Factors Associated with People perception of climate change in Nepal

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Abstract

A better understanding of local people's perception, attitude, and behavior about climate change will provide an important foundation for the government's policymaking, adaptation and mitigation strategies, and local people-based guidelines for sustainable development works. The objective of this study was to assess the perception and knowledge about climate change and its impacts on tourism and biodiversity. Data was taken from the national climate impact survey (NCCIS) 2016 with a sample size of 5060 based on 16 strata 3 from each development region and Kathmandu valley as separate strata. Descriptive analysis, as well as chi-square and logistic regression, are tested. The study revealed that more than half (55.3%) of the respondents are farmers, illiterate (43.5%), and low income i.e. less than Rs50,000 per year (26.6%). Less than half (49.2%)had some knowledge about climate change but (52.8%) did not. Among all the respondents (95.3%) perceived change in climate and the main cause of climate change is deforestation (49.6%) followed by natural cause (14.0%). Age, sex, education level, income, marital status, and occupation were significantly associated with the knowledge about climate change(p<.001). The local people's perception about temperature is more closed to observed trends but not clear about precipitation.

Introduction

Climate change is a major threat for the 21st century and it affects mostly biodiversity, ecosystem, and human system (IPCC, 2014). The implementation of climate change policy is influenced by people's beliefs, attitudes, and risk perceptions (Howe, Mildenberger, Marlon, & Leiserowitz, 2015). Local's perceptions of climate change reflect their concerns over the specific impacts of climate change on their daily life (Ayal & Leal Filho, 2017). The local people's perception of climate change is an important element of understanding climate change adaptation problems and their solutions (Weber, 2010). Formulation of adaptation planning based on instrumental and local people perception help to reduce uncertainty in planning (Marin, 2010). Local people's perceptions provide a strong basis to determine a change in climate variables in the absence of instrumental data (Alexander, et al., 2011). However, both instrumental observations of climate and periodic surveys of public perception of

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climate change tend to be largely confined to developed countries, with little evidence coming from the developing world (Roco, Engler, Bravo-Ureta, & Jara-Rojas, 2015). There have been few comprehensive studies of climate change and its impacts in the Himalayan region, including Nepal is a white spot for climate research (Pachauri, et al., 2014; Shrestha, Gautam, & Bawa, 2012; IPCC, 2014). Several studies are conducted in Nepal to examine trends in temperature, precipitation, and extreme events (Shrestha, Wake, Mayewski, & Dibb, 1999; Karki, Schickhoff, Scholten, & Böhner, 2017; Shrestha, Bajracharya, Sharma, Duo, & Kulkarni, 2017) and acknowledged local perceptions of climate change (Chaudhary, et al., 2011; Chaudhary & Bawa, 2011; Macchi, Gurung, & Hoermann, 2015; Mishra, Bhandari, Issa R, Gurung, & Khanal, 2015; Uprety, et al., 2017). Climatic extreme events have already affected hydrology, biodiversity, ecosystems, agricultural production, and human health, and has exacerbated disaster risks in this region (Duncan, Biggs, Dash, & Atkinson, 2013; Shrestha & Bawa, 2014; Dhimal, et al., 2015; Bhattacharjee, et al., 2017).

Data are taken from the most comprehensive nationally representative survey (n = 5060) of local peoples' perception of climate change ever conducted in the country. Then compared the locals' perceptions intending to examine the possible effect of demographic variables, place attachment (year of living in the locality), regional differences (geography), and prior understanding of climate change on the accuracy of locals' perceptions and association of demographic and socioeconomic variables with the climate knowledge (CBS, 2017).

Materials and Method

Survey Data

This study was conducted based on the National Climate Change Impact Survey (NCCIS)conducted from July to December 2016 by the Central Bureau of Statistics. This survey was conducted in Nepal to understand people's perception of climate change and its impacts on social, economic, health, and environmental sectors. This survey was conducted in 16 strata covering four climatic zones, five development regions, and Kathmandu valley to make it more representative nationally. Respondents were selected from the 253 primary sampling units (PSU) and 20 households per PSU The sample selection strategy was adopted in three-stage. In the first stage, selection of districts in such a way that from each stratum having 2 to 4 districts (1 selection), 5 to 7 districts (2 selection), and 8 to 10 districts (3 selection) and more than 10 districts (4 selection). This resulted in 26 districts in total for the survey. The sample selection

procedure adopted for the first stage was Probability Proportional to size(PPS). In the second stage, PSU was chosen to represent each district in such a way that a total number of households in a sample is divided by 20 times the number of districts selected. This results from 253 PSU from 26 districts based on PPS sampling. In the third stage, a household was chosen in such a way that the potential respondent was 45 years or older and residing in the community for at least 25 years. Large PSU were further sub-divided into a manageable size and one of them is selected based on PPS sampling and 20 households were selected based on systematic sampling (CBS, 2017). This survey covered people's perceptions of climate change about change in temperature and precipitation patterns, change in length of a season, frequency of extreme events.

