WISER
Weather and Climate Information Services for Africa

CLIMATE SYSTEM ANALYSIS GROUP
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WISER TRANSFORM
WORKING PAPER

Using environmental psychology to increase the use of climate information

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APRIL 2020

Fund Manager for WISER:
Met Office

Funded by:
UKaid
from the British people

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Date: April 2020

Table of Contents

List of tables

List of figures

1 Background

Climate change is recognised as one of the biggest threats facing humanity in the 21st century. While mitigation will reduce further warming, past emissions have already committed us to a degree of inevitable warming that requires adaptation action. Effective adaptation action should depend on, amongst other things, the use of appropriate and relevant weather and climate information for evidence-based decision-making. This is particularly important at the policy level because of the wide-reaching influence of natural resource management and sustainability policy on the direction of climate change adaptation.

However, to date, while responding to short-term weather extremes and implementing longer-term climate change adaptation measures is occurring, action often happens in the absence of climate information. Much of the climate services literature points to the weak link between disaster management/adaptation action and the use of climate information as being a result of a poor match between climate information and the local user context (e.g. Jones et al., 2015; Singh et al., 2018). Therefore, there is reason to believe that there is room for improvement in the way that climate information is designed, delivered and communicated within the climate services field in order to make it more appealing and accessible for specific audiences.

There are many ways to approach gaining an understanding of the climate services user context. However, due to the significant risks posed by climate variability and change, the field of risk perceptions offers a rich entry point. Risk perceptions also underlie both willingness to act and tangible action on climate risks. Therefore, a better understanding of the dynamics of the local drivers of risk perceptions provides valuable information about drivers to action. This knowledge can, in turn, be used to understand how the drivers of risk perception and action influence the use of climate information within a user group, providing a knowledge base from which to a) design more context-relevant climate services; and b) design climate services that are more suited to motivating action.

From this theoretical background, the WISER TRANSFORM project developed a research programme to understand the climate services user context of policy decision influencers in east Africa. Policy decision influencers are here defined as the people who have either a direct or indirect effect on countries' natural resource management and sustainability policies. They may include, for instance, governmental officials, NGO practitioners, researchers, development agency staff and so forth. Policy decision influencers are a particularly important audience to reach through climate services because of their potential to introduce and entrench both short- and long-term adaptation initiatives. Therefore, an understanding of the factors that drive their risk perceptions and actions provides valuable contextual understanding for designing more effective, contextually-specific climate services.

2 Aims of this research programme

This research programme of the TRANSFORM project had three overall main aims:

1. To strengthen the link between climate adaptation action of policy decision influencers, and use of climate services: by thinking about how to develop climate services that are better able to account for the various factors that drive people's actions (the action context). Ideally, the action context should be explored at both individual and structural (wider social, economic, institutional, political and regulatory) levels. However, in the TRANSFORM project, particular focus was paid to the individual level, as there has not been so much attention paid to this level in the climate services field, and relatively little in the adaptation field too. Structural factors behind why adaptation action occurs or does not occur have received much more attention, consider for example, the large literature on adaptation governance barriers and enablers.
2. To maximise the use and uptake of climate services by designing climate services that best fit/respond to the current status quo of climate services information use and desire among policy decision influencers.
3. To maximise the use and uptake of specific different types of climate information (timescales, "pure climate" vs. "impacts" information, and formats), by considering what elements of the action context (at both individual and structural levels), and of the current status quo of climate services information use and desire, need to be responded to. If more is known about what types of climate information policy decision influencers currently use, and why, and what they may desire and why, recommendations can be made for ways in which the use of specific different types of climate information may be optimised.

Addressing the three aims of the project requires exploring the following three broad topics:

- The factors that drive or impede people's actions at the level of the individual, how they interrelate, and what their relative contribution to action is, so that climate services can be developed that better match this action context. Some theoretical background is necessary to explain the WISER project's approach towards data collection on the action context at the level of the individual, and is presented in section 3.
- The factors that drive or impede people's actions at the structural level, so that climate services can be developed that better match this structural context; as mentioned, this was not an area of focus for this project, though the in-depth phase of the project (as described in the methodology) was designed to be open to information on structural-level factors arising through data collection. Therefore, no background will be provided on the action context at the structural level.
- The current use of different types and sources of climate information, and the desired use for different types and sources of climate information. Explanations for the use of and preferences for determined climate services will be offered based on the understanding gained of individual-level factors and structural-level factors.

3 The action context at the level of the individual: background

Climate services entail the tailoring and delivery of weather and climate information messages for use in decision-making with respect to climate variability and change. Hence climate services are speaking into a context of risk. Risk about how climate variability (heavy rains, prolonged dry spells etc.) may impact an area, or risks about the impacts of longer-term climatic changes. Risk messaging is likely to be more effective when it not only imparts knowledge but is also suited to the socio-cultural context to which it is targeted (van der Linden, 2015).

Risk perceptions are important to understand because they underpin individual action on climate change and the types of information people need or use to act. In other words, if people perceive a risk from climate variability or change then they are more likely to act on it. Risk perceptions are, broadly, people's perceived assessment of the likelihood and severity of a risk in combination with a perceived threat to personal or societal wellbeing. So, the question becomes, what drives this assessment?

Risk perceptions are influenced by a suite of determinants. One of these determinants is knowledge about the risk (what people know and understand about the risk). However, knowledge has been shown to exert a relatively small influence on people's risk perceptions and/or their associated behaviour. Yet, to date, climate services have concentrated most of their efforts on increasing knowledge about climate variability and change in the hope that it will encourage action. This approach can be argued to have been a somewhat misguided one because other determinants of risk perceptions have been shown to play a greater role in driving peoples' risk perceptions. In the following section, the suite of risk perception determinants that were examined through this project will be reviewed. In the subsequent sections their relevance to the production, design and dissemination of climate services will be explained.

3.1 Measuring risk perceptions and determinants of risk perceptions in this research programme

The literature about how risk perceptions should be measured is in disagreement. Some studies take the approach of asking respondents to rank "how risky is Y activity?" while others ask questions concerning people's perceived probability, consequence or emotion attached to a risk. In this project, the widely-applied approach of assessing people's worry about climate change as a measure of their risk perceptions was used, as has been done in other studies (e.g. Spence et al., 2012; Carlton and Jacobson, 2013; Lujala et al., 2015).

Adding to debates about measuring risk perceptions, there is also debate about what suite of factors *determine* risk perceptions. No one study has been able to identify a set of factors that determine 100% of the variance in risk perceptions. Therefore, in this project, determinants of risk perceptions were chosen based on a number of criteria: 1) they appeared as important risk perceptions determinants in the international literature; 2) their selection was appropriate for the African context; 3) they offered

potential to inform the development and design of climate services; and 4) they had potential for data collection within the constraints of the east African context.

Therefore, this study selected a set of climate change risk perception determinants (hereafter simply referred to as risk perception determinants) for inclusion. These are social norms, psychological distance (closeness) of climate change, experience of extreme weather events, values and demographic variables (gender, age and education). These determinants are each explained further in the following section.

3.1.1 The psychological distance (closeness) of climate change

Psychological distance is a measure of a person's personal perception of something (e.g. objects, events) as either close or far away, and can therefore influences people's perceptions of risk. The principles of psychological distance are defined with respect to four dimensions, namely: whether an event is close or remote in time and space (temporal and spatial dimension), whether it refers to ours or other people's experiences (social dimension) and whether it is certain or uncertain to occur (hypothetical dimension) (Trope and Liberman, 2003). Each of the four psychological dimensions have been shown to significantly correlate with each other. For instance, if an event is perceived as unlikely to occur then it also brings to mind people other than oneself (social distance), a distant future (temporal distance) and remote locations (spatial distance).

Literature from the global north has often documented climate change as a psychologically distant threat. In turn, the psychological distance of climate change is often cited as a reason that people do not act on climate change (Lorenzoni and Pidgeon, 2006; Spence et al. 2012; Mcdonald et al., 2015; Jones et al., 2017). However, there is very little literature on the psychological distance of climate change in Africa, including how this may affect risk perceptions and action on climate change.

3.1.2 Experience of extreme weather events

While it is difficult to attribute any particular extreme weather event to climate change, it has been shown that personal experience of extreme weather events can increase people's climate change risk perceptions, because extreme weather events result in a concrete understanding of the kinds of risks that climate change poses (Weber, 2006). There is a growing body of evidence that suggests a belief, within Africa, that extreme and erratic weather events are increasing, primarily as a result of climate change (Selormey et al., 2019). This increasing awareness of changing weather events attributed to climate change provides good reason to believe that the experience of extreme weather events in Africa may be important in informing climate change risk perceptions on the continent.

3.1.3 Social norms

Social norms can be defined as the shared ideas about "the right way to behave" (e.g. Cialdini 2003), the unwritten rules of behavior that are considered acceptable in a group or society. An example of a social norm, in certain cultures (particularly Western ones), is shaking hands when greeting another person. There are two main types of norms: (a) injunctive (prescriptive) norms, which describe what most people approve or disapprove of; and (b) descriptive norms, which refer to what most others do. If climate change is viewed as a high risk by the social groups to which an individual feels a sense of belonging, then it is likely that the individual's perception of climate risk will also be high. This is similarly applicable to the actions and behaviour that result from the social groups' perceptions of climate change. For instance, a carbon-dependent

lifestyle, which contributes to climate change, has become a socially-acceptable way of behaving in the West. This lifestyle includes activities such as driving to work, flying to overseas holidays, leaving appliances on stand-by and importing food from foreign countries. In these cases, social acceptability outweighs people's knowledge that these activities are exacerbating climate change.

3.1.4 Values

Values underlie the moral make-up of a person and guide their actions, judgements, attitudes, evaluations and choices. Importantly, values transcend particular situations and so are fairly stable. For instance, if honesty is a core element of a person's value system, then they will tend to apply this principle wherever they go, be it at work, socially or with strangers. According to Schwartz's (1992) influential work, values can be broadly broken down into 10 basic values held by people in dozens of nations around the world.

Some of these types of values cluster together into what Schwartz calls the "self-enhancement" and "self-transcendent" values. Self-enhancing values are exemplified by the pursuit of self-interest and concern the attempt to stand out from others through the acquisition of money, status, and the like. Self-transcending values, on the other hand, focus outside of the individual self towards the greater good of fellow humans and the environment. The two clusters of values tend to be in opposition to each other, in other words, a person tends to hold self-enhancing values at the expense of self-transcending values, and vice versa.

The two dimensions of self-enhancing and self-transcending values have been shown to link to lesser or greater acceptance of environmental action and engagement in related behaviours, including on climate change. For instance, people with more self-transcending values have been shown to have a greater perception of climate change risk and are more supportive of pro-environmental policies (Poortinga et al., 2019) whereas people with self-enhancing values have been shown to have a lower perception of climate change risk (Smith and Leiserowitz, 2012). It follows that values are likely to be important in informing climate change risk perceptions and associated action on climate change in the African context.

3.1.5 Demographics

Demographic variables include factors such as gender, age and educational qualification. Each of these factors have been linked to risk perceptions through previous literature. Research suggests that risk perceptions tends to be higher amongst women than men (Poortinga et al., 2019). This is similarly true for the older generation, who show a higher risk perception than the younger generation (Poortinga et al., 2019). Finally, higher educational attainment and socio-economic status has been variably linked to either increased or decreased risk perception (Sundblad et al., 2007; Akerlof et al., 2013).

4 Project approach

Respondents were required to be active in a sector or field relevant to natural resource management or directly impacted by climate variability or change. Respondents were sourced from the five east African countries of Kenya, Uganda, Rwanda, Tanzania and Ethiopia.

4.1 Data collection procedure

Data collection for the project was executed in two main phases:

1. A questionnaire survey that collected data relevant to each of the items in Table 1 below. The survey was designed to collect information on the factors that drive or impede people's actions at the level of the individual (risk perception determinants) and the current use of different types and sources of climate information, and the desired use for different types and sources of climate information. The surveying took place between September 2018 and January 2019 and was carried out by in-country enumerators, on a one-on-one basis, in each of the five countries. A total of 616 surveys were gathered.
2. Semi-structured interviews that collected in-depth data to explore and explain in greater detail the risk perceptions determinants, the factors that drive or impede people's actions at the structural level, the current use of different types and sources of climate information, and the desired use for different types and sources of climate information. A total of 36 face-to-face interviews were carried out by a trained interviewer with a purposive sample of policy decision influencers in Kenya and Ethiopia. Interviews took place between August and October 2019.

