



# Perspectives of environmental health officers on climate change adaptation in Australia: a cross-sectional survey

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## Abstract

**Aim** Climate change adaptation is critical for reducing and preventing many community health risks. The Environmental Health Profession has decades of experience of effective interventions for reducing and preventing many community health risks. However, in Australia adaptation is not included in the profession's scope of practice leaving the community health at risk to climate change. The aim of this study was to assess the perspectives of Australian Environmental Health Officers concerning climate change health adaptation and whether this should be included in their role.

**Subject and methods** Eighty-nine (89) eligible participants undertook a mixed method survey between November 2021 and January 2022. These participants were members of Environmental Health Australia and held a relevant degree in environmental health. The questions on the survey were related to six themed items: (1) climate change and health, (2) climate change adaptation, (3) the profession's role in capacity building for adaptation, (4) hurdles for building adaptive capacity, (5) health awareness as a bridging concept and finally, (6) disaster risk reduction.

**Results** The findings from this study indicate that the majority of participants were concerned for their community health from climate change impacts. A system thinking approach is required to effectively address and understand complex health risks. There was also an overwhelming support for the profession to integrate approaches of disaster risk reduction and climate change adaptation in health. However, the environmental health profession is facing some significant hurdles to building adaptive capacity to climate change.

**Conclusion** This study demonstrates the environmental health profession does want to have a role in climate change adaptation in Australia. These findings, with further qualitative research, could bolster the preventive public health approach in building community health resilience to climate change and related disasters.

**Keywords** Climate change adaptation · Environmental health profession · Disaster risk reduction · Health resilience

## Introduction

The latest report (AR6) from the Intergovernmental Panel on Climate Change (IPCC) identified signs of the negative impacts of global temperature increase, such as more frequent extreme weather events and related disasters (IPCC 2023). Climate risks are appearing faster and will become more severe, while also arriving earlier than previously reports expected (IPCC 2023). These impacts associated with climate variability are altering and intensifying existing risk (OECD 2020). The scientific evidence suggests there will be more warming for decades to come and there will be a need to manage the potential human health impacts (Berry et al. 2018b). Despite recognising health as a key factor in the outcome in adapting to climate change, global actions aimed at addressing the impacts has been slow (Pörtner

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et al. 2022). There is a significant adaptation gap present in managing the complex human health risks, and also for responses to the increasing disaster risks (Cissé et al. 2022).

Climate change and climate-related disasters have significant impacts on human health and these impacts are becoming increasingly important, globally (Aitsi-Selmi and Murray 2015; Beggs et al. 2022). New approaches to disaster risk management have shifted away from solely response and recovery, to also include prevention, mitigation and preparedness in the disaster cycle (Phibbs et al. 2016). Importantly, these new approaches encompass a focus on reducing present risks and preventing new risks also building resilience to these risks (Phibbs et al. 2016). However, globally, most governments are still prioritising disaster response and recovery in providing temporary results at a very high cost (Keim 2021). The Sendai Framework for Disaster Risk Reduction emphasises the importance for increasing health system resilience by reducing health impacts from extreme climate events, including also biological hazards (Aitsi-Selmi and Murray 2015; Wright et al. 2020). There are also explicit links between the health aspect of the Sendai Framework and eleven (11) of the seventeen (17) United Nations Sustainable Development Goals (Wright et al. 2020). Therefore, this approach is widely recognised as crucial for reducing health impacts of climate-related hazards and extreme weather events (Cissé et al. 2022).

There is a suggestion that climate change adaptation (CCA) can be integrated across the broader range of environmental health and disease prevention areas (Paterson et al. 2012; Smith et al. 2023). Prevention also has been proven to be an effective approach for managing human health risks (Keim 2021). For decades, the environmental health profession (EHP) has had experience in implementing effective interventions for reducing many health risks in preparing for and responding to hazards (Frumkin et al. 2008). Furthermore, the EHP has vast experience in training, skills and expertise, as well as their regulatory powers for effective interventions in reducing many health risks (Schwartz et al. 2006; Smith et al. 2023). These existing knowledge areas include air and water pollution, contaminated food, communicable diseases, environmental pollution control, vector-borne diseases and pre/post disaster management (Schwartz et al. 2006). Environmental Health Officers (EHOs) have a critical role in monitoring and controlling the quality and health of the human environment preventing diseases of environmental origin (Shezi et al. 2019; Wright et al. 2014). This disease prevention is achieved through monitoring and controlling environmental factors that may influence an individual's health and wellbeing (Wright et al. 2014). However, the scope of practice for the profession does not explicitly reference climate change and health-related adaptation strategies as their core responsibility (Shezi et al. 2019; Smith et al. 2023).

In Australia, there is a significant gap particularly evident in the climate and health field in focusing on adaptation at the community level. Additionally, there is a paucity of research connecting CCA to the EHP. To the authors' knowledge there is no published survey data globally that provides an in-depth analysis on the role of EHOs in CCA. Therefore, the aim of this cross-sectional survey was to develop an understanding of the current perspectives that EHOs in Australia have towards CCA. We sought to answer four questions assisting in understanding this gap: (1) Does CCA in health appeal to the wider EHOs population? (2) Do EHOs believe they have a role to play? (3) What are the main hurdles for the profession to achieve CCA? (4) Do EHOs believe an integrated approach with disaster risk reduction approach is suitable for their practice? The survey described here was the initial data collection phase of a mixed method research study design and will be used to build on the next qualitative phase of our research.

