profile of climate change as an urgent issue affecting the quality of life in their community.

The toolkit is built upon the notion that it is clear that climate change impacts already are being felt in communities and neighborhoods throughout the United States — and that resulting climate adaptation is playing an increased role in public policy debates (Bierbaum et al., 2013; Shi & Moser, 2021; Woodruff & Stults, 2016). At the same time, climate adaptation policy and plans are often

* Corresponding author.
E-mail address: wsolecki@hunter.cuny.edu (W. Solecki).

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disconnected from other already-existing policy initiatives that shape quality of life conditions for communities (Friedman et al., 2019). This disconnect has been hypothesized to be due to climate adaptation policy and plans[1] being designed under a technical–economic framing of climate resilience, which posits that specific technical–economic mechanisms need to be ensured to enhance the capacity of the human-natural system to respond to climate extremes and other specific weather conditions or climate trends (Biesbroek et al., 2017; Webber et al., 2020; Welsh, 2014). Where climate adaptation is being treated as an isolated issue (Buurman & Babovic, 2016), other issues that arise include competition between different city agencies for decision-making power (Paterson et al., 2017), and confusion among government actors about which adaptation strategies and tools to use (Siders & Pierce, 2021). As a result, climate adaptation is increasingly reported as reflecting the interest of a capital class and market interests (Webber et al., 2020). Further, adaptation planning has been found to result in gentrification in some cases and often unresponsive to community interests and needs of existing neighborhood residents (Anguelovski et al., 2019; Hardy et al., 2017; Shokry et al., 2020).

Many communities already have had significant debates regarding the climate risks they face, quality of life aspects, and requirements for adaptation and resilience. Part of the struggles around these three issues is the oft misaligned resiliency planning process (Byskov et al., 2021; Meerow, 2017). MART is designed to lessen the struggle between communities and municipalities around creating these plans by encouraging a discussion, recognition, and formulation of strategies that align quality of life issues, climate risk and adaptation and resilience actions. The Quality of Life (QoL) discussion is central to the toolkit and is a conceptual foundation that looks at macro-adaptation issues (i.e., long term, transformative change) as opposed to micro-adaptation issues (i.e., short term adjustments to promote resilience) to help bring forward social equity and environmental concerns into opportunities for climate action and maintain quality of life conditions within communities.

This research responds to these demands by developing MART and illustrating how it can be used as a vehicle to link together these issues through a process of community engaged workshop dialogues where framings of urban-environmental struggles are rooted in participant positions. An objective of this work is to situate climate adaptation within broader questions of well-being and QoL in Miami-Dade County Florida. With participants representing a range of local stakeholders including, nongovernmental organizations, academia, municipal government, workshop facilitators used a set of group exercises to reveal how quality of life is linked to climate adaptation and the extent to which the ambition to maintain community quality of life goals could require a robust evaluation of the range of adaptation options with an increased focus on transformative adaptation steps. To address these objectives and requirements, the research presented here addresses three questions:

(1) How can we understand the linkage between quality of life and climate change?
(2) What is the link between a desire to improve quality of life and the ambition to engage in climate adaptation?
(3) How does the desire to maintain community quality of life promote transformative adaptation?

The paper is organized into five sections. First, we provide a review of the relevant background literature that synthesizes the connections between climate change adaptation literature, quality of life and decision-support approaches. Next, we present the methods and structure of MART and its application in Miami-Dade County. The third substantive section assesses the effectiveness of the toolkit and implications for enhancing the link between quality of life concerns and climate adaptation. The fourth section discusses the findings within the context of the three proposed research questions. Finally, the conclusion will synthesize results, utility and limitation of the MART approach, and next steps regarding transferability and future application to Miami-Dade County and other sites.

2. Background

2.1. Quality of life and climate change

Defining the direct relationship between dwindling community access to amenities and climate change has been recognized as the foundation to socially just forms of adaptation (Markhvida et al 2020. For example, Albouy et al. (2016) demonstrates that under high emission scenario climate change, average US public welfare loss will be between 1 % and 4 % of income per year by year 2070–2099. Climate change research has demonstrated that climatic stressors reduce the quality of life across a variety of contexts. Such conditions include disappearing coastal communities due to sea-level rise and storm surge (Alexander et al., 2012; McGranahan et al., 2007; Wu et al., 2002), increasing frequency of storms that destroys places of local cultural and social value that give meaning to communities (Arias-Maldonado, 2015; Hino et al., 2017; Quinn et al., 2019), and the growing inhabitability of places under duress from extreme heat waves, which are increasing the risk of illness and death (Depietri et al., 2013; Margolis, 2021; Telesca et al., 2018). These quality of life stressors affect one's daily life, well-being, and emotional response to various social, environmental, and economic circumstances (Kaniasty, 2012). In connection with these observations, scholars are closely examining how socioeconomic changes associated with urbanization (e.g., real-estate driven development) affect risk exposure to hazards and quality of life in urban coastal environments where these relations are acutely pronounced (Markhvida et al., 2020). This includes evidence of broader connections of climate change to displacement, urban economic development and risk exposure (Anguelovski et al., 2019; Keenan, 2018), and dislocation of communities who cannot afford to rebuild following hurricanes (Aune et al., 2020; Barile et al., 2020).

[1] Adaptation policy and plans will also be used interchangeably with the term strategies across the manuscript.

