Knowledge, Attitudes, Practice & Risk Perceptions Regarding Heatwave Among Outdoor Workers in Nepal

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Acknowledgement

This report is based on the research conducted among the outdoor workers residing in different districts of Nepal. This is a collaborative work conducted in Nepal during June to October, 2022. Authors are grateful to the American Red Cross and the Global Disaster Preparedness Center (GDPC) for funding this noble work and to help highlighting one of the major issues of climate change. In addition, authors would like to acknowledge GDPC, the Red Cross Red Crescent Climate Center and the Global Heat Health Information Network (GHHIN) for providing continuous technical support to conclude this research.

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We hope this research will be able to emphasize the need of the outdoor workers before and during extreme heat events in Nepal.

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Executive Summary

There are evident impacts of climate change. With the annual rise in global temperature, people of low-income countries confront various challenges. There are several contributing factors that may lead to heatwaves. It is now a great deal of importance to understand these factors to thoroughly plan to mitigate climate change issues like heatwave.

A mixed method study was conducted to assess the knowledge, attitude, practices, and risk perceptions of heatwaves in selected 8 districts of Nepal. A total of 356 quantitative surveys and 11 focus group discussions were conducted.

The survey found that, though the participants had experienced change in climate, they were not much aware about heatwaves and were less informed through government or any other organizations. Despite the lack of awareness, participants were practicing preventive measures against heatwaves to some extent.

The focus group discussions further revealed that the participants were not much aware of the consequences of heatwaves although they seem to understand the relation between environmental degradation and climate change.

The findings of this study suggest that massive awareness raising activities and tailored intervention targeting climate change and its impacts including heatwaves need to be conducted at community level.

Keywords: Heatwave; Climate change; Outdoor Workers; Risk perception; KAP regarding heatwaves; Heat prone areas.

Introduction and Literature Review

Weather extremes such as heat waves are expected to become more common and severe because of climate change.[1,2] Heat waves, characterized by stagnant warm air masses and high temperatures for several nights in a row[3] and linked to heat-related morbidity and mortality, are considered a public health issue.[4] Heat waves, in general, are events characterized by hot, persistent temperatures that have significant consequences for human mortality, economy, and ecosystems.[5] It is widely accepted that increased exposure to heat has a detrimental effect on human health, resulting in increased mortality (death) and morbidity (illness) across a variety of geographical locations.[6,7,8,9] There are numbers of reports of rising temperatures around the globe disrupting socio-economic lives of millions.[10] It has been estimated that the temperature will continue to rise despite several efforts/interventions. In such, the impact of extreme heat is a growing concern, particularly in low- and middle-income countries with compromised healthcare, poor housing, less knowledge, and poor practice on heatwaves.[11]

One of the main causes of high heat wave mortality is lack of risk communication, which includes the type of risk messages, how the recipients of the messages perceive and respond to communications between concerned authorities and the general population.[12] Based on the socio-demographic characteristics, infants, elderly, individuals with disabilities, people in low-income countries and those with health difficulties are among the most vulnerable categories of heatwave.[13,14,15] There are studies conducted in several countries suggesting that there is an urgent need for action to tackle climate change. However, this represents the smallest part of the human impact as a greater proportion of the people will not seek healthcare.[16] A study in India reported that mortality risks rise by 2% for every degree above

[1] IPCC. Summary for policymakers. In: Solomon S., Qin D., Manning M., Chen Z., Marquis M., Averyt K.B., Tignor M., Miller H.L., editors. Climate Change 2007: The Physical Science Basis. Contribution of Working Group I to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change. Cambridge University Press; Cambridge, UK: 2007.
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36.2°C.[17] Heatwaves have been found to not only induce physical but also psychological health impacts, such as anxiety, depression and aggression presenting diverse effects on different community groups.[18,19] Some groups of people are considered more at risk for health problems during heatwaves, such as outdoor worker, people with pre-existing medical conditions and other vulnerable groups.[20] A study conducted in Netherland highlighted the fact that elderly are facing headache, fatigue, thirst and excessive sweating because of increased temperature.[21] Comparably, outdoor workers in Slovenia and Greece experienced similar symptoms resulting from prolonged exposure to heat.[22] Whereas, a study conducted in Karachi, Pakistan[11] emphasized the need for climate financing, risk communication and raising awareness through various methods and media.

Nepal is a south Asian country with almost 80% of the people living in rural areas. Complex topography and social vulnerability make the country particularly susceptible to geological and climate-related disasters like heatwaves.[23] Historically, weaker policies related to climate action have intensified this vulnerability. It has been estimated that Nepal will be facing 2.2% of annual GDP loss due to climate change by the year 2050. Nepal also identified that the country's energy, agriculture, water, forestry, and biodiversity are most at risk due to climate change.[24] Likewise, Global Facility for Disaster Reduction and Recovery,[25,26] has classified Nepal as an extreme heat hazard area. The current median probability of a heat wave in Nepal is around 3% and the probability of heatwave is projected to increase significantly, potentially as high as 27% by the 2090s under the highest emissions pathway.[27] Risk perception- the subjective assessment of the probability of a specified type of accident happening and how concerned we are with the consequences, is identified as a key aspect of resistance to preventive action.[28,29]

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Purpose of the study

Between the year 2002 – 2010, 25 heatwaves have been reported in Nepal marking low terrain (terai region) as the most heat affected area. As a result of that, 25 deaths were claimed and 280 people were affected.[30] However, it is only the tip of the iceberg.

There is limited literature on heatwaves available in Nepal. The data on morbidity and mortality related to heatwaves are not recorded. The lack of pertinent data, resources and integrated reporting mechanism on climate-related events makes it more challenging to communicate among the people. Exploring and identifying the risk perception of the people can aid policymakers to design relevant targeted risk communication strategies with the public. This will further help to understand the ways in which people think about and respond to risk, and then effective policies and programs can be implemented to minimize the possible effects of heatwave. As such, Nepal needs to do further research and co-design policies through risk-informed governance on heatwave. Through this study, we will explore the perceptions of people regarding their understanding of the risks of heat waves. The findings of this study will help us to take an initial step towards developing strategies to timely communicate and help in mitigating the risk.

Objectives of the Study

General Objective

- To explore the knowledge, attitude, practice and perception of different population-at-risk groups regarding heatwaves in heat prone areas in Nepal.

Specific Objectives

- To assess the knowledge regarding heatwaves among the outdoor workers in heat prone areas.
- To explore the attitude related to heatwave
- To assess the practices regarding the protective behaviors against heatwave.
- To explore the perceptions regarding the risks related to heatwave.

[30] Dhimal MN. Assessing Trends of Heat Waves and Perception of People about Health Risks of Heat Wave in Nepal. Nepal Health Research Council: Kathmandu, Nepal. 2018.

Methodology

Study design

We conducted a mixed method study involving qualitative and quantitative approaches. We quantitatively assessed the knowledge, attitude and practices of heatwave using a descriptive cross-sectional design. Following this, a qualitative study was done to explore the risk perceptions regarding the heatwave among the outdoor workers.

Study site

The study was conducted in 8 districts (Kailali, Rupandehi, Makwanpur, Morang, Surkhet, Banke, Chitwan, and Nawalparasi) of Nepal as these districts have been recording higher temperatures during summer. The selection of districts was done based on the increasing temperature as per the National Weather Service (NWS) Classification of Heat Index (2009).[31]

Study population

We included groups of outdoor workers who are exposed to heat or high temperatures in the selected districts. We targeted the population groups involved in mainly outdoor occupations like farmers, labor workers, rickshaw drivers/pullers, street vendors, business owners, and service providers.

Sampling technique

For the qualitative part, we used a purposive sampling technique and for the quantitative part, we used a cluster random sampling technique.

Sample size

For the qualitative part, we conducted 11 FGDs involving 80 participants with groups of outdoor workers involved in several occupations like farmers, rickshaw drivers/pullers, street vendors, business owners and service providers. The sample size for FGDs was determined based on the principle of saturation. The size of FGD ranged from 6 to 8 participants.

Similarly, for the quantitative part, we involved 356 participants who were mainly engaged in outdoor occupations. Based on the previous study[32,30] we used a 90% prevalence of perception of heatwaves, with a 5% margin of error and 95% confidence, we calculated an

[31] National Oceanic and Atmospheric Administration NWS. What is the heat index? Amarillo, TX, USA; Available from: https://www.weather.gov/ama/heatindex.
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effective sample size of 139. Since we used a cluster random sampling, where the cluster was defined as a municipality, the calculated sample size was adjusted for the design effect (delta=0.2)[33] The final computed sample size was 351. However, a total of 356 participants were enrolled in the quantitative study.

Data collection technique

For the qualitative part, we conducted 11 FGDs with the study participants using a semi-structured FGD guide. We identified eligible participants, of whom the interested participants were invited at the feasible time and place for an FGD. All the FGDs were conducted face to face in Nepali language adopting all the COVID-19 preventive measures. The FGDs were audio recorded with the consent of the study participants.

Similarly, for the quantitative part, we conducted the survey among the consented study participants. The research assistants administered a face-to-face structured set of questionnaires to the participants.

Data collection tools

We used structured questionnaires and interview guides for collecting the data and information. The quantitative survey consisted of 5 sections: a) socio-demographic information; b) knowledge related to heatwave; c) knowledge statements (responses in 5-point Likert scale); d) attitude statements (responses in 5-point Likert scale) and e) practice related statements (responses as always, sometimes, and never). The questionnaire and guides were prepared after the review of literature and discussion within the research team. The tools were initially prepared in English and translated into Nepali for the ease of communication. For the qualitative part, we used a semi-structured FGD guide.

Data analysis

For the qualitative part, we used thematic analysis to generate the findings of the FGDs. The data were analyzed using a combination of inductive and deductive approaches. We initially developed a codebook deductively based on the literature review and the additional codes were added inductively. The data collection and analysis were done based on the pre-specified themes. The analysis was done manually on MS-Excel.

For the quantitative part, we used descriptive analysis and ANOVA test. The frequency and percentage distribution were calculated for the descriptive analysis. In addition to descriptive analysis, a one-way ANOVA test was used to describe the association between

[33] Howe PD, Markowitz EM, Lee TM, Ko CY, Leiserowitz A. Global perceptions of local temperature change. Nature climate change. 2013 Apr;3(4):352-6.

the responses to the knowledge, attitude and practice questions at provincial level. Responses to the Likert scale question of knowledge and attitude were recoded as "0" for 'Neutral'; "1" for 'somewhat agree'; "2" for 'strongly agree'; "-1" for 'somewhat disagree' and "-2" for 'strongly disagree'. Similarly, the practice related responses were recoded as "0" for 'never'; "1" for 'sometimes' and "2" for 'always'. Furthermore, we compared the mean difference between the provinces for the knowledge and attitude related statements using Tukey test. The significance level (α) was set at 0.05 for all statistical tests. All the statistical analyses were conducted on STATA-13.

