Assessing Trends of Heat Waves and Perception of People about Health Risks of Heat Wave in Nepal

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Assessing Trends of Heat Waves and Perception of People about Health Risks of Heat Wave in Nepal

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Prof. Dr. Anjani Kumar Jha
Executive Chairperson
NHRC

EXECUTIVE SUMMARY

The number of heat waves is increasing worldwide due to climate change and land-use development and especially urban areas magnify the effects of heat waves by concentrating heat emissions (and air pollution) from vehicles and by trapping and absorbing heat between buildings and the pavement. Global warming will unquestionably increase the impact of heat on individuals who work in already hot workplaces in hot climate areas. The increasing prevalence of this environmental health risk requires the improvement of assessment methods linked to meteorological data. Such new methods will help to reveal the size of the problem and design appropriate interventions at individual, workplace and societal level. The aim of this study was to assess the trend of heat waves and perception of people about associated health risks of heat wave in Nepal.

A mixed method study with concurrent triangulation design was done. The trend of heat wave was assessed using secondary analysis of retrospective meteorological data of last 30 years whereas descriptive cross-sectional study was done to explore people's perceptions and behavioral responses towards extreme heat exposure in a warming climate. A qualitative study was also done to assess the current organizational policies on heat wave and to explore key informants' (health service providers, officials of the line ministries, employers etc.) recommendations for improvement.

Meteorological data was collected using the pre-structured format from all the 40 meteorological stations of Nepal that have the record of the required climate variables of the given time range. For the cross-sectional study, face-to-face interview was done using questionnaire among 318 research participants in three districts. For the qualitative study, key informant interview was done among school teacher, organization manager, community leaders and farmers using key interview guideline. The questionnaire and guideline were developed after comprehensive review of literature on occupational heat exposure and expert review.

Among 318 participants, from each 3 districts there were 106 participants selected, among them majority were male, 30-49 years and involved in labor activities. Most of them have secondary level of education.

Most of participants were working on outdoor location. Furthermore, participants felt their working environment was hot but 30% participants were not using any kind of Personal Protective Equipment. 58% participants were suffered from any kind of heat related events, however, 80% participants were deprived from paid leave if suffered from heat related illness/sickness and 89% of participants felt there is increment in temperature every year.

Despite the increasing heat related events such as heat waves are increasing in later days, awareness regarding heat waves and its consequences is not adequate enough among the people residing heat prone areas. Similarly, organization effort to combat with heat waves is not sufficient enough. Furthermore, heat related morbidity and mortality data need to be improved in terms of recording and reporting so that empirical relationship can be developed between trends of heat waves and heat related illness for evidence informed decision making in Nepal.

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LIST OF ABBREVIATIONS

DoHS	Department of Health Services
ERB	Ethical Review Board
KII	Key Informant Interview
NHRC	Nepal Health Research Council
RCPs	Representative Concentration Pathways
WHO	World Health Organization

CHAPTER I
INTRODUCTION

Study Area

Nepal, a mountainous country situated in the centre of Himalayan arc, extends from 26 °22' to 30°27' N latitude and 80°04' to 88°12'E longitude, encompassing an area of 147,181 km2 and an elevation range of 60–8848 m above sea level (asl). The country can be broadly categorized into three broad categories from its standard five physio-geographic regions, namely, Lowland (Terai and Siwaliks), Mid-Mountains and Hills (Middle and High Mountains) and High Mountains (High Himalayas) from south to north.[1, 2] Owing to extreme variations in altitude and aspect (**Figure 1**), country features a variety of climates that ranges from tropical/sub-tropical in the southern Terai to polar in the northern high mountains within a short horizontal distance of less than 200 km[3].

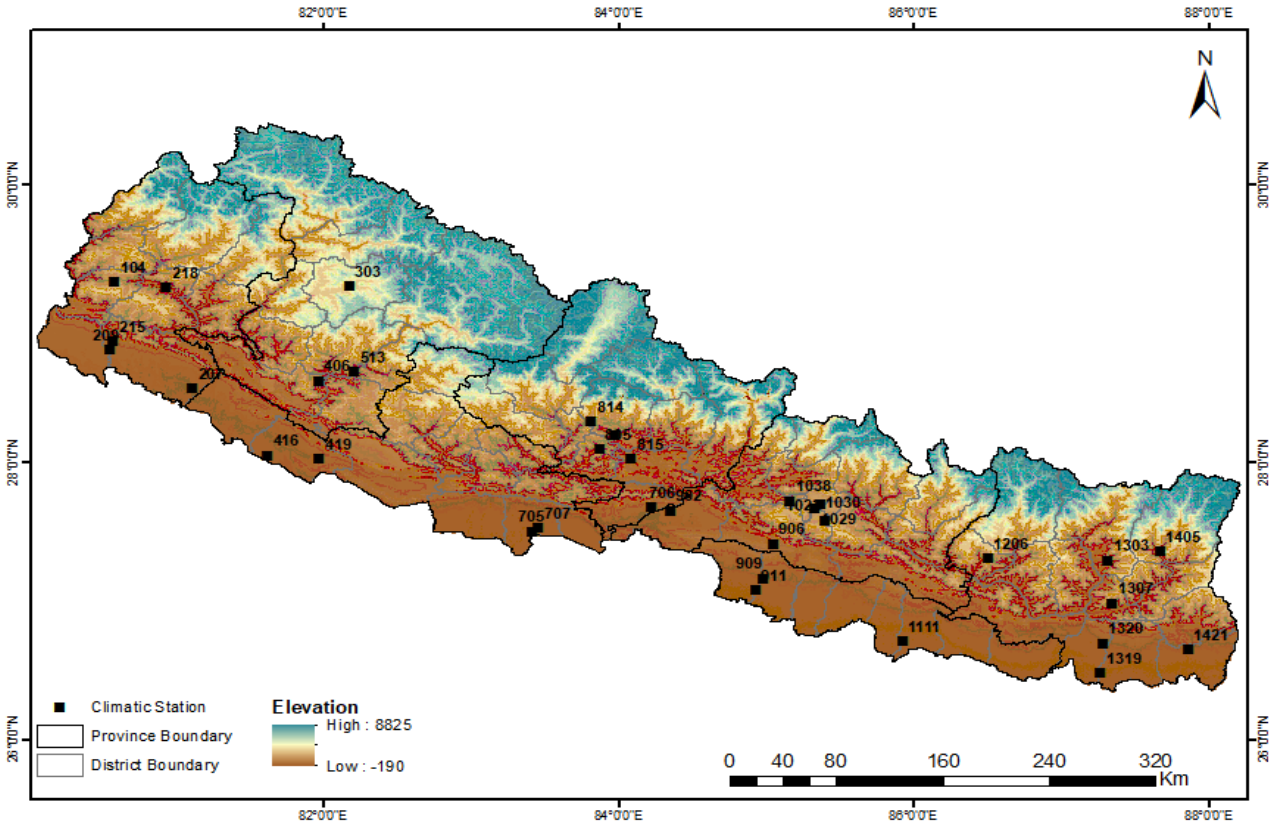

Figure 1 : Spatial distribution of climate stations used for the study. Topography shaded in the background and station numbers are the index number of stations as presented in annex 1

Nepal has four typical climate seasons, namely, pre-monsoon (March- May), monsoon (June-September), post-monsoon (October-November) and winter (December-February).

Pre-monsoon season is characterized by hot, dry and westerly wind. Highest temperature of the year observed in late pre-monsoon and early monsoon (May-June) is resulted due to highest insolation. Day time temperature in southern plains reaches beyond 40°C in these months [4]. Besides South-north gradient of temperature owing to elevation, west-east gradient of temperature in southern plains is also evident in the season, which is due to the closeness of western region from Indian deserts and relatively low moisture availability (**Figure 2**). In the season, precipitation usually observed in the

evening hours is associated with localized convective instability with heating. [5] Nevertheless, in the eastern region, considerable amount of precipitation of this season also occurs in May, when the moisture flow from Bay of Bengal starts to increase. [6]

With the arrival of monsoon in mid-June, precipitation activity starts to increase from east towards west, leading to slight decrease of temperature. However, increasing amount of moisture (humidity) in the environment makes the feeling of warmness even higher.

Post-monsoon is a dry season with pleasant weather and comfortable temperature, whereas winter is a coldest season. Therefore, heat stresses are the pre-monsoon and monsoon seasons feature and, especially southern Terai plains are more prone to these hazards.

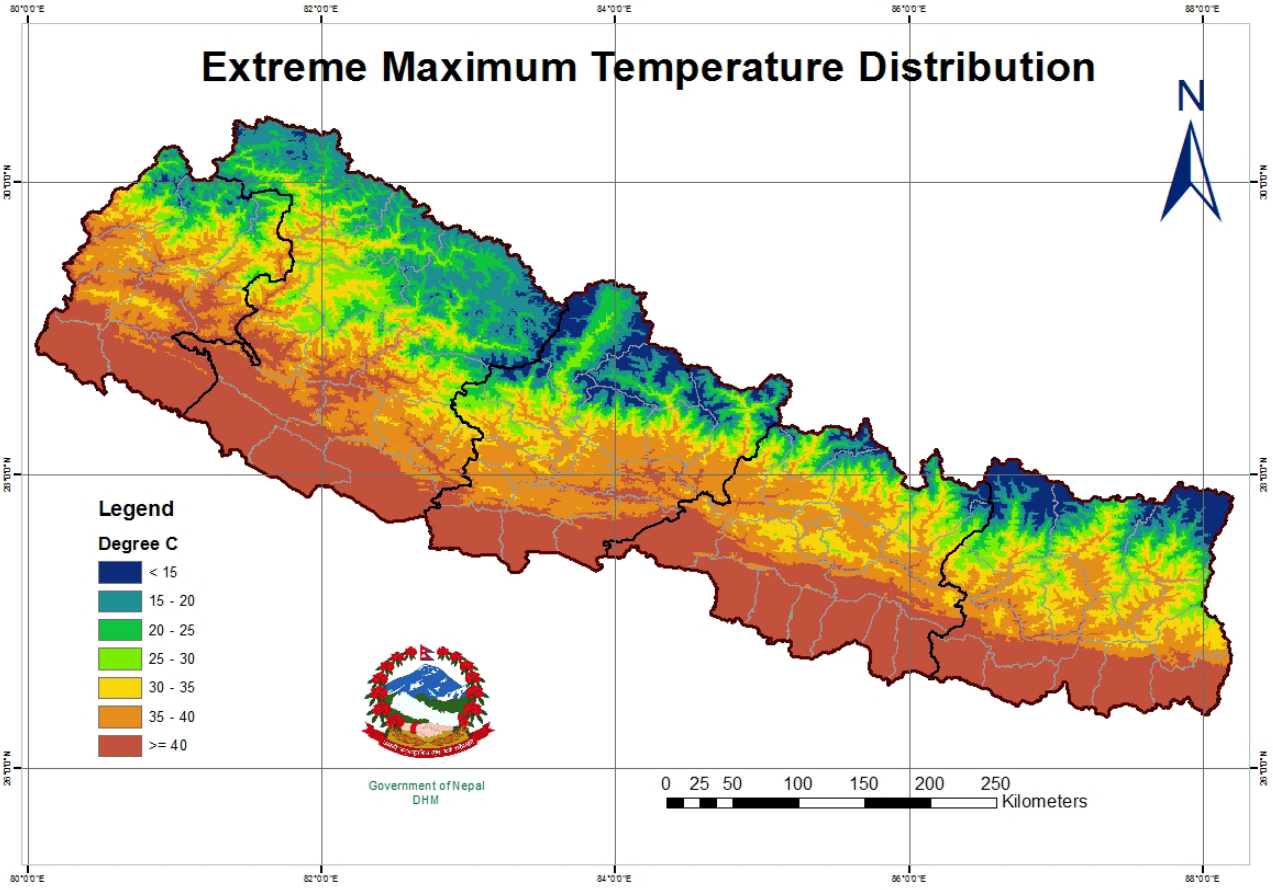

Figure 2: Spatial Distribution of extreme maximum temperature for Nepal (adopted from DHM, 2015, their Fig. 21).

