

Chapter 3

Climate Change in Nepal: Policy and Programs



Abstract This chapter sums up the climate change policies and programs, status of greenhouse gas emissions, trend of weather variables and other aspects of climate change in Nepal. Nepal started addressing the issues of climate change in its policy documents from 2002, however it has been struggling to develop specific policy instruments to implement the climate policy paradigms. The country achieved reduction in the GHG emission in recent years mainly through the promotion of alternative energies and forest conservation facilitated by international climate regimes. There is a consistent increase in temperature with marked spatial differences in its trend. Precipitation, however, shows large interannual variations with negative trend. Precipitation is expected to get more intense in the future. The increased temperature and more erratic precipitation are expected to impact the glacier in the Himalayas, livelihood assets through increased incidence of water-related disasters, human health, and agriculture sector.

Keywords Emission · Mitigation · Trend · Projection · Impact

3.1 Climate Change Policies and Programs in Nepal

Climate change is a global phenomenon and Nepal is not an exception to it. The latest data suggests that Nepal shares only 0.044% of the total global greenhouse gas (GHG) emission (World Resources Institute 2017). In 2014, the GHGs equivalent emitted by one Qatari national was equivalent to that emitted by about 56 Nepali nationals (Boden et al. 2017). On the other hand, Nepal is one of the countries that are the most vulnerable to the vagaries related to climate change. Rugged topography, geologically fragile hills and mountains, livelihoods predominantly dependent on natural resource-based sources like agriculture and forests, limited institutional capacity, and low level of infrastructure and technological development add to the gravity of the problem (Regmi and Adhikari 2007).

Although Nepal is a signatory of the UNFCCC and the Kyoto Protocol (KP), the government of Nepal addressed the issues of climate change in its policy documents only in the tenth periodic plan (2002–2007). Thereafter, the government committed in the 3-Year Interim Plan (2007–2010) to promote carbon trade by participating in

the Clean Development Mechanism (CDM). Alternative energy and forest management were recognized as the potential resources for carbon trading (NPC 2007). Climate change was explicitly mentioned only from the 3-Year Plan Approach Paper (2010–2012) with objectives of promoting green development, making development activities climate friendly, mitigating the adverse impacts of climate change, and promoting adaptation (MoE 2010). Recently, the government also passed the Climate Change Policy 2011.

Delay in the prioritization of climate change in the national plans and policies is also demonstrated by the fact that Nepal was the last among the signatory developing countries to the UNFCCC to submit NAPA only in September 2010. A parallel LAPA has also been developed and approved in November 2010 to promote a bottom-up approach of adaptation activities based on the location-specific priorities (Jones and Boyd 2011). Recently the government of Nepal received a grant of 1.8 billion Nepali Rupees (approximately 22.5 million US\$) for implementing local level adaptation project, which the government is planning to spend in the 14 least developed districts in the mid- and far-western regions of Nepal under the program Nepal Climate Change Support Programme (NCCSP). The NAPA and Climate Change Policy 2011 has provision to spend 80% of the international grants received for climate change adaptation for local adaptation activities (Ghimire 2012). Channeling of climate finance to the field level activities was further emphasized through the endorsement of Climate Change Budget Code 2013 (MoPE 2017).

Following the decision made by the 16th Session of the Conference of the Parties to the United Nations Framework Convention on Climate Change (COP16), currently the Government of Nepal is involved in the process to formulate “National Adaptation Plan” (NAP). The process was launched on September 18, 2015 with the overall objective to formulate Nepal NAP and improve institutional capacity of the government to implement climate resilient development plan in Nepal (MoPE 2017).

The paradigm of broader and specific climate or climate-related policies in Nepal is shifting from their earlier focus on disaster response and relief (1997–2002) to disaster risk reduction (2003–2008) and to climate change adaptation (2009–2011). The recent policy focus from 2012 till date is on localized action for climate change adaptation and disaster risk reduction (Vij et al. 2018). However, the government of Nepal is struggling to develop specific policy instruments to implement the paradigms. It is mainly because of “layering” mode of changes in paradigms. Such mode creates fragmentation of policy efforts leading to the possibility of overlapping efforts, confusion, and competition within various paradigms as it adds more actors and instruments. Unstable political situation, lack of financial support, influence of national and international nongovernmental organizations, and global policy frameworks can be attributed for the “layering” of different climate policy paradigms (Vij et al. 2018).

3.2 Greenhouse Gas Emissions in Nepal: Prospects for Mitigation

The government of Nepal has prepared only three GHG inventories till date, the first for 1990/1991, the second for 1994/1995, and the third one for 2000/2001 (MoSTE 2014). Methane emission from energy, land use change and waste, N₂O emission from energy and waste, and emission/sink from Land Use, Land Use Change, and Forest (LULUCF) were included in the GHG emission inventory for 2000/2001. However, these items were excluded in Fig. 3.1 in order to make the figures comparable with only the items listed in the GHG emission inventory in 1990/1991 and 1994/1995. In the figure, CO₂ is the sum of fossil fuel and cement production; CH₄ is the sum to rice cultivation, livestock and biomass burning; and total CO₂ is the sum total of CO₂, CH₄, and N₂O. CH₄ and N₂O is calculated in terms of CO₂ equivalent (CO₂-eq).

