

## Climate Change: Altering the River ecosystem of Manipur

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### Abstract

Climate change is altering river ecosystems and their services by disturbing the aquatic species or indirectly affecting the migration of species. These changes would result in severe disasters such as floods and droughts. Just as rivers symbolize climate threats, rivers also provide the source of powerful solutions. It is the right time to come together as a river and clean water movement to ensure decision makers at every level to enhance resilience to ongoing changes. Whether we are impacted by pollution, heat, flood, or drought, these difficult challenges require unprecedented cooperation around water and rivers. The Intergovernmental Panel on Climate Change (IPCC) released its Sixth Assessment Report 'Rivers and Clean Water are at Risk' on the physical science basis of climate change. Conservation and management of the river ecosystem of Manipur is a state priority, our own priority.

**Keywords:** climate change, rivers, flood, drought, aquatic, IPCC, Manipur

### Introduction

Rivers are considered as the most sensitive of all the ecosystems to the impacts of climate change, both directly and indirectly by the combination of various other stressors (**Durance & Ormerod 2007, 2009**). River networks provide an important route for commerce, exploration, hunting, and cultural traditions. Rivers are well known as a source of drinking water and offer essential recharge to groundwater aquifers. In particular, Rivers are connectors and connect mountains to the sea, map migration routes for birds, fish and animals, and travel routes for people etc. Long back, the water of *Nambul turel* was clean and navigable that of '*Hee-Honba*' starts their journey from '*Thanga-Karang*' to '*Thong Nambonbi*' early in the morning with their local vegetable's products from Loktak *pat* and return down the river after finishing their businesses at '*Khwairamband Keithel*,' is one of the perfect picturesque during the time. On the other, *Thongjaorok turel* is an excellent example of asymmetrical basin. The bird 'Black headed bunting' was sighted for the first time in *Thongjaorok turel*. Furthermore, the *Iril turel* is the largest and longest tributary of *Imphal turel*. The presence of indigenous fishes like *Ngaton*, *Khabag* and *Sareng* was captured by the local fisherman in the month of July and August was remarkable. The *Kongba turel* was considered as one of the most important rivers for the traditional communities of Meitei, the major inhabitants of the State. The *Imphal turel* flows on the east of Historical *Kangla* fort and forms a natural protection of the capital from

enemies. The river was used by Japanese soldiers to reach the capital Imphal during the Second World War. In describing the biophysical structure of the State, Iril, Imphal and Nambul rivers are regarded as the main arteries of the body, *Koubru* being the head and *Loktak pat* as the pelvic zone. Now, in this era of climate variability and change, the scales of climate changes are exceptional and in the coming years, the risks would be much more intense. The impact of climate change on a river brings a plethora of consequences which affect the entire dynamics of the river, such as water resource management (Middelkoop et al. 2001; Alcamo et al. 2007; Pahl-Wostl 2007; Kundzewicz et al. 2008), water quality (Delpla et al. 2009; Whitehead et al. 2009), eutrophication (Feuchtmayr et al. 2009; Rabalais et al. 2009; O'Neil et al. 2012), acidification (Sabine et al. 2004), accumulation of toxic substances (Gouin et al. 2013; Landis et al. 2013), hydromorphological changes (Boon & Raven 2012), catchment land-use changes (Oliver & Morecroft 2014), and invasion of exotic species (Hellmann et al. 2008; Rahel & Olden 2008) etc. A number of studies on the effects of climate change on riverine systems have also been carried out (Verghese & Iyer 1993; Gosain et al. 2006, 2011; Boon & Raven 2012; Hosterman et al. 2012; Deshpande et al. 2016; Hosseini et al. 2017). The changes would result in severe disasters of floods and drought but also help in reducing the carrying capacity as well as assimilative capacity of the river. This led to serious threats to the survival and existence of different varieties of aquatic floral and faunal species, including human population etc. Moreover, increasing urbanization and development help to degrade the pristine quality of the river. Thus, the effects of changing climate on the river will certainly influence many other associated ecosystems too. Therefore, the utmost importance of this hour is to study the impacts of climate change on the river's ecosystems and services.

