

Impact of climate change on the Manipur ecosystem: an overview

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Abstract

Climate change is a global phenomenon and one of the burning issues in the present scenario. This article provides a description of the impacts of climate change on Manipur's agricultural, woodland, and wetland ecosystems; a north-eastern Indian state. Some major findings in the correlation with the effects of climate change on different ecosystems have been discussed however the more observations in the context of climate change are still to be inextricably linked. The impacts addressed in the area are rare and in many cases do not require a common methodology and standard instrumentation and only based upon the literature survey by pre-existed researches done on the regard of climatic changes and its influence in Manipur ecosystem. The impacts of climate change were also classified based on the most recent different climatic elements, such as heavy rains, temp, CO₂ concentration, etc. Also there is need to interface with some other potential researchers in concern subject to make use of synergies in the best interests of subsistence and to ensure the safety of the livelihoods of the inhabitants of the province and of the adjoining grasslands.

Keywords: Mitigation, Manipur ecosystem, Global warming, Impact assessment, Climate change, Vulnerability.

1. Introduction

Climate change is a worldwide phenomenon and a raging problem in the 21st century with a potential negative impact on the global economy and society. Due to disturbance in natural balancing green's house gases and increasing anthropogenic activities like industrialization, globalization, forest fire, carbon emission from fossil fuel etc. have been making the blanket of green's house gases enhancing the global warming. Besides this it also alter the heat radiated from lower atmosphere and earth surface and reradiated to atmosphere since green's gases absorb outgoing radiation. In results, there is change in temperature, rainfall, humidity etc. resulting outbreak of disease, change in forest ecosystem, biodiversity, water physiochemical and biological characteristic and socio-economic problem[1].

According to the IPCC, climate change is referred to as change in the state of climate which can be defined by increasing the mean or variation of its characteristics and lasts for an extended period of time, usually ten years or further. Simply, it means there is any change in climate overtime due to disturbance in natural balance or influence of human activity [2]. Climate change mean long term chance in average weather pattern over a

period of time which may range from a decade to a millions of years. Change in natural ecosystem and increase human activities help in causes climate change indirectly or directly.

Climate change may occur in a specific region or across the world. Green house's gases are contributing to increase the atmospheric temperature and causes global warming. Global warming refer increasing atmospheric temperature near the earth's surface and ocean. GHGs like water vapour, CO₂, CH₄, ozone (O₃) and N₂O have a capable of absorb the infrared radiation frequency and this incoming insolation frequency causes vibrate and irregular dipole movement thus causes the greenhouse effect[3].

The zones of Manipur that exercise cereal based farming have been worst affected by the impact of climate change. The hilly regions of Manipur are primarily rice-growing state and paucity of irrigation facilities. The area is also biologically fragile and the soil drainage is strong [4]. Agribusiness is also at risk. Food safety in the field might be undermined if scientific approaches in the agriculture of the areas are not taken into account. Given North East India's heavy emphasis on farming, which then in effect is heavily dependent on weather suitability, any slight unpredictable climate shifts (particularly rain and temperature) may theoretically jeopardize the food and socioeconomic safety of the Manipur residents. Climate change vulnerability appraisals will therefore be main tools for developing climate change adaptation techniques where appropriate such as climate variability and extents[5]. However it is a function of the nature, extent and intensity of climate change that the system is subjected to, its sensitivity, and its capacity to evolve.

2. Climate change in Manipur

Manipur is a small north eastern state of India with GPS coordinate between 23° 83'N-25°68'N and at longitude in between 93°03'E-94°78'E with gross geographical area of 22,237sq.km. Manipur have state bordering with Nagaland, Mizoram, Assam one international border with Myanmar. It has a favorable climatic condition, not so hot in summer nor so cold in winter. And 905 of total geographical area is cover with evergreen forest and total population of Manipur is 28.56 lakh with a population density of 128 persons per kilometer according to 2011[6].

2.1. Factors influencing the climate change of Manipur

- a) Geographic features of Manipur such as terrain diversity, altitudinal variation, windward position, lake, river regime and natural ecosystem.
- b) Anthropogenic activities like industrialization, urbanization, population growth, deforestation/degradation of forests, increasing burning of fossil fuel, poor chimney, lack proper waste disposal etc.[7].
- c) Effect of seasonal winds, the North-East monsoon blowing from land to sea and the South-West monsoon blowing from sea to land covering the Indian Ocean, the Arab Sea and the Bay of Bengal [8].

