Utrecht University

Master's Thesis – Master Sustainable Business and Innovation

Title: Examining climate change risk perceptions and climate change action in East Africa

Student: *Romany Sascha Boertjes*

Supervisor: *Karlijn van den Broek*

ABSTRACT

This study examines the way East Africans perceive climate change risk, as well as their level of informedness, impact knowledge, place attachment, and the social norms related to concern about climate change, to determine how these affect climate change action. It is crucial to understand the relationships between such sociopsychological determinants to be able to communicate climate change risk effectively, and thereby to better understand how to empower locals to take action to minimize and adapt to the increasing negative impacts of climate change.

Theory

Prior research indicates that several determinants of risk perceptions, such as climate change beliefs and social norms, significantly affect climate change action. Climate change beliefs and social norms were therefore selected as independent variables in this study to determine whether the same effect can be found in East Africa. Climate change informedness was selected to provide a better understanding of climate change information sources, and how frequently this information is sourced in this region. Place attachment is selected to provide clarity on its effects on climate change risk perceptions and action, as current research is still inconclusive.

Method

A survey containing both self-constructed measures and verified scales was conducted across Tanzania, Kenya, and Uganda (*N*=1094), representing East Africa. Each measure contained two subordinate categories, e.g., perceived severity and perceived harm form risk perceptions. Two

hierarchical multiple regression models were conducted for both dependent variables, i.e., climate change risk perceptions and climate action.

Results

Social norms had the biggest impact on taking climate action, whereas impact beliefs had the biggest impact on climate change risk perceptions. The two subcategories within place attachment, i.e., place identity and place dependence, had opposing effects on climate change risk perceptions. Therefore, when combined into one mean, place attachment had a weak influence when tested on climate change risk perceptions and action. The models for climate action and risk perceptions only explained 9.6% and 14.4% of the variance, indicating that there may be many socio-cultural influences affecting risk perceptions and climate action that can be explored in further research.

Conclusion

The findings from this study can aid in increasing local coping capacity by providing insight for a communication campaign that aims to inform residents about climate change impact, as well as to instill social norms that encourage the appropriate climate change mitigation and adaptation behaviors to stimulate climate change action in East Africa.

EXAMINING CLIMATE CHANGE RISK PERCEPTIONS AND CLIMATE CHANGE ACTION IN EAST AFRICA

A recent report from the Intergovernmental Panel on Climate Change (IPCC, 2022) shows that greenhouse gas emissions over the last decade are at the highest levels in human history. This shows that urgent global action is required, and unless there are extensive emission reductions across all sectors, capping global warming at 1.5°C will be beyond reach. Climate change is therefore an urgent, complex global problem that poses significant challenges to societies worldwide, and addressing climate change is arguably one of the most pressing issues facing our planet and its inhabitants (Swim et al., 2009). However, even though most people acknowledge that the global climate is changing, they do not consistently engage in actions that would reduce climate change (Steg, 2018). The urgency of climate change mitigation thus calls for a profound shift in individual behavior (Ortega-Egea, 2014), but simply informing people is not enough to motivate a change in usual behavior (Schultz, 2011). Since the impact of global climate change on human and natural systems will be severe, far-reaching, and most damaging for the physically and economically vulnerable (Semenza et al., 2011), society should respond by minimizing and adapting to the consequences of climate change. Increasing local adaptive capacity and encouraging climate action is therefore crucial, as a coordinated individual and collective response is needed to reduce the rate of greenhouse gases currently emitted (Smith & Mayer, 2018).

Africa has been highlighted by the IPCC (2014) as particularly vulnerable to climate change. Africa contributes only a small share of the global greenhouse gas emissions responsible for

climate change but stands to suffer disproportionately from the negative impacts (Nyiwul, 2019). Many individuals and businesses in African countries have social and institutional conditions that form a barrier to climate action, such as a lack of trust and problems of corruption (Eakin et al., 2014; Smith & Mayer, 2018). Climate services in Africa have some serious constraints, as there is a lack of understanding how and if climate knowledge is framed and used in local contexts (Vogel et al., 2019). Climate change action is heavily reliant on the opinions of experts, resulting in the brokerage of knowledge becoming the driving force of the engagement process (Vogel et al., 2019). Climate action initiatives with a bottom-up approach are lacking, and the hearts and minds of Africans are not being adequately considered – leading to a lack of internally driven initiatives and a lack of local ownership of such initiatives (Vogel et al., 2019). This calls for an innovative approach to climate change initiatives, as an integrated, more holistic approach targeted at the actualization of sustainable development goals is needed to address the climate change risks that Africans are facing (Jude et al., 2019). Innovative practices in the public sector require a different approach to project management, in which risk and complexity is better managed through including input from and collaborating with citizens and service-users (OECD, 2014). Increasing the adoption of sustainable practices in vulnerable regions, particularly those relying on fragile ecosystems for food, such as in the case of Lake Victoria in East Africa, is becoming increasingly important.

Any population exposed to hazards wants and needs to be optimally informed about risk characteristics, preventative measures, and appropriate behaviors. It is apparent that risk communication is key in linking risk perception to risk management (Rohrmann, 2008). Risk communication programs are therefore crucial in effective climate risk management and need

to be based on a sound understanding of the underlying sociopsychological processes and preconditions to be successful (Rohrmann, 2008). Research suggests that human behavior is predicted by a multitude of factors, including cognitive, psychological, psychosocial, social, and situational/contextual factors (Busch et al., 2019). More specifically, individual climate change action is shown to be affected by age, gender, education, climate change beliefs, and social norms (Jaeger et al., 1993). However, our understanding of the psychological determinants and relationships that affect individual climate change action is still incomplete. While some research examines the effect of psychographics such as environmental worry on climate change action (Bouman et al., 2020), O'Connor et al. (1999) noted that the success of risk perceptions in accounting for behavioral intentions related to climate change should lead to more research that examines risk perceptions as independent variables. As such, climate change risk perceptions will be examined as a predictor of climate action in this study. Xie et al. (2019) add that further research is needed to develop a comprehensive model of engagement in climate change action. This is needed to address the need for communication to combat mitigation and adaptation response inefficacy (Steynor et al., 2021).

Research aim

The aim of this study is to contribute to a better understanding of how climate change risk is perceived, the determinants of climate change risk perception and action, and how risk perception impacts climate change action for East Africans. This research aims to provide insight into the effects of climate change informedness, beliefs, social norms, and place

attachment. This is done with the goal of using the relevant socio-psychological and socio-demographic variables as building blocks for new, inclusive climate risk communication programs, which aid NGO's, policymakers, and businesses in communicating climate risk and encouraging climate action. This can, in turn, innovate the coping capability of local communities and businesses in East Africa in dealing with climate change.

Research questions

RQ1: What are the effects of climate change risk perceptions, climate change informedness, climate change beliefs, social norms, and place attachment, on climate change action?

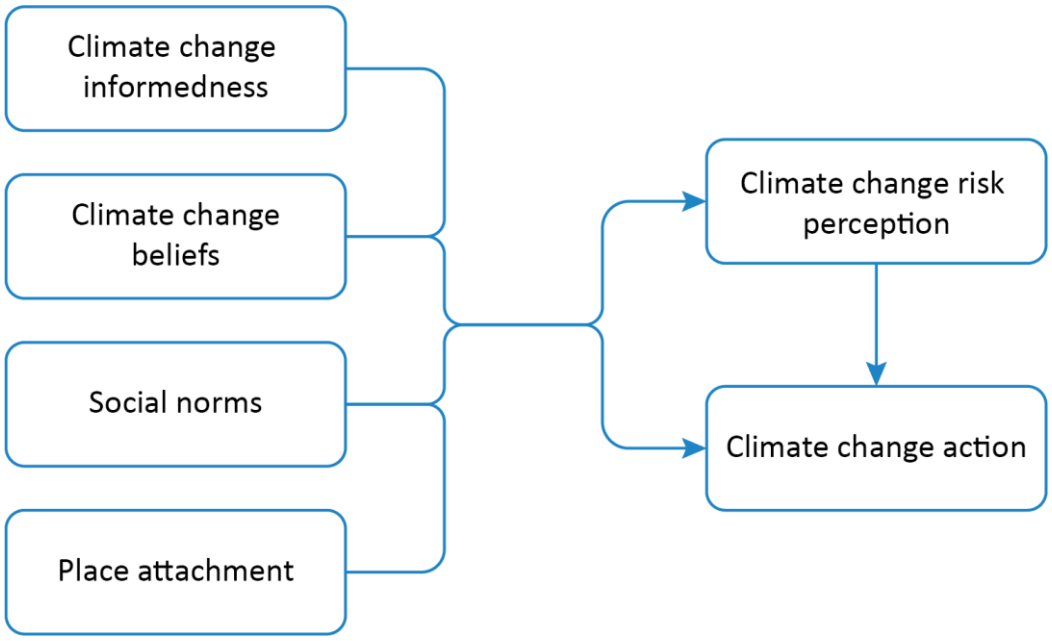
RQ2: What are the effects of climate change informedness, beliefs, social norms, and place attachment on climate change risk perceptions?

Research framework

The constructs of climate change risk perception and climate change action have been examined separately, to determine how climate change risk perceptions affect climate change action for locals in East Africa, but also to determine the effects of relevant predictors on both constructs. The effect of climate change beliefs and social norms was tested, as it was frequently noted in prior research as particularly relevant in the perceptions and responses to climate change (van der Linden, 2015; Jaeger et al., 1993; Xie et al., 2019). The impact of place attachment was tested as an extension to existing models. To provide specific insight for public

climate change communication, the effect of climate change informedness has also been examined. The research framework is included in Fig. 1 below.

Figure 1: *Research framework*



Scientific relevance

This study contributes to climate change action and risk perception research by addressing a literature gap in the understanding of the socio-psychological factors that underpin individual climate change action and risk perception for locals in East Africa. The extent to which individual climate change risk perceptions impact East Africans in engaging in climate change action remains unclear, which has been examined in this study. Additionally, the effect of cognitive factors (climate change beliefs and informedness) and psychosocial factors (social

norms and place attachment) was tested on climate change action and climate change risk perceptions respectively. These variables have not only not been included in a single model but have also individually received little scientific attention in the African region. Studying the various perceptions of climate change in this region is therefore increasingly important as global emissions continue to rise.

This study can contribute to a better understanding of how East Africans perceive climate change risk, their beliefs about climate change, how informed they are, what the social norms are, how attached they are to where they live, and how this impacts individual climate change action. This research thereby adds to existing literature by working towards a comprehensive framework of determinants for individual climate change action as well as climate change risk perceptions.

Societal relevance

Research regarding the way locals perceive and respond to climate change is especially important in Africa due to its particular set of challenges posed by ethnic, cultural, and religious beliefs, large rural, poor, uneducated, remote populations, literacy deficits, weak institutional systems, legislation and communication capacity, and variable competence of government officials (Dodoo & Hugman, 2012). Such barriers can hinder the public from correctly understanding the consequences of climate change, thereby impacting individual climate change perceptions, and resulting climate change action. Research by Richardson et al. (2022) shows the projected impact of climate change in East Africa across various dimensions, and highlights problems such as rising temperatures, rainfall variability, food insecurity, soil erosion,

and flood risk, to name a few. Researching environmental psychographics in Africa is therefore highly relevant, particularly to African societies, as residents stand to experience increasingly negative impacts from climate change and have higher difficulty adapting to climate change consequences.

The results of this study can be used to aid managers and policymakers to design communication strategies that will be effective at increasing the adoption of sustainable practices in vulnerable regions, particularly those relying on fragile ecosystems for food, such as in the case of Lake Victoria in East Africa – the main area of study. To have the capacity to implement effective climate risk communication strategies in Africa, public sector innovation is required, taking a bottom-up approach to risk management. Understanding the sociopsychological factors of the way in which the local population perceives climate change risk should thus form the basis of risk management and communication strategies.

This study reflects on how those insights could be used in future research to fundamentally improve the communication of climate risk in East Africa. By providing the insight needed to develop an innovative, integrative approach to climate risk communication, East Africa's local coping capabilities could increase, as people and businesses that are dependent on critical ecosystems will be empowered with the knowledge needed to mitigate and adapt to climate change risks.