Ethical considerations

We obtained an ethical approval (IRC: 273-2022) from Nepal Health Research Council (NHRC) for conducting this study. All the participants were explained regarding the objectives and purpose of the study and written informed consent was obtained from each of the study participants. We also obtained consent to record the discussions in FGD. Most important, the participation was voluntary. Safety and confidentiality of the participants was maintained in this study.

Findings

A total of 356 participants were enrolled in the quantitative survey. The study was conducted in a total of 8 districts from 5 provinces. The distribution of participants sample at each district and provinces is shown in Table 1 below:

Province	**District**	**Sample size**
Province 1	Morang	55
Bagmati Province	Makwanpur	50
	Chitwan	34
Lumbini Province	Rupandehi	50
	Nawalparasi	42
	Banke	37
Karnali province	Surkhet	41
Sudurpaschim province	Kailali	47
Total		**356**

Table 1: Distribution of sample by Province and District

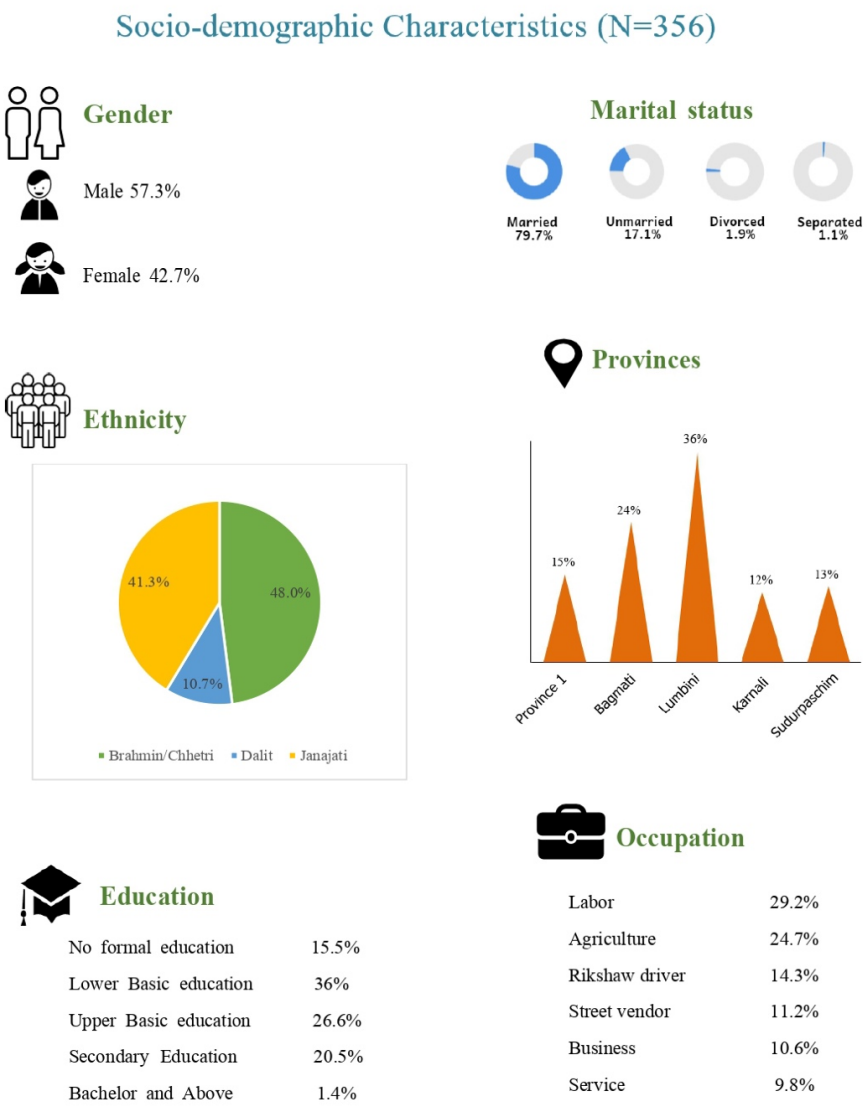

Figure 1: Socio-demographic characteristics of the participants

As shown in Figure 1, a total of 356 participants were enrolled in the survey and their mean age was 37.2 $\pm$ 10.5 years. Of the surveyed participants, more than 57% were male. Most of the participants had a lower basic education. Almost all the participants were outdoor workers, and their primary occupation was labor, agriculture, rikshaw driver, street vendor and business. Their mean years of working experience was 10.7 $\pm$ 8.6 years.

Knowledge on heatwave

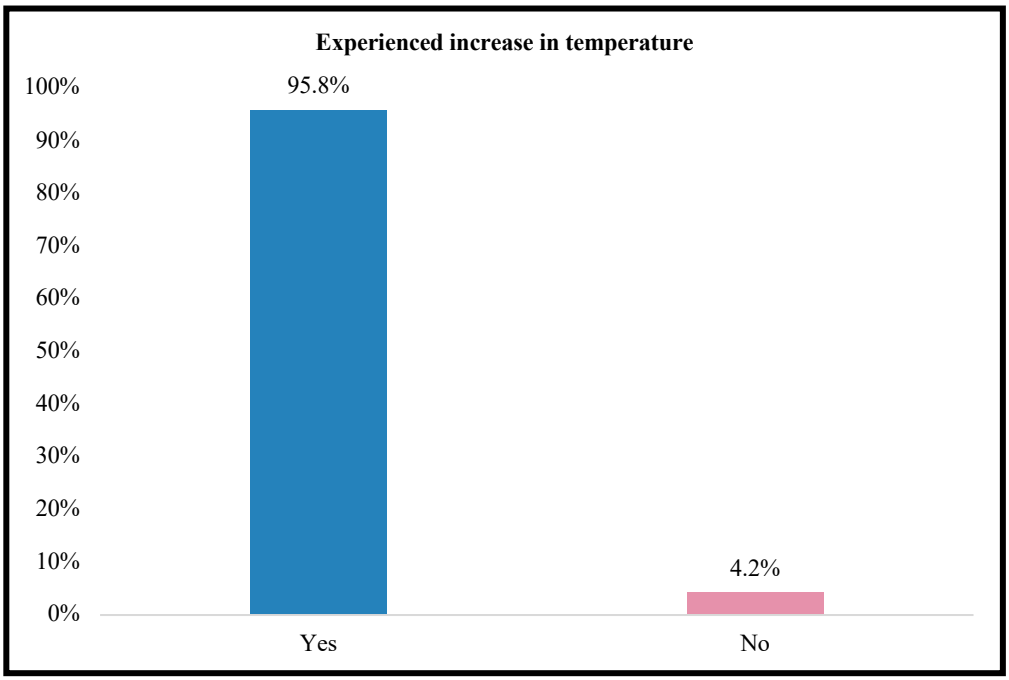

Figure 2: Bar chart for participants who have experience of increase in temperature

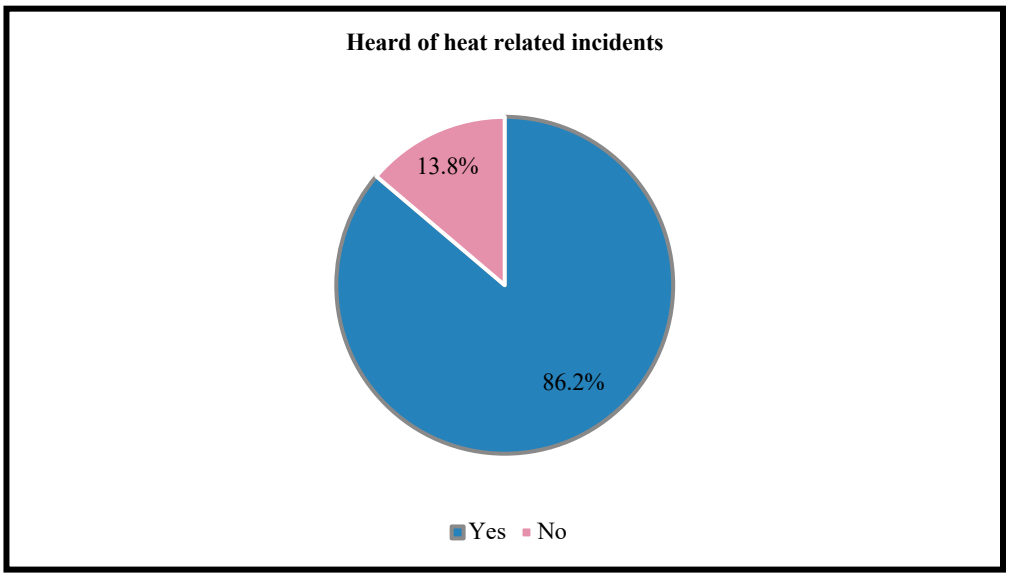

Figure 3:Pie chart for participants who have heard about heat related incidents

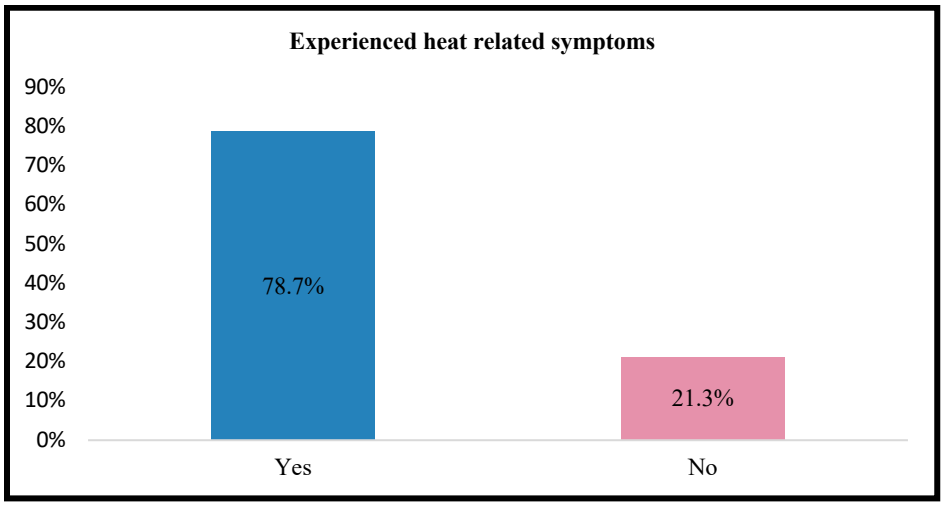

Figure 4: Bar chart for participants experiencing heat related symptoms

Most of the participants (95.8%) have experienced a gradual increase in temperature in the past years. More than 86% of the surveyed participants have heard about the various heat related incidents and around 79% have experienced the heat related symptoms in the summer days. This information is shown in the bar graphs and pie chart in figure 2, 3 and 4 respectively.

