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Climate Change and Indigenous People: Perceptions of Transhumant Herders and Implications to the Transhumance System in the Himalayas

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Abstract

Climate change poses differential vulnerability for different communities, sectors and regions. People, whose subsistence livelihood is based on the direct utilisation of natural resources are most affected by climate change and have different but accurate perceptions of climate change than those people following modern lifestyles. The herders of the higher Himalayas follow vertical transhumance and combine it with subsistence agriculture for their livelihood. Although, climate models have predicted pronounced warming in high altitude areas of the Himalayas and there are many indications that climate change impacts different aspects of transhumance, there is no information on how transhumant herders have perceived change in climate and how these changes might impact transhumance system. One hundred and forty five transhumant herders were interviewed from three Village Development Committees (VDCs) namely Khumjung in Solukhumbu, Kalinchok in Dolakha and Majhigaun in Bajhang; representing Eastern, Central and far-Western mountainous areas of Nepal respectively to explore their perceptions about climate change and other observed changes in biophysical indicators. About 80% of the herders perceived increasing summer temperature, 92% decreasing winter rainfall and more than 93% noticed decreasing snowfall. Majority of the herders agreed that there was fast melting of snow in the rangelands, rainfall events were becoming more and more unpredictable, drought events increased, there was early induce in greenery and maturity of grasses in the rangelands and appearance of new livestock diseases. These observations suggest that transhumant herders in the Himalayas have experienced change in climatic variables and have noticed change in bio-physical indicators that have implications to the transhumance system. The findings help to devise adaptation strategies for indigenous communities and incorporate them in the climate change policies in the Himalayas.

Keywords: Climate change; Himalayas; Impacts; Nepal; Perception; Transhumance system

Introduction

Although climate change has emerged as a global challenge, it poses differential vulnerability for different communities, sectors and regions [1-4]. The perceptions and understandings of people towards climate change differ accordingly. People adopting livelihood options based on direct utilization of natural resources are affected more and their perceptions might be different and accurate than those following modern lifestyles. It is claimed that the indigenous knowledge can be better applied for the assessments of climate change [5-7] and indigenous people can better respond climate change [8-10]. The indigenous knowledge is also acknowledged for its crucial role in further advancing the understanding of scientific knowledge of climate change [11,12].

The grazing based livestock production suffers more and complex than other livestock production systems [13,14]. Transhumance is a form of pastoralism in which livestock are moved seasonally between fixed points to utilize the seasonal availability of grazing resources [15-17]. Transhumance is practiced by the inhabitants of settled communities to adjust varying environmental conditions combining [18-20]. The transhumance has a direct bearing with the timing of rainfall and grass production, cropping seasons, persistence or melting of snow in the rangelands, and availability of water in the grazing areas etc. which are very sensitive to the changes in climatic variables. Projected warming trend for many areas may change timing of snowfall and duration of snow cover, grass production, and phenology of plants in the rangelands [3,21]. Furthermore, the changing precipitation might impact vegetation and water availability in the rangelands. These changes can adversely affect the transhumance system.

In the higher Himalaya, where snowfall is the current norm, there will be increasing precipitation in the form of a rain [3]. The climate change has declined snow cover duration in the Himalayan rangelands that can alter timing of grass production and flowering or maturing. There is a consistent warming and rise in maximum temperature at an annual rate of 0.04 to 0.06°C in Nepal [22]. Warming is more pronounced in the high altitude regions as compared to the low lands [11,22,23].

Transhumant herders in the Nepal Himalaya follow vertical transhumance where they move their livestock to high altitude in the summer season and come back to low altitude in the winter season [24-27]. They combine livestock husbandry with sedentary agriculture for their subsistence livelihood [28]. This system was historically evolved to utilise the seasonal availability of grazing resources at different altitudes, and has been shaped by centuries of trial and errors generating experiences and ideas for sustaining livelihood and natural resources [29]. As they directly depend upon nature and natural resources, transhumant herders across the mountains of Nepal are vulnerable to climate change [18].