THEORY

Climate change action

Climate change action can be taken through mitigation and adaptation strategies by industries, commerce, governments, and individuals (Semenza et al., 2011). Mitigation refers to the reduction of the rate of increase, and scale of changes, in greenhouse gases (GHG)(Zhao et al., 2018), whereas adaptation aims to improve the capacity of resilience, which consequently reduces the negative impacts of climate change (Zhao et al., 2018; Ge et al., 2009). Given the multi-faceted nature of individual adaptation or mitigation behavior, climate change action encompasses a broad range of actions in private and public spheres of life, one-off and regular decisions, as well as low and high impact actions with different levels of effectiveness in mitigating climate change (Ortega-Egea et al., 2014). This makes climate change action challenging to measure accurately. Climate change action therefore needs to be measured across multiple dimensions, as it has to encompass a broad range of actions, and perceptions thereof. Ortega-Egea et al. (2014) highlight the importance of environmental psychographics, including environmental attitudes, concern, values and motivations, and knowledge, as well as socio-demographics such as gender, age, education, and nationality in understanding individual mitigation behavior. Important environmental psychographics also include feelings of individual responsibility to take climate action, as well as perceptions of the extent to which people around them feel responsible for taking climate action. The Value-Belief-Norm theory states that feelings of personal responsibility are crucial in translating feelings about abstract goals,

such as taking climate change action, into more specific and concrete actions (Bouman et al., 2020).

The study by Steynor et al. (2021) examines climate change action across 5 East African countries. The results highlight a dual pathway to taking climate change action, dependent on individual value systems. This study argues that people have either predominantly self-enhancing values, which are values that emphasize the enhancement of one's own well-being, or self-transcending values, which emphasize the welfare of others beyond oneself. This dual pathway to action means that people with more self-enhancing values perceive lower climate change risk and are therefore not likely to take climate action, and people with more self-transcending values are more likely to take climate action. This research also specifically demonstrates the importance of climate change risk perceptions in motivating climate action. Climate change risk perceptions are therefore examined in further detail below to determine the known impacts on individual climate change action.

Climate change risk perceptions

Risk perception in this study is defined as an individual judgement of risks with limited and uncertain information (Slovic, 1987) regarding climate change. Individuals perceive risks depending on the likelihood of a risk occurring, the severity of its consequences, and the unknowns related to both (Wilson et al., 2018; Slovic, 2000). Public risk perception underpins political, economic, and social action to address risks, and can encourage or constrain such actions (Leiserowitz, 2004). The way in which individuals perceive and respond to climate change risk is influenced by many variables, and varies widely across countries (Lee et al.,

2015), cultures (Van der Linden, 2017), individuals (Van der Linden, 2017) and changes over time (Xie et al., 2019). This leads to the perception of climate change risk being very subjective, thus leaving considerable room for variation in the intensity of public concern and willingness to address climate change (Van der Linden, 2017). The low sense of urgency can be attributed partly to climate change being an abstract, statistical concept that refers to long-term changes in the variability of the planet's climate (Weber, 2010). Anthropogenic climate change is thus unique as an ecological risk, as it is a global phenomenon stretching over centuries (Breakwell, 2010) that is difficult for individuals to directly perceive and experience (Weber, 2010). To explain the variance in individual climate change risk perceptions, we can refer to the climate change risk perception model by van der Linden (2015). The climate change risk perception model by van der Linden (2015) has explained the most variance in risk perceptions to date (nearly 70%) and includes four dimensions as determinants of climate change risk perceptions: socio-demographics, a cognitive dimension (cause, impact, and response knowledge), an experiential dimension (emotion and personal experience), and a socio-cultural dimension (social norms and value orientations).

New climate change risk perception research is often conducted with the aim of finding a comprehensive framework that includes the different dimensions of risk, and all socio-psychological determinants that explain the variance in the way risk is perceived (Van der Linden, 2015). Existing models often divide risk into various dimensions, but the dimensions are not adequately explained (van der Linden, 2015) and the average variance explained by the determinants chosen leaves substantial room to further develop the theoretical and empirical explanatory power of current climate change risk perception literature (Swapan & Sadeque,

2021). Yet, although a wide variety of characteristics have proven to be relevant, whether certain factors systematically stand out in explaining and predicting climate change risk perception still needs to be determined (Van der Linden, 2017). The focus of including risk perceptions in this research is in determining whether certain predictors yield the same results in East Africa, and whether new predictors have a significant effect. In addition, it is included as an independent variable to confirm that climate change risk perceptions positively influence climate change action in East Africa.

Thus, this study examined the relationship between climate change risk perception and climate change action, as well as the effect of climate change informedness, beliefs, social norms and place attachment on both climate change action and climate change risk perception. Climate change beliefs and social norms were selected as predictors, as prior research indicated a significant positive relationship with both climate change action as well as climate change risk perceptions. These relationships will be tested to determine whether this is also the case in East Africa. Climate change informedness was chosen because the aim of the study is to provide insights for communication campaigns in Africa, and knowing how informed people perceive themselves to be, and what sources they get climate change information from are an important basis for such projects. Consequently, it was important to determine the effect of climate change informedness on climate change risk perceptions and action, to see whether participants that were more informed perceived higher climate change risk, and whether this translated into taking more climate action. The effect of place attachment on climate change risk perceptions and action was included as current research is inconsistent on the role that place attachment plays in perceptions of climate change. In addition, place attachment is not

included in the climate change risk perception model (van der Linden, 2015), even though it plays into the socio-cultural dimension of the model, which has the highest explanatory power. Considering the high vulnerability to climate change in the area of study, many human-place bonds will be threatened in the near future. Thus, place attachment was important to include as a variable of interest in this study. Each predictor of climate change action and climate change risk perceptions examined in this study is explained below, alongside the known effects for each relationship.

The effect of climate change risk perceptions on climate change action

Risk perception has been shown to play an important role in shaping climate policies (Lujala, Lein & Rød, 2015), and is an important predictor of public willingness to help reduce climate change (Swapan & Sadeque, 2021; Leiserowitz, 2006). Several studies have also confirmed that risk perceptions are positively associated with policy support and willingness to take personal action to address climate change (Leiserowitz, 2006; Smith & Mayer, 2018). Wang et al. (2021) note that lower climate change risk perception is not only associated with less positive attitudes toward climate action, but also linked to lower willingness and frequency of engagement in taking climate action (Xie et al., 2019). Wang et al. (2021) also show that higher levels of climate change risk perception are related to less climate change inaction. In East Africa, it has also been shown that climate change risk perceptions positively affect climate change action (Steynor et al., 2021). In this study it is therefore hypothesized that climate change risk perceptions significantly positively affect climate change action.

H1: *Climate change risk perceptions significantly positively affect climate change action*

Climate change informedness

Climate change informedness refers to the state of being informed about climate change. The individual perception of how informed one is about climate change is very subjective, as individuals are forced to rely on indirect sources of information on climate change, which can be manipulated by actors with disparate interests (Arbuckle et al., 2015). Accurate climate change information is needed, considering the complex nature of climate change, which is difficult to understand based on personal experience alone since the environment changes slowly over a long period of time. In Africa, there is often a gap between the climate change information most frequently requested by the public, such as rainfall data, and the capacity of climate service providers to produce scientifically valid information (Hellmuth et al., 2007). Alongside the frequency of gathering such information, it is also important to determine how informed people perceive themselves to be about climate change. However, the extent to which people perceive themselves to be informed about climate change can be biased and does not reflect how much accurate knowledge people have on the subject (Van der Linden, 2015). Therefore, a clear distinction has been made between climate change informedness, which examines the state of being informed about climate change, and climate change beliefs.

The effect of climate change informedness on climate change action

Research on climate action showed that feelings of personal responsibility, as well as perceptions of the emphasis of climate change concern in social circles are important parts of individual climate change action. The study by Kellstedt et al. (2008) showed that more informed participants felt less personally responsible for climate change and showed less concern for climate change. This could be partially due to the quality of the information, and/or inflated perceptions of climate change informedness in self-reported measures.

As the aim of this research is to innovate the way in which climate change information can be used to increase local coping capabilities, it is critical to determine which sources of climate change information are currently most frequently consulted by the East African public. This will also provide a more complete understanding of the state of informedness that does not solely rely on a single self-reported measure of informedness. As one of the main challenges for the African public is the lack of access to critical climate change information, which consequently affects their level of awareness and adaptive capacities (Popoola et al., 2020), the following is hypothesized:

***H2**: Climate change informedness significantly positively affects climate change action*

The effect of climate change informedness on climate change risk perceptions

Prior research has found both significant and insignificant effects when testing the influence of climate change informedness on climate change risk perceptions. Research by Kellstedt et al.

(2008) shows that informedness has a significant effect on risk assessments of climate change. In contrast, Maltby et al. (2021) find no significant effect when testing this relationship, and attribute this to participants levels of climate change skepticism. Skeptical beliefs are said to result in individuals being less willing to accept new information about climate change, or not attributing observed environmental changes to climate change if they are uncertain of its impacts (Maltby et al., 2021). It is therefore important to determine how such information is generated and communicated, or if this information challenges existing values to determine the role of skepticism (Lorenzoni et al., 2006, Capstick & Pidgeon, 2014; Maltby et al., 2021). Maltby et al. (2021) note that such insights are important for climate risk communication, as the methods and messages that are often used in risk communication may need to be adapted to generate more engagement. It is suggested in prior research that the adaptations could include using trusted figures to communicate issues and contextualizing impacts to local experiences (Lorenzoni et al., 2006; Nursey-Bray et al., 2012, Hine et al., 2016; Maltby et al., 2021). For this study, it is hypothesized that climate change informedness significantly positively affects climate change risk perceptions.

H3*: Climate change informedness significantly positively affects climate change risk perceptions*

Climate change beliefs

The theoretical background of climate change beliefs in this study is based on climate change knowledge, as van der Linden (2015) highlights the importance of making a distinction between

accurate knowledge, and what people believe to be true. Thus, due to the nature of the measures for knowledge in this study not sufficiently reflecting accurate knowledge, but rather the participants perception of climate change impacts, the term climate change beliefs will be used. Climate change beliefs should consist of cause, impact, and response beliefs, according to van der Linden (2015). For this study, climate change response beliefs have too much overlap with climate change action. Thus, causal and impact beliefs will be examined. Individual beliefs about climate change can vary according to geographical location, occupation, political, socioeconomics, ecological, and cultural background (Adeleke et al., 2018).

The effect of climate change beliefs on climate change action

Climate change beliefs are measured by multiple dimensions, since merely having heard of the concept of climate change does not necessarily lead to acceptance of its anthropogenic cause nor to transformative responses to climate change (Simpson et al., 2021). Climate change cause beliefs encompass the awareness of climate change and its anthropogenic cause, and thus underpin informed mitigation and adaptation responses (Simpson et al., 2021). Accurate beliefs about the causes of climate change is an important determinant of behavioral intentions and support for climate policies, whereas a lack of accurate beliefs can influence people's attitudes and willingness to act and support mitigation policies (Tobler et al., 2012). It is therefore hypothesized that climate change beliefs significantly positively affect climate change risk perceptions and climate change action.

***H4**: Climate change beliefs significantly positively affect climate change action*

The effect of climate change beliefs on climate change risk perceptions

Van der Linden (2015) argues that knowing about the concept of climate change is a prerequisite to reasoning about the risk of climate change. Therefore, participants that have not heard of the concept of climate change should be excluded in climate change risk perception research. Van der Linden (2015) reports that having accurate climate change beliefs has been shown to be a significant predictor of climate change risk perceptions, but it remains relatively unclear to what extent a cognitive understanding in terms of climate change beliefs – whether accurate or not – can explain and predict risk perceptions. Therefore, it is hypothesized that climate change beliefs significantly positively influence climate change risk perceptions.

***H5**: Climate change beliefs significantly positively affect climate change risk perceptions*

Social norms

Social norms are defined as individual expectations of how you, or others around you, are supposed to act, think, or feel in specific situations (Van der Linden, 2015). Social norms consist of both 'descriptive social norms' (the extent to which surrounding others are taking action to help reduce the risk of climate change) and 'prescriptive social norms' (the extent to which one feels socially pressured to view climate change as a risk that requires action)(Van der Linden,

2015). This author also mentions that few studies have looked at the role of social factors as drivers of risk perceptions, even though the socio-cultural dimension was the largest contributor to the climate change risk perception framework.

