CHAPTER I
INTRODUCTION

This chapter offers a concise summary of the research, organized into six sections. It begins with an introduction to the background, followed by the identification of the problem and objectives, the scope of the study, the research methodology, and the thesis structure. A more detailed explanation is provided in the subsequent chapter.

1.1 Background of the Research

Data from the Badan Pusat Statistik shows that the harvested area of corn in Indonesia has been increasing year by year, reaching 2.49 million hectares in 2023, with a production of 14.46 million tons. This significant growth, particularly in Indonesia, which saw an increase from 68,214 hectares in 2021 to 95,690 hectares in 2022, has contributed positively to economic gains and the welfare of farmers [1]. However, corn prices often experience significant fluctuations, which in turn can cause losses for farmers and suppliers. In the Figure 1, the decline in corn prices is influenced by various complex factors such as intricate and slow pricing policies, pest attacks, unfavorable environmental conditions, and excessive corn imports. Corn price fluctuations can have a significant impact on the economic sustainability and welfare of farmers, as they reduce their income and harm their overall business [2][3].

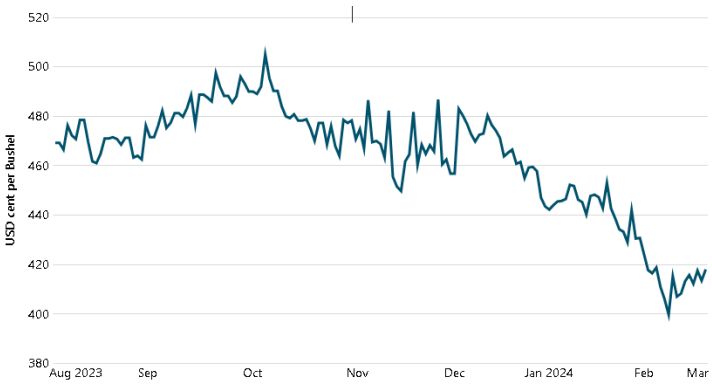

Figure 1 Corn Prices in the International Market Rp 2,638.7 per Kg

Because corn price fluctuations can significantly impact the economic sustainability and welfare of farmers, Bapanas, as the national food agency responsible for setting corn commodity prices, requires a tool capable of predicting corn prices and providing in-depth analysis to support better policy-making. In this context, the use of artificial intelligence (AI), particularly Deep Learning (DL), becomes relevant for conducting in-depth analysis of the factors influencing corn prices [4].In their research conclusion, Silva et al. (2021) [5] revealed that the use of traditional econometric models (ARIMA and SARIMA), machine learning (ML) models (SVR and LSTM), and ensemble ML models (with different configurations) were evaluated to predict the daily prices of corn and sugar in Brazil. It was observed that: (i) the SVR model provided the best results for both products, followed by the ensemble SVR and LSTM models.

In this research, the author uses the Long Short Term Memory(LSTM) ,Support Vector Regression (SVR) and Hybrid LSTM - SVR methods. These methods were chosen due to their respective advantages in analyzing and processing time series data as well as spatial data [6].

- **LSTM:** *Long Short Term Memory*(LSTM) is a type of recurrent neural network (RNN) that is suitable for modeling and predicting time series data, such as corn prices over time. LSTM has the ability to understand complex patterns in sequential data and retain information over longer periods, which is useful in predicting future corn price trends based on historical data.

- **SVR**: *Support Vector Regression* (SVR) is a machine learning method used for regression. SVR is a variant of Support Vector Machine (SVM), which is typically used for classification. SVR aims to find a function that approximates the relationship between input features and output in the data while minimizing prediction errors.

By utilizing a combination of LSTM and SVR, this research aims to provide a better understanding of the factors influencing corn prices and generate more accurate predictions to support more effective policy-making in the corn agriculture industry.

1.2 Problem Statement

The problem formulation in this manuscript includes the following aspects:

a) How can the average corn price be predicted for the next few days?
b) Among the algorithms LSTM, SVR, and Hybrid LSTM-SVR, which is the most effective in predicting the average corn price?

1.3 Goal

In this research, there are several goal points that the authors will discuss, with the scope of the issues to be addressed as follows :

a) Developing LSTM, SVR, and Hybrid LSTM-SVR algorithms to predict the average corn price.
b) Training models using the available dataset to predict the average corn price for the next few days.
c) Evaluating the performance of LSTM, SVR, and Hybrid LSTM-SVR models.
d) Creating a policy brief on the use of machine learning for decision-making related to corn prices.

