EFFECTS OF DATA NORMALIZATION ON WATER QUALITY MODEL IN A RECIRCULATORY AQUACULTURE SYSTEM USING ARTIFICIAL NEURAL NETWORK

By

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ABSTRACT

Water Quality remains as one of the most important factors that influence the aquaculture system as its effects can make or mar the state of organisms as well as the environment. Furthermore, the use of Artificial intelligence especially the Artificial Neural Network (ANN) has greatly improved the forecasting capability of water quality due to better solutions produced as compared to other approaches. The performance of these AI techniques lies in the quality of dataset used for its implementation, which is in turn a function of the preprocessing (Normalization) techniques performed on them. In this paper, the effect of different normalization techniques, namely the Min-Max, Decimal Point, Unitary, and the Z-Score were investigated on the prediction of the water quality of the Tank Cultured Re-circulatory Aquaculture System at the WAFT Laboratory, using the ANN. The Water Quality Index was based on the prediction of the Dissolved Oxygen (DO) as a function of the Temperature, Alkalinity, PH, and conductivity. The performance of the techniques on the ANN was evaluated using the Mean Square Error (MSE), Nash-Sutcliffe Efficiency (NSE) coefficient. The comparison of the evaluation of the various techniques depicts that all the approaches are applicable in the prediction of the DO. The Decimal point technique has the least MSE as compared to others, while the Min-Max technique has better performance with respect to the NSE.

Keywords: Aquaculture System, Artificial Neural Network, Dissolved Oxygen, Prediction, Water Quality Index.

INTRODUCTION

The processes involved in the cultivation and rearing of aquatic animals in controlled environment and conditions is referred to as Aquaculture (Garcia, Sendra, Lloret, & Lloret, 2011; Folorunso, Aibinu, Kolo, Sadiku, & Orire, 2017). In attaining a sustainable aquaculture system, the role and importance of water quality cannot be over emphasized as its effects can make or mar the entire cultivation process (Folorunso et al., 2017; Chuang & Lin, 2010; Badiola, Mendiola, & Bostock, 2012). The amount of Dissolved Oxygen (DO) in the aquatic environment reflects the balance in the rate of production of oxygen and consummation of oxygen therein (Olyaie, Abyaneh, & Mehr, 2017). The amount of DO is used in estimating and quantifying the quality of the water in the environment (Olyaie et al., 2017).

Though, other environmental parameters, such as temperature, salinity, turbidity, pH as well as water level in the system also plays significant roles in the estimation of the DO and consequently the water quality in the system (Folorunso et al., 2017; Africa, Aguilar, Lim, Pacheco, & Rodrin, 2017).

Over the years, there exist different approaches for the estimation and prediction of the water quality index in the aquaculture systems with respect to the DO level. One of such approach is the use of artificial intelligence based