Between 1990/1991 and 1994/1995, there was 63.5% increase in CO₂ emission with an annual growth rate of 13.1%. Carbon Dioxide Equivalent (CO₂-eq) emission between the two inventory periods increased at an annual rate of 5.8% (Fig. 3.1), with agriculture contributing a significant 69% of total CO₂-eq emission, followed

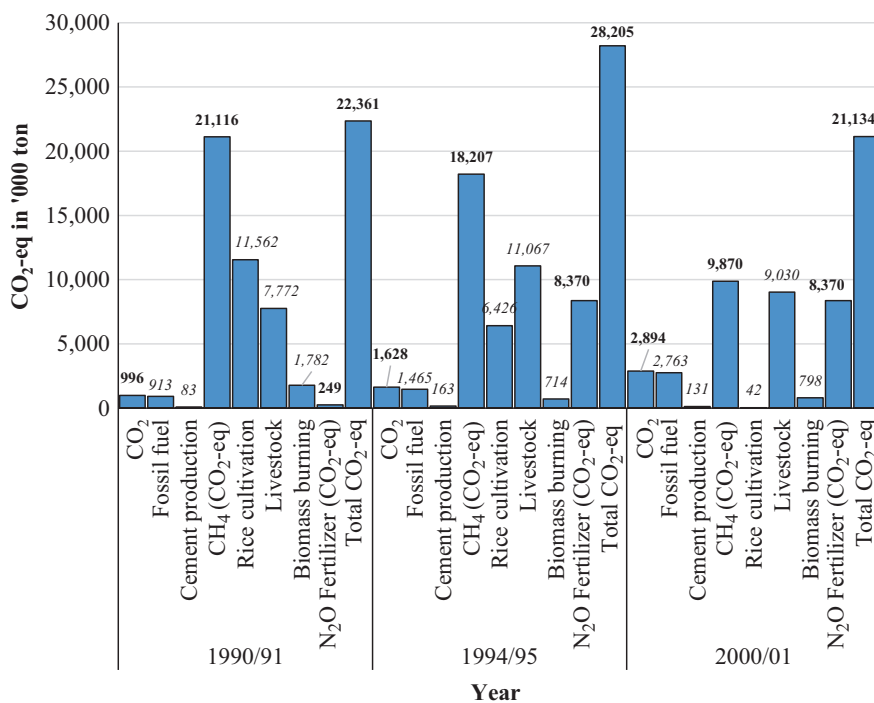


Fig. 3.1 Different forms of GHG emission from various sectors in Nepal in different years (Sources of data: MoSTE 2014; Joshi 2011; IPCC 2007; MoPE and UNEP 2004; DHM 1997 (cited in Dhakal 2001))

by land use change and forestry contributing around 21% in 1994/1995 (MoPE and UNEP 2004; Dhakal 2001). The total CO₂-eq emission in 2000/2001 declined mainly driven by a sharp decline in CH₄ emission from rice cultivation and live-stock. Besides the achievements made through promotion of System of Rice Intensification (SRI) (Joshi 2011), some discrepancy in the emission reporting can be attributed to such sharp decline. For instance, in the previous inventory, whole of paddy area in the country was considered to be grown under continuous flood despite the fact very limited proportion of cultivable land is irrigated. However, this fact was realized in later inventories; thus, it was considered that most parts of the country rice are grown under water stress, and multiple aeration is very common (MoSTE 2014). There is a decline in emission from cement production (industrial process). Similarly, manure management as well as replacement of fuelwood achieved through the installation of biogas plants between the years 1992/1993, 1994/1995, and 2000/2001 could be the reason behind significant reduction in CH₄ emission from biomass burning (Joshi 2011).

The recent calculation by World Resources Institute also suggests the decline in the total national GHG emission of Nepal. The decline can be observed from 2005 (Fig. 3.2). The year coincides with the year when Nepal ratified the KP and in the same year entered into the force. This has opened the windows of opportunities for Nepal to realize financial benefits from the tools, namely, CDM, provisioned in the KP. Nepal’s initiatives in the promotion of renewable energies resulted in the mitigation of GHG as its positive externality. Biogas, micro-hydro, improved cooking stoves, and improved water mills are some of the alternative energies having

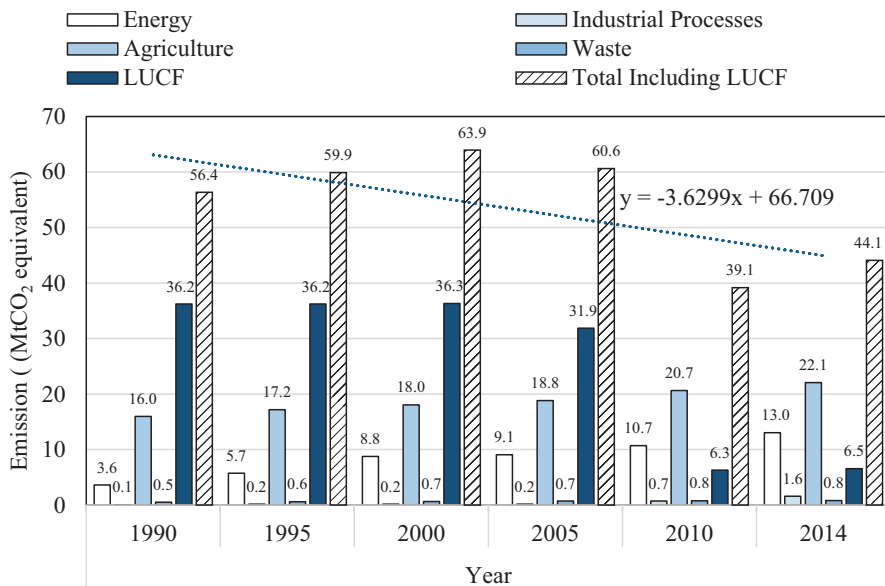


Fig. 3.2 GHG emissions by sectors in Nepal in different years (Source of data: World Resources Institute 2017)

