Comparing People's Perceptions on Changes in Climate and the Facts of Changing Climate: Exploring reasons for inconsistencies

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Abstract

This paper provides an overview of changing climatic context in Kathmandu valley based on the analysis of climatic data and perception of local people on key climatic variables. Elaborating on the subjective interpretations which generated the climatic perceptions among the local people in peri-urban areas of Kathmandu valley; it correlates the two sources of knowledge on climate change. Indicating the consistency and inconsistency between two, the paper discusses on the reasons for the inconsistency that exists. Changes in climate perceived by peri-urban farmers were assessed through focused group discussions and household questionnaire survey. Rainfall and temperature data were analyzed to understand the long term climatic trends.

Temperature trend perceived by local people was in line with the recorded long term temperature trend, both showing an increasing trend. People perceived a decreasing trend in rainfall while the analysis of rainfall records did not reflect any clear temporal change in rainfall pattern. The

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possible deviation in actual and perceived change in rainfall could be the consequence of water stress increasing with water increasing population and declining sources of water at Lubhu. The study showed that the local perceptions on climate was basis of local knowledge of climate and directed decision making on climate issues. Further it showed that rather than in isolation, perceptions could be a relevant resource in understanding the changes in climate and taking adaptive actions on it through validation using scientific means as the perceptions could be influenced by other social factors.

Key-words: climate change, temperature, rainfall, perception, comparison

1. Introduction

Climate Change has been hot global issue and it has gained momentum in Nepal as well. Several studies have been done and many are ongoing to understand climate change issue. Most of the studies on climate change are focused on analysis of meteorological records for identifying climatic trends and climate modeling to forecast the future changes in changes in climate. These studies definitely have contributed in understanding the processes of global and regional climate change. Simultaneously it has also been well realized that these data based trend analysis and climate change projections are unable to capture the micro-level changes and impacts of climate change (IPCC, 2007).

Rebetez (1996) pointed out the difficulties in receiving and making use of scientific information in decision making process by policy makers, politicians, media personnel's and even scientists from other disciplines; making use of their own experiences and interpretations in understanding the issues. Besides, all results of scientific researches not necessarily reach community levels to the actual recipient of climatic impacts. Thus they rely on their own perceptions, observations and longstanding experiences and familiarities with a set of local climate indicators (LI-BIRD, undated; Smit and Wandel, 2006; Gbetibouo, 2009; Green and Raygorodetsky, 2010; Piya, 2012). Ban and Hawkins (2000) define perception as the process by which we receive information or stimuli from our environment and transform it into psychological awareness. It is important to be aware of the perceptions since people frequently act on their perceptions, change their behavior, and develop adaptive strategies based on these, whether or not they are consistent with meteorological data (Vedwan and Rhoades, 2001; Gearheard et al., 2010; Speranza et al., 2010).

In Nepal, climatic perception studies are limited and primarily focused in rural and few in urban areas (Chapagain et al., 2009; NCVST, 2009; NCDC, 2010; Practical Action, 2010; Tiwari et al., 2010; Chaudhari and Bawa, 2011; Maharjan et al., 2011 and Piya et al., 2012). However, there is a dearth of literature on these types of studies in peri-urban area, a transition zone of urban and rural areas characterized by a mix of both urban and rural characteristics. Piya et al., (2012) stated that the perception of local people about the climate change can be entirely different from what science says about climate change. Thus bringing forward complementary information on which the climatic perceptions are based is not only interesting but also essential to bridge the gap between theory and practice in the discussion of climate change.

In this context this paper analyses climatic data and explores local climatic perceptions. It spotlights on the subjective interpretations made by local people in peri-urban areas of Kathmandu valley in generating climatic perceptions. Furthermore, it correlates the two sources of knowledge on climate change indicating the consistency and inconsistency and elaborates possible reasons for the inconsistency that exists between two.