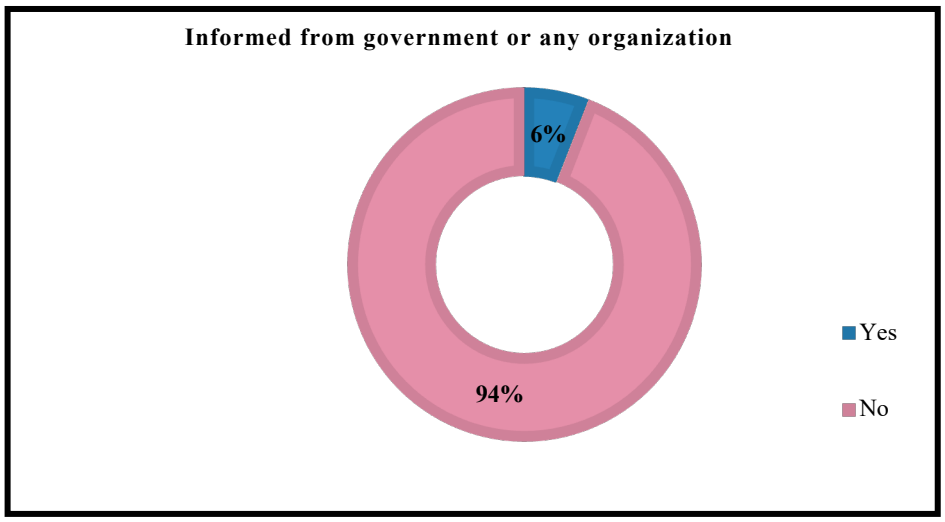

Figure 5: Pie chart for participants if they are informed about heatwave from government or any organization

We asked the participants if the government or any organizations have informed them about the heatwave, its effects, and possible measures for prevention. As illustrated in figure 5, only 6% have heard some news and information regarding the increasing temperature through local radio stations.

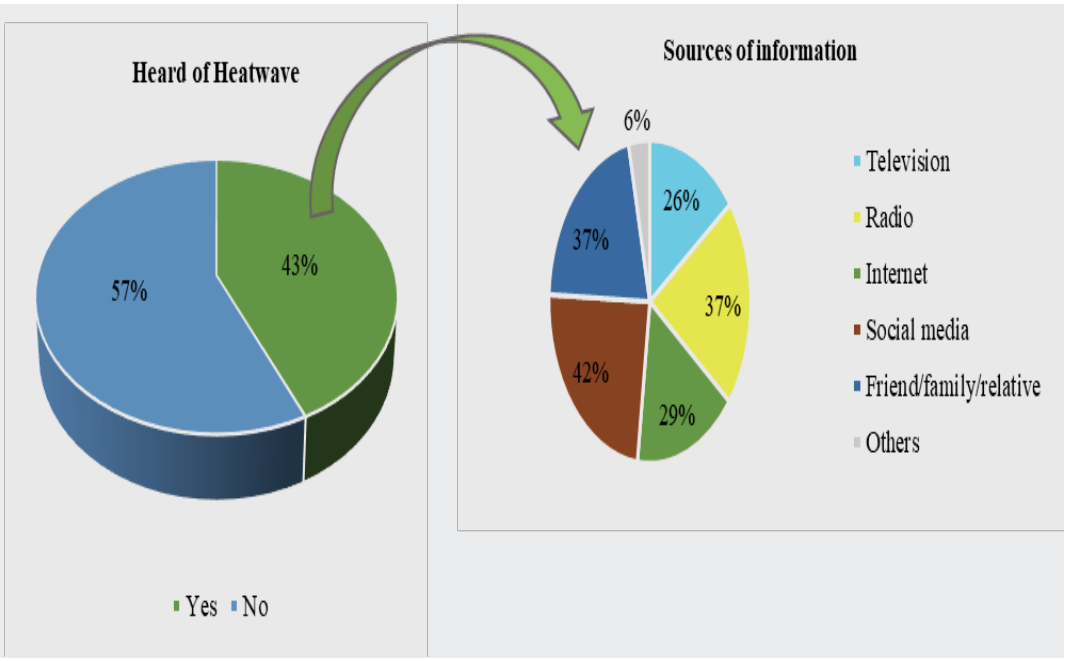

Figure 6: Pie of pie for the participants who have heard about heatwaves and sources of the information

As shown in figure 6, only 43% of the study participants had heard about the heatwave. Among them, the major sources of information were various means of social media, radio, friend/family/relative, internet.

Knowledge statements

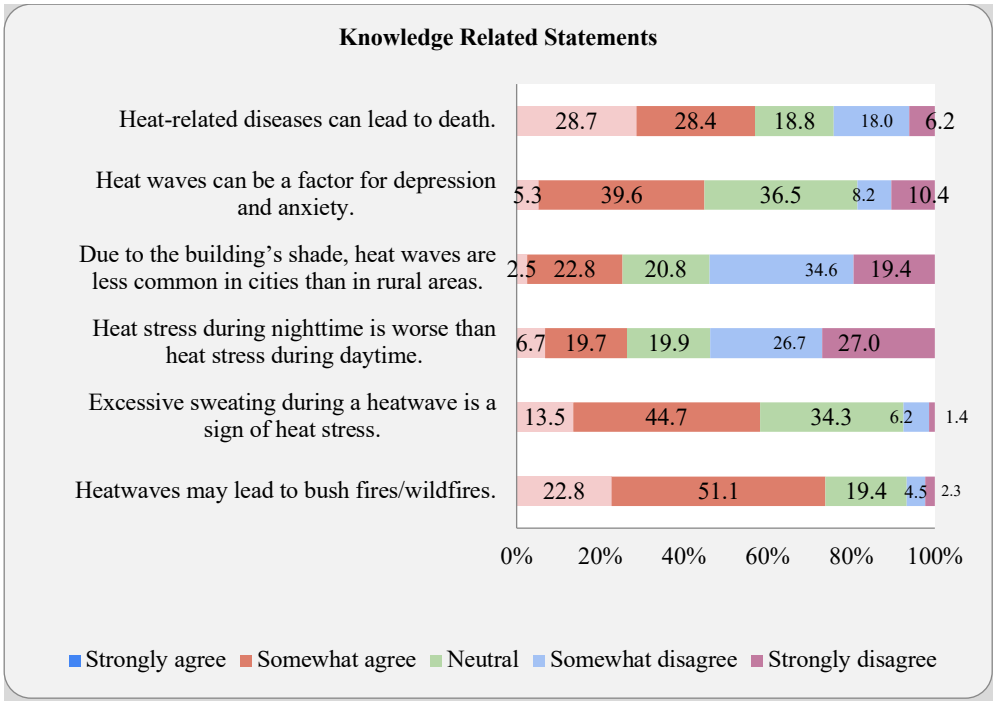

Figure 7: Responses of statements for assessing knowledge

We assessed the knowledge of the participants using 6 statements about heatwaves. The responses were set as: strongly agree; somewhat agree; neutral; somewhat disagree and strongly disagree as per the 5-point Likert scale. Most of the participants agreed upon the positive statements and disagreed upon the negative statements that showed fair knowledge related to heatwave.

Attitude related statements

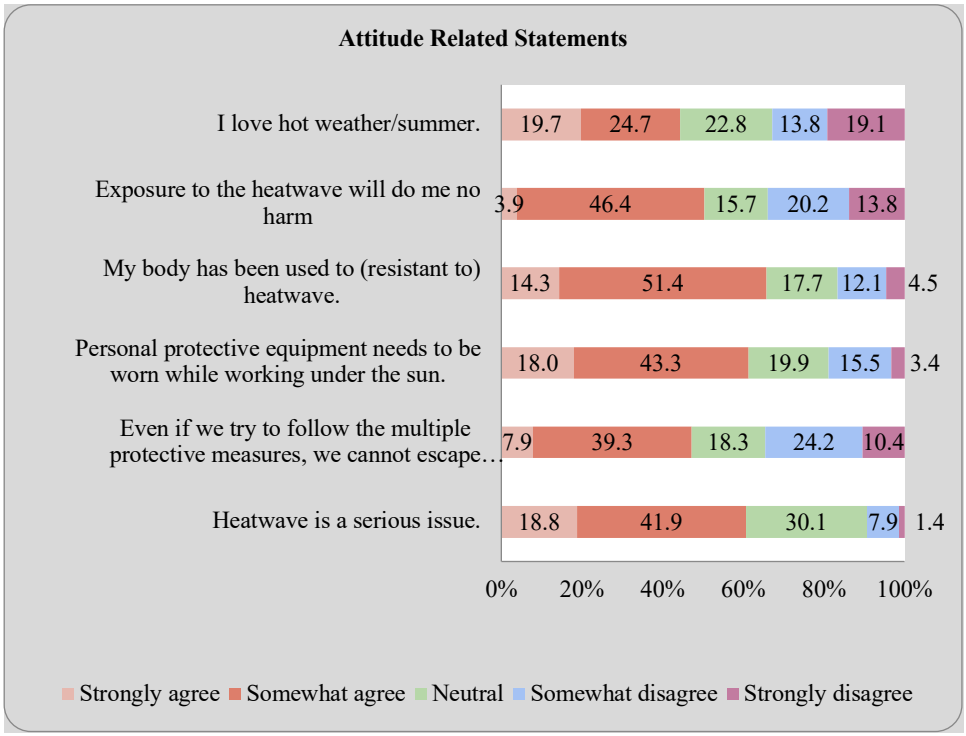

Figure 8: Responses of statements for assessing attitude

Similar to knowledge, we assessed the attitude of the participants using 6 statements about heatwave. The responses were set as: strongly agree; somewhat agree; neutral; somewhat disagree and strongly disagree as per the 5-point Likert scale. Majority of the participants agreed that heatwave is a serious issue and personal protective equipment (like hat, umbrella, glasses, sun blocks, full sleeved clothes etc.) help them to protect us from the effects of sun which showed a positive attitude towards heatwave and its effects. But majority of the participants also agreed that their body has been resistant to heat and exposure to heatwave will do no harm to them which showed that they had negative attitude towards the possible harms resulting from exposure to heatwave.