Effects of climate change

Climate change has led to significant rise of 0.8°C–0.9°C in global mean temperature over the last century and is likely to have increased by 1.5 - 4°C under different representative concentration pathways (RCPs) by the end of the 21st century compared to the baseline years 1850 to 1900[7]. The higher increase of surface temperature has been recorded over the last three decades in the northern hemisphere[7, 8] with the highest increase in the Himalayas [5] and in Nepal, under a 'business as usual' high emissions scenario, the mean annual temperature is projected to rise by about 6°C on average from 1990 to 2100 and the number of days of warm spell is projected to increase from less than 20 days in 1990 to almost 245 days on average in 2100 [9].Climate change has been linked with significant increases in the frequency and severity of heat waves (extreme heat events).[7, 10] Generally, heat wave can be defined as: "a prolonged period of excessively hot

weather, which may be accompanied by high humidity". Generally, 35°C is viewed as a general critical temperature for heat wave. However, depending on humidity level of location or cities, there is a practice of setting different threshold of critical temperature. For example, at temperatures of 27°C and a relative humidity of 40%, some healthy individuals may begin to experience heat stress with prolonged activity or exposure[11]. One of the consequences of climate-related extreme heat exposure is dehydration and volume loss, leading to acute mortality from exacerbations of pre-existing chronic disease, as well as from outright heat exhaustion and heat stroke. Heat waves cause lots of heat related diseases such as heat stroke, cardiovascular diseases, respiratory diseases, and kidney diseases and so on. Thus, heat wave increases the morbidity and mortality of a country and therefore, it needs attention in public health sector. The recent global assessment of climate change impacts on human health has brought the broader health and well-being impacts of heat on working people to a higher visibility.[7] The increasing heat exposure due to climate change during the hottest parts of the day in the hottest seasons will affect the productivity of people who have to work in the ambient climate, and the impacts on economic output is likely to be very large[12]. In many tropical and sub-tropical countries the loss of labor productivity due to workplace heat will increase by billions of US dollars each year (Monitor, 2012). In South-East Asia as much as 15% to 20% of annual work hours may already be lost in heat-exposed jobs, and this may be doubled by 2050 as global climate change progresses [13]. In Nepal, under a high emission scenario heat-related deaths in the elderly (65+ years) are projected to increase to about 53 deaths per 100,000 by 2080 compared to the estimated baseline of approximately 4 deaths per 100,000 annually between 1961 and 1990 [9]. Nepal's Terai region is the hottest part of the country. The maximum temperature reaches more than 45 ºC during the summer and heat waves are especially common during long periods of drought. 'Heat wave' is defined as a period of abnormally and uncomfortably hot and humid weather.[14] In order to calculate, heat wave, meteorological data such as air temperature, humidity, wind velocity and solar radiation data are needed. However, wind velocity and solar radiation data are limited only in certain areas and years in Nepal. Hence, as a proxy measure of heat wave, a very direct measure of the impact of global warming on human health and comfort i.e., 'Heat Index' can be used. Among the heat indices, 'Steadman Heat Index' which is a measure of the stress imposed on humans by elevated levels of atmospheric moisture (this version of the index neglects the effects of wind and radiation changes) is widely used.[11] It is defined as a measure of the combined effects of temperature and atmospheric moisture on the ability of the human body to dissipate heat. According to the latest study by Department of Hydrology and Meteorology, Government of Nepal, warm days and warm nights are in increasing trend significantly in majority of the districts of Nepal.[15] As per data of Ministry of Home Affairs, a total of 25 heat waves occurred between 2002 and 2010. However, no record of heat waves was observed in the year 2008. The greatest number of heat waves occurred in 2009 and 2010. The increasing trend reflects the rise in average temperature. There were 25 killed and 280 affected due to heat waves in that duration. However, reported figure are grossly reported as there is no reporting system in Ministry of Health and Population by health professional through health institutions.

The number of heat waves is increasing worldwide due to climate change and land-use development and especially urban areas magnify the effects of heat waves by concentrating heat emissions (and air pollution) from vehicles and by trapping and absorbing heat between buildings and the pavement [11]. This combination of development and land-use leads to urban heat islands where urban temperatures may be up to 10 °C warmer than surrounding suburban areas or farmland [11]. Thus, heat waves in urban areas can have an even worse impact on occupational heat exposure than in peri-urban or rural areas. Building local resilience in low income countries to the health effects of climate change should be a high priority. This includes investing now in water and sanitation, systems for nutritious food access, electricity supply, and basic public health services for all communities in low income countries like Nepal. In addition, available methods of reducing the impact of current

climate conditions should be applied. Such methods include architectural and urban design that minimizes heat stress inside new factory and office buildings, as well as in family housing. Cooling systems need to be applied (including air conditioning in many buildings) during long hot seasons each year, and the energy for such cooling systems should ideally be provided from renewable energy sources, such as solar photovoltaic cells, wind power or hydropower. Adaptation measures vary for different work situation such as indoor and outdoor, agriculture and industrial sector, and offices and households. Global warming will unquestionably increase the impact of heat on individuals who work in already hot workplaces in hot climate areas. The increasing prevalence of this environmental health risk requires the improvement of assessment methods linked to meteorological data. Such new methods will help to reveal the size of the problem and design appropriate interventions at individual, workplace and societal level [16]. Therefore, there should be local level studies which identify health risks perceptions and possible preventive measure to avoid morbidity and mortality from heat waves especially in Terai region, river valleys and urban areas of hilly regions of Nepal. However, there are not any studies which have documented long term trend of heat wave and health risks perception of heat waves in Nepal. Therefore, this study aims to assess trend of heat waves and the perception of people about the associated health risks of health waves in Nepal.

Objectives of the study

The general and specific objectives of this study were:

General Objective

To assess the historical trends of heat wave and explore the perception, behavioral response and preventive measures adopted by community people towards heat wave.

Specific Objectives

- To calculate trends of heat index as a proxy of heat waves in Nepal
- To explore people's perceptions and behavioral responses towards extreme heat exposure in a warming climate

CHAPTER II
METHODOLOGY

The details about the methodology used in this study are described below:

Study design

This study was a national level study done in Nepal. We did a mixed method study with concurrent triangulation design. There were three different types of study conducted. First, the trend of heat wave in Nepal was assessed using secondary analysis of retrospective meteorological data of last 30 years. For this the meteorological data of last 30 years from throughout the country were used. Second, the health risk perception study was carried out using a descriptive cross-sectional design. Third, a qualitative study was done with the key stakeholders to assess the current organizational policies on heat wave and to explore key informants' (health service providers, officials of the line ministries, employers etc.) recommendations for improvement.

Study site

For the trend analysis, whole data from Nepal was retrieved. For the perception survey, three districts: Morang, Rupandehi and Kailali were selected. These three districts were selected upon preliminary analysis of meteorological data and selection basis was top three districts in terms of heat index and also based on heat wave tolls as reported in Ministry of Home Affairs data base (http://drrportal.gov.np/) as well as documents of Ministry of Health and Population. The key stakeholders from these three districts were involved in the qualitative study as well

Study population and unit of analysis

For perception survey, people exposed to heat or a high temperature in the selected districts was the study population. For trend analysis, the unit of study was described at an aggregate level in different years whereas for perception study the study units were individual outdoor worker. Only those people (≥15 years) who have worked for at least one year in the selected occupational setting or residing in the area for at least since one year were included in the study. . Some groups of the targeted populations were outdoor workers like: Traffic Police, Rickshaws Puller and street vendors.

Sample size calculation

The trend analysis part used a census method as data of all of the 40 meteorological stations throughout Nepal that had the data of the time duration we needed were included.

For the perception survey, since we did not have the sampling frame and also did not have data on prevalence of perception and behavior, we assumed our prevalence as 50% to maximize our sample size. At 95% CI and 10% allowable error, sample size to be taken in each district was calculated to be n=z^2*P*Q/d^2= (1.96^2*0.5^2)/(0.1^2) =96 When we added 10% for non-response, our sample in each district was 106. Thus, our total sample size for all three districts was 106*3 = 318.

For the qualitative study, we took a total of 8 key informant interviews based on saturation method. In this we stopped doing the interviews when a level of saturation was felt in the information obtained from the respondents.

Sampling technique

For trend analysis, daily meteorological data on seven climate variables: Minimum temperature,

Maximum Temperature, Rainfall, Humidity, Precipitation, temperature index, diurnal temperature range; of last 30 years from all 40 meteorological stations which have this time range data were used. So no sampling was done for trend analysis of heat index.

For perception survey, since we did not have sampling frame of outdoor workers in different districts of Nepal, we used a convenience sampling method to recruit study participants as done in previous similar study[17]. We first collaborated with local partners in the selected districts to list people who are exposed to high temperature including occupational setting in the district and also mapped the possible location for the sampling for the study. In order to get in-depth information about outdoor occupational risks and prevention strategies adopted, we took Key Informant Interview (KII) with key stakeholders. Targeted stakeholders were health professional, community leaders and government officials.

Tools and techniques of data collection

Procurement of daily climatic data of last 30 years from the Department of Hydrology and Meteorology, Government of Nepal was done. Data was collected in a pre-structured format. The sample is provided in Annex I.

Thirty three meteorological stations spread across mountains and low land regions of Nepal, featuring high-quality continuous record of daily maximum (Tmax) and minimum (Tmin) temperature, and relative humidity for the 30 years period (1987-2016) were selected for this study (**Figure 1**). These stations are maintained by Department of Hydrology and Meteorology, Nepal (DHM) and details are provided in Appendix Table 1. Measurement from the stations comprises single daily value of maximum and minimum air temperature, whereas relative humidity (RH) has two measurements (at 03 and 12 UTC) per day.

Data quality controlling is particularly important to distinguish the changes that occurred due to non-climatic factors, such as change in station location, exposure, observational practices, aggregation method and erroneous values. DHM data are in general quality controlled from in-house database systems for Tmin < Tmax, possible temperature ranges for the locations, and for humidity range from 0 -100 percent. We further used RClimdex tool[18] to filter out the erroneous or unreasonable values in the time series. In addition to the basic quality control of DHM database, it also identifies the daily temperature values that lies outside of the user defined limits from mean (i.e. mean $\pm\pm$ factor of standard deviation) and marks them as erroneous. In this study, four standard deviation threshold as used by Shrestha et al was used.[19]

Station wise daily mean temperature ((Tmax + Tmin) /2) and relative humidity (average of two times value) were computed, and then subsequently used for calculation of the Heat Index as defined in the following section. As heat waves are the feature of hot months, we limit our comprehensive seasonal analysis for pre-monsoon and monsoon season only, although the general climatology of heat wave are presented for all months.

To study the perception and behavioral responses towards extreme heat exposure in a warming climate we will conduct face-to-face questionnaire survey was done. For the qualitative study, key-informant interviews (KIIs) were conducted in the selected study sites. The questionnaire and KII guidelines were developed after a comprehensive review of literature on occupational heat exposure and also reviewed by expert (Please see Annex II). The questionnaire were designed in English and translated into Nepali which was then back translated to English for analysis purpose.

Data management and analysis

A multidisciplinary study team was formed consisting of environmental health expert, climatologist,

clinical expert, and public health expert having experience in climate and health research.

The observed meteorological data of Department of Hydrology and Meteorology were used to analyze trends of seven climate variables on daily basis at local level as well as country level.

Several methods and indices for heat index calculations based on different approaches are available. Giving considerations to the type of data availability in Nepal and reliability of the method, NOAA's National Weather Service (NWS) method of estimating Heat Index was used[20] in this study. This method was initially developed by Rothfusz (1990) [21] using multiple regression analysis, on the basis of Steadman (1979) theory. Later, NWS added some modifications for its operational applications, including its categorization to different ranges of heat index in terms of its severity to health (Fountain, 1999).

The original regression equation of Rothfusz (1990) is[21]

$$HI = -42.379 + 2.04901523\times T + 10.14333127\times RH - .22475541\times T\times RH - .00683783\times T\times T - .05481717\times RH\times RH + .00122874\times T\times T\times RH + .00085282\times T\times RH\times RH - .00000199\times T\times T\times RH\times RH \quad [1]$$

Where, T is mean daily temperature (°F) and RH is mean daily relative humidity (%). HI is the heat index expressed as an apparent temperature in degrees °F.

In general, this method is applicable for most of the cases except few exceptions for certain threshold of temperature and relative humidity values, in which some adjustments are needed or Steadman's (1979)[22] method is applicable. These are explained in details in the following paragraphs;

For RH < 13% and T between 80 and 112 °F, the adjustment to be substracted from equation 1 is;

$$\text{ADJUSTMENT} = [(13-RH)/4] \times \sqrt{[17 - ABS(T - 95.)]/17}\sqrt{[17 - ABS(T - 95.)]/17} \quad [2]$$

Where, ABS is the absolute value.

While, for RH > 85% and T between 80 and 87 °F, the adjustment to be added to equation 1 is;

$$\text{ADJUSTMENT} = [(RH-85)/10] \times [(87-T)/5] \quad [3]$$

For HI <80 °F, equation 1 of Rothfusz regression is not appropriate and a simpler formula consistent with Steadman's (1979)[22] is applicable;

$$HI = 0.5 \times \{T + 61.0 + [(T-68.0) \times 1.2] + (RH\times 0.094)\} \quad [4]$$

As discussed earlier, NWS has categorized the HI index into four different classes (as presented in Table 1 in SI unit), relating it to severity to health effects for its practical applications.

