Editorial

The North Eastern Region, (NER) falls under high rainfall zone with subtropical type of climate. The NER receipt heavy rainfall and falls in low rainfall variability category, which ranges from 8-15% and the normal annual rainfall ranges from 200-300 cm. Droughts and floods are the adverse climatic conditions arising out of deficit and excess rainfall, respectively, which has dramatically affected the lifestyles and livelihood options of thousands of people in the states and their households in the remote areas. Environmental security and sustainability of the region are greatly challenged by these impacts.

The North East Region has the highest forest cover in India, which provides a number of adaptive advantages. Forests can reduce soil erosion and runoff, regulate flooding and temperature and mitigate climate change. The impacts of climate change on region like northeast India are less explored and less known making the future scenarios more uncertain for vulnerability assessment and risk management. However, certain indicators point to visible impacts being already in the region.

Changes in extreme events of rainfall and temperature might have direct or indirect impacts on different sectors in the region. The agricultural practices that conserves natural resources and delays the effect of stress should be given importance and necessary policy or subsidy may be encouraged. Thus, it is essential that we need to address the extreme events in rainfall and its influence on the other socio-economic factors over the region. However, more rigorous study needs to be done at regional scale before anything can be said conclusively. Conservation agriculture, afforestation, rain water harvesting, efficient use of inputs, following proper agro-techniques for management of adverse climatic conditions arising out of deficit and excess rainfall, are some of the management options should be taken up by the community, Institutes, NGOs, Schools and Government Department that needs to be immediately popularized among the farming communities to mitigate the impact of rainfall.

The theme of the issue have stressed on the rainfall pattern and its consequences in Southern Assam of northeast India.
Erratic Rainfall Patterns and its Consequences in Barak Valley, Southern Assam, Northeast India

Pulak Das*, Santosh Joshi**

Introduction:
Rainfall is an important driver in deciding the vegetation, hydrology, water quality, and climate related disasters over any region on the earth. Pattern of rainfall is a complex phenomenon and is important to understand and interpret its variation over a period of time. Being an end product of complex interactions between a variety of dynamic processes with characteristic spatial and temporal scales, it is highly variable (Singh and Singh, 1996). Changes in rainfall pattern are one of the main characteristics of climate change which have impacts on biological and socio-economic factors of any region (ASTEC, 2011). There is a direct influence of global warming on changes in precipitation (a general term for rainfall, snowfall, and other forms of frozen or liquid water falling from the clouds) and heavy rains. As climate varies or changes, several direct influences alter precipitation amount, intensity, frequency, and type (Trenberth, 2005).

North-East (NE) India (comprising seven states) is one of the highest rainfall intensity zones of the country (National Institute of Hydrology, 1998-1999). The region including Assam is highly prone to consequences of climate change because of its sensitive geo-ecological set-up, strategic location with international boundary, presence of the Eastern Himalayan ranges, transboundary river systems, inhabitation of ecosystem by people of different ethnic groups and inherent socio-economic differences (ASTEC, 2011). The impacts of climate change on NE India or comparatively a smaller state like Assam are less explored and less known till now, making the future scenario more uncertain for risk management (ASTEC, 2011). Assam, the largest state of NE India is predominantly rural and its economy is primarily agrarian in nature, with almost 70% of population directly dependent on agriculture and another 15% dependent on allied activities for its livelihood (Bujarbarua and Barua, 2009). The state has two principal drainage systems namely the Brahmaputra and Barak. Barak Valley in southern part of Assam is an important valley system

![Figure 1: A1-Average seasonal rainfall in Barak valley in five years; A2- Annual rainfall in Barak valley in five years; B1-Change in trend in monthly rainfall in Barak valley in five years; B2-Five years (2004-2008) average monthly rainfall in Barak valley.](image)