While it is clear that climate change impacts affect quality of life – and that these effects are both direct and indirect - the connection between climate change, adaptation, and quality of life is complex. This complexity is born out in the climate change and quality of life scholarship as a critical adaptation gap (Solecki and Friedman, 2021; Eakin et al., 2017). Current climate adaptation policies and plans across cities follow an urban resilience framework which defines connections between urban socioeconomic processes and conditions of changing climate impacts to determine how "disturbances shape people's adaptive capacity and vulnerability as well as to identify those forms of change driving adaptive cycles and transformation" (Satorras et al., 2020, p. 4). Although social equity and justice considerations are gaining importance, this framework's prioritization of technical–economic solutions in some cases appears to overshadow the already existing inequalities of urban development including housing quality, affordable housing, access to housing in less hazardous areas and access to social, economic and public health resources in general (Bulkeley et al., 2014)—thereby failing to address already-existing social inequities, and potentially increasing the scope of inequity across communities (Meerow et al., 2019).

These inequities underscore negative community response to climate adaptation policy and plans, as many strategies exhibit a disconnect to community concerns and lack an incorporation of the conditions that create meaning and purpose out of places (Kim et al., 2018; Lamb & Steinberger, 2017; MacKinnon & Derickson, 2013). The factors behind this adaptation gap can be largely attributed to top-down decision-making structures dominating climate policy planning,which frame climate change as a technical and economic problem—leaving little policy space to consider strategies that take into account the underlying drivers of vulnerability (Dewulf, 2013). These techno-managerial problem framings tend to focus on risk management (Bosomworth, 2015) and institutional restructuring (e.g., municipal sustainability departments) (Hölscher et al., 2019; Vink et al., 2013). Ultimately, these resilience framings do not entirely benefit urban climate governance, because related policy and planning processes tend to maintain status quo power relations rather than formulating strategies to challenge these marginalizing power structures (Welsh, 2014, p. 21).

2.2. Community resilience and decision-support approaches

There is a growing recognition that climate adaptation should be integrated into municipal development planning to stimulate more socially just and equitable climate adaptation, as opposed to existing as a separate policy, in order to improve general public welfare across all city sectors while improving capacities to respond to climate risk (Chu et al., 2019). In response, transformative adaptation has been advocated to "deliberately and fundamentally [change] systems to achieve more just and equitable adaptation outcomes…[by] investigating the factors that maintain the status quo and strategically addressing them to intentionally shift systems in new directions" (Shi & Moser, 2021, p. 3). At the same time, approaches that attempt to integrate this concept into municipal adaptation strategies are varied, and who stands to benefit is often unclear (Woodruff & Stults, 2016). In this section we further conceptualize these linkages through a review of empirical findings and theoretical statements.

Current climate resilience practices demonstrate a growing interest in centering social justice in climate adaptation as municipalities are attempting to create meaning around climate adaptation through community resilience strategies that use bottom-up approaches to make residents an integral part of the decision-making process (Mees et al., 2019; Summers et al., 2017). This community-centered climate action focuses on "acknowledging the city-specificity of resilience, and that cities are highly heterogenous communities with diverging ideas of resilience" (Marschütz et al., 2020, p. 2). In turn, researchers and governmental practitioners have grown increasingly interested in the creation of decision-making spaces that attempt to address the concerns of communities along with concerns of maintaining municipal services (Magis, 2010; Troxler et al., 2021; Wamsler et al., 2020a).

How to create more equitable decision-making spaces has been promoted through the use of knowledge co-production strategies to evaluate climate adaptation policy issues and potentially transform where communities, policymakers and experts share their views on issues and use this exchange to generate new knowledge on climate resilience (Muñoz-Erickson et al., 2017; Satorras et al., 2020). The last 15 years of operationalizing the knowledge-policy interface in the United States has used knowledge co-production activities to engage city practitioner and community knowledge on various social, environmental and economic issues driving urban risk through workshop engagements (Plank et al., 2021). A majority of these activities have focused on using co-production as a normative lens to:

> "better reconcile the supply and demand for climate science across the 'useability gap' and go beyond a 'loading dock' model where science is 'dropped off' for users to take up. Its emphasis is less on fundamentally restructuring new modes of climate science, which completely integrate nonscientists into the research process, and more on ways of tailoring scientific information to the decision-making context through regular consultation". (Bremer & Meisch, 2017, p. 17)

However, this process has shown a "lack of organizational flexibility and support to facilitate citizen [i.e. community] involvement that goes beyond stakeholder interactions as a 'technocratic compromise'…Consequently, involvement tends to be punctual, isolated, and often counterproductive, even when authorities increase their efforts in some areas" (Wamsler et al., 2020b, p. 247). In particular, this process has been critiqued as exhibiting a one-way knowledge-power building dynamic, where knowledge of experts and professionals is valued more in the policymaking process than community knowledge and experiences of urban-environmental struggles (Khirfan & El-Shayeb, 2020). At the same time, co-production can potentially produce new pathways in pursuing the "just city" if activities begin with a mutual understanding of challenges in climate governance where exclusive focus can be placed on existing challenges and conditions (Borquez et al., 2017; Iwaniec et al., 2020; Perry & Atherton, 2017). Specifically, social and political science scholars suggest knowledge co-production exercises should explicitly prioritize the assessment of social and economic vulnerability to challenge top-down decision-making dynamics of current climate policy and plan development practices by re-centering quality of life and well-being as climate change issues (Birkmann et al., 2022; Forsyth, 2018; Schlosberg et al., 2017). Knowledge co-production studies beginning with an explicit vulnerability framing identified more often reflexive learning pathways where different positions, values and understandings of urban risk shape the direction of climate adaptation planning and policy process (Buurman &

Babovic, 2016; Rosenzweig & Solecki, 2014; Tschakert et al., 2016). Reflexive learning-based engagements center on 'who' defines and sets objectives for climate adaptation trajectories (Werners et al., 2021) and uses this framing to explore already existing vulnerabilities forming debates that locate interventions that can accommodate different desired characteristics of adaptation (Butler et al., 2020; Westling et al., 2019).