The effect of social norms on climate change action

Social norms are important to examine in the context of climate change action, as they are shown to be a crucial factor influencing individual lifestyle and purchase intentions, which are key factors influencing carbon emissions (Yu et al., 2019). Prior research has also found that participants with more social connections in their network that emphasize climate problems, had a higher score on individual climate change action (Jaeger et al., 1993). Social norms regarding environmental concern, as also supported by the research from Steynor et al. (2021), are therefore shown to be significant in predicting individual climate change action. Several studies have indicated that studying social norms could assist in and provide constructive suggestions for promoting climate change policies (Alló & Loureiro, 2014; Yu et al., 2019). Steynor et al. (2021) show that social norms have also been found to significantly positively affect climate change action across 5 East African countries. Thus, it is hypothesized that social norms related to climate change significantly positively influence climate change action.

H6: *Social norms related to climate change significantly positively affect climate change action*

The effect of social norms on climate change risk perceptions

The way in which people approach and evaluate risks is influenced by other people (Joffe, 2003). Van der Linden (2015) notes that both the "social representations theory" (Lazlo, 1997) and the "social amplification of risk framework" (Kasperson et al., 2022) highlight that interpersonal interactions and mass media play a crucial role in further circulating existing social representations of risk in each culture. Social norms have been found to significantly positively affect climate change risk perceptions across 5 East African countries (Steynor et al., 2021). It is therefore hypothesized that social norms significantly positively influence climate change risk perceptions.

H7: *Social norms related to climate change significantly positively affect climate change risk perceptions*

Place attachment

The human sense of belonging to a place derives from the psychological processes of familiarity, attachment, and identity (Billig, 2006). Place attachment is shown to play a role in how people both perceive and respond to climate change risks (Scannell & Gifford, 2010; 2013). Vaske & Kobrin (2001) define place attachment by two subscales: place dependence (i.e., a functional attachment) and place identity (i.e., an emotional attachment). The study by Vaske & Kobrin (2001) showed that place dependence significantly influenced place identity, and place identity was significantly related to environmentally responsible behavior. It is thus important to determine how the subordinate categories within place attachment, (i.e., place dependence

and place identity) affect climate change action and climate change risk perceptions individually.

The effect of place attachment on climate change action

The study by Vaske & Kobrin (2001) showed that place dependence significantly influenced place identity, and place identity was significantly related to environmentally responsible behaviour. These authors hypothesize that encouraging individual connection to a natural setting fosters the development of environmentally responsible behavior. Scannell & Gifford (2013) highlight that strong place attachment can have implications for climate change mitigation and adaptation, as strong place attachment positively impacts the level of engagement with climate change issues. However, it is also frequently noted that high place attachment can lead to underestimating the consequences of climate change and makes individuals less likely to relocate when facing the environmental effects (Bonaiuto et al., 2016; Swapan & Sadeque, 2021). This indicates that highly place-attached individuals may not engage with the necessary climate change adaptation actions, if this means having to leave the home that they feel so attached to. Thus, individuals with strong place attachment are a target group to which adaptation and mitigation strategies could be promoted (Scannell & Gifford, 2013). Based on prior research finding both positive and negative relationships between place attachment and various kinds of climate mitigation and adaptation actions, it is hypothesized that the effect is significant, but excludes the direction of the relationship.

H8: *Place attachment significantly affects climate change action*

The effect of place attachment on climate change risk perceptions

A person's place attachment has been researched as an important influencing factor of climate change risk perception, as individuals that are more attached to their place are often unlikely to leave, regardless of high risk (Boon, 2014). Bonaiuto et al. (2016) compiled a literature review on the way in which place attachment affects climate risk perception and found both positive and negative relationships. The positive relationship pattern found in the review is that regardless of risk area or risk type, highly place-attached individuals strongly perceive the natural environmental risks to which they are exposed (Bonaiuto et al., 2016; Bernardo, 2013). The negative relationship between place attachment and climate change risk perception can be traced back to climate change risk denial when facing natural hazards (Bonaiuto et al., 2016). Due to both positive and negative relationships having been found in research, the hypothesis does not include a relational direction, and is as follows:

H9: *Place attachment significantly affects climate change risk perceptions*

In summary, it has been found in prior research that climate change risk perceptions, climate change beliefs, and social norms regarding environmental concern have a significant positive effect on taking individual climate action. This includes a broad range of mitigation and adaptation actions. The effect of climate change informedness is difficult to determine due to

the subjectivity of self-reported informedness, as well as the variation in information quality. Literature has found both negative and positive relationships between climate change informedness and individual action. This study assumes a positive relationship. Both positive and negative relationships have also been found between place attachment and climate change action. Thus, a specific direction of the relationship is excluded in the hypothesis.

For the determinants of climate change risk perceptions, the cognitive dimension is not the main contributor to the variance in the model (van der Linden, 2015), but selected predictors such as climate change informedness and impact beliefs would fall into this category. Research on climate change informedness indicates both significant and insignificant relationships with risk perceptions. Insignificant relationships are attributed to high levels of climate change skepticism. For this study, a significant positive relationship between both climate change informedness and climate change beliefs and risk perceptions is assumed.

The socio-cultural dimension is found in prior research to be the largest contributor to climate change risk perceptions (Van der Linden, 2015). This dimension covers the selected predictors such as social norms and place attachment. A significant positive relationship has been found in prior research between social norms regarding environmental concern and climate change risk perceptions, specifically in East Africa. The effect of place attachment remains unclear, as literature shows both positive and negative relationships with climate change risk perceptions.

METHODOLOGY

Participants

Sampling was focused on 4 groups of interest: farmers (27%), urban dwellers (21%), cattle ranchers (21%), and fishers (31%). Participants in selected regions around the Lake Victoria basin were sampled through random sampling where possible. Only participants over the age of 18 could partake in this study. A total of 1094 participants completed the risk perception survey that will represent East Africa, consisting of 366 participants in Uganda, 346 in Kenya and 382 in Tanzania. The participants received an incentive to complete the survey in line with local standards. The socio-demographic section consists of 7 items, measuring individual characteristics such as gender, age, profession, and level of education. The age range of participants was between 18 and 82 years old. The average age of participants was 41.33 years old (SD = 13.22), of which approximately 70% were men and 30% were women.

Research procedure and design

This study will be quantitative, correlational research. The data for this study has been obtained from the MECCA project and conducted in the Lake Victoria basin area in Tanzania, Kenya, and Uganda. Data collection has been done by NaFIRRI in Uganda, KMFRI in Tanzania, and TAFIRI in Kenya, in randomly selected regions from a list compiled by the MECCA research team. The survey used in this study is included in Appendix 1. The results of this study have not yet been published and will not be shared with third parties. The data protection and informed consent

for participants was included in the survey during data collection and responses are completely anonymous.

The survey consists of 9 sections measuring different variables within climate change perceptions. The scales and items for each variable are listed in Appendix 2. The figures that visualize the descriptive statistics for each variable are attached in Appendix 3. The items in the survey are derived from both verified scales and self-constructed measures. Each scale was tested for reliability to ensure a Cronbach's Alpha above 0.6. Of the total 1094 participants, several participants failed to answer all the questions. Pairwise deletion has been applied to deal with the missing responses.

Measures

Climate change action

Climate change action is measured by several constructs, all ranked on a 5-point Likert scale. Climate change action has 17 items in total. The climate change action scale consists of two subscales. The first includes questions regarding the frequency of engagement in individual climate action. The frequency of engaging in individual climate change actions is measured through determining how often participants engage in common climate change related actions, such as: (1) temporarily relocating during floods (2) tree planting (3) praying to God for help, etc. These 11 items are derived from a prior unpublished study in this area as a part of the MECCA project. The mean of this subscale is M = 2.93 (SD = 0.51). The item that scored highest

in frequency of engagement in climate change action is 'praying to God for help.' The Cronbach's Alpha of this scale is α = .75.

The second subscale consists of questions related to the ease of taking action, the level of personal responsibility in taking action, and the level of confidence that action will help solve climate change problems (α = .72). These items have been adapted from the European Social Survey (ESS), and include a 5-point Likert scale rating from 'very easy' to 'very difficult' questions such as: "How easy is it for you personally to take action to stop or slow climate change?" The mean of this subscale is M = 3.34 (SD = 0.49). The items of this subscale and how they compare to one another can be seen in Fig. 2 in Appendix 3.

Climate change risk perceptions

Climate change risk perceptions has 6 items, constructed based on literature that measures risk perception through perceived severity and perceived harm (Slovic, 1987). Thus, there are two subscales within climate change risk perceptions. The perceived severity of climate change risks is measured by 4 items which determine how serious of a threat climate change is to the participant personally, to the people in their nation, to people worldwide and to the natural environment. This threat is rated on a 5-point Likert scale from 'not very serious at all' to 'a very serious threat.' The Cronbach's Alpha for this scale is α = .89. The mean of this subscale is M = 3.99 (SD = 0.91). The items of this subscale are compared in Fig. 3 in Appendix 3. Perceived harm is the second subscale, which is measured by 2 items determining to what extent the participant deems it likely that they will be personally harmed by climate change in their

lifetime, as well as the likelihood of people around them being harmed by climate change in their lifetimes. The Cronbach's Alpha for this scale is α = .78. The mean of this subscale is M = 4.17 (SD = 0.77).

Climate change informedness

Climate change informedness consists of 8 items and contains two subscales: perceived informedness and frequency of information sourcing regarding climate change. Perceived informedness is a single, self-reported item determined by asking participants: "How informed are you about climate change? Rate on a 5-point Likert scale from 'Not informed at all' to 'Very informed.' The mean of this subscale is M = 2.91 (SD = 0.87). As this is a single item, Cronbach's alpha cannot be provided.

The second subscale, frequency of information sourcing, provides an indication of which climate change information sources are mostly used in these areas, and how frequently these are consulted comparatively (Fig. 4). Frequency of information sourcing contains 7 items and asks participants how frequently they get climate change information from sources such as books, TV, radio, social media, etc. on a 5-point Likert scale from 'never' to 'very often.' The mean of this subscale is M = 2.44 (SD = 0.66). This scale has a Cronbach's Alpha of α = .68.

Climate change beliefs

This measure consists of two subscales: causal beliefs and impact knowledge. Causal beliefs are measured through a four-item measure determining what participants think the causes of climate change are, with the given options of 'natural processes,' 'human activities,' or 'God.' The mean scores for causal beliefs can be seen in Fig. 5 in Appendix 3. 'Causal beliefs has been excluded from mean climate change beliefs, as the result is a dummy variable that measures whether participants were able to select 'human activities' as (one of) the main cause(s) of climate change. This binary subscale had a mean of $M = 0.74$ (SD = 0.44). However, this subscale cannot be combined with impact beliefs, which is on a 5-point Likert scale. As it is important to measure the perceptions of environmental impact in detail, it was decided to not reduce impact beliefs down to a binary measure in order to combine the two subscales. Thus, the results for climate change beliefs solely reflect climate change impact beliefs. The effect of causal beliefs is excluded from the climate change beliefs predictor, but the individual effect can still be seen in the regression model that shows the impact of the individual subscales.

The second subscale, impact beliefs, consists of 12 items, and asks the question: "In your experience living at Lake Victoria, how do you think each of the following issues have changed in recent years?" Several environmental issues are listed, including heat, rainfall, and floods, to be rated on a 5-point Likert scale from 'much less' to 'much more.' The item that most participants perceived to have changed in recent years is heat. The mean of this subscale is $M = 3.24$ (SD = 0.7), and this scale has a Cronbach's Alpha of $\alpha = .75$. Impact beliefs regarding the perceptions of the various environmental changes are shown in Fig. 6 in Appendix 3.

Social norms

Social norms for environmental concern consists of 7 items, measured by two subscales: descriptive and prescriptive social norms regarding climate change. Descriptive social norms includes questions such as "How often do people you know talk about climate change?" Rate on a 5-point Likert scale from 'never' to 'very often.' The mean of this subscale is M = 2.75 (SD = 0.71). Prescriptive social norms are measured through 5 items such as "Most people around me expect me to be concerned about the environment." Rate on a 5-point Likert scale from 'strongly disagree' to 'strongly agree.' The mean of this subscale is M = 3.97 (SD = 0.57). The Cronbach's Alpha for this scale was < .6, and therefore the reversed questions were removed (e.g., "I would be embarrassed to identify myself publicly as someone that is concerned about the environment."). Removing these two items resulted in a Cronbach's Alpha of α = .67. The results for the prescriptive versus the descriptive social norms can be found in Fig. 7 in the Appendix.