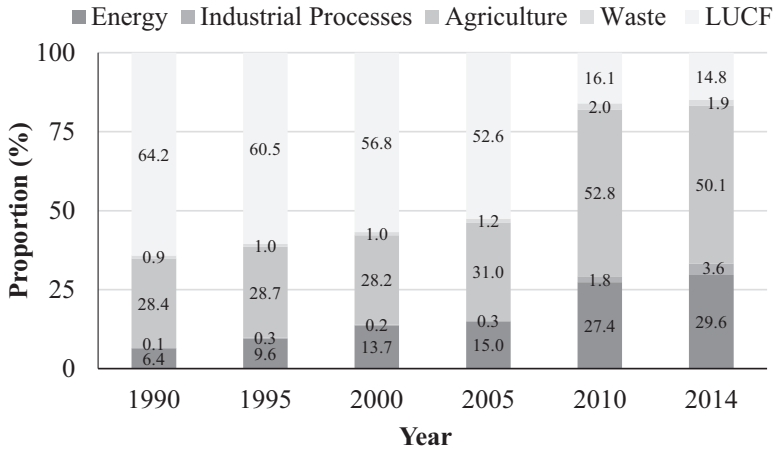


Fig. 3.3 Share of different sectors in the total GHG emission of Nepal in different years (Source of data: World Resources Institute 2017)

prospects to generate revenue from the CDM. Some of these projects such as biogas have already generated the revenue, some of them are already registered (biogas and micro-hydro projects), some of them are under the process of validation (biogas, improved cooking stoves, and improved watermills), and the project design document (PDD) is already prepared for solar home system (MoSTE 2014).

In 2014, agriculture sector shares 50.1% of total national GHG emission followed by energy sector, Land Use Change and Forest (LUCF), industrial process, and waste (Fig. 3.3). The majority of mitigation-related actions are focused on the energy sector, especially through the promotion of alternative energies. Yet, the share of energy sector has continuously increased from 6.4% in 1990 to 29.5% in 2014. Similarly, the share of agriculture sector has increased from 28.4% in 1990 to 50.1% in 2014. Organic farming and System of Rice Intensification is the practice in agriculture which can contribute in mitigating GHG emission from agriculture sector and also could generate revenue through CDM (Joshi 2011). Similarly, livestock feed management is another aspect in mitigating GHG emission from agriculture sector in Nepal.

The management of natural resources especially forest, which can mitigate the GHG emission through its role in carbon sequestration, can be related with the GHG emission from LUCF. Any initiative in realizing the carbon sequestration benefit has also been identified as a means for generating financial resources in long term through carbon trading. The CDM and Reduced Emissions from Deforestation and forest Degradation (REDD) are two international legal framework related with such carbon trading (Joshi 2011). Nepal is a signatory of both of these legal frameworks.

The government of Nepal established REDD forestry and climate change cell (REDD Cell) led by the Joint Secretary of the Ministry of Forests and Soil Conservation. The REDD cell is responsible for preparing and submitting the Readiness Preparation Proposal (R-PP) to the World Bank’s Forest Carbon Partnership Facility (FCPF). Nepal’s R-PP was submitted to the FCPF on September

2010. Further, Nepal submitted a midterm report on R-PP progress. A readiness package prepared by Nepal was endorsed by the FCPF in 2016, which enabled access to an additional grant to complete readiness activities and achieve the mitigation reduction target. At present the REDD Implementation Center is established under the Ministry of Forests and Environment (MoFE) as the coordinating entity. Besides, there is also a REDD+ multi-sectoral and multi-stakeholder coordinating and monitoring committee, which is called the apex body and REDD working group under the MoFE to oversee and implement REDD+ in the country. On April 19, 2018, the government of Nepal endorsed Nepal National REDD+ Strategy with the vision to enhance carbon and non-carbon benefits of forest ecosystems in order to contribute to the prosperity of the people of Nepal. The strategy was developed to align with the principles of the Forest Policy, Forestry Sector Strategy 2016 and Nationally Determined Contribution 2016 (MoFE 2018).

All these initiatives have put Nepal in the position to implement a prototype of REDD+, gain experience, and build capacity to operationalize REDD+ in the community forests of Nepal in an experimental way under the FCPF. With the implementation of first-ever pilot Forest Carbon Trust Fund, Nepal successfully started generating revenue from the community forests of three watersheds in Dolakha, Gorkha, and Chitwan. Besides, the community forest users' groups in various districts of Nepal have started to earn revenue for their role in carbon sequestration from international donor agencies like Norwegian Agency for Development (NORAD) (Acharya 2012; Tripathi 2011). Joshi (2011) estimated the possibility of generating as much as US\$42.7 million from community forests and US\$82.4 million from protected areas (excluding buffer zones) annually with any successful initiative to implement REDD+. All these could have contributed in the sharp decline of LUCF's share from 64.2% in 1990 to 14.8% in 2014 (Fig. 3.3).

3.3 Trend of Climate Variables in Nepal

Climate change related studies in Nepal are restricted due to the limited availability of weather data. There are 282 meteorological stations recording meteorological data in Nepal (DHM 2018). However, 32 of them were closed before 1970s. The data for precipitation are consistently available for more than 35 years in 222 stations, while the same data for minimum and maximum temperature are available only for 59 stations. These stations are scattered across the country, although the stations are more concentrated in the central areas and further scarce in the mountains (Fig. 3.4). The monthly precipitation data recorded in 222 stations and monthly temperature (both minimum and maximum temperature) data recorded in 59 stations between 1978 and 2015 were purchased from the Department of Hydrology and Meteorology, Nepal. The data were then compiled and analyzed to assess the trend of temperature and precipitation in Nepal. The results are presented in the successive subsections hereafter.