Indeed, while reflexive learning-based engagements would be useful, in order to close the 'adaptation gap' between the dynamic risks of urbanization and climate change, even the most socially justice centered co-production engagements tend to focus on conforming community knowledge to governmental frameworks, and fail to situate climate change as a co-produced phenomena between environmental change, social relations and values (Nightingale et al., 2020, p. 346). This paper's use of Miami-Dade County as an example illustrates how these tensions may play out, where while a number of climate resilience initiatives are in the pipeline (Miami-Dade County et al., 2019) and tensions have emerged surrounding who benefits and loses from this process (Grove et al., 2020).

3. Methods and structure of mart application

The goal of the MART toolkit is to reveal to participants how climate change will impact community quality of life, and what actions might be taken to maintain and possibly enhance quality of life. MART connects resiliency efforts with broader and longer-term transformative adaptation through the use of a structured dialogue and an indicator focused approach, to explore social, economic and environmental characteristics that influence individual and community responses to global environmental change (Paveglio et al., 2017; Sietz et al., 2019). Indicators can simplify these rather complicated conditions and therefore, allow participants to evaluate their connection to complex processes, which has proven to be especially important in sustainability practice that seeks to connect broader socioeconomic dynamics to local concerns (Moser et al., 2019; Oberlack et al., 2019). Specifically, we categorize this complex set of issues within the context of quality of life conditions, referred to here as QoL indicators. Within MART, QoL indicators are created through an iterative discussion that entails review of policies and workshop dialogue with participants. While QoL indicators and assessments have been used to evaluate socio-ecological impacts of climate change, there is a lack of methods that use QoL indicators within the context of climate change (Estoque et al., 2019). Therefore, this paper fills a critical gap by establishing the relationship between climate risk and QoL.

The MART process includes a series of stages to identify community conditions and the social context of climate resilience activities in the specific community or region of focus (Table 1). Review of relevant materials and consultations with local resilience policy stakeholders, who provide their position on climate stressors make up Stage 1. This provides an overview of municipal efforts to implement climate adaptation actions, which then are used to shape the content of workshop activities. By design, the workshop is structured to be an iterative process where larger sets of critical climate risk issues are discussed, and then reduced to major categories of issues that are of most concern to participants. Empowering participants to define QoL issues that are most significant in Stage 2 facilitates their identification of which aspects of QoL are of most concern within the context of climate change impacts.

The key goals of Stage 2 are to: 1) Help define the key quality of life conditions of the community; 2) Connect climate change conditions and quality of life indicators; 3) Engage climate change adaptation policy development and implementation that can be employed to enhance quality of life indicators; and, 4) Promote discussion on how the identified strategies and projects can be brought into action. In Stage 3, post-workshop activities assess findings and is followed by the development of a report to be disseminated to the participants. The report is to act as a jumping off point for further workshop engagement or a document for use by municipalities and other relevant governmental authorities for climate adaptation policy development. Follow on interviews and surveys could be conducted to evaluate the implications of MART engagement; however, in the application presented below, the evaluation took place during an informal discussion session immediately following the workshop.

The MART process can be run by two or three facilitators. The timeline of the exercise can be varied but the dialogue tasks in Stage 2 require a minimum of 2.5 h. The facilitators engage with local representatives in Stage 1 to frame the workshop process and gain the background knowledge to run the workshop. The facilitators play key roles during the workshop to introduce the tasks to the participants, enable consensus-building and provide boundaries for the discussion. MART by design is a dialogue-based process where the results and conclusions of the exercise are defined within qualitative measures and not quantitative nature.[2]

4. Application of mart toolkit

Prior to the workshop, Stage 1: pre-planning a MART workshop was conducted. In this stage, we performed a background review of Miami-Dade County community conditions and context in relation to climate resilience plans and policies. The results of this content analysis identified key QoL conditions and potential connection to climate risk that could be explored in a workshop.

The MART workshop (Stage 2) was conducted in October 2019 in Miami-Dade County, Florida during a weekday afternoon. The 14 workshop participants represented a highly professional group broadly involved in economic development and climate adaptation/resilience issues for metropolitan Miami. The participants included four architects and/or planners, two local government staff from

[2] The 2.5 h minimum does constrain the amount of evaluation and assessment of the workshop discussion and conclusion. For example, in a longer MART treatment – quantitative measures also can be derived and used to" locate" the relative amount of QoL change associated with climate change. For further detail, view link for in-depth report: https://www.ccrun.org/wp-content/uploads/2020/11/MART-Guide-Version-3.0.pdf. It is important that facilitators adjust their approach and depth of discussion and investigation of the issues associated with each task with each adjustment in the amount of time available and overall ambition of the participants.

Table 1
Outline and description of the MART process.

Toolkit Stage	Stage 1: Pre-planning a MART Workshop	STAGE 2: MART Workshop	STAGE 3: Post-workshop activities
Timeline	Starting a minimum of four weeks before the workshop	2.5 h minimum	Up to six weeks following workshop
Description	• Initial consultation • Co-generation of MART implementation goals and objectives with framing document produced • Background review of community conditions and context • Invite community members to the workshop	Four tasks • Task 1: Identification of key Quality of Life indicators; • Task 2: How Might Climate Change Impacts Affect Quality of Life?; • Task 3: How Do We Enhance QoL with respect to climate change impacts and adaptation? • Task 4: How to Make the Needed Action Realized?	• Consult with MART team – immediately following the workshop to do initial assessment of workshop and results • Development of draft workshop report • Review of draft workshop report • Development and submission of final workshop report

the City of Miami and Miami-Dade County, three NGO leaders that focus on climate change education and advocacy, two local journalists, three graduate students either studying or affiliated with ongoing Miami-Dade resilience efforts. The workshop lasted for approximately 2.5 h, which included approximately 15 min of introduction, 15 min of impromptu evaluation and assessment at the end, and 30 min for each workshop tasks (MART – STAGE2, Task 1–4). Given the number of participants, it was not deemed necessary to organize into breakout groups. The single group setting also allowed the facilitators to more effectively use the 2.5 h available (i.e., no report backs, etc.) The following sections will highlight discussions focused on attempts to: (4.1) identify and describe quality of life issues of most concern, (4.2) illustrate how enhanced climate risk would affect QoL, (4.3) define how to enhance QoL through adaptation, and (4.4) understand how to potentially achieve this enhancement through policy and planning. The discussions were facilitated and documented in written form by the facilitators with summations presented back to the participants at the end of each task. The next sub-sections will describe the basic sequence of steps taken with each task and the role of the facilitators to steer and guide the conversation.