Reliability and Validity

The reliability and validity of the questionnaire are obtained by conducting a pilot survey, a desk review of the pilot survey questionnaire, international expert review, pretest of the questionnaire, and finalization of the questionnaire based on the pretest and the feedback from the subject experts.

Ethical Approval and Consent

The data were collected by the Central Bureau of Statistics(CBS). The information asked in the questionnaire is confidential according to the statistical act, 2015. Individual information is not published and only used for statistical purposes.

Statistical Analysis

Data were analyzed by using software IBM SPSS version 25.0. Descriptive statistics were used to illustrate respondents' demographic characteristics and the percentage of categorical variables. Chi-square or Fisher exact tests were used to test for the relationship between demographic variables and perception variables.

Results

Respondents' Demographic Characteristics

A total of 5060 participants from 16 strata in Nepal were interviewed and the following information is obtained. All participants were the head of their household, comprising 3396 males (67.1%) and 1664 females (32.9%). The average age of the participants was 58.45 years with a standard deviation of 10.4 years. The average time

spent in the locality was 49.56 years. A majority (55.3%) of the respondents were a farmer and 43.5% of the respondent are illiterate and only about 3.6% of the respondent are graduate and above. Most of the respondents (95.8%) had their own house and had drinking water sources (53%) as pipe water and 40.3% of the respondents from the sub-tropical area. (Table 1)

Table 1 : Characteristics of the Participants(n=5060)

Variable	Frequency (%)
Gender	
Male	3396(67.1)
Female	1664(32.9)
Age	
mean(SD)	58.45 (10.439)
Duration of stay in this locality in years' mean	49.56
Education	
Illiterate	2199(43.5)
Informal education	994(19.6)
Primary	835(16.5)
Secondary	852(16.8)
Graduate and above	180(3.6)
Occupation of the respondent	
Agriculture	2797(55.3)
Jobs	649(12.8)
Other non-agriculture Business	608(12.0)
Housewife	298(5.9)
Not working (unemployed/retired/unable to work)	708(14.0)
Climate zone	
Tropical	1705(33.7)
Sub-tropical	2038(40.3)
Temperate	297(5.9)
Sub-alpine	20(0.4)
Type of the house	
Owned	4850(95.8)
Rented	168(3.3)
Institutional	4(0.1)
Others	38(0.8)

Respondents' Knowledge towards Climate Change

Table 2 shows the responses of the participants towards climate change knowledge. Less than half (49.2%) had not heard about climate change and the main source of information about climate change were radio (37.1%), television (34.3%), and neighbor and friends (14.9%). Most of the respondents (95.3%) claim that the climate of their place had been changed. The main cause of climate change was deforestation (49.6%), natural cause (14%), urbanization (9.7%), god wish (3.9%), and earthquake (1.1%).

Table 2 : Respondent Knowledge (Perception) about Climate Change

Variable	Frequency (%)
Have you heard about climate change?	
Yes	2490(49.2)
No	2570(50.8)
what is your main source of information about climate change?	
Radio	
Television	924(37.1)
Newspaper	854(34.3)
Awareness campaign	124(5.0)
Neighbour/friends	132(5.3)
Family member	372(14.9)
Others	42(1.7)
Do you think the climate of this place is different than it was 25 years before?	11(0.4)
Yes	
No	4823(95.3)
What may be the main reason for climate change?	237(4.7)
Deforestation	2393(49.6)
Natural cause	674(14.0)
Industrialization	220(4.6)
Urbanization	470(9.7)
Human intervention	278(5.8)
God's wish	188(3.9)
Earthquake	51(1.1)
Others	54(1.1)
Don't know	495(10.3)

Respondents' Perception Towards Impacts of Climate Change

Respondents were asked how concerned they were about the impacts of climate change (Table 3). More than half of the respondents (56.7%) strongly agree climate change increased the emergence of new diseases in crops, the emergence of new insect/pest in crops (65.9%), increase in vector-borne diseases (80.1%), overall changes in water sources and observed changed in the number of tourists (70.1%).

