International Journal of Engineering Technology Science and Research
IJETSR
www.ijetsr.com
ISSN 2394 – 3386
Volume 4, Issue 11
November 2017

Global Warming and Its Impacts in Manipur, Northeast India

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Abstract

The North Eastern Region of India is expected to be highly prone to the consequences ofglobal warming. The term global warming is synonymous with enhanced greenhouse effect, implying an increase in the amount of greenhouse gases in the earth's atmosphere, leading to entrapment of more and more solar radiations, and thus increasing the overall temperature of the earth. Global warming occurs when carbon dioxide (CO_2) and other air pollutants and greenhouse gases collect in the atmosphere and absorb sunlight and solar radiation that have bounced off the earth's surface. Normally, this radiation would escape into space—but these pollutants, which can last for years to centuries in the atmosphere, trap the heat and cause the planet to get hotter. The burning of fossil fuels to make electricity is the largest source of heat-trapping pollution, producing about two billion tons of CO_2 every year. Coal-burning power plants are by far the biggest polluters. Scientific research and field observations confirm that Manipur is suffering from the impacts of climate change already. Due to its unique location and topography, it has distinct precipitation and drainage patterns. From March to May, thunderstorms contribute about 20% of annual rainfall. From June to September, monsoon rains supply another 70%. Because of climate change, moreover, rainfall is becoming more unpredictable and erratic. The impact of global warming on agriculture, water resources, natural ecosystem, forestry, health, sanitation, infrastructure, energy and livestock is devastating and set to get worse. The climate forecasts indicate that these trends will be exacerbated in the future. Average temperatures are projected to increase by about 1.7°C in almost all the districts of the Northeast India. Currently available scientific data about the vulnerability of the region to climate change, conservation agriculture, afforestation, rain water harvesting, efficient use of inputs, following proper agro-techniques for management of drought and flood are some of the management options that needs to be immediately popularized among the farming communities to mitigate the impact of climate change. For this, we have to plan and implement adaptation practices in Manipur.

Key words: global warming: greenhouse effect; vulnerability; climate change; fossil fuels

Introduction

The North Eastern Region (NER) comprises of the states of Arunachal Pradesh, Assam, Manipur, Nagaland, Mizoram, Meghalaya and Tripura. The annual rainfall in the region is received mainly from south-west monsoon from middle of May and continues till October. On an average, the NE region receives about 2450 mm of rainfall. Manipur, one of the seven sister states of the North Eastern Region of India, is an isolated hill-grit state stretching between Longitudes 93.03°E and 94.78°E and Latitudes 23.80°N and 25.68°N; bounded on the north by Nagaland, on the west by North Cachar hills and Cachar districts of Assam, on the east by Myanmar and on the southwest by Mizoram.

The impacts of global warming are being felt across the Northeast states of India. Each year, scientists learn more about the consequences of globalwarming and many agree that environmental, economic, and health consequences are likely to occur if current trends continue. There has been a particularly alarming effect of global warming on the climate of Northeast India including Manipur. It has led to an increase in the frequency and intensity of these climatic disasters. It is also posing a great threat to the food security situation in the state with recurring and severe droughts and ravaging floods engulfing the arable land. It has such an impact on the climate that it increases the severity of precipitation at one time, and minimizes it in the other. In the wake of such a shift in climate in the region, there is an urgent need for reassessment of the agricultural practices. The agricultural practices that conserve natural resources and have the advantage to delay effect of stress should be given importance and necessary policy or subsidy may be encouraged.

Research also suggests that erratic monsoons will have serious effects on rain-fed agriculture with projected decreases in the productivity of crops including rice, maize, potato, yongchak (*PerciumOxydraghi*) and even pineapple. The recent flood and landslides due to climate change impact in Manipur had claimed at least 22 lives besides destroying many houses and standing crops and live stocks. Studies indicate that increased droughts and floods are likely to increase production variability and lead to considerable effects on microbes, pathogens, and insects needed for the upkeep of healthy agricultural systems.Chaturvediet.al (2010) suggest that low vegetation vulnerability in North-eastern India means these regions are suitable especially for forest conservation projects.Ravindranathet.al (2011) assess the district level vulnerability profiles of agriculture, water and forest sectors for North-eastern India. The study estimates that a majority of grids (area covering roughly 50 by 50 kilometres boxes on the map) in North Eastern India are vulnerable to climate change even under the current climate. Projected climate change increases the vulnerability even further.