4.1. STAGE 2, Task 1– Identification of key quality of life indicators

The objective of Task 1 is to guide participants in a discussion that debates and defines the key quality of life conditions within the community. These QoL conditions both illustrate aspects of the community's everyday life as well as the prospects for maintaining and growing the community within the context of climate change vulnerability, impacts and adaptation.

In advance of the workshop, the facilitators divided QoL indicators into three categories based on the content analysis performed in Stage 1, pre-planning for MART workshop: 1) environmental and ecological, 2) social-cultural, and 3) economy. The categories were created based on a review of climate change impacts and environmental hazard studies for South Florida generally and how they relate to conditions of social equity and inequality specifically. These three groupings represent the dominant themes discussed within the literature and the assumption was that a majority of participant responses would fall within these categories. A QoL indicator was framed to the participants as a quality about the place or community that one can define as a paramount positive element to the place, and whose loss or disappearance would result in diminishment of community members' life experiences in that place.

Through this introduction, participants were presented trending QoL issues in Miami-Dade County based on an ongoing survey disseminated at citizen science events and community environmental education webinars conducted by the Florida International University Sea Level Solutions Center.[3] The most recent survey had been conducted one month before the workshop and identified 17 key quality of life indicators including healthcare, environment quality, community engagement, education, housing/affordability, green space/parks, food access, jobs/employment, safety/security and transportation. These issues were presented as useful starting points for discussion among the participants, and allowed them to quickly engage with the facilitators to develop a set of key QoL indicators considered to be most significant or prominent. Each individual was asked to place a post-it with the title (descriptor) of their chosen indicators onto a poster within one of the three QoL indicator categories defined in the beginning of this section (i.e., environmental and ecological, social-cultural, economy). Questions emerged from participants about whether they should be ordering the QoL indicators in terms of *priority* (i.e. conditions most desirable) or *problem* (i.e. a quality of life condition under imminent threat), as well as the time scale – within the next decade or within the next 50 years. With respect to quality and time frame, participants were asked to focus on environmental, economic and social and cultural conditions that were of most meaning to them and would be threatened in the short and long-term. The full list of the participant defined indicators were organized into the three key QoL indicator categories presented in Table 2.

Participants provided input regarding the organization of the indicators. They were asked to cluster the indicators into generalized subcategories to visualize broader issue categories as they worked through the proceeding exercises (Table 3). Due to time constraints,

[3] The FIU Sea Level Solution Center regularly surveys Miami-Dade residents about their quality of life interests and concerns, see https://environment.fiu.edu/slsc/solutions/index.html for more information.

Table 2
List of QoL indicators identified from Task 1, Exercise 1 discussion.

Environmental QoL Indicators	
• Access to nature (green spaces along the water)	• Living in a way that doesn't overextend the resources available to support health, well-being and happiness
• Beach and water quality – to maintain recreational options and aquatic life	• Not having to lose the plants that butterflies/birds depend upon
• Clear water with abundant sea life	• Transportation
• Environmental quality	• Urban heat islands
• Flooding	• Water quality/preservation of drinking water supply
• Green infrastructure - more shade	
• Green spaces/canopy	
• Heat – A/C access and anxiety mental stress	
• Heat – affordable air conditioning	
Social and Cultural QoL Indicators	
• Access to jobs not dependent on tourism economy/ construction	• Healthcare
• Cultural vibrancy	• Quality/opportunities of education
• Displacement gentrification, loss of sense of place	• Sense of connection to a community
• Education – skill training	
• Ethnic flavor of communities	
Economic QoL Indicators	
• Affordability – cost of living, housing	• Income inequality
• Cost of home insurance	• Livable minimum wage
• Fair economic approach for everyone, especially for neighborhoods that lack money	• Sea level rise adaptation
	• Sense of having control over your life and future vis-a-vis financial mobility, job availability, affordable housing, etc.
• Funding that support state, regional and local services (e.g. public transportation)	• Sustained tax base
• Higher paying jobs	• Transportation – connectivity
• Housing affordability to keep the communities of people in place who founded Miami	• Water

participants were asked to choose three of the seven QoL indicators that they would want to use for task 2 to explore the impacts of climate risk.

4.2. STAGE 2, Task 2 – How might climate change impacts affect quality of Life?

Task 2 of the MART exercise focuses on allowing the participants to visualize the trajectories of three key QoL indicators within the context of climate risk. For this task, participants were presented the following questions: 1) What might climate change mean for QoL indicators in Miami-Dade County and 2) What level of adjustment would be desired to enhance the level of each QoL indicator? Participants were asked to focus on how climate change will have a negative or positive effect (or possibly have no effect) on QoL conditions. In order to contextualize this focus, brief presentations were given on climate change conditions and projections for South Florida that specifically discussed sea-level rise, flood risk, hurricane severity and extreme heat events (These were synthesized and prepared during the pre-workshop planning activities of Stage 1).