Missing data is an important issue to be dealt with while studying the trend of weather data. There are many missing weather data in the case of Nepal as well. The

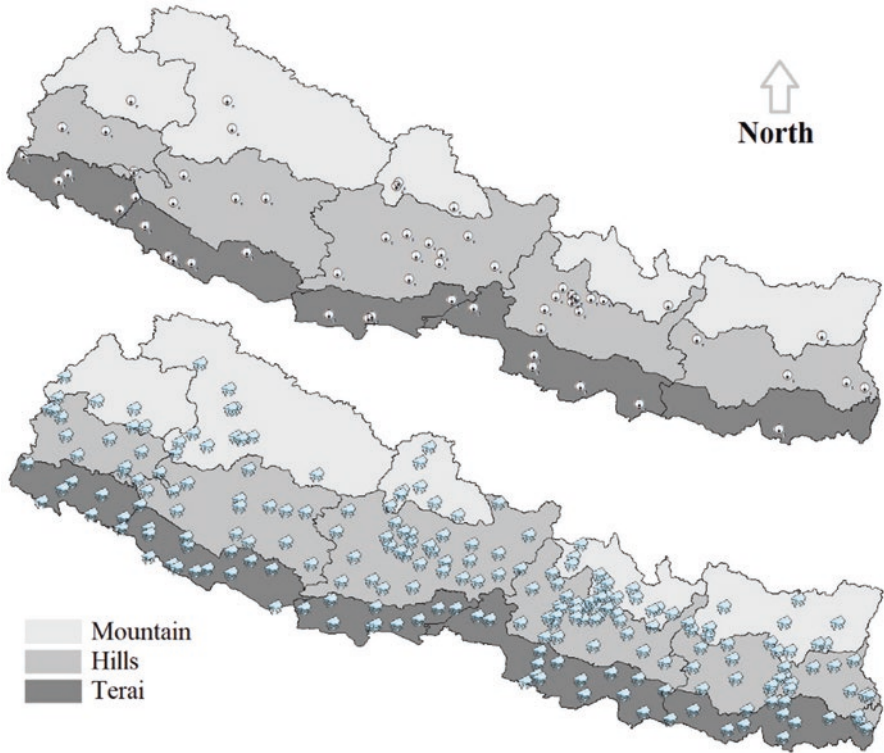


Fig. 3.4 Distribution of rainfall (above) and temperature (below) stations in Nepal (Source of data: DHM 2018)

proportion of missing data is 5.7, 7.3, and 6.3 for precipitation, minimum temperature, and maximum temperature, respectively. Multiple linear regression analysis is one of the effective methods to estimate the missing value (Kashani and Dinpashoh 2012). The coefficients of five closest (neighboring) stations obtained through multiple linear regression analysis and the observation of respective year were used to estimate the missing values. The trend analysis done in this chapter is complemented by the similar analyses done for a relatively shorter time frame in previous studies (see DHM 2017; Practical Action 2009).

3.3.1 Temperature Trend in Nepal

Historical analysis of temperature for the period 1977 to 1994 shows that the annual mean temperature in Nepal is growing at the rate of 0.06 °C annually (Shrestha et al. 1999), while for the period of 1976 to 2005, it was found to be growing at an annual rate of 0.04 °C (Practical Action 2009). Our analysis for the data between 1978 and

2015, however, suggests that the annual mean temperature in Nepal is growing at the rate of 0.02 °C annually (Fig. 3.5). This rate is relatively low compared to the estimations reported earlier.

The temperature trend varies spatially and seasonally across the country (Figs. 3.6, 3.7, 3.8, 3.9, and 3.10). Practical Action (2009) reported for the period of 1976–2005 that the average annual maximum temperature is increasing faster than the minimum temperature at 0.05 °C and 0.03 °C, respectively. Our data also suggests similar tendency, but the rate is relatively low. Between 1978 and 2015, the average annual maximum temperature is increasing at 0.04 °C, and average annual

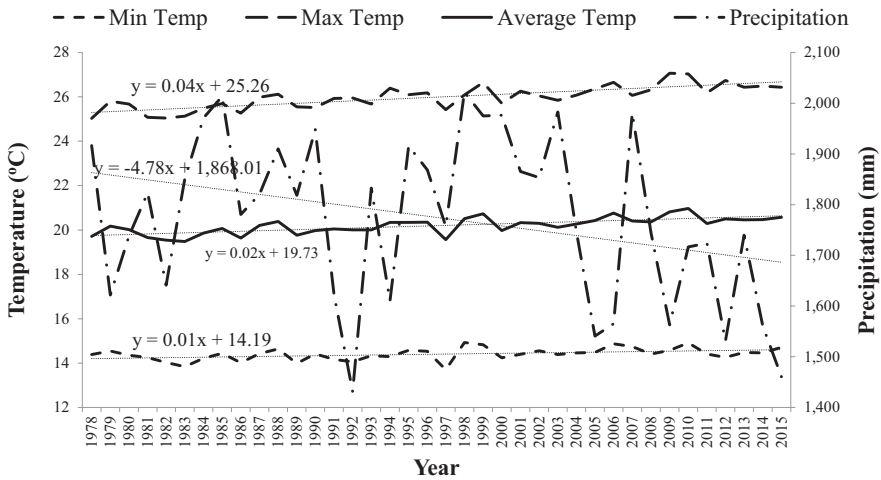


Fig. 3.5 Trend of average annual weather variables in Nepal (Source of data: Raw data from DHM)

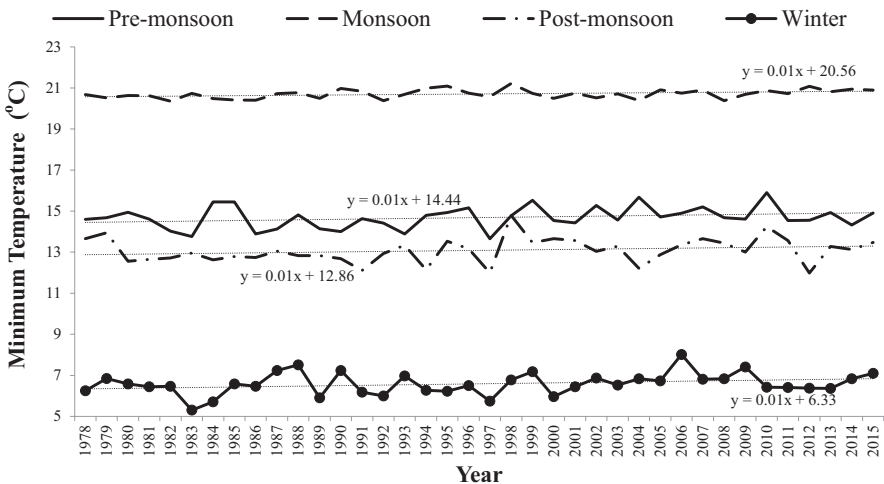


Fig. 3.6 Trend of average seasonal minimum temperature in Nepal (Source of data: Raw data from DHM)

