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ORIGINAL ARTICLE

A gendered lens to self-evaluated and actual climate change knowledge

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Abstract

Gender-sensitive and gender-responsive approaches are important to increase adaptive capacity in a changing climate given the gendered nature of exposure levels to climate shocks. Nonetheless, knowledge and perception of the public to climate change influence behavioural intention to adapt. While literature is replete with public perception and adaptation strategies to climate change, there is a dearth of information exploring the influence of gender on climate change knowledge. This paper employs quantitative and qualitative data to examine the influence of gender on knowledge in climate trends in Beitbridge Rural District, Zimbabwe, using questionnaire surveys. This survey tool consisted of demographic questions on gender and other variables. Our results indicate that compared to women, actual knowledge of trends in selected variables of climate change was higher among men. Furthermore, male respondents had higher self-evaluated knowledge on climate trends compared to female participants. We recommend gender disaggregated data in the vulnerability and adaptation assessments and the education, training and awareness sections of the National Communications to the United Nations Convention on Climate Change.

Keywords Gender · Beitbridge · Zimbabwe · Vulnerability · Adaptation

Introduction

The warming of the climate system is now undisputable (Alliance for Green Revolution in Africa 2014; IPCC 2014a; Raab 2019). Climate change indicators such as changing precipitation patterns, increase in global average temperature and the changes in frequency and severity of extreme weather events such as droughts, floods and cyclones are already evident globally (Kristjanson et al. 2017) and specifically in sub-Saharan Africa (SSA) (Kotir 2011). Globally, climate change poses serious threats to the attainment of all Sustainable Development Goals (Getvoldsen et al. 2018).

Specifically, a decline in rainfall has been observed by several authors in Zimbabwe (Unganai 1996;Chamaille-Jammes et al. 2007; Tadross et al. 2009; Dube and Phiri 2013). This has been corroborated by perceptual studies (Kupika et al. 2019). A rise in the frequency and severity of dry spells has also been observed (Mutekwa 2009; Rurinda et al. 2014; Government of Zimbabwe 2017; UNDP 2017). With reference to Beitbridge, Mupangwa et al. (2011) observed an increase in dry spell occurrence during the peak rainfall season. Zimbabwe is also becoming warmer (Dube and Phiri 2013; Kupika et al. 2019). Several authors have confirmed that the occurrence of droughts is on the increase in Zimbabwe (Unganai 1996; Tadross et al. 2009; Muzari et al. 2014; Nhemachena et al. 2014; Rurinda et al. 2014; UNDP 2017; Kupika et al. 2019).

Evidence points to an increase in temperature (Zougmoré et al. 2018) and decline in rainfall (Masih et al. 2014; Sifundza et al. 2019) in SSA. According to the highest Representative Concentration Pathway (RCP8.5), the monthly summer temperatures over SSA will reach 5 °C above the 1951–1980 baseline by 2100 (Serdeczny et al. 2017). A study by Kotir (2011) indicates that in Zimbabwe, the mean annual and diurnal temperature range (DTR) have dropped by between 0.5 and 1 °C, respectively, since the 1950 (Kotir 2011) implying a general increase in temperature since both the minimum and maximum temperatures have gone up.

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All these expose smallholder farmers, who rely on rain-fed agriculture, to major risks of poverty and food insecurity (Hansen et al. 2019). Adaptation is, therefore, necessary to reduce farmers' vulnerability in the wake of the more variable climate.

Various studies have indicated that female-headed families are more vulnerable to climate change compared to male-headed families (Rao et al. 2019). High vulnerability of the former is due to limited mobility (Balikoowa et al. 2019), low adaptive capacities due to poor representation in key decision-making processes and inadequate access to crucial resources (World Bank et al. 2019). Furthermore, rural women, particularly those in developing countries are at high risk of the debilitating effects of climate change (Kakota et al. 2011). Indeed, the adaptive capacity and vulnerability of women and men involved in agriculture have a gender dimension (Fisher et al. 2015).

Studies in SSA have also shown that the responsibility to cope with the vagaries of climate change was more likely to fall on the shoulders of women, who coincidentally supply more than 80% of food produced in the region (Adeniyi 2010). More so, more than 50% of the total workforce in the agricultural sector in SSA is provided by women (Adeniyi 2010). In the case of SSA, the agriculture sector is vulnerable to climate change due to high dependence on rainfall (Assefa et al. 2018), which exhibits high temporal and spatial variation. The projected rise in aridity index in SSA (Serdeczny et al. 2017) water stress and land degradation; mainly soil nutrient mining and erosion exacerbate this situation.

