

## Original Research Article

### **Climate change: Trends and farmers perceptions in Chepang community of Chitwan district, Nepal**

**Abstract** - To access the trends and farmers perception on temperature and precipitation in Chepang community, a research was conducted in Chitwan district of Nepal in the year 2016. Two VDCs, Shaktikhor and Siddhi were selected purposively and sixty households from each village were selected randomly for the study. Primary information was collected from household using semi-structured interview schedule and secondary data were collected from Department of Hydrology and Meteorology (DHM), Kathmandu. Microsoft Excel was used for data analysis. Around half of the respondents perceived about increase in summer and winter temperature but decrease in rainfall amount. Monsoon rainfall was in decreasing (0.541 mm per year) trend and the overall trend of rainfall was also decreasing over the time (1983-2014). Maximum and minimum temperature was increased significantly over the time (1983-2014) by  $0.013^{\circ}\text{C}$  and  $0.0075^{\circ}\text{C}$  per year respectively. The analysis of climatic data strongly supports the farmer's perception. There is still a significant proportion of population, who are not still known about the change in climatic patterns. They cannot adopt the appropriate mitigation measures to reduce adverse impact of climate change in their farming systems until they were aware about changes in climatic parameters. This clearly shows that, NGOs, INGOs, and Government sectors should working together at grassroots level for raising awareness towards climate change parameters and their impacts on farming systems. The findings of this study can be useful for making effective policy and plan.

**Key words:** Temperature and rainfall trends, People's perception, Chepang community

#### **I. INTRODUCTION**

Climate change refers to the increase of earth temperature due to the release of gases such as  $\text{CO}_2$ ,  $\text{CH}_4$ , CFCs,  $\text{N}_2\text{O}$  and  $\text{O}_3$  into the earth atmosphere (IPCC, 2007). Change in temperature is the major indicator of climate change which rises at the rate of  $0.06^{\circ}\text{C}$  per annum. Such a rise in average temperature is variable across the country (Gautam and Pokhrel, 2010), higher in the mountain and Himalayan ( $0.08^{\circ}\text{C}$ ) as compared to low-lying Terai ( $0.04^{\circ}\text{C}$ ). Rural communities are expected to be affected more due to excessive dependence on climatic variables and limited adaptive capacity to the changes (UNFCCC, 2009). The climatic factors, affect millions of livelihood around the world (IPCC, 2007). Nepalese agriculture is highly dependent on the climatic condition; hence even small change in climatic condition could largely affect the food security in the country (Bhandari, 2008). Nepalese agriculture is one of the worse hot sectors due to climate change (FAO, 2007b). Extreme weather condition such as irregular rainfall, drought, flood, cold waves, relative humidity, which ultimately decrease the productivity of crops (NAPA, 2010). The Nepalese agriculture production system is highly uncertainty and vulnerable for two reasons. First, the existing system of food production is highly climate sensitive because of its low level of capital investment and non-adoption of modern technological options. Second, agriculture is the main source of livelihoods for a majority of the population i.e. 65% population depends on agriculture (MoAD, 2015). Rising temperature, variation in summer and winter

temperature, erratic and higher intensity of rainfall for few periods has increased number of droughts and floods, more often; with landslides, water shortage and increasing land degradation. Similarly, farmers are unable to plant the crops in appropriate time which certainly lowers the production and ultimately affect the food security. In developing countries like Nepal, insufficient research and credible evidence on the impacts of climate change is a major challenge. The research on community vulnerability within the country is very less. Micro scale vulnerability assessment is more important than macro level in our context which has high diversified climatic patterns. Hence, local level study is important (Sharma, 2009).