Although the climate change is more pronounced in the high

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altitude region than in low altitude region, there is no information on how people living in high altitude region have perceived climate change, what bio-physical changes related to climate change they have noticed and how these changes might impact their subsistence livelihood based on agriculture and animal husbandry. Therefore, the objectives of this study are to: (i) explore perceptions of transhumant herders towards the changes in climatic variables, (ii) explore observed change in bio-physical indicators, and (iii) to discuss the implications of changes in climatic variables and bio-physical indicators to the transhumance system in the mountainous areas of Nepal.

Methods

Description of study areas

The study areas lie in the northern mountainous region of Nepal. Three mountainous Districts; Solukhumbu in Eastern, Dolakha in in Central and Bajhnag in Far-Western Nepal where transhumance system exist were selected. One Village Development Committee (VDC) in each selected districts were selected for data collection. Thus selected VDCs were Khumjung, Kalinchok and Majhigaun in Solukhumbu, Dolakha and Bajhang District respectively.

All study areas are characterised by rugged and steep topography with high elevation gradients. The rangelands are covered with snow in the winter season and are available for grazing in summer season. Sub-alpine and alpine vegetation predominate the summer grazing areas. Generally, rainfall in Nepal decreases from east to west. It also decreases above certain elevation (about 2000 m asl). However, this general pattern is affected by aspects of hill and mountains. In high altitude areas, the climate limits agricultural production; therefore, livestock production is more common.

The livelihood of the people in the selected VDCs is based on subsistence agriculture and livestock production. Livestock production follows transhumance system [30-32]. In Khumjung, yaks/naks (*Bos grunniens*) are the dominant livestock types followed by *chauri/jockpyo* (hybrids of yak/nak (*B. grunniens*) and cows/oxen (*Bos taurus*) and vice-versa). Other livestock type consists of cows/oxen (*B. taurus*) and horses (*Equus caballus*). In Kalinchok, goats *(Capra hircus)* and cows/oxen were dominant with other types being buffaloes *(Bos buballis)* and *chauri/jockpyo*. In Majhigaun, cows/oxen (*B. taurus*) was the dominant livestock and remaining were goats (*C. hircus*), buffaloes (*B. Buballis*) and horses (*E. caballus*) (Cockfield & Maraseni 2014) [18,19].

In Khumjung, most of the villagers are now engaged in some aspects of tourism business [33,34], and the numbers of herding families have been declining. In Kalinchok and Majhigaun, youth migration in search of jobs has increased considerably recently. In Kalinchok, almost one third of HHs have at least one family member working overseas (mainly in Middle East countries: UAE, Saudi Arabia, Qatar, Kuwait, and Israel; and Malaysia) whereas people of Majhigaun move to Indian cities seasonally for supplementary income [35,36].

Methods of data collection and analysis

The field visits were organised from April to July 2013. A total of 145 herders were purposively selected and interviewed. Fifty four herders were interviewed from each of Kalinchock and Majhigaun. There was a total of 140 and 111 HHs practicing transhumance in Kalinchok and Majhigaun respectively. Only 37 herders from Khumjung were engaged in transhumance so all of them were interviewed.

A snowball sampling method was applied to the selection of HHs for the interviews. At first, secretories of the selected VDC's were approached to identify contact of some herders and then those herders asked about other herder's HH. A face to face and semi-structured interview was done with the herder from selected HHs. Interview tool mainly focused on perception about climatic variables and impacts of climate change to the transhumance system. Likely impacts of the climate change to the grazing based livestock production system were identified from the literatures and included in the questionnaire as different statements. Their relevancies in the context of mountainous area of Nepal, and to the transhumance system were validated with expert's consultation in Kathmandu. The response of herders towards these statements were collected in 1 (strongly disagree) to 5 (strongly agree) scale format [37-39].

Results

Majority of transhumant herders have perceived change in temperature, rainfall and snowfall patterns (Table 1). Hundred percent of those, who noticed change in summer temperature perceived that it has been increasing. Similarly, all herders who have noticed change in winter rainfall and amount of snowfall mentioned that both of these have been decreasing. The perception of herders was not uniform for change in winter temperature change, total amount of rainfall and amount of rainfall in monsoon season.