Table 1: NWS Classification of Heat Index (2009) [23]

Heat Index (HI)	Categories	Health Risk
27 – 32°C	Caution	Fatigue is possible with prolonged exposure and activity. Continuing activity could result in heat cramps.
32 – 41°C	Extreme caution	Heat cramps and heat exhaustion are possible. Continuing activity could result in heat stroke.

41 – 54°C	Danger	Heat cramps and heat exhaustion are likely; heat stroke is probable with continued activity.
> 54°C	Extreme danger	Heat stroke is imminent.

After completion of data collection, questionnaires were checked for completeness. Serial number was given to each questionnaire. The filled format was handled with great care, stored and coded for further analysis. Data were entered into EpiData version 3.1 with pre-set jump and skip commands. The quantitative survey data were analyzed in SPSS software version 16 and Microsoft Excel (for heat index calculation). Frequency and percentages were calculated to explore the characteristics of variables. Descriptive statistics, mean, median and standard deviation were calculated for continuous variables. The probability of significance was set at 5 % level of significance and statistical power at 80%.

The qualitative data were recorded in digital tape recorder after getting permission from the participants. Then these data were transcribed and then translated in English language. The qualitative data were then manually analyzed by preparing matrix tables. The matrix table contained the answer to questionnaire and the relevant verbatim. These tables were merged in respect to each district and then coded and analyzed using appropriate themes to be included in the report.

Potential bias and limitations

Because of limitation of health related illness and heat wave data on same scale we were not able to assess the association between health wave and health risks.

Validity and reliability

The questionnaire were translated in local Nepali language and back translated into English from another independent translator. Necessary revisions were made in the questionnaire after pretesting. Public Health graduates were oriented /trained in data collection tools and techniques. Since the secondary data used for trend analysis was retrieved from HMIS database, Ministry of Home Affairs and Department of Hydrology and Meteorology, Government of Nepal; we believe that the data source is reliable and valid.

Ethical considerations

Ethical approval was taken from Ethical Review Board (ERB) of Nepal Health Research Council (NHRC) as well as administrative approval was taken from district level health office. The written informed consent was taken from the study participants. In the process of obtained informed consent, detailed study related information was read out and explained in the local language from a printed information sheet. Information sheet contained objectives and methods of the study, duration of data collection, and frequency of contacts with research participants, the risks and benefits of the study. For the participants who were unable to sign the consent form, finger impression was obtained.

The participants of this study were given the right to refuse to answer any question without providing the reason for their decisions and were allowed to withdraw from the study at any time. The information provided by the research participants was dealt with highest confidentiality and used only for this study. Privacy of the participants was fully maintained during data collection.

CHAPTER III

FINDINGS

Historical trend of health index

To identify the historical trend of heat index, thirty three meteorological stations spread across mountains and low land regions of Nepal, featuring high-quality continuous record of daily maximum (Tmax) and minimum (Tmin) temperature, and relative humidity for the 30 years period (1987-2016) were selected for this study

Climatology of heat index

Mean monthly (1987-2016 period average) value of the HI values for different elevation ranges shows decrease of HI value with elevation (Figure 3), indicating the dominant control of temperature on it. However, there is higher decrease of HI with elevation during warmer months than in colder months, due to humidity effect. For instance, HI value is around 35 °C for lower elevation (< 500 m) during monsoon season, and corresponding seasonal value is about 21 °C for higher elevation (> 15 00 m).

This shows the difference of about 14 between lower and higher elevation. However, the winter season difference between these two elevation ranges is only half (7 °C) of this.

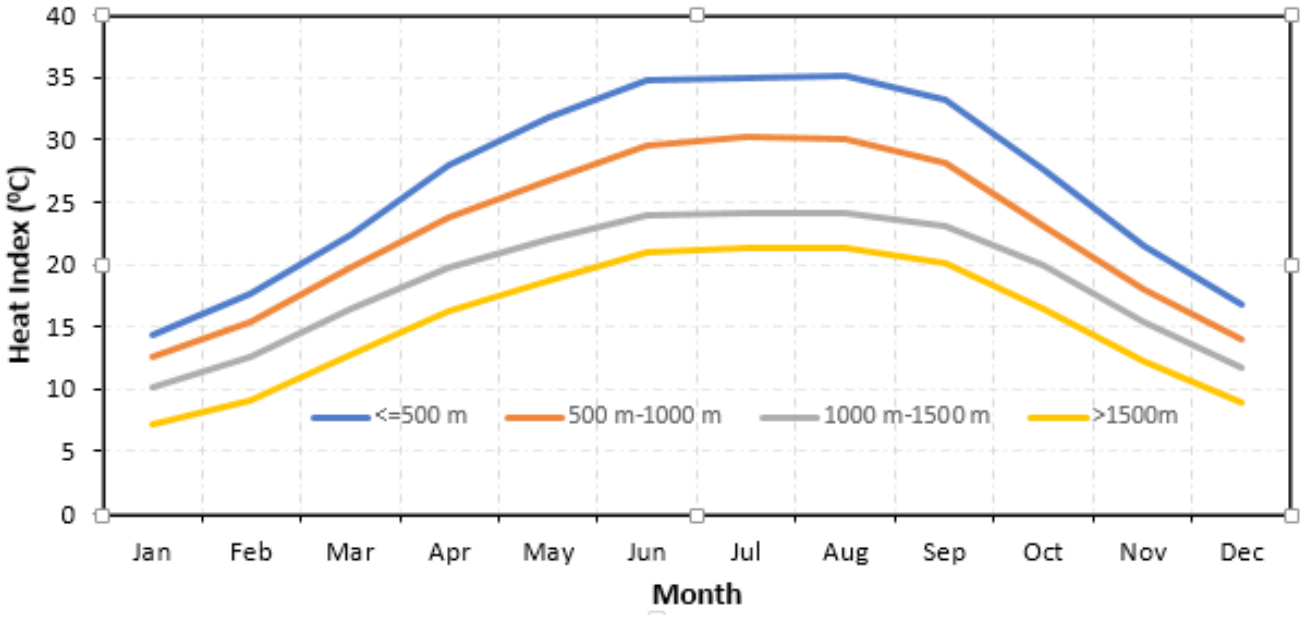

Figure 3:. Mean monthly values (1987-2016 average) of heat index over different altitudinal ranges.

Season cycle of HI features peak value during monsoon and lowest in January. Highest value in HI in monsoon is caused by the combined effect of high humidity and high temperature. As the intra- seasonal variation of temperature and humidity values are stabilized by monsoon, the intra-seasonal variability of HI is also very low during these months. The second highest Hi is evident in pre-monsoon season, which is mainly due to the highest temperature as humidity value is low during the season.

Our interest being on the HI values that adversely affect the human health, the focus is on detail investigation of trend and climatological values during the pre-monsoon and monsoon months only.

Spatial variation of mean seasonal HI values for pre-monsoon and monsoon, in terms of its health effect indices (detailed in Table 1) are also presented in Figure 4. As in earlier Figure 3 ,we observe the highest risk of HI in the lower elevation zone in monsoon season. Pre-monsoon feature 'caution' heat stress in lower elevation and higher elevation have relatively comfortable values at the season, but with the increasing amount of moisture in the air with the arrival of monsoon, pre-monsoon season 'caution' value of lower elevation region rises to 'extreme caution' and 'caution' value of that region spread to higher elevation in the monsoon season. This signifies the higher and wider risk of HI in monsoon season compared to pre-monsoon.

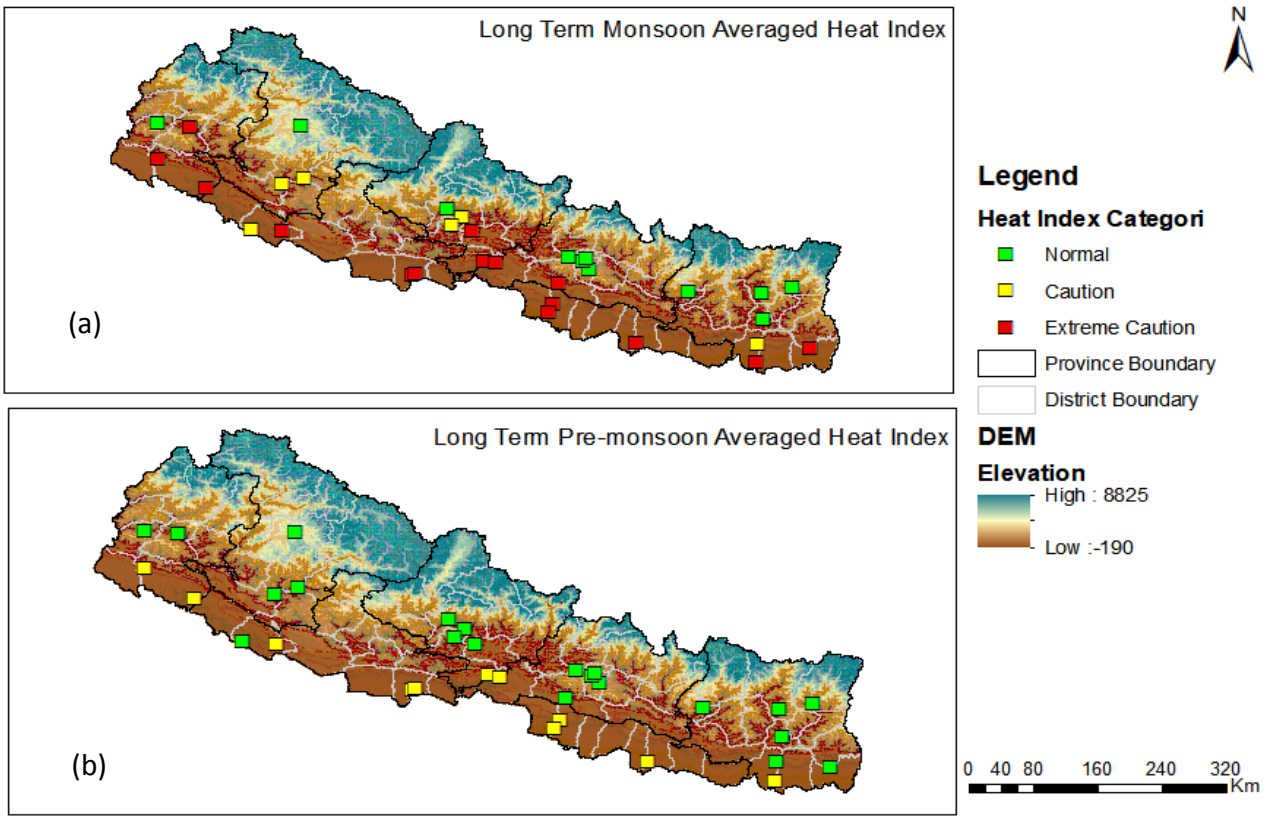

Figure 4: Seasonal average (1987- 2016) heat index presented in health effect indices terms a) Monsoon and b) Pre-Monsoon

Long-term trend of HI value for pre-monsoon and monsoon season and trend of annual number of days in four different categories of heat indices (as defined in Table 1) are presented in this section.

1 Seasonal Trend

The pre-monsoon and monsoon season trend values for HI is shown in Figure5 . Consistent to the rising temperature across the nation, most of the stations show an increasing trend in HI values, where magnitude of the trends are mostly in the range of 0.01 to 0.05 °C/year for stations mainly over the middle hilly region and 0.06 to 0.1 °C/year for stations in the lower region.

also suggest the comparatively higher trend in the lower elevation region. In general, this finding suggests the increasing risk of heat wave across Nepal in the context of anthropogenic warming and consequent rise of temperature and precipitation extremes across the country.

