Ecological risk assessment in surface water quality of River Ganga System using HPI vis-à-vis PTEs toxicity

GAGAN MATTA*, AVINASH KUMAR, ANJALI NAYAK, PAWAN KUMAR

The aim of this study is to determine the spatio-temporal variation, source identification and pollution index of 11 Potential Toxic Elements (PTEs) in Ganga River water, Uttarakhand, India. The observed concentrations of PTEs were found below the permissible level proposed by BIS (Bureau of Indian Standards) for drinking purpose, except Fe, Mn, and Cd in river water samples during the study period. The higher Heavy Metal Pollution Index (HPI) value was evaluated for monsoon season (40.95) followed by post-monsoon (37.67), summer (6.03) and winter season (3.21) whereas higher HPI (31.46) was estimated at downstream site (site-9) and lower value (15.01) was reported for upstream site (site-1). The overall HPI results were found below the critical index value (100). The Principal component analysis (PCA) along with cluster analysis (CA) was applied to deduce association and to ascertain the main accountable sources of water quality degradation. The high concentration of Fe, Mn and Cd highlights the geogenic inputs, agricultural and at some places industrial waste runoff in the river water which makes it unsuitable for direct consumption for drinking purposes. Therefore, proper monitoring, follow-up of legislation, are required for the River conservation.

Keywords: Heavy metal toxicity, River Ganga, Uttarakhand, Heavy metal indexing, PCA, CA

Introduction

Water quality is considered to be an important factor for human health, a status of disease and river water quality in a region, mostly affected by both anthropogenic inputs and natural disasters (Kazi et al. 2009; Matta et al. 2018). Surface water pollution with physicochemical and biological factors due to human activities is of high interest in all around the world (May et al. 2006; Ouyang et al. 2006; Noori et al. 2010). River water systems refer to the water naturally exposed to the atmosphere, e.g. lakes, rivers and reservoirs water (Noori et al. 2010). Rivers play a significant role in watershed for carrying-off domestic, commercial wastewater and agricultural run-off, and are one of the most sensitive aquatic bodies to pollutants (Singh et al. 2004; Singh et al. 2005; Wang et al. 2007; Matta et al. 2018a; Matta et al. 2018b). In Indian sub-mainland, the River Ganga system support at least 25,000 types of microorganisms and well-evolved creatures, it fills in as a lifesaver to the populace more than 500 million individuals.

In June 2014, The Namami Gange programme was approved by the Union Government of India as an ecological venture to enhance the effect of abatement of pollution, rejuvenation and conservation of River Ganga. It was the most significant single endeavour on the planet to tidy up a sullied waterway yet did not make any progress concerning contamination control and improvement in stream water quality. The essential reason for a disappointment of Ganga Action Plan might be straightforwardly associated with the ecological administration and arrange which incorporates human-condition connection, and so forth (MoEF, 2009). Human interventions has become a great challenge to the world to maintain ecological integrity and to prevent the unsustainable use of rivers water. Water pollution, construction water diversions, dams, changing in land use pattern, sedimentation, deforestation, chemical toxicity, soil erosion and climate change are causing the major threats to the ecology of Ganga River basin (Sarkar et al. 2010, Sinha 2014).

Human activities are mainly responsible for having an impact on river water quality by emitting vehicular emission, effluent discharges and the fertilizers in agriculture, in addition to the high consumption of water resources (Niemi et al. 1990). Due to which enormous stress in the form of heavy metals, has generated on water bodies, which leads the decrease in water quality, biodiversity and the overall reduction in quality of life for the local population (Herrera-Silveira & Morales-Ojeda, 2009). The regular discharges of municipal, industrial wastewater, agriculture run-off and due to the climate change, all affect the river water quality. However, rivers are the primary freshwater sources for agricultural irrigation, industrial and domestic uses in any region (Yu & Sang, 2003), river water quality is essential factor directly relating to human health and living organisms (Kazi et al. 2009). For that reason, it is vital and necessary to possess authentic information on water quality parameters for remedial measurements and management of pollution.

It is, therefore, necessary to prevent and control water pollution and to implement regular monitoring programs. For

Dr. Gagan Matta* (Assistant Professor), Avinash Kumar (PhD student), Anjali Nayak (PhD student), Pawan Kumar (PhD student) Hydrological Research Lab., Department of Zoology & Environmental Science, Gurukula Kangri Vishwavidyalaya, Haridwar, India

Coresponding Author: drgaganmatta@gkv.ac.in

267