2. Materials and Methods

2.1 Study Area

Lubhu Village Development Committee (VDC) - a peri-urban area with mix of rural and urban livelihood is situated at the periphery of Lalitpur sub-metropolitan city. It is 700 years old traditional Newar settlement located at south-eastern part of Kathmandu Valley and lies at 85^0 24” East and 27^0 39” North, comprising a total area of 4.76 km^2. It has 2326 households with 10374 populations (male- 5126 and female- 5248) (CBS, 2012). This village is dominated by Newar caste households with around 62% followed by around 27% of Cheetris, 5% Bhramins, 4% Dalits (disadvantaged group) and 2% Magars. Few households of Tamang and Gurung also reside in this VDC. According to VDC profile (2008), around 59% households are involved in agriculture followed by 17% in business, 7% in service and around 17% involved in other kinds of income generating activities. Though most of the households are involved in agriculture, around 83% of the income source is from off-farm activities.

Figure 1.

2.2 Methods

A mixture of both quantitative and qualitative research approach was used in this study. Participatory research tools were used to gather the qualitative data. Series of focus group discussions and household questionnaire survey were conducted to assess perception on climate change and subjective interpretations which generated the perceptions. The multi-stage stratified random sampling technique was applied in household survey. 10% of the total households were determined as the sample size while social stratification based on caste was followed as the sampling basis. The survey was conducted at 202 households using prepared structured questionnaires.

Focus group discussions on climatic perceptions were organized with local people belonging to different age groups and occupations using check list prepared based on the findings from preliminary survey. A time frame based on major events of past 40 years that local people could recall were used for collecting the retrospective experiences on climate during these discussions. The information collected was supplemented through review of secondary literatures and reports including those published at local level.

Rainfall data for seven (Godawari, TIA, Changu Narayan, Naikap, Sankhu, Panipokhari and Khumaltar) and temperature data for four stations (Khumaltar, TIA, Panipokhari and Godawari) within Kathmandu valley were analyzed to understand the long term climatic trends. These stations were selected based on their proximity to the peri-urban belt of Kathmandu. All the stations except Naikap had data over 30 years and qualified the meteorological data analysis criteria as defined by World Meteorological Organization (WMO, 1966). Trend analysis was done using a linear trend line as well as Mann-Kendall test. The null hypothesis H_o was that there was no trend, the two-sided alternative hypothesis H_a was that there was an increasing or decreasing trend at level of significance of 0.05.

3. Results and Discussion

3.1 Actual temperature trend

The analysis of temperature records of Kathmandu valley showed the numbers of days with maximum temperature above 30°C was increasing while the number of days with minimum temperature below 0°C was decreasing (Figure 2).

An average increase of 0.04°C per year was found for minimum temperature. For maximum temperature, an average increase of 0.05°C per year was found. These values are higher than the

South-Asian[2] and global average. The increase of both maximum and minimum for Kathmandu was highest in winter (Table 1).

Figure 2.

The illustrations from the earlier studies on trend of temperature change in Nepal are comparable to these findings, showing an increasing trend (Shrestha et al., 1999; Baidya et al., 2008; Practical Action Nepal, 2009, Joshi et al., 2011). Joshi et al., (2011) analysis of seasonal temperatures over the whole of Nepal for the period 1978-2008 found a yearly increase of 0.03°C for maximum temperature in summer and 0.05°C for maximum in winter. These values are respectively equal and slightly lower than the numbers given in Table 1. They found an increase of 0.01°C for summer minimum temperature and a decrease of 0.001°C in winter minimum temperature. Both numbers are lower than values given in Table 1. The higher values for Kathmandu valley could be indicating the possible influence of an urban heat island in the valley. Shrestha et al., (1999) pointed the warming after 1970 has raised the Kathmandu temperature by 1°C since 1975.

Table 1.

3.2 Perceived changes in temperature

76% of the respondents perceived the rising summer temperature while very negligible percentage felt the decrease in summer temperature. Nearly 44% felt that the winter was getting warmer and around 27% noticed that the winter was becoming colder. More than 50% of the respondents noticed increase in extreme hot days, hot days and less cold winter. Similarly, majority of respondents perceived decreasing cooler days, extreme cold winter days and decrease in cloudy and foggy days in winter. In an average 24% of the respondents did not perceive any

[2] In general for South-Asia, a temperature increase from 0.01°C to 0.03°C per year is found (Cruz et al., 2007). The worldwide temperature increase is estimated between 0.010°C and 0.016°C per year (Bernstein et al., 2007).

change in temperature related attributes. This is comparable to the study by Piya et al., (2012) where they found 38.5% perceived same. In their paper, they agreed to the Vedwan and Rhoades (2001) where the perception of no change in parameters of temperature is attributed to the invisible features of change in temperature. The detail changes in different attributes of temperature according to the household survey are given in figure 3.