Following these presentations, participants were asked to engage in a visual exercise to explore what might be the impact of these changes on QoL indicators. Participants were instructed to select three QoL indicators from Table 3 that they would like to work with to explore the impacts of climate risk. The three QoL indicators chosen were a) gentrification, b) air/heat/water quality and c) jobs/wages (i.e., generally referring to the number, access to and quality of jobs and higher wages). The decision to combine heat/air/quality into one topic was done on the basis that these conditions represented different aspects of environmental health. Therefore, they seemed to work well as a general category. These QoL indicators were presented visually on an X-Y axis with four quadrants (Fig. 1). The X-axis focused on whether climate change would negatively (Significant limiting) or positively (Significant enhancement) impact the QoL indicator. The Y-axis posed the question as to whether the impact would be concentrated (Highly concentrated effects) in certain communities - potential reflecting inequity concerns - or widely dispersed across multiple communities (Highly distributed effects). Overall, positions to the left of the nexus (negative territory) were associated with a decline in QoL due to climate change and positions to the right were a positive or enhancement of the QoL—representing a desired state by the participants. The X-Y nexus was considered as a *status quo* of current QoL or that climate change would not have any or extremely little impact on that specific QoL indicator.

To complete this task, participants were asked to consider and weigh the relative influence of different key climate risks that are affecting the region including flood risk and extreme heat events. Participants debated how should one risk take precedent over the other, how does one decide which is more important, and are there resources to handle them simultaneously? After debates over these questions, the air/heat/water quality and gentrification indicators were placed in the upper left quadrant (i.e., where the QoL indicators are expected to be limited/diminished and where the effects are expected to be highly concentrated). Jobs/wages were identified by participants as being negatively affected as well but highly distributed throughout the community and was thus placed in

Table 3
Generalized subcategories for each QoL indicator.

Environmental QoL Indicators	1. Public health quality Green space access Air/heat/water quality protection
Social and Cultural QoL Indicators	2. Diversity promotion Gentrification limitation
Economic QoL Indicators	3. Housing affordability Jobs diversity/wage enhancement

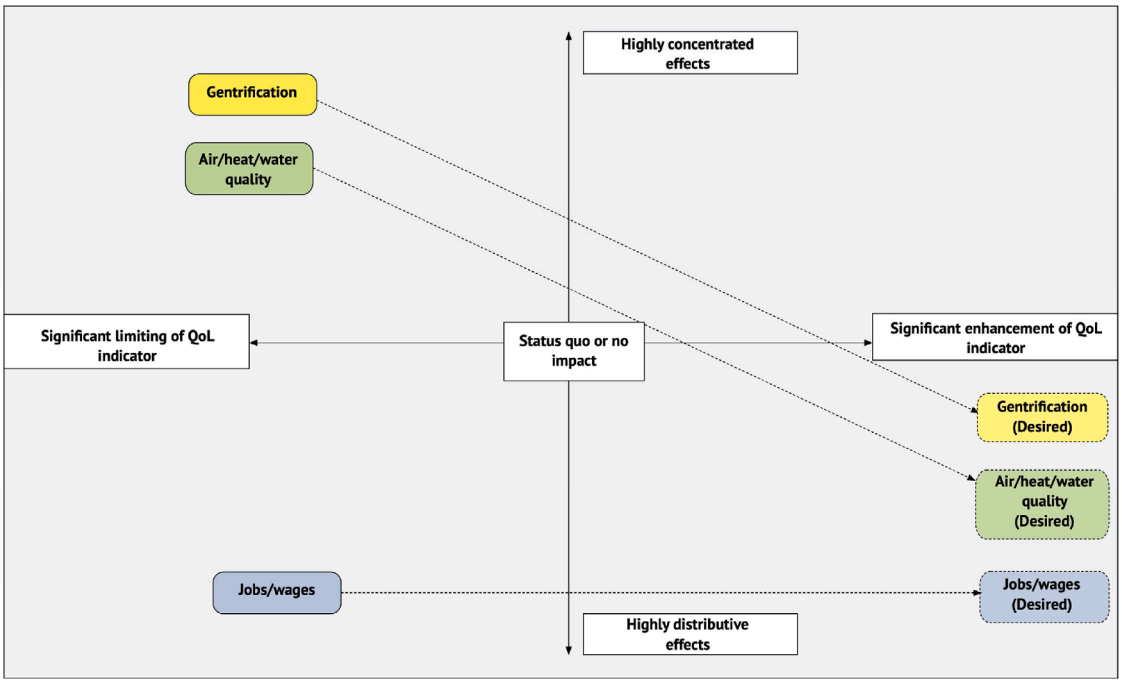

Fig. 1. Graphic illustration of how participants visualized the trajectories for selected QoL indicators within the context of climate risk and the socio-spatial distribution of effects.

the lower left quadrant.

During this task, much discussion was around a QoL indicator's desired (i.e., future) state, which expressed participant *ideal desires*, or *practical desires*, and illustrated the distribution/concentration of a QoL indicator's *individual effects* or *spatial distribution*. Participant consensus was that the desired state would be aspirational – at the high end of practical desires. Highly concentrated effects of QoL indicators (positive points on the Y axis) were understood by participants to be very few areas of Miami-Dade County that would be affected by climate change impacts and in turn, would be sites for focused adaptation efforts. Participants understood highly distributed effects of QoL indicators to represent a wide geographic scope of impacts and response (negative points on the Y axis).

Within these debates, participants espoused their aspirations for enhancing local quality of life. The participants were asked to confirm that the community simply does not want to face a decline in quality of life related to climate change, and they want to define a future with sustained or improved quality of life conditions. For each QoL indicator, the participants promoted a call to not only ensure resiliency to climate change but to also promote an improved quality of life. In the case of the X-Y diagram (Fig. 1), that meant a trajectory from the left side of the figure to the right (positive QoL) side of the diagram. The location of this desired enhancement of each QoL indicator became the basis for Task 3 of the MART exercise. The value added of this process lies at facilitating a collective reasoning of complex topics often not discussed in workplace settings. In addition, the discussions allowed a more nuanced understanding of QoL considerations.