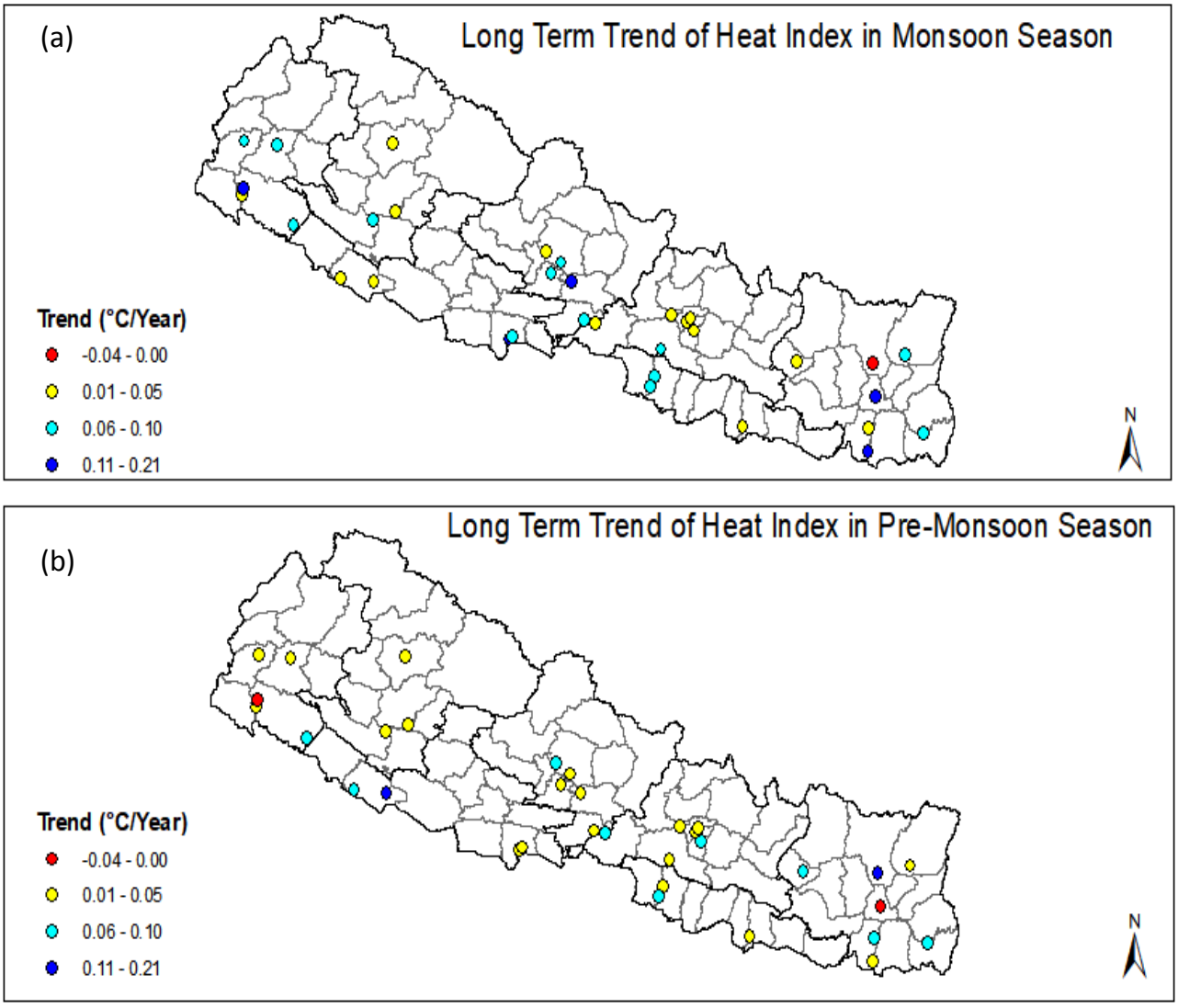

Figure 5: Spatial distribution of heat index trends for (a) Monsoon and (b) Pre-Monsoon season.

In station level (Annex 2), Bhairahawa Airport, Biatnagar Aiport and Godawari (west) of southern plains shows the relatively higher trend value of 0.17, 0.14 and 0.120C/year, respectively in monsoon. Similar pattern is observed in pre-monsoon, where Godawari (west) and Biratnagar Airport show trend value of 0.21, and 0.100C/year, respectively. The overall country average trend of HI for both seasons is 0.06°C/year.

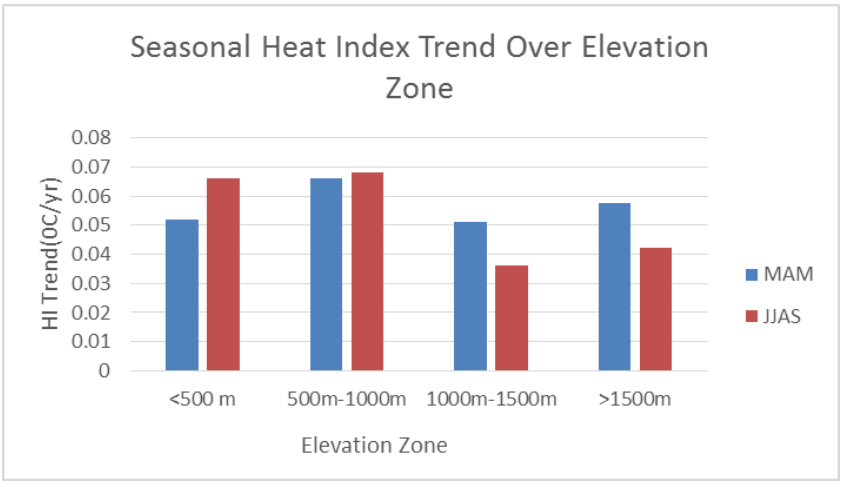

Figure 6: Seasonal Heat Index Trend Over Elevation Zone

2 Category wise heat index trend

Station wise trend of total annual number of days fewer than four different categories of heat indices

were also computed (**Annex 3**) and presented for comprehensive analysis of heat index.

As discussed earlier, there are four categories of heat indices viz; caution, extreme caution, danger and extreme danger, presented in ascending order for its severity to health. Due to their threshold ranges, more severe classes' trends are evident only in the southern lower elevation areas, while stations in mountains are characterized by milder heat indices classes only. That means the number of stations featuring trend values increases towards milder classes and absence of trend in mountains for severe HI classes is due to absence of HI values in those categories.

Because of the elevational effect, **extreme danger** category does not feature trend in about 80% of the stations mainly concentrated over the mountainous region. Trend evident in very few stations (4 stations) of southern plains of the country, exhibit mixed results of increasing and decreasing values. Most of the stations in southern lower elevations and few low elevation stations in mountain river valley feature trend in the '**danger'** category and reveals rising trend in most of the stations. The number of stations showcasing trends in extreme caution category are relatively higher than in former two classes, and the stations featuring trend expands towards mountains as well. Consistent to danger category, most of the stations are characterized by rising trends in **extreme caution** category. In this category, Surkhet in middle hills is showing the highest magnitude of increase i.e. 1.589 days/year. The trend in **caution** category is observed in most of the stations. Unlike other categories, about half of the stations show decreasing trend. Pokhara Airport in mountain valleys shows the highest increasing trend of 1.432 days/year in this category.

Thus, increasing trend in seasonal HI values can be mostly attributable to the increasing trend in more severe heat waves.

When averaged over the entire country, similar inference as station-wise trends can be drawn.

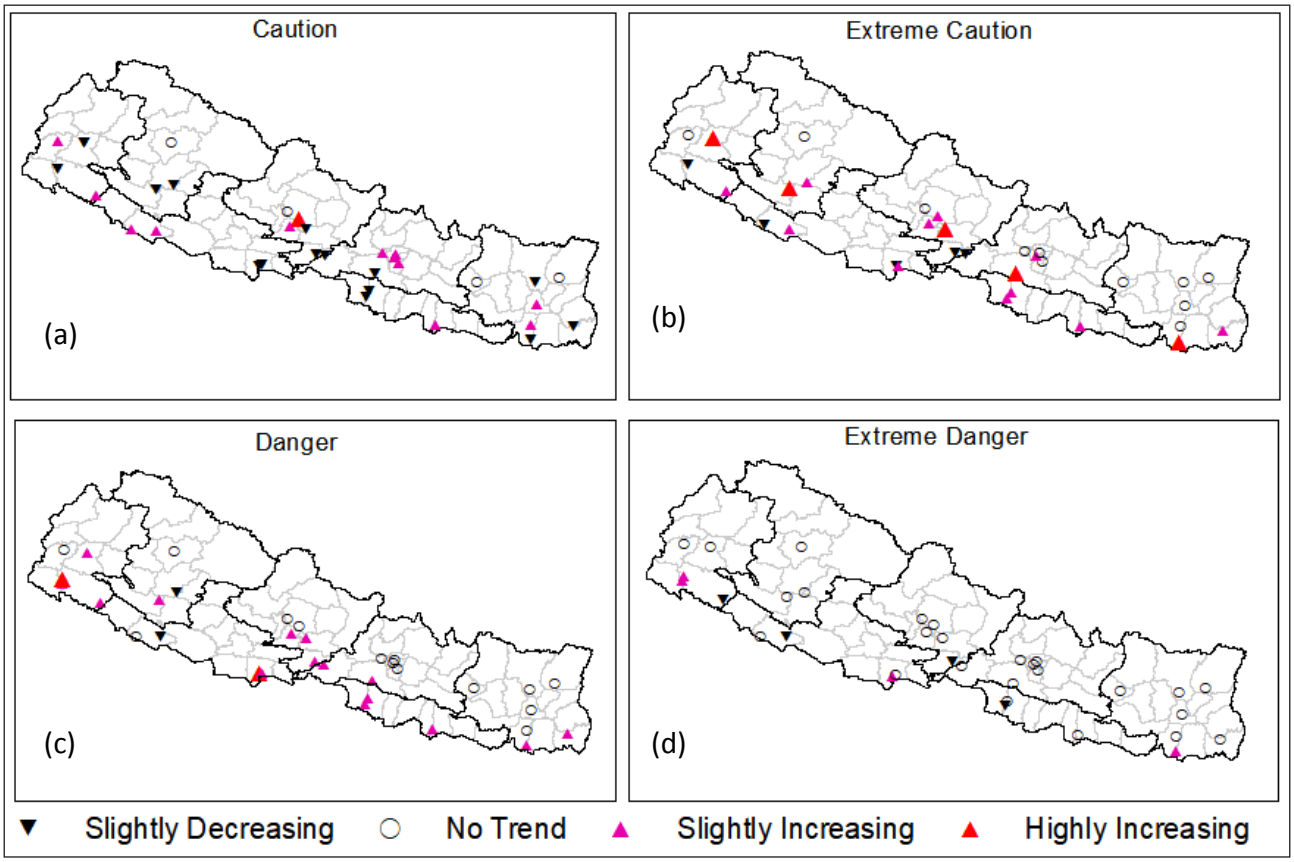

Figure 7: Spatial distribution of trend of heat Index for four different categories a) Caution, b) extreme caution, c) danger and d) extreme danger.

Country average trend of total annual number of days in extreme danger, danger and extreme caution are increasing, whereas caution category has decreasing trend by -0.028 days/year.

In summary, results suggest the increasing risk of severe heat waves in the country. In particular, southern plains of the country are more prone to the increasing heat stress related disasters.

Heat-wave related perception and behaviors

The study is conducted in three districts namely Morang, Rupandehi and Kailali among indoor and outdoor working groups. From each districts 106 people were interviewed about heat-wave related perception and behaviors questions. Findings are displayed below:

Table 2: Socio-demographic distribution of participants

Characteristics	Districts			
	Morang (%) (n=106)	Rupandehi (%) (n=106)	Kailali (%) (n=106)	Total (%) (n=318)
Sex(n=318)				
Male	75(33.63)	74(33.18)	74(33.18)	223(70.12)
Female	31(32.63)	32(33.68)	32(33.68)	95(29.87)
Age(n=318)				
15-29 years	0(0)	15(27.78)	39(72.22)	54(16.98)
30-49 years	93(42.47)	72(32.88)	54(24.66)	219(68.87)
50 and above years	13(28.89)	19(42.22)	13(28.89)	45(14.15)
Marital status(n=318)				
Single	19(33.93)	13(23.21)	24(42.86)	56(17.61)
Married	87(33.72)	91(35.27)	80(31.01)	258(81.13)
Divorced	0(0)	2(50)	2(50)	4(1.26)
Religion(n=318)				
Hindu	99(32.46)	103(33.77)	103(33.77)	305(95.92)
Buddhism	0(0)	1(100)	0(0)	1(0.31)
Islam	6(75)	2(25)	0(0)	8(2.52)
Christian	0(0)	0(0)	3(100)	3(0.94)
Others	1(100)	0(0)	0(0)	1(0.31)
Ethnicity(n=318)				
Dalit	5(17.24)	13(44.83)	11(37.93)	29(9.11)
Disadvantaged Janjati	21(70)	9(30)	0(0)	30(9.44)
Disadvantaged Tarai Nondalit	25(32.05)	49(62.82)	4(5.13)	78(24.53)
Religious Minorities	8(80)	2(20)	0(0)	10(3.15)
Relatively Advantaged Janjati	5(7.14)	9(12.86)	56(80)	70(22.01)
Upper Caste	42(41.58)	24(23.76)	35(34.65)	101(31.76)
Educational status(n=316)				

Characteristics	Districts			
	Morang (%) (n=106)	Rupandehi (%) (n=106)	Kailali (%) (n=106)	Total (%) (n=318)
Not able to read and write	15(35.71)	21(50)	6(14.29)	42(13.29)
Informal education	15(28.3)	19(35.85)	19(35.85)	53(16.77)
Primary education	17(39.53)	16(37.21)	10(23.26)	43(13.61)
Secondary education	28(30.43)	32(34.78)	32(34.78)	92(29.11)
Higher Secondary education	14(31.11)	13(28.89)	18(40)	45(14.24)
Bachelor or above	17(41.46)	4(9.76)	20(48.78)	41(12.97)
Occupation(n=318)				
Farming	17(20.24)	35(41.67)	32(38.1)	84(26.42)
Labor activities	22(28.21)	46(58.97)	10(12.82)	78(24.53)
Driver	25(44.64)	5(8.93)	26(46.43)	56(17.61)
Business	29(63.04)	8(17.39)	9(19.57)	46(14.47)
Service sector	12(41.38)	2(6.9)	15(51.72)	29(9.12)
Others	1(4)	10(40)	14(56)	25(7.86)

Out of 318 participants, majority (70.13%) of them were male .From each districts, male and female participants were nearly in equal proportion.