The study reveals that the global temperature will rise between 1.5<sup>0</sup>C to 4.5<sup>0</sup>C by sometime in the 21<sup>st</sup> Century. In addition, it has been suggested that warming of more than 2.5<sup>0</sup>C could reduce global food supplies and contribute to higher food prices (UNEP and UNFCCC, 2002). The amount of precipitation varies significantly across the country because of the non-uniform and rugged terrain. Analysis on precipitation data recorded in all-Nepal (1948-1994) and sub-regions (within Nepal from 1959-1994) showed a large inter-annual and decadal variations (Shrestha *et al.*, 2000). Similarly, a study conducted on the annual precipitation data from 1976-2005 from 166 stations across the Nepal revealed the overall an increasing trend of precipitation (Practical Action Nepal, 2009). Furthermore, the projection also revealed an increasing trend of rainfall intensity during monsoon and post monsoon while this showed a decreasing trend in winter (MoEnv, 2010). This paper analyzes how the study community in the rural Mid-Hills of Nepal perceives the changes in temperature and rainfall and whether these perceptions match with the recorded data or not.

## II. MATERIALS AND METHODOLOGY

### **Chepangs: The study community**

Chepangs are one of the indigenous people inhabiting since time immemorial in the remote geographical terrain of Dhading, Makwanpur and Gorkha districts of Central Nepal (Limbu and Thapa, 2011). According to the 2003 Census, the total population of Chepang has been recorded to be 52,237 in Nepal. Out of which, 18,413 people live in Chitwan (35.24 percent) followed by 17,237 in Makawanpur (32.99 percent), 2,734 in Gorkha (5.2 percent) and 10,328 in Dhading (19.77 percent) district (CBS, 2003).

The primary occupation of the Chepang is agriculture. They do both shifting and permanent cultivation. A few chepang households have no irrigated field, khoriya land is their prime means of survival. The major crops are Maize, Millet. Cowpea, black gram, broom corn millet, buckwheat and rice bean in their khoriya plots (Limbu and Thapa, 2011). Chepangs still depend upon wild and uncultivated edible plants (Maharjan *et al.*, 2010).

Due to rugged topography and stony nature of the land, only a small percentage of Chepang households are fully food self-sufficient (Piya *et al.*, 2011a). Food self-sufficiency and food insecurity is the most prominent issue in the livelihood of the Chepang community. Only one percent of the Chepangs have cereal food surplus and about 60% of the families have food that does not last more than six months (NCA, 2004). The rest of the months they depend on wild and uncultivated foods and wage labor work to meet their food demand (Regmi *et al.*, 2006). Insecure land tenure and possession of citizenship certificate is the most important issue for most of the Chepang community (Aryal and Kerhoff, 2008).

## Study area and data source

Saktikhor and Siddhi VDC of Chitwan district were selected purposively for the study. The study sites were selected purposively because dominance of Chepang population resides in these areas. One cluster was formed in each representative village of the Chitwan district for assessing the trends of climate change. Each cluster consisted of 60 households and there were altogether two clusters i.e. 120 households for the study. The respondents were selected above the age of 40 years, since they could provide the valuable information regarding the past trends of the climatic trends. Household survey was conducted using semi-structured interview schedule. The researchers visited the selected households and face-to-face interviews were conducted with the household members on the selected household's premises.

The main purpose of this household survey was to find out whether individual households perceived any changes in climate, and if they did, what were the changes perceived. For comparing the community perceptions with the actual climate data, historical weather data comprising of mean monthly maximum temperature, minimum temperature, and rainfall were obtained for the year 1983-2014 from the Department of Hydrology and Meteorology (DHM) in Kathmandu, Nepal.