## Materials and methods

### Participants

Participants were required to be members of Environmental Health Australia, hold an appropriate degree and be or have been, working in the profession within Australia. No prior sample size calculation was undertaken. As incentives increase response rates (Dillman et al. 2009), participants who completed the survey in full were offered an entry in a prize draw for a chance to win one of six \$50 gift cards.

### Survey instrument

The survey instrument was developed and administered online through Qualtrics Survey Software version November 2021 (Qualtrics 2021) with no identifying information collected. The Central Queensland University Ethics Committee approved the study protocol (Ethical No. 22504). The electronic survey was prefaced with an information sheet incorporating a brief description of the study and outlining the purpose.

### Validity and reliability testing

A new survey instrument was created as there was no useful published survey identified, or that could be modified. To validate this instrument, we applied face, content, and construct validity tests. At the beginning of each survey theme, any key terms used in the subsequent statements were defined to assist in instrument reliability to provide a consistent understanding to the respondents. Respondents were reminded that the setting for their responses was

within the Australian context. The survey was provided to seven (7) people known to the survey designer to undergo a face validity test. These participants were able to provide an evaluation on the survey's clarity of the questions, feasibility, readability, consistency of style and any formatting that may require modifying. The feedback received was considered and, if necessary, changes were made to the instrument. Next, the survey questions were examined by an expert in quantitative survey design for content validity.

To maximise content and face validity, the survey was further pilot tested on twelve (12) EHOs, not meeting the survey inclusion criteria (i.e. not an EHA member). The answers provided by the respondents were examined to assess for unexpected results that required further checking relating to the purpose of the question. The pilot survey dataset for the Likert scale statements (i.e. opinion dimension) were run through Statistical Package for the Social Sciences (SPSS) software version 28 (SPSS 2022) to perform an exploratory factor analysis. Any statements that were identified as being too complex were rephrased or removed. Cronbach's alpha was used to measure the construct reliability of the redrafted instrument. The results revealed that the climate change scale with five items ( $\alpha=0.89$ ), EHO profession with five items ( $\alpha=0.82$ ) and health awareness with four items ( $\alpha=0.89$ ) were considered good for internal consistency. The adaptation scale with four items ( $\alpha=0.68$ ) was considered borderline acceptable.

### Survey setting and format

Participants were purposefully selected to meet the desired target group. The survey was made available by email via Environmental Health Australia to members on their mailing list. The email included a URL linked to the online survey. A follow-up reminder was sent after two weeks. Collection of data started on 22 November 2021 and was officially closed on 12 January 2022.

The questions on the survey were related to six themed items. Most questions asked respondents for answers scored using a 5-point Likert scale, i.e. 1 = strongly disagree, 2 = disagree, 3 = undecided, 4 = agree, 5 = strongly agree. The remaining questions asked respondents to select six hurdles from a range of options or required 'yes' or 'no' response followed by an open-ended response describing their reasoning.

The survey featured a forced response to all questions meaning that respondents could not proceed further unless they completed each question, unless the question was skipped by design (e.g. did not work for a government or agency). No missing data replacement was required because of this. For full survey wording and response options, refer to the survey instrument in Attachment 1. At the survey conclusion, a closing message thanking respondents for their responses was displayed.

## Statistical analysis

### Quantitative data

Data from the survey were exported from Qualtrics to SPSS and then analysed descriptively to determine normality, variability, and central tendency. The data were cleaned prior to the analysis. As the initial analysis revealed that the data were not normally distributed, non-parametric tests were used. Non-parametric pairwise comparisons (Wilcoxon signed-rank tests) and group means test were used to determine if, on average, respondents were more likely to rank within a group. A  $p$ -value of  $<0.05$  was used to determine significance (two-tailed). Chi-squared tests  $X^2$  were applied to the other questions with nominal and ordinal variables for comparison against expected values for odds ratios and 95% confidence intervals. The inferential statistics analysis did not reveal any significant results between groups, meaning the groups were consistently answering the survey statements similar to each other.

### Qualitative data

Open-ended responses were organised and analysed thematically (T.W. & R.P.) using NVivo Version 28 software (QSR) (NVivo 2023). These qualitative results were integrated by comparing with the results to expand the understanding of the quantitative data.

## Results

### Demographics

One hundred and eighteen (118) EHOs attempted the survey. However, 29 (24.5%) respondents were excluded from the analysis because they either did not consent, did not meet inclusion criteria or did not provide any data beyond demographic questions. The results presented here are from the eighty-nine (89) who undertook the survey. Due to the several separate branch member databases within Environmental Health Australia, it was not possible to obtain an accurate estimation of the population sampled.