In this study majority (69.09%) of participants belong to 30-49 years age group followed by 15-29 years age group. Among 15-29 years age group participants, majority of them were from Kailali districts followed by Rupandehi. From Morang district, none of participants were from 15-29 years. Participants from 30-49 years age group, majority belongs to Morang district. More than 98% of participants were married followed by single and divorced. Among the married participants also, large number of participants were from Rupandehi followed by Kailali districts.

Regarding religion of participants, 95% of participants were Hindu followed by Muslim participants in low number. Among Hindu participants, participants were almost uniformly distributed among 3 districts. Similarly, nearly one third of participants were from upper caste group followed by disadvantaged Terai non-dalit and relatively advantaged janjati group. Among upper caste group, more 40% participants are from Morang followed by Kailali and Rupandehi districts.

Nearly 30% participants, had a secondary education followed by informal education, higher education, primary education, illiterate and Bachelor or above in almost in uniform manner.

Most of participants were from farming (26%) and labor activities (24%) occupation. Participants from these two groups also, large numbers of participant were from Rupandehi districts.

Table 3: Participants experience about heat effects

Characteristics	Districts				
	Morang (%)	Rupandehi (%)	Kailali (%)	Total	*p-value*
Yearly increment in temperature (n=318)					0.006
Yes	98(34.27)	89(31.12)	99(34.62)	286(89.94)	
No	8(33.33)	14(58.33)	2(8.33)	24(7.55)	
Don't Know	0(0)	3(37.5)	5(62.5)	8(2.52)	
Heat related events(n=317)*					0.002
More	31(33.7)	32(34.78)	29(31.52)	92(29.02)	
Low	45(44.12)	25(24.51)	32(31.37)	102(32.18)	
No changes	10(16.95)	19(32.2)	30(50.85)	59(18.55)	
Don't Know	20(31.25)	29(45.31)	15(23.44)	64(20.13)	
Work station(n=318)**					0.000
Mainly indoor	25(30.49)	37(45.12)	20(24.39)	82(25.89)	
Mainly outdoor	53(27.6)	65(33.85)	74(38.54)	192(60.38)	
Both of them	28(63.64)	4(9.09)	12(27.27)	44(13.84)	
Temperatures(n=318)**					0.000
Very hot	32(25.2)	49(38.58)	46(36.22)	127(39.94)	
Hot	61(38.36)	38(23.9)	60(37.74)	159(50)	
Average	13(40.63)	19(59.38)	0(0)	32(10.06)	
Humidity(n=318)**					0.000
Very humid	0(0)	0(0)	2(100)	2(0.6)	
Humid	5(50)	1(10)	4(40)	10(3)	
Average	31(39.74)	42(53.85)	5(6.41)	78(24.53)	
Dry	53(29.61)	50(27.93)	76(42.46)	179(56.29)	
Very Dry	17(34.69)	13(26.53)	19(38.78)	49((15.41)	
Ventilation(n=232)**					0.000
Air circulates adequately	92(54.44)	74(43.79)	3(1.78)	169(72.84)	
Air circulates	10(27.78)	17(47.22)	9(25)	36(15.52)	
Air doesn't circulate adequately	3(12)	5(20)	17(68)	25(10.78)	
Air doesn't circulates	0(0)	1(50)	1(50)	2(0.8)	
Health Stress(n=317)*					0.032
Slightly	19(23.75)	24(30)	37(46.25)	80(25.24)	
Normally	28(35)	24(30)	28(35)	80(25.24)	
Very frequently	59(37.58)	57(36.31)	41(26.11)	157(49.60)	

Characteristics	Districts				
	Morang (%)	Rupandehi (%)	Kailali (%)	Total	*p-value*
If any injury or illness(n=318)					0.007
Yes	51(27.57)	73(39.46)	61(32.97)	185(58.18)	
No	52(40)	33(25.38)	45(34.62)	130(40.88)	
Don't Know	3(100)	0(0)	0(0)	3(0.9)	
Leave due to heat events(n=185)**					0.000
Yes	29(49.15)	12(20.34)	18(30.51)	59(31.89)	
No	22(17.46)	61(48.41)	43(34.13)	126(68.11)	
Anyone suggested to take leave(n=59)					0.802
Yes	12(44.44)	6(22.22)	9(33.33)	27(45.76)	
No	17(53.13)	6(18.75)	9(28.13)	32(54.24)	
Hospitalized(n=59)					0.105
Yes	9(37.5)	8(33.33)	7(29.17)	24(40.68)	
No	20(57.14)	4(11.43)	11(31.43)	35(59.32)	

**p-value <0.05*

***p-value<0.001*

Regarding participants experience about temperatures changes, most of the participants opined that they have experienced yearly increment in temperatures followed by no increment temperatures in low number. Among participants mentioning yearly increment in temperatures, most of them were from Kailali (34.62%) and Morang (34.27%) respectively.

Out of 317 participants, most of them reported low number (32.18%) of yearly heat related events followed by more health related events (29.02%). Among participants mentioning low number of heat related events, most of them were from Morang districts.

Most (60.38%) of the participants were working on outdoor environment followed by indoor environment and indoor and outdoor both. Among outdoor working participants, large numbers of participants were from Kailali districts followed by Kailali (38.54%) and Morang (27.60%) respectively.

Regarding participants perception about working place majority of them perceived working place is hot (50%) followed very hot (39.94%). participants perceiving there working place as hot were from Morang and Kailali districts. Similarly, large number (71%) of participants explained there working place as dry place. Furthermore, majority (72%) of participants mentioned that there working as well-ventilated i.e air circulates adequately.

Most (50%) of Participants opined that they were stressed on working hot environment. And large numbers of participants were from Morang districts.

58% of participants said that they were suffered from heat related illness/sickness in last year. Among them, 39% were from Rupandehi district. Due to heat related illness, 31.89% participants stayed on leave from their regular jobs. Among participants who took leave, 40% of participants were hospitalized to heat related illness.

Table 4: Participants perception about heat waves related issues.

Characteristics	Districts				
	Morang (%)	Rupandehi (%)	Kailali (%)	Total (%)	*p -value*
Perceived that Heat risk get lowered if habituated(n=318)*					0.034
Yes	75(32.05)	84(35.9)	75(32.05)	234(73.59)	
No	20(46.51)	13(30.23)	10(23.26)	43(13.52)	
Don't Know	11(26.83)	9(21.95)	21(51.22)	41(12.89)	
Feeling tired while working on hot region is dangerous problems (n=318)**					0.000
Strongly disagree	0(0)	3(100)	0(0)	3(0.94)	
Disagree	3(5.45)	26(47.27)	26(47.27)	55(17.30)	
Neutral	3(25)	7(58.33)	2(16.67)	12(3.77)	
Agree	91(47.89)	32(16.84)	67(35.26)	190(59.75)	
Strongly agree	9(15.52)	38(65.52)	11(18.97)	58(18.24)	
Personal protecting equipment use(n=318)**					0.000
Strongly disagree	1(33.33)	2(66.67)	0(0)	3(0.94)	
Disagree	2(50)	1(25)	1(25)	4(1.2)	
Neutral	1(50)	1(50)	0(0)	2(0.06)	
Agree	91(42.52)	76(35.51)	47(21.96)	214(67.30)	
Strongly agree	11(11.58)	26(27.37)	58(61.05)	95(29.87)	
Use of PPE will not reduce heat stress(n=318)**					0.000
Strongly disagree	4(44.44)	5(55.56)	0(0)	9(2.83)	
Disagree	59(33.71)	87(49.71)	29(16.57)	175(5.5)	
Neutral	9(33.33)	4(14.81)	14(51.85)	27(8.50)	
Agree	32(32.99)	10(10.31)	55(56.7)	97(30.50)	
Strongly agree	2(20)	0(0)	8(80)	10(3.15)	
Old people, women and child is at risk(n=318)**					0.000
Strongly disagree	0(0)	9(100)	0(0)	9(2.8)	
Disagree	3(12.5)	13(54.17)	8(33.33)	24(7.5)	
Neutral	1(14.29)	2(28.57)	4(57.14)	7(2.2)	
Agree	81(36.49)	68(30.63)	73(32.88)	222(69.81)	
Strongly agree	21(37.5)	14(25)	21(37.5)	56(21.70)	

**p-value <0.05*

***p-value<0.001*

Regarding perception about heat related risk, majority (73.59%) of participants responded that if one is habituated to heat risk, heat related illness/sickness will be reduced. This perception was approximately uniformly distributed over three districts.

Almost 68% of participants agree that feeling tired while working in hot region is problem. Similarly, 68% of participants perceived that Personal Protective Equipment is useful in working hot environment. Furthermore, majority of participants agreed that old people, women and child are at high risk of heat related illness.

Table 5: Participants behavior on heat related issues

Characteristics	Districts				
	Morang (%)	Rupandehi (%)	Kailali (%)	Total (%)	*p-value*
Work on normally on hot situation also(n=317)*					0.001
Yes	64(43.84)	39(26.71)	43(29.45)	146(45.91)	
No	42(24.56)	66(38.6)	63(36.84)	171(54.09)	
Any methods use to work in hot environment(n=318)**					0.000
Yes	80(40)	83(41.5)	37(18.5)	200(62.90)	
No	26(22.22)	22(18.8)	69(58.97)	117(36.79)	
Don't Know	0(0)	1(100)	0(0)	1(0.03)	
Paid leave(n=318)					0.054
Yes	16(25.4)	18(28.57)	29(46.03)	63(19.81)	
No	90(35.29)	88(34.51)	77(30.2)	255(80.18)	

**p-value <0.05*

***p-value<0.001*

Out of 317 participants, almost 54% participants said that they won't work normally on hot environment. Similarly, majority (63%) participants said that they adopt any method to work in hot environment.

Furthermore, majority (80%) of participants said they don't get paid for any leave due to heat related issues.

Perception and behavior of different stakeholders about heat wave

1. Perception and behavior representative of different organizations

The findings from interviews with 10 participants of different organizations have been presented under different thematic areas.

Awareness about heat wave, perception and its effects

Participants presented different views regarding the perception of climate change with examples. Most of them were aware about the effects of global warming in today's world. One of them answered "*Climate change refers to the condition of increase in temperature, in a way that the*

temperature or heat increases and seasonally environment goes to its extreme." They shared about how the climate change has degraded the natural sources and affected human life. Sharing the experiences of past years almost all the participants shared that they are experiencing increase in temperature every year. A participant said "In *past 10years the trend in high temperature is increasing due to which in winter it is excessive cold. I think all this is due to climate change."* Majority of the participants stated that they were facing different health related problems like anorexia, dizziness, high blood pressure etc due to increase in temperature. Every participants highlighted deforestation, urbanization, industrialization and pollution as major factor that increase the risk of high heat wave as one participant said "*Increasing temperature should be viewed in global context. Because of production of excessive smoke from vehicles and industries, molecular test, high density of population in urban area or in plane area, there is increase of vehicles day-by-day. Deforestation is also one of the causes."*

Organizational Policy

According to staff there is no any policy or guideline to prevent field staff from hot environment and there were no pre-plans for unexpected high heat situation rather than adopting preventive measures except one school which had provision of providing summer vacation to students. Very few participants said that they will provide money to their staff if they need to stop work urgently while others said that they have provision of giving leave for certain days and they will not be provided money if they exceed their leave days as one of the participant shared *"There is a leave and other certain facility for teachers, they will be paid for those leave. But they will not be paid if their leave days have been finished according to rules*". About half of the participants felt the current policies, management and guidelines sufficient to acknowledge problems of their staff. However, one of the participants shared, "*Policy is needed for system only. I think this policy doesn't work. If the company is good and staff has positive thinking then there is no need of policy. "*

Collaboration with other organization

No collaborative efforts were made with other organization to work in the sector of climate change or high heat wave.

Recommendation to protect people with heat waves

In response to the recommendation to protect people with heat waves, there were different perspectives of participants. Some of the major recommendations highlighted but not limited to, were conservation of natural resources, proper revision and implementation of policies, establishing factories and industries away from residential areas, plantation of trees, revision of curriculum etc. For instance, one of the principal (participant) recommended," *It would be better if everything is integrated in curriculum. It is good if there is a facility of providing information on issue of climate change in a special package or program."*

2. Perception and behavior of community leader

The findings from interviews with 2 community leaders have been presented under different thematic areas.

