RAINFALL TRENDS IN THE BRAHMAPUTRA VALLEY OF ASSAM

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Introduction

Probably the aspect of climate, which most interests the layman and the scientists, is speculation regarding its possible trends. Unfortunately, as well as being the most interesting, it is also the most uncertain aspect of the meteorological research (Barry and Chorley, 1987). Realisation that climate has changed radically with time came only during the 1840s when indisputable evidence of the former ice ages was obtained. Yet in many parts of the world the climate has altered sufficiently, even within the last few thousand years, to affect the possibilities for agriculture and settlement. Reliable weather records have only been kept during the last hundred years or so and therefore it is only the recent climatic fluctuations, which can be investigated adequately. Therefore, for a proper understanding of the climatic impacts, it is necessary that specific areas of interest be zoomed in for climatic trends and variability studies, so that the regional controls can be established which can form important inputs to the policy making process.

With recurrent floods and droughts occurring over different parts of the country, the question of periodicities and trends of rainfall, if any, over different parts of India has assumed great importance (Alvi and Koteswaram, 1985). For the Brahmaputra valley, where flood is a regular feature, especially during the rainy season, analysis of rainfall trends for the region is of even greater significance.

Rainfall is an important and most dynamic element of climate. Hence, the change in rainfall has been focus of study of a number of scientists as it influences man and environment both. The present study is an attempt to see whether rainfall in the Brahmaputra valley has been increasing or decreasing over the years (1975–2000) through an analysis of rainfall trends over the region. The result shows an increase in rainfall for most of the stations studied. This also negates the common belief that rainfall is decreasing in the region due to global warming and deforestation in the area.

The Study Area

The Brahmaputra valley of Assam is located between 25°8′N and 27°8′N Latitudes and 89°46′E and 96°10′E Longitudes. The Brahmaputra valley is a narrow elongated tract with an east-west distance of about 660 km and an average north-south width of about 70 km. At its widest, the valley is about 90 km and the narrowest point, exaggerated by the jutting of the Karbi Anglong hills, is about 50km. The gradient of the Brahmaputra valley is extremely low *i.e.*, only 14cm per km (Taher and Ahmed, 1998). It has a geographical area of 54,315 km^2.

Methodology and Database

It is obvious that the great year-to-year variability of climatic conditions may conceal gradual trends from one type of regime towards another (Barry and Chorley, 1987). To remove the effects of short-term irregularities, various statistical techniques have been used. In the present study, three different statistical techniques have been used to ascertain the trends in rainfall over the Brahmaputra valley. These are moving average (or running mean), semi-average and least squares method.

Annual rainfall data for the period 1975 to 2000 have been collected from nine meteorological stations of the study area (Figure 1) to calculate annual and seasonal rainfall trends in the Brahmaputra valley of Assam. The concerned data have been collected from the Regional Centre, Indian Meteorological Department, Guwahati.

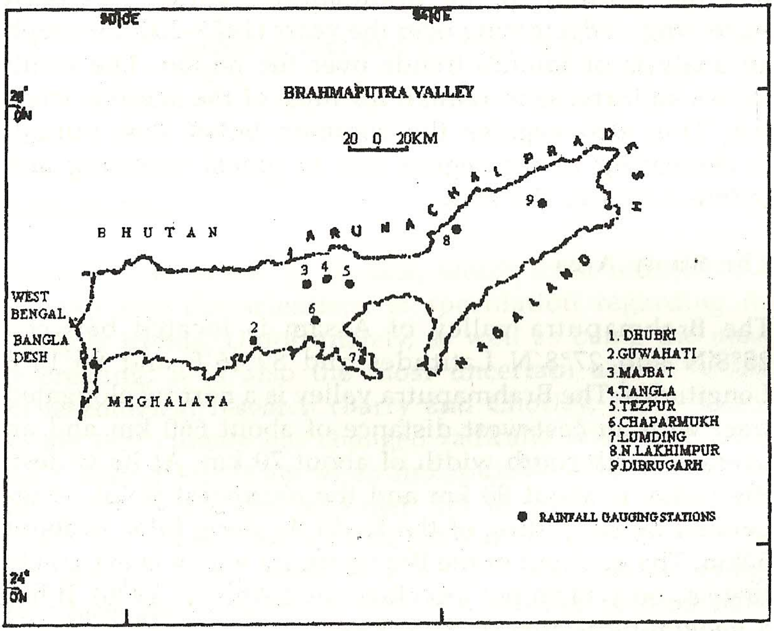


Figure 1

Analysis

It is difficult to discuss any trend on actual annual rainfall graph as such (Figure 2). The rainfall patterns show great deal of variations from year to year and it is not easily possible to observe any trend of increasing or decreasing rainfall. Still, an increasing trend of rainfall is visible, especially after 1988. A relatively wet period is observed in