Table 3: Participants' Perception and Awareness Towards Influence of Climate Change on Tourism, Environment, and Biodiversity

Influence of climate change (%)	Yes (%)	No (%)	Don't know (%)
The emergence of a new disease in crops last 25 years	2870(56.7)	1335(26.4)	855(16.9)
The emergence of new insect/pests in crops last 25years	2770(65.9)	1435(34.1)	0
Increase in the incidence of disease in last 25 years	2158(42.6)	2902(57.4)	0
Increase in incidence of water borne diseases in last 25 years	1124(22.2)	3936(77.8)	0
Increase in incidence of vector-borne diseases in last 25 years	1005(19.9)	4055(80.1)	0
Observation on the overall change in water sources in last 25 years 4071(80.5) 989(19.5)	0		
Observation on early flowering/fruiting in tree species in last 25	1958(38.7)	2061(40.7)	1041(20.6)
The observed change in the number of tourists in the last 25 years	1075(70.1)	335(21.8)	124(8.1)

Cross tabulation was done to examine the association between sociodemographic variables and climate change knowledge. Age, sex, education, income, occupation, and marital status were significantly associated with the knowledge of participants (Table 4).

Table 4 : Association Between Socio-Demographic Variables and Knowledge of Climate Change

Variable	Knowledge of climate change			Statistics
	Yes(%)	*No(%)*	*Total(%)*	

Age group

Age group				
45-54	1152(22.8)	931(18.4)	2083(41.2)	χ 2 = 60.108
55-64	718(14.2)	804(15.9)	1522(30.1)	df = 3
65-74	493(9.7)	643(12.7)	1136(22.4)	p<.001
>75	127(2.5)	192(3.8)	319(6.3)	
Total	2490(49.2)	2570(51.8)	5060(100.0)	

Sex

Sex				
Male	1869(37)	1527(30.2)	3396(67.1)	χ 2 = 140.234
Female	621(12.2)	1043(20.6)	1664(32.8)	df = 1
Total	2490(49.2)	2570(50.8)	5060(100.0)	p<.001

Education

Education				
Illiterate	467(34.7)	880(65.3)	1347(100.0)	
Informal	583(45.2)	708(54.8)	1291(100.0)	χ 2 = 893.86
Primary	402(49.8)	406(50.2)	808(100.0)	df = 4
Secondary	266(52.2)	244(47.8)	510(100.0)	p<.001
Bachelor & above	467(34.7)	880(65.3)	1347(100.0)	
Total				

Income

Income				
<50000	467(34.7)	880(65.3)	1347(100.0)	χ 2 = 328.7
50000-150000	583(45.2)	708(54.8)	1291(100.0)	df = 5
150000-250000	402(49.8)	406(50.2)	808(100.0)	p<.001
250000-350000	266(52.2)	244(47.8)	510(100.0)	
350000-450000	190(60.7)	123(39.3)	313(100.0)	
>450000	582(73.6)	209(26.4)	791(100.0)	
Total	2490(49.2)	2570(51.8)	5060(100.0)	

Marital Status

Marital Status				
Single	22(61.1)	14(38.9)	36(100.0)	
Married	2230(52.5)	2019(47.5)	4249(100.0)	χ 2 = 127.8
Widow/widower	227(31.3)	499(68.7)	726(100.0)	df = 3
Divorced / separated	11(22.4)	38(77.6)	49(100.0)	p<.001
	2490(49.2)	2570(50.8)	5060(100.0)	
Total				

Table 5 : Predictor Knowledge from Logistic Regression Analysis

F01. Knowledge about climate change		B	Sig.	Odds Ratio	95% Confidence Interval for Odd ratio	
					Lower Bound	Upper Bound
No	Intercept	-3.206	.000			
	Age of respondent	.008	.010	1.008	1.002	1.014
	male	-.214	.002	.807	.703	.927
	female	0[b]	.	.	.	.
	illiterate	2.943	.000	18.980	9.591	37.560
	Informal education	3.707	.000	40.736	20.658	80.331
	Primary education	2.628	.000	13.840	6.980	27.442
	Secondary education	1.400	.000	4.053	2.026	8.110
	Bachelor and above	0[b]	.	.	.	.

The reference category is: Yes.
This parameter is set to zero because it is redundant.