Place attachment

Place attachment counts 17 items and is based on the measures of place dependence and place identity, derived from a verified scale by Adewale et al. (2020). The first 6 items in the scale are related to place identity. This includes questions such as: "I prefer this place to any other place." Responses are recorded on a 5-point Likert scale ranging from "strongly disagree" to "strongly agree. The mean of this subscale is M = 3.69 (SD = 0.83). The levels of place

attachment versus the levels of place identity for East Africans can be seen in Fig. 8 in the Appendix. The Cronbach's Alpha of this subscale is α = .79

The remaining 11 items of the place attachment scale are related to place dependence. This includes questions such as: "I feel secure in this place." The mean of this subscale is M = 3.97 (SD = 0.68). The Cronbach's Alpha of this subscale is α = .92. It should be noted that the Cronbach's Alpha for the entire place attachment scale, disregarding the individual subscales, was very high (α = .93). It is therefore not methodologically necessary to split them up into subscales. However, due to the conflicting results found in prior research for a number of the selected variables in this study, examining the effects of the individual subscale elements was considered critical for the deeper understanding of the relationships between sociopsychological determinants of climate change action and risk perceptions.

Data analysis

To analyze the data, a hierarchical multiple regression method was chosen. Three separate regression models were conducted for both dependent variables (climate change action and climate change risk perceptions). This was done in order to show to what extent sociodemographics can explain climate change action and risk perceptions, and to consequently show the additional variance explained by the predictors. The subscales are included to gain a deeper understanding as to how the predictors affected climate change action and risk perceptions in this way.

The first regression model includes the effect of relevant socio-demographic characteristics, such as age, gender, and level of education. To create the second regression model, which is used to answer the hypotheses, the means per participant for each subscale in each measure have been combined into one single variable (e.g., mean perceived severity & mean perceived harm becomes risk perceptions). The model thus includes the means per participant of climate change risk perceptions, climate change informedness, climate change beliefs, social norms, and place attachment.

Model 3 includes the individual effects of the subordinate scales used to form each independent variable in Model 2, to provide additional insight into how the various dimensions within the variables tested interact with climate change action and risk perceptions. These 3 regression models have therefore been conducted for both climate change action and climate change risk perceptions and can be found in Table 1 and 2.

RESULTS

Testing the effects of the predictors

A hierarchical multiple regression analysis was used to evaluate to what extent sociodemographics, total climate change informedness, climate change beliefs, social norms, and place attachment can explain and predict climate change risk perceptions, as well as how all factors influence climate change action. Starting with a baseline model, the influence of relevant socio-demographic characteristics is presented in model 1. The effects of total climate change informedness, beliefs, social norms and place attachment on climate change action and

risk perceptions can be seen in model 2. Results from model 3 show the individual effects of the subordinate categories within the independent variables of risk perceptions, informedness, beliefs, social norms, and place attachment.

The effects of the predictors on climate change action

The three models representing the results for the effects of the predictors on climate change action can be found in Table 2 below. Results from model 1 show that gender, age, and level of education are all significant predictors of climate change action, with a strong positive effect found for education levels. A moderately significant negative effect was found for gender. These sociodemographic characteristics explain a total of 3.2% of the variance in climate change action ($F(3, 1080) = 12.809$, $p < 0.001$, Adj. $R2 = .032$).

The results from model 2 indicated that the independent variables tested explained 9.6% of the variance in climate change action ($F(8, 1060) = 15.107$, $p < 0.001$, Adj. $R2 = .096$). Social norms had the most significant (positive) effect on climate change action (r (1067) = .181, p = < 0.001)(*H6*). Climate change risk perceptions (r (1067) = .106, p = < 0.01)(*H1*) are shown to have had a moderately significant positive influence on climate change action. Place attachment (r (1067) = .075, p = < 0.05)(*H8*) had a weak significant effect on climate change action. Climate change informedness (r (1067) = .027, p = .739)(*H2*) and climate change (impact) beliefs (r (1067) = .046, p = .147)(*H4*) did not significantly impact climate change action.

Model 3 shows that the subordinate scales that form place attachment and risk perceptions do not individually significantly impact climate change action. However, prescriptive (r (1057) = .181, p = < 0.001), and descriptive social norms (r (1057) = .141, p = < 0.001) were both found to

have a highly significant positive effect on climate change action. It should be noted that causal beliefs, although excluded from climate change beliefs, also had a highly significant positive effect on climate change action (r (1057) = .168, p = < 0.001).

Table 2. *Climate change action model results*

Independent variables	**Model 1**	**Model 2**	**Model 3**
Gender	-.101**	-.083**	-.058*
Age	.074*	.005	-.007
Level of education	.149***	.118***	.074*
Perceived informedness	-	-	-.033
Frequency of information sourcing	-	-	.024
Total informedness	-	.027	-
Causal beliefs	-	-	.168***
Impact beliefs	-	-	.021
Total (impact) beliefs	-	.046	-
Descriptive social norms	-	-	.141***
Prescriptive social norms	-	-	.181***
Total social norms	-	.181***	-
Place identity	-	-	.070
Place dependence	-	-	.025
Total place attachment	-	.075*	-
Perceived severity	-	-	.036
Perceived harm	-	-	.029
Total risk perceptions	-	.106**	-
N	1084	1069	1059
Adj. *R2*	.032	.096	.135
R2 change	.034	.102	.145
*F*change	12.809	15.107	13.677

Dependent variable: Climate change action. Values represent standardized coefficients.

(n.s. = not significant) *p < 0.05, **p < 0.01, ***p < 0.001

The effects of the predictors on climate change risk perceptions

Results from model 1 show that gender, age, and level of education are all highly significant predictors, explaining a total of 4.9% of the variance in climate change risk perceptions (F(3, 1080) = 19.794, p < 0.001, Adj. $R2$ = .049). Results from model 2 indicated that the independent variables tested explained 14.4% of the variance in climate change risk perceptions (F(7, 1061) = 26.593, p < 0.001, Adj. $R2$ = .144).

Climate change (impact) beliefs (r (1067) = .249, p = < 0.001)(*H5*) had the strongest effect on risk perceptions. Social norms (r (1067) = .098, p = < 0.01)(*H7*) and climate change informedness (r (1067) = .101, p = < 0.01)(*H3*) had a moderately significant positive influence on climate change risk perceptions, whereas place attachment (r (1067) = .057, p = 0.052)(*H9*) did not have a significant effect on risk perceptions.

The diminished effect of place attachment on risk perceptions is explained in part through the results of the subscales shown in model 3. Model 3 shows that where place identity had a moderately significant negative effect on climate change risk perceptions (r (1057) = -.129, p = < 0.01), place dependence had a highly significant positive effect (r (1057) = .199, p = < 0.001. Both causal beliefs (r (1057) = .145, p = < 0.001) and impact beliefs (r (1057) = .206, p = < 0.001) had a highly significant positive effect on climate change risk perceptions. Descriptive social norms (r (1057) = .127, p = < 0.001), are also found to have had a highly significant positive effect on risk perceptions, whereas prescriptive norms did not have a significant effect.

Table 3. *Climate change risk perceptions model results*

Independent variables	**Model 1**	**Model 2**	**Model 3**
Gender	-.103***	-.088**	-.084**
Age	.183***	.099**	.075*
Level of education	.117***	.041	.029
Perceived informedness	-	-	.072*
Frequency of information sourcing	-	-	-.013
Total informedness	-	.101**	-
Causal beliefs	-	-	.145***
Impact beliefs	-	-	.206***
Total (impact) beliefs	-	.249***	-
Descriptive social norms	-	-	.127***
Prescriptive social norms	-	-	.056
Total social norms	-	.098**	-
Place identity	-	-	-.129**
Place dependence	-	-	.199***
Total place attachment	-	.057	-
N	1084	1069	1059
Adj. *R2*	.049	.144	.175
Adj. *R2* change	.052	.149	.183
*F*change	19.794	26.593	21.339

Dependent variable: Climate change risk perceptions. Values represent standardized coefficients.

(n.s. = not significant) *p < 0.05, **p < 0.01, ***p < 0.001

DISCUSSION

This study has tested the effect of climate change risk perceptions on climate action, as well as the effect of climate change informedness, climate change beliefs, social norms, and place attachment, on both climate change action and climate change risk perceptions in East Africa. This was done with the aim of improving our understanding of the determinants and perceptions of climate change risk and action in East Africa, which is needed to improve climate change risk communication.

Climate change risk perceptions were shown to have had a moderately significant positive influence on climate change action. This supports the hypotheses in prior research by Leiserowitz (2006) and Smith & Mayer (2018), in that higher climate change risk perception leads to more personal action. The results of this study also showed that climate change informedness did not lead directly to individual climate action, in consensus with research by Schultz (2011). This can be partially attributed to the quality and accessibility of climate change information in East Africa, as the mean perceived informedness and mean frequency of information sourcing were relatively low in this study. Climate change impact beliefs also did not directly lead to individual climate action, in contrast to research by Jaeger et al. (1993). This means that perceiving more environmental impacts of climate change did not result in participants taking climate action. This could be attributed to causal beliefs, which significantly positively affected climate change action. This entails that being able to identify human activities as (one of) the main cause(s) of climate change did lead to taking more individual action. This is in consensus with existing research, which states that accurate beliefs about the

causes of climate change is an important determinant of behavioral intentions and support for climate policies (Tobler et al., 2012). A lack of accurate causal beliefs could therefore explain why the effect of impact beliefs was insignificant in this study, as one can perceive environmental changes, but if attributed to the incorrect causes, taking individual climate action becomes irrelevant.

A highly significant positive relationship was found for the effect of social norms on climate change action. This result supports the research from Steynor et al. (2021), which found the same effect across East Africa. Both descriptive and prescriptive norms had a highly significant effect. The effect of place attachment on climate change action, although having lower significance, is still a positive one. This means that East Africans that feel more dependent and emotionally connected to the place where they live, take more climate action. This result supports the research by Scannell & Gifford (2013). Place dependence and place identity were individually insignificant in their effect on climate change action.

When examining the results of the predictors on climate change risk perceptions, a moderately significant positive relationship was found between climate change informedness and risk perceptions. The logical conclusion would also be that more informedness on the topic would lead to perceiving more risk. Notably, when examining the effect of the subscales, even though the effect of the frequency with which climate change information is sourced was insignificant, the direction of the relationship was negative. This indicates that the quality of such climate change information may also be problematic in the perceptions of climate change risk. The self-reported measure for perceived informedness on climate change had a significant positive effect on climate change risk perceptions. This means that participants that perceived

themselves to be more informed about climate change, perceived more climate change risk. This is in consensus with the research by Kellstedt et al. (2008).

Climate change risk perceptions are highly positively affected by both causal and impact beliefs, which supports the conclusions from the climate change risk perception model by van der Linden (2015). This indicates that the cognitive processes and understanding of climate change and its impacts do influence the way climate risk is perceived but does not necessarily lead to taking climate action. Climate change communication campaigns should therefore inform East African people of the appropriate causes and impacts of climate change in order to increase climate change risk perceptions, which consequently leads to more individual action.

Climate change risk perceptions were also moderately positively affected by social norms, and when examining the effects of the subscales, solely descriptive social norms were significant. This means that participants that perceived more frequent mention of climate change and climate change action in their social circles perceived more climate change risk. Considering that talking with friends, family and colleagues was also the most popular item among the climate change information sources, this indicates socio-cultural influences are deeply engrained in the way climate change risk is perceived. This is in consensus with the research from van der Linden (2015).

When examining the effects of the measures within place attachment on climate change risk perceptions, place dependence and place identity do not appear to measure the same construct. The effect of total place attachment (the combination of the subscales) was insignificant on climate change risk perceptions, in contrast to research by Swapan & Sadeque

(2021). However, when examining the effect of the subscales, place dependence had a significantly positive effect on risk perceptions, whereas place identity had a significantly negative effect on risk perceptions. This indicates that participants that had developed a strong sense of personal identity in relation to the place where they live, perceived climate change risks to be lower. In contrast, participants that relied more on the practical needs and emotional well-being provided by the place where they live, perceived climate change risks to be higher. This result also shows that place attachment should not be measured as a singular construct, considering that its effects are somewhat diminished in this study due to the subscales within place attachment having opposing effects on risk perceptions. This could be part of the reason why current research on the effects of place attachment on environmental psychographics such as risk perceptions remains inconclusive (Bonaiuto et al., 2016), as not all studies account for the effects of place identity and place dependence individually.