The authors, * Independent Environment Researcher, Silchar-788006, Cachar ** Korean Lichen Research Institute, Sunchon National University, Sunchon, Jeonnam-540742, South Korea
The valley constitutes about 8.9% of the geographical area of India. The Barak Valley region (comparatively smaller than Brahmaputra Valley) forms the southern part of the state and is situated between longitude 92° 15' and 93° 15' East and latitude 24° 8' and 25° 8' North covering an area of 6948 km². The valley constitutes about 8.9% of the geographical area of the state and shares its border with North-Cachar Hills district and the state of Meghalaya in the north; the state of Manipur in the east; the state of Mizoram in the south and the state of Tripura and the Sylhet district of Bangladesh in the west. Administratively the region is comprised of three districts, namely the Cachar, the Karimganj, and the Hailakandi. Cachar is the largest, followed by Karimganj and Hailakandi. The region has an undulating topography characterized by hills, hillocks, wide plains and low-lying water logged areas. The climate of Barak Valley region is subtropical, warm and humid. The average rainfall as per estimate based on data from 1970 to 1989 by the Regional Agricultural Research Station, Karimganj, is 3180 mm with average rainy days of 146 per annum. During the summer monsoon season and post-monsoon season. During monsoon season, comparatively fewer departures are observed for all the districts in five years. Months of August and September in the monsoon season recorded highest departures; negative for Cachar district in the year 2006 and positive for Hailakandi district in the years 2007-2008. However, Karimganj district shows record highest departures (positive) in June and July months of 2005 and 2006 in the same season. From seasonal rainfall patterns, the observations in three districts are as follows; Monsoon rainfall exhibits widest range (989.6mm to 2469.7mm) in Karimganj district followed by Cachar (1534.9mm to 2194.2mm), and Hailakandi (1449.9mm to 1749.6mm). Similarly pre-monsoon rainfall also exhibits widest range in Karimganj but followed by Hailakandi and Cachar, whereas post-monsoon variability is highest in Cachar followed by Karimganj and Hailakandi districts. Winter rainfall is observed to be highly variable in Hailakandi district with no rainfall in 2004, followed by Cachar and Karimganj.

On an average in Barak valley (Fig. 1 A1), the correlation of rainfall is statistically significant only for pre-monsoon season irrespective of decreasing trend in pre-monsoon and summer monsoon rainfall and increasing trend in post-monsoon and winter rainfall. District wise, only in Karimganj high throughout the year with minor recess during the months of March and April.

The present work is undertaken on the basis of annual data extracted from Hydromet Division of India Meteorological Department (IMD) (http://www.imd.gov.in) for rainfall totals from three districts of Barak Valley. The five years data from 2004 to 2008 were taken to interpret the results. The district rainfall (mm) data is the arithmetic average of rainfall of stations under the district, and percent (%) departure is the departures of rainfall from the long period averages of rainfall for the district. The present study is concerned with temporal variations in the seasonal rainfall in particular, along with annual changes and monthly averages in general, and consequent natural hazards aroused by these changes. In India, seasonal classification of rainfall is done on the basis of IMD definition of seasons; Winter season (January-February), Pre-monsoon season (March-May), Southwest monsoon season (June-September), and Post-monsoon season (October-December).

Results and discussion:

The long time departures (%) during the study period ranged from -100 to 148 in Cachar district, -100 to 266 in Hailakandi district, and -100 to 300 in Karimganj district. Maximum departures in the valley are detected in winter season, pre-monsoon season and post-monsoon season. During monsoon season, comparatively fewer departures are observed for all the districts in five years. Months of August and September in the monsoon season recorded highest departures; negative for Cachar district in the year 2006 and positive for Hailakandi district in the years 2007-2008. However, Karimganj district shows record highest departures (positive) in June and July months of 2005 and 2006 in the same season. From seasonal rainfall patterns, the observations in three districts are as follows; Monsoon rainfall exhibits widest range (989.6mm to 2469.7mm) in Karimganj district followed by Cachar (1534.9mm to 2194.2mm), and Hailakandi (1449.9mm to 1749.6mm). Similarly pre-monsoon rainfall also exhibits widest range in Karimganj but followed by Hailakandi and Cachar, whereas post-monsoon variability is highest in Cachar followed by Karimganj and Hailakandi districts. Winter rainfall is observed to be highly variable in Hailakandi district with no rainfall in 2004, followed by Cachar and Karimganj.

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district the correlation is statistically significant (for pre-monsoon rainfall).