The involvement of women in agriculture shows the importance of addressing the gender dimension for effective adaptation to climate change. Also, women's concerns, responsibilities and knowledge on climate change are central to effective adaptation, especially in the wake of harsh climate extremes like droughts, floods and cyclones.

Cyclone Idai, an extremely destructive category 4 cyclone that hit Chimanimani and Chipinge districts on the 15th March 2018, destroyed livelihoods, crops, grain reserves and infrastructure. The heavy destruction of social protection systems may have exposed women and girls to vulnerable conditions. Based on existing studies, these extreme weather events will become the new norm and many places that are susceptible to extreme events will face more intense hazards (Ebi and Bowen 2016). Elsewhere, studies have shown that compared to men, women, particularly those with low socio-economic status, are comparatively at higher risk of anxiety and mood disorders after catastrophes (Norris et al. 2002). Similarly, post-traumatic disorders are more prevalent in women compared to men (Olff et al. 2007) and violence against women tends to increase after disasters (Oxfam 2010).

Accordingly, building adaptive capacity to reduce the vulnerability of at-risk individuals, particularly women is an important research area. Some publications have concluded that the perception and attitudes of individuals are strongly related to their behaviour intention to cope with climate change (Akompab et al. 2013; Yu et al. 2013). García de Jalón et al. (2013) suggested the need for understanding perceptions of societies towards climate change and the associated demographic variables as key to effective adaptation planning while Patwardhan et al. (2009) pointed out the significance of knowledge in reducing the adverse effects of climate change, reducing vulnerability as well as generating effective adaptation strategies. Even though communities may not comprehend the physical science basis of climate change, their experience and knowledge on the impacts of a changing climate is important in adaptation studies (Gyampoh et al. 2009). The communities have also been monitoring and "peer reviewing" the atmosphere over a long period (Yeh 2016), which is critical in community-based adaptation. Yet, literature is awash with studies focusing on economic, social and environmental impacts of climate change (IPCC 2014b), while there is dearth of literature focusing on public perception in most adaptation studies (Bradford et al. 2012). This perception is a function of individuals' knowledge of climate change and is crucial in the success of the adaptation process (Nugun et al. 2019). Men and women have different exposure levels to climate shocks based on their different roles in a household or community (Perez et al. 2015). Women, who reside in countries where rain-fed agriculture is the main source of livelihood, may be more vulnerable to climate change given a glut of barriers they face in adopting improved agricultural innovations (Perez et al. 2015).

Studies in Uganda have revealed that male-headed families are less vulnerable to climate change compared to female-headed families (Balikoowa et al. 2019). However, men are at higher risk of disasters, because of their "heroic", "masculine" behaviour (Hemmati 2005) emanating from a high self-perceived knowledge. Furthermore, high self-perceived knowledge is reported to have detrimental effects on an individual's ability to assimilate new information or knowledge. Thus, the gender variable can determine an individual's knowledge and perception of science (McCright 2010) and preparedness to change behaviour and support of climate adaptation policies (Hemmati 2005).

Climate change disproportionately affects women, who constitute more than 50% of the world's poor people globally (Chant 2006; Munoz Boudet et al. 2018). Hence, the change in the climate will worsen the gender dimension of vulnerability, which are embedded in the current social inequalities. The change in climate is therefore anticipated to threaten economic activities, particularly for female-headed households. Gender-sensitive studies, including reports of gender-disaggregated data, are critical to enhancing climate change mitigation and crafting of gender-sensitive climate policies. To the best of our knowledge, there is scant literature on gendered climate change knowledge globally, particularly

women's perception of climate change (Selm et al. 2019). To bring greater focus to the importance of gender in climate change, it is important to understand better how actual knowledge on climate trends and the self-evaluation of this knowledge is influenced by gender. This present research study attempts to rectify this problem.

Our study is premised on two critical questions.

a) Does actual climate trends knowledge differ between genders?
b) How does the self-evaluation of climate trends knowledge differ between men and women?

