INDIAN INSTITUTE OF TECHNOLOGY GUWAHATI
SHORT ABSTRACT OF THESIS

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Thesis Title: Assessment and Modelling of River Water-Sediment Pollution Load based on Spatial and Temporal Variations

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SHORT ABSTRACT

This doctoral thesis attempts to understand the interrelationship between the two critical components of river ecosystem, i.e., its surface water and benthic sediments, as sediments are said to source and sink many contaminants in a river. In order to fully understand the aspects of the river ecosystem, the study has been divided into five objectives to get a better understanding of pollution load in surface water and benthic sediments, their sources and the need for monitoring and treatment. In the first part of **Objective I**, a survey of the probable catchment area of the river was carried out to select the sampling locations from which surface water and benthic sediment samples were collected. Sampling and analysis of surface water were carried out for 21 parameters at 18 different sites, whereas sampling and analysis of benthic sediments were carried out for 9 parameters, particularly heavy metals, at 9 different sites. The analysis of surface water samples revealed that with respect to pollution load, heavy metals present a higher risk to the consumer of surface water of Kolong river. The aim of the second part of **Objective I** was to use the analysed surface water samples to evaluate the drinking water quality using fuzzy logic and information entropy. Fuzzy logic based index, i.e., fuzzy water quality index (FWQI) results are more stringent than information entropy based index, i.e., entropy weighted water quality index (EWQI), as it is more sensitive to parameter variation. The aim of **Objective II** was to assess the benthic sediment quality or load in the river using total metal concentration and metal speciation fractions based indices. Total metal concentration based indices include geoaccumulation index (I_{geo}), pollution load index (PLI), enrichment factor (EF), potential ecological risk of individual metal (E^i_r), potential ecological risk index (PERI), and metal speciation fractions based indices, include pollution index (I_{POLL}), mobility factor (MF), individual (ICF) and global contamination factors (GCF), modified ecological risk index (MRI). After comparing both types of indices, it was found that the speciation-based index quantifies the risk associated with heavy metal contamination better as the indices developed using this approach gave consistent results and gel well with the variation of the dataset.

After establishing the pollution load in surface water and benthic sediment of the river, **Objective III** identified the latent sources of pollution using environmetrics tools such as cluster analysis (CA), discriminant analysis (DA), principal component analysis (PCA) and positive matrix factorisation (PMF) on the water quality variation and sediment quality variation. PCA, Pearson correlation and PMF revealed that pollution in the winter and post-monsoon months attribute to domestic discharges and metal pollution. Moreover, another pollution source gets added in the monsoon and pre-monsoon months due to heavy precipitation in the region, which brings the agricultural or surface runoff quotient of pollution into the river. Till objective III, the assessment was carried out based on data collected during the study period, but to evaluate the effect of prolonged exposure to heavy metals on the human population, health risk assessment was carried out in **Objective IV** using deterministic and probabilistic approaches. Heath risk assessment revealed that the dermal pathway could be a root cause for carcinogenic and non-carcinogenic risk and children being at higher risk than adults. Finally, in **Objective V**, linear regression and AI were utilised to develop two regression based predictive models to estimate the heavy metal concentration in the surface water of the river. Among the models developed using different techniques, the random forest models had better efficiency in predicting the concentration of heavy metals.