2.2. Impact of climate change in Manipur ecosystem

Forest play an important role in global climate change and act as a 'carbon sink' by trapping CO₂ from the atmosphere and 'carbon resource' due to burning of forest biomass and decomposition of plant debris[9]. Due to climate change, there is change in environmental condition of Manipur's forest like increase annual temperature, affecting precipitation pattern, climate variability, frequency and intensity of extreme weather will lead to disturb the native forest ecosystem of Manipur and give a chance to establishment for invasive alien species(ALS)[10] like establishment of *lantana camera* (sambal lei), *eichornia crassipes* (kabo kang) etc. This ALS has a potential to survive at severe environmental condition, disease resistance and can create a surviving competition with indigenous plants and affected the forest of Manipur. This ALS had a potential to stem human disease like allergic, small pox and cholera [11].

a) Impact on Forest ecosystem

Forest insect and disease are major disturbance in forest ecosystems of Manipur. Change in forest spp. and climate had a chance to cause outbreak of insect and disease directly and can affect forest. Dry and warmer climatic condition is favor for bamboo flowering[12] which help in outbreak of rodenticide. Forest ecosystems is habitat of many flora and fauna species and change in climatic lead to alteration the forest ecosystem and give an opportunity to invade the invasive species[13].

b) Impact on Temperature

Temperature in Manipur is greatly change from last two decade (1950-2009) and there is increase temperature in summer from 20 °C to 36 °C and there is decrease in number of wetland[14]. Change in climatic condition of Manipur have an effects on parasitism population in freshwater. Increase temperature of water, drying up wetland, alteration in fish metabolism and physiology, increase the concentration of host is positively correlated to parasitism population and transmission rate of parasitism to host. Due to change in temperature, there is new record of parasitism species in fresh water of Manipur like *Ichthyophthirius*[15].

c) Impact on agricultural activities

Agricultural activities in Manipur had an impact if there is any change in climatic condition since it agriculture is depend on the rainfall. Effect of climatic change in agriculture of Manipur is constructed at different district level. The indicator of climatic change effect in agriculture is based by several index and vulnerability indices are categorized into less vulnerable, moderate vulnerable and high vulnerable. The mean annual precipitation and mean annual temperature is directly correlated agriculture activity of Manipur [16]. Again, annual rainfall of Manipur is high due to climatic change and this change in rainfall intensity will increase the leachate of nutrient from soil, keep the soil in more acidic. Iron and aluminum percentage in soil in increase and all other

nutrient were leachate due to lower pH value of soil[17]. Fe is micro nutrient for crop cultivation but too much iron in soil will create disease in crop like bronzing in rice leave[18].

d) Impact on wetland ecosystems

Wetland ecosystem like river, lakes, marshes give many services to human population and wildlife also. They are home of many microbe and wildlife, so it is called as biological supermarket and they are life of many people surrounding it. Due to change in nature and magnitude of climatic condition causes to modification of hydrological regime. This change in hydrological regime include, change in temporal and spatial water levels and its role to manage the causes of drought and flood[19]. The effect of climate change in wetland is depending on type of wetland, nature and location. Change in precipitation and evaporation of a lake causes change in water budget and hydraulic residence time of lake. Wetland which had shallow in depth and large surface area are more vulnerable in climate change. Again, warmer the air temperature due to global warming cause to rise the temperature of surface water by sensible heat transfer or by radiative transfer. Warmer surface water will have less density and can causes to create a thermal stratification of wetland and deep water become more cooler due to climate change and prevent nutrient exchange of different layer of water[20].

e) Impact on nutrient availability

Light and nutrient availability of a wetland will change if there is any change in climatic condition of a wetland and this change in nutrient availability and light will affect the species composition of a wetland which turns impact on higher food trophic level[21]. Change in species diversity will help in change in water quality in lake including releasing of taste and odor compound, decrease DO, increase COD, BOD, TDS, disturb zooplankton feeding, algal blooms. Warmer climatic condition of wetland or lake will lead to increase anoxia and increasing phosphorus loading to sediment which leads to algal bloom in the lake and turn to eutrophication of wetland. Many aquatic animals are sensitive to temperature even if there is any small change in water temperature. Due to increase in water temperature, cold water species are so vulnerable because there thermal tolerance limit is exceeded. Again change in water temperature also disturb the spawning of fish and their migratory behavior[20].