Full sample demographics are reported in Table 1. Members of the Queensland branch (32.6%) were the most involved, followed by (20.2%) from New South Wales. A low response for a large state of Victoria is likely because of a competing professional body operating in this state, resulting in fewer branch members. The sample included more regionally (55.8%) located EHOs

**Table 1** Demographics of respondents

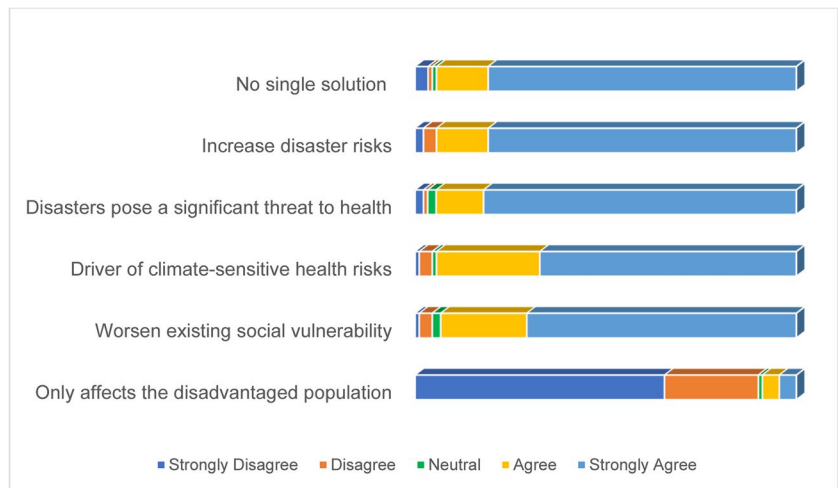
Variable	Level	Number	Percentage %
EHA branch	Queensland	29	32.6
	New South Wales	18	20.2
	Victoria	3	3.4
	Tasmania	8	9
	South Australia	15	16.9
	Western Australia	16	18
Location	Capital city	38	44.2
	Regional	48	55.8
Work sector	Local Government	63	70.8
	State Government	17	19.1
	Federal Government	1	1.1
	University	3	3.4
	Private contractor	2	2.2
	Retired	2	2.2
	Other	1	1.1
Education level	Associate Diploma or equivalent	9	10.1
	Bachelor degree	41	46.1
	Graduate Certificate/Graduate Diploma	17	19.1
	Masters	16	18
	Doctorate	6	6.7
Years experience	Under 5 years	23	25.8
	6–10 years	14	15.7
	11–15 years	10	11.2
	16–20 years	13	14.6
	21–25 years	8	9
	More than 26 years	21	23.6
Gender	Female	38	42.7
	Male	51	57.3
Age	21–30 years	13	14.6
	31–40 years	23	25.8
	41–50 years	25	26.1
	51–60 years	19	21.3
	61 + years	9	10.1

than those located in metropolitan areas (44.2%). As expected, respondents employed in the Local Government sector formed the majority (70.8%). Bachelor degree (46.1%) was the most common highest education level of respondents. There was a diversity of work experience with respondents having less than five years' experience (25.8%), making up the sample. Similar diversity was also found in age, with 41–50 age group (26.1%) consisting of the respondents. For gender, the sample included slightly more males (57.3%) than females (42.7%). The survey did ask the respondents if they worked for a Government Department or Agency (87.6%) to determine health department size ( $M = 7.6$ ,  $SD = 8.1$ ). Professionals indicating there were current vacant EHO positions within their department comprised (35.5%,  $n = 27$ ) of respondents.

### Climate change and health

Respondents were first asked about their opinions relating to the general climate change and health statements (Fig. 1). Most (94.3%) agreed or strongly agreed that climate change has no single solution and requires multiple approaches. The next statement was referring to climate change as a driver of disaster risks with most (94.3%) agreeing or strongly agreeing that the risks will increase. Climate change related disaster events and health impacts found that 94.3% agreed or strongly agreed that it poses a significant threat to human health. Similarly, 94.3% also agreed or strongly agreed that climate change will drive climate-sensitive health risks such as the deaths and injuries from extreme events. An overwhelming majority (93.2%) agreed or strongly agreed that climate change can make social vulnerability worse. The last

**Fig. 1** Responses as a percentage for climate change statements



question was asked because of a potential misunderstanding that climate change only affects disadvantaged populations; however, the majority (89.9%) disagreed or strongly disagreed.

The broad consistency in opinions in this section was expressed by one respondent in the open-ended questions:

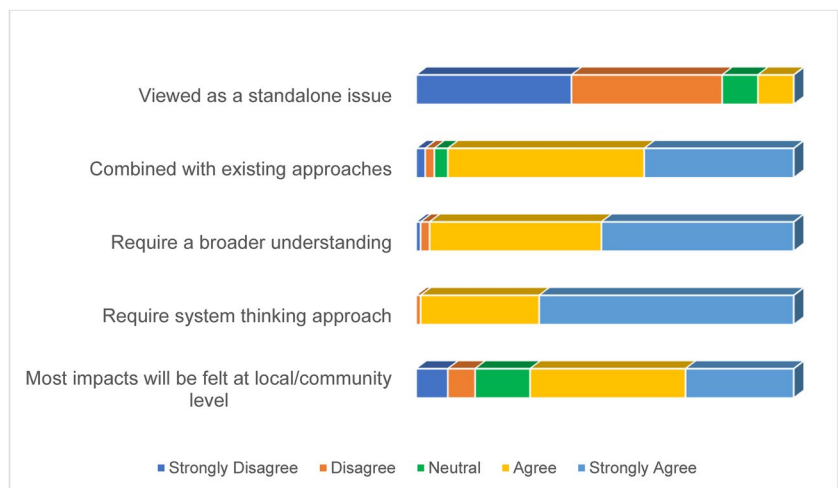
*Changes in the environment and weather conditions will increase risks regarding public health, e.g. heat-waves impacts on people, flood waters increasing the risk of disease in communities, and the impacts of increase in frequency and intensity of wildfires and cyclones on communities displacing people.* (P11-Frontline male EHO)

