Chapter 11
Assessment of Annual, Monthly, and Seasonal Trends in the Long Term Rainfall of the Garhwal Himalayas

Seema Rani
CSRD, Jawaharlal Nehru University, India

ABSTRACT

Climate change is one of the very significant apprehension argued in the recent two decades. Its influence on rainfall has brought in considerable attention worldwide. Hence, this chapter focuses on assessing the trends in the rainfall during 1901-2012 in the Dehradun, Haridwar, Uttarkashi, Tehri-Garhwal, Pauri-Garhwal, Rudraprayag and Chamoli districts of the Garhwal Himalayas by applying non-parametric Mann-Kendall and the Theil-Sen's Slope Estimator tests for the determination of trend and its magnitude. The findings revealed a statistically significant positive trend in annual and monthly rainfall (May and July) of Dehradun district. Rainfall shows a statistically significant positive trend in May (Haridwar and Tehri Garhwal) and a significant negative trend in January (Uttarkashi and Chamoli). On the other hand, Pauri Garhwal and Rudraprayag indicates no significant trend in monthly rainfall. An insignificant trend has also been observed in seasonal rainfall of most of the districts. Annual, monthly and seasonal rainfall shown no particular pattern in the region.

INTRODUCTION

One of the most important concerns confronting the world is undoubtedly the threat of climate change as it is expected to alter regional hydrologic conditions and could impact the water resource systems. There are many indicators of climate change such as changes in surface temperature, changes in atmospheric water vapor, changes in precipitation, changes in severe events, and changes in glaciers, changes in the ocean and land ice and changes in sea level. The latest report of the Intergovernmental Panel on Climate Change (IPCC, 2013) mentioned that the global combined land and ocean temperature data has increased about 0.89°C during 1901-2012 and 0.72°C during

DOI: 10.4018/978-1-4666-8814-8.ch011

1950-2012. It also mentioned that the Northern Hemisphere mid-latitude land areas show a likely overall increase in precipitation.

Climate change is expected to evident quite significantly in India also as it would induce changes in the complexion, distribution, quality and functionality of the natural resource base. Further, it would result in 'insecure livelihoods' due to disruptions in the social, cultural, economic, ecological systems, physical infrastructure and human assets; increasing health risks, and crippling or even negating the developmental gains and opportunities (State Action Plan on Climate Change, 2012). The study of rainfall trends is critically important for a country like India, whose food security and economy are dependent on the timely availability of water. In India, attempts have been made in the past to determine trends in the rainfall at national and regional scales. Naidu, Rao, and Rao (1999) studied the trends and periodicities of annual rainfall for 29 sub-divisions of India by using the rainfall series for a period of 124 years (1871-1994). A negative trend is seen over west central India, central north India and north-eastern parts of India. A positive tendency is present over north-west India, covering Haryana, Punjab, and East Rajasthan, West Rajasthan and West Madhya Pradesh, an isolated area in the east Gangetic West Bengal and the peninsula. Guhathakurta and Rajeevan (2008) constructed monthly, seasonal and annual rainfall time series of 36 meteorological subdivisions of India for the period 1901–2003. It has been found that the contribution of June, July and September rainfall to annual rainfall is decreasing for few subdivisions while the contribution of August rainfall is increasing in few other subdivisions. Kumar, Jain, and Singh (2010) also studied the similar trends in rainfall for the period of 1871-2005 for 30 sub-divisions (sub-regions) in India. For the whole of India, no significant trend was detected for annual, seasonal, or monthly rainfall. Annual and monsoon rainfall decreased, while pre-monsoon, post-monsoon and winter rainfall increased at the national scale. Pal and Al-Tabbaa (2010) found that the rainfall in June, July and September decreased, whereas in August it increased at the national scale. It was shown that there are decreasing trends in the spring and monsoon rainfall and increasing trends in the autumn and winter rainfalls over the period of 1954-2003. Several researchers (Rai, Upadhyay, & Ojha, 2010; Kumar & Jain, 2011; Jain & Kumar, 2012; Rana, Uvo, Bengtsson, & Sarthi, 2012; Mondal, Kundu, & Mukhopadhyay, 2012 ; Ratna, 2012; Babar & H., 2013) have contributed to the study of climate change with long term data in India and found that trend is either positive or negative in case of rain. Some researchers have indicated that the climate change was one of the causes for the Uttarakhand tragedy (DobhalL, Gupta, Mehta, & Khandelwal, 2013; Srinivasan, 2013).

Review of literature revealed a lack of studies in the assessment of trends in the rainfall of Uttarakhand Himalayas. Thus, in this chapter, an effort has been made to study the inter-annual and intra-seasonal variability in rainfall of the period 1901-2012 in districts (Dehradun, Haridwar, Tehri Garhwal, Uttarkashi, Chamoli, Pauri Garhwal and Rudraprayag) of the Garhwal division of Uttarakhand. Research questions of the study - Are there any changes in annual/seasonal/monthly rainfall in the districts? If there are changes, what are the patterns of the changes, i.e. whether the changes are showing a positive or negative trend? What is the magnitude of the trend? In which months/ seasons do they happen?

STUDY AREA

Uttarakhand state is in the northern region of India. The latitudinal and longitudinal extent of the state is 28°43' N to 31°27' N and 77°34' E to 81°02' E respectively (Figure 1). Area of the state is 53,483 km^2, out of which 86% area is hilly and the remaining area is plain. According to the 2011 census of India, Uttarakhand has a population of 10.1 lakh, making it the 19th most populous state