DEVELOPMENT OF A PRELIMINARY COMPUTERIZED SIMULATION MODEL TO MONITOR AND PREDICT THE POLLUTION LEVELS DUE TO NPK FERTILIZER LEACHING

by

LASANTHA MANORI GUNASEKERA

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ABSTRACT

Nutrient leaching into waterbodies effects the quality of water and their inhabitants. One major source of nutrients is the excess NPK fertilizer applied in agricultural practices. Lack of monitoring facilities to measure the degree of interference, makes it difficult to know the level of pollution.

This study was a preliminary attempt to develop a computerized simulation model to predict the pollution levels due to NPK fertilizer leaching into waterbodies. The level of pollution is measured by the algal growth which is given as a number of algal cells. The computerized simulation model is a computer software package which consists of three parts that are the main components of any simulation model, namely, a way of input data, internal processing of these data and the use of these processed data to make predictions as output.

The computer simulation model was developed allowing input of any number of variables permitting future expansion of the model. However, the model was tested for only two such variables namely fertilizer concentration and temperature. The regression relationship for fertilizer concentration and temperature with algal growth was tested in the laboratory.

Laboratory experiments were carried out to find the relationships between nutrient concentration verses algal growth and the temperature verses algal growth. The results indicated that the algal growth varies with both NPK fertilizer concentration and temperature. There is a optimum level of fertilizer concentration and a optimum range of temperatures which show the highest algal growth. Below and above of these fertilizer concentration and temperature levels, the growth decreases.

The model was constructed according to the steps of the **Prototyping** system development life cycle. The first step, 'Feasibility Analysis' of the system enabled the determination of the system requirements. Then the model was designed in two steps; 'Broad Design' and 'Detailed Design'. Broad design was done to show systems inputs processing and outputs. During the detailed design, system database, user procedures along with the user manual and program structures of the computer programs which are needed to execute the model were designed. In addition, the user interface screen layouts were also designed during the detailed design. After designing of the system, model implementation was commenced. Programming was done using **Visual Basic** (version 5) computer language.

Three tests were done to ensure the model validity. (i) **Structural validity** was established by showing that the structure of the model corresponds to the structural relationships of the real system. (ii) **Behavioural validity** was established by showing the similarity of dynamic behaviour of the real system developed using the experimental results and the dynamic behaviour of the model system and for (iii) **Empirical validity**, the results obtained from the model were compared with the empirical data of the real ecosystem.

The statistical analysis done to establish the relationship between algal growth, fertilizer concentration and temperature was highly significant and therefore the statistical model is adequate for the purpose. The model validation tests also established that the simulation model is adequate and therefore it is acceptable.

In future, it should be upgraded by considering all other variables for better predictions.