Despite the temporal increasing trend of temperature within the village, respondents perceived that the cities were getting much hotter that their village. They noted micro-climatic change within their village which they stressed was result of changing environment. For example the rapidly upcoming buildings were increasing interception of the solar radiation in the agricultural fields adjacent. As per farmers, this was responsible for crop yield decline.

Figure 3.

3.2.1 Subjective interpretations leading to perceived changes in temperature

As talked by Saarinen (1976) social perception is concerned with the effects of social and cultural factors on cognitive structuring of our physical and structural environment. Respondents during the study related socio-cultural rituals to the seasonal cycle of summer and winter and the perceived changes in temperature were interpreted through these. *Shree Panchami*, a small Hindu festival celebrated during the month of February/March, was symbolized as the day for the onset of summer. Winter was believed to start on *Naag Panchami*, a cultural day celebrated in the month of July/August for worshipping serpent. Most of the respondents perceived a gradual increase in duration of summer season after 1980s and large increase in the 2000s. They perceived that if the summer duration continued to expand in the perceived rate, winter season would be vanished in next few decades.

Similarly, increasing temperature trend was perceived in other seasons. They felt the spring that used to be distinct starting around *Fagu Poornima*[3] and autumn seasons bringing festive weather during *Dashain-Tihar*[4] were no more distinct. They felt that the days during these seasons were much hotter giving feeling of prolonged summer.

Local people felt prior to 1980s, it used to be cold by *Kartik* (October/November) and the peak winter season months used to extend from November second week to mid February (*Mangsir* to *Magh*). They iterated in 2000s winter began much later and ended earlier. Even during the months considered as peak winter, they noticed that though mornings were cold, afternoon temperature was higher giving no more feeling of winter. This increasing temperature amplitude was reason that the warm clothes worn to avoid the morning chills caused them discomfort as the temperature rose in the afternoon.

As per them frost occurrence duration used to extend from November second week to February second week but they perceived large decline in number of frost days. Similarly *thanto*, icy film formed on the water surface during peak were rarely visible in the recent years. In addition occurrence of fog was perceived to have delayed from second week of September to second week of October. A decline in the fog density, foggy duration within a day and overall foggy period in every passing year was noted. Owing to this weather pattern, a local statement "*Poush Fas Fus*" was generated indicating passing away of the days of *Poush* (December/January) by the time fog dissipated. These changes noticed by local people supported the general warming trend of the warmest and the coldest day of the year as showed by the temperature records. People in Lubhu believed the black topped roads, vehicles and the expanding built up areas were capturing more heat in cities making cities hotter compared to their village.

[3] *Fagu Poornima*-full moon day and a festival of colors celebrated in the month of March
[4] *Dashain-Tihar*- festivals celebrated during the month of October- November

The farmers in Lubhu reported that the emergence of new pests in crops was causing decrease in crop production. They felt this was primarily the impact of increasing temperature. This had compelled the farmers to increase use of chemical fertilizers and pesticides. Studies have shown linkage of increase in temperature with the increases in the risks of pests, invasion of new weeds and diseases in crops (Dukes and Mooney, 2000; Patz et al., 2000; Masters and Wiebe, 2000; Malla, 2003; Chakraborty et al., 2008; Ziska et al., 2011).

3.3 Observed trends in rainfall

Analysis for rainfall record showed no clear increasing or decreasing trend in the total annual rainfall. Trend analysis using a linear trend line as well as Mann-Kendall and Seasonal Mann-Kendall test did not demonstrate temporal changes in the total rainfall. An overview of Seasonal Mann-Kendall test is shown in Table 2. These findings confirmed the conclusion of Shrestha et al., (2000) that there is no significant long term trend in rainfall while contradicts with Cruz et al., (2007) which states the total amount of rainfall in South-Asia has decreased.