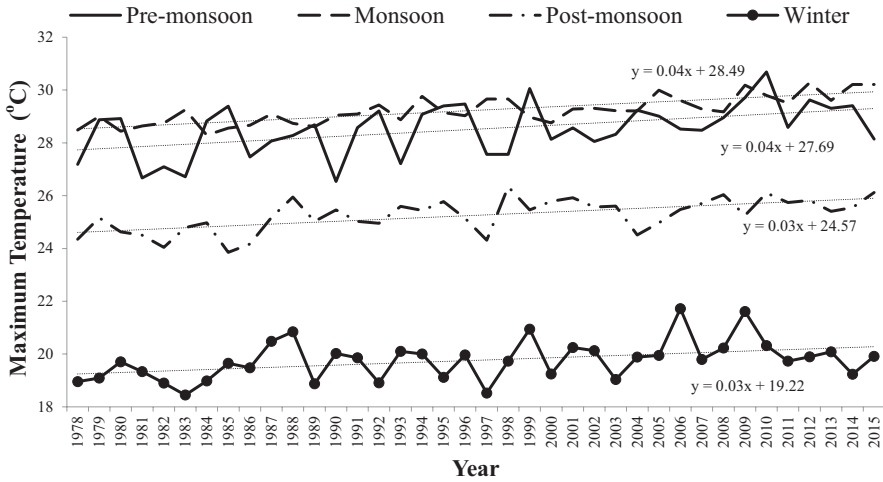


Fig. 3.7 Trend of average seasonal maximum temperature in Nepal (Source of data: Raw data from DHM)

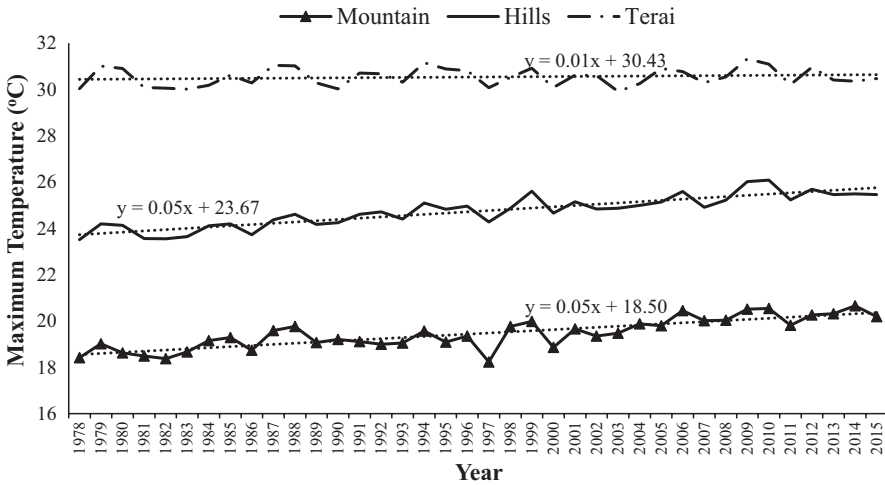


Fig. 3.8 Trend of average annual maximum temperature in the three ecological regions of Nepal (Source of data: Raw data from DHM)

minimum temperature is increasing at 0.01 °C (Fig. 3.5). DHM (2017) also reported similar tendency that the annual average maximum and minimum temperature are increasing at the rate of 0.056 °C and 0.002°, respectively, between 1971 and 2014. There is, however, not much difference in the rate of increase of seasonal average minimum and maximum temperature across the season. The similar result was also reported by DHM (2017). The average seasonal minimum temperature is increasing at the rate of 0.01 °C per annum in all four seasons (Fig. 3.6), and seasonal average maximum temperature is increasing at the rate of 0.03 °C in post-monsoon and

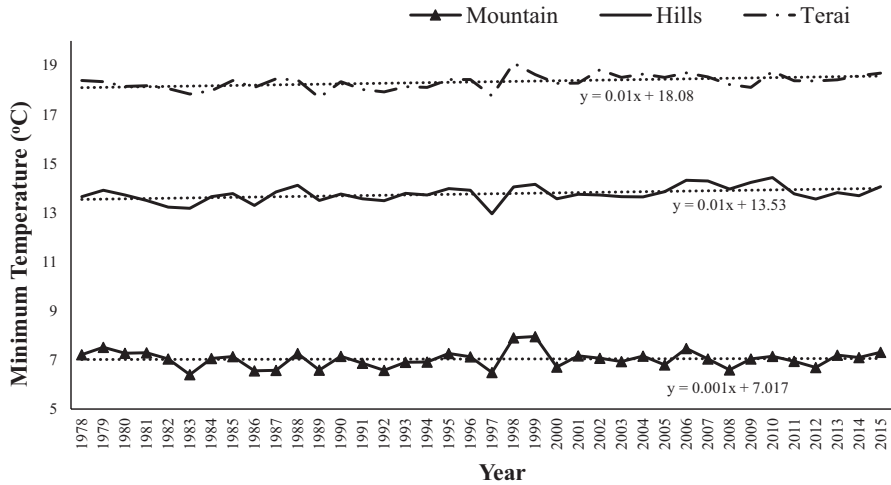


Fig. 3.9 Trend of average annual minimum temperature in the three ecological regions of Nepal (Source of data: Raw data from DHM)

