

## REGIONAL ANALYSIS AND FORECASTING OF BROILER AND LAYER POULTRY PRODUCTION IN TÜRKİYE: A STATISTICAL AND MACHINE LEARNING APPROACH

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### ABSTRACT

#### Introduction and Purpose:

As well as cattle farming and sheep & goat farming, poultry farming also has a significant place in Türkiye's agricultural economy. There are two important branches, such as broiler and egg in this sector. There is not enough systematic research which examines the regional perspectives and provide future projections in poultry farming as in many areas of agriculture and livestock. The main purpose of this study is to analyze broiler and layer production in Türkiye, identify the main producing regions, and generate forecasts using both traditional statistical models and modern machine learning algorithms.

#### Materials and Methods:

The regional broiler and layer production datasets have been acquired from the web-based data platform of Turkish Statistical Institute (TÜİK). Top producer regions and long-term changes in broiler and layer chicken production have been identified using descriptive statistics. Two statistical techniques- Autoregressive Integrated Moving Average (ARIMA) and Exponential Smoothing (ES)- have been used to anticipate the total national production of broiler and egg chicken. Two machine learning models such as Random Forest and Gradient Boosting, nevertheless, have been created. Random Forest allows for assessing variable importance and capturing nonlinearities, and Gradient Boosting provides flexible parameterization (e.g., learning rate, tree depth) and can be tuned effectively to the dataset. The model performance has been evaluated by way of Mean Absolute Error (MAE), Root Mean Square Error (RMSE), and  $R^2$ . The projections for ten years have been generated.

#### Results:

The broiler chicken production has been largely concentrated on the north-west line. The top three producer regions are TR42 (Kocaeli-Sakarya-Düzce-Bolu-Yalova), TR33 (Manisa-Afyonkarahisar-Kütahya-Uşak), and TR22 (Balıkesir-Çanakkale) respectively. The models ES and ML envisioned moderate growth in broiler chicken production, on the other hand, the suggestion of ARIMA is a flatter trend. The top three producer regions in layer chicken production are TR33 (Manisa, Afyonkarahisar, Kütahya, Uşak), TR52 (Konya-Karaman), and TR83 (Samsun-Tokat-Çorum-Amasya) respectively. A slight decline from the recent peak has been indicated by ES. On the other hand, moderate growth has been referred to by ARIMA. ML models harmonized the differences between statistical models by drawing a more balanced growth path.

#### Discussion and Conclusion:

This research shows the importance of using both statistical and machine learning approaches together with the purpose of identifying the trend dynamics and nonlinear relationships in

broiler and layer chicken production. The results reveal that north-western regions are leading in the broiler chicken production. On the other hand, western-central regions are dominating the layer chicken production. The results of this study can be utilized to create critical policy deductions and decisions of targeted investments by considering these distinct geographies. The proposed methodological framework can be adapted to other livestock production data as well.

**Key Words:** Poultry Farming; Broiler; Layer; Türkiye; Regional Analysis; Forecasting; Machine Learning