Awareness about heat wave, perception and its effects

Both the community leader had good knowledge about the effects of climate change. One of the leaders highlighted that temperature is increasing excessively by 15 days than previous years and other participant reported that there is no rainfall in time. Responding to the problem related to high temperature, the participant shared," *I have face health problem due to high temperature i.e. blood pressure"* One of the participant reported that farmers and laborer are mainly affected due to high heat wave.

Organizational policy

Regarding the pre-plans for unexpected high heat wave, one of the participant highlighted that," *Now we are making initiative ourselves to save/prevent and keep people safe from high temperature and moving forward keeping this in mind."* One of the participants reported that the current policies, management and guidelines sufficient to acknowledge problems of their staff.

Recommendation to protect people with heat waves

In response to the recommendation to protect people with heat wave, one of the participants stated, "*I feel that, facility of electricity for those homeless people who are under poverty line if given to me, I will provide electricity or give instruction so that poor people can be prevented from high temperature."*

3. Perception and behavior of service providers

The findings from interviews with 7 health workers have been presented under different thematic areas.

Awareness about heat wave, perception and its effects

Almost all the participants were aware about the climate change and its effect except one participant who seems to be confused in differentiating seasonal change with climate change. Few of the participants highlighted the cause of increasing the temperature and its effect on human health. One of them said, "*After increase in temperature, workers who work outside have many problems like accident at work site, high blood pressure, low blood pressure, dizziness, anorexia, and diarrhea".* Sharing the experiences of past years almost all the participants shared that they are experiencing increase in temperature every year and there is fluctuation in seasons. For instance, a participant shared, "*Sometimes it is very dry, there is no rainfall and sometimes there is heavy rainfall and again drought for long time. Because of this there is increase in temperature."*

Regarding the problems faced by high temperature, the participants stated different types of diseases faced by their families due to its effects. They shared that they and their families suffered from diseases like diarrhea, fever, common cold, measles, heat stroke, fainting attack, skin diseases, lethargy due to excessive sweating, respiratory diseases due to increase in temperature. Participants reported that industrialization, population growth, unplanned urbanization, deforestation were the major factors that increase the risk of high heat wave and mostly affected groups are children, field workers, persons with disease, pregnant women etc. For instance, one of the participants said," *Burning of waste in D (P) HO, hospital also cause heat effect. Those who work like technician, rickshaw puller farmer and laborer who build house in 40-45° C are also affected. The effect is to children or elderly people because in heat old people have problem in breathing, children have sweating which cause irritation and lethargy."*

Effect of increasing temperature

All the participants reported that there is high patient flow during summer season as one of the participant said, " *In hot season, due to dust, smoke, polluted water, high incidence of diarrhea, maximum communicable diseases, others diseases like encephalitis, malaria are seen. It is seen in unexpected way."* According to the participants, they had to work during day time on direct exposure to sun without management of prevention of high temperature which causes impacts on their health.

Organizational policy

Every participant stated that there is no any policy or guideline to prevent field staff from hot

environment and no any pre-plans are made to for unexpected high heat situation. One of the participants highlighted," *While working in field during rainy season there is no umbrella, raincoat, boot to wear. Has to carry files, there is no facility of bag from local level and upper level. We have to work in field at the time of holiday also."* Though there is no provision of informing staff about hot situation, few of them advice staff to take preventive measures. Few of the staff mentioned that there is provision of providing money to staff if they had to stop work for certain period of time due to natural calamities. Most of the participants reported that current policies, management and guidelines sufficient to acknowledge problems of increasing temperature as one of the participant said," *Working hour is timed from 10-4 which is the peak time of high temperature, for the workers working outside, this policy and guideline is not sufficient."*

Collaboration with other organization

As stated by participants, though the health facility has collaboration with other organization for other programs, no collaborative efforts were made with other organization to work in the sector of climate change or high heat wave.

Recommendation to protect people with heat waves

The major recommendations given by participants were afforestation, preserving natural resources, aware people for taking preventive measures, revising policies etc. One of the participant said, *"There are laborer who work outside, if policy is made to work during morning time from 6am for 7 hours and made it legal giving responsibility to local level then it will be good."*

4. Perception and behavior of service providers Farmers

Five farmers were interviewed in depth and the findings from the interview are presented below in different thematic areas:

Perception about climate change and increasing temperature

Most of the farmers perceived increasing temperature as climate change and they said the temperature has increased than previous years. They perceived that because of the increased temperature, different diseases were occurring. According to the farmers, deforestation was the main reason behind the increase in temperature. One of the farmers said, *"because of climate change sun is getting hotter, winter seasons are excessively cold and rainy season is shortened".*

When asked about their experience of difference in temperature during summer season in last 10-12 years, all of them said that there was very high heat now compared to the past. Regarding the months, one one of the farmer said that summer starts from Falgun but it is excessively hot during Jestha-Ashad, whereas another said the temperature rises from Baisakh-Jestha and is high until Ashwin-Kartik.

Problems faced due to high temperature

Farmers reported problems among human, effect on domestic animals and on agriculture. According to them, the major problems among humans were: rashes, measles, skin diseases, fever, headache, dizziness, itching, vomiting and sudden fainting. They said animals also suffered from different diseases due to high heat. In agriculture sector, they faced problems like dryness, and problem in irrigation due to no rain.

Factors increasing the risk of high heat wave

The major factors behind high heat wave as mentioned by majority of farmers were: deforestation, increase in industries (like brick factory and other industries), environmental pollution, occupation

(e.g. farmers), age group (e.g. 30-40 years aged and small children) and low rainfall leading to dryness.

Recommendation to protect people from heat wave

The major recommendation were plantation of trees, managing work time in morning and evening when there is low heat , using protective equipments like umbrella and drinking plenty of water. One of the respondents also talked about using appropriate medicine as we cannot control the temperature. One of the participants said, *"Plantation of trees has to be done, plants should be germinate, from here temperature decreases. Factories should be controlled."*

CHAPTER IV

DISCUSSION AND CONCLUSIONS

In the context of frequent reporting's' of heat stress related death in Nepal, this study analysed the climatology and trend in heat index based on last 30 years (1987-2016) of climatic data from 33 stations, widely spread across the country. NWS method was applied for the computation of the daily, monthly and seasonal climatology of the heat index. Giving emphasis to the hot days, seasonal trend of pre-monsoon and monsoon heat index trends were computed. To analyse the risk of heat stress in terms of its severeness to health, station wise trend of total annual number of days for caution, extreme caution, danger and extreme danger categories of heat indices were also analysed comprehensively.

The climatology of heat stress shows the high heat stress risk in pre-monsoon and monsoon season over the southern plains and low elevation areas of river valleys of the mountains. The heat stress is the combined effect of temperature and relative humidity, thus the risk is more severe and expands towards mountains in monsoon with the increasing amount of warm maritime originated moisture by monsoonal winds. The heat index trend for monsoon and pre-monsoon is increasing across the country, particularly over the southern lower elevation regions of the country. Similar inferences are drawn from trend of annual number of days in different categories of heat stress.

Increasing trend of heat index across the country is consistent to the increasing trend of temperature, hot days and warm nights across the country.[24, 25]The expansion of heat stress risk to mountain could be due to the elevation intensification of warming[25] because it does not only increase temperature but also the moisture holding capacity of the air and eventually humidity. However, increasing trend in more severe heat stresses in the southern lower elevations might be associated to increase in moisture in lower level due to increasing trend in pre-monsoonal and monsoonal precipitation in the region as well.[6, 15]. .. This study is the first of its kind for Nepal and focused only the identification of heat stress based on mean temperature and mean relative humidity. Calculation of separate trends for both day time maximum, and night time minimum temperature, along with the calculation of trend values of both temperature and relative humidity is recommended for future research, in order to get clearer pictures and attribution of heat stress trends. The southern plains are not only prone to heat stress risk in warmer months but are also vulnerable to cold waves during winter. Therefore, future research should be focused on cold wave aspect too.

The observed trends of heat index is consistent with perception of research participants. They also observed heat related illness. However, there are not clear institutional policy for compensation of workers. The findings indicate the urgent need of adaptation measures to minimize the adverse effect. Providing early warning and now-cast of heat stress risk from meteorological authorities, and awareness programme to the public from local and health authorities could be some of the immediate measures in this regard.

Recommendations

1. Data recording and reporting of heat related illness should be improved so that empirical relationship between heat waves and heat illness can be developed for evidence informed decision making
2. Massive awareness programme is needed in heat waves prone areas to aware people about preventive measures of heat stress
3. More research studies are needed in future to understand nexus between heat waves and health risks

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ANNEXURE

Annex I: Metadata of the 33 station considered for study.

Index No	Station Name	District	Latitude (°N)	Longitude (°E)	Elevation (m)
104	Dadeldhura	Dadeldhura	29.30135	80.58775	1879
207	Tikapur	Kailali	28.5365	81.11512	149
209	Attariya	Kailali	28.81278	80.56003	181
215	Godawari	Kailali	28.87623	80.57919	281
218	Dipayal	Doti	29.2621	80.9369	564
303	Jumla	Jumla	29.27465	82.17959	2364
406	Surkhet	Surkhet	28.58787	81.9685	685
416	Nepalgunj(Irri)	Banke	28.05208	81.62288	141
419	Sikta	Bankey	28.02989	81.97492	160
513	Chaujhari	Rukum	28.65399	82.21031	864
705	Bhairahawa Airport	Rupandehi	27.50692	83.42052	93
706	Dumkauli	Nawalparasi	27.68067	84.22853	156
707	Bhairahawa (Agric)	Rupandehi	27.52915	83.45795	96
804	Pokhara Airport	Kaski	28.20015	83.97952	811
805	Syangja	Syangia	28.0986	83.87242	871
814	Lumle	Kaski	28.29662	83.81792	1738
815	Khairini Tar	Tanahun	28.02697	84.0866	504
902	Rampur	Chitwan	27.65389	84.35056	173
906	Hetaunda N.F.I.	Makwanpur	27.41667	85.05	474
909	Simara Airport	Bara	27.16667	84.98333	130
911	Parwanipur	Sarlahi	27.07895	84.93275	97
1022	Godavari	Lalitpur	27.58333	85.4	1400
1029	Khumaltar	Lalitpur	27.66667	85.33333	1350
1030	Kathmandu Airport	Kathmandu	27.7	85.36667	1337
1038	Dhunibesi	Dhading	27.72311	85.16417	988
1111	Janakpur Airport	Dhanusa	26.71065	85.92439	76
1206	Okhaldhunga	Okhaldhunga	27.30812	86.50423	1731
1303	Chainpur (East)	Sankhuwasabha	27.2921	87.31697	1277
1307	Dhankuta	Dhankuta	26.98326	87.34592	1192
1319	Biratnagar Airport	Morang	26.48397	87.26701	62
1320	Tarahara	Sunsari	26.69882	87.27874	120
1405	Taplejung	Taplejung	27.35861	87.67	1744
1421	Gaida (Kankai)	Jhapa	26.65083	87.86056	107

Annex II: Stationwise Seasonal Trend of Heat Index

Index No	Station Name	District	MAM	JJAS	Annual
104	Dadeldhura	Dadeldhura	0.07	0.05	0.10
207	Tikapur	Kailali	0.02	0.06	-0.01
209	Attariya	Kailali	0.06	0.04	0.04
215	Godawari (West)	Kailali	0.21	0.12	0.04
218	Dipayal	Doti	0.08	0.08	0.09
303	Jumla	Jumla	0.06	0.03	0.07
406	Surkhet	Surkhet	0.07	0.09	0.09
416	Nepalgunj(Irrigation)	Banke	0.02	0.00	0.03
419	Sikta	Bankey	-0.04	0.00	0.03
513	Chaujhari	Rukum	0.06	0.01	0.06
705	Bhairahawa Airport	Rupandehi	0.07	0.17	-0.03
706	Dumkauli	Nawalparasi	0.05	0.08	0.04
707	Bhairahawa (Agric)	Rupandehi	0.06	0.07	0.06
804	Pokhara Airport	Kaski	0.06	0.07	0.03
805	Syangja	Syangia	0.06	0.07	0.10
814	Lumle	Kaski	0.04	0.04	0.04
815	Khairini Tar	Tanahun	0.07	0.11	0.11
902	Rampur	Chitwan	0.01	0.03	0.05
906	Hetaunda N.F.I.	Makwanpur	0.06	0.07	0.06
909	Simara Airport	Bara	0.08	0.10	0.09
911	Parwanipur	Sarlahi	0.04	0.06	0.06
1022	Godavari	Lalitpur	0.02	0.02	0.12
1029	Khumaltar	Lalitpur	0.07	0.03	0.06
1030	Kathmandu Airport	Kathmandu	0.08	0.05	0.07
1038	Dhunibesi	Dhading	0.06	0.04	0.12
1111	Janakpur Airport	Dhanusa	0.06	0.03	0.08
1206	Okhaldhunga	Okhaldhunga	0.04	0.03	0.16
1303	Chainpur (East)	Sankhuwasabha	-0.04	-0.04	-0.01
1307	Dhankuta	Dhankuta	0.12	0.13	0.07
1319	Biratnagar Airport	Morang	0.10	0.14	0.09
1320	Tarahara	Sunsari	0.02	0.01	0.03
1405	Taplejung	Taplejung	0.08	0.06	0.18
1421	Gaida (Kankai)	Jhapa	0.00	0.06	0.05
Average			0.06	0.06	0.07