Discussion

This study showed a majority of the respondents believed that there had been a change in climate in the last 25 years. This is consistent with the data of (DHM, 2017) increasing the temperature trends and intensity of extreme events increased (Banstola, Chettri, Schneider, Stebbing, & Bastola, 2013; Jamaica, 2012; Toan, Kien, Giang, Hoang, & Wright, 2014). Climate change is happening and would lead to adverse impacts. They strongly agreed that agricultural production, human health, and natural ecology had already been affected by climate change. The findings are consistent with other studies (IPCC, 2007a; IPCC, 2014; Luber & McGeehin, 2008). This study showed that the radio, television, and newspaper (mass media) were the main sources of information about climate change. These results are similar to a previous study (Akompab, 2013; Wei, et al., 2014; Sheridan, 2007). Very few people mentioned hearing about climate change from other sources (1.7%). This indicates that mass media and discussions in the neighborhood are important sources of information. There is a sectoral gap of engagement from the government system, non-governmental organization (NGO),

and INGOs and consistent with other studies (Banstola, Chettri, Schneider, Stebbing, & Bastola, 2013). Similarly, this study also indicated women are more concerned about the environmental issue than the male which is consistent with other studies (Wei, et al., 2014; Liu, Smith, & Safi, 2014; McCright, 2010; Habtemariam, Gandorfer, Kassa, & Heissenhuber, 2016). The respondents considered the main reason for climate change are deforestation, natural causes, and urbanization and some of the respondents explained god wish as the cause of climate change. The majority of the respondents were relatively poor and had little formal education with an agro-based livelihood. It is examined that accuracy of climate change perception was associated with socio-demographic factors, place of attachment, regional differences, and prior understanding about climate change using chi-square tests. Our test found that there is an association between climate change knowledge and age, sex, marital status, occupation, and income($p<.001$).

Conclusion

This article has explored how changes in local climate are perceived by the respondents and investigating how these changes influence the livelihood and resources available to this population. The results show that unpredictable rainfall and increased temperature have led to perception changing climate among the respondents. This perception correlates with observed trends. This study provides evidence in support of the belief that reduced rainfall and increased temperature are responsible for the erosion of livelihood of resources i.e. food production, health, water, and biodiversity.

References

Akompab, D. (2013). Awareness of and attitudes towards heatwaves within the context of climate change among a cohort of residence in Adelaide, Australia. *Int. J. Environ. Res. Public Health.*, 1-17.

Alexander, C., Bynum, N., Johnson, E., King, U., Mustonen, T., Neofotis, P., . . . V., W. (2011). Linking indigenous and scientific knowledge of climate change. *BioScience, 61*(6), 477-484.

Ayal, D., & Leal Filho, W. (2017). Farmers' perceptions of climate variability and its adverse impacts on crop and livestock production in Ethiopia. *J Arid Environ, 140*, 20-28.

Banstola, A., Chettri, M., Schneider, R., Stebbing, M., & Bastola, a. (2013). Knowledge related to climate change and willingness to act for adaptation and mitigation practices in rural Nepal. *Vietnam Journal of Public Health., 2*, 22-32.

Bhattacharjee, A., Anadón, J., Lohman, D., Doleck, T., Lakhankar, T., Shrestha, B., . . . Krakauer, N. (2017).) The impact of climate change on biodiversity in Nepal: current knowledge, lacunae, and opportunities. *Climate, 5*(4), 80.

CBS. (2017). *National climate changes Impact Survey 2016. A Statistical Report, Central Bureau of Statistics.* Kathmandu: Central Bureau of Statistics.

Chaudhary, P., & Bawa, K. (2011). Local perceptions of climate change are validated by scientific evidence in the Himalayas. *Bio.Lett., 7*(5), 767-770.

Chaudhary, P., Rai, S., Wangdi, S., Mao, A., Rehman, N., Chettri, S., & Bawa, K. (2011). Consistency of local perceptions of climate change in the Kangchenjunga Himalaya landscape. *Curr Sci., 101*(4), 504-513.

(2007a). *Climate change: impacts adaptation and vulnerability.In: Parry, M.L., et al. (Eds). Contribution of Working Group II to the fourth assessment report of the Intergovernmental Panel on Climate Change.* Cambridge: Cambridge University Press,

Dhimal, M., Gautam, I., Joshi, H., O'Hara, R., Ahrens, B., & Kuch, U. (2015). Risk factors for the presence of chikungunya and dengue vectors (Aedes aegypti and Aedes albopictus), their altitudinal distribution, and climatic determinants of their abundance in central Nepal. *PLoS Negl Trop Dis, 9*(3), e0003545.