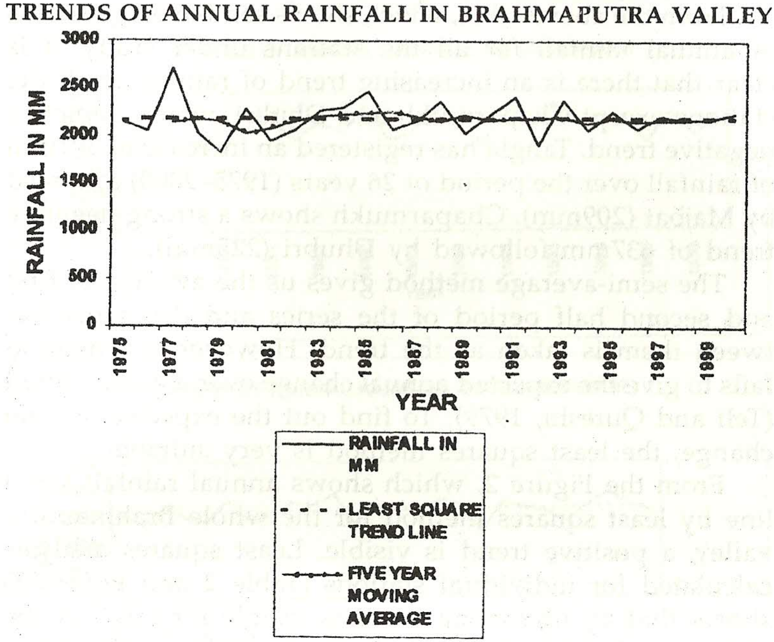


Figure 2

the actual rainfall graph since 1993. The actual and 5-year moving average graph depicts 10-year cycle for the recurrence of the peak amount of rainfall.

Table 1: Semi-average rainfall trends

S. No.	Stations	Average of Rainfall during 1975–1987 X1	Average of Rainfall during 1988–2000 X2	X2–X1	Mean of Rainfall (in mm) during 1975–2000 X
1.	Chaparmukh	2634.06	1996.88	–637.18	2315.47
2.	Dhubri	2915.54	2689.75	–225.79	2802.65
3.	Dibrugarh	2577.15	2705.58	128.43	2641.37
4.	Guwahati	1685.60	1755.09	69.48	1720.35
5.	Lumding	1164.377	1269.546	105.16	1216.96
6.	Majbat	1828.03	2038.02	209.99	1933.03
7.	N. Lakhimpur	3107.61	3294.25	186.64	3200.93
8.	Tangla	1803.34	2104.91	301.57	1954.12
9.	Tezpur	1881.35	1919.3	37.95	1900.32

Source: I.M.D., Guwahati.

From the above table, which shows semi-average trends of annual rainfall for all the stations under study, it is clear that there is an increasing trend of rainfall at all the stations except Chaparmukh and Dhubri, which depicts a negative trend. Tangla has registered an increase of 301mm of rainfall over the period of 26 years (1975–2000) followed by Majbat (209mm). Chaparmukh shows a strong negative trend of 637mm followed by Dhubri (225mm).

The semi-average method gives us the average of first and second half period of the series and difference between them is taken as the trend. However, the method fails to give the expected annual change over a given period (Teli and Qureshi, 1979). To find out the expected annual change, the least squares method is very suitable.

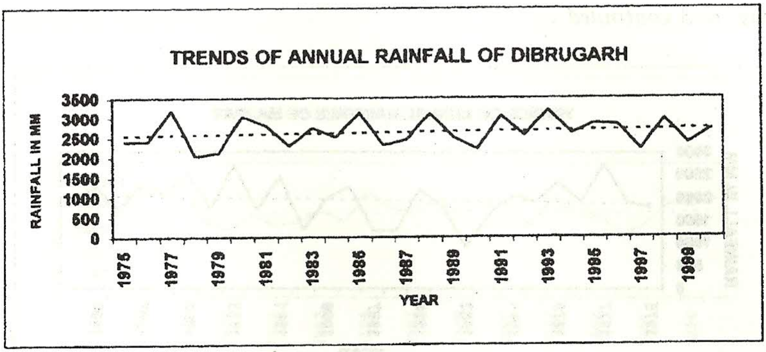
From the Figure 2, which shows annual rainfall trend line by least squares method for the whole Brahmaputra valley, a positive trend is visible. Least squares analysis calculated for individual stations (Table 2 and Figure 3) shows that an increasing trend is visible for most of the stations as 7 out of 9 stations have recorded positive trend of annual rainfall.