Annex III: Stationwise Trend

Index No	Station Name	District	Caution	Extreme Caution	Danger	Extreme Danger
			27°C -32 °C	32°C – 41°C	41°C – 54°C	>54°C
104	Dadeldhura	Dadeldhu	0.019	0.000	0.000	0.000
207	Tikapur	Kailali	0.074	0.166	0.186	-0.012
209	Attariya	Kailali	-0.121	0.356	0.217	0.000
215	Godawari (West)	Kailali	-0.794	-0.295	1.287	0.206
218	Dipayal	Doti	-0.295	1.154	0.093	0.000
303	Jumla	Jumla	0.000	0.000	0.000	0.000
406	Surkhet	Surkhet	-0.291	1.589	0.011	0.000
416	Nepalgunj(Irriga	Banke	0.554	-0.164	0.000	0.000
419	Sikta	Bankey	0.241	0.098	-0.093	-0.018
513	Chaujhari	Rukum	-0.102	0.377	-0.003	0.000
705	Bhairahawa Airpo	Rupandeh	-0.748	-0.081	1.044	0.003
706	Dumkauli	Nawalpar	-0.246	-0.013	0.805	0.000
707	Bhairahawa (Agri	Rupandeh	-0.230	0.226	0.620	0.000
804	Pokhara Airport	Kaski	1.432	0.251	0.000	0.000
805	Syangja	Syangja	0.109	0.886	0.017	0.000
814	Lumle	Kaski	0.000	0.000	0.000	0.000
815	Khairini Tar	Tanahun	-0.341	1.397	0.158	0.000
902	Rampur	Chitwan	-0.185	-0.107	0.445	0.000
906	Hetaunda N.F.I.	Makwanp	-0.534	1.334	0.063	0.000
909	Simara Airport	Bara	-0.220	0.853	0.345	0.000
911	Parwanipur	Sarlahi	-0.141	0.489	0.175	-0.003
1022	Godavari	Lalitpur	0.033	0.000	0.000	0.000
1029	Khumaltar	Lalitpur	0.017	0.005	0.000	0.000
1030	Kathmandu Airpo	Kathmand	0.295	0.000	0.000	0.000
1038	Dhunibesi	Dhading	0.287	0.000	0.000	0.000
1111	Janakpur Airport	Dhanusa	0.361	0.228	0.210	0.000
1206	Okhaldhunga	Okhaldhu	0.000	0.000	0.000	0.000
1303	Chainpur (East)	Sankhuwa	-0.085	0.000	0.000	0.000
1307	Dhankuta	Dhankuta	0.266	0.000	0.000	0.000
1319	Biratnagar Airpor	Morang	-0.687	1.430	0.479	0.005
1320	Tarahara	Sunsari	0.639	0.000	0.000	0.000
1405	Taplejung	Taplejung	0.000	0.000	0.000	0.000
1421	Gaida (Kankai)	Jhapa	-0.235	0.682	0.000	0.000
Average			-0.028	0.329	0.184	0.005

Annex IV: Participant informed consent form

नेपाल स्वास्थ्य अनुसन्धान परिषद

रामशाह पथ, काठमाण्डौं

सुचना फारम

आदरणीय सहभागी .....

पृष्ठभुमी र उद्देश्य	नेपाल स्वास्थ्य अनुसन्धान परिषद् (स्वास्थ्य मन्त्रालय) बाट ज्भबत धबखभ सम्बन्धि सर्भेक्षण हुन गईरहेको छ । यस सर्भेक्षण बाट बढ्दो तापक्रम प्रति जनमानसको धारणा र व्यवहारको बारेमा अध्ययन गर्नं यस अनुसन्धानको उद्देश्य हो । यस अनुसन्धानले नेपाल स्वास्थ्य अनुसन्धान परिषद, नेपालको आचार संहिता समितिबाट स्वीकृति प्राप्त गरेको छ । यो सर्वेक्षण नेपाल स्वास्थ्य अनुसन्धान परिषद (स्वास्थ्य मन्त्रालय) बाट तालिम प्राप्त स्वास्थ्यकर्मी/ तथ्याङ्क संकलकहरुद्वारा सञ्चालन गरिनेछ । तपाई यस सर्भेमा छनौट हुनुभएको छ । त्यसैले तपाईलाई यस सर्भेक्षणमा सहभागी हुनका लागि अनुरोध छ ।
गोपनियता	तपाईंले दिएका तथ्याङ्कहरु गोप्यताका साथ यस अनुसन्धानमा मात्र प्रयोग गरिनेछ । तपाईको नाम, ठेगाना तथा अन्य व्यक्तिगत विवरणहरु यस प्रश्नावलीबाट हटाई तपाईंको परिचयात्मक कोड मात्र प्रयोग गरिनेछ । तपाईलाई यस सर्भेक्षणका प्रतिनिधिले आवश्यक परेको खण्डमा सर्भेको समायावधी भर कुनै पनि समयमा भेटन आउन सक्नेछन् ।
सहभागीता	यस सर्भेमा तपाईको स्वेच्छिक सहभागीता हुनेछ । तपाईंले चाहेको खण्डमा वा कुनै पनि वेला यस सर्वेक्षणबाट अलग्गिन सक्नु हुनेछ । यसरी अलग्गिनु भयो भने पनि तपाईलाई कुनै क्षति हुने छैन, तपाईंले कुनै हर्जाना तिर्नु पर्ने छैन, तथा अन्य कुनै पनि असर पर्ने छैन । तपाईलाई यस सर्भेको बारेमा कुनै पनि कुराको जिज्ञासा भएमा जुनसुकै वेलामा पनि सर्भे टोलीलाई राख्न सक्नुहुनेछ । अनुसन्धानको सम्बन्धमा थप जानकारीका लागि नेपाल स्वास्थ्य अनुसन्धान परिषद रामशाह पथ टेलिफोन नं. ०१-४२५४२२० मा सम्पर्क राख्न सक्नुहुनेछ वा यस अनुसन्धानका अनुसन्धानकर्ताहरु डा. मेघनाथ धिमाल 9851167198 मा सम्पर्क गर्न सक्नुहुनेछ । .....

।लखित मन्जुरीनामा पत्र

सहभागीको परिचय नम्बर :

मलाई यस सर्वेक्षणको उद्देश्य र आधार, अन्तरवार्ता प्रक्रिया, आफ्नो भुमिकाको बारेमा पूर्ण जानकारी छ । दिईएको जानकारीमा म सन्तुष्ट छु । मलाई मेरो स्वेच्छाले कुनै पनि बेला यो अनुसन्धानबाट अलग हुन सक्ने कुरा जानकारी छ । मैले यो जानकारी पत्र आफैंले पढेको (.....) वा अन्तवार्ताकार्ताले पढेर सुनाएर (.....) जानकारी गराउनुभएको छ ।

हस्ताक्षर: म सर्भेमा सहभागी हुनका लागि मन्जुर छु ।

अन्तरवार्ता लिनेको नामथर.....

अन्तरवार्ता लिनेको सहिछाप.....

मिति .....

साक्षी बस्नेको नाम थर .....

साक्षी बस्नेको सहिछाप .....

मिति .....

Annex V. Sample sheet for meteorological data collection

A	B	C	D	E	F	G	H
Station ID	Day	Month	Year	Min temperature	Max temperature	Moraning relative humidity	Eventing relative humidity
	1	1	1970	10	20	70	60
	2	1	1970				
	2	1	1970				
	4	1	1970				
	5	1	1970				
	6	1	1970				
	7	1	1970				
	8	1	1970				
	9	1	1970				

Annex VI. Questionnaire for perception study

अन्तर्वार्ता प्रश्नावली

सामाजिक तथा जनासंख्यीक सम्वन्धित जानकारी			
क स	प्रश्नहरु	बैकल्पीक उत्तरहरु	कैफियत
A1	तपाईको हालको बसोबास स्थान ?	१. जिल्ला ..... २. नगरपालिका /गाउँपालिका..... ३.वडा नं.....	
A2	लिङ्ग	१. पुरुष २.महिला ३.अन्य	
A3	तपाईको पूरा उमेर (वर्षमा)?	.....	
A4	तपाईको वर्तमान वैवाहिक स्थिति?	१. एकल २.बिवाहित ३.विधुवा/विधुर ४.पारपाचुके/छुट्टिएको	
A5	तपाईको धर्म के होला ?	१. हिन्दु २. बौद्ध ३.मुसलमान ४.किराँत ५.इसाई ६.अन्य (उल्लेख गर्नुहोस).....	
A6	तपाईको जात-जाति के होला?	१.दलित २.पहुँच नपुगेका जनजाति ३.पहुँच नपुगेका तराईका गैर दलित समूह ४.धार्मिक अल्पसंख्यक ५.तुलनात्मक रुपमा पहुँच पुगेका जनजाति ६.उप्पलो जातका समूह	
A7	तपाईको शैक्षिक योग्यता कति हो ?	१. पढ्न,लेख्न नसक्ने २.अनौपचारिक शिक्षा ३.प्राथमिक ४.माध्यमिक ५.उच्च माध्यमिक ६.कलेज वा उच्च शिक्षा ७.अन्य व्यवसायिक शिक्षा	

A8	तपाईको वर्तमान पेशा के हो ?	१. खेती किसानी २. मजदुरीसँग सम्वन्धित ३. चालक ४. व्यवसाय ५.सेवा क्षेत्र ६.अन्य उल्लेख गर्नुहोस्	
A9	तपाई यो कार्यमा कति वर्षदेखि कार्यरत हुनुहुन्छ ?	.....वर्ष.....महिना	
A10	तपाई दिनको कति घण्टा काम गर्नुहुन्छ ?	..... घण्टा.....मिनेट	
ताप तरङ्गसंग सम्वन्धित अनुभव र यसका असरहरु			
B1	के तपाईलाई बर्षेनी गर्मी याममा दिनहु तापक्रम बढे जस्तो लाग्छ ?	१. लाग्छ २. लाग्दैन ३. थाहा छैन	
B2	तपाईको क्षेत्रमा केहि वर्ष यता गर्मीसंग सम्बन्धित घटनाहरु कति के भएका छन् ?	१. धेरैनै २. कम ३. केहि परिवर्तन छैन ४. थाहा छैन	
B3	तपाईको कार्य स्थल प्राय कहाँ हुन्छ ?	१. मुख्य गरि भित्र २. मुख्य गरि बाहिर ३. माथि उल्लेखीत दुवै ४. अन्य .....उल्लेख गर्नुहोस्	

B4	गर्मी समयमा तपाई आफ्नो काम गर्ने ठाउँको वातावरण/अवस्था कसरी मूल्याङ्कन गर्नुहुन्छ ?	१. ताफक्रम क. धेरै तातो ख. तातो ग. सामान्य घ. चिसो ङ धेरै चिसो २. आद्रता (ओसिला) क. धेरै ओसिलो ख. ओसिलो ग. सामान्य घ. सुख्खा ङ धेरै सुख्खा ३. वायू संचार (Ventilation) क. राम्रोसँग वायू संचार हुन्छ ख. सामान्य वायू संचार हुन्छ ग. राम्रोसँग वायू संचार हुदैन घ. वायू संचार हुदैन	
B5	तातो मौसममा काम गर्नुपर्दा तपाई कत्तिको चिन्तित हुनुहुन्छ ?	१. अलि अलि २. सामान्य ३. निकै ज्यादा ४.थाहा छैन	
B6	यदि अस्वस्थता छ भने, कस्तो खालको अस्वस्थता लागेको छ ? (जस्तै : लड्नु, चिप्लीनु, पोल्नु, तातो सामाग्रीले डाम्नु, सामान सार्दा ठोकिनु आदि) बहुउत्तर	१..... २..... ३..... ४.....	
B7	के तपाई कहिल्यै गर्मीका कारण चोटपटक वा बिरामी हुनु भएको छ ? (जस्तै : डाबर, घमौरा, स्ट्रोक, थकान आदि ।)	१. छ २. छैन ३. थाहा छैन	