The regression models used to answer the hypotheses in this study fit the data for climate change risk perception better than it did for climate change action. However, it became apparent that there is some overlap in the determinants of climate change risk perceptions and climate change action. Both climate change risk perceptions and climate change action were significantly positively affected by social norms. Although all four predictors tested in this study had a significant positive effect on climate change risk perceptions, this was not the case for climate change action. The amount of variance explained for both dependent variables was relatively low, which is in consensus with prior research, as we do not yet know all the factors that affect risk perceptions and climate action (Van der Linden, 2015;). This can be attributed to

many factors, including the complexity of the perceptions of climate change and the complexity of climate change as a global problem.

Limitations and future research

Considering the data for this study had already been obtained, several measures did not include all variables that could have been relevant according to the literature review. For example, measuring cause, impact, and response beliefs on the same scale could have contributed to a more complete understanding of climate change beliefs for East Africans. The level of explained variance could also be improved by including a more expansive section on a broader range of sociodemographics and socio-cultural influences. Climate change action is partially measured in this study through factors that relate to a person's frequency of engagement with more common (or typical) types and levels of mitigation and adaptation behaviors in that specific region. However, neither this measure nor the predictors sufficiently account for the specific attitudes, values and motivations affecting individual climate change action and risk perceptions. Expanding the model by including skepticism, as well as self-enhancing and self-transcending value pathways as shown in prior research could provide a more complete understanding of why we behave the way we do when it comes to climate change action. Considering the significant effects of causal beliefs on both climate change risk perceptions and action, examining the role that religion plays in the perceptions of climate change is clearly important in fully understanding its effect. The effect of religion in the perceptions of climate change and its causes, impacts and solutions is not sufficiently accounted for in this study, particularly considering its level of importance in this region (Tarusarira, 2017). Further

research is therefore required to better understand the impacts of religion, as well as other variables that may be relevant within the sociocultural dimension in this region, on climate change risk perceptions and climate action.

Implications

Theoretical implications

The insights gathered from this research expand the theoretical understanding of the underlying sociopsychological determinants that influence how East Africans perceive climate change risk and action. The results from this study indicated that the cognitive processes and understanding of climate change and its impacts do influence the way climate risk is perceived but does not necessarily lead to taking climate action. Climate change informedness is an extension to van der Lindens (2015) model, as it significantly impacted climate change risk perceptions. The results of this study regarding the role of place attachment shows that this is a multidimensional construct and suggest that place identity and place dependence have opposing effects on climate change risk perceptions. In addition, causal beliefs are an important consideration in climate change action, as well as risk perceptions. Those that can identify human activities as a main cause of climate change are significantly more likely to take and believe in climate change action. Since praying is considered the most popular climate change action, it can be assumed that the public lacks the information needed to make a clear distinction between the role of religion and the role of human activities on the effects of climate change. This assumption is thus recommended for further study.

Societal implications

Climate change action, as well as risk perceptions, are strongly influenced particularly by social norms. To stimulate pro-environmental responses, social norms should therefore be examined more closely. Thus, when designing a campaign to inform East Africans about the risks and impacts of climate change, taking a social norms-centered approach can be an effective way of spreading the information as well as stimulating climate change action (Fielding & Louis, 2020). Promoting pro-environmental social norms on the radio and in social circles can be an effective way to reach a large audience, as these are the most used methods by East Africans to gather climate change information. Doing so can, in turn, aid the public sector, NGO's and businesses in increasing local coping capacity by taking a bottom-up approach to climate change risk management.

Targeting religious communities with this approach could be helpful, as many participants pray to God for help was the most frequently chosen method of climate action in this study, as seen in the measure for climate change action. Even though the specific role of religion in climate change risk perceptions and action still requires further research, an informative campaign could potentially guide East Africans to rather take their fate into their own hands, and to act as stewards of the Earth. Van Valkengoed et al. (2022) provide a framework that provides specific intervention strategies attributed to key determinants of climate change behavior. For risk perceptions, the intervention strategy is to provide information regarding the consequences of environmental problems. This is supported by the fact that impact beliefs was the most significant and largest predictor of climate change risk perceptions in this study. Descriptive norms can be addressed by providing social comparison feedback and dynamic norm

information. Van Valkengoed et al. (2022) state that perceptions of the descriptive norm can be changed through social comparison feedback, which compares one's own behavior or performance to the behavior or performance of others, such as the neighborhood average. Van Valkengoed et al. (2022) also note that targeting people's perceptions of descriptive norms is most likely to be effective if a large group of people is already engaging in the behavior. If the behavior is not normative yet, dynamic norm information may be more effective: information that indicates that an increasing number of people are changing their behavior. While this study provides useful intervention strategies based on literature, it does not account for the dual pathway to climate change action, as suggested by Steynor et al. (2021). It could thus be useful to research intervention strategies per pathway, which differ depending on whether the participant shows predominantly self-ascending values or self-transcending values.

CONCLUSION

This study showed that from the selected predictors, social norms had the biggest impact on taking climate action, and impact beliefs had the biggest impact on climate change risk perceptions in East Africa. The selected predictors explained 9.6% of the variance in climate change action and 14.4% of the variance in climate change risk perceptions. The effect of climate change risk perceptions on climate change action was moderately significant, in consensus with existing research. The effects of climate change informedness and climate change impact beliefs on climate change action were not significant. Notably, the effect of causal beliefs, being the ability to identify human activities as (one of) the main cause(s) of

climate change, on climate change action was found to be highly significant. The effects of both descriptive and prescriptive norms had a highly significant effect on climate change action. Place attachment was also found to have a positive effect on climate change action. Climate change risk perceptions were moderately positively affected by climate change informedness and social norms. The subscales that showed individual significance within these relationships were the self-reported measure of perceived informedness, as well as specifically descriptive social norms. Climate change risk perceptions were most significantly affected by climate change beliefs. Both causal and impact beliefs had a highly significant positive effect on risk perceptions. No significant effect was found for place attachment. However, the subscales show a significant negative relationship between place identity and risk perceptions, and a positive relationship between place dependence and risk perceptions. The opposing effects of the subscales suggest a reason why existing research remains inconclusive about the effects of place attachment. The implications of the results are that there clearly exists a need for intervention, to ensure reliable, easily accessible climate change information for any business, government body or NGO to effectively communicate about climate change in East Africa. This research suggests an initiative to launch an informative communication campaign, designed around the instillment of pro-environmental descriptive and prescriptive social norms regarding individual and community-based adaptation and mitigation strategies. This way, a bottom-up, inclusive approach to climate change risk management is taken through empowering individuals in Africa with the information needed to increase their adaptive capacity.

REFERENCE LIST

Adeleke, M.L., Al-Kenawy, D., Nasr-Allah, A.M., Murphy, S., El-Naggar, G.O., Dickson, M. (2018). Fish Farmers' Perceptions, Impacts and Adaptation on/of/to Climate Change in Africa (The Case of Egypt and Nigeria). In: Alves, F., Leal Filho, W., Azeiteiro, U. (eds) *Theory and Practice of Climate Adaptation. Climate Change Management.*

Adewale, B. A., Ibem, E. O., Amole, S. A., & Adeboye, A. B. (2020). Place attachment in Nigerian urban slums: Evidence from inner-city Ibadan. *Cities, 107, 102902.*

Alló M, Loureiro ML (2014). The role of social norms on preferences towards climate change policies: a meta-analysis. *Energy Policy 73:563–574*

Arbuckle Jr, J. G., Morton, L. W., & Hobbs, J. (2015). Understanding farmer perspectives on climate change adaptation and mitigation: The roles of trust in sources of climate information, climate change beliefs, and perceived risk. *Environment and behavior, 47(2), 205-234.*

Bernardo, F. (2013). Impact of place attachment on risk perception: Exploring the multidimensionality of risk and its magnitude, *Studies in Psychology, 34:3, 323-329.*

Billig, M. (2006). Is My Home My Castle? Place Attachment, Risk Perception, and Religious Faith. *Environment and Behavior 38:2, 248-265.*

Bonaiuto, M., Alves, S., De Dominicis, S., Petruccelli, I. (2016). Place attachment and natural hazard risk: Research review and agenda. *Journal of Environmental Psychology, Volume 48, Pages 33-53.*

Boon, H. J. (2014). Disaster resilience in a flood-impacted rural Australian town. *Natural hazards, 71, 683-701.*

Bouman, T., Verschoor, M., Albers, C. J., Böhm, G., Fisher, S. D., Poortinga, W., Steg, L. (2020). When worry about climate change leads to climate action: How values, worry and personal responsibility relate to various climate actions. *Global Environmental Change, 62, 102061.*

Breakwell, G. M. (2010). Models of risk construction: some applications to climate change. Wiley Interdisciplinary Reviews: *Climate Change, 1(6), 857-870.*

Busch, K. C., Ardoin, N., Gruehn, D., & Stevenson, K. (2019). Exploring a theoretical model of climate change action for youth. *International Journal of Science Education, 41(17), 2389-2409.*

Capstick, S. B., & Pidgeon, N. F. (2014). What is climate change scepticism? Examination of the concept using a mixed methods study of the UK public. *Global Environmental Change, 24, 389-401.*

Dodoo, A., & Hugman, B. (2012). Risk perception and communication in sub-Saharan Africa. *Drug safety, 35(11), 1041-1052.*

Eakin, H. C., Lemos, M. C., & Nelson, D. R. (2014). Differentiating capacities as a means to sustainable climate change adaptation. *Global environmental change, 27, 1-8.*

Fielding, K. S., & Louis, W. R. (2020). The role of social norms in communicating about climate change. *Research handbook on communicating climate change, 106.*

Ge, Q., J. Qu, J. Zeng, and X. Fang. (2009). "Review on International Strategies and Trends for Adaptation to Climate Change." *Advancement Climate Change Research 5: 369–375.*

Hellmuth, M., Moorhead, A., Thomson, M.C., Williams, J. (2007). Climate Risk Management in Africa: Learning from Practice.

Hine, D. W., Phillips, W. J., Cooksey, R., Reser, J. P., Nunn, P., Marks, A. D., Watt, S. E. (2016). Preaching to different choirs: How to motivate dismissive, uncommitted, and alarmed audiences to adapt to climate change?. *Global Environmental Change, 36, 1-11.*

IPCC. (2014). Summary for policymakers. In: Climate Change 2014: Impacts, Adaptation, and Vulnerability. Part A: Global and Sectoral Aspects. *Cambridge University Press. pp 1–32.*

IPCC (2022). Climate Change 2022: Mitigation of Climate Change. Contribution of Working Group III to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change [P.R. Shukla, J. Skea, R. Slade, A. Al Khourdajie, R. van Diemen, D. McCollum, M. Pathak, S. Some, P. Vyas, R. Fradera, M. Belkacemi, A. Hasija, G. Lisboa, S. Luz, J. Malley, (eds.)]. *Cambridge University Press*, Cambridge, UK and New York, NY, USA.

Jaeger, C., Dorrenberger, I.G., Kastenholz, I.H., Truffer, Z.B. (1993). Determinants of environmental action with regard to climatic change. *Climatic Change 23:193-211.*

Joffe, H. (2003). Risk: From perception to social representation. *British journal of social psychology, 42(1), 55-73.*

Jude, J., Abubakar Kazeem, E. J., & Valentina, A. (2019). Integrating Innovations for Sustainable Development in Africa. *International Journal of Scientific Research in Science and Technology. 166-178.*

Kasperson, R. E., Webler, T., Ram, B., & Sutton, J. (2022). The social amplification of risk framework: new perspectives. *Risk Analysis, 42(7), 1367-1380.*

Kellstedt, P. M., Zahran, S., & Vedlitz, A. (2008). Personal efficacy, the information environment, and attitudes toward global warming and climate change in the United States. Risk Analysis: *An International Journal, 28(1), 113-126.*

Laszlo, J. (1997). Narrative organisation of social representations. *Papers on social representations, 6, 155-172.*

Lee, T.M., Markowitz, E.M., Howe, P.D., Ko, C.-Y., Leiserowitz, A.A. (2015). Predictors of public climate change awareness and risk perception around the world. *Nature Climate Change, 5 (11) (2015), pp. 1014-1020*.