Analysis of monthly rainfall data indicated rainfall decreased mainly in the months October to March; the period for winter rainfall implying decrease in winter rainfall. Rainfall increased from April to September, except for June. June is the month with the onset of monsoon. This average decrease in June could infer that the onset of monsoon had shifted to later in the season.

IPCC (2007) reported there is an increase in intensity or frequency of extreme weather events. However, there was no recognizable pattern to draw any conclusions concerning the rainfall intensity in Kathmandu valley as conducted for monsoon period in the study. Analysis of rainfall data throughout Nepal by Baidya et al., (2008) also did not find any significant trend for the daily intensity of precipitation while found an average increase of 0.001 for the number of days with more than 50 mm rainfall. The analysis of rainfall data for Kathmandu showed an increase in the number of events with daily rainfall exceeding 50mm. Cruz et al., (2007) also stated decrease in rainy days in South-Asia. However in this study, four out of seven analyzed stations showed a decrease in number of days with rainfall in non-monsoon period while only three stations showed a decrease in number of rainy days for monsoon period. Although not very prominent (with very low R^2 values shown in Table 3) the pattern in the negative direction (decrease in number of rainy days) showed relatively stronger signal than the positive directions. Naikap station showed the highest reduction in number of rainy days, both in and outside monsoon period but only 13 years of data is available from Naikap station, which is too short to draw any conclusion concerning climate. Thus no conclusion could be drawn on the temporal trend of the number of rainy days. Similarly the length of dry spells showed neither increasing nor decreasing trend.

Table 2.

Table 3.

3.4 Perceived changes in rainfall

The perception of respondents on different attributes of precipitation is illustrated by figure 4. Most of the respondent perceived decrease in rainfall trend. 47% respondents in household survey perceived increase in occurrence of dry spells. Based on their experiences a decrease in total annual rainfall, monsoon, winter and spring rainfall amounts were perceived. There was a wide divergence in opinion concerning the timing of the onset of reductions in rainfall. Dominant perception was that the total amount of rainfall started decreasing since 1990s and further declined in 2000s with relative improvements 2010 onwards. Additionally, they felt new rainfall pattern was not predictable and thus no more dependable. This was major stress for their agricultural practices. 65% respondents observed changes in timing of rice planting and harvesting and owed this to changes in normal rainfall timings. The adjustment in the timing of crop plantation and harvest, selection of less water demanding and drought resistant crop varieties and increasing use of groundwater in Lubhu were increasing as adaptive responses to changing rainfall. 53% of the households at Lubhu were found to have groundwater extraction systems.

Decrease in number of rainy days and persistence of rainfall was widespread. They felt that the rainfall intensity was increasing and observed that intense rainfall occurred in a small area while very close areas remained dry. Incidence of flood, on other hand, was perceived to have declined over time. The recent flood event recalled was that of 1996 which destroyed the main irrigation canal in the VDC.

Figure 4.

3.4.1 Subjective interpretations leading to perceived changes in rainfall

Knowledge of rainfall variability, its temporal and spatial pattern is based on a longstanding experience and familiarity with seasonal patterns of rainfall and a set of local climate indicators that provide clues of season onset and cessation (Thomas et al., 2007; Mertz et al., 2009; Green and Raygorodetsky, 2010). The rainfall events were related to traditional rituals such as *Krishna janmaastami* celebrated during August/September (*Bhadra*), *Shivaratri* in the month February/March (*Falgun*). Respondents recalled the occurrences of persistent rainfall lasting over days and nights prior to 1980s were annual process. The extent was such that they could not leave *Ghum*[5] for several days. Recalling the incidences of occurrence of lice in *Ghum*, elderly respondents quoted "*Ghum ma Likha Parthyo*". This was because they could not leave *ghum* due

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[5] *ghum- folded mat made from bamboo strips and leaves and used by farmers as an umbrella*

to persistent rainfall. Such events used to be regular during monsoon. Such events had generated several allegories "*sat din sat rat jhari*[6]" (rainfall lasting for days and nights for seven days), *Shaune jahri* (rainfall during July/August), *Shora Shraddha Jhari* (rainfall during September), *Nauratha Jhari* (rainfall during September/October in *Dashain*), *Maghe jhari* (rainfall during January/February), *Nag Panchami Jhari* were associated with persistent rainfall. These were annual phenomena especially prior to 1980s.

