養雞場環境因子、飲水量及死亡率關係之探討

Exploring the Relationships among Environmental Factors, Water Consumption, and Mortality in Poultry Farm.

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摘　要

隨著氣候變遷加劇，禽舍管理者對於環境因子影響禽隻生理行為與健康之了解至關重要，而過往研究顯示，禽隻之生長與環境因子不僅會影響禽隻的飲水量，亦可能與後續死亡風險產生關聯。因此，本研究旨在探討禽隻日齡與環境溫度對於單日飲水量與死亡率之影響。本研究彙整多個場域之實測數據，以日齡與溫度建構預測飲水量之多元線性回歸(Multiple linear regression, MLR)與廣義加成模型(Generalized additive model, GAM)，進而以實際飲水量對比模式預測值，以探討飲水異常與禽隻死亡率升高之關聯。結果顯示，本研究建構之模型均具有高度解釋力且日齡與溫度兩項變數均具有統計意義，其中又以納入日齡與溫度交互作用項之 GAM 表現最佳(R^2 = 0.974，MAPE = 23.43%，RMSE = 67.74)，而未納入交互作用項之 GAM(R^2 = 0.972，MAPE = 26.96%，RMSE = 88.03)與 MLR(R^2 = 0.955，MAPE = 25.55%，RMSE = 94.3)表現稍次。進而將模型整合至實際場域並比對預測值與實際觀測值後發現，禽隻實際飲水量連續高於所有模型預測值之情形，多出現於環境溫度升高之期間，且亦可能使禽隻單日死亡率上升，指出當高溫且禽隻實際飲水量持續異常高於預測值時，飼養管理者應視其為潛在健康風險之預警訊號。綜上所述，本研究結果可作為智慧飼養監測系統發展飲水預警功能之基礎，協助畜牧場即時掌握禽隻健康狀況，以提升應對高溫環境之管理效率。

關鍵詞：環境因子，禽隻飲水，迴歸模型，廣義加成模型，預警

Abstract

With the intensification of climate change, it is crucial for poultry farm managers to understand how environmental factors affect poultry physiology, behavior, and health. Previous studies have shown that both poultry growth and environmental factors influence water consumption and may be associated with mortality. Therefore, this study aims to investigate the effects of poultry age and environmental temperature on daily water consumption and mortality rate. We collected data from multiple sites to construct predictive models for water consumption using multiple linear regression (MLR) and generalized additive models (GAM). The predicted water consumption from these models is then compared with the actual value to further explore the relationship between abnormal water consumption and increased mortality rates. Results showed that all models have high explanatory power, with both age and temperature being statistically significant variables. GAM with the interaction terms between age and temperature has the best performance (R^2 = 0.974, MAPE = 23.43%, RMSE = 67.74), followed by GAM without interaction terms (R^2 = 0.972, MAPE = 26.96%, RMSE = 88.03) and MLR (R^2 = 0.955, MAPE = 25.55%, RMSE = 94.3). We observed that actual water intake continuously exceeded all predicted values, mostly occurring during periods of elevated environmental temperature, which may also increase the daily mortality rate.. This finding indicated that when high temperatures coincide with sustained abnormally high water consumption, farm managers should treat this as a warning signal of potential health risks. In summary, the results of this study can serve as a foundation for intelligent farming monitoring systems, helping farms to promptly grasp poultry health status and improve management efficiency under high-temperature conditions.

Keywords: Environmental factor, Poultry water intake, Regression model, Generalized additive model, Early warning.