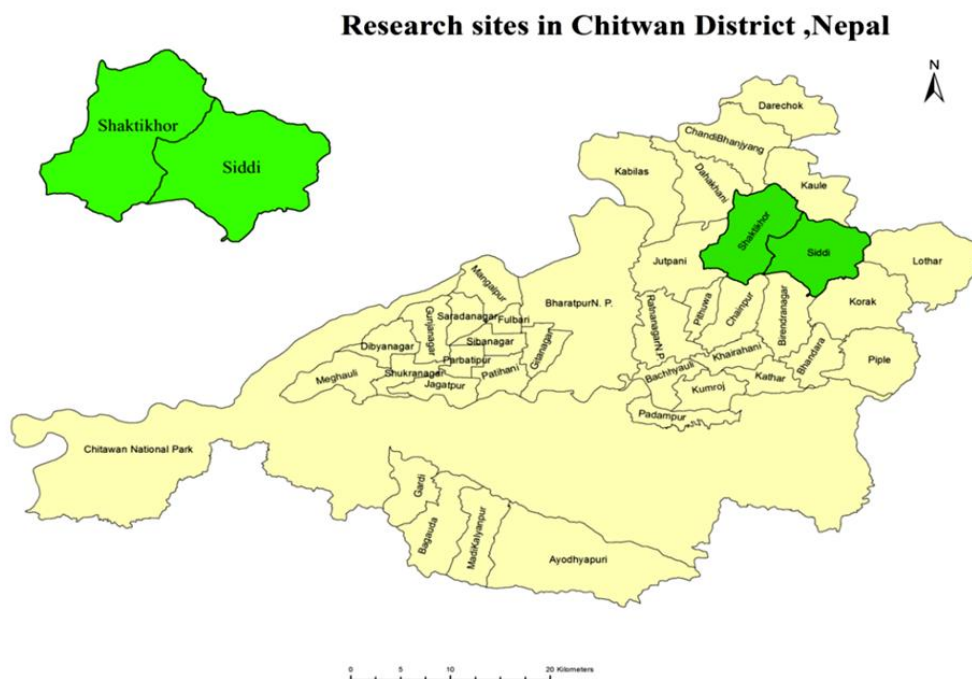


Figure 1. Map of Chitwan district showing study area

## III. RESULTS AND DISCUSSION

### Temperature: Trends and People's Perception

#### People's perception

The result indicate that, approximately 50 percent of respondent perceived that increase in summer temperature, 20 percent of respondent perceived that decrease in summer temperature, 6 percent perceived about neither increase nor decrease and 24 percent of respondent are unknown

about change in summer temperature pattern. Approximately 39 percent of respondent perceived that winter temperature is increasing year by year whereas 37 percent perceived decreasing, 3 percent perceived about neither increase nor decrease and 21 percent of respondents are unknown about change in winter temperature pattern. Same perception was found by Thapa M.S. (2010), while conducting household survey in Chepang community of Chitwan district.

