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A Rapid Test to Evaluate Eutrophication in Polluted Rivers

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ABSTRACT

The use of fertilizers and indiscriminate disposal of sewage has increased the nutrient concentration levels in open water bodies – rivers and lakes. This communication showcases a rapid test solution for the estimation total phosphorus and ammonia-nitrogen. These nutrients are of prime concern to eutrophication studies and dynamics.

Key words: Nutrients, Total Phosphorus, Ammonia-Nitrogen.

INTRODUCTION

Eutrophication is either caused by human indiscriminate disposal of waste into rivers or natural means(Harper, 1992). This waste contains substances such as nitrates, phosphates, fertilisers or sewage. Eutrophication was identified as a major lake pollution challenge in parts of Europe and North America around the mid-20th century (Richardson and Jorgensen, 1996). Over time, rivers in urbanized cities and towns especially in developing countries have also experienced widespread eutrophication as a result of rapid dumping of waste. The key contributor to eutrophication is total phosphorus (Schindler, 1977). This nutrient support plant growth and decay activity of algae and plankton. The excessive presence of this nutrient inhibits the lives of aquatic organisms such as fishes as it delimits the functioning of the ecosystem of the river. The monitoring of eutrophication activities has received wide studies across the world. Most studies have attempted to empirically relate eutrophication to the river flow dynamics and sediments(Beck and Van Straten, 1983). However, these measurements require a lot of time to estimate especially in the case of large river systems. Also, the expensive nature of regular monitoring may also pose a challenge for tight-budget economies to consider avoiding the process of monitoring this all together. Therefore there is the need to explore other inexpensive and yet reliable alternatives to measure eutrophication. For instance, what if there is a way to relate total phosphorus to other water quality parameters that are easily accessible? For example, if we know the pH and chemical oxygen demand (COD), can we reliably estimate total phosphorus? If this way is possible, it becomes plausible to provide a rapid way to estimate total phosphorus and subsequently inform the decision maker about the estimated-guessed eutrophication of the polluted river.

This work has provided the answer to this question by providing an empirical solution developed for the estimation of TP. A detailed description of the procedures for the TP is available in the research conducted by Kabo-bah (2012). In this particular instance, pH and chemical oxygen can be easily determined in-situ and the empirical formulae below used to estimate the total phosphorus (see equation 1 and 2):

$$TP = 0.171 + (27.797e-04)*[pH]*[COD] \quad ...(1)$$

$$TP = (28.025e-04) + (93.879e-03)*[NH_3 - N] \quad ...(2)$$

The second equation shows a direct relationship between total phosphorus and ammonia-nitrogen. Ammonia nitrogen is another important delimiting factor for aquatic life. Hence, a determination of the ammonia-nitrogen gives an indication of the level of the total phosphorus present, and at the same time the eutrophic activity. These two equations were successfully tested with data from rivers and wastewater systems and showed a prediction error of 15-20%. In water quality modelling where such empirical relationships are relevant to support forecasting and monitoring, the findings here provide a noble way towards a contribution to science and development.

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