Materials and methods

Study site

We conducted our research in Beitbridge Rural District in Matabeleland South Province, Zimbabwe (Fig. 1). The district has a total population of 80,335 with 19,574 households (Zimbabwe National Statistics Agency 2012). The average household size is 4.1, and the proportion of male to female population is 0.467:0.533. The rural district council has an area coverage of 12,697 m^2 and is divided into 15 wards making 58 villages. We selected Beitbridge district since it is ranked number one with regard to exposure to weather shocks, with an average hazard index of 0.7317 (UNDP 2016). The district receives a mean annual rainfall of 377 mm (Mazvimavi 2010). It is located in agro-ecological region V, making it one of the driest areas in Zimbabwe. The findings from our study are relevant to most rural settings in Zimbabwe, which have similar male to female ratio and are semi-arid. The study was conducted between November 2017 and December 2018. We obtained verbal consent from the respondents after a cover letter was distributed a few weeks prior to the administration of the questionnaire. Participants were not asked to put any form of identification on the questionnaire as a way of assuring anonymity.

Selection of the respondents

A simple random sampling was used to select six wards for the survey: numbers (1 to 15) were assigned to the wards and the RANDBETWEEN function in MS Excel was used for randomisation. To obtain the desired margin of error of 5% and a confidence level of 95% with an assumed response rate of 80%, a sample of 380 respondents were randomly selected from the total population of 19,574