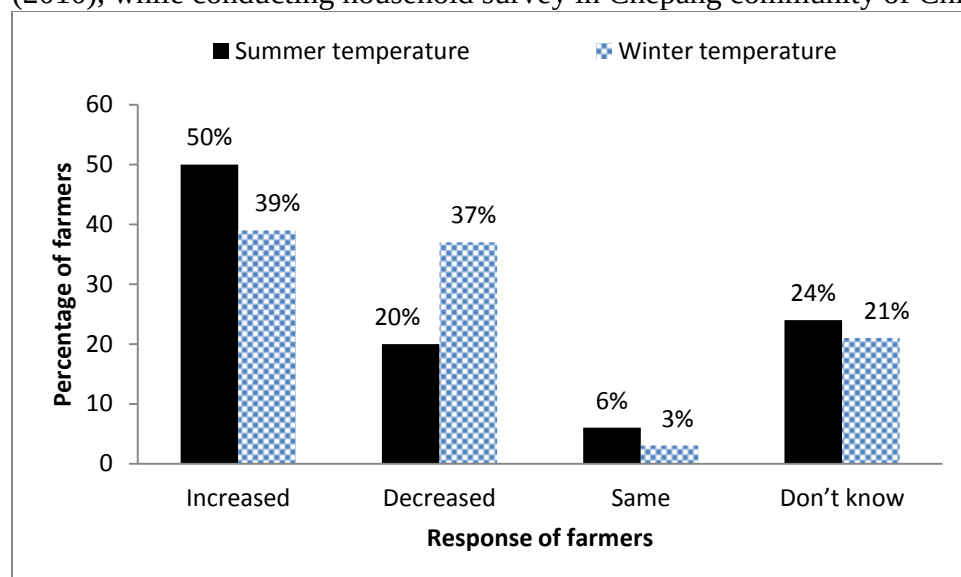


Figure 2. Perception of farmers towards changing temperature

### Observed Trend

Analysis of the maximum and minimum temperature of last 32 years (1983 to 2014) of Rampur Station (Figure 3) shows that maximum temperature and minimum temperature was increased significantly over the time by  $0.013^{\circ}\text{C}$  and  $0.0075^{\circ}\text{C}$  per year respectively. The highest and lowest annual mean temperature in the study area during summer season was respectively  $32.5^{\circ}\text{C}$  in the year 2013 and  $30.4^{\circ}\text{C}$  in 2008. The highest and lowest annual mean temperature in the study area during winter season was respectively  $18.7^{\circ}\text{C}$  in the year 2010 and  $15.0^{\circ}\text{C}$  in 2012. The average maximum temperature was less than the national average maximum temperature which was  $0.06^{\circ}\text{C}$  per year (Baidya et al., 2008). The trend analysis support the farmer perception that the summer was hotter and winter was also hot as compared to the past. Though this warming trend is in line with the average annual temperature increases in the area. Therefore, the local farmer's perceptions appear to be in line with the statistical data in the region (Shrestha et al., 1999).

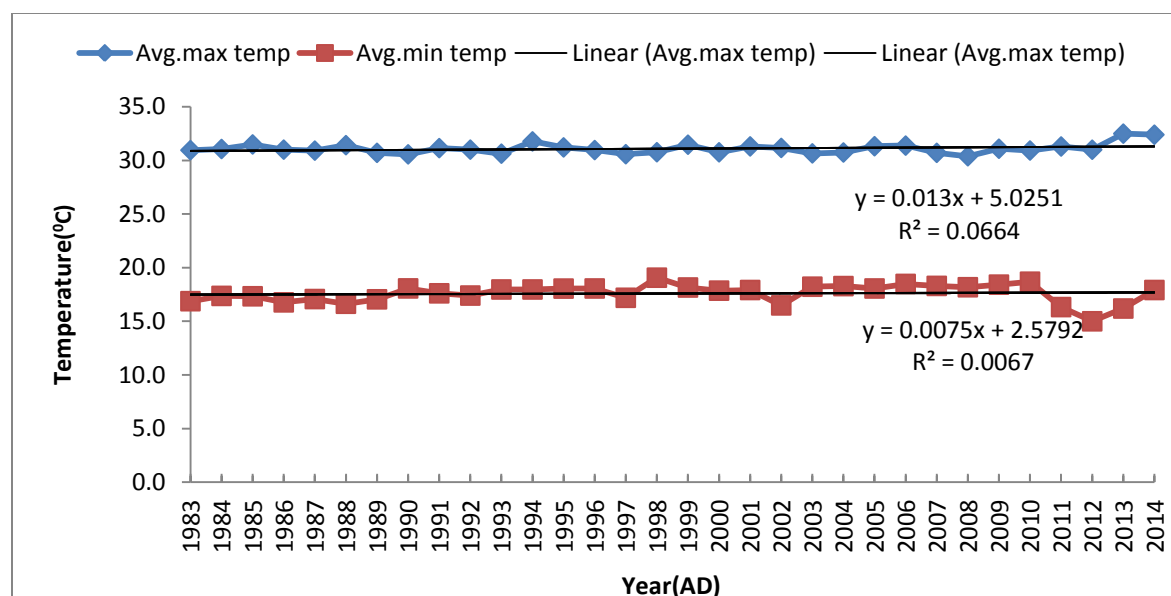


Figure 3. Trend analysis of maximum and minimum temperature over the last 30 years (1983 – 2014) in Rampur station, Chitwan