4.2 Questionnaire survey item measures and summarised survey results

With respect to the first phase of the data collection, Table 1 presents the items measured, how they were measured and the summary results of the survey. Associated graphed results are presented in the Annex. The results of the second phase of data collection are used to explore and explain the summary results, and as such inform and complement the discussions in the following sections (5 to 7).

TABLE 1: Items measured through the questionnaire, and corresponding summary results

ITEM MEASURED	MEASURED THROUGH	SUMMARY AUDIENCE RESULTS
Climate change action (in a professional capacity)	One question measuring action on climate change at work. Measured on a five-point Likert scale from 'strongly disagree' to 'strongly agree'	The vast majority of respondents agree/strongly agree that they take action on climate change in a professional capacity. (see Figure A1)
Risk perceptions	Three questions assessing worry about climate change. Measured on a five-point Likert scale from 'not worried' to 'very worried'	The vast majority of participants are worried/very worried about climate change, particularly in terms of how it may impact their local area. This indicates a high degree of climate change risk perceptions amongst the audience (see Figure A2)
Psychological distance (closeness)	Seven questions covering the four components of psychological distance. Measured on a five-point Likert scale from 'from 'strongly disagree' to 'strongly agree'	Climate change is psychologically close amongst the respondents. This result was particularly evident in the overwhelming perception that climate change is already impacting their local area (see Figure A3)
Experience of extreme events	Four questions assessing how often, in the last five years, respondents had experienced a) flood events, b) droughts, c) high temperatures/heat events d) change to the rainy season pattern. Measured on a five-point Likert scale from 'never' (zero times) to 'very often' (more than ten times)	Experience of extreme weather events is high amongst the respondents with most respondents indicating that they either sometimes/often/very often experience extreme weather events. The most commonly experienced event is changes to the rainy season's patterns. This is followed by the experiences of high temperatures and then flooding events (see Figure A4)
Social norms	Six questions assessing descriptive and prescriptive norms. Measured on a five-point Likert scale from 'strongly disagree' to 'strongly agree'	The majority of respondents agree/ strongly agree that they observe both descriptive and prescriptive social norms for taking action to prevent impacts from climate change. These activities include the use of climate information in their work (see Figure A5)
Values	Standard 21 questions from the Portrait Values Survey designed by Schwartz for the European Social Survey (https://www.europeansocialsurvey.org/docs/methodology/core_ess_questionnaire/ESS_core_questionnaire_human_values.pdf). Measured on a seven-point Likert scale from 'not like me at all' to 'very much like me'	The majority of respondents have a tendency towards self-transcending values (see Figure A6)
Socio-demographics: age	One question asking respondents to tick a 10-year age bracket	Respondents' ages primarily range from 20 to 60 years old, with the most respondents falling into the 30-39 year old category (see Figure A7)
Socio-demographics: gender	One question asking respondents to choose between female, male or non-binary genders	The majority of the respondents (more than two-thirds) are male, the remainder female (see Figure A7)

ITEM MEASURED	MEASURED THROUGH	SUMMARY AUDIENCE RESULTS
Socio-demographics: education	One question asking respondents to note their highest level of educational attainment	The respondents represent an educated sample, with the majority holding either a graduate or post-graduate degree (see Figure A7)
Use of weather/ climate information	One question assessing respondents' frequency of use of weather/climate information in their work. Measured on a five-point Likert scale from 'never' to 'very frequently'	The majority of respondents frequently/very frequently use weather/climate information in their job (see Figure A8)
Type of weather/ climate information currently used for work	One question asking respondents to selection the types of weather/climate information they currently use in their jobs. Selection options included: observed/historical data, daily to weekly forecasts, seasonal forecasts, 1–5 year forecasts, projections of climate 5 years or more into the future, and impacts information	The most frequently used types of weather/climate information are 1) daily/weekly forecast information 2) seasonal forecasts 3) observed/ historical information (see Figure A9)
Source of weather/ climate information	One open-ended question asking where the respondents get weather/ climate information	The most frequently cited sources of weather/climate information were, in first place, country National Meteorological Services, followed by the media (radio, TV or newspapers) in second place
Applications of weather/climate information	One open-ended question asking what the respondent uses weather/climate information for	While responses were distributed across a diversity of uses, the top three consisted of 1) daily operations, 2) research and 3) planning
Desired type of weather/climate information	Two questions asking respondents about their desire for different types of weather/climate information. Options, to be ranked by the respondent, included: observed/historical data, daily to weekly forecasts, seasonal forecasts, 1-5 year forecasts and projections of climate 5 years or more into the future. A separate open-ended question was asked about desire for impacts information	The most frequently desired types of weather/climate information were 1) daily/weekly forecast information, 2) seasonal forecasts, 3) observed/ historical information (see Figure A10)
Desired format of weather/climate information	One question asking respondents to rank their desired information format. Options, to be ranked by the respondent, included: raw data, visual data, a mixture of visual and text, text, and verbal	The most frequently desired format for weather/climate information were 1) visual information (maps/graphs), 2) raw data, 3) a mixture of text and visual information (infographics) (see Figure A11)
Trusted sources of information	One question asking respondents to choose (and rank) their 3 most trusted sources of weather/climate information	The majority of respondents highlighted the National Meteorological Service as their top trusted source of weather/climate information (see Figure A12)

5 Informing climate services that better match the individual-level action context

Analyses that informed this section

- Correlation analysis between each of the risk perception determinants, action and use of climate information services.
- Multiple linear regression analysis to investigate which of the variables explain the greatest variance in 1) climate change risk perceptions and 2) action on climate change.
- Structural equation modelling to develop and test a causal model between risk perception determinants and action on climate change (more details on the statistical analysis and the structural equation modelling will be presented in a forthcoming academic paper).
- Qualitative analysis of the semi-structured interviews to explain and interpret the results from the statistical analyses

As previously stated, if the climate services field engages appropriately with the determinants of risk perceptions and action, ultimately there may be more action taken on climate variability and change. If risk perceptions are related to action, the more risk perception determinants that climate services can account for when producing and disseminating climate information, the more action they may be able to stimulate (because they will be targeting the context, at the individual level, that underpins action on climate change).

This section addresses how the different risk perception determinants drive people's risk perceptions and action, how they interrelate, and what their relative contribution to action is. On the basis of this understanding, it explains at each step how the production, design and dissemination of climate information/services can appropriately account for the risk perception determinants.

5.1 A model for how risk perception determinants influence action on climate change

Through statistical analysis of the questionnaire survey results, the project developed a model for how risk perception determinants influence action on climate change amongst east African policy decision influencers. It is worth highlighting that no significant differences were found among the five east African countries regarding the results of risk perception determinants. In other words, the countries were fairly homogenous in terms of their responses to questions that informed the risk perception determinants. The final model is presented in Figure 1.

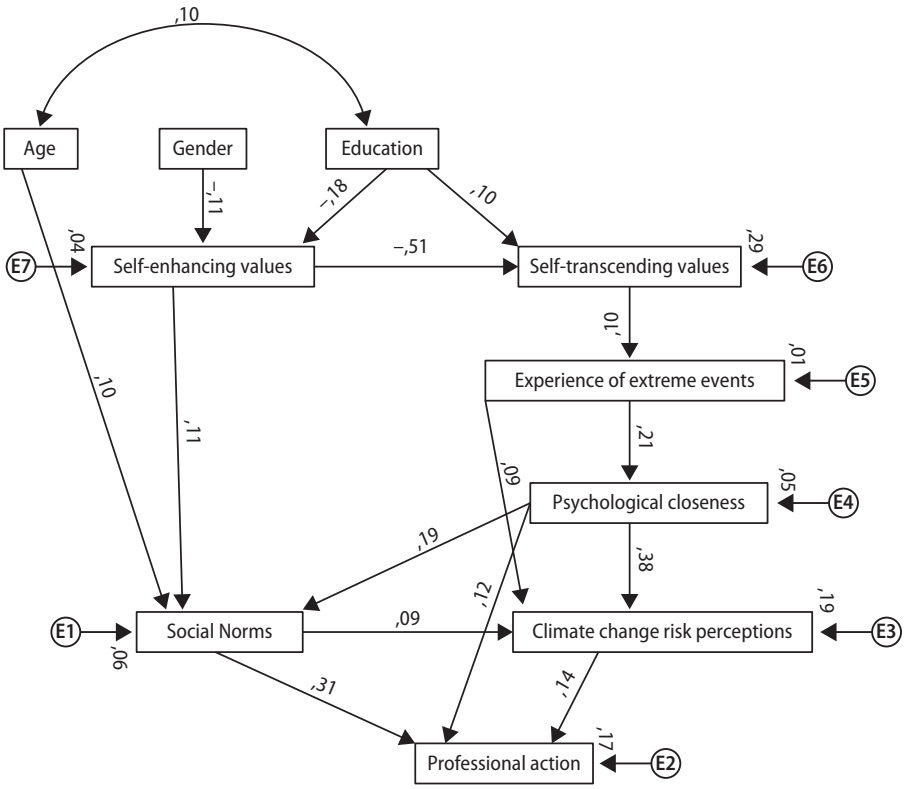

FIGURE 1: The pathway from determinants of risk perceptions to action (at work) on climate change. Standardised regression weights (all statistically significant) are shown as numbers on each line. The error terms are represented by E1 to E8.

The model shows that there are two main pathways that lead to action on climate change. **The first pathway to action** is an expected pathway, in that individuals with self-transcending values are more likely to report experiencing extreme weather events due to climate change, which in turn means they are more likely to view climate change as psychologically close. Greater psychological closeness also increases climate change risk perceptions and leads to a greater likelihood that respondents notice/feel there are both injunctive and descriptive norms in their personal and work environments that require them to act on climate change and use climate information in their job. Greater climate change risk perceptions lead to greater action. Greater reporting of injunctive and descriptive norms for action on climate change and use of climate information at work also leads to greater action, and has the strongest effect on action than any of the other risk perception determinants, or even a person's level of risk perception.

What leads to self-transcending values? While there are many factors that influence people's values, which were not explored by our study (and therefore will not appear in our model), one socio-demographic variable considered in our study was positively linked to self-transcending values. This variable was people's level of formal education: as people's formal education rose, so did their self-transcending values. **The recommendation that logically follows is that the climate services community may wish to consider how it can raise capacity among users by providing, for one example, targeted short courses to fill education gaps**.

The majority of the respondent sample possessed self-transcending values, which is not unexpected given that the average education level of the respondents was fairly high (refer to section 4, Table 1) and that the sample was made up of policy decision influencers, whom we might reasonably expect to report high levels of self-transcending values because of their involvement in fields related to natural resource management and climate-compatible development, which are related to environmental sustainability.

This pathway to action suggests that for samples made up of policy decision influencers, designing climate services that account for all the following risk perception determinants might increase climate action: personal experience of extreme weather events, psychological closeness, and social norms on climate change action and climate information use. They are explored in further detail in relevant sections below.

5.1.1 Accounting for personal experience of extreme weather/climate events

Designing climate services that account for personal experience of extreme weather events implies a need to establish which extreme weather events – and/or more broadly climate events or impacts – are seen to occur in a target area, and designing climate information products that are related to those events as a first step towards maximising the use of weather/climate information. The questionnaire survey revealed that the most frequent extreme weather events experienced by respondents were changes to the rainy season's patterns, followed by high temperatures and heat, then floods and then droughts – although there were not particularly large differences in reported numbers for these events. To some extent, there is alignment between these findings and what was revealed in the interviews, and the findings regarding what respondents reported desiring most frequently in terms of impacts information (crop yields and flood risk). However, it is surprising that neither the interviews nor the question on what respondents most desire in terms of impacts information raised a concern with high temperature/heat events, despite these being the second most frequent category of extreme events experienced across the sample. This finding may be a reflection of the fact that the survey asked respondents to indicate the extreme events that had occurred in their town or city. However, for the question on desired impacts information, and in the interviews, respondents were asked to think specifically in relation to their jobs, which may require them to think much broadly or outside of the experiences in their local area/city. As a matter of fact, the interviews made clear that mostly, respondents reported seeing the impacts of climate change and/or of extreme weather events in fields that were closely tied to their work expertise and experience, rather than their personal lives. The field of work a person is embedded in drives their work-related engagement with specific climate events/impacts and climate information (unsurprisingly). This finding implies that **if the climate services field wishes to increase the uptake and use of climate-related information in people's jobs, it is necessary to ask them about climate impacts/extreme weather events that have been experienced as part of their job, and use those events as entry points for engagement**.