Leiserowitz, A. (2004). Day after tomorrow: study of climate change risk perception. *Environment: Science and Policy for Sustainable Development, 46(9), 22-39.*

Leiserowitz, A. (2006). Climate change risk perception and policy preferences: The role of affect, imagery, and values. *Climatic change, 77(1), 45-72.*

Lorenzoni, I., Leiserowitz, A., de Franca Doria, M., Poortinga, W., & Pidgeon, N. F. (2006). Cross-national comparisons of image associations with “global warming” and “climate change” among laypeople in the United States of America and Great Britain. *Journal of risk research, 9(03), 265-281.*

Lujala, P., Lein, H., Rød, J.K. (2015) Climate change, natural hazards, and risk perception: the role of proximity and personal experience, *Local Environment, 20:4, 489-509.*

Maltby, K.M., Simpson, S.D., Turner, R.A. (2021). Scepticism and perceived self-efficacy influence fishers’ low risk perceptions of climate change. *Climate Risk Management. Vol. 31.*

Nursey-Bray, M., Pecl, G., Frusher, S., Gardner, C., Haward, M., Hobday, A. J., ... & van Putten, I. (2012). Communicating climate change: climate change risk perceptions and rock lobster fishers, Tasmania. *Marine Policy, 36(3), 753-759.*

Nyiwul, L. M. (2019). Climate change mitigation and adaptation in Africa: Strategies, synergies, and constraints. *Climate change and global development*: Market, global players and empirical evidence, *219-241.*

O'Connor, R.E., Bard, R.J., Fisher, A. (1999). "Risk Perceptions, General Environmental Beliefs, and Willingness to Address Climate Change," *Risk Analysis, John Wiley & Sons, vol. 19(3), pages 461-471.*

OECD. (2014). Innovating the public sector: from ideas to impact. *OECD Conference Centre, Paris.*

Ortega-Egea, J. M., García-de-Frutos, N., & Antolín-López, R. (2014). Why do some people do “more” to mitigate climate change than others? Exploring heterogeneity in psycho-social associations. *PLoS One, 9(9), e106645.*

Popoola, O. O., Yusuf, S. F. G., & Monde, N. (2020). Information Sources and Constraints to Climate Change Adaptation amongst Smallholder Farmers in Amathole District Municipality, Eastern Cape Province, South Africa. *Sustainability, 12(14), 5846.*

Richardson, K., Calow, R., Pichon, F., New, S. and Osborne, R. (2022) Climate risk report for the East Africa region. *Met Office, ODI, FCDO.*

Rohrmann, B. (2008). Risk perception, risk attitude, risk communication, risk management: A conceptual appraisal. In *15th International Emergency Management Society (TIEMS) Annual Conference (Vol. 2008).*

Scannell, L., & Gifford, R. (2013). Personally Relevant Climate Change: The Role of Place Attachment and Local Versus Global Message Framing in Engagement. *Environment and Behavior, 45(1), 60–85.*

Scannell, L., Gifford, R. (2010). Defining place attachment: A tripartite organizing framework. *Journal of Environmental Psychology, Volume 30, Issue 1, 2010, Pages 1-10.*

Schultz, P. W. (2011). Conservation means behavior. *Conservation biology, 25(6), 1080-1083.*

Semenza, J. C., Ploubidis, G. B., & George, L. A. (2011). Climate change and climate variability: personal motivation for adaptation and mitigation. *Environmental Health, 10(1), 1-12.*

Simpson, N.P., Andrews, T.M., Krönke, M. et al. Climate change literacy in Africa. *Nat. Clim. Chang. 11, 937–944 (2021).*

Slovic, P. (1987). Perception of risk. *Science, 236(4799), 280-285.*

Slovic, P. E. (2000). The perception of risk. *Earthscan publications.*

Smith, E. K., & Mayer, A. (2018). A social trap for the climate? Collective action, trust and climate change risk perception in 35 countries. *Global Environmental Change, 49, 140-153.*

Steg, L. (2018). Limiting climate change requires research on climate action. *Nature Climate Change, 8(9), 759-761.*

Steynor, A., Pasquini, L. (2022). Using a Climate Change Risk Perceptions Framing to Identify Gaps in Climate Services. *Front. Clim. 4:782012*.

Steynor, A., Pasquini, L., Thatcher, A., Hewitson, B. (2021). Understanding the Links Between Climate Change Risk Perceptions and the Action Response to Inform Climate Services Interventions. *Risk Analysis 41(10):1873-1889.*

Swapan, M.S.H., Sadeque, S. (2021). Place attachment in natural hazard-prone areas and decision to relocate: Research review and agenda for developing countries. *International Journal of Disaster Risk Reduction, Volume 52, 101937.*

Swim, J., Clayton, S., Doherty, T., Gifford, R., Howard, G., Reser, J., ... & Weber, E. (2009). Psychology and global climate change: Addressing a multi-faceted phenomenon and set of challenges. A report by the American Psychological Association's task force on the interface between psychology and global climate change. *American Psychological Association, Washington, 66, 241-250.*

Tarusarira, J. (2017). African religion, climate change, and knowledge systems. *The Ecumenical Review, 69(3), 398-410.*

Tobler, C., Visschers, V.H.M. & Siegrist, M. (2012). Consumers' knowledge about climate change. *Climatic Change 114, 189–209.*

Van der Linden, S. (2015). The social-psychological determinants of climate change risk perceptions: Towards a comprehensive model. *Journal of Environmental Psychology, Volume 41, 2015, Pages 112-124.*

Van der Linden, S. (2017). Determinants and Measurement of Climate Change Risk Perception, Worry, and Concern. *In M.C. Nisbet, M. Schafer, E. Markowitz, S. Ho, S. O'Neill, & J. Thaker (Eds.), The Oxford Encyclopedia of Climate Change Communication. Oxford University Press.* Oxford, UK.

Van Valkengoed, A.M., Abrahamse, W. & Steg, L. (2022). To select effective interventions for pro-environmental behaviour change, we need to consider determinants of behaviour. *Nat Hum Behav 6, 1482–1492 (2022).*

Vaske, J.J. & Kobrin, K.C. (2001). Place Attachment and Environmentally Responsible Behavior. *The Journal of Environmental Education. Vol 32:4, 16-21.*

Vogel, C., Steynor, A., & Manyuchi, A. (2019). Climate services in Africa: Re-imagining an inclusive, robust and sustainable service. *Climate Services, 15, 100107.*

Wang, C., Geng, L., Rodríguez-Casallas, J.D. (2021). How and when higher climate change risk perception promotes less climate change inaction. *Journal of Cleaner Production, Volume 321, 128952.*

Weber, E. U. (2010). What shapes perceptions of climate change?. Wiley Interdisciplinary Reviews: *Climate Change, 1(3), 332-342.*

Wilson, Robyn & Zwickle, Adam & Walpole, Hugh. (2018). Developing a Broadly Applicable Measure of Risk Perception. *Risk Analysis. 39. 10.1111/risa.13207.*

Xie, B., Brewer, M. B., Hayes, B. K., McDonald, R. I., & Newell, B. R. (2019). Predicting climate change risk perception and willingness to act. *Journal of Environmental Psychology, 65, 101331.*

Yu, TK., Chang, YJ., Chang, IC. et al. (2019). A pro-environmental behavior model for investigating the roles of social norm, risk perception, and place attachment on adaptation strategies of climate change. *Environ Sci Pollut Res 26, 25178–25189.*

Zhao, C., Yan, Y., Wang, C., Tang, M., Wu, G., Ding, D., Song, Y. (2018). Adaptation and mitigation for combating climate change – from single to joint. *Ecosystem Health and Sustainability. 4:4, 85-94.*

ACKNOWLEDGEMENT

A special thanks to Lucien van Bolhuis for the beautiful cover art and unwavering moral support.

APPENDIX 1: CLIMATE CHANGE RISK PERCEPTION SURVEY FROM MECCA PROJECT

Climate Change Risk Perception Survey

Item						
Intro 1	**Introduction** You are invited to take part in this study of climate change perceptions at Lake Victoria. This survey was developed by researchers from the University of Bergen (Norway), Utrecht University (Netherlands), Potsdam Institute for Climate Impact Research (Germany), and the University of Nottingham (United Kingdom) and in collaboration with TAFIRI (Tanzania), KMFRI (Kenya) and NaFIRRI (Uganda). The purpose of the survey is to get an understanding of how people at Lake Victoria view climate change and other related issues.					
Intro 2	**Participation** Your participation in this survey interview is completely voluntary. You can quit at any time without providing any reason and without any penalty. Your contribution to the study is very valuable to us and we greatly appreciate your time taken to complete this interview. We estimate that it will take between 30-40 minutes to complete the interview. The questions will be read out to you by the interviewer and cards will be shown to you to choose your answers. Some of the questions require little time to complete, while other questions might need more careful consideration. Please feel free to skip questions you do not feel comfortable answering. You can also ask the interviewer to clarify or explain questions you find unclear before providing an answer. Your answers will be recorded by the interviewer. Please note that the data you provide will only be used for scientific purposes, including presentations at academic conferences or publications in scientific journals.					
Intro 3	**Data Protection** Everything you say in this interview will be confidential and completely anonymous. This means that we will not ask for your name, date of birth, or any other personal information that can be traced to you by us or a third party. Your answers will be shared between the research team in Norway, Germany, the Netherlands, and the United Kingdom. The data will be securely stored in encrypted databases in accordance with the European Union General Data Protection Regulation and Personal Data Act. Only completely anonymized data may later be shared with other researchers. At the end of the interview, you will be provided with a link to our website where you can find additional information about the project as well as contact information to request reports and publications from the project if needed.					
Consent	**Informed consent** Do you have any questions about the survey interview? [Interviewer, please take your time to answer any questions related to the survey by the participants before you proceed]. If you are satisfied with the information that you have received about this study and you are willing to participate, I will tick the 'yes' option with your permission before starting the interview. If you do not want to participate, we will end the interview now.					
	Yes	No				
S1	**Section 1/9**					
A1	This survey has 9 sections. We will start with some general questions. What is your gender? [Note to interviewer: Do not read out options, ask and record. For clarity purpose, you should ask the participant to confirm the option you observed and record on the tablet].					
	Man	Woman				
A2	What is your age (in years)?					
A3	What is your nationality?					
	Kenyan	Ugandan	Tanzanian	Other (please specify)		
A4	How long have you been living here (in years)?					
A5	What do you do for a living?					
A6	How long have you been doing this (in years)?					
A7	What is the highest level of education that you have achieved?					
	No formal education	Primary	Secondary	College/ Polytechnic	Bachelor/ First degree	Postgraduate (Masters/PhD)	Other (please specify)
S2	**Section 2/9**					
B1	We now start with the second section out of 9. What is the first thing that comes to mind when you think of environmental problems?					
B2	In your experience living at Lake Victoria, how do you think each of the following issues have changed in recent years? [Interviewer use Card 1 for options, please note that these could be changes in duration, intensity, number of reported cases, amount, or frequency of occurrence etc.].					
	Much less	Less	No change	More	Much more	
B2a	Heat (outside temperatures during the day)					
B2b	Amount of rainfall					
B2c	Duration of rainfall					
B2d	Flooding					
B2e	Thunderstorms					
B2f	Air pollution, e.g., dust and fog					
B2g	Littering (solid wastes)					
B2h	Traffic jams					
B2i	Coastal erosion					
B2j	Sea level					
B2k	Crime					
B2l	Noise pollution					
B3	Have you ever heard the term 'climate change'? [Interviewer: If yes, go to B4 If no, proceed with section H]					
	Yes	No				
B4	How informed are you about climate change? [Use Card 2 for options].					
	Not informed at all	Not very informed	Somewhat informed	Informed	Very informed	
B5	What does the term 'climate change' mean to you? [Please record the respondent's answer as accurately/verbatim as possible].					
B6	How do you feel about climate change? [Please record the respondent's answer as accurately/verbatim as possible].					