B8	यदि छ भने उल्लेख गर्नुहोस् । (बहुउत्तर)	१. तातोका कारण डाबर आएको, घमौरा २. बाउडिने (Muscle Spasms) ३.थकान महसुस हुने (Fatigue and collapse resulting from prolonged exposure unaccustomed heat) ४. स्ट्रोक (ज्वरो आउनु वा कहिले बेहोस हुनु जुन अत्याधिक तापक्रमका कारण शरिरको तापक्रम नियन्त्रण गर्ने मेकानिजम फेल भएको अवस्था) ५. अन्य.....	
B9	के तपाई अघिल्लो वर्ष तातोका कारण बिरामी भएर बिदा बस्नु भएको थियो ? यदि छैन भने ख १५ मा जानुहोस्	१. थियो २. थिएन	
B10	यदि थियो भने हप्तामा कति दिन/घण्टा बिदा लिनु भएको थियो ?	.....घण्टा .....दिन	
B11	के तपाईलाई तातोका कारण बिरामी भएर बिदा लिनुहोस् भनेर कसैले सल्लाह दिनु भएको थियो ?	१. थियो २. थिएन	
B12	के तपाई तापका कारण बिरामी भएर अस्पतालमा वा स्वास्थ्य संस्थामा भर्ना हुनु भएको थियो ?	१. थियो २. थिएन	
B13	गएको गर्मी मौसममा तपाईले भोग्नु भएको रोग तथा लक्षणहरु के के थियो ?	**लक्षणहरु** **प्राय** **कहिलेकाही** **बिरलै** १. टाउको दुख्ने २. टाउको घुम्ने(रिंगटा लाग्ने) ३. मांशपेशी दुख्ने ४. बान्ता हुने ५. उच्च शारीरिक तापक्रम ६. बेहोस ७. श्वास फेर्न गाह्रो हुने ८. तातो र सुख्खा छाला हुने ९. खानामा रुची नहुने १०. अनिद्रा ११. अन्य (उल्लेख गर्नुहोस् .....)	

उच्च तापको जोखिमका बारेमा धारणा			
क स	**प्रश्नहरु**	**बैकल्पीक उत्तरहरु**	**कैफियत**
C1	तपाईको सोचाईमा यदि तपाईले गर्मीमा काम गर्ने बानी बसाल्नु भयो भने उच्च तापबाट हुने रोगहरुको जोखिम कम हुनसक्छ ?	१.सक्छ २.सक्दैन ३.थाहा छैन	यदि सक्दैन भने, C2 मा जानुहोस् र यदि थाहा छैन भने, C3 मा जानुहोस् ।
C2	यदि सक्दैन भने, किन ? (बहुउत्तर)	१. मलाई यो गम्भिर समस्या हो जस्तो लाग्दैन । २. मलाई म जोखिममा छु जस्तो लाग्दैन । ३. यसका बारेमा थाहा छैन । ४. के विधि अपनाउने थाहा छैन । ५. अन्य (उल्लेख गर्नुहोस्).....	
C3 कृपया तल दिइएका विवरणमा आफ्नो धारणा दिनुहोला ।			

क्र.स.	विवरण	दृढ असहमत	असमहत	अनिश्चित	सहमत	दृढ सहमत
१.	यदि गर्मी वातावरण काम गर्दागर्दै थकान महसुस भए भने गम्भिर समस्या हो ।					
२.	तापमा काम गर्ने बेलामा व्यक्तिगत सुरक्षा उपकरण प्रयोग गर्न जरुरी छ ।					
३.	जतिनै सुरक्षाका विधिहरु अपनाएपनि आफूलाई तापनी तनावबाट हुने असर हरुलाई रोक्न सक्दिन ।					
४.	वृद्ध, बालबच्चा र महिला तापनी तनावको बढी जोखिममा छन्					

तापतरङ्ग प्रति व्यवहारिक प्रतिक्रिया

क स	प्रश्नहरु	बैकल्पीक उत्तरहरु	कैफियत
D1	धेरै तातो वातावरणमा काम गर्दा आफूलाई तातोबाट कसरी बचाउनु हुन्छ ?	१. खुकुलो, हल्का र हल्का रंगको कपडा लगाएर । २. व्यक्तिगत सुरक्षा उपकरण प्रयोग गरेर (जस्तै चस्मा, टोपी, मास्क आदी) ३. धेरै नियमित झोल पदार्थ र पानी पिएर । ४. Planning heavy activities during early morning and or evening hours. ५. छायाँमा विश्राम गर्ने । ६. धेरै मात्रामा चिनी र कफी नपिउने । ७. अन्य ८. केहि पनि गर्दिन ।	केहि पनि गर्दिन भने, D2 जानुहोस्
D2	यदि तपाई केही गर्नुहुदैन भने, किन गर्नुहुदैन बताई दिनुहोस् ।	१. नचाहिने भएर। २. असजिलो भएर । ३. सुरक्षा नगर्ने भएर । ४. अन्य उल्लेख गर्नुहोस् ।	
D3	धेरै तातो वातावरणमा काम गर्दा तपाईलाई स्वास्थ्य समस्या भएमा के गर्नुहुन्छ?	१. शितल ठाउँमा जान्छु । २. प्रशस्त पानी पिउँछु । ३. स्वास्थ्य संस्थामा जान्छु । ४. औषधी सेवन गर्छु । ५. केही पनि नगरि निरन्तर काम गरिरहन्छु । ६. अन्य	
D4	के तपाई ज्यादै तातो वातावरणमा पनि आफ्नै गतिमा काम गर्नहुन्छ?	१.गर्छु २.गर्दिन ३.थाहा छैन	
D5	यदि निरन्तर काम गरिराख्नु हुन्छ भने,, किन ?	१. सहकर्मी साथीको दवावका कारण २. पर्यवेक्षक (Supervisor) का दवाबका कारण ३. कामको मागको दवाबको कारण ४. कार्य स्थल चिसो पारिने भएकाले । ५. अन्य.....	
D6	के तपाई काम गर्ने ठाउँमा तातो मौसममा काम गर्नका लागि कुनै विधि प्रयोग गरिन्छ ?	१. गरिन्छ २. गरिदैन ३. थाहा छैन	यदि गरि दैन/थाहाछैन भने, D8मा जानुहोस्

D7	यदि गरिन्छ भने कुन विधि प्रयोग गर्न दिइएको छ ?	१. गर्मी नहुने कपडा २.अन्य व्यक्तिगत सुरक्षा उपकरण (जस्तै : चस्मा, सन स्क्रीन, पन्जा, ठूला घेरा भएका टोपी अन्य) ३. चिसो पिउने पानीको व्यवस्था ४. तातो छल्नका लागि उपयुक्त विश्राम समयको व्यवस्था ५. दिउँसोको ताप छल्नका लागि लामो खाना खाने समय ६. विद्युतिय पंखा ७. काम गर्ने समयमा परिवर्तन ८. छायाँ भएको ठाउँमा विश्रामको व्यवस्था ९. यदि तापक्रम धेरै बढेमा काम गर्न बन्द गर्ने (यदि ४० डिग्री भन्दा माथी भएमा	
D8	यदि ज्यादै गर्मी भएका कारण काम बन्द गर्नुपर्ने भएमा के तपाइको संस्थाले विश्राम लिएको समयको पैसा दिने व्यवस्था गरेको छ ?	१. दिन्छ २. दिदैंन	

********** धन्यवाद **********

Annex VII: Key informant Interview Guideline

स्वास्थ्य सेवाप्रदायक/कर्मचारी प्रतिनिधि/चुनिएका सरकारी अधिकृतहरु

१. साक्षातकार दाताको सामान्यजानकारीमिति :

क. संस्थाको नामर प्रकार.....

ख. कार्यालय भित्र तपाईको भूमिकाको बारेमा जानकारी दिनुहोस्

(स्वास्थ्य **सेवा** प्रदायक बाहेकको अरु सेवाको लगी)

ग. कर्मचारी संख्या.....

घ. विशेषत बाहिरी वातावरणमा काम गर्ने कर्मचारीको संख्या .....

ङ सामान्य काम गर्ने समय र काम गर्ने दिन/हप्ता .....

२. गर्मीको लहर बारेमा जनचेतना, धारणा र यसका असर

क. वातावरण परिवर्तन सम्वन्धी विषयमा तपाईको बुझाई /धारणा के छ ?

ख. वातावरण परिवर्तन संगै गर्मीयाममा बढ्दो तापक्रम तपाईको बुझाई /धारणा के छ ?

ग. विगत १०/१२ वर्षलाई आधार मान्दा गर्मीयामको तापक्रममा केही फरक महसुस गर्नु भएको छ ?

- वार्षिक रुपमा देखिने परिवर्तन
- मासिक रुपमा देखिने परिवर्तन

घ. विगतको केहीवर्षमा, तपाईको परिवारमा उच्च तापक्रमसँग सम्वन्धित समस्याहरु सहसुस गर्नुभयो ? (विशेष गरि स्वास्थ्य , बालीनाली, गाई वस्तु)

ङ. तपाईको विचारमा उच्च तापक्रम (ताप तरङ्ग) को जोखिम बढाउन सहयोग गर्ने तत्वहरु के-के होलान् र कुन समुहका व्यक्तिहरु बढी प्रभावित हुन्छन ?(जस्तै : कस्तो खालको काम, कुनउमेर समूह आदि ।)

(स्वास्थ्य सेवा प्रदायकहरुका लागि मात्र ।)

क. के तपाईले केहि वर्ष यता ताप तरङ्गबाट प्रभावित व्यक्तिहरुको संख्यामा परिवर्तन अनुभव गर्नु भएको छ ? (जस्तै : गतवर्ष भन्दा यस वर्ष गर्मीका कारण बिरामी भएर स्वास्थ्य सेवा लिन आउने जससंख्या बृद्धि भएको छ ?)

ख. तातो वातावरणमा काम गर्ने कर्मचारीहरुलाई कस्तो खालको गतिविधिहरुले नकारात्मक असर पर्छ ?

(जस्तै : पानी नपिउनाले, शारीरिक परिश्रमका काम गर्नाले आदि ।)

३. संस्थागतनीति

क. तपाईको संस्थाका बाहिर काम गर्ने कामदारहरुलाई तातो वातावरणका कारण हुने तापका असरहरुबाट कसरी जोगाउनु हुन्छ ? त्यस्तै कुनै विशेष संस्थागत नीति प्रावधान, निर्देशिका छ भने उल्लेख गरि दिनुहोस् । (जस्तै बिदाका प्रावधान, व्यक्तिगत सुरक्षा उपकरणको प्रयोग, काम रोक्ने, सुरक्षाकामानक, तापमान ट्रिगर विन्दुको निर्दिष्टिकरण जहाँ काम कम हुनु पर्छ । आदि)

ख. के अप्रत्यासीत तातो स्थीति भएको खण्डका लागि अग्रीम योजनाहरु छन् ?

ग. तातो अवस्थाका बारेमा कर्मचारीहरुलाई कसरी सुचित गरिन्छ ? तपाईको लक्षित समूहको हुनुहुन्छ ?

घ. यदि अकस्मात काम रोक्नु परेमा के कर्मचारीहरुलाई सो समयको पैसा दिने व्यवस्था छ ?

ङ तपाईको विचारमा कर्मचारीहरुका समस्यालाई सम्बोधन गर्न विद्यमान नीति, व्यवस्था र निर्देशिकाहरु पर्याप्त छन् ?

४. अन्य संस्थासँगको सहकार्य

क. यस क्षेत्रमा काम गर्नका लागि अन्य संस्थाहरुसँग समन्वय गर्नुहुन्छ ? यदि गर्नु हुन्छ भने कृपया नामहरु उल्लेख गरिदिनुहोस् ।

ख. के तपाईको विचारमा अहिलेको सहकार्यले राम्ररी काम गरेको जस्तो लाग्छ ?वा अरु केही संस्थाहरुसँग यसमा काम गर्नुपर्छ जस्तो लाग्छ ?

५. भविष्यका लागि सिफारिस

क. के तपाईसँग ताप तरङ्गका असरहरुबाट मानिसहरुलाई सुरक्षित राख्नको लागि केहि विशेष सिफारीस छन् ? (सर

Annex VIII. Cost estimate of Meteorological data of Department of Hydrology and Meteorology Daily Data

Cost estimate of Meteorological data of Department of Hydrology and Meteorology
Daily data

Parameter	Rate /year	Terai	Whole Nepal	Remarks
Tmax	1200	39600	118800	one value/day
Tmin	1200	39600	118800	one value/day
Td	2400	79200	237600	Two value/day
Twet	2400	79200	237600	Two value/day
P	1200	39600	118800	one value/day
RH	2400	79200	237600	Two value/day
Grand Total		**277200**	**831600**	