In practical terms, it is not necessarily the "objective" occurrence of climate events that needs to be established. It is the climate events that the target audience deems their area of work to be vulnerable to. For example, in African regions, many areas are concerned with flooding events. These however may be less a result of changes in extreme rainfall, and more a result of inadequate drainage and waste management systems and increasing urbanization in urban areas. In rural areas, they may be more due to environmental degradation and siltation than to changes in rainfall. This implies a need to strike a balance between the extreme events that users perceive their sector/field of work to be vulnerable to (the "subjective" climate events), and the "objective" climate events that a sector may be experiencing as a result of changes in weather or climate. While flooding might be a foremost concern in some areas, if flooding is not linked to changes in extreme precipitation as much as it is to changes in land-use cover and human practices, it may be a helpful frame

to encourage the use of climate/weather information, but may not make much difference to resolving flood risk on the ground – if the behaviour that will make the most difference to flooding over time is, for example, reducing cultivation adjacent to river banks (rather than monitoring rainfall for flood early warnings).

It is, however, possible to consider how to use current events that are of existing concern to users as a starting point for discussions around, and engagements on, the uptake and use of climate services, and then where necessary, sensitize users to which events (and related climate information) may require greater attention and concern. In other words, initially focusing the production and dissemination of climate services upon the extreme events/climate impacts that an audience is concerned with could serve the purpose of using that concern as a "springboard" for encouraging greater use of weather and climate services, as long as one designs those engagements in a way that shifts the focus gradually to the climate services that are more objectively necessary for effective climate action on the ground. For a very simplistic example, a region may be concerned with drought and therefore wish to receive information on rainfall changes, but if evapotranspiration were to play a large role because of increasing temperature levels, climate services could sensitize the audience to the importance of temperature changes.

A key point for the climate services field is that it may be helpful to make clear for target audiences *when* and *how* using more weather/climate information can help with the management of climate-related events and impacts. In the case of flooding, for some areas it may be the helpful response for climate services to highlight that while a greater reliance on monitoring rainfall levels and developing forecasts can assist with flooding, the better response might be not to focus the greater part of resource allocation on improving early warning systems, but to improve drainage capacity by removing waste (i.e. in areas that are not expected to see as great changes in rainfall as they are expected to see changes in urbanization). Conversely, in some areas is may be appropriate for the climate services community to largely focus upon encouraging a reliance on monitoring rainfall levels and developing forecasts, because those areas are indeed expected to see significant changes in rainfall intensity.

Another relevant set of recommendation follows from the fact that extreme weather events are often linked to strong emotions: personal experiences with threats or hazards can raise strong emotions, therefore making them more memorable and dominant in information processing. The human brain relies on two information-processing systems (e.g. Chaiken and Trope, 1999). One system, called experiential, is intuitive, automatic, emotional and fast. The other system is analytical: it is deliberate, effortful, rational and slow. While these two systems act together to guide judgment and decision-making, experiential thinking is more prevalent than analytical thinking (e.g. Slovic et al., 2005; Marx and Weber, 2012). Affective reactions to risk dominate decision-making, such that where cognitive and affective assessments of risk diverge, it is affective assessments which tend to drive behaviour (Loewenstein et al., 2001). In other words, how we intuitively feel about a situation often has a stronger influence on our decision-making than what we know about it. Climate change is studied in statistical terms (e.g., by analysing long-term changes in temperature and precipitation patterns), and, hence, it is generally presented in abstract and analytical language, especially to decision-makers. This approach, however, assumes that people process uncertain information in a logical and analytical manner, an assumption that has been shown to be generally incorrect. Marx et al. (2007) suggest that analytical information is best understood when it is tailored to the context of the decision-maker's situation. **Climate information that is tailored to the emotional experiences of the audience has more impact and can lead to more public attention**. Scenarios, narratives and analogies can help the audience to engage with climate information and envisage a future where the potential consequences of climate change are played out, which influences both personal behaviour as well as public policy and is more likely to result in contingency planning. However, while it is beneficial to draw on experience-based

decision-making in communication, experiential processing is beset with its own biases such as the finite pool of worry (people have a limited capacity for how many issues they can worry about at once) and single action bias (relying on only one action to reduce a threat) (Leiserowitz, 2006). The most effective communication and engagement targets both processing systems of the human brain, and therefore both the analytic and experiential processing systems should be considered in the format and communication of climate information (Marx et al., 2007; CRED, 2009). Alongside the more common analytical tools (e.g. trend analyses, forecast probabilities, and ranges of uncertainty), experiential tools that can be used when presenting climate information include vivid imagery and messages designed to create, recall, and highlight relevant personal experience and to elicit an emotional response; examples include film footage, metaphors, personal accounts, real-world analogies, concrete comparisons, 3D modelling, and gaming approaches. In summary, climate services should be designed in a way that elicits personal (which in the context of policy decision influencers, we suggest means "work-related") experience with climatic events and impacts.

A specific note regarding climate change is required here. If one desires the audience to take action on long-term climate change, extreme weather events have been suggested to be able to provide effective frames with which to sensitise audiences to the potential impacts of climate change, because these events are vivid, concrete and dramatic (CRED, 2009). The numerous examples of different extreme events that respondents reported on in the survey (and examples of climate change impacts reported in the interviews) suggest there are many opportunities for the recurring "teachable moments" that CRED (2009: 10) suggests communicators can use to relate climate change to the experience of a local audience. **Therefore, the climate services field could use this technique to relate climate change to the extreme event experiences of target audiences** (although this recommendation is more relevant to target audiences that are not well-sensitized to climate change – not the case with the policy decision influencers examined here). CRED (2009) reports the example of a very long-lasting and severe drought that occurred in some parts of Australia and that increased awareness of climate change, resulting in greater support for measures to combat climate change.

5.1.2 Accounting for psychological closeness of climate change

Designing climate services that account for psychological closeness/distance requires an understanding of how the psychological closeness of a threat influences the way people think. This is explained through construal level theory, developed by Liberman and Trope (1998), who first introduced the concept of psychological distance. The main principle of construal level theory is that there is a relationship between the psychological distance of an event and the way people mentally construe (i.e. think about) the event and, in turn, the types of information they may use to act on the event. When an event is psychologically close it promotes emotional and cognitive engagement with the event. For instance, the imminent threat of a flood may bring to mind images of wading through one's house to rescue sentimental objects and evacuate vulnerable family members. These types of psychologically close threats are typically associated with "low-level" construal, which is a type of comprehension composed of concrete thinking and specific detailed features where feasibility, safety and the attainability of a good outcome become the primary areas of focus. On the other hand, when a threat is psychologically distant it can be more difficult to relate to and more effort is required to mentally construe it. For instance, the possibility of flooding in the long-term future, without recent experience of a flood, does not provide any direct specific contextualisation of the situation or sensory detail. Therefore, psychologically distant events are typically associated with "high-level" construal, which results in a type of comprehension composed of abstract and general features.

The questionnaire survey revealed that, amongst policy decision influencers in east Africa, climate change is psychologically close. This finding was particularly stark in the temporal distance component where the

overwhelming majority of survey respondents felt that they are already experiencing the effects of climate change. However, all of the climate change components of psychological distance (spatial, temporal, social and hypothetical) were psychologically close for respondents. This finding contrasts with the majority of studies undertaken in the global north, which predominantly find that climate change is psychologically distant (see section 3.1.1). It is worth noting that the interviews reinforced the findings from the questionnaire survey. Many of the participants noted that climate change is happening now and is already impacting people. None of the interviewees expressed any doubt that climate change is happening. The psychological closeness of climate change in an African context is an important finding of this study.

But what does this mean for designing climate services? An understanding of the psychological distance of climate change has potential to inform many aspects of climate services. Given that the results of the survey suggest that climate change is considered psychologically close in the east African region, policy decision influencers should be in a state of low-level construal, meaning that decisions about climate change will require concrete, solutions-based information from the climate services community. This is a mental state in which uncertain statements and mixed messaging creates frustration and may act as a hindrance to decision-making. Yet, the current status quo within the climate services community is to provide exactly the kind of uncertain messaging about climate change that lies in opposition to the user's mental state. Currently climate change projections are presented as ensembles (ranges of uncertainty) of change that are, often, divorced from impacts information. While it is not scientifically possible or feasible at this stage to reduce the scientific uncertainty, it is possible to work more closely with the impacts community to better understand what the projections may mean for impacts and, in turn, the kinds of solutions that may be proposed to address the impacts. **If these possible impacts and proposed suite of solutions were presented to the policy decision influencer community, in combination with the climate projections, they would likely go a long way towards providing the kind of concrete and solutions-based information that they seem to need to inform their decisions**.

The second aspect of climate services that can be informed by our understanding of climate change as psychologically close in east Africa is the timescale of priority for decision-makers. Of the four components of psychological distance measured in the survey, the most striking results came from the question measuring the temporal distance component. The participants were asked when they thought their local area would start feeling the effects of climate change. Ninety-three percent of the sample answered that they were already feeling the effects of climate change. This finding suggests that when people consider planning for climate change, they may not view it as planning for the distant future but may be considering themselves to be making decisions about climate change in the here and now. This means that the **climate services community likely needs to continue to recognize the importance of providing short-term (monthly to seasonal) forecasts to these communities, in combination with longer term projections (see also section 7.1.3 – longer term information use)**. Short-term planning for climate variability, in combination with knowledge of longer-term changes, has the potential to support robust climate change adaptation solutions that address short as well as long term needs. However, the current uncertainty inherent in the longer-term climate projections, together with the obvious and pressing need to address short-term problems related to extreme climate events, may be reasons why decision-makers tend to focus on short-term decisions without accompanying longer-term climate change considerations.

Finally, construal level (as informed by psychological distance) also has an influence on what format people like to receive information in. **Studies have shown that people in low-level construal (a state of psychological closeness) react better to information presented visually (Yan et al., 2016). For instance, infographics or clear maps may be more impactful than written reports or raw data**. In addition, the way

information is framed is also an important factor. **Studies have shown that when people are in low-level construal they react better to information framed in terms of losses (negatively framed information) as opposed to gains** (Chang et al., 2015) (see also section 6). For instance, when communicating the risk of flooding, a loss framed message may be: "deaths from Malaria may rise by 10% by 2030 unless insecticide-treated net programmes are expanded" whereas a gain framed message may be "expanding insecticide-treated net programmes will prevent deaths from Malaria rising by 10% by 2030". A subtle reframing of the manner and format in which messages are communicated can have a significant impact on whether the information is well-received and acted upon.

One important point in relation to information framed in terms of losses is that it is important to also highlight action(s) that can be taken to mitigate against those losses (as demonstrated in the example above). The messages most effective for achieving a desired change in behaviour are considered to be those that stress the negative consequences of the current behaviour while providing recommendations for how the negative consequences can be avoided (e.g. O'Neill et al. 2013). The reason is that psychology-based literatures suggest that one key determinant of action is the feeling of efficacy (e.g. Morton et al. 2011).

5.1.3 Accounting for social norms

The most important leverage point, however, is to design climate services that account for social norms on climate change action and climate information use, for two reasons. The first is that social norms have the strongest effect on action, and the second, is that they were the only pathway to action for people holding self-enhancing values. **The second pathway to action** is a pathway that, to our knowledge, has been rarely reported on in the climate change literature. In this pathway, individuals with self-enhancing values (which as expected, are negatively correlated with self-transcending values) still report taking climate-relevant action through the influence of social norms. In other words, the more a person holds self-enhancing values, the more likely they are to report noticing/feeling that there are both injunctive and descriptive norms in their personal and work environments that require them to act on climate change and use climate information in their job. We theorize that this effect may be due to the possibility that individuals with self-enhancing values are more likely to scan for, and respond to, cues in their professional environments that will support their personal advancement, consistent with their personally-oriented ambitions/goals. As the accepted norm appears to be to act on climate change, they may be more likely to want to conform to this norm.

Influencing social norms has been a popular lever for attempts to transform behaviour in real-world contexts, because "humans are especially motivated to understand and to follow the norms of groups that we belong to and care about" (Tankard et al., 2016: 184), and therefore, changing the perceptions people have about social norms is a powerful and cost-effective way of creating or reinforcing collective changes in behaviour. But how might the climate services field leverage social norms to influence use and uptake of climate information, and (if desired), climate-relevant action?