Practices

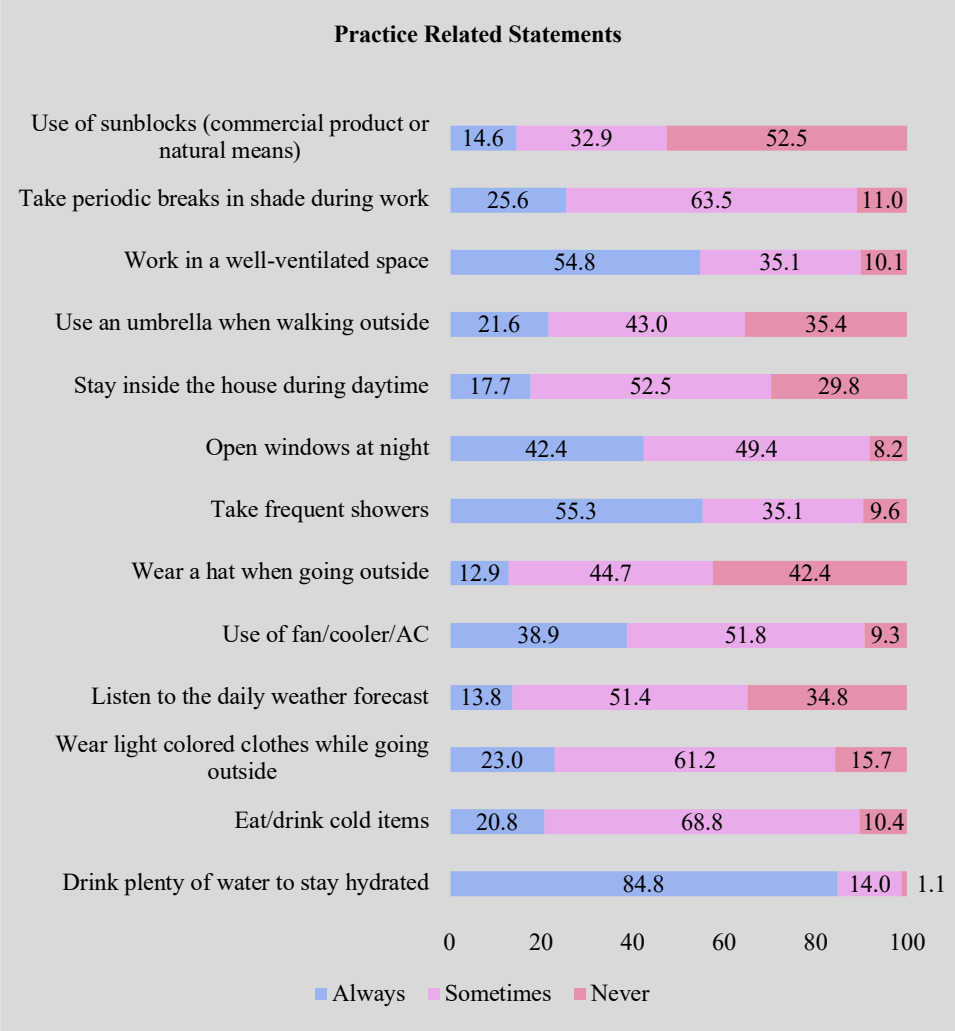

Figure 9: Responses of statements for assessing practices

For assessing the practices of participants against sun exposure, we used 13 practices based statements and took the responses of the participants as: always, sometimes, and never. Most of the participants responded that always or sometimes implement these practices during the summer season. This showed that though they had whatever their knowledge and attitude is, they implemented the protective practices to some extent. The least followed practices were: use of sun blocks, using umbrella, wearing cap/hat and listening to daily forecast. The participants mentioned that these practices were not feasible all the time though they knew about them.

Behavior change advice

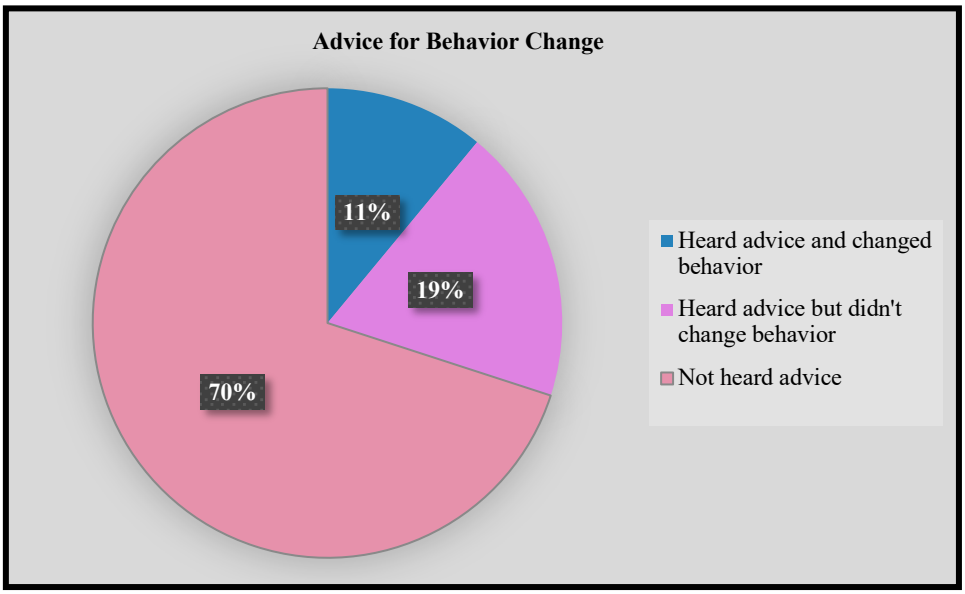

Figure 10: Pie chart for the responses of advice for behavior change

We asked the participants if they had heard any advice regarding behavior changes during heatwave and sun exposure from any organization or government. As the responses, 70% of the participants said that they had not heard behavior change advice from any organizations or government. 19% of the participants responded that they had heard advice but didn't change the behavior and 11% responded that they had heard advice and changed behavior too. When asked about what behavior they changed, we received responses like: drinking plenty of water, preventing direct exposure from sun using any kind of protective equipment and protecting their head from direct sun while working under direct sun in summer.

Distribution of responses for knowledge related statements by province and significance level from ANOVA test.

S. N.	Statements	Provinces (N=356)					p-value
		Province 1	Bagmati	Lumbini	Karnali	Sudur paschim	
1	Heat-related diseases can lead to death.						<0.001
	Strongly agree	2 (1.9)	16 (15.7)	80 (78.4)	2 (1.9)	2 (1.9)	
	Somewhat agree	18 (17.8)	32 (31.7)	20 (19.8)	4 (3.9)	27 (26.3)	
	Neutral	15 (22.4)	4 (5.9)	8 (11.9)	34 (50.8)	6 (8.9)	
	Somewhat disagree	20 (31.2)	25 (39.1)	11 (17.2)	1 (1.5)	7 (10.9)	
	Strongly disagree	0	7 (31.8)	10 (45.5)	0	5 (22.7)	
2	Heat waves can be a factor for depression and anxiety.						<0.001
	Strongly agree	9 (47.4)	2 (10.5)	8 (42.1)	0	0	
	Somewhat agree	37 (26.2)	26 (18.4)	60 (42.5)	2 (1.4)	16 (11.3)	
	Neutral	2 (1.5)	24 (18.5)	45 (34.6)	37 (28.5)	22 (16.9)	
	Somewhat disagree	7 (24.1)	15 (51.7)	3 (10.3)	2 (6.9)	2 (6.9)	
	Strongly disagree	0	17 (45.9)	13 (35.1)	0	7 (18.9)	
3	Due to the building's shade, heat waves are less common in cities than in rural areas.						<0.001
	Strongly agree	3 (33.3)	1 (11.1)	5 (55.6)	0	0	
	Somewhat agree	0	21 (25.9)	48 (59.3)	6 (7.4)	6 (7.4)	
	Neutral	0	5 (6.8)	34 (45.9)	26 (35.1)	9 (12.2)	
	Somewhat disagree	45 (36.6)	29 (23.6)	24 (19.5)	7 (5.7)	18 (14.6)	
	Strongly disagree	7 (10.1)	28 (40.6)	18 (26.1)	2 (2.9)	14 (20.3)	
4	Heat stress during nighttime is worse than heat stress during daytime.						<0.001
	Strongly agree	2 (8.3)	4 (16.7)	10 (41.7)	8 (33.3)	0	
	Somewhat agree	10 (14.3)	9 (12.9)	41 (58.6)	6 (8.6)	4 (5.7)	
	Neutral	2 (2.8)	3 (4.20	43 (60.6)	23 (32.4)	0	
	Somewhat disagree	38 (40)	30 (31.6)	17 (17.9)	2 (2.1)	8 (8.4)	
	Strongly disagree	3 (3.1)	38 (39.6)	18 (18.8)	2 (2.1)	35 (36.5)	
5	Excessive sweating during a heatwave is a sign of heat stress.						<0.001
	Strongly agree	5 (10.4)	11 (22.9)	20 (41.7)	2 (4.2)	10 (20.8)	
	Somewhat agree	39 (24.5)	46 (28.9)	45 (28.3)	6 (3.4)	23 (14.5)	
	Neutral	11 (9.1)	21 (17.2)	43 (35.3)	33 (27.1)	14 (11.5)	
	Somewhat disagree	0	5 (22.7)	17 (77.3)	0	0	
	Strongly disagree	0	1 (20)	4 (80)	0	0	
6	Heatwaves may lead to bush fires/wildfires.						<0.001
	Strongly agree	3 (3.7)	23 (28.4)	30 (37)	4 (4.9)	21 (25.9)	
	Somewhat agree	43 (23.6)	52 (28.6)	57 (31.3)	4 (2.2)	26 (14.3)	

	Neutral	9 (13)	4 (5.8)	29 (42)	27 (39.1)	0	
	Somewhat disagree	0	3 (18.8)	19 (56.3)	4 (25)	0	
	Strongly disagree	0	2 (25)	4 (50)	2 (25)	0	

(p-value <0.05= statistically significant association)

Table 2: Response to Knowledge statements by province

As illustrated in Table 2, a statistically significant association was seen between all six knowledge related statements and provinces. This shows that the mean knowledge is statistically significant between at least two provinces. We further assessed the mean difference between the knowledge statements and provinces through the Tukey test. When we did a pair-wise comparison, Lumbini province was significantly better (p value <0.05) in all those statements compared to at least one of the other provinces. The detailed results can be seen in Annex section (Annex 1).

Distribution of responses for attitude related statements by province and significance level from ANOVA test.