**Managing climate change impacts**

The respondents were asked for their opinion on issues around general CCA strategy for managing impacts

(Fig. 2). This was to determine how the profession believes adaptation can be enhanced to better manage the impacts of climate change. The first two statements were along similar lines but were phrased differently. Most of the respondents (80.7%) disagreed or strongly disagreed that adaptation should be viewed as a stand-alone issue, unconnected to other concepts. However, more respondents (91.6%) agreed or strongly agreed with the subsequent statement, that adaptation should be combined with existing approaches. Likewise, the next two statements were again similar but phrased differently. The respondents mostly (96.4%) agreed or strongly agreed that adaptation will require a broader understanding of issues. While an overwhelming majority (98.8%) agreed or strongly agreed that adaptation will require a system thinking approach to explore interrelationships in a holistic manner. The final statement in this section asked respondents if most climate change impacts will be felt at a local level, to which 69.9% agreed or strongly agreed.

**Fig. 2** Responses as a percentage for managing climate change impacts





This broader thinking was identified in the open-ended section as:

*We need to consider the WHO holistic definition of health and use that broader thinking as part of our decision making and consultation. (P10- State Government male Manager)*

In this section, the respondents were also asked, which level of government should have the leading role in managing adaptation to climate change impacts. They were given predetermined responses of Local (13.5%), State (14.6%) or Federal (53.9%) Governments and a free text option (11.2%) if none of these are responsible. In the free text option, eight respondents indicated that all three Governments have the leading role. The respondents were next asked, what percentage should each level of government have for front line climate change adaptation in managing the impacts at a local community level. They were provided with a sliding scale of 0–100 for each government level and the grand total required of all three options needed to equal 100. The percentage results were Local Government ( $M=35.6$ ,  $SD=20.7$ ), State Government ( $M=32.9$ ,  $SD=12.2$ ) and Federal Government ( $M=31.5$ ,  $SD=18.9$ ). A respondent acknowledged health at local level for the EHOs as:

*EHOs understand local communities and thus have the ability to shape disaster resilience to resemble what is needed for locals. (P42-Frontline female EHO)*

### EHP role regarding capacity building for adaptation

Respondents were asked for their opinion around their profession as a role regarding capacity building for adaptation (Fig. 3). This was to determine if EHOs acknowledge that the profession has a role to play. The first statement asked whether the profession is uniquely

positioned to manage health risks. Most respondents (81.5%) agreed or strongly agreed that the profession is uniquely positioned with interfaces between environment and health risks as well as between government and local communities. The majority of the respondents (90.1%) agreed or strongly agreed that the profession has a role in assisting their local community to adapt to health impacts. The respondents mostly (95.1%) agreed or strongly agreed that climate change will likely require changes to the scope of work for the profession. A similar majority (95.1%) agreed or strongly agreed that the profession should be proactive in preparing for the health impacts. For the last statement, 88.9% agreed or strongly agreed that CCA may result in new work opportunities for the profession.

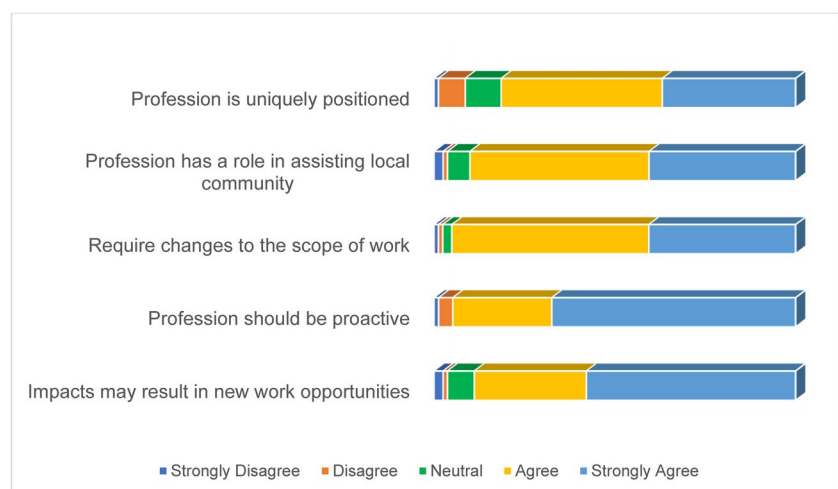
It was suggested by a respondent that the profession is well placed but not reaching its full potential.

*EHP is well placed to role in their local community.  
EHP have significant knowledge in their local area.  
Climate change may exacerbate many existing issues  
EHP is already aware of. EHP is an underutilised tool.  
(P15-Frontline female EHO)*

### Hurdles the profession is facing for building adaptive capacity

In the survey, participants were asked to identify six hurdles that the EHP is facing for building adaptive capacity from a list of 18 possible answers (Fig. 4). One option was a free text field. Most of the list of hurdles were identified through a literature review (Marcus and Hanna 2020; Simonet and Leseur 2019; Whiley et al. 2018). As shown in Fig. 4 below, the most commonly identified hurdle was the profession lacking being visible (64.2%,  $n=52$ ), following this was the lack of government leadership on adaptation (63%,  $n=51$ ). Other common hurdles identified were the profession's

**Fig. 3** Responses as a percentage for EHP role in capacity building for adaptation



**Fig. 4** Responses for hurdles inhibiting the EHP for building adaptive capacity (by number)



narrow focus on regulatory and enforcement roles (56.8%,  $n=46$ ), insufficient staff or staff resources (54.3%,  $n=44$ ) and health being missing from the climate change discussion (46.9%,  $n=38$ ).