S3	**Section 3/9**				
C1	In this third section, we would like to ask you about the sources of your information about climate change. How often do you get information about climate change from the following sources? [Use Card 3 to indicate a response].				
	Never	**Rarely**	**Sometimes**	**Often**	**Very often**
C1a	Television				
C1b	Radio				
C1c	Online and print newspapers				
C1d	Social media				
C1e	Books, journals and magazines				
C1f	Talking with friends, family, and colleagues				
C1g	Workshops, meetings and conferences				
C1h	Other (please specify)				
S4	**Section 4/9**				
D1	We now start with section 4. Which of the following do you think is a main cause of climate change (select one or more options)?				
	Natural processes	Human activities	God	Other (please specify)	
D2	Have you ever experienced climate change?				
	Yes		No		
Q45	If yes, please describe your experience in a few words. [Interviewer, please enter the respondent's answer as accurately/verbatim as possible].				
S5	**Section 5/9**				
E1	We are now at section 5. How often do people you know, and others around you, talk about climate change? [Use Card 3 for options].				
	Never	Rarely	Sometimes	Often	Very often
E2	How many people around you have done something or are trying to do something to address climate change? [Use Card 4 for options].				
	No one around me	A few people around me	Many people around me	Very many people around me	Almost all the people around me
E3	To what extent do you agree with the following statements? [Use Card 5 for options].				
	Strongly disagree	Disagree	Neither agree nor disagree	Agree	Strongly agree
E3a	Concern about the environment is an important aspect of who I am.				
E3b	I would be embarrassed to identify myself publicly as someone who is concerned about the environment.				
E3c	Most people around me expect me to be concerned about the environment.				
E3d	Concern about the environment is an important part of my culture.				
E3e	Most people around me believe that climate change is a form of punishment by God for people's sins.				
S6	**Section 6/9**				
F1	We are now at section 6. We would like to ask about your perceptions of climate change risks. How serious a threat is climate change to... [Show card 6 for options].				
	No serious threat at all	Somewhat serious threat	Moderate threat	Serious threat	Very serious threat
F1a	You personally?				
F1b	The people of Kenya/Uganda/Tanzania?				
F1c	Humanity as a whole?				
F1d	The natural environment?				
F2	How likely do you think it is that you will personally be harmed by climate change in your lifetime? [Show Card 7 for options].				
	Very unlikely	Unlikely	Neither unlikely nor likely	Likely	Very likely
F3	How likely do you think it is that people here will be harmed by climate change within your lifetime? [Show Card 7 for options].				
	Very unlikely	Unlikely	Neither unlikely nor likely	Likely	Very likely
F4	When you think about climate change, how strongly do you feel each of the following emotions? [Show Card 8 for options].				
	Not at all	A little	Somewhat	Strongly	Very strongly
F4a	Anger				
F4b	Sadness				
F4c	Fear				
F4d	Indifference				
F4e	Happiness				
F4f	Worry				
F4g	Hope				
F4h	Pride				
S7	**Section 7/9**				
G1	We now start with section 7. Next, we would like to know about the actions you and the people here are taking against climate change risks. Please name up to 3 things you think people here can do to address the problems of climate change [Enter the respondent's answers as accurately/verbatim as possible].				
G2	How often do you engage in the following activities to deal with the problems of climate change? [Show Card 3 for options].				
	Never	Rarely	Somtimes	Often	Very often
G2a	Maintaining flood protection in homes				
G2b	Proper waste disposal				
G2c	Cold shower to cool down in the heat				
G2d	Use of fans and air conditioners				
G2e	Temporary relocation to other areas during floods				
G2f	Dredging of canals				
G2g	Clearing of gutters				
G2h	Tree planting				
G2i	Participating in climate change awareness campaigns				
G2j	Obeying state environmental protection regulations				
G2k	Praying to God for help				
G3	How easy is it for you personally to take action to slow or stop climate change? [Use Card 9 for options].				
	Very easy	Easy	Neither easy nor difficult	Difficult	Very difficult
G4	How easy is it for people here to take action together to slow or stop climate change? [Show Card 9 for options].				
	Very easy	Easy	Neither easy nor difficult	Difficult	Very difficult

G5	To what extent do you feel personally responsible for taking action on climate change? [Show Card 10a for options].				
	I feel no responsibility at all	I feel a little responsibility	I feel a moderate level of responsibility	I feel a high level of responsibility	I feel an extremely high level of responsibility
G6	To what extent do you think other people here feel responsible for taking action on climate change? [Show Card 10b for options].				
	I feel no responsibility at all	I feel a little responsibility	I feel a moderate level of responsibility	I feel a high level of responsibility	I feel an extremely high level of responsibility
G7	How confident are you that the state government can take action to effectively address climate change? [Show Card 11 for options].				
	Not confident at all	Not very confident	Somewhat confident	Confident	Very confident
G8	How confident are you that climate change can be stopped by human action? [Show Card 11 for options].				
	Not confident at all	Not very confident	Somewhat confident	Confident	Very confident
S8	**Section 8/9**				
H1	We have arrived at section 8. In this section, we would like to ask about your feelings and attachments to the **place where you are living** here. To what extent do you agree or disagree with each of the following statements? [Show Card 5 for options].				
	Strongly disagree	Disagree	Neither agree nor disagree	Agree	Strongly agree
H1a	I do not want to leave this place				
H1b	I grew up here				
H1c	I feel deeply rooted in this place				
H1d	This place is the right place for achieving my goals				
H1e	I am attached to the place where I live				
H1f	I prefer this place to any other place				
H1g	This place says a lot about me				
H1h	This place enhances my personal image				
H1i	This place is a part of me				
H1j	I have an emotional bond with this place				
H1k	I feel secure in this place				
H1l	I miss this place when I am not here				
H1m	This place means a lot to me				
H1n	I feel that I belong here				
H1o	I feel at home here				
H1p	This place is a good place to live				
H1q	This place has some qualities that are not at any other place				
S9	Section 9/9				
I1	In this final section, we would like to ask about your general wellbeing and life satisfaction. In general, how satisfied are you with your life? [Show Card 12 for options].				
	Very dissatisfied	Somewhat dissatisfied	Somewhat satisfied	Very satisfied	
I2	I am now going to read out 5 statements for you to choose options that best describe your situation. Please indicate for each of the following 5 statements which is closest to how you have been feeling in the last 2 weeks. [Show Card 13 for options].				
	At no time	Some of the time	Less than half of the time	Half of the time	More than half of the time	Most of the time	All of the time
I2a	I have felt cheerful and in good spirits						
I2b	I have felt calm and relaxed						
I2c	I have felt active and vigorous						
I2d	I woke up feeling fresh and rested						
I2e	My daily life has been filled with things that interest me						
I3	I am now going to read out additional 5 statements for you to choose options that best describe your situation. In the past year, how often, if ever, have you or members of your family experienced the following? [Show Card 3 for options].				
	Never	Rarely	Sometimes	Often	Very often		
I3a	Not having enough food to eat						
I3b	Not having enough clean water for home use						
I3c	Not having medicines or medical treatment when needed						
I3d	Not having enough fuel to cook your food						
I3e	Not having enough cash income						
I4	Do you have any observations or comments? [Note to interviewer: If yes, please enter the respondent's answer as accurately/verbatim as possible, If no, end survey.]				
	Yes		No				
Q46	[Note to interviewer: If yes, please enter the respondent's answer as accurately/verbatim as possible]						
Q51	This was the end of the survey. Please thank the participant for their time and finish the interview.						

APPENDIX 2: MEASURES

Climate change action

1. How often do you engage in the following activities to deal with the problems of climate change? {Rate from 'never' to 'very often'}

(1.1) Maintaining flood protection in homes
(1.2) Proper waste disposal
(1.3) Cold shower to cool down in the heat
(1.4) Use of fans and air conditioners
(1.5) Temporary relocation to other areas during floods
(1.6) Dredging of canals
(1.7) Clearing of gutters
(1.8) Tree planting
(1.9) Participating in climate change awareness campaigns
(1.10) Obeying state environmental protection regulations
(1.11) Praying to God for help

2. How easy is it for you personally to take action to slow or stop climate change? {Rate from 'very easy' to 'very difficult'}
3. How easy is it for people here to take action together to slow or stop climate change? {Rate from 'very easy' to 'very difficult'}
4. To what extent do you feel personally responsible for taking action on climate change? {Rate from 'I feel no responsibility at all' to 'I feel an extremely high level of responsibility'}

5. To what extent do you think other people here feel responsible for taking action on climate change? {Rate from 'They feel no responsibility at all' to 'They feel an extremely high level of responsibility'}
6. How confident are you that the state government can take action to effectively address climate change? {Rate from 'not confident at all' to 'very confident'}
7. How confident are you that climate change can be stopped by human action? {Rate from 'not confident at all' to 'very confident'}

Climate change risk perception

- Perceived severity

1. How serious a threat is climate change to: {Rate from 'not a serious threat at all' to 'very serious threat'}

1.1 You personally?
1.2 The people of Kenya/Uganda/Tanzania?
1.3 Humanity as a whole?
1.4 The natural environment?

- Perceived harm

2. How likely do you think it is that you will personally be harmed by climate change in your lifetime? {Rate from 'very unlikely' to 'very likely'}
3. How likely do you think it is that people here will be harmed by climate change within your lifetime? {Rate from 'very unlikely' to 'very likely'}

Climate change informedness

- Frequency of information sourcing

1. How often do you get information about climate change from the following sources? [Rate from 'never' to 'very often'}

1.1 Television
1.2 Radio
1.3 Online and print newspapers
1.4 Social media
1.5 Books, journals, and magazines
1.6 Talking with friends, family, and colleagues
1.7 Workshops, meetings, and conferences

- Perceived informedness

2. How informed are you about climate change? {Rate from 'Not informed at all' to 'Very informed'}

Climate change beliefs

- Causal beliefs

1. Which of the following do you think is a main cause of climate change (select one or more options)? {Natural processes, Human activities, God, Other (please specify)}

- Impact beliefs

2. In your experience living at Lake Victoria, how do you think each of the following issues have changed in recent years? {Rate from 'much less' to 'much more'}

2.1 Heat (outside temperatures during the day)
2.2 Amount of rainfall

2.3 Duration of rainfall
2.4 Flooding
2.5 Thunderstorms
2.6 Air pollution, e.g., dust and fog
2.7 Littering (solid wastes)
2.8 Traffic jams
2.9 Coastal erosion
2.10 Sea level
2.11 Crime
2.12 Noise pollution

Social norms

- *Descriptive social norms*

1. How often do people you know, and others around you, talk about climate change? {'Never' to 'Often'}
2. How many people around you have done something or are trying to do something to address climate change? {'No one around me' to 'Almost all the people around me'}

- *Prescriptive social norms*

3. To what extent do you agree with the following statements? {'Strongly disagree' to 'Strongly agree'}

3.1 Concern about the environment is an important aspect of who I am.
3.2 Most people around me expect me to be concerned about the environment.
3.3 Concern about the environment is an important part of my culture.