### Precipitation: Trends and People's Perception

#### People's perception

Table 1 Perception of farmers towards change in rainfall pattern

| Table 1 Perception of farmers towards change in rainfall pattern |          |           |          |                      |  |
|------------------------------------------------------------------|----------|-----------|----------|----------------------|--|
| Rainfall amount                                                  | Village  |           |          | X <sup>2</sup> value |  |
|                                                                  | Siddhi   | Saktikhor | Total    |                      |  |
| Increased                                                        | 9(16.0)  | 12(19.0)  | 21(18.0) | 1.23                 |  |
| Decreased                                                        | 33(58.0) | 37(59.0)  | 70(58.0) |                      |  |
| Same                                                             | 11(19.0) | 8(13.0)   | 19(16.0) |                      |  |
| Don't know                                                       | 4(7.0)   | 6(10.0)   | 10(8.0)  |                      |  |
| Rainfall length duration                                         |          |           |          |                      |  |
| Increased                                                        | 7(12.0)  | 8(13.0)   | 15(13.0) | 0.79                 |  |
| Decreased                                                        | 32(56.0) | 36(57.0)  | 68(57.0) |                      |  |
| Same                                                             | 6(11.0)  | 9(14.0)   | 15(13.0) |                      |  |
| Don't know                                                       | 12(21.0) | 10(16.0)  | 22(18.0) |                      |  |
| Rainfall time                                                    |          |           |          |                      |  |
| Earlier                                                          | 5(9.0)   | 7(11.0)   | 12(10.0) | 1.99                 |  |
| Later                                                            | 8(14.0)  | 7(11.0)   | 15(13.0) |                      |  |
| Same                                                             | 7(12.0)  | 5(8.0)    | 12(10.0) |                      |  |
| Unpredictable                                                    | 25(44.0) | 34(54.0)  | 59(49.0) |                      |  |
| don't know                                                       | 12(21.0) | 10(16.0)  | 22(18.0) |                      |  |

Figures in parenthesis indicates percentage

The study shows that majority of the respondent (58 percent) perceived that decrease in rainfall amount as compared to past while 57 percent respondents perceived decrease duration of rainfall as compared to the past. 49 percent respondent perceived that rainfall time is unpredictable as shown in Table 1.

## Observed Trend

The rainfall of last 32 years at the Rampur Station has shown in Figure 4. Rainfall pattern is irregular. The overall total rainfall, monsoon rainfall and post monsoon rainfall all were varied across the time horizon. The highest rainfall was recorded as 2360 mm per year in 2007 and lowest was recorded as 1183 mm per year in 2011. Non-monsoon rainfall and monsoon rainfall was in decreasing trend and the overall trend of rainfall was also in decreasing order. The analysis of climatic data strongly supports the farmer's perception. These strongly indicate that farmers in such scenario couldn't predict the usual rainfall pattern and they were compelled to change their cropping calendar. The trend analysis showed that the total precipitation was decreased with 0.33 mm per year in this station.

About 70 to 90% of the rainfall occurs during summer monsoon (June to September) and the rest of the months are almost dry. Pre-monsoon (Jan-May) rainfall trend doesn't show great variations, but during the last few years of the study (2003 to 2009), there was a substantial decreased in the amount of rainfall especially in monsoon. And again in 2007 this rainfall trend was found to be increased. These strongly indicate that local peoples in such scenario couldn't predict the usual rainfall pattern. Baidhya *et al.*, 2007 have shown more erratic pattern (unusual high intensity, less rainy number of days) of rainfall in the country. Such events increase possibility of climatic extremes like irregular monsoon, droughts and floods. MoE, 2010; Practical Action, 2009, reported that total rainy days are decreasing and number of drier days are increasing. Moench, 2010 has reported that annual variation in precipitation has increased so far that has increased flooding and erosion and affecting agriculture.

