

## HYBRID MACHINE LEARNING APPROACH FOR PREDICTING FEED CONVERSION RATIO IN BROILERS: INTEGRATING TIME-SERIES ANALYSIS AND ENVIRONMENTAL VARIABLES

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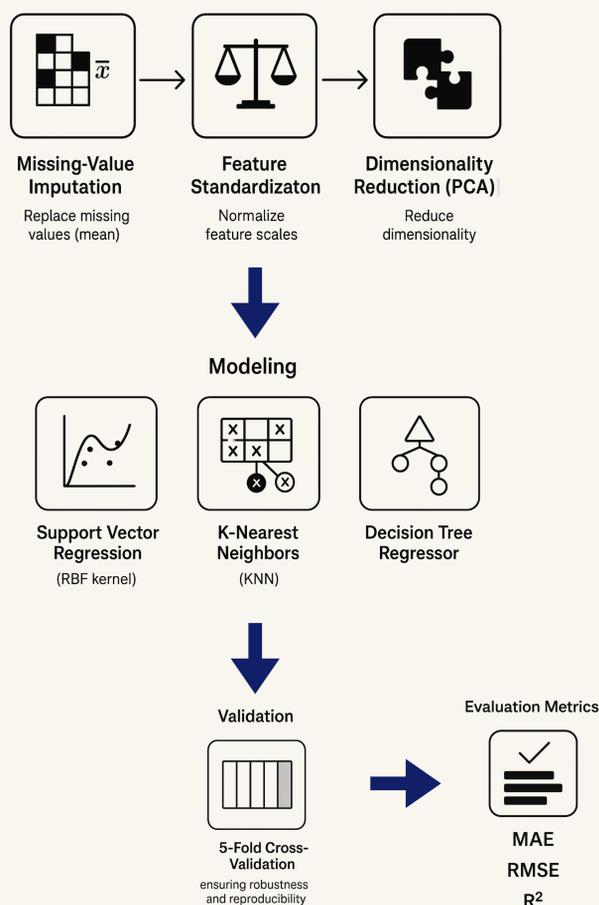
### INTRODUCTION

Feed Conversion Ratio (FCR) is a key efficiency and sustainability indicator in broiler production, where feed costs account for up to 80% of total expenses. This study proposes a hybrid machine learning model to predict FCR using pre-slaughter data from industrial broiler systems in southern Brazil, aiming to improve predictive accuracy and promote fairer farmer compensation by integrating zootechnical, environmental, and management variables.



### METHODOLOGY

A dataset comprising over 10,000 flock records (2022–2024) and 54 variables was used. The workflow included:



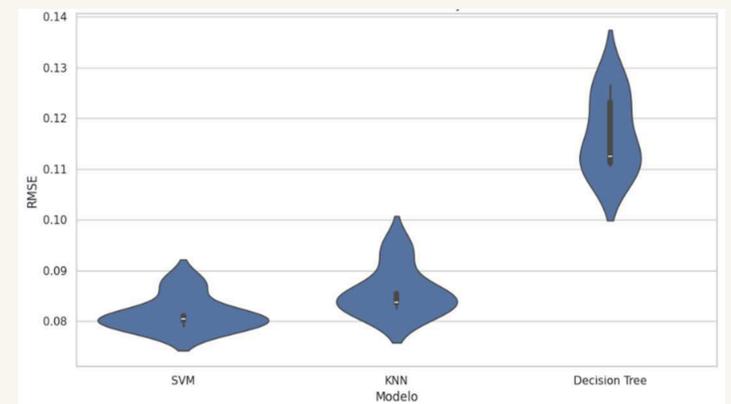
### ACKNOWLEDGMENTS

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### RESULTS AND DISCUSSION

PCA retained the 10 main components, explaining 68.33% of total variance. Among models tested, KNN achieved the best overall trade-off (MAE = 0.44, RMSE = 0.53,  $R^2 = 0.31$ ), followed by SVR ( $R^2 = 0.16$ ), while Decision Tree showed overfitting and instability ( $R^2 = -0.11$ ).

Violin-plot analysis revealed compact and symmetric error distributions for KNN and SVR, confirming their robustness across folds. The models effectively captured nonlinear patterns between FCR and zootechnical/environmental features.



### CONCLUSIONS

The hybrid pipeline proved effective for FCR prediction using pre-slaughter variables, offering a transparent and reproducible framework for practical deployment.

The findings highlight that machine learning techniques, particularly KNN and SVR, enhance fairness in producer compensation and operational efficiency.

However, large-scale implementation remains limited by contextual variability and data availability.

Future research should extend validation across companies, integrate time-series and IoT sensor data, and develop explainability frameworks to ensure scalability and trust in predictive systems

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