As perceived by them, decline in monsoon started in 1990s and continued decreasing profusely after mid 2000s. A local quotations "*Shrawan ma aakash ma euta tara dekhiyo vane, ek lakh muri anna ghattcha*" expressing traditional belief that there will be huge reduction in agricultural production if we could see a single star in the sky during July/August. This signified persistency of rainfall in monsoon. In Lubhu, rice was the major monsoon crop. The changes in monsoon rainfall was related with the timely completion of paddy transplanting in the area, availability of water in irrigation canals, standing water in the paddy fields at the time of weeding and soil moisture retention at the time of harvesting of the crop. Prior to 1980s, generally paddy transplantation used to be accomplished by the June with some exceptional years. Over the years, July had become the peak season for paddy transplanting. Consequently, paddy transplanting was found to be delayed more frequently. It was possible only after the monsoon started in full swing such that the delay of transplanting till August was being common. Highlighting the increasing the reason behind delayed paddy transplanting was declining rainfall in June was resulting. They also observed much decrease in the yield of springs during dry season and opined decline in the existence duration of *Asare Mul* (temporary springs appeared during and after rainy season).

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[6] *Jhari- Nepali term indicating persistent rainfall lasting for days*

The traditionally established belief was that the date on which winter rain started during December/January (*Poush*) and January/ February (*Magh*), used precisely suggest the start rain on June/July (*Ashad*) and July/August (*Shrawan*) respectively in the following years as these used to be the same dates. Respondents pointed that this system was dependable prior to 1980s while the disturbances progressively increased. They perceived massive decline in the number of rainy days making the rainfall erratic and unpredictable in 2000s.

The change in the rainfall pattern was perceived to be more stressful than the changes in the total annual rainfall. Very recently starting from mid 2000s, unusual changes in the pattern of rainfall were noticed making rainfall no more predictable. The respondents also surprised with the incidences of intense rainfall in one part of area while remaining completely dry in very nearby areas.

3.5 Co-relating observed climatic trends and perceived climatic trends

3.5.1 Relating perceived and actual temperature trends

As distinctly indicated by the temperature data analysis, the respondents clearly pointed increasing trend in temperature in all four seasons. The most prominent temperature increase was noted in winter as observed from temperature data analysis. They felt decline in frost days starting in 1990s which became more intense in 2000s. Frost refers to the condition that exists when air temperatures dropped to the freezing point of water (0°C), or lower. The decreasing trend in the number of days with minimum temperature below 0°C depicted by the temperature data analysis explained the perceived decline in the occurrence of frost. Fog begins to form when water vapor condenses into tiny liquid water droplets in the air. Mild and dry winter as a result of seemed to have linkage with changing occurrence of fog. This definitely needs more studies on climate change impacts on different forms of precipitation.

The perceived differences in the hotness at the peri-urban village and city cores suggested to the possibilities of urban heat island around Kathmandu valley. This was also indicated by the temperature data analysis. Validating this presumption requires more elaborate scientific research on urban heat island in Kathmandu.

3.5.2 Relating perceived and actual rainfall trends

Most of the respondents had strong view of decrease in rainfall. This was not completely supported by the rainfall data analysis as some months showed decreasing while some showed increasing trend. Unlike decline perceived fluctuations in the rainfall volume, rainfall data analysis did not show any distinct trend in the total annual rainfall amount. Similarly rainfall data analysis did not suggest that the rainfall was getting more intense or dry spells were increasing. It showed decline in the monthly total rainfall in the months October to March, the period for winter rainfall implying decrease in winter similar to the local perception. Monsoon is the main source of rainfall, which normally starts in the second week of June and reaches full development in July (Rai et al., 2011). The decrease in monthly rainfall in June shown by data analysis seemed similar to the perceived temporal shift which reported that the onset of monsoon had shifted to later in the season. Though analysis showed an increase in precipitation from April to September, it contradicted with local perception of decline in total monsoon rainfall.