Yamin et al. (2019) present a systematic review of social norm interventions applied across a range of fields. Based on their review, the following approaches may offer potential to the climate services community:

1. **Create climate services material that outlines what other similar groups are doing in terms of climate services use (social norms marketing).** These are interventions based on messages about the general rates in which people engage, approve or disapprove of the target behaviour (persuasive messages about the behaviour or opinion of the group). An example message for the climate services field, if the target audience were, for instance, urban local authorities, might be along the lines of "many African cities are joining climate networks and using global climate model projections to plan their development".

2. **Include strategic messages within climate services products that provide rates or prevalence of certain desired behaviours amongst a certain population.** This provides more fact-based information that aims to speak more directly to a certain audience but requires more background knowledge to inform the message. For instance, if one wanted to increase the use of a certain climate information timescale within a sector, an example message may be "80% of professionals in the water sector in Kenya are using climate change projections for the 2080s to plan their infrastructure projects".
3. **Host interactive or reflection processes that highlight the desired use of climate services amongst other groups or people and seek to correct misperceptions.** This category of approaches focuses on creating the conditions for exposing the target audience to the behaviours or opinions of others. This includes, for example, generating collective discussions between selected user, representing drama skits with personal experiences or simulated situations. Transdisciplinary co-production engagements, that are already taking place within many climate service activities, may present a perfect opportunity for this kind of social norm intervention, depending on their set up. For instance, they often enable the coming together of like-minded individuals to take action on climate change. The establishment of such a community provides a reinforcing effect, particularly if social referents (individuals that are especially influential over people's perceptions of norms) are endorsing or rejecting particular behaviours, for example endorsing the use of long-term climate information.
4. **Have respected or well-known figures publicly endorse the desired use of climate services.** Researchers have found that there are certain people in society who hold more influence than others when it comes to their persuasive effect. Some studies have shown that it is possible to change the behaviours of whole groups just by using this technique. The survey results from this project indicate that there were certain sources of information that are more trusted over others (e.g. country national meteorological services) – however, this question was primarily targeted at organisational sources as opposed to individuals. If this question were asked with respect to individuals, the question may yield different results depending on the audience questioned, for example people might name an eminent politician or a well-respected academic. In other communities/audiences this answer would probably change. For instance, rural communities may be very influenced by messages from community leaders/tribal chiefs/community elders, and religious communities may be strongly influenced by messages from religious leaders.

While these interventions may offer appeal, it is necessary to offer a word of caution. Studies that have looked at the relationship between descriptive (what one observes others doing) and injunctive (what one feels others think one should be doing) norms have shown that targeting descriptive norms alone can have a 'boomerang effect depending on the behaviour levels of the reference group (as reported in Yamin et al., 2019). For example, if an intervention to reduce energy consumption in households focused on informing homeowners about the average energy consumption of their neighbours/community, a message telling a homeowner that their household energy consumption levels are lower than their neighbours' might actually lead to an increase in undesirable behaviours ('it is okay to consume more, because it is what everyone else does'). These effects can be neutralized by adding injunctive elements to the messages (i.e. about social desirability or un-desirability of the behaviour), particularly if they reinforce the desirable behaviour (e.g. Nolan et al., 2008). In a study on voting behaviours, Gerber et al. (2009) also found evidence that descriptive messages about the high occurrence of a desired behaviour ('thousands of people vote so you should too') can be more effective to change behaviour than those about low occurrence ('a low proportion of people vote so you should do it') or even injunctive norms ('it's the right thing to do' or it's a civic duty'), especially among people that don't engage often in the behaviour. Injunctive norms seem to be more effective when formulated in a positive manner ('people think you should do this') in contexts where descriptive norms are weak (Mabry and Turner, 2016).

5.1.4 Some final considerations

The structural equation model highlights that increasing age has two positive effects on eventual climate action. First, it is positively correlated with education, meaning that older policy decision influencers are more likely to have higher education levels and as such higher self-transcending values. Second, it is positively correlated with observing social norms in one's environment. Therefore, the implication for the climate services field is that **targeting older policy decision influencers for engagement may hold positive implications for climate information use and climate action**, especially given that older policy decision influencers will likely hold more senior roles in their organizations and thus have greater decision-making influence (and also because, as will be discussed further in section 7.1.3, increasing age is correlated with increasing use of longer-term climate information).

The structural equation model shows that men tend to hold more self-enhancing values, which reinforces the idea that climate services could usefully consider how to leverage social norms to achieve greater use and uptake of climate services, given that it is likely for many countries that men dominate the policy influencers sphere. In the sample, the proportion of women respondents was 30% and the proportion of male respondents was 70%, which is not expected to be an artefact of the enumerators' sampling choices, given that, as will be discussed further in section 6, respondents feel that men still dominate the policy influencers sphere.

Since education is highly important for the self-transcending values pathway, and since the average education level of the sample was relatively high, we suggest that it is possible to be relatively confident that for policy decision influencer audiences, following the recommendations arising from the first pathway to action can be an effective way of increasing climate-relevant action, even if norms cannot be tackled or leveraged (though this increase would not be as strong as if social norms were leveraged). However, for audiences not consisting of policy decision influencers (at least as they have been defined in this study), or for audiences consisting of policy decision influencers with relatively low levels of education (whom are more likely to hold self-enhancing values, as education is inversely related to self-enhancing values), this assumption is unlikely to hold, and social norms would remain the strongest entry point for the climate services field. Different audiences (e.g. politicians, farmers) may have different pathways to action, and these will need to be explored. In general, however, given the widespread influence of social norms on human behaviour (as discussed in the section above), interventions based on social norms are likely to constitute an effective course of action to increase the use and uptake of climate services by a variety of users.

6 The implications of the structural context for action and climate services

Analyses that informed this section

- Qualitative analysis of semi-structured interviews.

Action is constrained, shaped or enabled also by factors that operate beyond the level of the choices made by individuals. These external influences may include the institutional or policy context as well as mandates, resources and facilities. These and other things make up the structural context for action, which also needs to be considered when designing climate services.

The interviews made apparent that while the respondents felt that there is increasing recognition of the risks of climate variability and change in their countries, the level of action – particularly in terms of preparing for long-term climate change issues – is not yet commensurate with the countries' levels of awareness and recognition.

The interviews made apparent that climate action is skewed towards short-term needs in sectors of prime importance for the country's immediate development priorities and concerns – particularly the water and agriculture sectors. As a matter of fact, a few respondents commented that there is a focus on the use of short-term and/or historical climate information in adaptation action, and a few that there is no use of long-term climate change information in adaptation action. This bias reflects a well-established tension in the literature (Jones et al., 2015; Nissan et al., 2019), that which exists between short-term developmental needs/priorities, and long-term sustainability imperatives (such as planning for long-term climate change). This tension is likely due to the issue of temporal (or delay) discounting: people tend to discount the importance of future costs and benefits, i.e. costs and benefits accrued in the present are typically considered to be worth more than costs and benefits accrued in the future. People typically perceive immediate threats as more relevant and of greater urgency than future problems (e.g. Weber, 2006), and research has shown that people count environmental and financial consequences as less important each year they are delayed (Hardisty and Weber, 2009).

One of the relevant implications for the climate services field is that **the uptake of climate information products might be maximised by focusing on consequences of climate changes for a country's development**, in other words, on impacts information, and that the focus should be on production and availability in the sectors that are assigned greatest priority in each country, in the first instance. Because little impacts information is currently available, one way in the short-term to increase its production might be to convene groups of sector-specific stakeholders/experts together

with national meteorological services staff to produce impacts information across sectors, as the Kenyan national meteorological services reportedly does (refer to section 7.1.2.1). The production of climate-related impacts information in sectors that are not of immediate focus in a country may help stimulate action in such sectors, possibly particularly so if the consequences of climatic variability and change in these sectors on developmental outcomes are made more evident. In some cases, this outcome may be achieved by highlighting the interconnections between non-priority and priority sectors. For instance, one interview respondent discussed the example of the need for his country (Kenya) to consider the development of infrastructure such as roads, even while agriculture and livestock are seen as the priority sectors, because in order to support the agricultural value chain and develop commercial agriculture, the provision of adequate (and climate-proofed) transportation links will become essential.

In terms of encouraging longer-term action, and thus the use of longer-term information, the climate services field can consider focusing its impacts information communications in a way that highlights potential current and future losses from not taking action on climate variability and change, rather than focusing on current and future gains from taking action on climate variability and change. The reason is that, if considering gains and losses of equal amount, people tend to give more weight to the threat of a loss than to the opportunity to gain (Elijido-Ten, 2017). When a "gain versus loss" framing is combined with a "now versus the future" framing, people discount future gains more than they discount future losses (Thaler, 1981). This kind of framing could also help motivate policy decision influencers to take action in sectors that are not of immediate priority, if action in the present is crucial to avoid major losses in the future, such as in the example already given above for the transport sector, where lack of action in the present could adversely impact the sustainability of the agricultural sector in the future.

The interviews highlighted that respondents would desire localised climate products for adaptation action. Some interview respondents explicitly commented that data from the national meteorological services does not have a sufficiently great spatial resolution to be used at the required levels, for example, at the farm level. This finding suggests that **the climate services field needs to consider whether it is scientifically feasible to provide climate information at finer spatial resolutions, and for which areas and sectors in a country this information is particularly necessary**.

Country governments are felt to prefer short-term action plans not only because of a focus on meeting immediate developmental needs, but also because for politicians, short-term electoral cycles push a need for "quick, demonstrable wins" to their electorate, meaning that long-term planning and action – such as that generally necessary for environmental sustainability and climate-compatible development – is unlikely. This finding has emerged in the literature before (e.g. Pasquini and Shearing, 2014). The literature (Pasquini and Shearing, 2014; Pasquini et al., 2015) has, however, also highlighted that political champions, when these support environmental/climate issues, have key roles to play in driving action on climate-related issues. Therefore, following recommendations made in Pasquini and Shearing (2014), **the climate services field may consider focusing on targeting politicians and political parties, which may require the climate services field to engage with those organizations working closely with political actors**. In South Africa, politicians take direction mainly from their party political structures (e.g. Lindell, 2008; Bawa, 2011), and if the situation is similar in other countries, targeting political parties with education, information, and awareness-raising interventions might prove a better strategy than focusing on particular politicians or political structures in specific locations. Further, because politicians are often replaced (through elections, through changes in party political lists), targeting dominant political parties and attempting to place climate issues on their political agenda might be one way to attempt to create a pool of political champions for environmental issues. These

recommendations echo the sentiments expressed in a few interviews, that political will is very important for climate action. In Kenya, one respondent commented that people listen to politicians and that, therefore, if politicians could be sensitised on climate-related issues, the impact of such sensitization would be large-scale. These findings highlight a more general point: that one entry point for climate services to engage desired target audiences on climate-related issues and information is to **establish, for each desired target audience, whom that audience listens to (i.e. who wields influence in that audience) e.g. politicians, tribal authorities, religious leaders, etc. The climate services community can work through such leaders to disseminate messages, sensitize audiences, promote the uptake and use of climate information, and change relevant norms** (similarly to point (4) under section 5.1.3).

As already mentioned in section 5.1.4, the interviews highlighted that men still dominate the policy decision influencer sphere, a trend that was ascribed to cultural factors influencing the choice of careers/professional fields for men and women. While it may not be in the remit of the climate services community to operate at cultural levels, the finding underscores, as mentioned already in section 5.1.4, the importance of working at the social norms level, given that men were found to hold greater self-enhancing values than women. It also suggests that the climate services field can make greater efforts to continue trying to encourage the entry of women into the policy decision influencer fields in which they currently do not have good representation.

7 Current use and desire of weather/climate information

Analyses that informed this section

- Statistical correlation analysis between each of the risk perception determinants and the use and desire for climate services.
- Qualitative analysis of the semi-structured interviews and open-ended questions in the survey.

7.1 Weather/climate information used

In both the questionnaire sample and the interview sample, respondents reported using climate information in their job frequently (see also section 4, Table 1, and Figure A8). In order of frequency of use of different categories of climate information, respondents in the questionnaire sample reported using (see Figure A9):

(1) daily to weekly forecasts;
(2) seasonal (three month) forecasts;
(3) observed (historical) records;
(4) projected impacts information;
(5) 1 to 5 year climate projections;
(6) projections of climate 5 years or longer into the future.

There are a number of reasons expected to be driving these results, which are addressed in the following sections.

7.1.1 Observed and short-term information use

When the risk perception determinants were statistically correlated to the types/time-scales of climate information used, one result that emerged is that the use of observed information and of seasonal forecast information is linked to increased observance of social norms.