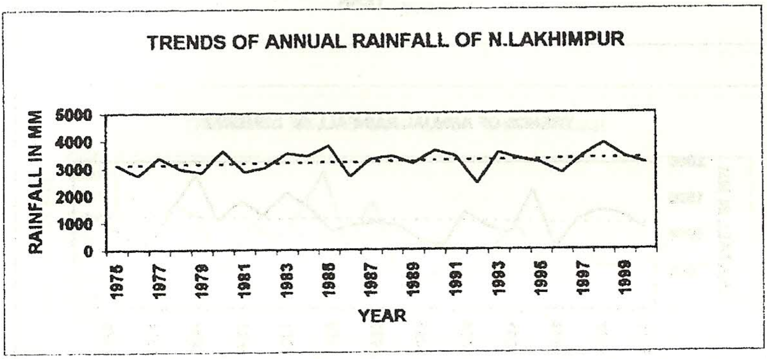
Table 2: Trends of rainfall as revealed by least squares analysis

S. No.	Stations	Least Squares Equations Y=a+bx
1.	Chaparmukh	Y=2329.05–41.107X
2.	Dhubri	Y=2809.76–5.85X
3.	Dibrugarh	Y=2641.48+6.67X
4	Guwahati	Y=1716.27+3.57X
5.	Lumding	Y=1216.96+2.88X
6.	Majbat	Y=1954.123+6.23X
7.	N.Lakhimpur	Y=3239.39+10.47X
8.	Tangla	Y=1954.16+25.83X
9.	Tezpur	Y=1900.93+3.125X

Source: I.M.D., Guwahati.

Tangla station has recorded the highest annual increasing trend of rainfall followed by North Lakhimpur and Dibrugarh stations. On the other hand, Chaparmukh





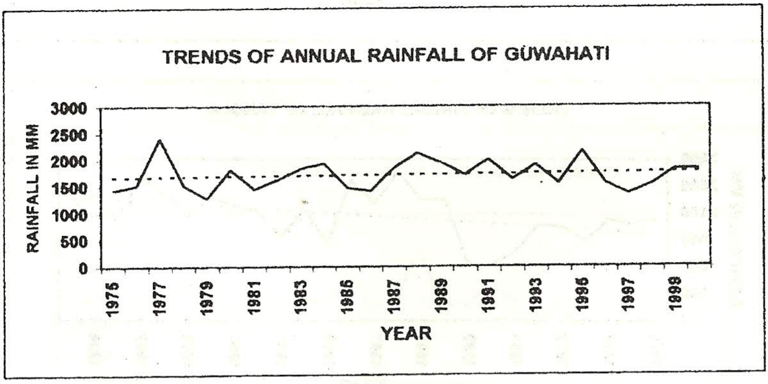


Figure 3: Trends of annual rainfall shown by least squares trend line

Figure 3 continued ...

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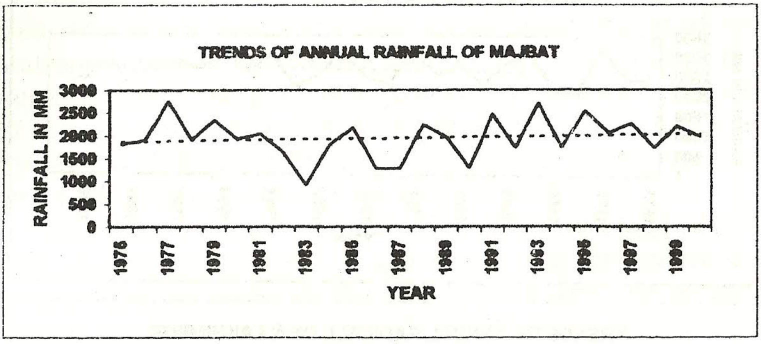