Today, Rivers in Manipur are polluted, degraded and level of water decreases because of various anthropogenic activities. Highly contaminated brownish colour water, sewage and garbage are seen at various part of the river flow. Many factors are responsible for altering the ecosystem and services of rivers; climate change is among them. As of now, climate change is ruling the State of Manipur by disturbing the temperature, changes in rainfall pattern, precipitation fluctuation and relative humidity etc. Scientifically, as climate warms, many of the ecological systems are experiencing higher temperature resulting to water related problems and issues. Over the years, the condition of rainfall is very erratic as well as the nature of rainfall pattern differs from place to place drastically. The variation in both temperature and precipitation reflects the physical effects of change in river ecosystem. As a result, altering the river ecosystem and services not only affect the species distributions but also the species richness patterns at this era. Studies suggest that global terrestrial carbon loss to rivers lies between 3.2 and 4.2 billion tonnes per year.

### Materials & Methods

1. **Study area:** River flowing in valley districts of Manipur (Nambul, Sengmai & Thoubal River)
2. Collection of primary data
3. Collection of secondary data through analysis of government reports, climate data and research studies

### Result & Discussion

The present study focused on key water quality parameters such as turbidity, total dissolved solids (TDS), and dissolved oxygen (DO), which are widely recognized as important indicators of water pollution and ecological system health. A detailed analysis (physical and chemical) of water sample of Nambul, Sengmai and Thoubal river is given below. Based on the parameters analysed, the water sample is above the acceptable limit, rendering it unacceptable.

#### 1. NAMBUL RIVER

SI No	Tested parameters	Observations		BIS acceptable limit (IS 10500)
		Site I	Site II	
1	Total dissolved solid (mg/l)	260	225	500
2	Turbidity (NTU)	20.40	52	1
3	Dissolved oxygen	0.40	0.61	

#### 2. SENGMAI RIVER

SI No	Tested parameters	Observations		BIS acceptable limit (IS 10500)
		Site I	Site II	
1	Total dissolved solid (mg/l)	88.00	87.00	500
2	Turbidity (NTU)	36.00	81.60	1
3	Dissolved oxygen	5.68	5.88	

#### 3. THOUBAL RIVER

SI No	Tested parameters	Observations		BIS acceptable limit (IS 10500)
		Site I	Site II	
1	Total dissolved solid (mg/l)	105.00	102.00	500
2	Turbidity (NTU)	23.60	132.80	1
3	Dissolved oxygen	7.50	7.50	

Regular monitoring of these parameters is essential to ensure safe drinking water, sustainable agricultural practices, and the protection of aquatic biodiversity. Therefore, effective water resource management and pollution control strategies should focus on maintaining these parameters within permissible limits. Moreover, the impacts of climate change may be more severe in these three rivers due to the urbanization and biodiversity dependent on it. Rising temperatures and altered discharge patterns, combined with existing anthropogenic pressures, are expected to significantly influence water quality and ecosystem stability. Rivers also receive thermal inputs from their catchment areas, which influence water temperature dynamics (Webb et al., 2008). Temperature variations are closely linked to changes in precipitation patterns (Shrestha et al., 2017). Studies suggest a mixed pattern of precipitation changes under climate change scenarios, with increased rainfall and flood events in certain

seasons, and prolonged drought conditions in others due to elevated temperatures. Changes in precipitation intensity and distribution are expected to increase nutrient loading in rivers through enhanced soil erosion from agricultural lands and surrounding catchment areas (**Rahman et al., 2016**). Altered flow regimes may significantly affect riverine habitats and biological communities. Reduced river discharge can lead to lower dissolved oxygen concentrations due to decreased aeration and dilution capacity, thereby increasing the risk of eutrophication (**Bocaniov et al., 2016**). Furthermore, higher evaporation rates coupled with reduced precipitation are likely to lower surface water availability and groundwater levels, ultimately intensifying water scarcity and ecological stress.

### Conclusion

A healthy river is defined as the community's first line of defence against climate impacts, offering clean water supplies, cost-effective flood protection, safe places to recreate and stay cool, and a connection to culture. It is the right time to come together as a river and clean water movement to ensure decision makers at every level to enhance resilience to ongoing changes. Whether we are impacted by pollution, heat, flood, or drought, these difficult challenges require unprecedented cooperation around water and rivers. Another very significant aspect in the management of the river is effective policy planning. Public participation is also essential in governing water-related issues. Thus, a decentralized approach to planning is vital for the effective implementation of schemes and positive outcomes. River flow monitoring on a regular basis is also essential to determine the climate change-induced alterations in flow pattern (**Palmer et al. 2009**). There should also be efforts for the management of nearby land areas, and anthropogenic activities should be minimized. Infrastructure development and industrial agglomeration along the river need to be curtailed in order to lessen the pollution load in the river. Moreover, bridging the gap between scientific/technical interventions and spiritual consciousness can be an effective step for the rejuvenation of the River Ganga.

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