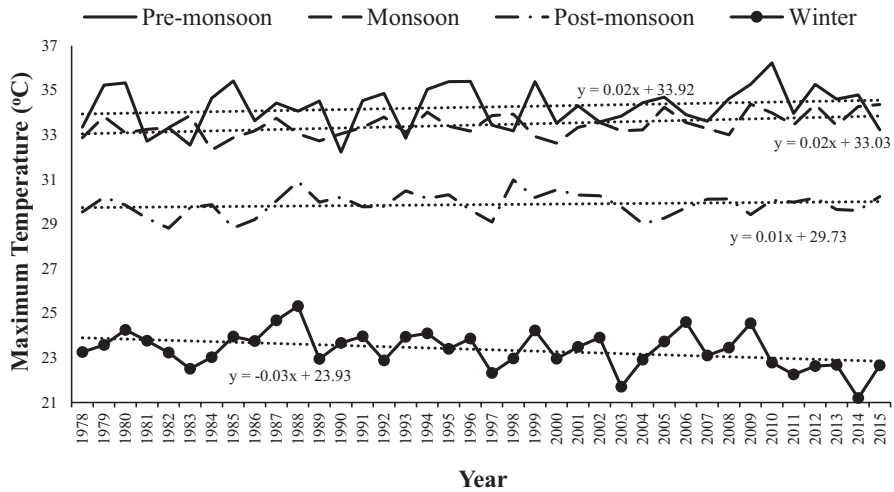


Fig. 3.10 Seasonal trend of maximum temperature in Terai, Nepal (Source of data: Raw data from DHM)

winter season and 0.04 °C in pre-monsoon and monsoon season (Fig. 3.7), which are relatively lower compared to the ones estimated by DHM (2017).

The rate of temperature increase was reported to be greater at higher altitudes by Practical Action (2009). Our latest data also reflects the similar trend in case of the average annual maximum temperature. The increase rate is 0.05 °C per year in mountain and hills compared to 0.01 °C in Terai (Fig. 3.8). This is supposed to

increase the risk of glacial lake outburst floods (GLOFs). Increasing incidence of GLOFs in recent decade and subsequent losses are evident (Joshi 2011). On the contrary, the rate of increase of average annual minimum temperature is lesser in the mountains at $0.001\text{ }^{\circ}\text{C}$ compared to that in the Terai and hills, which is increasing faster at the rate of $0.01\text{ }^{\circ}\text{C}$ (Fig. 3.9).

A disaggregated analysis of seasonal maximum temperature trends in different ecological zones reveals some interesting features. The trends of seasonal maximum temperature in mountains suggest that the winter temperature is increasing at the rate of $0.07\text{ }^{\circ}\text{C}$ per annum compared to other seasons, namely, pre-monsoon ($0.05\text{ }^{\circ}\text{C}$ per annum), monsoon ($0.03\text{ }^{\circ}\text{C}$ per annum), and post-monsoon ($0.05\text{ }^{\circ}\text{C}$) (not shown in figure). In the hills, the increase rate of seasonal maximum temperature is higher for winter and post-monsoon ($0.06\text{ }^{\circ}\text{C}$) compared to pre-monsoon and monsoon ($0.05\text{ }^{\circ}\text{C}$) (not shown in figure). Interestingly, similar disaggregated analysis of seasonal maximum temperature in Terai shows that the winter maximum temperature is decreasing (Fig. 3.10). It is reportedly severe in certain pockets of the Terai, caused due to the cold waves and resulting foggy conditions in winter along the Northern Gangetic Plain including the Terai of Nepal (Practical Action 2009). This means that winter is getting warmer in the mountains and hills, while it is actually getting colder in the Terai.

3.3.2 *Precipitation Trend in Nepal*

Analysis of historical precipitation trend shows that precipitation is highly variable across the country both spatially and seasonally (Practical Action 2009; DHM 2017). Precipitation is very erratic with large interannual variations, thereby resulting in no significant trend of precipitation over the years (Fig. 3.5). The data suggest that the annual precipitation is decreasing at the rate of 4.78 mm per year. DHM (2017) reported the decline rate of 1.33 per year between 1971 and 2014. Similar variations can be observed in the trend disaggregated into four different seasons and the three ecological regions (Figs. 3.11 and 3.12, respectively). Average precipitation is declining in all seasons, with the highest rate of decline for monsoon at nearly 4 mm per year.

Similarly, all three ecological regions experienced the decline in annual precipitation with the highest decline in hills (5.6 mm per year) followed by mountain (4.5 mm per year) and Terai (4.4 mm per year). Despite this decreasing trend of precipitation, concentration of precipitation in certain season remains the major concern for Nepal. Close to 80% of annual precipitation is received in monsoon (June–September). This share is as high as 84.4% in 1984. The share of monsoon rain in total annual precipitation is increasing over the years at the rate of 0.03% per year (Fig. 3.13). The increase in the share of monsoon rain in annual precipitation is the highest in the mountain, which could also contribute in further swelling of glacier lakes in the mountain, besides the swelling contributed by snow melt caused by higher rate of average maximum temperature increase. This remains the main cause for flash floods, subsequent landslides, and GLOFs in Nepal during the monsoon.

