CHAPTER 1

INTRODUCTION

1.1 Rationale

Water quality models are essential and important in the management of water resources for sustainable development [1, 2]. Water quality models for different management scenarios can provide a great support to decision making on various development plan. In Thailand, the government puts great importance to water resource management and includes it in a water-related policy in the 20-year national strategy (2560 – 2579 B.E.) and the 12th National Economic and Social Development Plan [3]. Several water quality models exist but they are not suitable for prediction of water quality of river in Thailand because of different environment, characteristics, and water monitoring system. Therefore, the development of water quality models in Thailand is urgently needed.

Water quality models have been developed and used for specific water resources because each resource has unique structure and characteristics [4]. Thus accurate models must be developed and calibrated based on real data collected from each resource. Most of the commercial models cannot be implemented precisely because of different water monitoring systems [5]. These problems motivate us to conduct the research on water prediction models, especially the models for predicting water quality of Chaophraya River. Thus, this would be a challenge to find the appropriate models that can predict water quality of Chaophraya River under different scenarios based on historical water quality data.

1.2 Problem formulation

Water quality prediction model development is often difficult due to the complexity of relations among water parameters. Several factors are associated with each parameter that cause difficulty in water quality prediction and become major problems of water quality modelling [6]. Moreover, monitoring data are not collected

under the same standard and there are the limits on the amount of data. These are also other major obstacles to model development [7].

One of the most popular machine learning techniques used for developing water quality prediction models is the artificial neural network (ANN) [8]. Recently, machine learning techniques play an important role in modeling for complex systems like environmental systems because they have advantages over traditional statistical models (such as linear regression) in terms of dealing with non-linear relationships [9].

However, traditional artificial neural network can accept only one dimensional data which is not suitable for water quality prediction; thus, the two-dimensional (2D) artificial neural network called the Space and Time neural network is proposed as a new technique for developing the water quality prediction model. The proposed technique is used to develop a unique model for prediction of any specific water quality parameter. The input of the proposed technique includes water quality parameters in different spaces and times. As a consequence, the model can be accurately developed from upstream data and historical data, simultaneously.

The proposed technique can theoretically improve the performance of prediction; however, it leads to another problem which is time complexity. Higher number of input from two-dimensional data makes the complexity of developing each model to be higher. Since, the two-dimensional input contains some redundant data and they are dependent on the adjacent dimension (either space or time); therefore, the complexity of the proposed technique is reduced by using the appropriate maximum number of time delay and the maximum number of upstream monitoring data to develop the optimal model.

1.3 Objectives

1. Design and develop a model for predicting a specific water quality parameter of Chaophraya River using the two-dimension artificial neural network.
2. Determine the most probable sets of input parameters for predicting water quality parameters using the two-dimension artificial neural network.

3. Predict any water quality parameter of Chaophraya River under different management scenarios using the two-dimension artificial neural network.

1.4 Scope

In this dissertation, the model is constrained as follows:

1. The scope of this dissertation is aimed to design a model from water quality data of Chaophraya River during 2538-2556 B.E. that had been collected by the Pollution Control Department, Ministry of Natural Resources and Environment.

2. The historical water quality data of Chaophraya River came from 19 monitoring stations along the river that start from Dechatiwong Bridge station, Nakhon Sawan to Phra Samut Chedi station, Samut Prakan.

3. The proposed two-dimension ANN model can accept two-dimensional data as input for predicting water quality parameters.

1.5 Research methodology

1. Study and review related literatures: In this task, the related works were studied. Different methods available at present were analysed and compared in order to get some new ideas which can be used to develop the new technique.

2. Define the problems: According to the previous task, the new idea was defined then the objectives and the scope of the work were stated.

3. Prepare primary source of data: The water quality data were taken from the Pollution Control Department, Ministry of Natural Resources and Environment.

4. Design the system: After the problems were stated and the data were already taken, the programming step was begun.

5. Conduct the experiments to optimize the model then conclude the results for writing the manuscripts and dissertation.

1.6 Expected outcomes

The expected outcomes are as follows:

1. The proposed technique could be used to develop a model to interpret the water quality of Chaophraya River based on the historical data collected by the Pollution Control Department, Ministry of Natural Resources and Environment.

2. The optimal sets of input parameters for predicting the water quality in the future could be obtained.

3. The proposed model for each parameter could be used to predict the water quality parameter of other rivers or watersheds similar to the Chaophraya River.