S. N.	Statements	Provinces (N=356)					p-value
		Province 1	Bagmati	Lumbini	Karnali	Sudur paschim	
1	I love hot weather/summer.						<0.001
	Strongly agree	0	3 (4.3)	65 (92.9)	2 (2.9)	0	
	Somewhat agree	29 (32.9)	17 (19.3)	27 (30.7)	2 (2.3)	13 (14.8)	
	Neutral	18 (22.2)	13 (16.1)	13 (16.1)	37 (45.7)	0	
	Somewhat disagree	8 (16.3)	21 (42.9)	8 (16.3)	0	12 (24.5)	
	Strongly disagree	0	30 (44.1)	16 (23.5)	0	22 (32.4)	
2	Exposure to the heatwave will do me no harm						<0.001
	Strongly agree	0	3 (21.4)	7 (50)	2 (14.3)	2 (14.3)	
	Somewhat agree	47 (28.5)	20 (24.2)	64 (38.8)	5 (3)	9 (5.5)	
	Neutral	5 (8.9)	2 (3.6)	29 (51.8)	20 (35.7)	0	
	Somewhat disagree	1 (1.4)	22 (30.6)	22 (30.6)	6 (8.3)	21 (29.2)	
	Strongly disagree	2 (4.1)	17 (34.7)	7 (14.3)	8 (16.3)	15 (30.6)	
3	My body has been used to (resistant to) heatwave.						<0.001
	Strongly agree	23 (45.1)	10 (19.6)	11 (21.6)	2 (3.9)	5 (9.8)	
	Somewhat agree	30 (16.4)	36 (19.7)	70 (38.3)	12 (6.6)	35 (19.1)	
	Neutral	0	8 (12.7)	32 (50.8)	23 (36.5)	0	
	Somewhat disagree	0	23 (53.5)	11 (25.6)	2 (4.7)	7 (16.3)	
	Strongly disagree	2 (12.5)	7 (43.8)	5 (31.3)	2 (12.5)	0	
4	Personal protective equipment needs to be worn while working under the sun.						0.002
	Strongly agree	8 (12.5)	18 (28.1)	20 (31.3)	10 (15.6)	8 (12.5)	

	Somewhat agree	40 (26)	40 (26)	43 (27.9)	2 (1.3)	29 (18.8)	
	Neutral	7 (9.9)	2 (2.8)	40 (56.3)	22 (31)	0	
	Somewhat disagree	0	20 (36.4)	24 (43.6)	3 (5.5)	8 (14.6)	
	Strongly disagree	0	4 (33.3)	2 (16.7)	4 (33.3)	2 (16.7)	
5	Even if we try to follow the multiple protective measures, we cannot escape the effects of heatwave						0.0005
	Strongly agree	3 (10.7)	2 (7.1)	19 (67.9)	2 (7.1)	2 (7.1)	
	Somewhat agree	7 (5)	50 (35.7)	54 (38.6)	4 (2.9)	25 (17.9)	
	Neutral	12 (18.5)	0	24 (36.9)	29 (44.6)	0	
	Somewhat disagree	30 (34.9)	19 (22.1)	22 (25.6)	2 (2.3)	13 (15.1)	
	Strongly disagree	3 (8.1)	13 (35.1)	10 (27)	4 (10.8)	7 (18.9)	
6	Heatwave is a serious issue.						<0.001
	Strongly agree	3 (4.5)	22 (32.8)	33 (49.3)	0	9 (13.4)	
	Somewhat agree	43 (28.9)	37 (24.8)	42 (28.2)	2 (1.3)	25 (16.8)	
	Neutral	8 (7.5)	13 (12.1)	40 (37.4)	35 (32.7)	11 (10.3)	
	Somewhat disagree	1 (3.6)	9 (32.1)	12 (42.9)	4 (14.3)	2 (7.1)	
	Strongly disagree	0	3 (60)	2 (40)	0	0	

(p-value <0.05= statistically significant association)

Table 3: Response to attitude statements by provinces

As illustrated in Table 3, a statistically significant association was seen between all six attitude related statements and provinces. This shows that the mean attitude is statistically significant between at least two provinces. We further assessed the mean difference between the attitude statements and provinces through Tukey test. When we did a pair-wise comparison, province 1 was significantly better (p value <0.05) in all those statements compared to at least one of the other provinces. The detailed results can be seen in Annex section (Annex 2).

Distribution of responses for the protective practice by province and significance level from ANOVA test.

S. N.	Practices	Provinces (N=356)					p-value
		Province 1	Bagmati	Lumbini	Karnali	Sudur paschim	
1	Drink plenty of water to stay hydrated						<0.001
	Always	55 (18.2)	84 (27.8)	112 (37.1)	10 (3.3)	41 (13.6)	
	Never	0	0	0	4 (100)	0	
	Sometimes	0	0	17 (34)	27 (54)	6 (12)	
2	Eat/drink cold items						0.2
	Always	19 (25.7)	16 (21.6)	24 (32.4)	2 (2.7)	13 (17.6)	

	Never	6 (16.2)	10 (27)	14 (37.8)	2 (5.4)	5 (13.5)	
	Sometimes	30 (12.2)	58 (23.7)	91 (37.1)	37 (15.1)	29 (11.8)	
3	Wear light colored clothes while going outside						<0.001
	Always	13 (15.9)	25 (30.5)	35 (42.7)	1 (1.2)	8 (9.8)	
	Never	0	7 (12.5)	24 (42.9)	22 (39.3)	3 (5.4)	
	Sometimes	42 (19.3)	52 (23.9)	70 (32.1)	18 (8.3)	36 (16.5)	
4	Listen to the daily weather forecast						<0.001
	Always	0	10 (20.4)	15 (30.6)	24 (48.9)	0	
	Never	17 (13.7)	36 (29)	35 (28.2)	7 (5.7)	29 (23.4)	
	Sometimes	38 (20.8)	38 (20.8)	79 (43.2)	10 (5.5)	18 (9.8)	
5	Use of fan/cooler/AC						<0.001
	Always	21 (15.2)	42 (29.7)	50 (36.2)	2 (1.5)	24 (17.4)	
	Never	0	0	13 (39.4)	20 (60.6)	0	
	Sometimes	34 (18.5)	42 (22.8)	66 (35.9)	19 (10.3)	23 (12.5)	
6	Wear a hat when going outside						<0.001
	Always	12 (26.1)	13 (28.3)	19 (41.3)	0	2 (4.4)	
	Never	3 (1.9)	50 (33.1)	44 (29.1)	26 (17.2)	28 (18.5)	
	Sometimes	40 (25.2)	21 (13.2)	66 (41.5)	15 (9.4)	17 (10.7)	
7	Take frequent showers						<0.001
	Always	39 (19.8)	59 (30)	52 (26.4)	6 (3.1)	41 (20.8)	
	Never	0	1 (2.9)	17 (50)	16 (47.1)	0	
	Sometimes	16 (12.8)	24 (19.2)	60 (48)	19 (15.2)	6 (4.8)	
8	Open windows at night						<0.001
	Always	53 (35.1)	27 (17.9)	49 (32.5)	14 (9.3)	8 (5.3)	
	Never	0	5 (17.2)	17 (58.6)	7 (24.1)	0	
	Sometimes	2 (1.1)	52 (29.6)	63 (35.8)	20 (11.4)	39 (22.2)	
9	Stay inside the house during daytime						<0.001
	Always	8 (12.7)	17 (26.9)	27 (42.9)	0	11 (17.5)	
	Never	2 (1.9)	25 (23.6)	32 (30.2)	31 (29.3)	16 (15.1)	
	Sometimes	45 (24.1)	42 (22.5)	70 (37.4)	10 (5.4)	20 (10.7)	
10	Use an umbrella when walking outside						0.04
	Always	7 (9.1)	27 (35.1)	35 (45.5)	2 (2.6)	6 (7.8)	
	Never	15 (11.9)	37 (29.4)	37 (29.4)	18 (14.3)	19 (15.1)	
	Sometimes	33 (21.6)	20 (13.1)	57 (37.3)	21 (13.7)	22 (14.4)	
11	Work in a well-ventilated space						<0.001
	Always	29 (14.9)	65 (33.3)	57 (29.2)	4 (2.1)	40 (20.5)	
	Never	0	0	10 (27.8)	24 (66.7)	2 (5.6)	
	Sometimes	26 (20.8)	19 (15.2)	62 (49.6)	13 (10.4)	5 (4)	
12	Take periodic breaks in shade during work						<0.001
	Always	13 (14.3)	25 (27.5)	32 (35.2)	8 (8.8)	13 (14.3)	

	Never	0	5 (12.8)	7 (17.9)	27 (69.2)	0	
	Sometimes	42 (18.6)	54 (23.9)	90 (39.8)	6 (2.7)	34 (15)	
13	Use of sunscreen (commercial product, coconut oil, aloe vera, or other natural means)						<0.001
	Always	4 (7.7)	16 (30.8)	29 (55.8)	2 (3.8)	1 (1.9)	
	Never	37 (19.8)	41 (21.9)	34 (18.2)	35 (18.7)	40 (21.4)	
	Sometimes	14 (11.9)	27 (23.1)	66 (56.4)	4 (3.4)	6 (5.1)	

(p-value <0.05= statistically significant association)

Table 4: Responses to practice statements by provinces

As illustrated in Table 3, a statistically significant association was seen between twelve out of thirteen protective practices and provinces. This shows that the mean practice is statistically significant between at least two provinces.

FGD Results

The findings from 11 FGDs, with a total participation of 80 participants have been presented under different thematic areas.

1. Knowledge on heatwave

Most of the participants perceived increasing temperature as well as increasing cold climate as climate change. They said that they had experienced a change in the pattern of summer and winter where the summer is extremely hot, and winter is extremely cold. According to the participants, deforestation and urbanization were the main reason behind the increase in temperature.

"Because of climate change the sun is getting hotter, winter seasons are excessively cold and rainy season is shortened".

When asked about their experience of differences in temperature during the summer season in the last 10- 12 years, all of them said that there is very high heat now compared to the past. Regarding their understanding of heatwave, most of them were not aware of the term heatwave (*Luu* in Nepali) but when we referred to other synonyms, they said that they have heard about it. Most of the participants expressed that they had experienced a heatwave. They said that heatwave is most common during the months of Chaitra- Jestha (April-June).

"People of the old generation usually talk about heatwave (Luu). The time for this wave starts from Falgun (February) and occurs more frequently between Falgun-Jestha (February- June). These days, the summer is longer."

2. Perceptions regarding the health and environmental impacts of heatwave

The participants reported that the heatwave has an impact on health and the environment. In health, the most common problems during heatwave as reported by the participants were: common cold, fever, rashes, headache, nausea and loss of appetite. Some participants said that diseases like pneumonia, dengue, typhoid etc. are common during hotter days. According to the participants, they had to work during day time on direct exposure to sun without management of prevention of high temperatures which causes impacts on their health.

The participants reported that industrialization, population growth, unplanned urbanization and deforestation were the major factors that increase the risk of a high heat wave and mostly affected groups are children, outdoor workers, elderly population etc.

The participants also reported that the heatwave has an impact on the environment and the most evident impact was on agriculture. They said that the crops had turned red and dry due to drought. In the agriculture sector, they faced problems like dryness, and problems in irrigation due to no rain.