During the years 2004-2008, the annual rainfall of Barak valley region has experienced a downward trend from 3285.67 mm (in 2004) to 2248.13 mm (in 2008) (Fig. 1 A2); a reduction of 31.58% (average reduction of 207.5 mm/year). Similarly, the monthly rainfall of Barak valley (average monthly rainfall of Cachar, Karimganj, and Hailakandi) is also exhibiting a downward trend between year 2004 and 2008 (Fig. 1 B1), and the reduction is more pronounced during the pre-monsoon and early part of monsoon season. It is interesting to note that although in last few years the pre-monsoon rainfall and earlier monsoon rainfall is decreasing, the departures from long period average are comparatively less than the other seasons. Further, it is observed (Fig. 1 B2) that the five years monthly average rainfall is highest in July (544.98 mm) and lowest in September (322.85 mm) in monsoon season. In pre-monsoon season the highest monthly average is observed to be in May (406.85 mm). The overall lowest average monthly rainfall is experienced in December (1.83 mm). It is observed that (mean) contribution of winter, pre-monsoon, monsoon, and post-monsoon seasonal rainfall is 1.52%, 28.64%, 63.35%, and 6.48% between 2004 and 2008 (Table 1).

<table>
<thead>
<tr>
<th>Year</th>
<th>Pre-monsoon</th>
<th>Summer</th>
<th>Post-monsoon</th>
<th>Winter</th>
</tr>
</thead>
<tbody>
<tr>
<td>2004</td>
<td>36.11</td>
<td>58.69</td>
<td>5.08</td>
<td>0.11</td>
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<tr>
<td>2005</td>
<td>34.66</td>
<td>57.75</td>
<td>5.84</td>
<td>1.75</td>
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<td>2006</td>
<td>24.63</td>
<td>69.99</td>
<td>3.97</td>
<td>1.41</td>
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<tr>
<td>2007</td>
<td>25.30</td>
<td>62.74</td>
<td>8.84</td>
<td>3.12</td>
</tr>
<tr>
<td>2008</td>
<td>18.20</td>
<td>71.61</td>
<td>9.01</td>
<td>1.18</td>
</tr>
<tr>
<td>Mean</td>
<td>28.64</td>
<td>63.35</td>
<td>6.48</td>
<td>1.52</td>
</tr>
</tbody>
</table>

Table 1: Inter-seasonal shift in rainfall quantities (%) in Barak valley between 2004-2008

Individual analysis of months reveals that March, April, May, July, and December experienced a decreasing trend in the rainfall between 2004 and 2008. The decrease is more prominent in July, followed by May, April, March, and December. All the other months have experienced an increasing trend in the rainfall. In a long term study between 1950 and 2000 for all India monsoon rainfall (Gautam et al., 2009) it is observed that June rainfall has increased since 1950. In the present study, behaviour of July rainfall is found to be similar to that of the monsoon seasonal rainfall as observed by Guhathakurta and Rajeevan (2006) for all India during 1901-2003. The significant deficit in July rainfall appears to have lowered the entire monsoonal rainfall trend inspite of slight increase in the rainfall in June, August, and September. In contrast, the winter rainfall exhibits an increasing trend because of increase in January and February rainfall although the December rainfall experienced a decrease between 2004 and 2008. Gautam et al. (2009) observed that the deficit from July to September appears to have compensated the marked rainfall increase in June resulting in a weak weakening trend of the recent composite monsoon rainfall in India.

When compared with the all India rainfall pattern, present study showed some contrasting results. Whereas the present work indicates towards a decrease in the summer monsoon rainfall, Ministry of Environment and Forests (MoEF, 2010) predicted an increase in the all-India summer monsoon rainfall. Similarly, although the pre-monsoon rainfall contribution for the India as a whole is quite lower (11%) than what is observed in present study (28.64%); the mean (1901-2003) summer monsoon rainfall for all India (74.2%) is higher than the Barak Valley (63.35%) (Guhathakurta and Rajeevan, 2006). The summer monsoon season is meteorologically most important for India because more than 80% of the land area gets about 90% of its annual precipitation during this period (Basu, 2005). It is well known that the summer monsoon rainfall over the Indian subcontinent exhibits considerable interannual variability too (Parthasarathy et al., 1995) with an abnormally low Indian monsoon rainfall case observed during 2000 (Krishnan et al., 2003). The past performances of the monsoon rainfall may give an indication of the future scenario (Guhathakurta and Rajeevan, 2006). The Indian summer monsoon (June to September) rainfall is very crucial for the economic development, disaster management, and hydrological planning for the country (Guhathakurta and Rajeevan, 2006). Variations in seasonal rainfall are also the main scale controlling ecological process (González-Hidalgo et al., 2001) such as forest fires and desertification (Lavorel et al., 1998; Puigdefábregas and Mendizabal, 1998), forest structure and composition, the regenerative capacity of ecosystems and restoration activities (Tessier et al., 1997; Mulligan, 1998; Rambal and Hoff, 1998), and eco-physiological responses (Kremer et al., 1996; Neilson et al., 1997). Pre-monsoon season in NE region in general, is also an important period contributing significant proportion of the down-pour in any year and unlike the monsoonal rainfall the incidences of floods are also low, or are of low magnitude leading to fewer interruptions in the agricultural activities (particularly in Barak valley area). Hence, understanding of the pattern and trend of rainfall in this season can be of importance (Sanderson and Ahmed, 1979). Although, overall a decreasing trend in rainfall is observed during the study period but seasonal
Majuli devastated by Sept flood
CORRESPONDENT