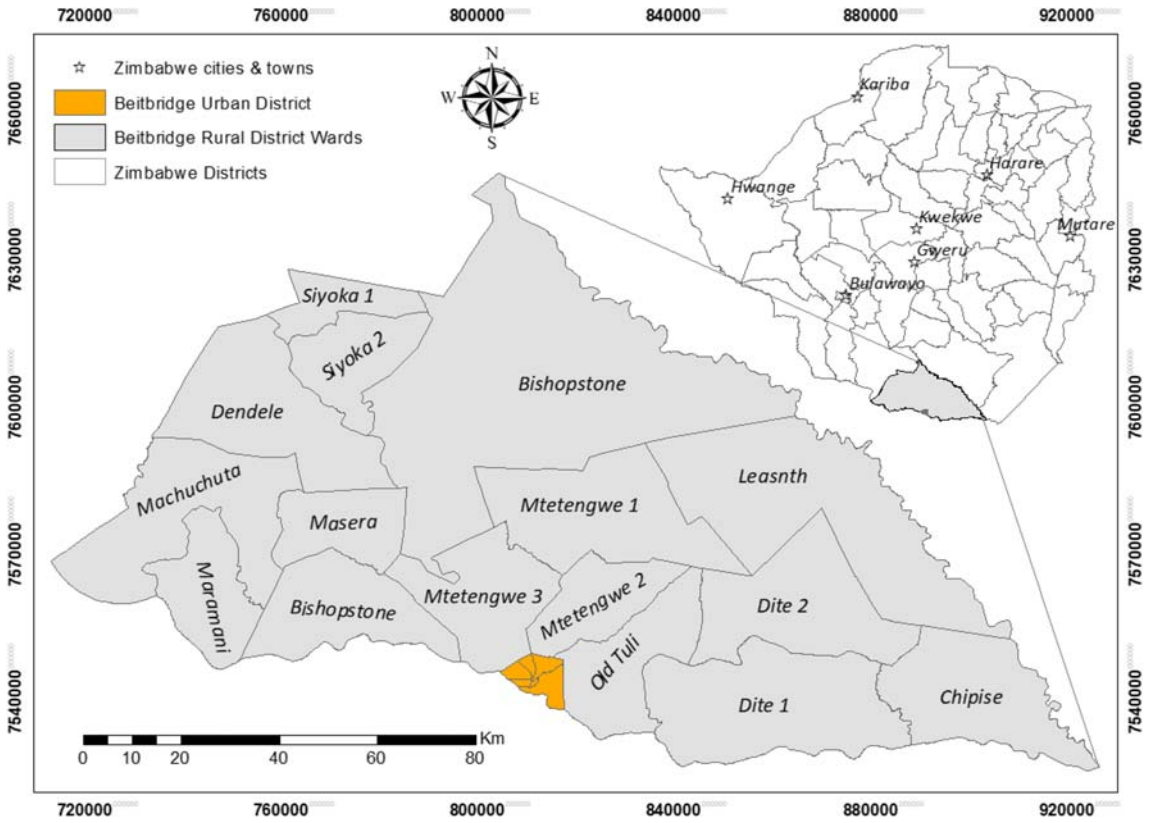

Fig. 1 Beitbridge Rural District study area map

households. Random sampling was used for the selection of participating households. A list of households in the six wards was obtained from the Agricultural, Technical, and Extension Services (AGRITEX) office. Each household in the six wards was given an identifying sequential number, and participating households from each ward were picked using the lottery method as proposed by Taherdoost and Group (2017). The survey instrument was administered at the household level, targeting the household head or the person entrusted with responsibilities in case the household head was absent. In our survey, 365 participants were successfully interviewed giving a response rate of 95.8% implying that the margin of error was within the desired range.

Data collection

We used a semi-structured questionnaire that was administered using face-to-face interviews with the respondents. The actual knowledge assessment instrument contained statements such as: "The rainfall is decreasing"; "The temperature is increasing" "The frequency of floods is increasing"; "The frequency of droughts is increasing" and "The frequency of dry spells is increasing". These variables for the assessment of actual knowledge on climate trends were selected based on literature review as shown in Table 1. The participants were asked to show their level of knowledge with regard to the above-mentioned climate trends statements using the following Likert Scale: Strongly Disagree (1), Disagree (2), Not Sure (3), Agree (4), and Strongly Agree (5). In our survey, we were also alive to the possibility that people who are actually incompetent in some subjects might have a miscalibrated scale of their own performance (Gross and Latham 2012). This phenomenon, commonly known as the Dunning Kruger effect, is particularly relevant in gendered climate change science where women tend to underestimate their intelligence in many subjects including the science of climate change (McCright 2010; Stoutenborough and Vedlitz 2014) in what some scholars have called the gender confidence gap (Kissinger et al. 2009). This has been attributed to negative stereotype and low self-confidence of women in science subjects (Grunspan et al. 2016) To explore this possibility, the participants were asked to rate their knowledge of climate trend parameters by responding to the statement "I am confident that I know the trends in climate parameters" based on the following Likert Scale: Strongly Disagree (1), Disagree (2), Not Sure (3), Agree (4), and Strongly Agree (5).

In order to identify potential challenges in the questionnaire, pre-testing was done before the main survey. Data from questionnaires were triangulated through focus-group discussions (FGDs) and key informant interviews so as to enrich the findings. Participants for the FGDs were chosen based on gender, age group and social class to ensure equal representation.

Data processing and analysis

Our data which were collected on a five-point Likert scale were collapsed to a binary response as suggested by Lovelace and Brickman (2013). This was because we were interested in the knowledge of the respondents on the trends in climate variables and not the depth of that knowledge. Responses with Strongly Disagree and Disagree were coded as No (0), while the Strongly Agree and Agree were coded as Yes (1). The response indicated as Not Sure was presumed to be nonresponse or lack of knowledge on the subject, and these were treated as No (0). To determine the overall actual knowledge of the participants on trends in climate parameters, the scores of an individual were added and expressed as a percentage. For example, a participant who scored four out of five would get 80%. All marks below 50% were coded as low (coded 1), 50–70 (good; coded as 2) and above 70 (excellent; coded as 3).

All the objectives were analysed using the Mann-Whitney U method to compare if there was a difference in the dependent variable for two independent groups (male and female). We used this method to test the null hypothesis "there is an equal probability that an observation from one sample will exceed an observation from the other sample" since the two samples come from the same population and the data met all the assumptions of this method. The differences in means were considered significant at $p < 0.05$.

Table 1 Climate change variables selected for the study based on literature review

Perception variable	Trend	Reference
Rainfall	–	Unganai (1996); Chamaille-Jammes et al. (2007); Zimbabwe National Statistics Agency (2012); UNDP (2017)
Temperature	+	Turner and Rao (2013); UNDP (2017)
Drought frequency	+	Mudavanhu and Chitsika (2013); Government of Zimbabwe (2013); Murwira (2014); UNDP (2017)
Dry spells frequency	+	Tadross et al. (2009); Mupangwa et al. (2011); UNDP 2017)
Flood frequency	+	Government of Zimbabwe (2013); Murwira (2014); UNDP (2017))

(+) increasing trend, (−) decreasing trend

Results

Gendered disaggregated selected demographic attributes

Our results suggest that there are more male-headed households than female-headed households in the district as the former accounted for almost two-thirds of those that participated in the survey (Table 2). Almost three-quarters of the participants had acquired secondary education. However, a greater proportion (about four-fifths) of the male respondents had acquired secondary education compared to the female category with slightly above two-thirds of the respondents having acquired this standard of education (Table 2). With regard to tertiary education, only 20% of the participants had acquired this standard of education. Yet, only 25% and 10% of male and female participants had acquired this level of education, respectively (Table 2).