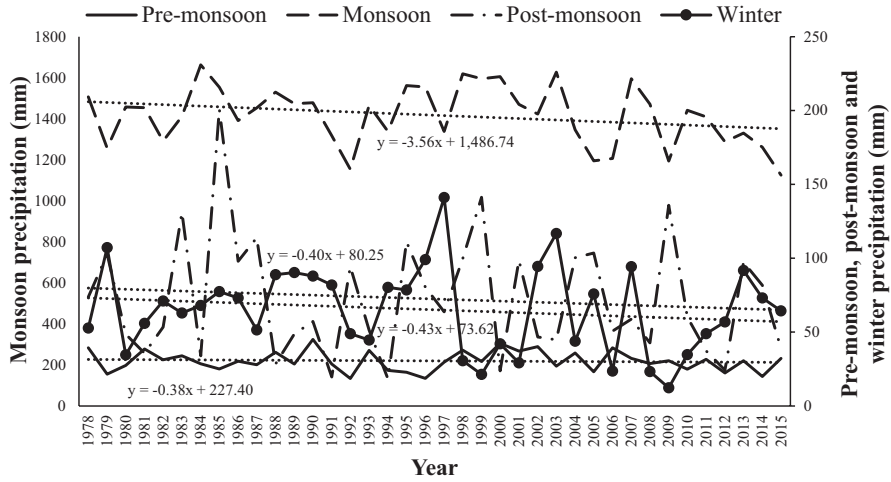


Fig. 3.11 Trend of seasonal precipitation in Nepal (Source of data: Raw data from DHM)

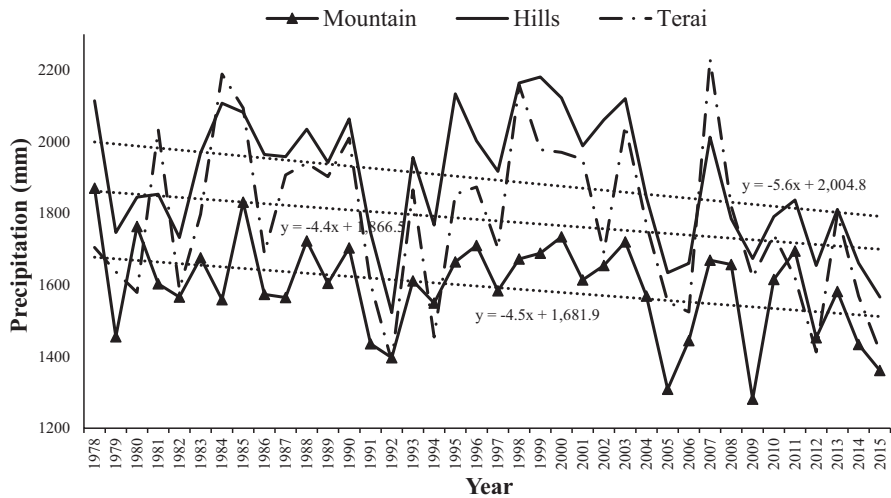


Fig. 3.12 Trend of annual precipitation in the three ecological regions of Nepal (Source of data: Raw data from DHM)

The trend analysis of weather variables presented in this chapter is done as an average for all the weather stations across the country. This analysis, however, is not representative of the changes observed at smaller scales. Historical trend analysis of temperature and precipitation done by Practical Action (2009) at the subnational levels shows that there are many microclimatic pockets scattered spatially along the country and the weather trend varies significantly even within small geographical area. It is difficult to make a single conclusion for the whole country, thereby necessitating studies at a micro-spatial scale.

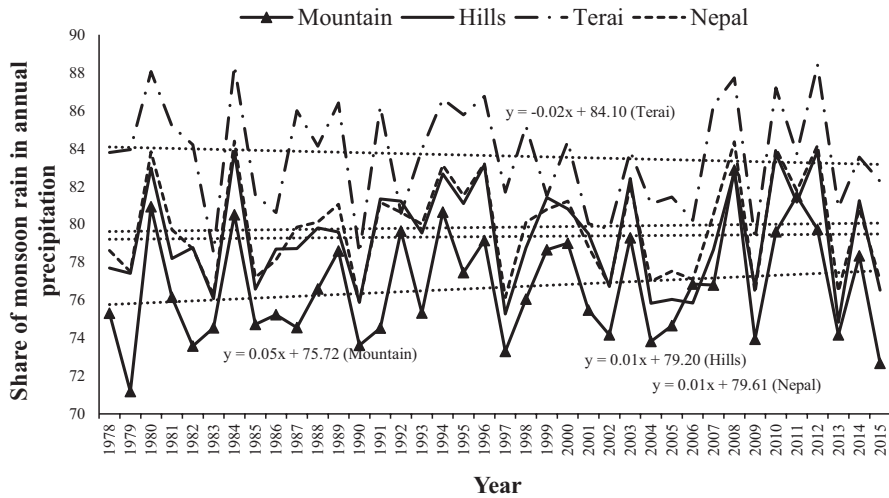


Fig. 3.13 Share of monsoon rain in the total annual precipitation in the three ecological regions of Nepal and its trend (Source of data: Raw data from DHM)

3.4 Projection of Temperature and Precipitation in Nepal

Future projections of temperature for Nepal by Global Circulation Model (GCM) and Regional Circulation Model (RCM) show an increase in average annual temperatures by 3–4.7 °C by the end of this century (Agrawala et al. 2003). The recent estimate suggests the increase to be 4.2 °C (The World Bank 2018). In general, temperature projections are higher for winter compared to summer, which coincide with monsoon in Nepal (Table 3.1). Temperature projections also vary spatially, with the highest projections for Western Nepal, and the lowest for Eastern Nepal (NCVST 2009; Agrawala et al. 2003). Similarly, in the Koshi river basin, the rate of temperature increase will be higher in the trans-Himalayan region during summer and the southern plains during winter (Rajbhandari et al. 2018).