About the study area

Manipur is a small state located in a hilly terrain of Northeast India with a small portion of valley in the central part of the state and has a monsoon climate confined within four summer months from June to September. The southwest monsoon is the main source of rain, and June is the rainiest month. There are three seasons in the area, winter, summer and rainy season, though rainy season, as in the rest of India, coincides with summer months. The two most important river basins of the state Manipur are Imphal river basin and Barak river basin. Imphal River and its tributaries drain the central part of the valley and while western part is mainly drained by the Barak and its tributaries. The Barak river basin belongs to Brahmaputra river system of the west and the Imphal river basin is a part of the Chindwin-Irrawady river system of the east. Nambul River is the only main river in Manipur that flows in heart of the Imphal valley and it falls in Loktak Lake.

Methodology and Data Analysis

The study involves statistical and graphical analysis and correlation of rainfall data from the India Meteorological Department (IMD), flood and draught history obtained from Manipur University. An index-based approach was used where a set of indicators that represent key sectors of vulnerability (agriculture, forest and water) is selected using the statistical technique principal component analysis. The impacts of climate change on key sectors as represented by the changes in the indicators were derived from impact assessment models. To our knowledge, this is the first study that relates global warming to extreme rainfall as well as draught and its impact on Manipur. In this study, we pay attention to the impact of global warming in recent decades over Northeast India (particularly Manipur) and to identify the processes behind these events.

Results and Discussion

The relationship between global warming and rainfall events becomes important when viewed in the background of the ongoing warming of the Indian Ocean (Webster et al. 2005).The frequency of occurrence of Indian Ocean Dipole (IOD) years in the recent decades is high compared to the previous decades. The summermean Sea Surface Temperature (SST) anomalies show a warming of about 0.6°C in the central equatorial Indian Ocean (50°E-80°E and10°S-10°N). The summer monsoon rainfall in Northeast region is strongly related to the Indian Ocean SST anomalies. Topography, land use system and present drainage system of the state play an important role for flash floods. Heavy precipitation, breaching of river banks, inadequate drainage facility and siltation are the main causes of recent floods in Manipur (Sherjit L and Dhar I., 2017).

Agriculture is totally dependent on climatic conditions such as yearly rainfall, humidity, precipitation, sunlight, heat and dryness. No agricultural product is possible without water or rainfall. Draughts, floods, extreme heat, extreme coldness, heavy rainfall, cyclones are not favourable conditions of agriculture. The current and future vulnerabilities of the agriculture in North-eastern India are shown in the figures below.

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ISSN 2394 – 3386
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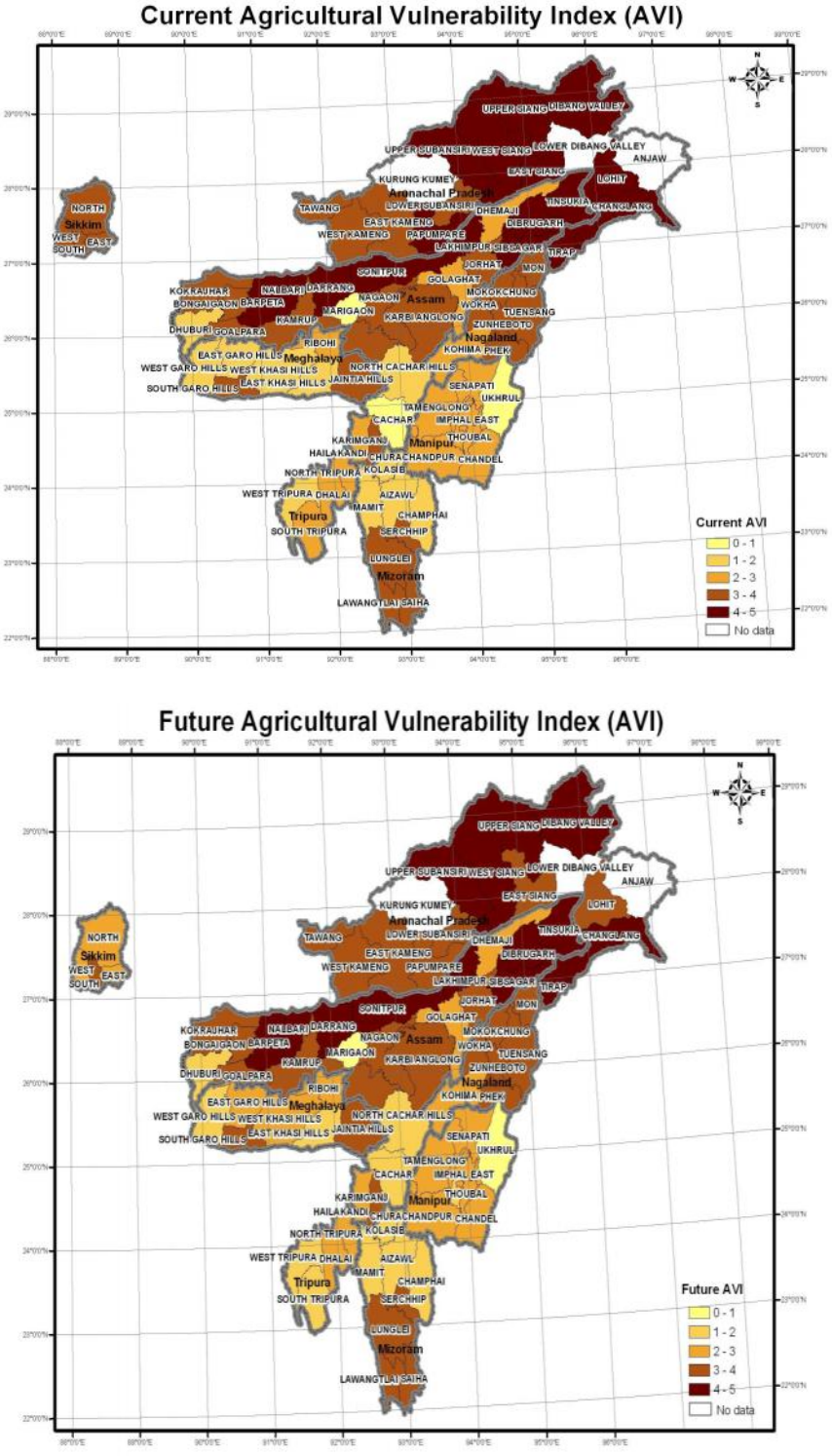