The perception of respondent on decreasing number of rainy days were though not strongly but were in line with findings from the analysis of hydrological data. However with no significant temporal change in dry spells, the perceived increase in dry spells and decline in rainfall persistency could not be confirmed. It should be understood that analysis was conducted for the changes in monthly and annual rainfall; which did not show distinct trend. This indistinct trend in rainfall could be increasing rainfall uncertainty which was referred by the local people as unpredictable and unreliable rainfall. At the same, the possibility was that there could be change in the distribution of rainfall within month which would require intra-monthly analysis of rainfall data

3.6 Exploring reasons for inconsistency in perceived and observed rainfall trends.

Prior to 1980s, main sources of water for Lubhu were rivers, springs, dug wells, stone spouts and ponds. Many of these traditional water systems however vanished over time due to urbanization and rampant construction of physical infrastructures. The community water supply services started in 1981. In absence of reliable natural sources of water within the VDC, the operational community water schemes were primarily based on spring sources in the neighbouring VDCs. However till date, system of private water supply connection was not available in Lubhu. Thus the entire households depended on public stand posts which supplied limited water. Lubhu being located close to expanding sub-metropolitan city, continuous increase in population and changing life style with increasing urbanization was increasing the water demand in this peri-urban VDC.

Similarly irrigation systems in Lubhu were poorly functional. There were seven community based irrigation canal in the VDC. Dovan River Rajkulo (state sponsored irrigation system) was the main irrigation source for Lubhu. This virtually degenerated after being damaged by the flood in 1996. With declining water at the sources, smaller irrigation systems in Lubhu were increasingly dependent on rainfall. The water supply in these was much lower. The pollution of Godawari River flowing along the administrative border due to the discharge of sewage and effluents from the increasing number of textile factories further decreased the availability of dependable water at Lubhu. With poor functioning of irrigation systems, agriculture in Lubhu was primarily rain-fed.

For several reasons, availability of water in Lubhu was decreasing while water demand was increasing making water management a real challenge. Perceptions are based on the individual‘s past experiences and present sets, needs, social circumstances, interest and expectations (Banjade, 2003). The existing situations of water management and consequent increase in water stress could be a possible cause of dominant perception of declining rainfall among local people in Lubhu.

Cruz et al. (2007) has attributed water shortages in Nepal to rapid urbanization and industrialisation, population growth and inefficient water use, which are aggravated by changing climate and its adverse impacts on demand, supply and water quality. Such a situation was apparent at Lubhu

4. Conclusion

The study showed that majorities of local people at Lubhu perceived changes in climate. These perceptions constituted the understanding of climatic changes and were also the basis for adaptive decisions on the impacts of climate change. However the perceptions were influenced by existing situations primarily increasing water scarcity, thus communicating findings of scientific analysis on climate change was essential in upgrading the local knowledge on climate change. Further it showed that rather than in isolation, climatic perceptions could be a relevant guide in structuring adaptive actions on climate change through validation with scientific studies.