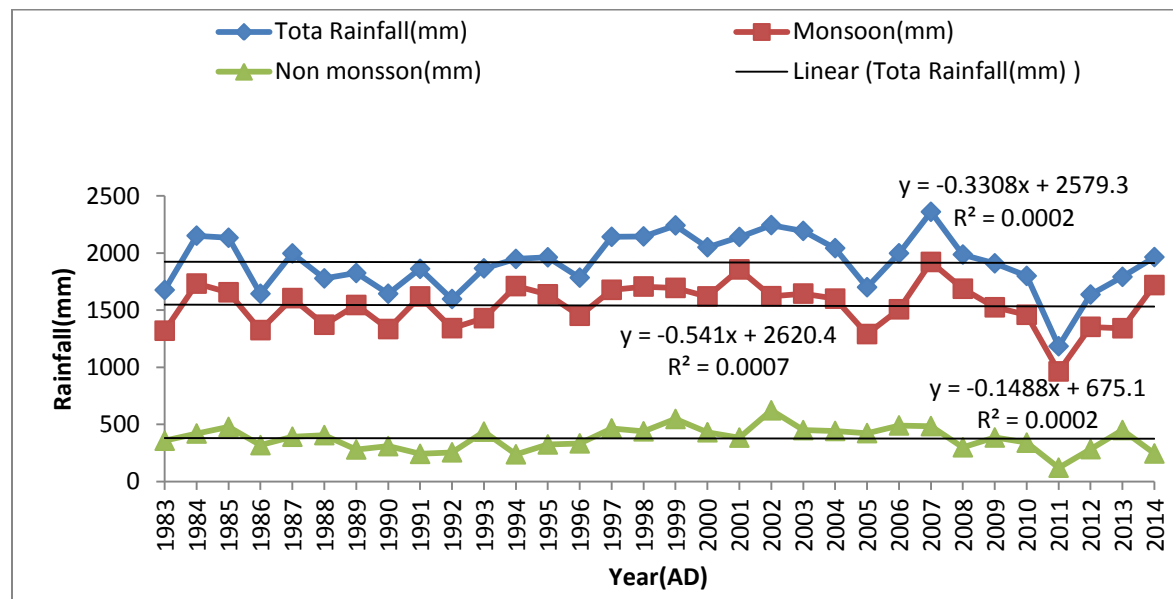


Figure 4. Trend of rainfall in Rampur station in last 32 years (1983-2014)

## IV. CONCLUSION

This paper analyzed the trends and farmers perceptions about climate change in Chepang community of Chitwan district. Onset and retreat of monsoon rainfall varies from year to year and is decreasing in trends in long term basis. Furthermore, the actual trend shown by the recorded data was justified by the perceptions of the local people resembling with the findings of

the study, whereas summer and winter temperature increasing over a period of time. This clearly indicates the warming trend in the area. This increasing temperature and decreasing patterns of rainfall clearly shows that this area is prone to the drought which may cause decrease in agricultural production. There is still a significant proportion of population, who are not still known about the change in climatic patterns. They cannot adopt the appropriate mitigation measures to reduce adverse impact of climate change in their farming systems until they were aware about changes in climatic parameters. This clearly shows that, NGOs, INGOs, and Government sectors should working together at grassroots level for raising awareness towards climate change parameters and their impacts on farming systems. The findings of this study can be useful for making effective policy and plan.

## REFERENCES

- Piya, L., Maharjan, K. L. and Joshi, N. P. 2011a. Forest and food security of indigenous people: A case of Chepangs in Nepal. *Journal of International Development and Cooperation*, 17(1), 113-135.
- Maharjan, K. L., Piya, L. and Joshi, N. P. 2010. Annual subsistence cycle of Chepangs in the Mid-Hills of Nepal: An integration of farming and gathering. *Himalayan Journal of Sociology and Anthropology*, 4, 105-133.
- Bhandari, D.2008. Food security and climate change in Nepal. *Mountain forum Bulletin* 8(1): 21-24.
- FAO., 2007b. Building adaptive capacity to climate change: Policies to sustain livelihoods and fisheries. *New Directions in Fisheries: A Series of Policy Briefs on Development Issues* No. 08.Rome.
- Gautam, A. K. and S. Pokhrel. 2010. Climate Change effects on Agricultural Crops in Nepal and Adaptation Measures. Presented in: Thematic Working Group In: Agriculture and Food Security Meeting (Feb 23rd, 2010), Kathmandu, Nepal.
- IPCC., 2007. New Assessment Methods and the Characterization of Future Conditions: In *Climate change 2007: Impacts, adaptation and vulnerability*, pp: 976. Contribution of working group II to the fourth assessment report of the Intergovernmental panel on climate change. Cambridge university press, Cambridge, UK.
- NAPA., 2010. Thematic working group summary report. National adaption Programme of action (NAPA), Ministry of Environment, Kathmandu, Nepal, 138p.
- UNFCCC., 2009. Climate Change: Impacts, Vulnerabilities and Adaptation in Developing countries.
- MoAD., 2015. Statistical Information on Nepalese Agriculture 2014/2015 (2071/2072). Kathmandu: Ministry of Agricultural Development, Government of Nepal.