An area where moderators had to engage significantly to reach consensus was on the connection between climate change and impact on jobs and wages. This was a complex topic that required time for participants to agree upon key connections. The participants noted that the level of impact could be highly industry specific. For example, the tourism-based economy and related service sector might be significantly affected by climate change. The impact on jobs would be less so if the region made a transition to an economy based on the production of renewable energy or solar manufacturing. The discussion also included reference to gentrification driven by climate change. The participants cited anecdotes that climate gentrification was already taking place, resulting in the dislocation of

lower wage earning, long-term residents.

4.3. STAGE 2; Task 3– How do we enhance QoL with respect to climate change impacts and adaptation?

The goal of Task 3 is to conceptualize how QoL indicators could/would be enhanced. If participants reach consensus that they want community QoL indicators boosted even within the advent of climate change impacts (as determined in Task 2), the next step is to determine what would be needed to achieve this goal? Specifically, Miami-Dade County participants aspired to have QoL heightened and to have these benefits widely and equitably distributed throughout the county. As designed with the MART framework, these consensus goals enabled a general discussion regarding emerging conditions in South Florida in response to climate change and the capacity of the region's institutions and civil society to act.[4] For example, early on statements by participants focused on the city's financial structural issues. As noted, Miami-Dade County struggles to raise financing for climate action given that there is no local or state income tax and strict limits on annual tax increases, leaving limited government revenue options to fund adaptation measures. As according to one participant, "our economy is tourism and real estate." Follow up comments were introduced on the need to incentivize working from home and reimagining the notion of work, and interest in a 'civilian corps' with specific post-disaster jobs. A more focused discussion then ensued on how to connect specific QoL indicators with policy and practice proposals. Solutions developed by the participants centered on mechanisms to restructure public financing and incentives for adaptation practice. A consensus emerged that adaptation can only be achieved with public support yet, in most cases, the general public was not considered to be supportive of a ballot issue to raise taxes to pay for adaptation. The participants lamented that the local property tax base is directly linked to building construction especially in coastal high value at-risk sites. Given this situation, the need for incentivizing climate smart development as a key economic strategy was expressed.

Overall, the facilitated discussion brought forward a broadly recognized need for a new policy agenda in the context of climate change impacts. The dialogue included a variety of comments illustrating the wider context of the climate change challenge. For example, climate mitigation, not just adaptation, also was cited as a need to be addressed. One participant stated, "that's why these exercises [on adaptation], while they delight me, they [also] frustrate me." The frustration grew from the observation that Miami-Dade County will have to spend greater amounts of money on adaptation if there is no significant global mitigation response and reduction of greenhouse gas emissions.

Significant large-scale QoL challenges limiting metropolitan Miami-Dade County's capacity to enable transformative adaptation also were expressed by the participants. These included the lack of 1) a diversified economy including a larger component that can utilize online work and professions, 2) a livable minimum wage, and 3) incentives to promote 21st century work skills including a renewable energy economy and employment opportunities. While participants acknowledged that some progress had been made, the pace of change was considered too slow compared to the rate at which hurricane frequency and intensity are increasing.[5] As expressed by one participant, "the next major hurricane will be a game changer.".

Participants felt that a future opportunity for action would be a post-extreme event window following a major storm. They discussed how the region could be best prepared to take advantage of such circumstances and what would be appropriate post-extreme responses. Specifically, several individuals indicated that discussions had already begun on how to create a workforce trained with secondary skills, that can be put into action in a post-hurricane setting[6]. This issue became a topic of discussion among the wider group of participants. The group discussion focused on how immediately after a hurricane, a critical need exists to quickly restore order and operations, open up transportation corridors, begin critical repairs to buildings, and more generally implement a pre-planned "post-major hurricane plan B strategy." It was recognized by one participant that "if one is going to see this random event transpire in the future, it is not just capacity to respond but is to take action now to make a progressive policy agenda so when that window opens, we can best take advantage [of it].".

The participants began a rich conversation on the limits and barriers to more transformative resilience efforts and adaptation as well as potential enabling conditions. For example, constraints on a directing post-disaster recovery were highlighted. Participants agreed that federally backed disaster recovery funds and flood insurance are complicated because they enable rebuilding in increasingly high-risk locations. Participants also expressed the need for policy mechanisms that incentivize greater hazard resilience in high-risk locations. Specifically, the group agreed that a significant positive step would be regulations that ensured rebuilding does not take place in the same location without building standards and codes that take future sea level rise and catastrophic storm damage into account. The full financial, social, and ecological cost of building on highly vulnerable sites must be recognized. As one participant noted, "this is not just a linear curve in terms of risk, almost in addition to not rebuilding and taking precautionary measures, one needs to include the actual price of risk [into the conversation]." While these adjustments might seem to reenforce the current urban development paradigm in the city, the participants feel that the integration of resilience into the building and construction process would be by itself transformative given the local context.

Participants expressed the sentiment that new government action could ensure that private property owners act in ways to minimize future risk by incentivizing a post-disaster redevelopment protocol to reduce vulnerability and exposure. It was clear that this

[4] These topics were discussed with the whole group as opposed to breakout groups (defined in MART guidebook) due to time constraints.

[5] Miami-Dade administration and business community have recognized the need to diversify the local economy but it is beyond the scope of this analysis to critically evaluate the magnitude and impact of these changes vis-à-vis climate resilience.

[6] This statement was not independently verified but nonetheless the group discussion proved important as a vehicle to link together the collective thoughts of the participants.

opportunity will introduce trade-off considerations, such as limits of private property rights. The attendees also stated that it was uncertain what might be the appetite for such trade-offs within the broader community. However, other participants noted that this is consistent with current state regulations of the Florida Building Commission (state building code authority) that has mandated a BFE + 1ft freeboard requirement in flood hazards areas for residential structures since 2017 and in some cases, local jurisdictions (e.g., Miami Beach) are permitting freeboard up to 5 feet, facilitating even greater flood risk reduction for substantially renovated residential buildings and new construction.