While it would seem strange that the use of daily-weekly forecasts was not also linked to social norms, the likely reason is that a large proportion of the sample appeared to interpret the question on use of different types of climate information for their job very broadly. The qualitative analysis of the responses to the question 'why do you use this information, what for?' revealed that many respondents added using the weather forecast to plan clothing and travel choices to their list of answers of what they used climate information for (even though this is kind of use is strictly speaking not a part of a person's job). The interviews, which have the ability to be much more focused, also highlighted that people do not report using daily-weekly forecasts much for the conduct of their actual job, but rather reported using mostly observed information and seasonal forecasts. As such, it is likely that daily-weekly forecasts are not used as frequently for actual work purposes as the questionnaire results suggest. This being the case, the fact that observed information and forecast information should be linked to increased observance of social norms makes sense. Given that interviews revealed that both are frequently-used forms of climate information in people's work, it is logical

that as most people use observed and seasonal data, the people around them should also use these forms of information, as they observe and follow what those around them do. Where, then, does this use of observed and seasonal data come from in the first place?

The interview results suggest that in part, use of observed information and seasonal information, and norms around use of such information, are linked to 'the way things have always been done' in various climate-related sectors – e.g. the use of historical/observed data to design water supply and storage schemes – and to the countries' focus on immediate development needs and on demonstrable results, hence a focus on sectors like agriculture and on short-term timelines, which push a reliance on/desire for short-term, seasonal forecasts.

The questionnaire and interview results also suggest that the focus on observed and seasonal information is linked to the current landscape of climate services production and availability at a structural level. What does this landscape look like?

When respondents were asked in the survey which were their most trusted sources of climate information, their trust in their country's national meteorological services far outstripped their trust in other potential sources. These findings regarding the use of the national meteorological services as the main source of climate information are easily explained by the interviews, which highlighted that national meteorological services are the mandated body to provide climate information. This use of national meteorological services by respondents suggests that these agencies also contribute to 'setting' the intra-organizational norm that people should use observed and seasonal data, because within national meteorological services, the production and dissemination of climate data is skewed towards observed and short-term forecasting, up to the seasonal timescale. None of the east African national meteorological services provide climate projections longer than a seasonal forecast (see section 7.1.3.1 for further information on this).

To summarize, it is likely that the creation of the intra-organizational norm to use observed and seasonal forecast information is a result of a two-way interaction between producers and users of climate information. The focus on demonstrable results in the short-term and 'the way things have always been done' are likely to push climate information users to demand short-term and observed information, and the bias towards production of these forms of climate information in national meteorological services will reinforce their use.

Given that there is high use and desire for observed and seasonal climate information, an obvious implication for the climate services field is that the current focus on supply of these products can be continued, however, there are ways in which these services can be improved upon based on the emerging feedback on barriers to the use of observed and short-term information.

7.1.1.1 Barriers and enablers to observed and short-term information use

A few trends emerged from the interviews in terms of the barriers and enablers behind the current landscape of climate information production and availability. One is that while respondents use national meteorological services as their main source of climate services – as the mandated authority for the provision of such services – many reported using alternate information sources (mostly international bodies) for obtaining forecast information for verifying, validating or improving national meteorological services forecasts. **In response to these shortcomings, it is worth continuing to strengthen the collaborations between individual country national meteorological services and other international bodies in order to build in-country capacity for ongoing research and development of forecasting products, development of user-oriented products and communication. In particular, enhanced partnerships between national meteorological services and research institutions (both local and international) can assist in broadening the capacity to deliver reliable climate services**.

A couple of respondents from Ethiopia reported on one interesting enabler to climate information availability in the country: the integration of indigenous/traditional community knowledge (pastoral forecasting methods) with modern technology-driven forecasts is considered to be potentially very useful because traditional forecasting methods constitute a valuable source of information, and neither method alone is "complete". Previous research has shown that a combined scientific and indigenous forecast leads to greater trust and uptake of the forecast (Ziervogel and Opere, 2010). **Therefore, a combination of indigenous and scientific forecasts, for instance in the seasonal forecast, may hold potential for increasing the uptake of the seasonal forecasts amongst certain groups**.

Another set of barriers related to the requirement for users to have to pay for obtaining certain types of climate information from the national meteorological services (a way for this body to raise much-needed income). Such data was reported to be unaffordable, particularly the observed data records at finer resolutions, which is what users perceive to be most useful. One respondent noted that some observed data (the data at very high resolutions) cannot even be purchased from the national meteorological services. While this is a barrier that has been documented through many previous projects, it is a harder barrier to overcome without substantial economic reform of the way national meteorological services are funded and operate.

7.1.2 Impacts information use

A second result from correlating the risk perception determinants to the types/time-scales of climate information used is that the use of projected impacts information is positively correlated to personal experience of extreme weather events and to self-transcending values, and negatively correlated to self-enhancing values. The fact that as people's self-enhancing values grow, the less they use impacts information, could be explained by the fact that when climate change threatens people's worldviews and threatens to adversely impact their interests, people tend to downplay and discount it, as a form of denial or suppression (Wong-Parodi and Feygina, 2020). Therefore, it is possible that projected impacts information, which is likely more 'vivid' about the (negative) consequences of climatic variability and change, may be too 'threatening' for those holding strong self-enhancing values, although these explanations should be seen merely as hypotheses. The opposite finding, that people with self-transcending values and personal experience of extreme weather events make greater use of projected impacts information, makes sense considering that personal experiences of events can raise strong emotions, therefore making them more memorable and dominant in information processing. People's emotional reactions to risks often depend on the vividness with which negative consequences can be imagined (Loewenstein et al., 2001; Weber, 2006), and it seems logical that a preference for information that depicts the consequences of climatic variability and change would follow where people have personal experience of extreme weather events (which goes hand-in-hand with self-transcending values).

Given that the majority of respondents in the questionnaire sample reported self-transcending values and personally experiencing EWEs, what then explains the relatively low use of projected impacts information?

7.1.2.1 Barriers and enablers to use of projected impacts information

We expect the low frequency of use of projected impacts information to be due to its limited accessibility or detail, more than by desire to use it (see also section 6). An inspection of online climate services production and availability in east Africa reveals that many national meteorological services provide historical impacts information for the previous weeks, months and/or seasons. However, there is relatively low centralised production of projected impacts information, with the exception of broad projected impacts information included within monthly and seasonal forecast bulletins produced by some country's national meteorological services (e.g. the Kenya national meteorological seasonal bulletin, which provides high-level projected impacts for sectors such as agriculture, disaster risk, health, transport, water resources and energy).

More detailed projected impacts information appears to be primarily produced internally within sectors, ministries and organizations, based on forecasts obtained by national meteorological services. The production of this impacts information ranges all the way from relatively sophisticated (e.g. through coupling climate and crop models together) to fairly crude (e.g. making "rudimentary inferences" about health impacts based on experience of past events). One finding that emerged is that the knowledge of local, "on-the-ground" staff/observers is often drawn upon to generate impacts information, and so is experience of past events. In other words, experiential, localised knowledge is important in the production of impacts information. This finding is demonstrated nicely in the case of Kenya, where one respondent reported that although the national meteorological services is supposed to generate impacts information, they prefer to get sector-specific specialists (from within government agencies/departments) to co-generate impacts information based on the national meteorological services forecasts, through forum discussions. **In these cases, there is scope for continued and/or enhanced collaboration between the NMS and sector-specific specialists in pulling together sources of projected impacts information into a central repository for easy access by those who need it**.

Given the demand for forecasted impacts information (see section 7.2), in countries where there is little generation of projected impacts information, it is worth focussing on how to **strengthen the centralised generation of projected impacts information. One way of going about this could be to convene groups of sector-specific stakeholders/experts together with national meteorological services staff (as is being done in Kenya) to produce more detailed forecasted impacts information that span priority sectors**. The national meteorological services map rooms (available on many east African national meteorological services websites) have potential for hosting this more detailed impacts information, however, at the time of the review, many of the map rooms were not functioning.

Finally, the most frequently desired types of impacts information related to the impact of extreme weather events (droughts and floods) on the agricultural sector (crop yields), reflecting a concern with the sector of prime importance to East African countries' development, and with some of the extreme weather events respondents reported experiencing most frequently. But all this implies **a need to sensitize stakeholders to the fact that there are more impacts of climate variability and change than those on crop yields, and on flood and drought risk** – given that heat/high temperatures was reported as the second most frequent extreme weather event that policy decision influencers had experienced in their immediate spatial locations. The variety of impacts is something that policy decision influencers do have some understanding of, given that: a) across the sample, there was wide variation in impacts information desired; and b) the interviews showed that when respondents were asked more broadly about what impacts they had experienced from climate variability and change, many more impacts were reported in total than just flooding and drought. But this recognition of the myriad impacts of climate change is still insufficient.

7.1.3 Longer-term climate information use

A third result from correlating the risk perception determinants to the types/time-scales of climate information used is that the use of longer-term climate information is positively correlated to age and education, and negatively correlated to self-enhancing values. Use of projections longer than 5 years into the future increases with age. While it is not possible to offer any data-driven explanations for this finding, one hypothesis is that it could be due to a greater appreciation of the need to plan for the long-term the more an individual has spent in the policy decision influencer sphere and witnessed the disadvantages of short-term planning. Use of both 1-5 year projections and 5+ year projections increases with education, which may be due to the fact that climate change and long-term projections are relatively new additions to curricula and often still the preserve of specialized fields of study. The negative correlation between use of longer-term climate information and self-enhancing values could be due to efforts to suppress the need to consider climate change due to the threat it poses to people's values, as mentioned in section 7.1.2.

While the majority of respondents in the questionnaire sample had relatively high levels of educational attainment in general (as a reminder, 46% Bachelors degree, 35% Masters degree and 6% PhD), bachelor-level degrees outside of atmospheric science/climatology degrees have probably limited coverage of the use of longer-term projections, at least at the time respondents would have completed their degrees (40% of the sample fell in the 30-39 age category bracket, with only 23% younger than that). However, it might have been expected that there would have been greater use of longer-term climate projections in the sample given the relatively high general levels of education, and the fact that 37% of the sample was 40 or older. It is therefore expected that the low frequency of use of longer-term climate information is due to two major factors: the first, the general focus on short-term needs in sectors of prime importance for a country's immediate development priorities and concerns, which leads to a focus on the use of short-term and/or historical climate information in climate action, and little use of long-term climate change information (refer back to section 6). This theory is supported by the literature, in which a mismatch of timescales between longer-term information and the short-term priorities of decision-making is highlighted in many African contexts (Jones et al., 2015; Hansen et al., 2019; Carr et al., 2020).

7.1.3.1 Barriers and enablers to use of longer-term climate information

Many interview respondents felt that there was a strong expectation in their organization to work on climate variability and change, and this norm in a few cases was explicitly linked to increasing experience with extreme weather events. While experience with extreme weather events therefore seems valuable in shaping risk perceptions, norms and action on climate-related issues, this experience could potentially be a double-edged sword when considering the different foci on climate change vs. climate variability. The literature has shown that personal experience with extreme weather events can lead to greater concern on climate change, where individuals believe those extreme weather events are caused by climate change (see van der Linden, 2015). However, one interview respondent highlighted that the increase in frequency in extreme weather events leads to such a great need for emergency response (and an attendant focus on short-term/seasonal climate information), that long-term planning – required to deal with climate change, and not just climate variability – takes a backseat. This may explain (at least in part) why no correlation is seen between the use of longer-term climate change, and personal experience of extreme weather events, which might otherwise have been expected. Experience with extreme weather events may, paradoxically, therefore contribute to the low observed use of longer-term climate information. Therefore, if the climate services field highlights/works with extreme weather events, this may on the one hand be a way for the climate services field to better respond to the existing context of climate services used and desired; but on the other hand, it may reinforce action on only climate variability (even while it is likely to generally raises climate change risk perceptions at the same time).

If one wishes to maximise the uptake of long-term climate information specifically, one option is to better 'advertise' the link between planning for the long-term, and short-term immediate development needs. To do this, the inter-relationships between current choices and future consequences must be made clear, particularly for sectors that the country is most concerned with (see section 5.1.2 and section 6).

The second factor limiting the use of longer-term climate information (a limited use that was strongly confirmed by the interviews) is likely to be its limited accessibility and understandability. A review of climate services literature in Africa revealed several factors that may contribute to this situation: insufficient access to relevant and useful weather and climate information that is suited to the decision context (Jones et al., 2015; Singh et al., 2018; Hansen et al., 2019; Carr et al., 2020), insufficient technical capacity to understand and use the information (Singh et al., 2018; Nkiaka et al., 2019; Carr et al., 2020) and a lack of trust in the information (Nkiaka et al., 2019; Vogel et al., 2019). These sentiments were confirmed during the interviews.