The number and percentage of respondents in different response category (strongly agree to strongly disagree) for each statement are shown in (Table 2). In addition to this, the percentage of respondents agreeing (sum of strongly agree + agree) to each statements are also calculated (Figure 1). Except for one statement, "Grassland zones are shifting up", majority of the respondents agreed to all other statements. The highest percentage of respondents (about 99%) agreed the statement "Melting of snow in the rangelands is faster" whereas there was the least percentage of respondents agreeing the statement "Grassland zones are shifting up" for which majority of respondents (64.8%) were in "Neither agree or disagree" category.

Discussions

The rising summer temperature as perceived by transhumant herders is consistent with previous studies [23,40,41] which report increasing temperature in the Himalayas. There was no uniform

SN	Change in	Number of herders				
		Yes	No	Don't know	If yes	
					Increasing	Decreasing
1	Temperature of summer season	113 (77.9)	9 (6.2)	23 (15.9)	113 (100)	0 (0)
2	Temperature of winter season	114 (78.6)	11 (7.6)	20 (13.8)	59 (51.7)	55 (48.24)
3	Total amount of rainfall in a year	112 (77.2)	10 (6.9)	23 (15.9)	46 (41.07)	66 (58.92)
4	Total rainfall in monsoon season	111 (76.55)	10 (6.9)	24 (16.5)	54 (48.64)	57 (51.35)
5	Total rainfall in winter season	134 (92.4)	2 (1.38)	9 (6.2)	34 (25.37)	100 (74.62)
6	Amount of snowfall in a year	135 (93.1)	6 (4.1)	4 (2.8))	0 (0)	135 (100)

Table 1: Perceptions of transhumant herders toward change in climatic variables; figure in the parenthesis indicate percentage of respondents.

SN	Statement	Number of herders				
		Strongly agree	Agree	Neither agree nor disagree	Disagree	Strongly disagree
1	Melting of snow in rangelands is faster than in the past	95 (65.5)	48 (33.1)	2 (1.4)	0 (0)	0 (0)
2	Rainfall is becoming more and more unpredictable	78 (53.8)	59 (40.7)	8 (5.51)	0 (0)	0 (0)
3	Drought events are increasing	34 (23.4)	88 (60.7)	22 (15.2)	1 (0.7)	0(0)
4	Greenery induce in the rangelands earlier than in the past	14 (9.6)	107 (73.8)	21 (14.5)	3 (2.1)	0(0)
5	New livestock diseases are appeared	23 (15.9)	91 (62.8)	25 (17.2)	5 (3.4)	1 (0.7)
6	Summer starts earlier	11 (7.6)	98 (67.6)	33 (22.8)	3 (2.1)	0 (0)
7	Water sources are drying up	30 (20.7)	78 (53.8)	35 (24.1)	2 (1.4)	0(0)
8	New species of plants are appeared in rangelands	3 (2.1)	102 (70.3)	36 (24.8)	3 (2.1)	1 (0.7)
9	Plants flower and mature earlier in the rangelands	1 (0.7)	95 (65.5)	48 (33.1)	1 (0.7)	0(0)
10	Grassland zones are shifting up	2 (1.4)	25 (17.2)	94 (64.8)	12 (8.3)	12 (8.3)

Table 2: Number of respondents with different level of agreements towards different statements; figure in the parenthesis indicate percentage of total respondents.

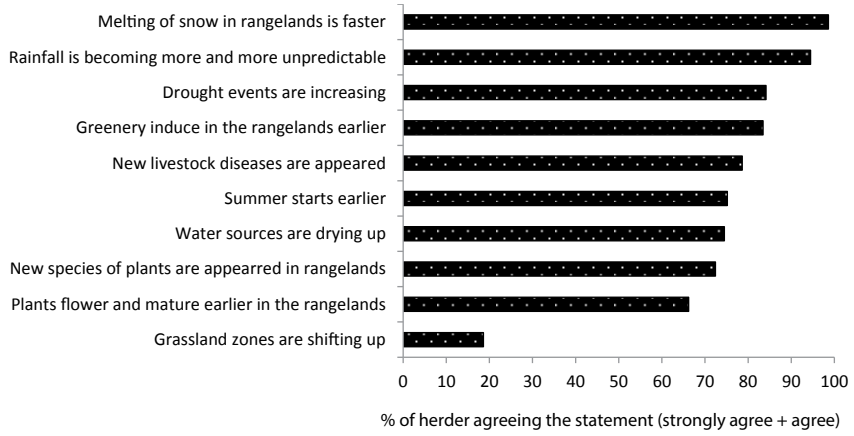

Figure 1: Percentage of respondents agreeing (strongly agree + agree) different statements.