Significant discussion also focused on protecting community diversity and the negative impacts of gentrification. Recalling that group ambition was to "move" gentrification pressure from highly concentrated (upper left quadrant of X-Y graph) to highly distributed (the lower right quadrant), one participant raised the question of whether it is appropriate to refer to gentrification as an adaptation gap[7] as it is a process that will continue with or without climate change adaptation. The elaboration on this point was profound. As was stated by a participant: "I believe there is a deeper problem beyond sea level rise and climate change…I am thinking we are using the problem space as a repressive force and is making it [gentrification] happen quicker than it would happen normally." Extended conversation took place on the connection between climate change risk and impacts, gentrification and the role for intervening variables and processes, such as real estate speculation, property tax rates, and mortgage financing. A collective appreciation was recognized that by linking quality of life to climate change risk and impacts and a potential adaptation gap, one was able to reveal that policies now in place result in inequities and that climate adaptation discussions should not hide these underlying issues. It was also appreciated that climate adaptation policies by themselves could be used to mask underlying social and environmental inequities.

4.4. STAGE 2; Task 4– How to make the needed action Realized?

The next task of the MART process pivots on another basic question: *What actions would be required to affect change and close the QoL-adaptation gaps identified in Task 3*? Participants expressed the opinion that even though collaboration is one of Miami-Dade County's biggest assets, it was not certain that it would be possible to define pathways to create and combine financial mechanisms and incentives to promote climate adaptation. In turn, the facilitator asked participants, "Is there a way to leverage resources collaboratively and create a database of examples of how people can create [adaptation] change and the resources to make it happen?" Initial responses to this question centered on activating collaboration opportunities between university researchers, government officials, and the public to filling gaps in climate risk and adaptation data availability. As an example, participants noted that the existing stormwater management plan for the city is an uncoordinated effort and suffers from data gaps including basic data such as updated high-resolution elevation data (e.g., LiDAR) that is crucial for advanced flood risk mapping. Better mean monthly high tide (i.e., King Tide) projection data also was seen as a critical need.

Furthering this conversation, participants proposed what they thought would be "doable" solutions to address some of these issues. For instance, it was mentioned that creating a boundary organization that is at the policy-science interface with a full-time program manager would be very helpful and relatively easy to do. This idea extended into conversations about how education and job training related to climate action should be supported, with one participant noting:

> "It is critical to break the cycles that create separate siloes of education and job training. The presence of an extension service [that links science, policy and practice] can be a significant step in that direction. The agricultural extension service model [developed at land grant universities] could provide a useful example that can be adapted for urban settings like Miami."

The extension service model suggestion, as noted by participants, is an old but reliable model in taking knowledge generated from research and taking it out to the public. This model could be easily translated to the emerging green infrastructure industry in Miami-Dade County and construct a state-of-the-art web-based data portal that would enable data coordination and sharing.

5. Implication of the workshop results

The MART workshop provided an avenue in which the participants as members of multiple interest groups with a stake in the design and implementation of climate adaptation policy and plans could synthesize the connections between climate change, quality of life and climate adaptation – answering a call to understand the dynamics and politics of urbanization within broader institutional and socioeconomic contexts (Birkmann et al., 2014). The approach taken here connected climate change to quality of life conditions. The participants' debates on which climate risk to focus highlighted the observation that risks of most concern was deeply connected to concerns about living conditions and underlying issues of access to resources, amenities, and of social and environmental inequalities. The discussions emphasized that the underlying drivers of vulnerability such as gentrification and job security were of apprehension to communities in Miami-Dade County, and in conjunction with climate risk, were threatening everyday quality of life in the area. This revealed the critical need to mainstream equity and vulnerability-based thinking into various aspects of urban resilience planning (Coaffee et al., 2018; Eakin et al., 2017; Leichenko, 2011; Therrien et al., 2021).

One important issue that emerged from the workshop concerned creating a diversified economy in which the current workforce expands beyond the tourism and service industries to build careers around preparation for, monitoring of, and recovery from extreme weather events. Asking the community to define a future that contains sustained or improved quality of life conditions is very much in

[7] Adaptation gap was defined in the MART workshop as the difference between existing adaptation efforts and adaptation need, and is consistent with the definition in the broad research literature.

keeping with the internationally recognized goal of creating climate resilient development pathways (IPCC, 2018) and illustrates ways in which climate resiliency can take place along with sustainable development where local quality of life can be bettered (Singh & Chudasama, 2021). The participants' focus on defining and improving the socioeconomic conditions of Miami-Dade County centered around debates over how to take advantage of new opportunities in climate-focused economy industry would hold for the region, such as the creation of new jobs centered on climate risk assessment and management, and instituting job training that supports these needs.

Recognizing the need to diversify a tourism and real estate dependent economy is also part of a broader observation by climate adaptation studies. Specifically, these works have noted the importance of climate resilience planning in acting as a driver to transform local economies from industries that are vulnerable to extreme weather events to concentrating efforts that integrate climate change considerations across different economic sectors to financially and technically withstand hazards (de Koning et al., 2019). At the same time, a study in Broward County, adjacent to Miami-Dade County, found that socioeconomic issues challenge climate resilience planning in the area (Paterson et al., 2017).

Furthermore, using quality of life issues as the ambition driver to keep communities focused on climate adaptation highlighted the importance of innovative and empowered leadership in bringing these issues to the fore of planning. This condition is reflective of urban governments, in general, struggling to engage communities on climate-related issues (Anguelovski & Carmin, 2011). Becker and Kretsch (2019) made similar findings in Rhode Island, where a leadership void severely impeded how community concerns were integrated into adaptation planning. In addition, this concern brought to light critical challenges found within urban climate governance within municipalities, where public welfare concerns find it difficult compete with economic development interests (Archer et al., 2014; Bulkeley & Betsill, 2013; Chu et al., 2017; Hughes, 2015).