Some hurdles also emerged in the open-ended sections such as:

*We do have a role but need to be 'heard at the table' and be able to participate. (P38-Frontline female EHO)*

*In recent years our profession seems to have settled into a smug food safety and noise complaint comfort zone. We have gone missing on the biggest challenges of our time, COVID & climate change. (P46-Local Government male Manager)*

Next, display logic was applied to allow respondents to just see their six hurdles chosen. The question requested the respondents to rank these selected hurdles from most important to the least important. Lack of government leadership ( $n=27$ ) was clearly the most significant hurdle EHP is facing in building adaptive capacity. This was followed by the profession's narrow focus on regulatory and enforcement roles ( $n=11$ ) and the lack of visibility the profession has to the wider community ( $n=6$ ). While one respondent in the open-ended section provided a suggestion that the introduction of regulation can assist the EHP.

*EHPs need a mandate/legislation to work within. I believe one of the issues is the reluctance of Liberals [conservative government at the time of the survey] to introduce regulations as they see it as red tape hindering development and entrepreneurial activities. Regulations can have an educational focus. (P3-Acadamic male)*

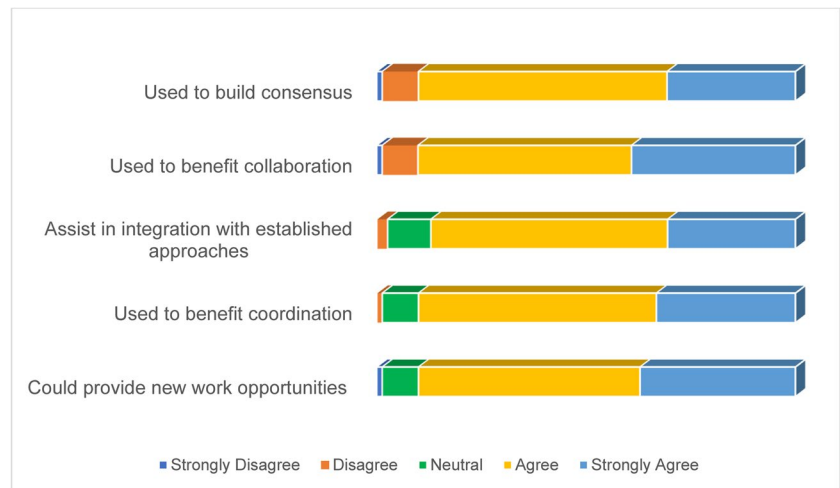
### Health awareness as a bridging concept

The respondents were asked for their opinion on health awareness as a bridging concept to assist in CCA (Fig. 5). This was to determine if EHOs believe having health awareness could build bridges and connections to assist in implementing adaptation. Most respondents (89.7%) agreed or strongly agreed that health awareness can be used to build consensus to work together to develop a mutually acceptable solution. The next statement stated collaboration with most respondents (91%) agreeing or strongly agreeing that health awareness is useful in working together in reaching a common goal. The respondents mostly (87.2%) agreed or strongly agreed that health awareness could assist in integrating already established approaches. Most (89.7%) agreed or strongly agreed that health awareness can be used to benefit the coordination process in organising different activities or people involved. The last statement asked if health awareness linking could provide new work opportunities for the profession and 89.7% agreed or strongly agreed.

Respondents raised the significance of health and could provide new work opportunities for the profession, as captured by this respondent:

*Definitely as it is a complex, multifaceted concept that is affected by a range of factors. By including health in climate change adaptation approaches, resilience can be established within the communities, at the local level, by EH professionals. (P43-Frontline female EHO)*

**Fig. 5** Responses as a percentage of health awareness as a bridging concept



**Disaster risk reduction**

For the last section of the survey, a paragraph and diagram (Fig. 6) explaining how traditional disaster management approaches require expanding, to also include prevention, mitigation and preparedness as part of DRR (Schipper and Pelling 2006). Enabling a more holistic all-hazard approach aimed at preventing and reducing disaster risk could contribute to strengthening community resilience and achieving sustainable development goals (Schipper and Pelling 2006). There are commonalities with DRR and CCA, with both aiming at reducing vulnerability and increasing community resilience under an umbrella of sustainable development (Banwell et al. 2018b).