perception of herders with winter temperature change. The mismatch of perceptions is generally explained as people's more concern toward weather event than climate [42]. People usually falsely assign unique weather events to climate change [43]. People gradually forget the distant past's events [44] and recent events get overestimated indicating the need of collaborative approaches among scientists, practitioners and local people to correct those false perceptions [45]. People's perceptions are also related to the perceived risks, expectations, beliefs, and cultures.

Observations of transhumant herders about climatic variables can compliments modern sciences, and indeed, offer some clues about climate change and provide a chance to cross validate findings from scientific observations. This is particularly important in the data deficit region such as in the higher Himalayas which is declared as 'white spot' due to lack of observations and limiting understanding [3]. Studies from other regions of the world [46] have also proven that indigenous communities whose livelihood depend upon the direct utilisation of natural resources, and directly interact with the nature better and accurately perceive changes in climatic variables and they can complement to the western science. Local people use physical environmental indicators such as rains, first snowfall, melting of snow [9] to compare trends. Furthermore, these people can develop effective adaptation strategies to combat effects from changing climate [8,10].

Majority of the transhumant herders have observed early onset of summer season, rapid melting of snow, early induce in greenery, and early flowering/maturing of vegetation and appearance of new plant species in the rangelands. The drying of water resources, increase in drought, and appearance of new livestock diseases were also perceived by transhumant herders. These observations are in line with the findings of previous scholars [41,47,48] who have reported advancing growing season and change in the phenology of the vegetation in the Himalayas. There are some literatures that have indicated drying of water resources and increase in drought in the eastern part of Nepal [40,49] and our results for Khumjung and Kalinchok also correspond to them. Large proportions of herders agreed statements that new livestock diseases appeared. New vectors such as tick have been reported in Majhigaun and Kalinchok Local people notice change in physical environmental indicators as well as biological indicators such as spring budding, leafing, and blooming flowers [9].

There were very less proportion of herders who agreed that grassland zones are shifting. This particular observation of herders is not in line with other studies [50,51] that report shift of range for many plant species, tree line and vegetation belt. Different factors might be responsible for differential response of herders. First, vegetation shift is very slow and gradual process so that herders might have not noticed this compared to other physical change such as melting of snow in the rangelands and increase in drought. Though, low proportion of herders agreed the statement indicating that grasslandr zones were shifting, there were large proportion of respondents who agreed that new species of plants were appeared in the rangelands. Second, topographic factors of the study area might have also played role to this finding. For herders of Kalinchok and Majhigaun, the summer grazing areas include even top of mountains because they are located comparatively at lower elevation and are accessible compared to grazing areas for herders in Khumjung. There are no other tall summits adjoining to these areas

where gradual increase/shift in grassland zones could be observed. The elevation rises sharply and there are cliffs and steep topography without soil in Khumjung. These topographical features might have restricted shifting in grassland zone or slowed down the process to be observed by herders.

Conclusions

Transhumant herders have perceived increasing summer temperature, decreasing winter rainfall and decreasing snowfall. However, for winter temperature, there was no single perception. These perceptions of herders are supported by the previous studies and predictions for the Himalayan region which indicate that the perception of transhumant herders can complement modern science and offer alternative approach for climate change studies in data deficit areas. Herders have observed change in biological indicators such as emergence of new plant species, appearance of new livestock diseases, early induce of greenery and early flowering/maturing of grasses in the rangelands and change in physical indicators such as early onset of summer, fast melting of snow in the rangelands, increased drought and drying of water resources. Most of the herders did not perceive shift in grassland zone which could be either due to very slow process to be detected by herders or could be related to topographical factors. Findings of this study suggest that perceptions of transhumant herders provide important insights to study climate change in remote mountainous and data deficit areas. In addition, identification of climate change impacts to the transhumance system helps to design adaptation and intervention strategies for the sustainability of the transhumance system in the Himalayas.

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