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Figures and Tables

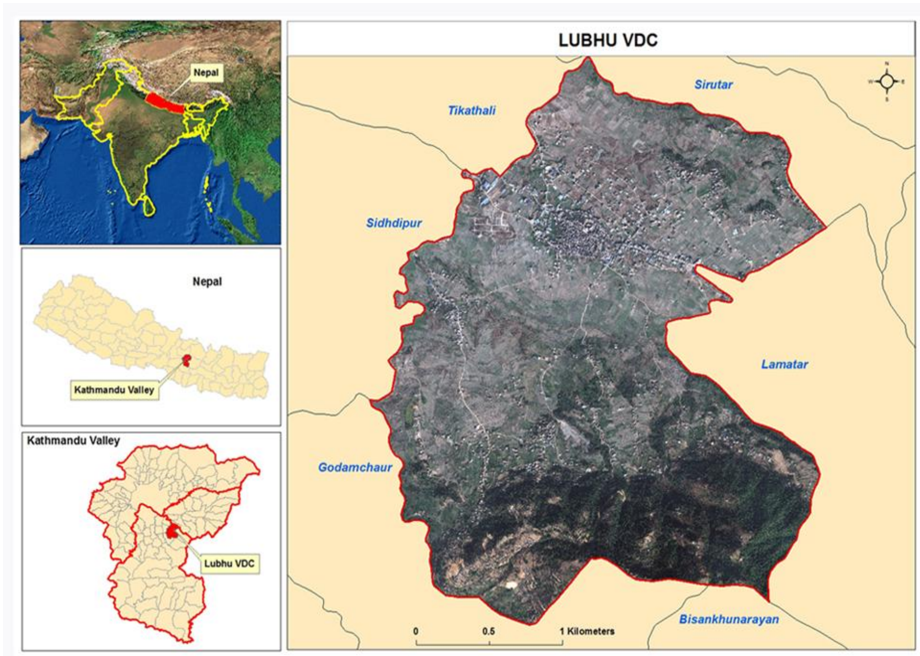

Figure 1: Location Map of the Study Area

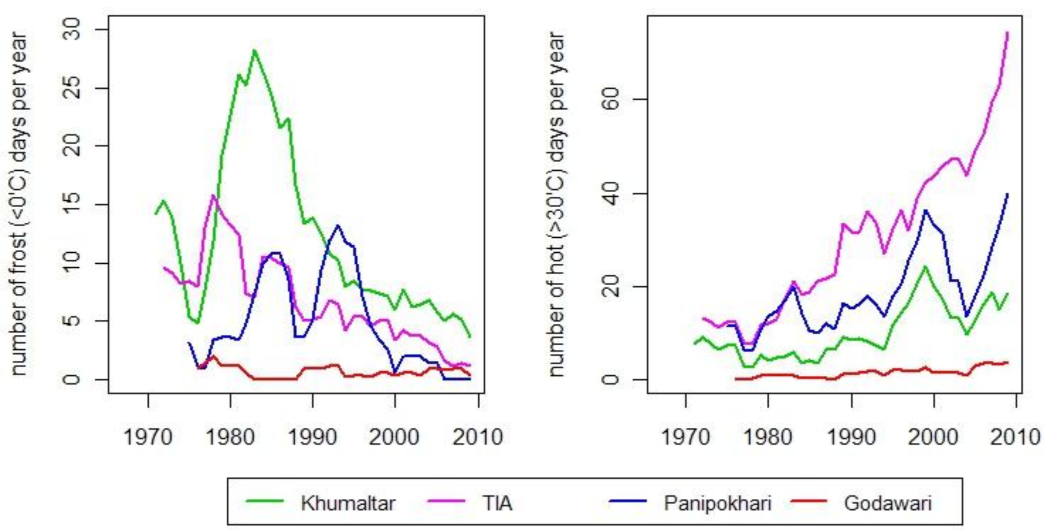

Figure. 2. Five year moving average for the annual number of days with temperature above 30°C and number of days with temperature below 0°C. The increasing trend of former and decreasing trend of latter clearly shows increasing trend of hot days.

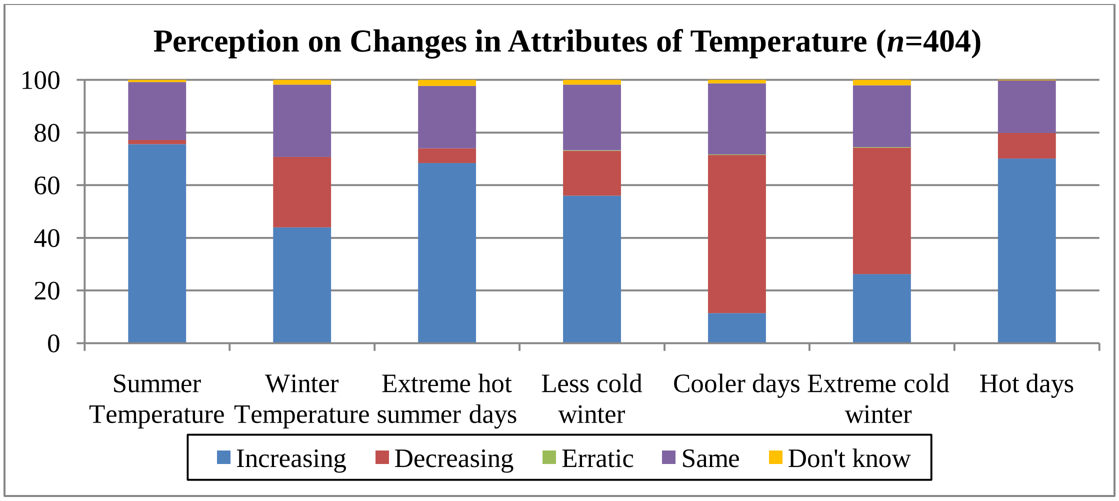

Figure 3: Perception of respondents on changes in different attributes of temperature