Place attachment

1. To what extent do you agree or disagree with each of the following statements? {Rate from 'strongly disagree' to 'strongly agree'}

Place identity	
1.	I do not want to leave this place
2	I grew up here
3	I feel deeply rooted in this place
4	This place is the right place for achieving my goals
5	I am attached to the place where I live
6	I prefer this place to any other place
Place dependence	
7	This place says a lot about me
8	This place enhances my personal image
9	This place is a part of me
10	I have an emotional bond with this place
11	I feel secure in this place
12	I miss this place when I am not here
13	This place means a lot to me
14	I feel that I belong here
15	I feel at home here
16	This place is a good place to live
17	This place has some qualities that are not at any other place

APPENDIX 3: DESCRIPTIVE STATISTICS - VISUALS

Figure 2: *Climate change action: Personal and societal perceptions*

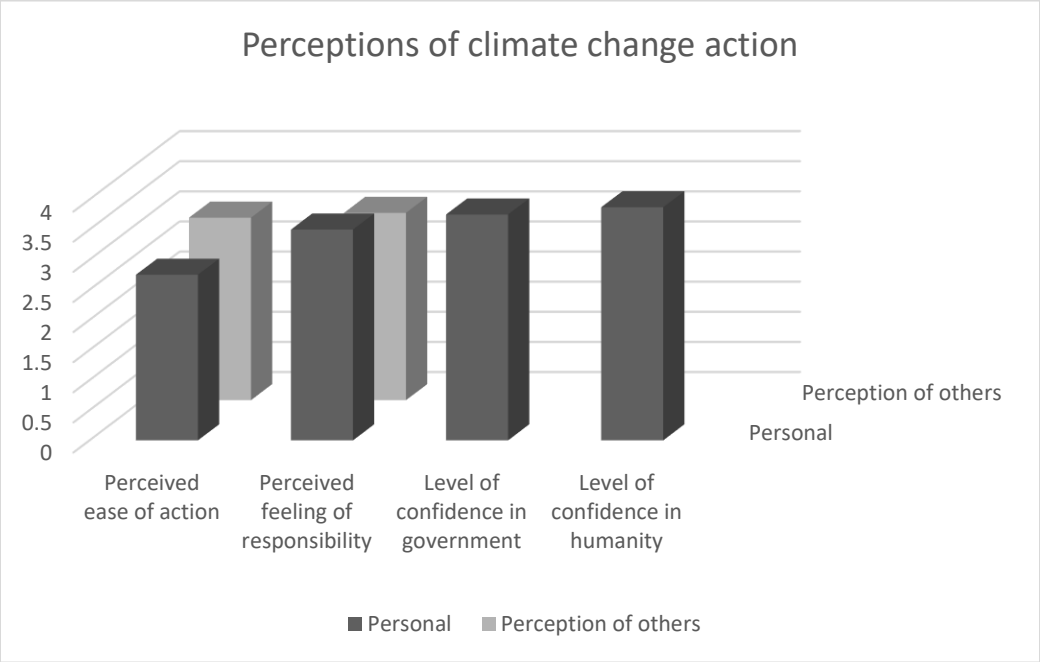


Figure 3: *Climate change risk perceptions: Perceived severity*

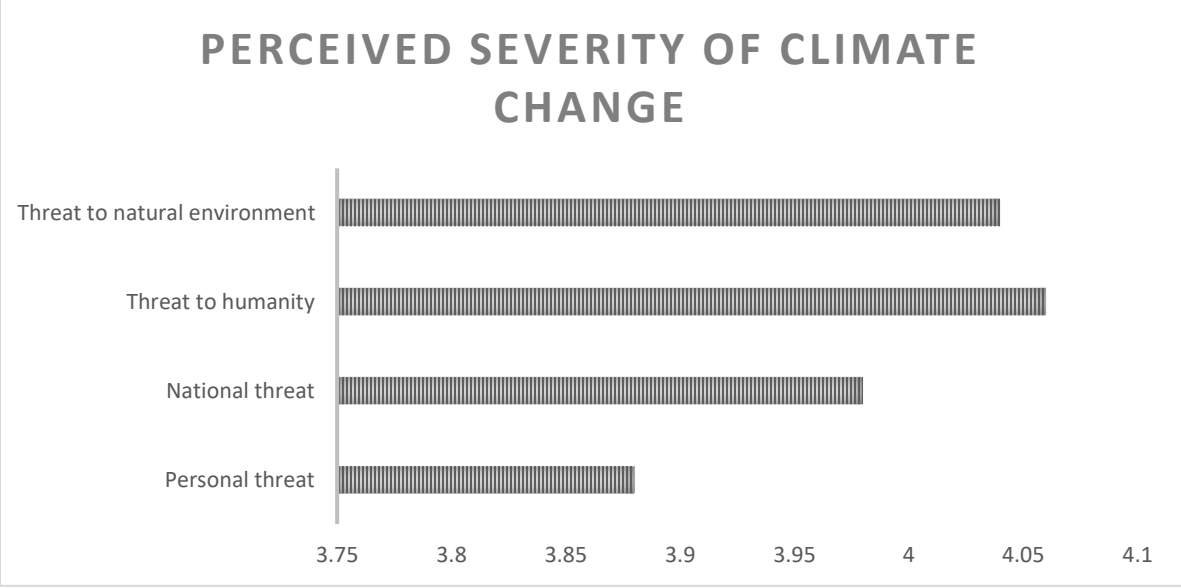


Figure 4: *Climate change informedness: information sourcing*

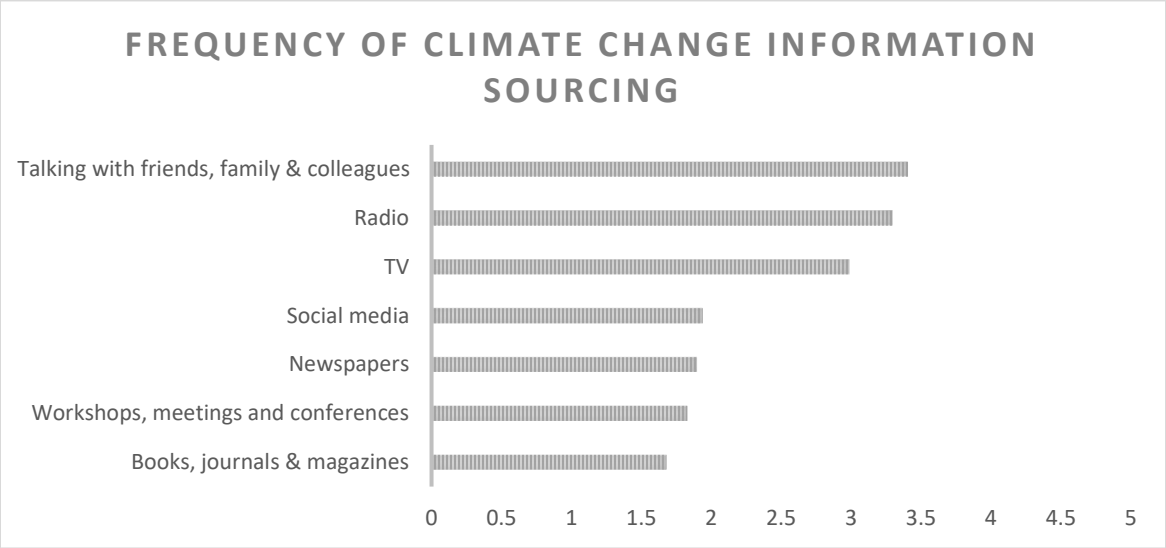


Figure 5: *Climate change beliefs: Causal beliefs*

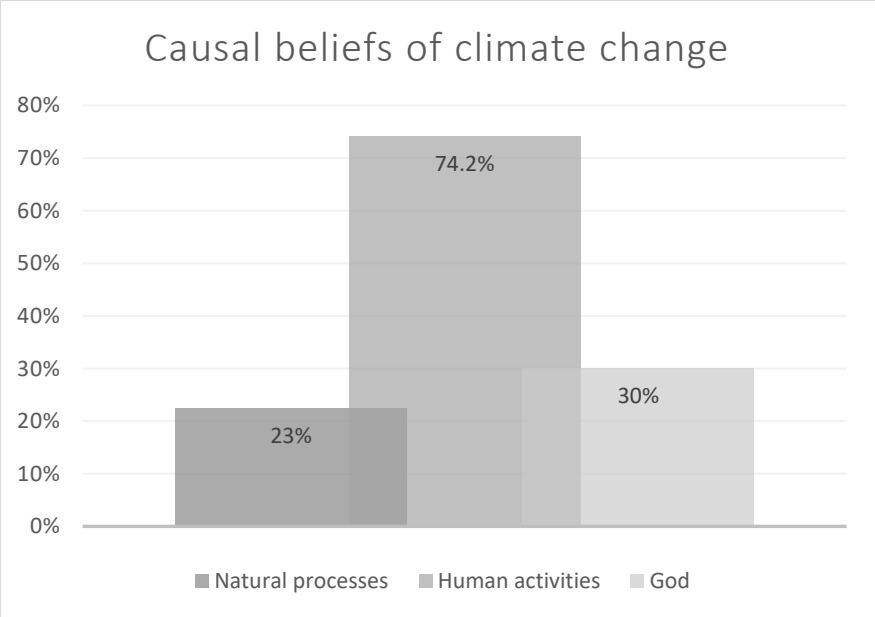


Figure 6: *Climate change beliefs: Impact beliefs*

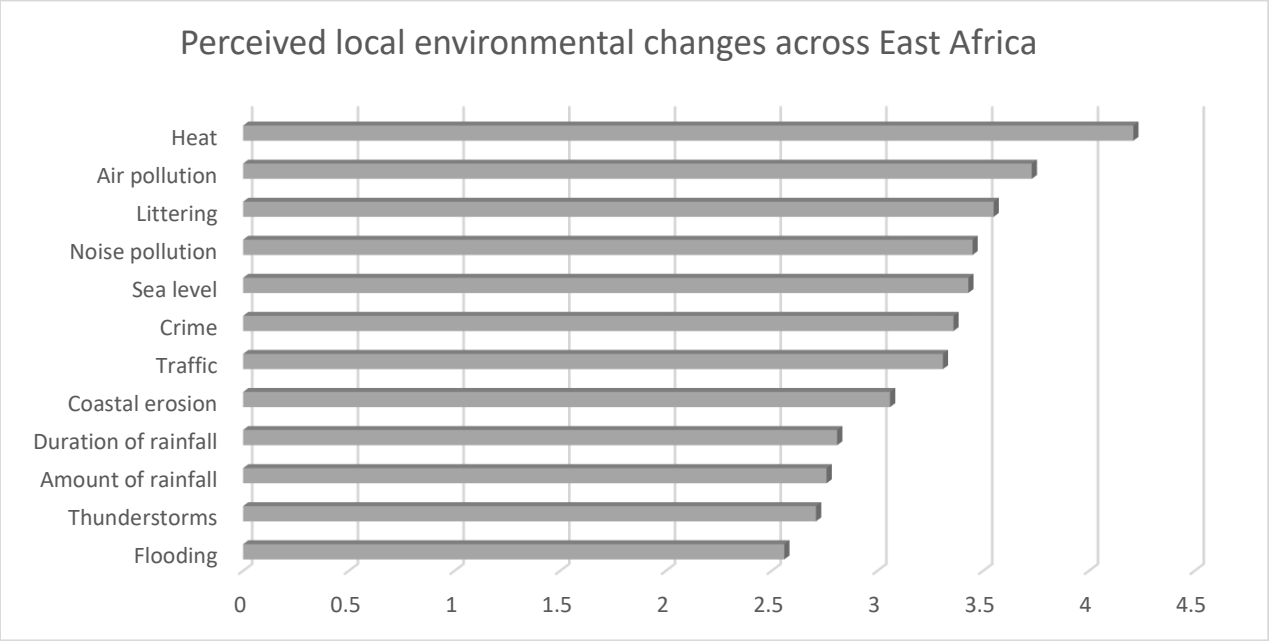


Figure 7: *Social norms for environmental concern*

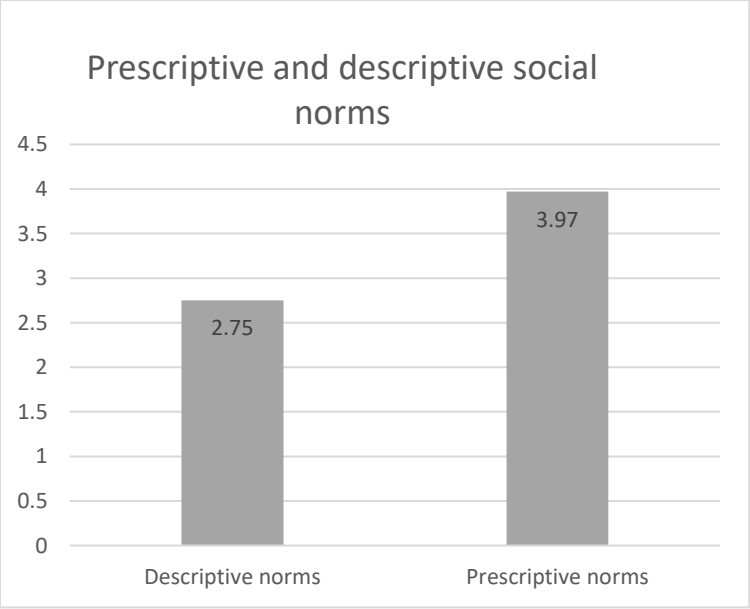


Figure 8: *Place attachment: Place dependence and place identity*