Actual knowledge of climate trends between genders

The results for assessing perceptions of the trends in individual climate parameters are shown in Table 3 and Table 4. The results revealed that there was a significant difference between the genders with regard to actual knowledge in the trend of the climate parameters. Results for actual knowledge on climate trends show that a greater proportion of men had actual knowledge of the trends on 4 of the 5 climate change variables compared to their female counterparts (Table 3). Thus, compared to their female counterparts, the male participants were better informed about climate trends. Specifically, there were significant differences in knowledge scores on variables: decline rainfall ($U = 12{,}891$, $p = 0.01$); increase in temperature ($U = 13{,}510$, $p = 0.000$) and increase in the frequency of dry spells ($U = 11{,}741$, $p = 0.000$) (Table 3). However, no significant differences were recorded with respect to actual knowledge on increase in drought frequency ($U = 14{,}884$, $p = 0.935$) and increase in the frequency of floods ($U = 13{,}897$, $p = 0.150$) (Table 4).

Gendered self-evaluated and actual knowledge on climate change

The results for gendered perception on self-perception and overall actual knowledge are shown in Table 5 and Table 6. With regard to self-evaluation of knowledge on climate trends, Table 5 illustrates that a greater fraction of male participants (mean rank = 196.57) in our study judged themselves as having "good" knowledge of climate trends, compared to female respondents (mean rank = 156.63). Concerning overall actual knowledge, again there was a significant difference between the genders, where the male participants exhibited more overall knowledge in the perception of climate variables ($U = 12{,}098$, $p = 0.000$). We also observed a significant difference between men and women on self-evaluated knowledge as shown on Table 5 ($U = 11{,}702$, $p = 0.000$), where men perceived themselves as being better informed about trends in climate parameters than women.

Having initially established that there was a statistically significant difference between men and women in the self-evaluated and actual knowledge, the mean values were inspected to find difference in performance. The actual test mean score of the overall climate change trends was 2.53 ± 0.753 meaning that participants had excellent knowledge of the trends in climate parameters. The self-evaluated mean score was 1.90 ± 0.668 indicating a very low self-evaluation of knowledge by the participants.

Discussion

Gendered actual knowledge of trends in selected climate variables

Our results show that actual knowledge in trends in selected climate variables is significantly different between men and women and higher among men than women. Generally, respondents were more knowledgeable about the decreasing trend in rainfall. Several studies (Unganai 1996;Chamaille-Jammes et al. 2007; Tadross et al. 2009; Dube and Phiri

Table 2 Education level by gender

Highest education level	Gender					
	Male		Female		Total	
	Number	%	Number	%	Number	%
None	1	0.41	5	4.03	6	1.64
Primary	16	6.64	2	1.61	18	4.93
Secondary	163	67.63	105	84.68	268	73.43
College/tertiary	61	25.31	12	9.68	73	20.00
Total	*241*	*100*	*124*	*100*	*365*	*100*

Table 3 Mean rank and sum of ranks for male and female response on actual knowledge of trends in selected climate variables

	Gender	N	Mean rank	Sum of ranks
Rainfall is decreasing	Male	241	191.51	46,154.00
	Female	124	166.46	20,641.00
	Total	365		
Temperature is increasing	Male	241	188.94	45,535.00
	Female	124	171.45	21,260.00
	Total	365		
Flooding frequency is increasing	Male	241	178.66	43,058.00
	Female	124	191.43	23,737.00
	Total	365		
Dry spell frequency is increasing	Male	241	196.28	47,304.00
	Female	124	157.19	19,491.00
	Total	365		
Droughts are increasing	Male	241	183.24	44,161.00
	Female	124	182.53	22,634.00
	Total	365		