JORHAT, Oct 7 – The economy of Majuli has been devastated by the recurring floods this year. The little hope remaining among the majority of the inhabitants engaged in agriculture in Majuli after the flood in June was also totally washed away by the last monstrous flood in the month of September this year.

As the water level receded and the vacant crop fields came out of water there remain only sorrow and hopelessness among the agrarian people in Majuli.

The last wave of flood affected almost 33011 families of 243 villages in the river island. Crops in the 22857 ha were washed away. Crops included Sali, Bao and Boro rice and other crops. The loss of agricultural product in Majuli this time is almost Rs 28 crore, 69 lakh and 82 thousand.

The sub divisional agriculture officer of Majuli has already submitted a proposal to the government for assistance so that the people of the river island can cope with the situation. In the proposal he suggested that mustard seeds should be provided to the farmers for cultivating 6000 ha of land in Majuli. Likewise, the proposal also mentions that seeds of Boro rice, peas and potato to be cultivated in 2000 ha, 3000 ha and 1000 ha respectively for the people of Majuli.

He also advocated that government should undertake the task of ploughing 5 bighas of land of each farming family in the river island. But, the people of Majuli are wondering if they could receive government aid in time. If the season is over there will remain no need for any government plan to revive the agrarian economy in the river island.

The communication system has also been affected to a great extent by the last flood in September. In Majuli the total length of the PWD road is 224 km. The last flood washed away the portions of the roads at 49 places. The condition of 25 places has remained very bad and beyond repair till now. The flood washed away as many as 15 culverts in Majuli. The approaches of 7 concrete bridges were damaged by the flood.

PWD department and local people have somehow managed to do the repair of 41 places of the washed away roads by making bamboo bridges as temporary solutions.

Source: The Assam Tribune, Guwahati, Monday, October 08, 2012

Environment Calendar

October 3 World Habitat Day- The earth is the habitat of not only human beings but also all living creatures. Increasing human activities is threatening the habitat of other living things.

October 1-7 World Wildlife Week - Celebrate this week by building awareness on the importance of preservation of our wildlife.

October 4 World Animal Welfare Day- The welfare of animals has to be looked into and given due importance.

October 13 International Day for Natural Disaster Reduction- Due to a change in the environment there has been an increase in the number of natural disasters. Efforts have to be taken to reduce these disasters.

November 14 Children’s Day in India- Children can work together for a better tomorrow by improving the environment around them.

December 2 Bhopal Tragedy Day- Mark this occasion by taking a pledge to put in your best efforts to prevent such a tragedy from occurring again.

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   2. Natural Resource
   3. Pollution
   4. Solid waste
   5. Natural hazards
   6. Energy
   7. Sustainable development
   8. Deforestation
   9. Weather and climate
   10. Waste water treatment
   11. Urbanisation
   12. Landslide
   13. Environment education
   14. NGOs and environment
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ENVIS-Assam Newsletter/October to December, 2012
differences in the pattern is also prominent. Pre-monsoon and summer monsoon rainfall which together contributes about 92% of total rainfall is decreasing in the Barak valley region while the post-monsoon and winter rainfall together contributing 8% is increasing over the years. It is worth mentioning here that the northeast Indian region as a whole is experiencing a decrease in summer monsoon rainfall (ASTEC, 2011). It has been illustrated that the seasonal rainfall exhibits a correlation with the summer monsoon rainfall in some places of India (Singh and Singh, 1996). Such correlations are also found in smaller spatial scales as observed in the present study.