Lastly, the toolkit was designed to make connections between the current state of climate adaptation policy and plans and the state of everyday life for communities of Miami-Dade County. In contrast to other toolkits, MART activated quality of life conditions of participants as a critical long-term issue which defines the outcomes of transformational adaptation. In creating exercises that promote thinking about ways climate change will impact key QoL conditions, participants were allowed to not only consider recovery from extreme events, but to formulate ideas on transformative, long-term measures that enhance quality of life. Strengthening capacities for transformative adaptation has shown to be embedded in creating a decision-making space, or at least a discussion space, where vulnerability and climate change can be critically discussed (Hölscher, 2019). In this way, the toolkit placed quality of life at the forefront by first asking what the loss of this quality would mean for the community, without initially biasing participants about climate change risk, which may impede the kinds of quality of life issues a participant considers a climate change issue or not (Corner et al., 2012). We extended this approach by having participants focus on the ways climate change would negatively or positively affect certain QoL conditions to facilitate participant understanding and the rationale for solutions that broadly consider climate risks in decision-making.

While these conversations brought forward critical issues that may affect the ability of communities of Miami-Dade County to respond to climate disasters, the conversation about translating what the participants suggested as strategies to close the adaptation gap proved challenging because of the complexities of the governance, financing, disaster preparedness, and structural economic issues involved. Based on examples from other urban climate contexts, these gaps could be addressed with exercises that bring together policymakers and community members to mobilize different understandings of risk management across varying perspectives and policy domains (Borie et al., 2019). Workshop discussion would need to have been extended to develop a deeper conversation that synthesizes QoL conditions with strategies to improve QoL indicators as a climate resilience strategy and to map out how these ideas could be placed into action. Unfortunately, the participant discussion was limited by the time constraint of 2.5 h and holding the toolkit workshop in single session, rather than a more extended, multi-session engagement that would have allowed for more reflection.

6. Conclusions – Critiques and opportunities for broader application of MART

This paper presented MART as a decision-support toolkit which can connect quality of life issues with current and projected climate risk. The approach introduced the use of QoL indicators as a way that could connect dynamic (biophysical, social, economic) changes of the urban environment to climate resilience policies and planning. This QoL indicator approach helped reveal many circumstances and elicited a set of high profile QoL indicators from Miami-Dade County participants, the potential implications of climate change on these conditions, what participants wanted to do in response to protect and enhance local quality of life, and how these responses could be put into practice.

The workshop provided an opportunity for local community participants to collectively reveal their range of perspectives and approaches that might be required for maintaining and enhancing quality of life in the region. While follow up surveys to evaluate the legacy implications of MART engagement were not conducted, for the authors and the participants the workshop and MART approach forged a new direction in terms of framing climate change communications around conditions relating to every day quality of life. A more extended, multi-session engagement could have enabled some of this reflection and increased potential for translation to strategies or specific actions. Even so, several important outcomes of the participant dialogues were identified.

One significant result was the recognition that there is a significant gap between a) the actions that could be taken to achieve enhanced QoL, b) the steps that would be needed to make these actions a reality, and c) the capacity to realize these enhancements. Identifying the gaps and synthesizing connections and possible solutions enabled a vigorous discussion among participants on current and proposed climate resilience strategies. The links to social welfare policies and conditions were of most concern to the participants. With the workshop dialogues, tensions were revealed between climate resilience plans —which were seen by participants to reflect mostly economic interests—and participant concerns about the daily lives of local residents that were rapidly changing due to the dynamic and declining environment of Miami-Dade County and the concurrent social stresses such as lack of access to affordable

housing and job insecurity. These stresses in turn were affecting how residents could cope with current and future climate change impacts. The tension between resiliency planning and stresses faced by the communities of the region was identified as a foundational 'adaptation gap'.

The toolkit aims to provide an approach for closing this gap by giving climate change adaptation planners a method for connecting adaptation planning to quality of life conditions prioritized by community members. MART's primary innovation is to focus on how community members' quality of life could be impacted by disaster risk reduction and climate change adaptation planning and how QoL concerns can be applied to better shape and influence the goals of adaptation strategies. Paying attention to quality of life concerns allows for better understanding of where adaptation strategies can fit within communities and their everyday lived experiences. These toolkit results could have been enhanced with an additional session that places participant ideas into action by identifying the formal actors and governance processes to put these strategies into motion. Creating a map of action could also identify broader power structures that are limiting government responses or community engagement by situating their concerns at the forefront of climate resilience planning.

The toolkit outlined the steps intended to lay the groundwork for transformative adaptation by enabling participants to conceptualize large-scale shifts in the local economic structure, perceive science-policy-practice linkages, and in some ways reimagine daily life in the region. Defining transformative action is determined by the social, economic and environmental context of the area in question. In Miami-Dade County, participants considered changing building codes and urban development patterns were considered transformative. The participants were greatly concerned that numerous high density developments continue in areas at risk from flooding and sea level rise. The discussion illustrated a clear need for improved decision-making, technical capacities and strategic investments. These include actionable data, advanced education and job training. The juxtaposition of current and planned resiliency efforts and these broader scale transformative changes were useful and illuminated potential pathways for change.

Overall, translating this engagement process to other decision-making contexts can support policy-relevant research that advances the conceptual connections between livelihood needs and climate resilience policies and plans. MART could be easily extended to other potential entities that may benefit from its dialogue structure. These could include civic associations, block associations, community group/boards, and local organizations/agencies that have an aligned mission and vision. More evaluation is needed however to understand its applicability to other cultural and development settings.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Data availability

Data will be made available on request.

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