The interviews also confirmed that the national meteorological services do not produce long-term climate information. The few respondents who reported using long-term projections named international climate centres/bodies and 'global datasets/models' as their sources. Lack of resources was reported as a barrier preventing the local production and availability of long-term climate information: funding, human capacity for long-term projections, necessary infrastructure (high-power computing), and sufficient quality and quantity of data on which to base projections. The existence of these international climate centres/bodies, and the existence of working relationships between some respondents' organizations (and/or the national meteorological services) and these bodies, were highlighted as crucial for the production/availability of long-term climate information. While the existence of long-term climate information from global datasets, models and centres is an obvious plus in the Eastern African region, some respondents did note drawbacks to these long-term projections: that they are too large-scale to be useful and/or require downscaling to be useful, and that they need to be evaluated for suitability (reliability, accuracy) to the local context. One respondent reported that there was a lack of trust in long-term climate information from external sources, because the sources of data used in such projections, and the manner in which such data is processed, cannot be verified. **As such, if national meteorological services were better equipped to become conduits for longer-term information (such as GCMs and CORDEX downscaled information) produced through a variety of international and regional centres, this may assist in gaining the trust of users for using longer-term projections**. This would alleviate the demand for national meteorological services to produce their own long-term projections but would provide credibility for the projections that are already being produced through other centres. However, caution should be applied in not endorsing some products over others in this process, otherwise the space for innovation and scientific advancement will become constrained to a few select "chosen" institutions. **Where national meteorological services have the potential to add value to these externally produced projections is in the development of country-specific guidance for how to use and apply these longer-term projections in their specific country context. This should include the context-specific suitability, strengths and/or limitations of each product for application. This guidance should be co-produced through a user-producer dialogue, thereby drawing on sectoral and thematic expertise to maximise the utility of the guidance for application in decision-making**.

7.2 Weather/climate information desired

The questionnaire survey asked respondents to indicate what kind of climate information they would like to receive for their job if they could have "any information they liked" (Figure A10). The results, however, closely matched the responses for what kind of climate information respondents currently use most frequently (Figure A9), suggesting that respondents may not have sufficiently understood the purpose of the question, or that they may not have considered different potential ways of using climate information in the conduct of their jobs (for example, due to habit or inertia).

However, when respondents were asked through an open-ended question in the survey about what kind of impacts information they might like to receive for their job, the vast majority of respondents desired receiving impacts-related information, and the majority desired more than one type of impacts information, with >40 types of impacts information mentioned in total. These findings confirm the expectation, mentioned above, that the low use of impacts information is unlikely to be related to desire for, or utility of, such information, but is more likely to be related to its low levels of production/availability. Unsurprisingly, the most frequently desired types of impacts information related to the agricultural sector (crop yields) and to extreme weather events (flood and drought risk), reflecting a concern with a sector of prime importance to East African countries' development, and with the extreme weather events respondents reported experiencing most frequently.

When the risk perception determinants were statistically correlated to the types/time-scales of climate information desired, the only finding of significance was that women had a greater desire for longer-term climate information (both 1-5 year projections, and >5 year projections). This finding may reflect the broader trend in risk perceptions research that suggests that risk perceptions tend to be higher amongst women than men (Poortinga et al., 2019), which may ultimately lead to greater sensitivity to long-term risks and therefore to desire for longer-term climate information, though these are, again, just hypotheses. While the climate services field may not be able to (or find appropriate) working to influence gender representation in the policy decision influencer sphere, **if better uptake of longer-term information is desired, the climate services community could explicitly choose to work more closely with the women who are already represented in the policy decision influencer community**.

7.3 Formats of climate information products desired

With regard to the formats that people would desire to receive climate information products in, the questionnaire survey did not reveal any clear favourites – "visual", "raw data" and "mixture of raw data and text" (in that order of priority) were all similarly highly ranked. "Text" was highly ranked much less often, and "verbal" was highly ranked the least of all (Figure A11). However, these results are not considered likely to hold much significance in the light of the interview findings. The interviews explored in greater detail people's preferences for maps, raw data, graphs, text and infographics by providing physical examples of each and discussing them with respondents. What the discussions made clear is that no one format emerges as clearly superior or preferred – much has to do with individuals' jobs, experience and needs. For example, graphs were considered to be of use to statisticians, economists and researchers/scientists, but of not much use for other audiences. As another example, while the questionnaire survey revealed a very low preference for "verbal" forms of communication among the policy decision influencers sampled, one respondent highlighted how this is an important format for farmers who are often illiterate. The interviews, thus, made clear also that much more detailed research on the topic is required to narrow down exactly which formats are most useful for which audiences. One strong finding that emerged from interviews, however, was people's interest in infographics. Many respondents felt that infographics are very useful for users because they are easy to understand, and a few highlighted that this mean they can be particularly useful for dissemination to non-technical end-users, with politicians, policy-makers and local communities provided as some example audiences. Importantly, some respondents underlined how little production of infographics occurs in-country. Therefore, **the climate services community can work to strengthen the production and dissemination of infographics where non-technical end-users consist of the target audience(s)**.

8 Additional concluding recommendations

While it may appear obvious, it seems worthwhile to highlight that the findings discussed thus far suggest that there are aspects of centralized forms of governance that have positive implications for the use and uptake of climate services, as well as for climate action. Given policy decision influencers' reliance on using national meteorological services, as the mandated agencies of government for climate services production and dissemination, there is the possibility for consistent sources and content of climate information products, that can hence lead to more coherent, coordinated climate action. Respondents' reliance on national meteorological services means that potential agents of change in the climate services community can direct their communication and capacity-building efforts regarding climate information products upon these agencies, in addition to working on an audience-by-audience basis.

Given that the use of different types of climate information appears strongly linked to the current landscape of climate services produced and available, it follows that **placing effort on making more types of climate information available, and "advertising" their availability, may change the types of climate information that policy decision influencers start using** – particularly if one works with national meteorological services, given that as discussed, there is a broader norm that national meteorological services should be primarily used for sourcing climate information products. Therefore, if national meteorological services change the products they produce, this shift would likely lead to some change in the norms around what type of climate information is used in the workplace.

It is clear, from the TRANSFORM research, that climate change risk perceptions in east Africa are different from those so far documented in the global North. For instance, a fundamental difference is seen in the psychological closeness of climate change amongst this east African audience as well as the number of extreme events that respondents report experiencing, factors that contribute to high climate change risk perceptions among this audience. Therefore, it stands to reason that messaging about climate change should take into account differences in context, rather than designing products in a "catch-all" approach. For designing climate services products in the east African context, multiple suggestions have been made through this project. However, it is important to note that, while not explicitly researched under TRANSFORM, the principle of differentiation is likely to be relevant to transdisciplinary engagement processes as well. The way in which transdisciplinary engagements are designed needs to, for instance, take into account the unique cultural and value systems of the audience, look to understand and even leverage particular social norms, and specifically draw on knowledge about currently-experienced extreme events amongst the community being engaged. **Sensitively designing audience-specific engagements is expected to assist in the development of the essential trust relationships that are required for successful transdisciplinary engagements, while also maximising the potential for uptake of any resultant climate services products.**

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Annex: Survey results

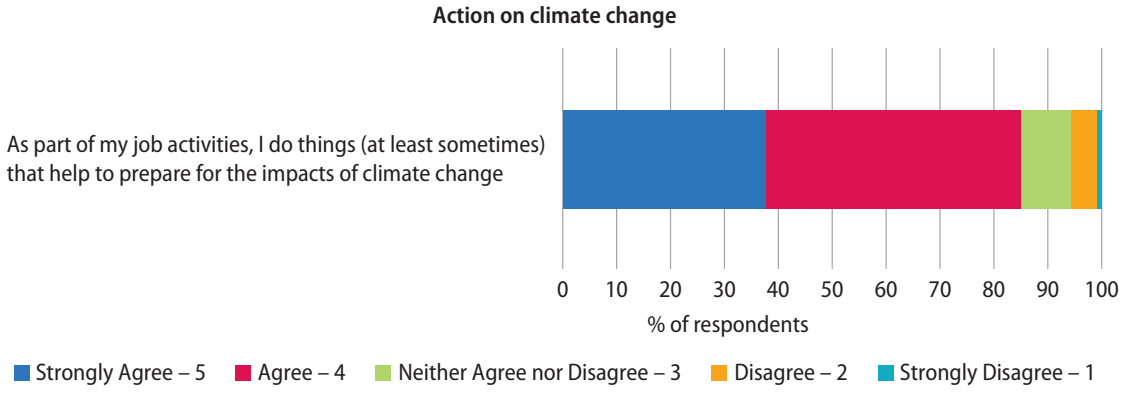

FIGURE A1: Climate change action (in a professional and private capacity)

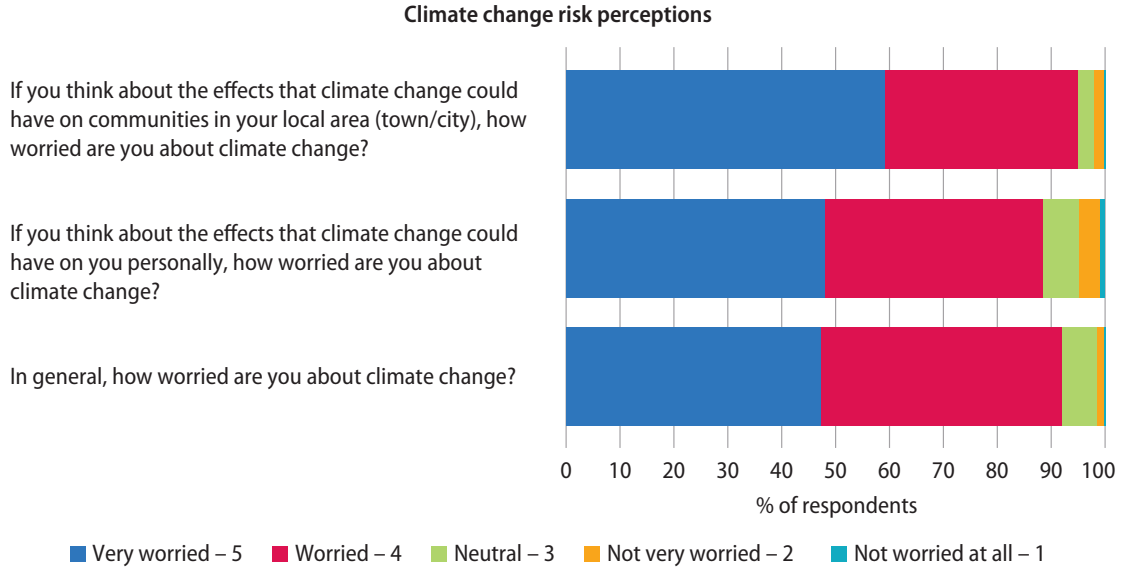

FIGURE A2: Risk perceptions

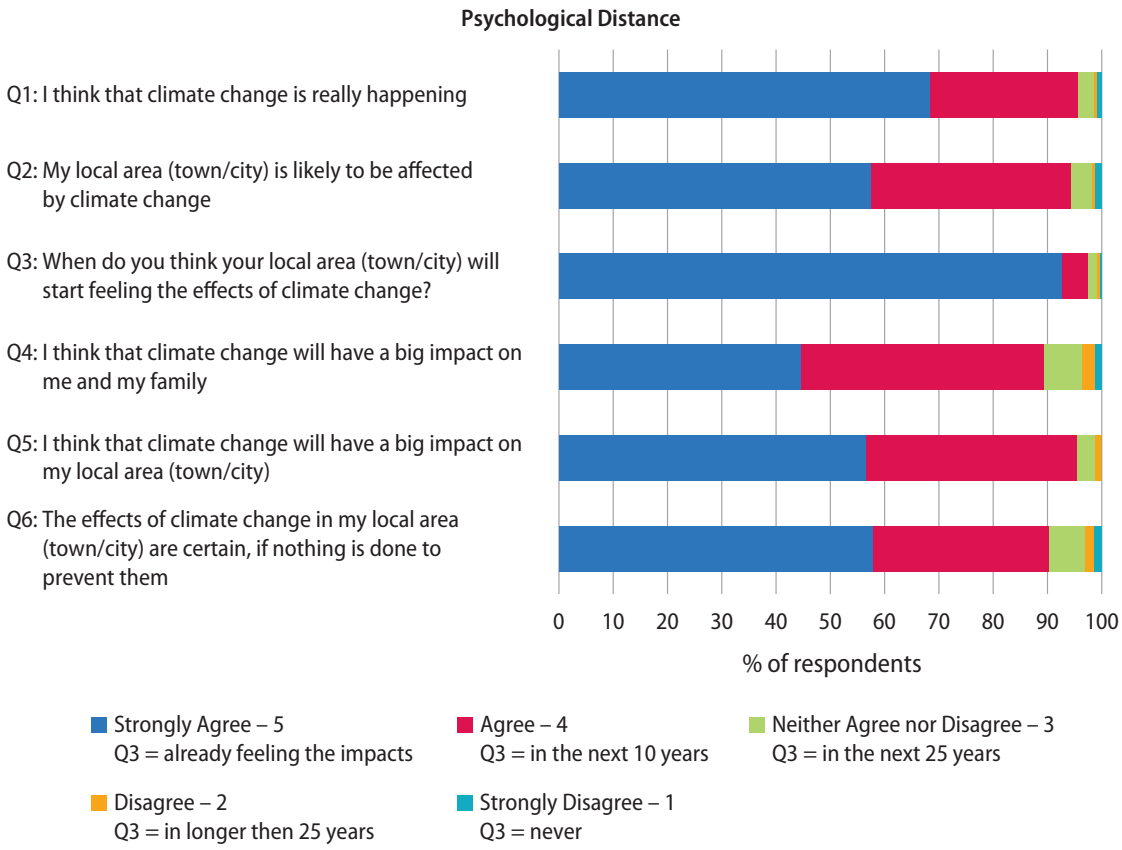

FIGURE A3: Psychological distance (closeness)