It is observed (ASTEC, 2011) that in 2006 the summer rainfall in Assam was below normal (nearly 40%) and more than 75% of the 26 million people associated with livelihoods related to agriculture in several districts were affected and the state suffered a loss of more than 100 crores rupees due to crop failure and other peripheral effects. In the year 2008 also the state of Assam has observed drought. The present work also indicates towards both the incidences in southern part of Assam (Fig. 1 A2). Such fluctuations in rainfall are considered as results of inter-annual variability of the southwest monsoons, which become erratic because of climate change (ASTEC, 2011). Many areas of Assam are observed to be facing anomalies in rainfall particularly in the onset of monsoon (Sarma, 2010). Deficiency of rainfall between 1998 and 2003 as indicated by rainfall variability (significant variability of monthly and seasonal rainfall) is also observed in Karbi Anglong (near Barak Valley) (Sarma, 2010)).

Rainfall has likely decreased by 3% on average over much of the subtropical land areas (IPCC, 2002). Over the 20th century there has been a consistent, large-scale warming of both the land and ocean surface and possibly most of the observed warming over the last 50 years has been due to the increase in greenhouse gas concentrations (IPCC, 2002). Increasing global mean surface temperature is very likely will lead to changes in precipitation and atmospheric moisture because of changes in atmospheric circulation, a more active hydrological cycle, and increases in the water-holding capacity throughout the atmosphere (IPCC, 2002). Therefore it is expected that global warming will lead to an increase in the variability of Asian summer monsoon precipitation (IPCC, 2002). The climate of the Barak valley area is subtropical, warm and humid. The average annual rainfall of the region is 3180 mm with 146 rainy days (Assam Agricultural University, 2007). Generally, the period from December to February is rather dry. The period of March-April is characterized by low and erratic rainfall with occasional hailstorm. The period from May to September is characterized by high rainfall with apprehension of flood. Even after adequate total rainfall, the distribution is not uniform and about 56% of the total rainfall is received during June to August (Assam Agricultural University, 2010). The changes in annual rainfall, seasonal rainfall pattern, and inter-seasonal shifts in rainfall quantities have a delicate balance with the agricultural activities and the consequent socio-economic status particularly in rural areas. It also affects the planning of agricultural activities in a region. The intensity and distribution of rainfall during the pre monsoon (March-May) and monsoon (June-August) periods are the chief determinants of area coverage and productivity of rice in the Barak valley.

Early onset of pre-monsoon is important for timely sowing and planting of ahu rice but detrimental to boro rice in low lying area particularly when the intensity is high. Heavy rainfall during June-August frequently damages both ahu and sali rice (Assam Agricultural University, 2007).

Conclusion:

Some important conclusions from this study can be summarized as follows: the total annual rainfall has reduced about 31.58% (at an average rate of 207.5 mm/year) between 2004 and 2008 in Barak valley region. Summer monsoon rainfall in all the three districts of Cachar, Karimganj, and Hajilakandi experienced least departures from long time average of the region as compared to pre-monsoon, post-monsoon and winter rainfall. Pre-monsoon and summer monsoon rainfall in the Barak valley region as a whole is experiencing a decreasing trend during the study period while the post-monsoon and winter rainfall exhibits a marginal increase. Study of rainfall patterns and trends in Barak valley is thus of importance in the wake of frequent floods and unpredictable drought conditions and its management, and also for planning seasonal agricultural activities.

Reference

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**Upcoming Events**

**International Conference on Global Scenario in Environment and Energy**

14th to 16th March 2013, Bhopal, Madhya Pradesh, India

The conference is aimed at creating an effective forum for exchanges of innovative ideas and research works in the areas of Energy, and Environment. All research article will be considered for publication in IJCTR [ISSN: 0974-4290]

Organized by: Maulana Azad National Institute of Technology, Bhopal

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Photo Gallery-ENVIS Centre, Assam

Location of the Photograph: Sivasagar
Name: CHINESE PANGOLIN (Manis pentadactyla). This Pangolin found in Northern India, Nepal, Bhutan, Myanmar to Northern India-China, Taiwan, Southern China etc.

Location of the Photograph: Jorhat
Name: ANDAMAN PADAUK (Pterocarpus Dalbergioides). It is a state tree of Andaman & Nicobar Island. It is found in the Andaman Island. It grows upto the height of 120 feet.

Location of the Photograph: Jorhat
Name: SAINT ANDREW’S CROSS SPIDER OR ASIAN SIGNATURE SPIDER (Argiope Versicolor)

Photographs: Mr. Palash Ranjan Goswami
Seven Look, Milonpur, Sakekhati, Sivasagar

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