Economic and efficiency based optimisation of water quality monitoring network for land use impact assessment

ABSTRACT

The evaluation of the importance of having accurate and representative stations in a network for river water quality monitoring is always a matter of concern. The minimal budget and time demands of water quality monitoring programme may appear very attractive, especially when dealing with large-scale river watersheds. This article proposes an improved methodology for optimising water quality monitoring network for present and forthcoming monitoring of water quality under a case study of the Selangor River watershed in Malaysia, where different monitoring networks are being used by water management authorities. Knowing that the lack of financial resources in developing countries like Malaysia is one of the reasons for inadequate monitoring network density, to identify an optimised network for cost-efficiency benefits in this study, a geo-statistical technique coupled Kendall's W was first applied to analyse the performance of each monitoring station in the existing networks under the monitored water quality parameters. Second, the present and future changes in non-point pollution sources were simulated using the integrated Cellular Automata and Markov chain model (CA–Markov). Third, Station Potential Pollution Score (SPPS) determined based on Analytic Hierarchy Process (AHP) was used to weight each station under the changes of non-point pollution sources for 2015, 2024, and 2033 prior to prioritisation. Finally, according to the Kendall's W test on kriging results, the weights of non-point sources from the AHP evaluation and fuzzy membership functions, six most efficient sampling stations were identified to build a robust network for the present and future monitoring of water quality status in the Selangor River watershed. This study proposes a useful approach to the pertinent agencies and management authority concerned to establish appropriate methods for developing an efficient water quality monitoring network for tropical rivers.

Keyword: Monitoring network; Water quality; Geo-statistical; Kendall's WAHP; Land use change