2013) corroborate a decline in rainfall for Zimbabwe. In a perception study on climate variability in the Middle Zambezi Biosphere Reserve in Zimbabwe, Kupika et al. (2019) showed that the majority of the respondents agreed that precipitation amount is on the decline. Although Zimbabwe exhibits high seasonal rainfall variability, a gradual decline in precipitation has been noticed in the country. This decline in rainfall is consistent with observed trends for southern Africa (Fauchereau et al. 2003) and Zimbabwe (Brazier 2015). A general decline in precipitation patterns is projected for SSA (Serdeczny et al. 2017) while the African continent is generally becoming warmer and drier (Masih et al. 2014; Sifundza et al. 2019).

Furthermore, a rising trend in temperature has been observed in Zimbabwe (Dube and Phiri 2013; Kupika et al. 2019). The general rise in temperature in Zimbabwe is consistent with regional and global trends (Serdeczny et al. 2017). With respect to dry spells, several studies have concluded that Zimbabwe is becoming drier with increased frequencies and severity of dry spells (Mutekwa 2009; Rurinda et al. 2014; Government of Zimbabwe 2017; UNDP 2017). More specifically, Mupangwa et al. (2011) observed a 48 to 69% chance of getting a two-week dry spell during the peak rainfall season in Beitbridge. Surprisingly, majority of the respondents did not agree that there is an increase in the intensity and severity of droughts as several authors (Unganai 1996; Tadross et al. 2009; Muzari et al. 2014; Nhemachena et al. 2014; Rurinda et al. 2014; UNDP 2017; Kupika et al. 2019) indicated that drought frequency and intensity are on the increase in Zimbabwe.

Numerous factors may be attributed to the gendered knowledge gap between men and women. This could stem from structural issues within the society where in the past, girls were not accorded equal opportunities as boys. Boys would study Science, Technology, Engineering and Mathematics (STEM) subjects to prepare them for masculine jobs such as engineering, while women were encouraged to study fashion and fabrics with less interaction with climate sciences; thus, their actual knowledge of climate change is lower than that of the males. In the area of research, the percent share of women researchers in natural sciences and engineering is only 24.9% in Zimbabwe (UNESCO 2018). Elsewhere, studies in Kenya

Table 4 Gendered differences in actual knowledge on trend in climate parameters

	Rainfall	Temperature	Floods	Dry spells	Droughts
Mann-Whitney *U*	12,891.000	13,510.000	13,897.000	11,741.000	14,884.000
Wilcoxon *W*	20,641.000	21,260.000	43,058.000	19,491.000	22,634.000
Z	− 3.204	− 3.494	− 1.440	− 4.865	− 0.082
Asymp. sig. (2-tailed)	**0.001**	**0.000**	0.150	**0.000**	0.935
Exact sig. (2-tailed)	**0.002**	**0.001**	0.166	**0.000**	0.951
Exact sig. (1-tailed)	**0.001**	**0.001**	0.095	**0.000**	0.472
Point probability	**0.001**	**0.001**	0.035	**0.000**	**0.001**

Table 5 Gender disaggregated response on self-evaluated knowledge on climate trends

	Gender	N	Mean rank	Sum of ranks
Actual knowledge	Male	241	194.80	46,947.00
	Female	124	160.06	19,848.00
	Total	365		
Self-evaluated knowledge	Male	241	196.57	47,373.00
	Female	124	156.63	19,422.00
	Total	365		

have shown that fewer girls take up STEM courses at college level or higher than boys (Mbaki et al. 2010). In South Africa, women are under-represented in STEM subjects and STEM-related jobs. Although universities in SSA have been trying hard to close the gender gap since the 1990s, nothing significant has come out of this considering that only 10% of females participate in natural sciences (UNESCO 2018). Factors such as socio-cultural norms, career preferences, lifestyle values, beliefs and self-perceptions and gender-based stereotypes and bias expectations take away many young scientifically talented women from studying science subjects. At international forums such as the UNFCCC meetings, there is little consideration of the gender aspect, as most of the delegations are male-heavy, meaning that women are not being granted the space and opportunity to speak on behalf of women (Hemmati 2005).

