

IMPACT OF CLIMATE CHANGE ON RIVER GANGA: RECENT STATUS AND MITIGATION

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Climate change and climate variability is a major attraction for the researchers. The impact of climate change over the years has certainly affected the largest river system of the country Ganga in different ways. The change is vivid from the effect on fish physiology and ecology of river Ganges through temperature fluctuation across the stretch. Further, the impact can also be perceived through impact on natural fish seed production of the river as depicted in several published data. In this regard, the present article provides compact information about the impact of climate change on the ecology and fisheries of river Ganges.

Introduction

Climate change and climate variability is a major concern and received the attention to the researchers. The ill-effects of climate change can destroy the bond between abiotic and biotic factors of the ecosystem. The term climate change denotes the shifting of global weather patterns that persist for a longer period, may be decades or more and the report of climate trends has shown varying situation in major river basins of India, among them, in the Ganges River basin, temperatures have increased by 0.20 to 0.47°C while rainfall decreased by 257-580 mm over the past few decades. The impacts of global climate change are already perceptible in various factors of the environment i.e. melting of ice, glaciers shrinking. Changes in the timing of precipitation combined with rising levels of water pollution will create pressure in ecosystems and threaten the survival of many fish and wildlife species. Moreover, the climate change

affected almost all the ecosystems of the world.

Rivers are considered as one of the vulnerable ecosystems in the world. Moreover, rivers are also stressed directly or indirectly due to the impacts of climate change. Mighty rivers the Ganga support many other ecosystems as flood plains, wetlands, estuaries along riparian areas by providing water, nutrients, and energy. Impact of climate change on river Ganga influence the hydrology and dynamics of the river and also create severe threats to the survival and existence of aquatic life including floral and faunal diversity¹. The present compilation highlights the observation made on climate change research in Ganga river and discuss strategies which can provide suitable management directions to reduce the risk of climate change.

Impact of Climate Change on Fish

Almost all fishes are obligate poikilothermic and influenced by the surrounding water temperature from the spawn to the adult. The ecosystem of Ganga River has experienced atmospheric temperature rising thus resulting in abnormalities of the heat budget of the riverine ecosystems. Climate change can affect almost every situation of an individual fish's life including habitats, survival, growth, reproduction, and successful hatching,

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as well as metabolic demands. A predictive climate models have indicated rising trend of mean annual temperature of 1–4°C in Ganga River basin up to 2050². The studies shown that combined effect of climate change and anthropogenic vulnerability affects biotic and abiotic and communities in aquatic ecosystems. Change in plankton assemblage, composition, diversity and structure toward dominance of fewer species have been reported due to warmer and fluctuating temperature conditions. Direct or indirect response from many species of plankton have evolved in response to the climate signal. The impact of climate and ecosystem abnormalities on tiny planktons showed seasonal differences³.

Recent studies have indicated decrease of rainfall by 56% over 133 districts along entire Ganga basin largely due to climate change⁴. Freshwater fish have already experienced for changes in their distributions and habitat alteration in response to recent climatic changes. The positive influence of climate change in Cyprinids fish family was reported earlier⁵. Natural recruitment of IMC's in the Ganga River System has been largely affected, resulting in declining in fish spawning due to impact of climate change. On the other hand, considerable decline in fish seed availability have been noticed from 78.82 % (1960's) to 34.48% (2004)⁶.

The Inland Heat waves (HWs) have been observed globally expecting to amplify in magnitude and frequency under anthropogenic climate variation⁷. The first study³ on impact of heat waves in a stretch of Ganga River and a wetland of West Bengal indicated predominant and periodic occurrence of inland heat waves under 'caution' category over these ecosystems during summer months (April-July). The analysis revealed IHI influenced pH, transparency and water depth positively and TDS, salinity and conductivity negatively indicating that heat waves may affect the water quality thereby affecting the sustainability and survival of aquatic life and IHI affect plankton concentration and diversity thereby altering the food composition of the planktivorous fishes in the ecosystem.

In recent few decades several fish species showed extended breeding season (*Catla catla*, *Labeo rohita*, *Cirrhinus mrigala*, *Liza parsia*, *Tor putitora*, *Oncorhynchus mykiss*, *Schizothorax richardsonii* and *Puntius sophore*). Shifting of breeding season was predicted for *Mystus tengara*, *M. cavasius*, *Eutropiichthys vacha*, *Mastacembelus armatus* and *Ompok bimaculatus*). Modeling pre-spawning fitness and climate referendum towards fishes is necessary to realise the impact of climate change on species level including prediction in future

scenarios and also to identify climate resilient and its possible impact on sensitive species^{3, 8}.

Climate Change Impact on Fish Seed Production

Previous reports on fish spawn availability from the river have indicated decreasing trend of wild IMC spawn (10%) during the period 2005-2009 in percent contribution compared to other fish stocks (90%). On the other hand, considerable decline in fish seed availability have also been noticed from 78.82% (1960's) to 34.48% (2004)⁹. The number of fish spawn (approx.) varies greatly depending upon the time of commencement of monsoon. Generally, the entire Ganga River basin receives heavy rainfall (80%) during the period from June to September with average of about 1200 mm. However, recent studies have indicated decrease of rainfall by 56 % over 133 districts along entire Ganga basin largely due to climate change. As a result, the river experiences several floods during the collection period i.e., extending over a period of 30 days. The bulk appearance of the spawn is observed only during first two floods during the peak season, while the remaining yield only traces of spawn. The first flood which contribute maximum of the spawn commences very late nowadays owing to delayed monsoon. However, on the other side, the operation also reaches its peak when the river water appears a reddish tinge in colour owing to the addition of water of river Son from north. It appears generally by last week of July and retains till 1st week of August. This is the probable reason behind the shorter span of collection time.

Conclusion

Climate change adaptation influence habitat changing in aquatic environment as species will tend to follow their preferred thermal niche in surrounding ecosystem. Precipitation changing patterns during summer and winter are also expected to increase the nutrient load in rivers leads to increasing erosion in river beds and associated catchment areas. Rising temperature enhance the melting intensity of glaciers which affect the river flow and makes catastrophic changes in ecosystem and it associates. Freshwater fish species are more vulnerable to climate change and at high risk of extinction. Climate changing also promote the habitat adaptation of exotic fish species which become a major threat for native fish species in Ganga. The current knowledge on climate change impact on lotic aquatic ecosystem is limited. The study suggests more research relating the climatic and anthropogenic influences in a more systematic way. □

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