3. Socio-economic and health impacts

Climatic change can in a variety of ways which impacts the socio-economic environment of Manipur and also every part of the world. It may affect the economy along with human health (e.g., agriculture, livestock, forestry, tourism, fishery, etc.). The World Health Organization reports that the rising temperatures and variable precipitation due to climate change that has occurred since the 1970s claimed over 140000 deaths. Globally, weather-related natural disasters result in over 60 000 deaths every year, mainly in developing countries. Detailed knowledge and information on human well-being in the Manipur remain minimal, although

it is obvious that people would feel the impact of climate change in their lively hood, health and the protection of natural resources, amongst other things[22]. Availability of agricultural products is affected by climate change directly through impacts on crop yields, crop pests, diseases, soil fertility and soil water-holding properties. Economic inequality, poor infrastructure, dependency on subsistence farming outlets makes Manipur susceptible to climate change. One of the most serious impacts of climate change is how it is affecting water resources around the world. Water is intimately tied to other resource and social issues such as food supply, health, industry, transportation and ecosystem integrity[23]. Climate change directly affects human's fitness (e.g., injury in floods and storms, impacts of thermal stress) and indirectly by alterations in disease vector ranges, air quality, water quality, food and productivity supply, endothelial dysfunction and lung diseases, spread of epidemiology and crop loss shortage. The distributions of vector species of mosquito that alter with an increase in surface temperature and trends in rainfall patterns. Climate change often endangers the cultures and traditions of native peoples by influencing the ecosystem and resources of tribal societies [24]. Despite fewer plants and animals for use in cultural traditions or sacred ceremonies, native culture and lifestyles can be significantly impacted. A further issue is that climate change may provide for the emergence or introduction of more malignant diseases species or more effective vectors into new locations.

4. Research and development concerns for ahead policy

Taking into account the potential effects of climate change on Manipur environment covering certain important places, researchers and policy makers should pay close attention. Several of the interesting research fields could also be:

- a) Policies on adaptations must be well developed that can facilitate adaptation by legislating practices which can reduce vulnerability. Better land-use planning, for example, might help to keep away from flood-prone areas, and stricter building codes might help reduce the effects of serious happenings.
- b) Collection of climatological data including standard technique and percussion.
- c) Geoengineering implementation may sometimes require systematic global distortions of the climate system [25]. Geoengineering may help reduce greenhouse gas concentrations in the atmosphere, gradually reverse the warming effects of growing greenhouse gas concentrations on the climate system, target specific impacts of climate change, or provide desperate solutions in the situation that sudden, disruptive or otherwise undesirable effects of climate change became apparent.
- d) Burning of coal, oil and natural gas must be removed. This may be the most difficult challenge because wealthy people literally feed, wear, work, play and even sleep on products manufactured from these prehistoric sunlight[26].
- e) 33 million acres of forest are cut down each year. Many of the possible trees used for constructing home interior designers such as timber harvesting alone through the tropics add 1.5 billion metric tons of carbon to the atmosphere. This reflects 20 per cent of human-made greenhouse gas emissions and a fairly easily avoidable source. These will eventually help to a certain degree in managing climate control[27].

- f) Water conservation also decreases carbon pollution. This is because boiling, heating and treating water require a lot of resources. So take bigger showers, turn off the tap while brushing your teeth and switch to fixtures and appliances labelled with Water Sense. The EPA estimates that if only one out of each 100 households in India were retooled with water-efficient systems, around 100 million kilowatt-hours of electricity would be preserved annually — averting 80,000 tons of global warming emissions.

5. Conclusion

Due to climate variability and climate change, agricultural sector in Manipur and its regions could be adversely affected. Throughout the current study, an effort was made to evaluate the sector's susceptibility to climate change and climate variance. In contrast with mountain districts, the hill provinces of Manipur are observed to be more susceptible. There is unevenness in the rising surface temperatures among different time periods in one year. Such findings along with the adverse effects of climate change incidents are contributing to the significance of regional climate change. In the future, the interplay between the different Manipur ecosystems will play a crucial role in the regional environment. Such overlapping effects demonstrate why another effort should be made to recognize the uncertainties in climate change science, especially at regional level. Advancements in the empirical network, regional climate modeling and much more socioeconomic knowledge are also important. Science based action is therefore necessary from government of Manipur and local communities in order to create a stable climate framework that will alter to some degree the detrimental effects of climate change.

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