"*The crops are turning red due to heat. Last year there was no rainfall during the rainy season, and it rained heavily during the time of harvest. This year also, it is showing the same trend. The seasons are also changing with time."*

"The elderly people and school going children are affected more due to heat. Along with them the people who work in outdoor setting are also affected more due to increasing heat."

3. Protective measures

Though the participants reported that heatwaves and exposure to the extreme sun are harmful, they also expressed that they had no choice other than working under the sun even during hot temperatures.

"There is no option for us other than getting exposed to sun at work. This work is the only option for running our daily life. If we do not work in the day, we won't have food at the evening."

Most of the participants said that they practiced some protective behaviors while working under sun but they also said that protective behaviors were not viable options for most of

the times. The common protective measures practiced by the participants were: taking periodic breaks under shade, drinking more water, wearing hats/shawls for protecting their head, wearing sunglasses (especially for males) and so on.

4. Role of government and concerned authorities in minimizing the impact/effect of heatwave and Risk communication

The major recommendations given by participants were afforestation, preserving natural resources, making people aware people for taking preventive measures, revising policies etc.

One of the participants said, *"There are laborers who work outside, if policy is made to work during morning time from 6am for 7 hours like in foreign countries, it can be easy for us. But in our country, if we do not work all day, we don't have anything to eat at night."*

The participants were not much aware of how to prevent the health impacts of heatwave. They reported that working under hot temperature has been habitual for them. The majority of the participants said that they had not got any information/news regarding heatwave from any organization or government level. The ones who had heard of the term 'heatwave' mostly said that they had heard about the term heatwave from their parents/family members/relatives only.

Some participants mentioned that they had heard about news regarding notices of increasing temperature on the radio, but they did not have much information about the preventive measures of heatwave. They also said that as they did not have comprehensive information about heatwaves, they are not sure if heatwave is a serious issue or not.

"*We have experienced an increase in temperature, but we do not know what its consequences could be. Without knowing about the consequences, we cannot say for sure if heatwave is a serious issue or not."*

Most of the participants said that they had never heard about heatwaves from any news sources.

5. Policy/Organizational support

The participants said that they do not expect any support from policy/organizational level. They expressed lack of expectation from the higher levels. The participants were not aware about how serious issue heatwave is. Most of the participants did not know about the consequences and impacts of heatwave. This could be a reason for their reluctance to express the need for support. Another reason they mentioned was that the government had

not met their expectations in basic demands like water, health service, education, and employment requirements. For this reason, most of them expressed lack of anticipation.

"We have been struggling with the local government for basic needs like drinking water supply. The government has not provided relief materials during the flood and other disasters to us. In such context, we do not expect the government to provide us with any support for heatwave or other such issues."

Strengths and Limitations

This is one of the few studies conducted on topic of Heatwaves in Nepal. In addition, this research adds value in terms of cost-effectiveness and delivers a guiding framework for future research on climate change.

Response authenticity was the limitation of this research as the participants of this study might have under reported or overreported their perceptions and experiences regarding the extreme heat/ heatwave.

Conclusion and Recommendations

The impact of climate change related disasters like heatwaves has a several adversities on human health, social capital, and entire eco-system. In a country like Nepal, heatwaves can have detrimental effects especially among the vulnerable populations. The prolonged exposure to heat has affected outdoor workers in Nepal as they possess lack of knowledge, wrong perception about heatwaves and tend less utilize protective measures.

Government of Nepal should act timely in terms of assessing the social vulnerabilities, conduct further research on climate change, adopt proactive measures, plan for cost effective interventions, and co-design climate related policies which can address the searing issue like heatwaves. In addition, the government should deliver massive awareness program in heatwave prone areas to make people aware about the preventive and protective measures.

Our study highlights the fact that Civil Society Organizations (CSOs) can greatly contribute to reducing and mitigating climate change impacts. This study urges CSOs and other government counterparts to advocate for climate change issues like heatwaves through national, transnational, and global cooperation. In addition, CSOs can assist the government through technocratic and social media approaches. They should regularly monitor and timely disseminate information regarding the heatwave to the most vulnerable population of Nepal.

Annex

Annex 1: One-way ANOVA and Tukey test for knowledge related statements

1. Heat-related diseases can lead to death.

```
. anova heatanddeath_rec provinces
```

Number of obs =	356	R-squared	=	0.1376	
Root MSE =	1.16455	Adj R-squared	=	0.1278	

Source	Partial SS	df	MS	F	Prob>F
Model	75.965268	4	18.991317	14.00	0.0000
provinces	75.965268	4	18.991317	14.00	0.0000
Residual	476.02069	351	1.3561843		
Total	551.98596	355	1.55489		

```
. tukeyhsd provinces

Tukey HSD pairwise comparisons for variable provinces
studentized range critical value(.05, 5, 351) = 3.8778433
uses harmonic mean sample size =   59.876
```

grp vs grp	group means		mean dif	HSD-test
1 vs 2	0.0364	0.2976	0.2613	1.7359
1 vs 3	0.0364	1.1550	1.1187	7.4331*
1 vs 4	0.0364	0.1707	0.1344	0.8928
1 vs 5	0.0364	0.2979	0.2615	1.7376
2 vs 3	0.2976	1.1550	0.8574	5.6972*
2 vs 4	0.2976	0.1707	0.1269	0.8431
2 vs 5	0.2976	0.2979	0.0003	0.0017
3 vs 4	1.1550	0.1707	0.9843	6.5403*
3 vs 5	1.1550	0.2979	0.8572	5.6955*
4 vs 5	0.1707	0.2979	0.1271	0.8448

Note: the levels of provinces have been recoded.

2. Heat waves can be a factor for depression and anxiety

```
. anova heatanxiety_rec provinces
```

Number of obs =	356	R-squared	=	0.1246	
Root MSE =	.970634	Adj R-squared	=	0.1147	

Source	Partial SS	df	MS	F	Prob>F
Model	47.08784	4	11.77196	12.50	0.0000
provinces	47.08784	4	11.77196	12.50	0.0000
Residual	330.68744	351	.94212946		
Total	377.77528	355	1.0641557		

```
. tukeyhsd provinces

Tukey HSD pairwise comparisons for variable provinces
studentized range critical value(.05, 5, 351) = 3.8778433
uses harmonic mean sample size =   59.876
```

grp vs grp	group means		mean dif	HSD-test
1 vs 2	0.8727	-0.2262	1.0989	8.7607*
1 vs 3	0.8727	0.3643	0.5084	4.0529*
1 vs 4	0.8727	0.0000	0.8727	6.9575*
1 vs 5	0.8727	0.0000	0.8727	6.9575*
2 vs 3	-0.2262	0.3643	0.5905	4.7078*
2 vs 4	-0.2262	0.0000	0.2262	1.8032
2 vs 5	-0.2262	0.0000	0.2262	1.8032
3 vs 4	0.3643	0.0000	0.3643	2.9046
3 vs 5	0.3643	0.0000	0.3643	2.9046
4 vs 5	0.0000	0.0000	0.0000	0.0000

Note: the levels of provinces have been recoded.

3. Due to the building's shade, heat waves are less common in cities than in rural areas.

```
. anova buildingshade_rec provinces
```

Number of obs =	356	R-squared	=	0.1307	
Root MSE =	1.04661	Adj R-squared	=	0.1208	

Source	Partial SS	df	MS	F	Prob>F
Model	57.798848	4	14.449712	13.19	0.0000
provinces	57.798848	4	14.449712	13.19	0.0000
Residual	384.48205	351	1.0953905		
Total	442.2809	355	1.2458617		

```
. tukeyhsd provinces

Tukey HSD pairwise comparisons for variable provinces
studentized range critical value(.05, 5, 351) = 3.8778433
uses harmonic mean sample size =   59.876
```

grp vs grp	group means		mean dif	HSD-test
1 vs 2	-0.9636	-0.7381	0.2255	1.6675
1 vs 3	-0.9636	-0.0155	0.9481	7.0099*
1 vs 4	-0.9636	-0.1220	0.8417	6.2229*
1 vs 5	-0.9636	-0.8511	0.1126	0.8323
2 vs 3	-0.7381	-0.0155	0.7226	5.3424*
2 vs 4	-0.7381	-0.1220	0.6161	4.5554*
2 vs 5	-0.7381	-0.8511	0.1130	0.8352
3 vs 4	-0.0155	-0.1220	0.1064	0.7870
3 vs 5	-0.0155	-0.8511	0.8356	6.1776*
4 vs 5	-0.1220	-0.8511	0.7291	5.3906*

Note: the levels of provinces have been recoded.

4. Heat stress during night is worse than heat stress during day.

```
. anova heatatnight_rec provinces
```

Number of obs =	356	R-squared	=	0.2721	
Root MSE =	1.08222	Adj R-squared	=	0.2638	

Source	Partial SS	df	MS	F	Prob>F
Model	153.68439	4	38.421098	32.81	0.0000
provinces	153.68439	4	38.421098	32.81	0.0000
Residual	411.08808	351	1.1711911		
Total	564.77247	355	1.5909084		

```
. tukeyhsd provinces

Tukey HSD pairwise comparisons for variable provinces
studentized range critical value(.05, 5, 351) = 3.8778433
uses harmonic mean sample size =   59.876
```

grp vs grp	group means		mean dif	HSD-test
1 vs 2	-0.5455	-1.0595	0.5141	3.6757
1 vs 3	-0.5455	0.0620	0.6075	4.3435*
1 vs 4	-0.5455	0.3902	0.9357	6.6904*
1 vs 5	-0.5455	-1.5745	1.0290	7.3576*
2 vs 3	-1.0595	0.0620	1.1215	8.0192*
2 vs 4	-1.0595	0.3902	1.4498	10.3660*
2 vs 5	-1.0595	-1.5745	0.5149	3.6819
3 vs 4	0.0620	0.3902	0.3282	2.3469
3 vs 5	0.0620	-1.5745	1.6365	11.7011*
4 vs 5	0.3902	-1.5745	1.9647	14.0479*

Note: the levels of provinces have been recoded.