Duncan, J., Biggs, E., Dash, J., & Atkinson, P. (2013). Spatio-temporal trends in precipitation and their implications for water resources management in climate-sensitive Nepal. *Appl Geogr., 43*, 138-146.

Habtemariam, L., Gandorfer, M., Kassa, G., & Heissenhuber, A. (2016). Factors influencing smallholder farmers' climate change perception: a study from farmers in Ethiopia. *Environ Manag, 58*(2), 343-358.

Howe, P., Mildenberger, M., Marlon, J., & Leiserowitz, A. (2015). Geographic variation in opinions on climate change at state and local scales in the USA. *Nat Clim Chang., 5*(6), 596-603.

Jamaica, P. I. (2012). *Report on climate change knowledge, attitude, and behavior practice survey.* Kingston: Caribean Institute of Media and CommunicationKnowledge.

Karki, R., Schickhoff, U., Scholten, T., & Böhner, J. (2017). Rising precipitation extremes across Nepal. *Climate, 5*(1), 4.

Liu, Z., Smith, W., & Safi, A. (2014).) Rancher and farmer perceptions of climate change in Nevada, USA. *Clim. Change, 1-2*, 313-327.

Luber, G., & McGeehin, M. (2008). Climate change and extreme heat events. *Am. J. Prev.Med.*, 429-435.

Macchi, M., Gurung, A., & Hoermann, B. (2015). Community perceptions and responses to climate variability and change in the Himalayas. *Climate Dev, 7*(5), 414-425.

Marin, A. (2010). Riders under storms: contributions of nomadic herders' observations to analyzing climate change in Mongolia. *Glob Environ Chang, 20*(1), 162-176.

McCright, A. (2010).) The effects of gender on climate change knowledge and concern in the American public. *Popul Environ, 32*(1), 66-87.

Mishra, S., Bhandari, P., Issa R, N. D., Gurung, S., & Khanal, V. (2015). Climate change and adverse health events: community perceptions from the Tanahu district of Nepal. *Environ Res Lett, 10*(3), 034007.

Pachauri, R., Allen, M. R., Barros, V., Broome, J., Cramer, W., Christ, R., . . . Dubash, N. (2014). *Climate change 2014: synthesis report. Contribution of Working Group I, II, and III to the fifth assessment report of the Intergovernmental Panel on Climate Change.* IPCC.

Roco, L., Engler, A., Bravo-Ureta, B., & Jara-Rojas, R. (2015). Farmers' perception of climate change in Mediterranean Chile. *Reg Environ Chang, 15*(5), 867-879.

Sheridan, S. (2007). A survey of public perception and response to heat warnings across four North American cities: an evaluation of municipal effectiveness. *Int. J. Biometeorol., 52*, 3-15.

Shrestha, A., Bajracharya, S., Sharma, A., Duo, C., & A., K. (2017). Observed trends and changes in daily temperature and precipitation extremes over the Koshi river basin 1975–2010. *Int J Climatol, 37*(2), 1066-1083.

Shrestha, A., Wake, C., Mayewski, P., & Dibb, J. (1999). Maximum temperature trends in the Himalaya and its vicinity: an analysis based on temperature records from Nepal for the period 1971–94. *J Clim., 12*(9), 2775-2786.

Shrestha, U., & Bawa, K. (2014). Impact of climate change on the potential distribution of Chinese caterpillar fungus (Ophiocordyceps Sinensis) in Nepal Himalaya. *PLoS One, 9*(9), e36741.

Shrestha, U., Gautam, S., & Bawa, K. (2012). Widespread climate change in the Himalayas and the associated change in the local ecosystem. *PLoS ONE, 7*(5), e36741.

Toan, D. T., Kien, V., Giang, K., Hoang, V., & Wright, P. (2014). Perceptions of climate change and its impact on human health: an integrated quantitative and qualitative approach. *Glob Health Action, 7*, 23025.

Uprety, Y., Shrestha, U., Rokaya, M., Shrestha, S., Chaudhary, R., Thakali, A., . . . Asselin, H. (2017). Perceptions of climate change by highland communities in the Nepal Himalaya. *Climate Dev, 9*(7), 649-661.

Weber, E. (2010). What shapes perceptions of climate change? *Wiley Interdiscip Rev Clim Chang, 1*(3), 332-342.

Wei, J., Hansen, A., Zhang, Y., Li, H., Liu, Q., Sun, y., & Bi, P. (2014). Perception, attitude, and behaviour in relation to climate change: A survey among CDC health professionals in Shanxi province, China. *Environmental Research*, 301-308.