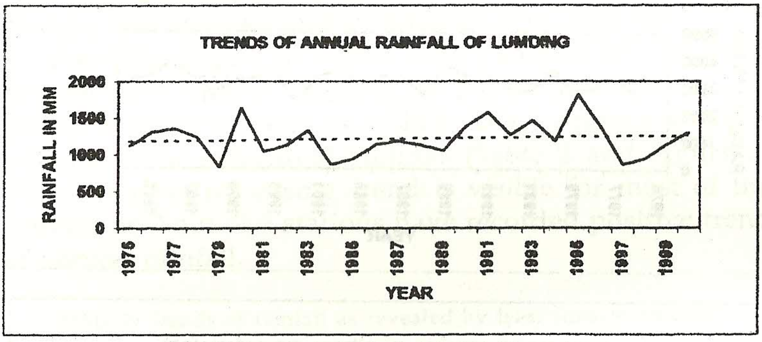

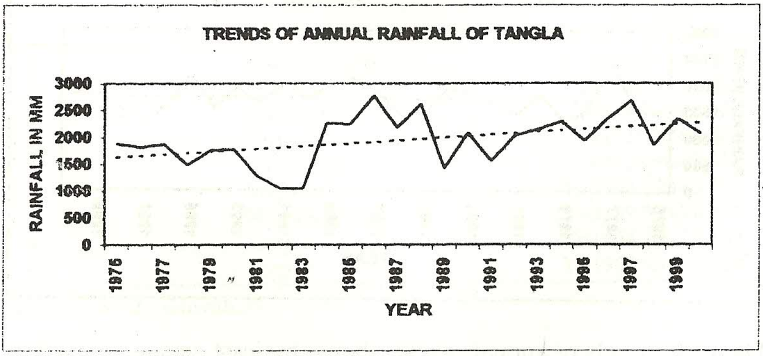

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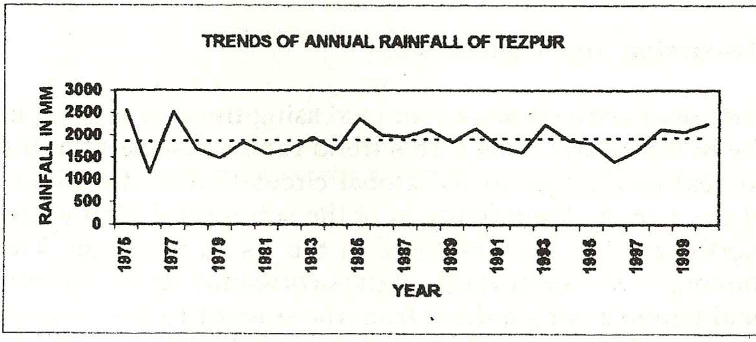

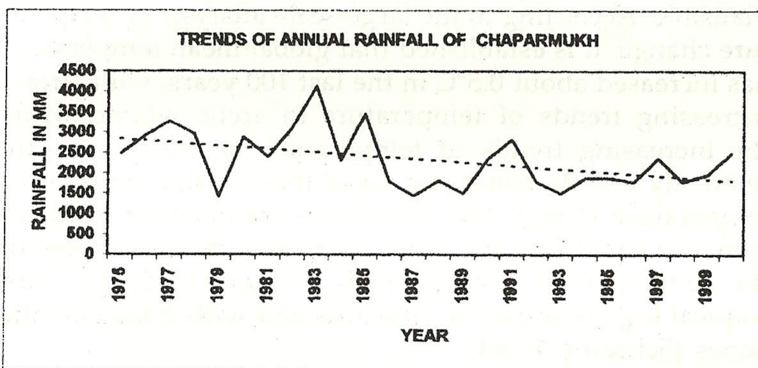

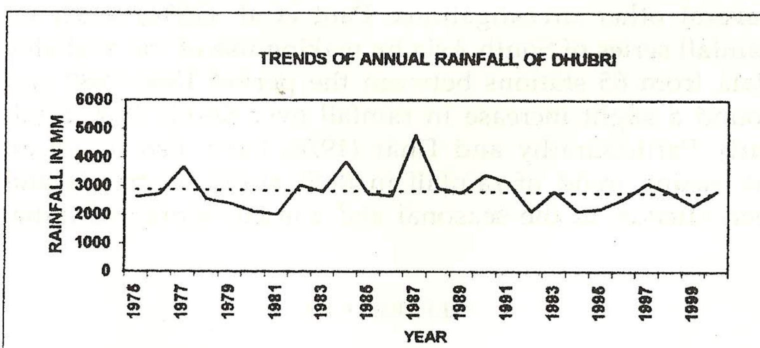

recorded the highest decrease of annual trend in rainfall followed by Dhubri.

Discussion and Conclusions

The trend analysis shows an increasing trend of rainfall in the Brahmaputra valley. This trend can be discussed in the context of changes in the global circulation of the atmosphere, namely the moving in of the subtropical high to the North and the changes there in the Asian monsoon. The moving of the subtropical high is correlated to the meridional temperature gradient from the equator to the poles. A northward shifting of the subtropical high seems to be plausible. According to the large-scale analysis of temperature change, it is established that global mean temperature has increased about 0.5°C in the last 100 years, with strong increasing trends of temperature in arctic winter, while the increasing trends of temperature in the tropics are relatively low. As consequences of these spatial patterns of temperature change the meridional temperature gradient from the equator to the poles decreases, the main force of the circulation of atmosphere is weakened. Finally, subtropical high is shifted northwards and with it the climatic zones (Schaefer, 1996).

The results of this study are consistent with those of several other investigations. Pant *et al.* (1996) analysed rainfall series of South Asia by making use of the available data from 65 stations between the period 1866–1980 and found a slight increase in rainfall over South Asia. Similarly Parthasarathy and Dhar (1976) have also found an increasing trend of rainfall in their study on trends and periodicities in the seasonal and annual rainfall of India.

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