5. Excessive sweating during heatwave is a sign of heat stress.

```
. anova sweating_rec provinces
```

```
                           Number of obs =       356    R-squared     =  0.0709
                           Root MSE      =  .818868    Adj R-squared =  0.0603

                  Source | Partial SS        df         MS        F     Prob>F
-------------------------+----------------------------------------------------
                   Model |  17.950389         4   4.4875972     6.69   0.0000
                         |
               provinces |  17.950389         4   4.4875972     6.69   0.0000
                         |
                Residual |  235.36141       351    .67054532
-------------------------+----------------------------------------------------
                   Total |   253.3118       355    .71355436
```

```
. tukeyhsd provinces

Tukey HSD pairwise comparisons for variable provinces
studentized range critical value(.05, 5, 351) = 3.8778433
uses harmonic mean sample size =   59.876

                                          mean
grp vs grp       group means              dif    HSD-test
-----------------------------------------------------------
  1 vs   2     0.8909     0.7262      0.1647   1.5565
  1 vs   3     0.8909     0.4651      0.4258   4.0236*
  1 vs   4     0.8909     0.2439      0.6470   6.1140*
  1 vs   5     0.8909     0.9149      0.0240   0.2266
  2 vs   3     0.7262     0.4651      0.2611   2.4670
  2 vs   4     0.7262     0.2439      0.4823   4.5574*
  2 vs   5     0.7262     0.9149      0.1887   1.7832
  3 vs   4     0.4651     0.2439      0.2212   2.0904
  3 vs   5     0.4651     0.9149      0.4498   4.2502*
  4 vs   5     0.2439     0.9149      0.6710   6.3406*

Note: the levels of provinces have been recoded.
```

6. Heatwaves may lead to bushfire/ wildfires.

```
. anova bushfire_rec provinces
```

```
                           Number of obs =       356    R-squared     =  0.1607
                           Root MSE      =  .819056    Adj R-squared =  0.1512

                  Source | Partial SS        df         MS        F     Prob>F
-------------------------+----------------------------------------------------
                   Model |  45.092279         4   11.27307     16.80   0.0000
                         |
               provinces |  45.092279         4   11.27307     16.80   0.0000
                         |
                Residual |  235.46952       351   .67085333
-------------------------+----------------------------------------------------
                   Total |  280.5618        355   .79031492
```

```
. tukeyhsd provinces

Tukey HSD pairwise comparisons for variable provinces
studentized range critical value(.05, 5, 351) = 3.8778433
uses harmonic mean sample size =   59.876

                                          mean
grp vs grp       group means              dif    HSD-test
-----------------------------------------------------------
  1 vs   2     0.8909     1.0833      0.1924   1.8179
  1 vs   3     0.8909     0.7752      0.1157   1.0932
  1 vs   4     0.8909     0.0976      0.7933   7.4951*
  1 vs   5     0.8909     1.4468      0.5559   5.2518*
  2 vs   3     1.0833     0.7752      0.3081   2.9111
  2 vs   4     1.0833     0.0976      0.9858   9.3130*
  2 vs   5     1.0833     1.4468      0.3635   3.4339
  3 vs   4     0.7752     0.0976      0.6776   6.4019*
  3 vs   5     0.7752     1.4468      0.6716   6.3450*
  4 vs   5     0.0976     1.4468      1.3492  12.7469*

Note: the levels of provinces have been recoded.
```

Note: 1= Province 1; 2 = Bagmati province; 3 = Lumbini province; 4 = Karnali province; 5 = Sudurpaschim province

Annex 2: One-way ANOVA and Tukey test for attitude related statements

1. I love hot weather/ summer.

```
. anova ilovesummer_rec provinces
```

```
                           Number of obs =       356   R-squared     =  0.2767
                           Root MSE      =   1.18706   Adj R-squared =  0.2685

                  Source | Partial SS        df       MS          F     Prob>F
-------------------------+----------------------------------------------------
                   Model |  189.20673         4   47.301684      33.57   0.0000
                         |
               provinces |  189.20673         4   47.301684      33.57   0.0000
                         |
                Residual |  494.59945       351   1.4091152
-------------------------+----------------------------------------------------
                   Total |  683.80618       355   1.9262146
```

```
. tukeyhsd provinces

Tukey HSD pairwise comparisons for variable provinces
studentized range critical value(.05, 5, 351) = 3.8778433
uses harmonic mean sample size =   59.876

                                                mean
grp vs grp       group means           dif    HSD-test
-----------------------------------------------------------
  1 vs   2        0.3818     -0.6905      1.0723   6.9899*
  1 vs   3        0.3818      0.9070      0.5252   3.4233
  1 vs   4        0.3818      0.1463      0.2355   1.5350
  1 vs   5        0.3818     -0.9149      1.2967   8.4528*
  2 vs   3       -0.6905      0.9070      1.5975  10.4132*
  2 vs   4       -0.6905      0.1463      0.8368   5.4549*
  2 vs   5       -0.6905     -0.9149      0.2244   1.4629
  3 vs   4        0.9070      0.1463      0.7606   4.9583*
  3 vs   5        0.9070     -0.9149      1.8219  11.8761*
  4 vs   5        0.1463     -0.9149      1.0612   6.9178*

Note: the levels of provinces have been recoded.
```

2. Exposure to heatwave will do me no harm.

```
. anova noharm_rec provinces
```

```
                           Number of obs =       356   R-squared     =  0.1647
                           Root MSE      =   1.07711   Adj R-squared =  0.1552

                  Source | Partial SS        df       MS          F     Prob>F
-------------------------+----------------------------------------------------
                   Model |  80.297022         4   20.074256      17.30   0.0000
                         |
               provinces |  80.297022         4   20.074256      17.30   0.0000
                         |
                Residual |  407.21702       351   1.1601625
-------------------------+----------------------------------------------------
                   Total |  487.51404       355    1.373279
```

```
. tukeyhsd provinces

Tukey HSD pairwise comparisons for variable provinces
studentized range critical value(.05, 5, 351) = 3.8778433
uses harmonic mean sample size =   59.876

                                                mean
grp vs grp       group means           dif    HSD-test
-----------------------------------------------------------
  1 vs   2        0.7636     -0.1190      0.8827   6.3412*
  1 vs   3        0.7636      0.3256      0.4381   3.1470
  1 vs   4        0.7636     -0.3171      1.0807   7.7639*
  1 vs   5        0.7636     -0.8085      1.5721  11.2944*
  2 vs   3       -0.1190      0.3256      0.4446   3.1942
  2 vs   4       -0.1190     -0.3171      0.1980   1.4226
  2 vs   5       -0.1190     -0.8085      0.6895   4.9531*
  3 vs   4        0.3256     -0.3171      0.6427   4.6169*
  3 vs   5        0.3256     -0.8085      1.1341   8.1474*
  4 vs   5       -0.3171     -0.8085      0.4914   3.5305

Note: the levels of provinces have been recoded.
```

3. My body has been used to (resistant to) heatwave.

```
. anova resistant_rec provinces
```

```
                           Number of obs =       356   R-squared     =  0.1268
                           Root MSE      =  .959594   Adj R-squared =  0.1168

                  Source | Partial SS        df       MS          F     Prob>F
-------------------------+----------------------------------------------------
                   Model |  46.915708         4   11.728927      12.74   0.0000
                         |
               provinces |  46.915708         4   11.728927      12.74   0.0000
                         |
                Residual |  323.20789       351   .92082019
-------------------------+----------------------------------------------------
                   Total |  370.1236        355   1.0426017
```

```
. tukeyhsd provinces

Tukey HSD pairwise comparisons for variable provinces
studentized range critical value(.05, 5, 351) = 3.8778433
uses harmonic mean sample size =   59.876

                                                mean
grp vs grp       group means           dif    HSD-test
-----------------------------------------------------------
  1 vs   2        1.3091      0.2262      1.0829   8.7323*
  1 vs   3        1.3091      0.5504      0.7587   6.1180*
  1 vs   4        1.3091      0.2439      1.0652   8.5895*
  1 vs   5        1.3091      0.8085      0.5006   4.0366*
  2 vs   3        0.2262      0.5504      0.3242   2.6143
  2 vs   4        0.2262      0.2439      0.0177   0.1428
  2 vs   5        0.2262      0.8085      0.5823   4.6957*
  3 vs   4        0.5504      0.2439      0.3065   2.4714
  3 vs   5        0.5504      0.8085      0.2581   2.0815
  4 vs   5        0.2439      0.8085      0.5646   4.5529*

Note: the levels of provinces have been recoded.
```

4. Personal protective equipment needs to be worn while working under the sun

```
. anova ppe_rec provinces
```

```
                           Number of obs =       356   R-squared     =  0.0460
                           Root MSE      =    1.0391   Adj R-squared =  0.0351

                  Source | Partial SS        df       MS          F     Prob>F
-------------------------+----------------------------------------------------
                   Model |  18.26218         4   4.565545       4.23   0.0023
                         |
               provinces |  18.26218         4   4.565545       4.23   0.0023
                         |
                Residual |  378.9822       351   1.0797214
-------------------------+----------------------------------------------------
                   Total |  397.24438       355   1.1189983
```

```
. tukeyhsd provinces

Tukey HSD pairwise comparisons for variable provinces
studentized range critical value(.05, 5, 351) = 3.8778433
uses harmonic mean sample size =   59.876

                                                mean
grp vs grp       group means           dif    HSD-test
-----------------------------------------------------------
  1 vs   2        1.0182      0.5714      0.4468   3.3269
  1 vs   3        1.0182      0.4264      0.5918   4.4072*
  1 vs   4        1.0182      0.2683      0.7499   5.5843*
  1 vs   5        1.0182      0.7021      0.3161   2.3536
  2 vs   3        0.5714      0.4264      0.1451   1.0803
  2 vs   4        0.5714      0.2683      0.3031   2.2574
  2 vs   5        0.5714      0.7021      0.1307   0.9733
  3 vs   4        0.4264      0.2683      0.1581   1.1771
  3 vs   5        0.4264      0.7021      0.2758   2.0536
  4 vs   5        0.2683      0.7021      0.4338   3.2307

Note: the levels of provinces have been recoded.
```

5. Even if we try to follow the multiple protective measures, we cannot escape the effects of heatwave.

```
. anova nodifference_rec provinces
```

Number of obs =	356	R-squared =	0.0549		
Root MSE =	1.13962	Adj R-squared =	0.0442		

Source	Partial SS	df	MS	F	Prob>F
Model	26.50453	4	6.6261326	5.10	0.0005
provinces	26.50453	4	6.6261326	5.10	0.0005
Residual	455.85502	351	1.2987323		
Total	482.35955	355	1.3587593		

```
. tukeyhsd provinces

Tukey HSD pairwise comparisons for variable provinces
studentized range critical value(.05, 5, 351) = 3.8778433
uses harmonic mean sample size =   59.876
```

grp vs grp	group means		mean dif	HSD-test
1 vs 2	-0.4182	0.1071	0.5253	3.5669
1 vs 3	-0.4182	0.3876	0.8058	5.4712*
1 vs 4	-0.4182	-0.0488	0.3694	2.5082
1 vs 5	-0.4182	0.0426	0.4607	3.1284
2 vs 3	0.1071	0.3876	0.2805	1.9043
2 vs 4	0.1071	-0.0488	0.1559	1.0587
2 vs 5	0.1071	0.0426	0.0646	0.4386
3 vs 4	0.3876	-0.0488	0.4364	2.9630
3 vs 5	0.3876	0.0426	0.3450	2.3428
4 vs 5	-0.0488	0.0426	0.0913	0.6202

```
Note: the levels of provinces have been recoded.
```