Figure 1: Distribution of Current and future Agricultural Vulnerability over the districts of Northeast India (Source: Ravindranath et. al, 2011).

Ukhrul in Manipur is the district with least agricultural vulnerability. Imphal East is projected to decrease from high to moderate levels. The district of Bishnupur is projected to exhibit decreased vulnerability from moderate to low levels. The other districts do not show much variability from the current scenario. Since

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agricultural vulnerability is a function of crop production and input, the high vulnerability of some districts may be attributed to the lower input levels (fertilizer, irrigation). In addition, the high relative variability and inter-annual variability of rainfall have created increased occurrence of droughts and floods in the recent times, leading to uncertainty in yield and increased agricultural vulnerability. Under the change circumstances with the change of climatic condition, there is every possibility of forest areas to become wasteland like situation and reasons for extinction of certain species which cannot adapt with the changing climatic condition. Forest degradation/deforestation is one of the main causes of climate change. So the forest has also to be conserved as it is not only a biodiversity hotspot but also it serves as a carbon sink to reduce greenhouse gas effect. As per a study carried out by Indian Institute of Science, Bangalore, no change is projected in the forest type within a short time up-to 2030s but districts like Bishnupur, Churachandpur, Senapati, Imphal East, Tamenglong and Chandel are likely to have high composite forest vulnerability index. The forest ecosystem might be vulnerable on account of the altitudinal and latitudinal shift of the species of the forest ecosystem on account of increased occurrence of forest cutting, forest fire, diseases, and invasive species. The impact of climate change is likely to affect the natural ecosystem of state in different ways. It will have a profound impact on the time of flowering, reproduction and harvesting season. There is probability of reduction of yield like rice and potatoes because of high rainfall, floods and draughts. As some of the species are likely to be extinct, it will disturb the food chain system resulting in the loss of some another species living on those species. The livestock and animal husbandry sector will be affected. Fishery and aquaculture will be affected by the changing/rising level of water, floods etc. The climatic variability in terms of rise in the average rate of surface temperature and changes in precipitation pattern are likely to enhance incidence of infectious diseases and increase in vector borne diseases such as Malaria, Japanese Encephalitis and Dengue.

Climate change and deforestation lead to vanishing of many springs in the state. It creates serious problems in hilly areas mainly in Ukhrul district of Manipur where spring is the main source of water. Warmer climate leads to uncontrolled growth of weeds in the lakes that pollute water. Increasing “phoomdis”(floating biomass) in Loktak Lake may be related to climate change (Sherjit S. and Mohon S, 2017).

During the southwest monsoon season, frequent floods are responsible for both human casualties and property damage as the powerful Imphal river flows are constricted through the narrow Imphal valley, fed by torrential rains during rainy season. The Indo-Swiss Bilateral Cooperation on Climate Change has taken up various projects and activities such as to strengthen the resilience of vulnerable communities, capacity building, risk assessment and raise public awareness on the impact of climate change in the state. Adaptation is needed to prepare communities, regions, countries and societies for the consequences of climate change. Adaptation is an expansive subject covering many sectors and socio-economic frameworks.

