CHAPTER V
CLOSING

5.1. Conclusion

Based on the implementation and evaluation results that have been carried out, the following conclusions were obtained:

1. The TCN model was successfully implemented with a CausalConv1d architecture, TCNBlock (residual connection + batch normalization), and a fully connected layer, using a 60-day lookback across three horizons (H+7, H+15, H+30). A total of 60 models were produced 30 baseline and 30 Optimized TCN via Bayesian Optimization (Optuna, 30 trials per combination) all of which were integrated into the Flask-based Papan Pasar web application to monitor historical and predicted prices.
2. The EDA provided insight into the heterogeneous characteristics across commodities: red chili and bird's eye chili had the highest volatility, while rice and granulated sugar tended to be stable. Outliers were retained because they represent genuine volatility. Feature engineering produced 15 backward-looking features, using MinMaxScaler and a time-based split (70/15/15%).
3. Evaluation using the RMSE, MAE, and MAPE metrics showed that Bayesian Optimization consistently improved prediction accuracy compared to the baseline model across all horizons and commodities. The decreases in RMSE/MAE/MAPE reached 18.44%/22.52%/37.37% at H+7, 13.34%/16.36%/20.53% at H+15, and 16.45%/18.69%/21.12% at H+30, respectively. The largest MAPE decrease occurred at H+7, at 37.37%, indicating that the optimization was most effective for short-term predictions. The per-commodity evaluation confirmed a consistent pattern, where commodities with stable prices such as rice, granulated sugar, and chicken eggs produced lower MAPE values, while bird's eye chili and red chili consistently recorded the highest MAPE at every horizon, reflecting the inherent prediction difficulty of horticultural commodities.

Overall, the TCN model proved effective for predicting strategic food prices based on daily time-series data, with a systematic and well-structured pipeline and workflow.

5.2. Recommendations

Based on the results of the research that has been carried out, there are several limitations that can serve as a basis for improvement and development in future research.

1. The number of Bayesian Optimization trials in this study was limited to 30 trials per horizon-commodity combination. Increasing the number of trials, for example to 50 or 100, could potentially discover a more optimal hyperparameter configuration, particularly for volatile commodities such as bird's eye chili and red chili, which still recorded the highest MAPE values in this study.
2. This study's pipeline only makes use of features derived from historical price data (univariate). Adding external features that are readily available to the public, such as national holiday features and religious holiday features known to significantly affect food demand patterns, could be a realistic development step that would not require complex additional data sources.
3. This study limited the scope of the data to modern markets in East Java Province. Given that the National PIHPS is available for 82 cities across Indonesia, replicating the same pipeline on traditional market data or other regions outside Java could be carried out as a comparison to determine whether the model's patterns and performance are consistent or differ across regions and market types.
4. Future research could explore a direct comparison between TCN and other deep learning architectures commonly used for food price prediction, such as LSTM or GRU, using the same dataset and pipeline. This comparison would provide stronger empirical evidence regarding the relative advantages of TCN and serve as a more comprehensive reference for future researchers.

Overall, this study has successfully demonstrated that the *Temporal Convolutional Network (TCN)* model is an effective approach for forecasting strategic food prices based on daily time-series data. The resulting pipeline provides a methodological

contribution that can serve as a reference framework for the broader development of food commodity price prediction systems in Indonesia.