The results, which indicate convergence of male and female respondents on the actual knowledge of trends on flood and drought frequency, show that men and women are equally affected by natural disasters. However, the increase in the mean rank for women compared to the other variables can be attributed to the gendered effects of these extremes. Women are affected more by natural disasters, particularly if their socioeconomic status is low. A post-cyclone Idai report on Zimbabwe indicated that women and girls in the affected areas were vulnerable to gender-based violence (The World Bank 2019). Furthermore, it is reported that 70% of the victims of the Asian tsunami of 2004 were women (Habtezion 2015). Equally, the same report indicates that poor women were the majority of victims of Hurricane Katrina, which occurred in New Orleans, United States of America, in 2005. These calamities also bring about post-traumatic stress disorders of which studies done elsewhere indicate that post-traumatic stress disorders are more likely to affect women than men (Charak et al. 2014; Birkeland et al. 2017).

Table 6 Gendered differences in actual and self-evaluated knowledge on climate trend

	Actual knowledge	Self-evaluated
Mann-Whitney *U*	12,098.000	11,702.500
Wilcoxon *W*	19,848.000	19,452.500
Z	− 3.647	− 3.762
Asymp. sig. (2-tailed)	**0.000**	**0.000**
Exact sig. (2-tailed)	**0.000**	**0.000**
Exact sig. (1-tailed)	**0.000**	**0.000**
Point probability	**0.000**	**0.000**

The gendered concern about disasters can be linked to the livelihood options of communities. In a risk perception study in South Africa, Thomas et al. (2007) observed that compared to men, a majority of women underscored the occurrence of heavy rains as a distinct risk, while men were worried about drought, because of their gender-specific roles for ensuring food security during droughts. In Zimbabwe, several drought adaptation strategies include good postharvest storage practices (Muzari et al. 2016), adjusting the timing of planting, planting drought-tolerant crop varieties and practicing water-conserving technologies (Frischen et al. 2020). However, Zimbabwean women are largely excluded from making these key decisions (FAO 2017). In Botswana, most women were worried about high rainfall variability and particularly to drier climate since they derived their food and income from the veldt products (Omari 2010). All these point to the differential impacts of climate phenomenon on men and women depending on their roles in the household (CARE International 2010).

While our statistical analysis shows an intersection between males and females on the actual knowledge of trends on floods and drought, we are alive to the potential influence of the timing of our research on these results. The research was done soon after cyclone Dineo which caused massive flooding in southern Zimbabwe including Beitbridge (UNDP 2017). Such extreme events that occur just before perception surveys are conducted have the potential to skew the results towards the most recent event (Warikandwa 2019) thereby creating "memory illusions" in the perception of trends of climate (Roediger 1996; Daw 2010).

Self-evaluated knowledge on climate trends

In terms of self-evaluated knowledge on climate trends, this was higher in men compared to women. However, female respondents generally had low levels of self-evaluated knowledge on climate trends. The high self-evaluated knowledge on climate trends in men together with their "heroic" behaviour tends to put them at high risk of disasters (Hemmati 2005). It can also be a barrier to the assimilation of new information or knowledge.

Our results, which indicate an accurate self-evaluation of knowledge in climate trends in men compared to women, are a departure from previous studies which have shown the following: on average, men tend to overestimate while women

underestimate their self-evaluated intelligence (Dahl 2009); students who may have low metacognitive ability may have high self-efficacy; and some people would not "know what they knew" (Clauss and Geedey 2010). These results in corroboration with the overall high actual knowledge and low self-evaluated knowledge suggest an absence of the Dunning Krugger effect in the studied population. This can be attributed to the experiential nature of the climate phenomena and the tested climate variables. Although the results suggest an absence of the Dunning Krugger effect in the studied population, this does not suggest its absence in the other populations or country and in science communication at global level where absolute expertise may lead to misinformation or alarmism. However, this may be reduced by taking interdisciplinary perspectives on climate research and communication seriously, in consistent with the need to perforate boundaries between disciplines with different epistemologies in climate change research as recommended by the Intergovernmental Panel on Climate Change's Third Assessment Report (Nielsen and D'haen 2014). This entails getting different perspectives from other disciplines exploring climate issues and communicating inconvenient truths. This allows for a comprehensive understanding on the context of the problem and foregrounds attempt to address a complex real-world problem of climate change. This approach can be used to further climate change research and education beyond the disciplinary boundaries with the impact of reaching a wider audience.