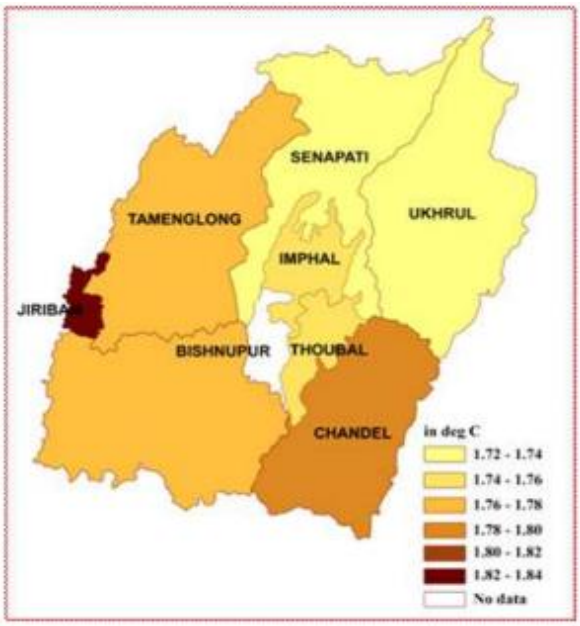

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Figure 2:District-wise projected increase in surface annual temperature (°C) for the period 2021-2050 (A1B SRES scenario) compared with baseline scenario (1975).(Source Prof.Ravindranath, IIS Bangalore)

Figure 3:District wise projected increase in annual rainfall (%) and JJAS rainfall for the period 2021-2050 (A1B SRES scenario) compared to baseline (1975), (Source Prof.Ravindranath, IIS Bangalore).

The United Nations Framework Convention on Climate Change (UNFCCC) defines adaptation as "adjustment in natural or human systems in response to actual or expected climatic stimuli or their effects, which moderates harm or exploits beneficial opportunities. Various types of adaptation can be distinguished, including anticipatory and reactive adaptation, private and public adaptation, and autonomous and planned adaptation" (UNFCCC, 2007).With growing interest in incorporation of adaptation into developmental programmes, two viewpoints have to be considered, adaptation to current climate variability and future climate variability. Parry et al (2007) suggest various types of adaptation measures, which are described below:

- Anticipatory adaptation: It is the form of adaptation that takes place before impacts of climate change are observed. It is also referred to as proactive adaptation.
- Autonomous adaptation: It is the form of adaptation that does not constitute a conscious response to climatic stimuli but is triggered by ecological changes in natural systems and by market or welfare changes in human systems. It is also referred to as spontaneous adaptation. It is essentially planning that should have taken place already but has not. For instance, traditional water harvesting systems to supplement household water supply.
- Planned adaptation: Is to plan for changes in the medium and long-term. It is the result of a deliberate policy decision, based on an awareness that conditions have changed or are about to change and that action is required to return to, maintain, or achieve a desired state.

India has already incorporated adaptation to climate change at various policy levels.

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Figure 4: Adaptive Capacity of India's State (Source: The National Intelligence Council, 2009)

Conclusion

Manipur is one of the most vulnerable states to climate change in India. In Manipur the poorest are especially vulnerable to current climate variability as well as projected climate change. There have been major improvements in India's response to climate change adaptation. However considerable adaptation deficit exists even under the current climate. Food production in the North East, particularly in rain fed conditions, is highly subjective, based on climate variability. Climate change will be an additional stress and will have direct consequences on food-production systems and indirect impacts on food security. These problems are aggravated by the climate-induced extreme events (floods and droughts) leading to low agricultural produce and massive soil erosion in the region

With greater understanding of India's risk and vulnerability to climate change it is important to accelerate its efforts further. Furthermore, the plan needs to make space for adaptation responses to be incorporated in relevant programmes, including those relating to watershed management, forest management, agricultural technologies and practices, and health.

In summary, adaptation to climate change is still a relatively new field of work. Apart from the high priority of reducing emissions of greenhouse gases through mitigation, the importance of dealing with inevitable impacts of climate variability and change through adaptation is being recognised. However more studies are required for better understanding the impacts of climate change in India especially north east India. Efforts are needed that can provide an understanding for implementing relevant policies at national and state levels.

Acknowledgement

Authors are grateful to the Department of Geology, Imphal College, Imphal for extending facilities and study materials to carry out the work. The first author is indebted to his colleagues of NEHU Shillong for their moral support. He wishes to express his thanks to faculty members of Department of Environmental Studies, NEHU Shillong and Department of Earth Sciences, Manipur University, Canchipur who gave him deep knowledge of Environmental Geology.

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