Estimation of Nutrient Concentrations in Runoff from Beef Cattle Feedlot using Adaptive Neuro-Fuzzy Inference Systems

Halis Simsek[1], Bilal Cemek[2], Mehmet Serhat Odabas[3], Shafiqur Rahman[1]*

[1]*Agricultural & Biosystems Engineering, North Dakota State University, Fargo, North Dakota, USA*

[2]*Department of Agricultural Structures and Irrigation, Faculty of Agriculture, Ondokuz Mayis University, Samsun, Turkey*

[3]*Bafra Vocational School, Ondokuz Mayis University, Samsun, Turkey*

Abstract

Nutrient concentrations in beef cattle feedlots runoff were estimated with an adaptive network-based fuzzy inference system (ANFIS) in two techniques, a grid partition based fuzzy inference system (GPB-FIS) and a subtractive clustering based fuzzy inference system (SCB-FIS). The input parameters were pH and electrical conductivity (EC); and the output parameters were total Kjeldahl nitrogen (TKN), ammonium-N (NH_4-N), orthophosphate (Ortho-P), and potassium (K). Models performances were evaluated based on root mean square error, mean absolute error, mean bias error, and determination coefficient statistics. For the same dataset, the ANFIS model outputs were also compared with a previously published nutrient concentration predictability model for runoff using artificial neural network (ANN) outputs. Results showed that both GPB-FIS and SCB-FIS models predicted the runoff nutrient concentration successfully. The comparison results revealed that the GPB-FIS model performed slightly better than SCB-FIS model in estimating TKN, NH_4-N, Ortho-P, and K. When compared with the ANN model for the same dataset, ANFIS outperformed ANN in nutrient concentration prediction in runoff.

Keywords: Nutrient concentration; cattle feedlot; grid partition based fuzzy inference system (GPB-FIS); subtractive clustering based fuzzy inference system (SCB-FIS)

---

* Author to whom all correspondence should be addressed: e-mail: s.rahman@ndsu.edu; Phone: 701-231-8351; Fax: 701-231-1008