6. Heatwave is a serious issue.

```
. anova seriousissue_rec provinces
```

Number of obs =	356	R-squared =	0.0898		
Root MSE =	.876694	Adj R-squared =	0.0794		

Source	Partial SS	df	MS	F	Prob>F
Model	26.614423	4	6.6536057	8.66	0.0000
provinces	26.614423	4	6.6536057	8.66	0.0000
Residual	269.77603	351	.76859267		
Total	296.39045	355	.83490267		

```
. tukeyhsd provinces

Tukey HSD pairwise comparisons for variable provinces
studentized range critical value(.05, 5, 351) = 3.8778433
uses harmonic mean sample size =   59.876
```

grp vs grp	group means		mean dif	HSD-test
1 vs 2	0.8727	0.7857	0.0870	0.7680
1 vs 3	0.8727	0.7132	0.1595	1.4082
1 vs 4	0.8727	-0.0488	0.9215	8.1335*
1 vs 5	0.8727	0.8723	0.0004	0.0034
2 vs 3	0.7857	0.7132	0.0725	0.6402
2 vs 4	0.7857	-0.0488	0.8345	7.3655*
2 vs 5	0.7857	0.8723	0.0866	0.7646
3 vs 4	0.7132	-0.0488	0.7620	6.7253*
3 vs 5	0.7132	0.8723	0.1592	1.4048
4 vs 5	-0.0488	0.8723	0.9211	8.1301*

```
Note: the levels of provinces have been recoded.
```

Note: 1= Province 1; 2 = Bagmati province; 3 = Lumbini province; 4 = Karnali province; 5 = Sudurpaschim province

Annex 3: Tools for quantitative survey

Quantitative Part

A. Background Information

Age:
Sex:
Marital status:
Ethnicity:
Educational status:
Occupation:
Years of engagement in the occupation:
Working hours per day:
Income:
Place of residence (Location):
Temperature record (in Celsius):

B. Knowledge Regarding Heatwave

S. N	Question	Options	Remarks
1	Have you experienced an increase in temperature in recent years?	No	
		Yes	
2	Have you heard about any incidents related to heat? (heat rashes, deaths, faint, heat stroke etc.)		
3	Have you experienced any wound or felt sick due to heat (rashes, cramps, exhaustion, dizziness, stroke, etc)?		
3.1	If yes, please specify symptoms.	_____	
4	Have you heard about heatwave?		
5	If yes, from where did you hear about heatwave? (Multiple response)	Television	
		Radio	
		Internet	
		Social Media	
		Friend/Family/Relatives	
		Campaigns/Programs	
		Others (specify)	
6	Did the government or other organizations notify you about the occurrence of heatwave?	No	
		Yes	
7	If yes, from whom and through what medium?	_____	
8	How well-informed do you think you are about heat waves?	Very well informed	
		Fairly well informed	
		Not very well informed	
		Not informed at all	
9	How closely do you follow news about heat waves?	Very closely	

		Somewhat closely	
		Little closely	
		Not at all	
10	What problems/discomfort can one feel due to increased temperature/heatwave? (Multiple choice)	Fatigue	
		Headache	
		Diarrhea	
		Vomitting	
		Nausea & Loss of appetite	
		Dizziness	
		Irritability	
		Dehydration	
		Sleeplessness	
		Restlessness	
		Difficulty in breathing	
		Excessive sweating	
		Muscle ache	
		Others (Specify)	

C. Statements for assessing knowledge

S. N	Statements	Strongly agree	Somewhat Agree	Neutral	Somewhat Disagree	Strongly Disagree
1	Heat-related diseases can lead to death.					
2	Heat waves can be a factor for depression and anxiety.					
3	Due to the building's shade, heat waves are less common in cities than in rural areas.					
4	Heat stress during nighttime is worse than heat stress during daytime.					
5	Excessive sweating during a heatwave is a sign of heat stress.					
6	Heatwaves may lead to bush fires/wildfires.					

D. Attitude Related to heatwave

S. N	Statements	Strongly agree	somewhat agree	Neutral	Somewhat disagree	Strongly disagree
1	I love hot weather/summer.					
2	Exposure to the heatwave will do me no harm					
3	My body has been used to (resistant to) heatwave.					

4	Personal protective equipment needs to be worn while working under the sun.					
5	Even if we try to follow the multiple protective measures we cannot escape the effects of heatwave					
6	Heatwave is a serious issue.					

7	Would you like to get notified about the occurrence of a heatwave in the future?	No	
		Yes	
		Don't know	
8	If yes, through which medium you would like to choose for receiving the notification? (Multiple response)	Television	
		Radio	
		Social media	
		SMS	
		Health person	
		Family member/Relative	
		Others (specify)	

E. Practices regarding the protective behaviors against heatwave.

How do you describe about your actions on the health advice for heatwave?	Not heard advice
	Heard advice but did not change behavior
	Heard advice and changed behavior

Please respond to the following practices based on how often you implement them as Always, sometime or never.

S. N	Practices	Always	Sometimes	Never
1	Drink plenty of water to stay hydrated			
2	Eat/drink cold items			
3	Wear dark colored clothes when going outside			
4	Listen to the daily weather forecast			
5	Use of cooler/AC/fan			
6	Wear a hat when going outside			
7	Take frequent showers			
8	Open windows at night			
9	Stay inside the house during daytime			
10	Use an umbrella when walking outside			
11	Work in a well-ventilated space			
12	While working take periodic breaks in shade			
13	Use of sunscreen (commercial product, coconut oil, aloe vera, or other natural means)			

Annex 4: FGD guide

FGD Guide

Introduction (Participants Information)

Age:

Sex:

Marital status:

Ethnicity:

Educational status:

Occupation:

Years of engagement in the occupation:

Working hours per day:

Income:

Place of residence (Location):

1. Knowledge on Heatwave:

- What is your opinion regarding Climate change?
  (When we say Climate change, write down the first two to three words that come to your mind when you think of Climate Change.)
- What do you think about the change in temperature along with the change in climate? (The summer extremes?)
- Over the past years, how have you experienced the changes in temperature? What do you think is the trend? How did you conclude about that trend?
- If you think the temperature is increasing over the past years, what problems do you think it has or will bring to you and your community? Have you experienced any of those problems, please elaborate?
- How familiar are you with the heatwave? How did you familiarize yourself with heat wave?
- What are your opinion/understanding about the heatwave, its causes (facilitators), and the consequences?
- In your opinion, is there a group of people who are at higher risk of the heatwave than others?
- When you think about yourself and your family, how do you think you are impacted by heat wave? Can you provide some examples?

2. Perception on impact of a heatwave, Health impact and Environmental impact

- Which areas are majorly affected by heatwave? (Health, environment, economy, education)
- What do you think of the association between heatwave and the environment? (Or how is the environment affected by heatwave?)
- How does heatwave impact health? (Disease conditions)
- How can we link heatwave with disaster?
- What could be the mitigating measures for minimizing the risk of heatwave in environment and/or health?

3. Protective measures

- Can you provide some examples of you experiencing any heat wave events?
- What adaptive/protective measures did you follow to overcome or avoid heatwave? (How frequently do you follow these measures?)

- Do you think there are other ways that you cannot practice overcoming or avoid these heat waves?
- What could be the facilitators and barriers to adopting these behaviors?

4. Role of government and concerned authorities in minimizing the impact/effect of heatwave and Risk communication

- What information have you received regarding heatwave? How did you know/hear about that information?
- Have you been informed regarding the heatwave (from the government- not only from the government but from all stakeholders?
- Do you think the current communication strategies regarding heatwave is sufficient, why?
- What strategies could be adopted for effectively communicating the risk of the heatwave?
- What medium would be best to communicate the risk?

5. Policy/Organizational support

- What are your expectations and suggestions to the government and concerned stakeholders in regards to minimizing the impacts of the heatwave?

Annex 5: Ethical Approval from Nepal Health Research Council

Government of Nepal
Nepal Health Research Council (NHRC)
Estd. 1991

Ref. No.: 4531

13 July 2022

Dr. Biraj Man Karmacharya
Principal Investigator
Dhulikhel Hospital
Dhulikhel

Ref: Approval of research proposal

Dear Dr. Karmacharya,

This is to certify that the following protocol and related documents have been reviewed and granted approval through the expedite review process by the Expedited Review Sub-Committee meeting for it's implementation.

Protocol Registration No/ Submitted Date	273/2022 P 11 June 2022	**Sponsor Protocol No**	NA
Principal Investigator/s	Dr. Biraj Man Karmacharya	**Sponsor Institution**	American Red Cross, Global Disaster Preparedness Center
Title	Exploring the knowledge, attitude, practice and risk perceptions regarding heatwave among the outdoor workers of heat-prone areas in Nepal		
Protocol Version No	NA	**Version Date**	NA
Other Documents	1. Data collection tools 2. Informed consent form 3. Role and responsibility of Investigators 4. Donor agreement letter 5. Work plan	**Risk Category**	Minimal risk
Co-Investigator/s	1. Dr. Lava Timsina 2. Ms. Anjali Joshi 3. Mr. Sudim Sharma 4. Ms. Sabina Marasini		
Study Site	Kailali, Rupandehi, Makwanpur, Morang, Surkhet, Banke, Chitwan, and Nawalparasi districts of Nepal		

Tel: +977 1 4254220, Fax: +977 1 4262469, Ramshah Path, PO Box: 7626, Kathmandu, Nepal
Website: http://www.nhrc.gov.np, E-mail: nhrc@nhrc.gov.np

Government of Nepal
Nepal Health Research Council (NHRC)
Estd. 1991

Ref. No.: 4531

Type of Review	✓	**Expedited**	**Timeline of Study** 13 July 2022 to September 2022 **Duration of Approval** 13 July 2022 to 13 July 2023 **This approval will be valid one year**	**Frequency of continuing review** NA
		Full Board		
	Meeting Date: 12 July 2022			
Total budget of research	**$ 9,900.00**			
Ethical review processing fee	**$ 100.00**			

Investigator Responsibilities

- Any amendments shall be approved from the ERB before implementing them
- Submit progress report every 3 months
- Submit final report after completion of protocol proceedures at the study site
- Report protocol deviation / violation within 7 days
- Comply with all relevant international and NHRC guidelines
- Abide by the principles of Good Clinical Practice and ethical conduct of the research

If you have any questions, please contact the Ethical Review M & E Section at NHRC.

Thanking you,

Dr. Meghnath Dhimal
Acting Administrative Chief

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Website: http://www.nhrc.gov.np, E-mail: nhrc@nhrc.gov.np