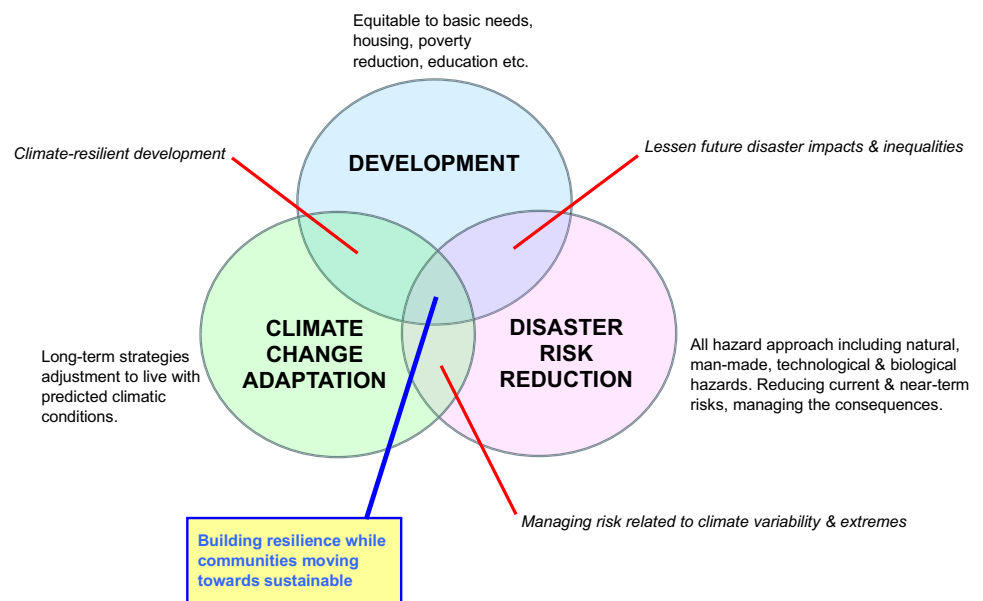
The first question relating to this figure was, *would risk reduction be considered as a cross-cutting theme to*

*reduce vulnerabilities in all three concepts (development, climate change adaptation and disaster risk reduction)?* Most respondents (94.1%) agreed that risk reduction was a cross-cutting theme to integrate in three concepts. Risk reduction was described as a positive outcome theme ( $n = 32$ ) such as applying risk management to reduce vulnerabilities. A respondent described this as:

*Risk reduction is a cross-cutting theme as reducing vulnerabilities within one concept (e.g. development) would greatly benefit the overall goal of building resilience. Reducing risk within each concept is a more achievable approach to resilience building and will inevitably reduce overall risk. (P42-Frontline female EHO)*

The agreeing respondents also indicated risk as an integrating theme across the concepts ( $n = 18$ ) suggesting

**Fig. 6** Synergies and differences adapted from Assessing disaster risk reduction and climate change adaptation synergies of risk insurance (Prabhakar and Solomon 2014)





risks within climate, disasters and development are connected and intertwined. This was explained by a respondent as:

*Risk reduction theme is aimed at targeted impacts across all three system areas of climate change adaptation, development and disaster risk reduction. Therefore, the risk reduction theme can benefit all areas by not losing focus of the main goal and having a much wider impact. (P49-Frontline female EHO)*

The last theme suggested risk reduction can provide a broader understanding ( $n=13$ ) by permitting a more holistic system approach to consider. A respondent defined this as:

*People understand the idea of risk reduction and will assist with the integration responses and encourage the systems approach. (P4-Frontline male EHO)*

Three respondents (5.9%) disagreed with the statement that risk reduction was cross-cutting, indicating it was more about shifting or losing focus on what they are trying to achieve ( $n=3$ ). This was captured as follows:

*Risk reduction has the ability to shift focus from primary objectives throughout the course of a project or operation. By definition, this would mean that risk itself cannot be classified as a cross-cutting theme (P25-Private sector male EHO)*

The second question was, *could human health be considered as a cross-cutting theme to integrate all three concepts to share a common goal?* Most respondents (85.7%) agreed that health was cross-cutting, resulting in three themes emerging. Health was considered a motivator or a driver ( $n=34$ ) which indicates the impacts on health can be used as reason to act. This was expressed by a respondent as:

*Human health is a cross-cutting theme as it is the reason for building resilience and should be at the forefront of all three concepts. Prioritising human health within each concept will have a beneficial impact to disaster risk reduction and how to build resilience effectively for each community. (P42-Frontline female EHO)*

The agreeing respondents also indicated health as an integrating theme across the concepts ( $n=17$ ) suggesting health is also connected and intertwined within the concepts. A respondent explained integration of health as:

*Development as defined above is a key determinant for health, and both climate change and disaster risk can impact on health and well-being and development goals. Therefore, health is both influenced by and a key driver for all three concepts. (P36-Frontline female EHO)*

The last theme suggested using health from a holistic perspective ( $n=13$ ) to fully understand the system affecting community health. Health was described holistically and focused as:

*Health is a cross-cutting theme, as it can be considered at all stages of the system (development, climate change adaptation and disaster risk reduction); without losing focus of the common goal. (P49-Frontline female EHO)*

The minority of respondents (14.3%) disagreeing that health was not cross-cutting indicated health was not the right term or meaning ( $n=8$ ). As one example was:

*Health is very broad ranging and many aspects will have no impact on development or climate change (possible people's resilience to climate change if there [sic] health is better) (P19-Frontline female EHO)*

The final survey question was, *do you think the EHP has a role in this disaster risk reduction approach by moving a community towards the central goal in the above figure for addressing CCA?* There was an overwhelmingly result, with the respondents (98.5%) agreeing they could see the EHP has a role in disaster risk reduction to address CCA. The first theme emerging from this question was identified as the profession having the right skill set ( $n=37$ ) required to do the role as their existing skills and knowledge in the work they do is transferable. This was expressed by respondents as:

*EH is only one player but the profession does have a unique skill set that it doesn't always understand or take credit for. We generally look at things from a risk perspective and look at preventative methodologies to reduce risk. Those skills could make a significant contribution. (P18-Sole trader male EHO)*

*The broad scope of EHP provides many skills and knowledge that can be incorporated in a broad range of roles, tasks and could potentially providing the overall benefits of climate change adaptation. Promoting and taking the community on the journey to promote the need for climate adaptation. (P45-Frontline female EHO)*

The second predominant theme emerging from the question was that the EHP is well positioned for having this DRR role ( $n=31$ ). This positioning could be in the form of their existing health stake in disaster management, having general understanding of environmental and social determinants of health, or where they are located within the community to provide health protection. Some examples of responses in the free text fields included:

*EHP are professionals at the interface of business, industry and community and are critical to the good*

*management of Disaster Risk Management and reduction to assist and guide the local community to a better safer outcome.* (P27-Retired male EHO)

*EHP is ideally and uniquely situated to provide a leading role in the disaster risk reduction approach and can provide an essential role towards moving and focusing the community to the central goal for climate change adaptation.* (P49-Frontline female EHO)

Just one (1) respondent disagreed that the EHP has a role to play, because:

*Health should be cross-cutting but the EHP will not be part of the solution because of the way the profession is perceived by government, particularly local government. The Western Australian Government via the Dept of Health and Dept Local Government are hell bent on getting rid of [EHOs].* (P40-Frontline male EHO)

## Discussion

Results of the survey clearly demonstrate that EHOs believe climate change and climate sensitive disasters can and do impact community health in Australia, with disproportionate impacts upon socially vulnerable groups. As expected, EHOs generally accept the broader scientific opinion (IPCC 2023) that climate change is worsening and the resultant effects are likely to in some way affect not just disadvantaged groups but the population as a whole. The respondents almost unanimously agreed that climate change will require changes to the scope of work for the profession. Indeed, the profession's core work will be increasingly influenced by climate change, yet the scope of practice does not clearly reference health-related CCA (Smith et al. 2023). Similarly, there was broad agreement amongst respondents that the profession should be proactive in building adaptive capacity by preparing for the health impacts. This also suits the fundamental role of being EHOs is to assess the human health risks, control those risks to prevent the individual or population from becoming sick or injured. These were noteworthy findings in defining the professional's role. For instance, the respondents were identifying the competencies required to undertake their practice rather than just viewing their capabilities from the imposed legislative obligations (Whiley et al. 2023).

Despite general agreement that the effects of climate change will be global, respondents also agree that the effects are more likely to be felt at a local level. Most respondents believed that the Federal Government should have the leading role in CCA. However, Australia does not currently have a National Adaptation Plan to provide this leadership. This

absence is reflected in the survey results, with a large majority of respondents citing lack of government leadership as an important hurdle in implementing CCA. The Federal Government also recorded a high percentage when asked which level of government should be responsible for managing the impacts at the local community level. This was a surprising result, as the question was clearly specific to managing the impacts at the front-line, local level. At best, the Federal Government would only be providing funding to manage the impacts such as disaster recovery payments. Although national and state governments have a role to respond to climate change, the responsibility of adequate preparedness and resilience rests at the local level (Roser-Renouf et al. 2016). As many of the physical and social conditions affecting human health from climate change will be experienced at the local level, the preparedness of local public health departments is crucial, as leaders to managing the impacts (Austin et al. 2019; Eidson et al. 2016; Grossman et al. 2019; Phibbs et al. 2016; Roser-Renouf et al. 2016; Wheeler and Watts 2018). This is important in CCA for health because the majority of health services are provided at this local level.

This apparent disconnect between local and national may perhaps be explained through current workforce issues. A significant majority of EHOs are employed at the Local Government level. Respondents identified a range of hurdles to involvement of EHP in CCA activities, including a lack of visibility, insufficient staff and resources. Vacant positions were common occurrence, highlighting the recruitment issues in the profession. It is likely that the workforce dilemmas are contributing by EHOs trying to manage demanding workloads while addressing emerging environmental health issues (Whiley et al. 2023). The possible interrelating factors causing this are (1) misperceptions in the actual scope of environmental health practice and (2) the lack of recognition and value given to the EHP (Whiley et al. 2023). However, it may be that respondents consider the Federal Government needs to take responsibility for CCA. For instance, by providing sufficient funding and resources so that front-line staff have the capacity to incorporate relevant activities into their work. This approach would make sense, given respondents were firm in their belief that the EHP has a substantial role to play. Most respondents agreed that the profession is uniquely positioned with interfaces between environment and health risks as well as between government and local communities. Additionally, that the profession has a role in assisting their local community to adapt to health impacts. These statements resonate that this is the only profession in Australia that provides population health protection to the community at the local level (Whiley et al. 2018).