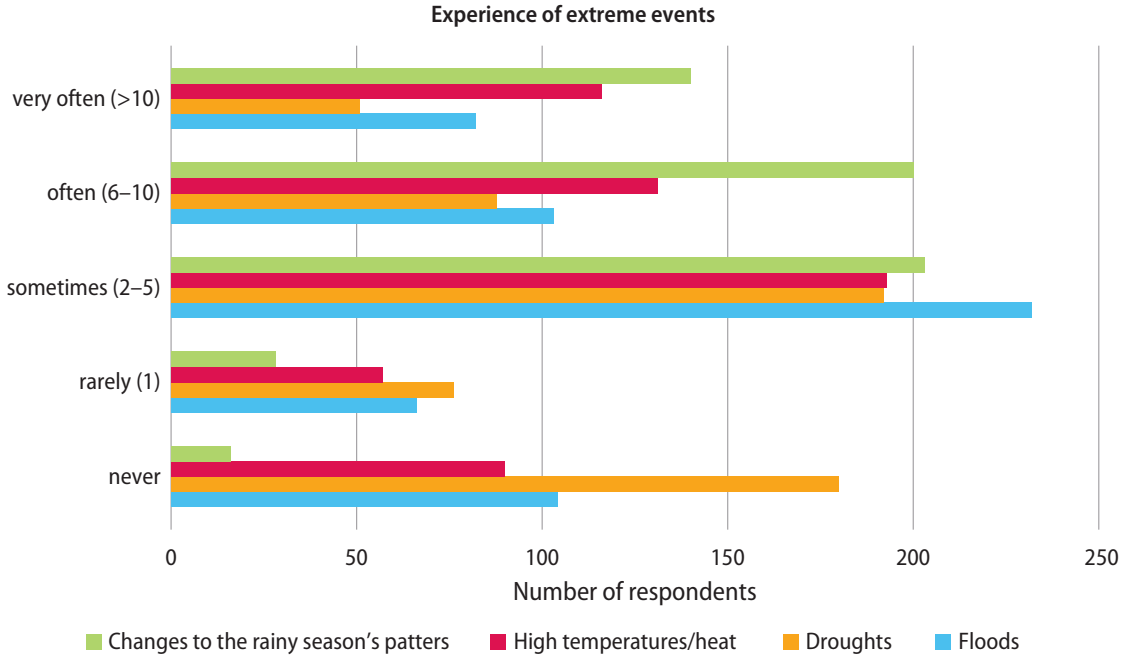

FIGURE A4: Experience of extreme events

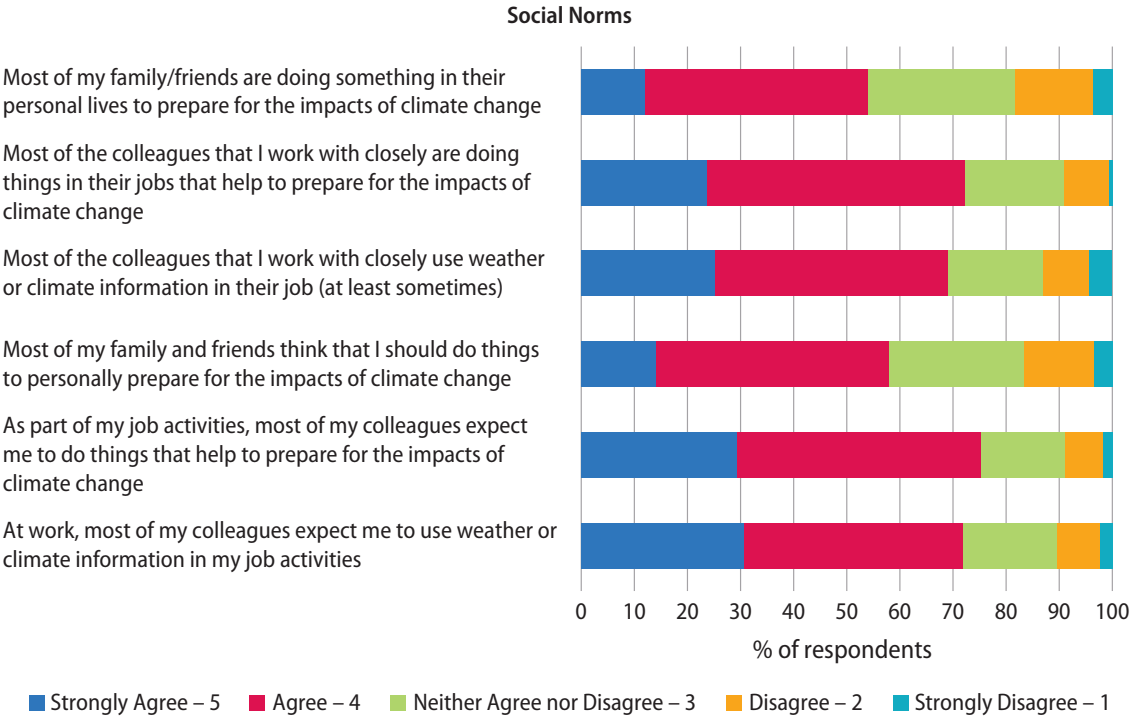

FIGURE A5: Social Norms

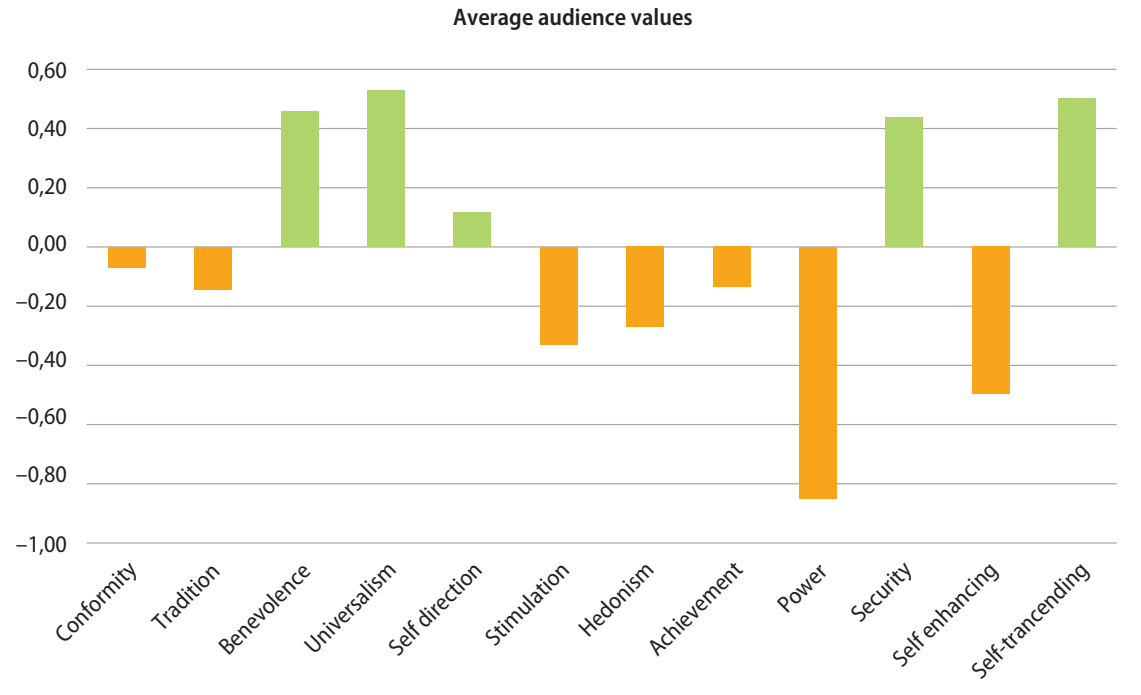

FIGURE A6: Values

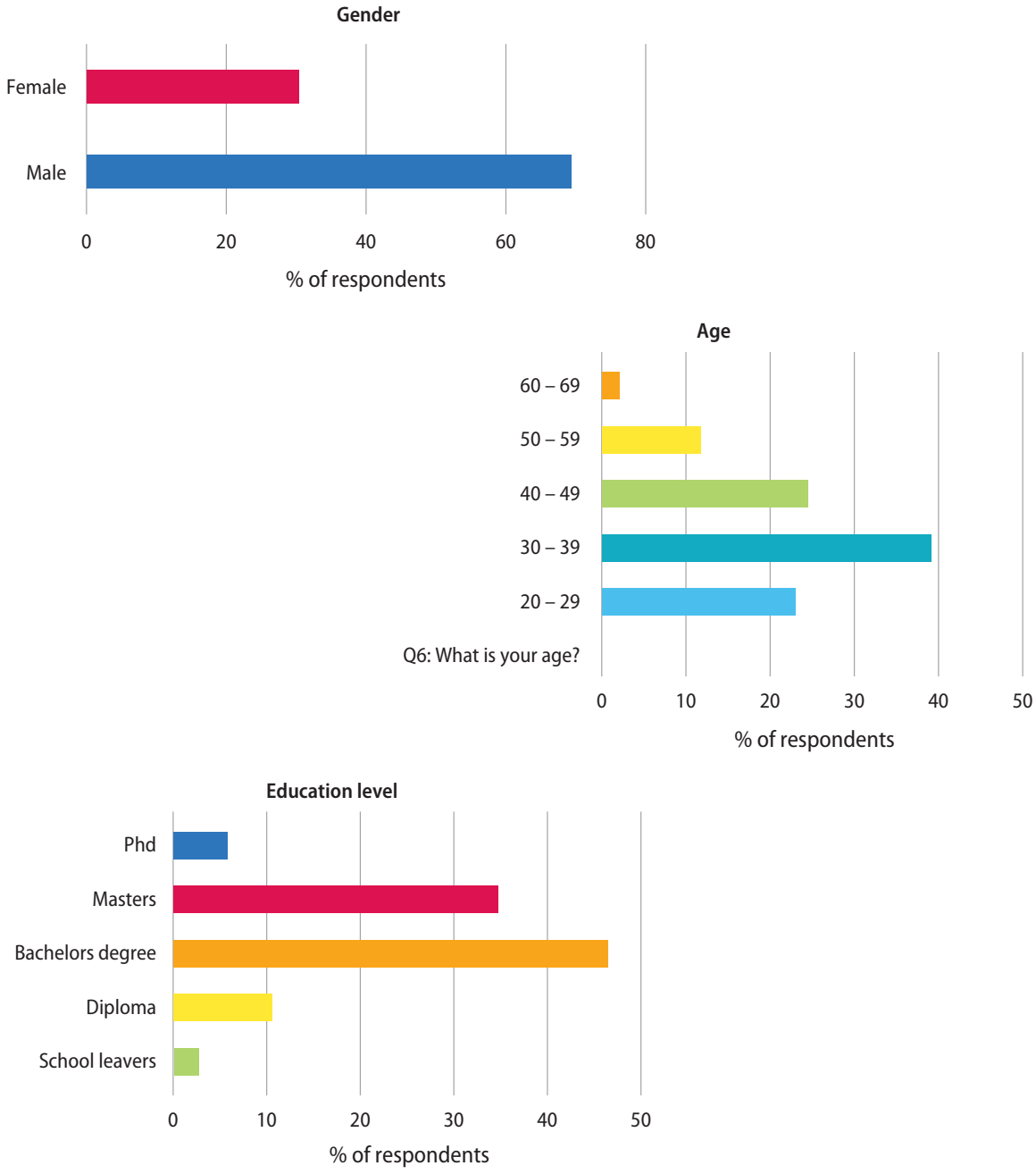

FIGURE A7: Socio-demographics: Age, Gender, Education

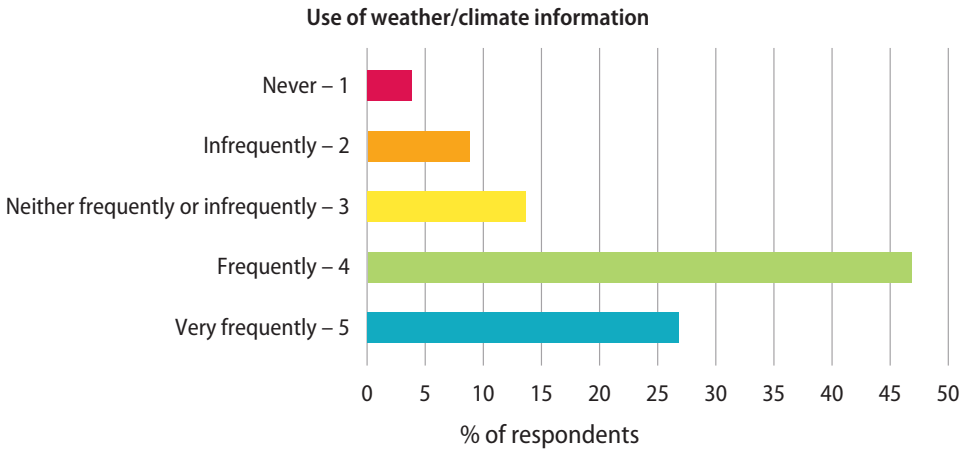

FIGURE A8: Use of weather/climate information

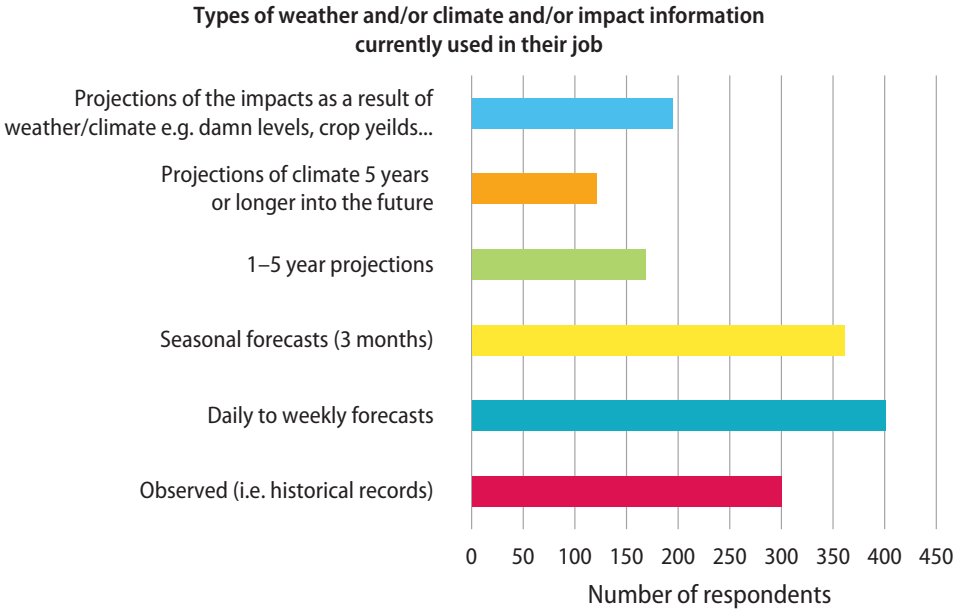

FIGURE A9: Type of information currently used in a professional capacity

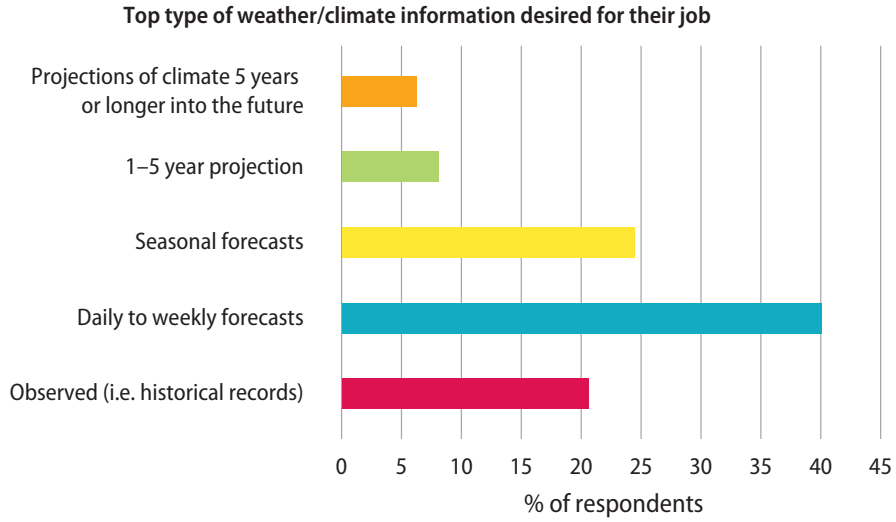

FIGURE A10: Desired type of information

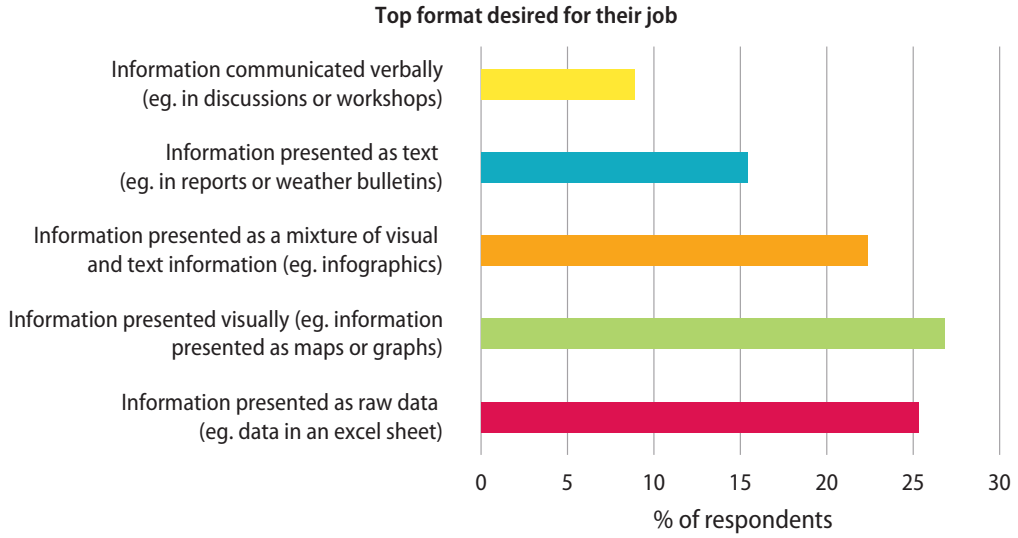

FIGURE A11: Desired format of information

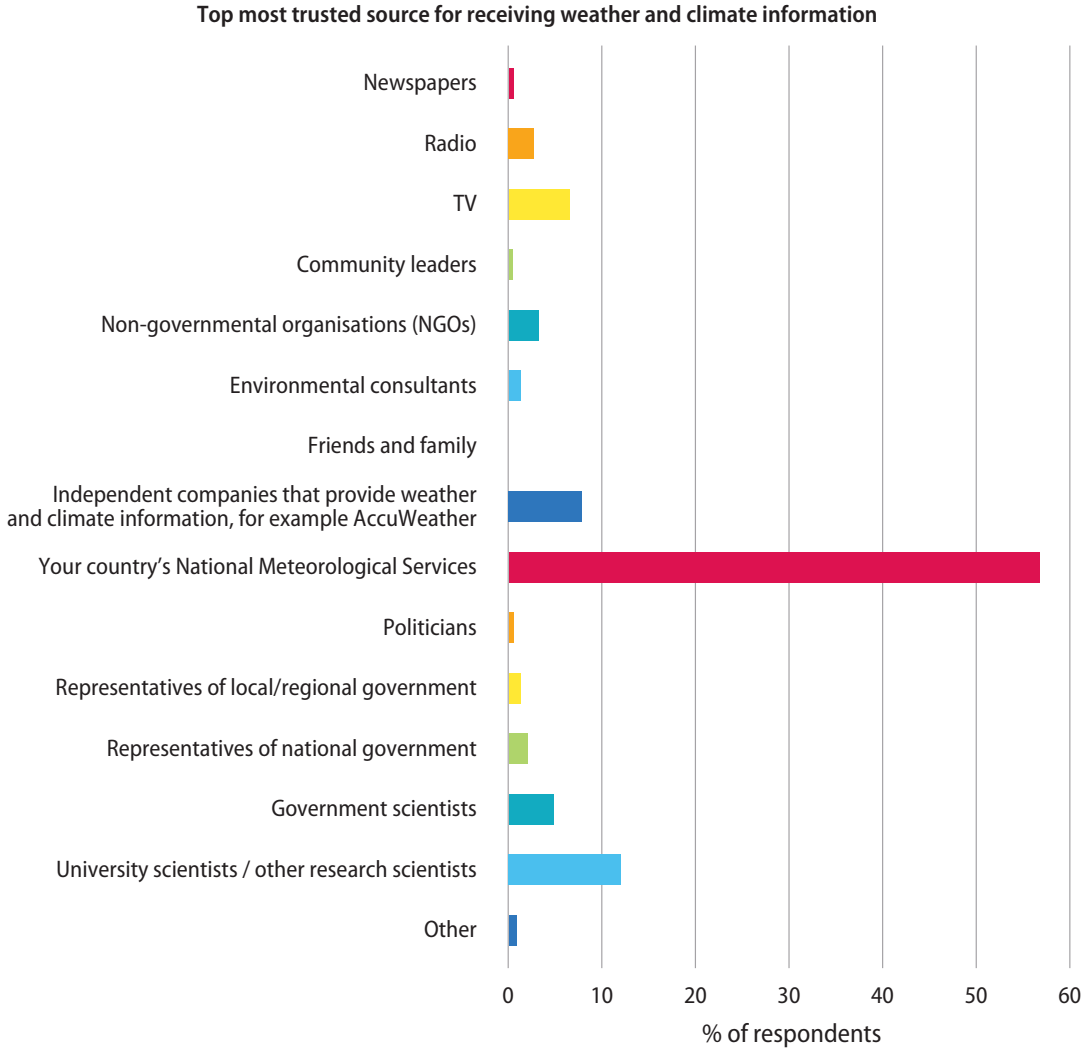

FIGURE A12: Trusted sources of information

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About WISER TRANSFORM

The Weather and Climate Services for Africa (WISER) programme's mission is to deliver transformational change in the quality, accessibility and use of weather and climate information services at all levels of decision making for sustainable development in Africa. WISER is a programme of the UK Department for International Development (DFID) which is split into two components: one Pan-African, managed by the African Climate Policy Center (ACPC); and the other focused on East Africa, managed by the Met Office, based in the UK. Under the East Africa component, the TRANSFORM project was tasked with better understanding how to improve the supply of climate information in a manner that is relevant and responsive to the context and needs of climate services users (and therefore increase the likelihood of uptake and use of climate information) through an environmental psychology approach.

The TRANSFORM project is a consortium led by SouthSouthNorth with the Climate System Analysis Group (CSAG) at the University of Cape Town, global consulting services company, ICF, the Overseas Development Institute (ODI) and the International Research Institute for Climate and Society (IRI) at Columbia University.

WISER
Weather and Climate Information Services for Africa

Fund Manager for WISER:
Met Office

Delivered by:
CLIMATE SYSTEM ANALYSIS GROUP
CSAG

Funded by:
UKaid
from the British people