The GCM projections for precipitation by the Climate Research Unit of University of East Anglia shows an overall increase in mean annual precipitation in Nepal (Table 3.1). Rainfall is predicted to increase throughout the year with the highest increase in monsoon. Increase rate will decline in post-monsoon and bounce back to the level of 2040–2059 in 2080–2099 after falling sharply in 2060–2079 in pre-monsoon (Table 3.1). This indicates that monsoon rain is going to be more intense, while the post-monsoon will be even drier. Heavy rainfall events with maximum downpour within a short period of time are increasing in frequency over the recent years (Baidya and Karmacharya 2007), with the maximum 24-hour rainfall occurring in the foothills of Siwalik and Mahabharata range (Practical Action 2009). This is expected to increase further. The rainfall projections shown in Table 3.1 are substantially higher than those made by Agrawala et al. (2003). The number of days with rainfall above 50 mm is expected to increase by 2.4 days by the end of this century (Table 3.1). A separate GCM and RCM estimates by NCVST (2009) proj-

Table 3.1 Projection of weather variables in Nepal under RCP8.5 scenario

Variable	Period	Pre-monsoon	Monsoon	Post-monsoon	Winter	Annual
Temperature	2040–2059	2.1	1.3	1.8	1.8	1.7
	2060–2079	3.0	2.3	3.0	3.3	2.9
	2080–2099	4.7	3.2	4.5	5.0	4.2
Precipitation	2040–2059	14.1	156.4	24.1	27.5	222.0
	2060–2079	0.5	162.7	4.0	46.4	213.6
	2080–2099	15.0	248.9	2.7	58.5	325.1
Number of days with rainfall >50 mm	2040–2059	0.0	0.8	0.0	0.0	0.8
	2060–2079	0.0	1.3	0.0	0.0	1.3
	2080–2099	0.1	2.3	0.0	0.0	2.4

Source of data: The World Bank (2018)

Table 3.2 Precipitation projections for Nepal (GCM and RCM estimates)

Year	Annual mean	
	Multi-model mean	Range
2030	0%	–34 to +22%
2060	+4%	–36 to +67%
2090	+8%	–43 to +80%

Source of data: NCVST (2009)

ects an overall increase in the annual mean precipitation in both the medium and long term time frame. However, the range of projections also depicts the possibility of decrease in annual rainfall in Nepal (Table 3.2).

3.5 Climate Change Impacts in Nepal

NAPA has identified six major areas impacted by climate change in Nepal, viz., agriculture, water resources, climate-induced disasters, forests and biodiversity, health, and urban settlement and infrastructure. Erratic precipitation, increasing droughts, and changes in the local rainfall patterns have impacted the agricultural sector of the country. Occurrence of drought in 2005 is reported to decrease the production of paddy and wheat by 2% and 3.3%, respectively, in that year. Similarly, it has been reported that rice production in Eastern Terai decreased by 27–39% in

2006 due to drought in that area (Regmi 2007). In the same year, the country as a whole experienced 21% and 3% decline in rice and millet production, respectively, due to which Nepal experienced negative food balance in 2006, the first time after 1999 (MoAC 2006). Malla (2003) reports that there is an initial possibility of yield increase for rice, wheat, and maize in all ecological regions of Nepal owing to the rise in temperature and CO₂ fertilization. However, temperature rise above 4 °C will reduce the rice and wheat yields in the Terai where temperature is already quite high. Although hills and mountains might still experience increases in yield thereafter, decrease in soil fertility and nutritional value of crops is more likely at higher temperatures.

One of the highlighted climate change impacts is the melting of snow in the Himalayas, thereby increasing the threats of GLOFs, which causes destructions of settlements, agricultural lands, infrastructure, human lives, and properties. According to the United Nations Environmental Programme (UNEP), out of the total 2,323 glacial lakes in the Himalayas within the Nepalese territory, 20 glacial lakes have the threats of outbursts due to the consequences of global warming. MoPE and UNEP (2004) report that 1 °C increase in temperature can result in the disappearance of 20% snow and glacier in the mountains above 5,000 m and the estimations of reductions in snow for 2 °C, 3 °C, and 4 °C rise in temperatures are 40%, 58%, and 70%, respectively.

Several studies reveal that the duration of monsoon rainfall have been decreasing over the last few years; however, the total amount of average national monsoon rainfall has increased, which means monsoon rainfall is getting intense. Because of such changes in the rainfall patterns, the problem of flashflood and landslide has been increasing in the wet season, whereas drought is becoming harsher in the dry season (Gautam et al. 2007a, b; Pokhrel 2007; Vidal 2006). Intensive rainfall and subsequent floods and landslides cause severe damage on livelihood assets claiming lives and properties.

Temperature increase has been reported to cause an upward shift in flora and fauna in Nepal (Malla 2007). As reported by MoPE and UNEP (2004), if the CO₂ concentration is doubled from the existing level, 3 out of the 15 types of forests in Nepal as categorized by Holdridge model will disappear. Specifically, it is reported that the tropical wet forest and warm temperate rain forest will disappear, and the cool temperate vegetation will be converted into warm temperate vegetation, thus affecting the forest biodiversity.

Temperature increase has also impacted the human health. Mosquitoes, previously found only in the Terai and mid-hills, have been reported to appear in the high-hills. As a consequence, the vector-borne diseases like malaria are now moving at higher altitudes, and 8 out of 16 mountain districts of Nepal were classified as the malaria prone districts in 2010 (WHO 2011). In addition, incidence of previously unseen vector-borne diseases like *kala-azar* and dengue has been frequently reported in the Terai districts. Alternate heat and cold waves during summer and winter seasons have also emerged as livelihood threats in the Terai settlements in the recent years. In the year 2002, 60 cases of fatalities were recorded in the Terai due to the extreme temperatures.

With almost negligible contribution to the global GHG emissions, Nepal has very less to offer in the mitigation of GHGs. However, since the impacts of climate change are already quite significant, adaptations must be the priority for the country. NAPA has identified both short-term and long-term prioritized adaptation options for each of the thematic areas mentioned above. It aims to mainstream the adaptation processes within the goals and priorities of the national development plans, putting more emphasis on dissemination of information, skills, and technology to the vulnerable communities and increasing their adaptive capacity through livelihoods support, improved governance, collective responses, improved delivery services, access to technology, and finance (MoE 2010).

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