- Sharma, K.P. 2009. Climate Change Trends and Impacts on Livelihood of People. Jalrsort Vikas Santha (Nepal Water Partnership), Kathmandu, December 2009.
- UNEP and UNFCCC., 2002. Climate Change Information Kit. UNEP and UNFCCC. Available at:[http://unfccc.int/resources/does/publications/infokit\\_2002\\_en.pdf](http://unfccc.int/resources/does/publications/infokit_2002_en.pdf) (Retrieved on Jan 12, 2012).
- Shrestha, A. B., Wake, C. P., Dibb, J. E. and Mayewski, P. A. 2000. Precipitation Fluctuations in the Nepal Himalaya and its vicinity and Relationship with some large scale climatological parameters. *International Journal of Climatology* (20), 317-327.
- Practical Action Nepal. 2009. *Temporal and spatial variability of climate change over Nepal (1976-2005)*. Kathmandu: Practical Action Nepal Office.
- MoEnv., 2010. *National Adaptation Programme of Action to Climate Change*. Kathmandu: Ministry of Environment, Government of Nepal.
- CBS., 2003. National Census of Agriculture; Central Bureau of Statistics, Kathmandu.
- Limbu, P. and K. Thapa. 2011. Chepong food culture: contribution of wild edible and neglected plant species. Local Initiatives for Biodiversity, Research and Development (LI-BIRD), Pokhara, Nepal.
- NCA, 2004. Project document of Chepong Mainstreaming programme ; Nepal Chepong Association, Kathmandu.
- Regmi, B.R., K.P. Aryal., B.B. Tamang. and P.K. Shrestha. 2006. Homegardens: An Opportunity to minimize pressure on slash and burn system and options for improving dietary diversity of Chepong households. (pp. 35-47). Pokhara: Li-BIRD and SDC
- Aryal, K. P. and Kerchoff, E. E. 2008. The Right to Practice Shifting cultivation as a Traditional Occupation in Nepal: A case study to apply ILO Conventions Nos. 111 (Employment and Occupation) and 169 (Indigenous & Tribal People), Kathmandu: ILO and ICIMOD.
- Baidhya, S.K., R.K. Regmi. and M.L. Shrestha. 2007. *Climate Profile and Observed Climate Change and Climate Variability in Nepal*.
- Baidya, S., Shrestha, M. and Sheikh, M. 2008. Trends in Daily Climatic Extremes of Temperature and Precipitation in Nepal. *Journal of Hydrology and Meteorology*, **5**, 38-51.
- Practical Action. 2009. Temporal and Spatial Variability of Climate Change Over Nepal (1976-2005). Practical Action, Kathmandu.
- Moench, M. 2010. Responding to Climate and other Change Process in Complex Context: Challenges Facing Development of Adaptive Policy Frameworks in Ganga Basin. Technological Forecasting and Social Change. 77:975-986.

279 MoEnv. 2010. *National Adaptation Programme of Action to Climate Change*. Kathmandu:  
 280 Ministry of Environment, Government of Nepal.  
 281  
 282 Shrestha, A.B., C.P. Wake, P.A. Mayewski. J.E. Dibb. 1999. Maximum Temperature Trends  
 283 in the Himalaya and the Vicinity: An Analysis Based on Temperature Records for Nepal for the  
 284 period 1971-94. *Journal of Climate* (12), 2775-2786.  
 285  
 286 Thapa M.S. 2010. Analysis of perception and local adaptation in Agriculture to climate change  
 287 by Chepang communities in Chitwan district.  
 288  
 289 Regmi, B.R., Morcrette, A., Paudyal, A., Bastakot, I.R. and Pradhan, S. 2010. Participatory  
 290 Tools and Techniques for Assessing Climate Change Impacts and Exploring Adaptation Options:  
 291 A Community Based Tool Kit for Practitioners. Livelihoods and Forestry Programme (LFP),  
 292 Kathmandu.  
 293  
 294  
 295