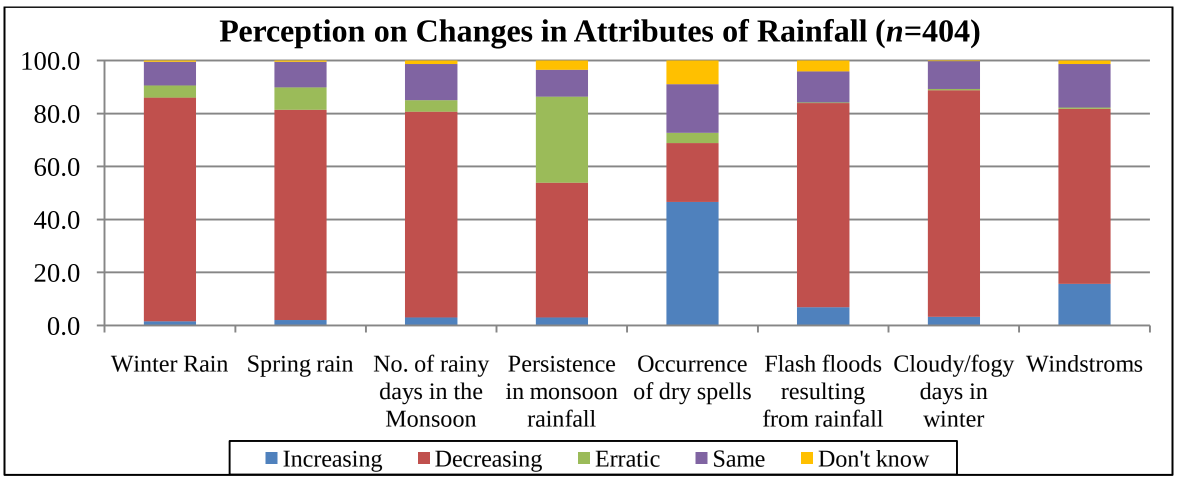

Figure 4: Perception of respondents on different attributes of precipitation

Table 1. Average Sen's Slope per season

Season	Months	Tmax	Tmin
Winter	Dec-Feb	0.06	0.04
Spring	Mar-May	0.04	0.04
Summer	Jun-Aug	0.03	0.02
Fall	Sep-Nov	0.06	0.05

(Seasons adapted from Thapa and Joshi 2009)

Table 2: Kendall Tau[7] and significance of Seasonal Mann- Kendall

Station	Kendalls Tau	P-value (2 sided)
Khumaltar	0.00	0.996
TIA	0.01	0.703
Godawari	0.01	0.801
Panipokhari	0.02	0.514
Changunarayan	-0.02	0.633
Sankhu	-0.02	0.594
Naikap	-0.05	0.324

[7] Kendall's tau gave an implication if the trend was increasing for positive tau) or decreasing (negative tau) or no trend (tau= zero). The two sided p-value showed if the trend was significant at level of significance of 0.05. All the p-values were above the significance level. Thus the null hypothesis could not be rejected which implied the rainfall data showed no significant trend.

Table 3. Slope of trend line through number of rainy days per year

Station	Non-Monsoon	[8] R^2	Monsoon	R^2
Khumaltar	0.22	0.09	0.19	0.10
TIA	0.35	0.17	0.16	0.13
Godawari	0.12	0.01	0.12	0.01
Panipokhari	-0.68	0.33	-0.11	0.04
Changunarayan	-0.46	0.16	-0.31	0.18
Sankhu	-0.35	0.09	0.06	0.01
Naikap	-1.03	0.25	-2.03	0.52

[8] R^2 values (with value ranging between 0 and 1) indicate to what extent the linear trend explains the variation in data. The low R^2 values indicate a large variation over the years and zero means that there is no linear relation at all between time (x-axis) and the number of rainy days (variable on the y-axis).