In our attempt to an interdisciplinary approach through data collection, analysis and integration of insights from natural sciences, social sciences and humanities, we, however, acknowledge that the process of data transformation from a Likert scale to a binary analysis has a potential to lead to a different conclusion compared to a non-transformed data.

Certain interventions could be critical in improving the knowledge of climate change. Under the UNFCCC, each country that is part of this convention is expected to observe the various commitments under the convention including periodically submitting National Communications. The national communications contain aspects on National Greenhouse gas inventory, National Circumstances, Vulnerability and Adaptation Assessments, Research and Systematic Observation, Technology Transfer; Education, Awareness and Training initiatives; Policy, Gaps and Constraints.

A gender lens to reporting these issues could be the starting point; especially gender-disaggregated data on vulnerability and adaptation assessments, policy, and education, training and public awareness relating to climate change. However, the gender lens in which the climate information is framed should be country-specific and tailor-made to resonate with the social context of the people. Education, Awareness and Training programmes on climate change should target women considering that lower perceptions of knowledge may result in negative implications in women's engagement in climate change education and advocacy if their cognitive understanding of climate change is not improved. Such interventions are critical since women who are victims of disasters are also good agents of social change. In addition, the women also make a significant contribution to disaster risk reduction and have proven skills, experience and capacities in community mobilization (Oxfam 2010).

Conclusion

Our research was premised on the following two critical questions: (a) Does actual climate trends knowledge differ between genders? (b) How does the self-evaluation of climate trends knowledge differ between men and women? We found out that gender has an influence in determining both actual as well as self-evaluated climate trends knowledge. Specifically, men had higher actual climate trends knowledge than women. Our results also indicate that women have low self-evaluation of climate trends knowledge compared to men.

These findings have implications on transforming climate policy approaches and the distribution of resources particularly towards education and training to mitigate the impacts of the social construction of male and female on access to climate knowledge as well as transforming the language from masculine- to a gender-responsive language. Contrary to the notion of limited effects of climate change knowledge on concern and environmental sustainability, the findings on the knowledge of floods and drought trends implies and invokes care and concern about environmental sustainability, livelihoods and food security. This is interwoven with gender as an "organizing" principle of social life and, therefore, should form the basis for the continuation of climate change education and dissemination. However, these initiatives should be particularly sensitive to the ways of transforming policy framing and rethinking the constitution of those who participate in the policy-making process beyond the status quo of male dominancy.

Future climate research should explore how and in what ways the social structures and gender identities influence climate change knowledge as well as exploring the perceptions on risk through a gender lens. In making these research pointers, we also suggest a methodological plea in which interdisciplinary methods like mixed methods for data collection and analysis are employed and perspectives from different disciplines inform each other to untangle complex issues in climate change research. Second, we suggest use of more nuanced gender measures beyond females and males to include non-binary attributes and behaviours, such as masculinity or femininity. These tend to be inclusive and allow for an analysis of males and females who exhibit masculine or feminine traits by choice or circumstances especially as household heads. This corroborates with

McCright (2010) and Bauer (2012) who suggested use of a multidimensional indicator of gender identity to address some of these concerns. We also recommend gender-disaggregated reporting on vulnerability and adaptation assessments, policy, education, awareness and training programmes in the country's national communications to the UNFCCC.

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Author contributions Dr. Raymond Mugandani, Mr. Tavengwa Chitata, Mr. Elvis Mupfga and Mr. Batanai Sammie designed the research under the guidance of Dr. Mugandani and Mr. Chitata. Dr. Raymond Mugandani, Mr. Elvis Mupfga and Mr. Batanai Sammie collected the data. Mr. Sammie cleaned and recorded the data. Dr. Mugandani, Mr. Chitata and Mr. Liboster Mwadzingeni designed the analysis procedure. Dr. Mugandani, Mr. Chitata and Mr. Mwadzingeni analysed the data. All the authors worked on the flow, clarity, organizational structure, discussions and conclusions under the guidance of Dr. Mugandani and Mr. Chitata. Dr. Mugandani and Mr. Chitata took the lead in writing the manuscript, and all authors commented on previous versions of the manuscript. All authors read and approved the final manuscript.

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Data availability Data are available upon request.

Compliance with ethical standards

Conflict of interest None.

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