IPCC has moved away from static framing of risk, to have this as a more dynamic nature as interrelating risk is subject to change over time (Reisinger et al. 2020). The majority

of respondents also agreed that managing climate change health impacts will require systems-based approach be used to effectively prepare for and manage these dynamic health risks (Cissé et al. 2022). Incorporating complex systems thinking can be used to understand the manifesting of complex, compounding and cascading risk factors as well as developing effective strategies to achieve a desired outcome (Berry et al. 2018a). These multifaceted risks are not always apparent and using traditional linear risk management/assessments approaches will be inadequate within complex adaptive systems. This has also been extensively discussed in the DRR field. Systemic risks emerge from the interactions of climate change, natural hazards and with other interconnected systems (UNDRR 2022). Having a systems-based approach, with increasing awareness in health, can assist in linking CCA and DRR for effectively addressing the numerous impacts.

Increasing calls have been made to integrate DRR and CCA as interconnected disciplines will not only be necessary but essential to deal with climate-sensitive disasters and their risks (Howes et al. 2015). To assist in building these links, understanding the health concept has an important role in contributing to this integration (Banwell et al. 2018a). Together the approaches allow for a broader consideration of the factors that are influencing vulnerability to a hazard that places the community at risk (Schipper 2009). The concepts of risk and vulnerability reduction are cross-cutting themes for health issues in both DRR and CCA (Aitsi-Selmi et al. 2017). Additionally, these conceptual overlaps provide a pathway and motivation to achieve common goals such as building resilience and sustainable development (Begum et al. 2014; Yuan et al. 2017). An overwhelming number of respondents could see their preventative approach and risk understanding in this integrated approach for addressing CCA.

Lastly, we believe, which has also been clearly supported in this survey, that the EHP is well-suited to understand and manage the simultaneous climate change and disaster health risks. Firstly, the profession is already part of disaster management to reduce and prevent health risk in the local community. However, this area needs expanding as they are currently inhibited in the full disaster cycle to only be recognised in the immediate response and recovery phases. Secondly, EHOs have an advanced understanding of the complex social and, particularly, the environmental determinants affecting community health. These determinants of health are similar to the understanding required of vulnerability and risks of CCA and DRR approaches (Phibbs et al. 2016). Thirdly, the profession has the essential tools for understanding and diagnosing the problems, predicting future impacts and recognising vulnerable populations. Finally, the profession has profound knowledge on how the environment affects

human health outcomes and ways to reduce or prevent these health risks. They are familiar to addressing similar types of risk through utilising preventative health strategies. This preventative risk-based approach could be a useful tool for assessing health risks of climate change and related disasters (Smith et al. 2023). The profession not only has the ability but also has the responsibility to communicate these health risks including the opportunities to advance policy. However, EHP in Australia is vastly missing out on an opportunity to exploit and optimise their skills and experience to effectively protect their community from the rapidly changing climatic conditions.

### Strength and limitations

After the rigorous vetting process of the survey instrument, we feel confident the results from this study were validated in correctly interpreting the findings. There are several study limitations that should be noted and therefore generalisability may be limited. The study did have a small number of participants and surveyed members of Environmental Health Australia, whose members may not represent the entire cohort of the profession. The survey invitation was released during the peak of the COVID-19 pandemic which may have resulted in fewer EHOs willing to participate due to their busy schedule. Sampling bias may be a factor, where potential participants chose not to take part in the research as the topic did not interest them. Despite these limitations, we believe this survey does provide meaningful results to further research the EHP role in CCA.

### Conclusion

The findings of this study suggest, in Australia, the EHP does have a role in protecting community health from climate change impacts. This role would benefit from taking a system thinking approach to adequately address the complex, compounding and cascading nature of health risks relating to climate change. Results suggest that the majority of EHOs in Australia do believe developing the adaptive capacity of the community should be included in their scope of practice. An emerging approach to achieve this would be integrating CCA with DRR approaches, as both have similar goals to reducing risk, vulnerability and increasing community resilience. Lastly, this study revealed there is an overwhelming EHO support for this integrated systems approach to be included in the profession's prevention toolbox. Further qualitative research is warranted to further develop these study findings from a health prevention lens so Australia can be adequately prepared for climate change impacts and related disasters.

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**Author contributions** T.W.—conceptualised and designed the survey, performed the literature search and conducted the statistical data analysis and interpreted the data and wrote the first and subsequent drafts. T.W. and R.P.—analysed qualitative data. L.B., R.P. & E.C.—advised on and contributed to the conception and design of this research, critically reviewed the manuscript, revised the manuscript for important intellectual content. All authors have read and approved the final manuscript as submitted.

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**Data availability** The dataset used and analysed during the current study are available at <https://doi.org/10.25946/25139546.v1> or from the corresponding author on a reasonable request.

## Declarations

**Consent for publication** Clear explanations were provided regarding the intended use of the data and images, ensuring participants understood the potential risks and benefits of publication. Any personal identifiers have been removed or anonymised to protect the privacy and confidentiality of the participants. Participants provided consent for the publication of their de-identified data.

**Approval** The Central Queensland University Ethics Committee approved the study protocol (Ethical No. 22504).

**Consent to participate** All participants provided voluntary informed consent to participate in this study. They were informed about the purpose of the research, the nature of their involvement, and any potential risks or benefits associated with their participation. Participants were assured of the confidentiality and anonymity of their responses. They were also informed of their right to withdraw from the study at any point without any negative consequences. Informed consent was obtained from each participant before they began the survey.

**Conflict of interest** The authors have no competing interests to declare that are relevant to the content of this article.

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