1.4 Scope Of Work

In this research, the scope of work is focused on several key aspects related to the prediction of corn commodity prices using Deep Learning methods, specifically LSTM (Long Short Term Memory) ,SVR (Support Vector Regression) and Hybrid LSTM - SVR . The scope of this work includes the following important points:

a) Algorithms Used

LSTM, SVR, and Hybrid LSTM-SVR Algorithm. This research utilizes a combination of LSTM and SVR algorithms to develop a corn price prediction model.

b) Data Used

This study employs various time series datasets collected from 2021 to 2024, including:

- Average of National Corn Price Data
- Average of Corn Price Data from Lampung Province
- Average of Corn Price Data from East Java Province
- Average of Corn Price Data from South Sulawesi Province

c) Scope of the Research

The research focuses on corn production centers in Indonesia, specifically in:

- Lampung Province
- East Java Province
- South Sulawesi Province

d) Report Compilation

A Technology and Regulation report will be compiled in the form of a Policy Brief, outlining the implications of implementing a corn price prediction model using the LSTM-SVR approach.

1.5 Hypothesis

Based on previous research [10][11], the author used the LSTM method to forecast data related to food prices such as potatoes, tomatoes, and shallots. In this study, the author recommends using a Hybrid method to improve prediction results. In a study conducted by Tami & Owda (2024) [13], the authors obtained model accuracy data with RMSE: 0.14; MAPE: 3.04; R-squared (R2): 98.2% using the LSTM algorithm.

Furthermore, in the study by Silva et al. (2021) [5], it was found that the SVR model provided the best results for both products, followed by Hybrid SVR and LSTM, with SVR having MAE 0.287, MSE 0.145, R2 0.990 for corn products. Based on these studies, the hypothesis of the author in this research is as follows:

(H1) The use of the Hybrid LSTM-SVR model will demonstrate a significant improvement in prediction performance on food commodity price data compared to other traditional prediction methods.

(H2) The Deep Learning LSTM-SVR model enhances decision-making for corn industry stakeholders in Indonesia. With more accurate price predictions, they can plan pricing, production, and inventory strategies more efficiently, optimize the corn supply chain, and minimize risk of losses. This has the potential to improve farmer welfare and overall food market stability.

(H3) The LSTM model has the potential to predict time series data with high accuracy, but with the integration of SVR, prediction accuracy can be further enhanced.

(H4) The Deep Learning LSTM-SVR model improves the efficiency of corn supply management in Indonesia, potentially increasing regional economic productivity and welfare.

(H5) The implementation of this model enables the government to make more effective and timely regulatory decisions, reducing the risk of losses for corn consumers and producers.

1.6 Research Method

This section explains the methodology used in the research to predict corn prices in Indonesia using a Deep Learning model based on *Long Short Term Memory*(LSTM) , *Support Vector Regression* (SVR) and Hybrid LSTM - SVR , including:

a) Literature Study

Exploring previous studies on forecasting commodity prices, the application of Deep Learning technologies, corn price regulations, and economic impact assessments, utilizing sources like academic journals and data from relevant Bapanas websites.

b) Dataset

The dataset used in this research consists of several essential data components for predicting corn prices. The primary data related to corn prices are obtained from Bapanas (National Food Agency), which provides information on corn prices over a specific period. This data includes daily variations in corn prices necessary for time series analysis. In this research, the data used includes the average national corn price obtained from the National Food Agency's website, as well as the average corn price data from major corn production centers.

The components of the dataset are as follows:

Table 1 Research Dataset

Date	National Average Price	East Java Average Price	Lampung Average Price	South Sulawesi Average Price
01/01/2021	3700	3500	3100	3790
02/01/2021	3700	3500	3100	3790
03/01/2021	3790	3500	3100	3790
04/01/2021	3790	3500	3100	3560
05/01/2021	3560	3500	3100	3560
—	—	—	—	—
22/09/2024	4580	4790	4670	4100
23/09/2024	4530	4740	4670	4060
24/09/2024	4530	4730	4670	4110
25/09/2024	4560	4750	4670	4110

In Table 1, the dataset used in this research contains four attributes, all sourced from the BAPANAS website. However, the dataset is not entirely complete and includes some missing data. Therefore, a data cleaning process was conducted, involving downscaling techniques to address these gaps. This step aims to improve the quality and validity of the data for analysis. The primary focus of this stage is to understand the data characteristics before proceeding to the corn price prediction process for the next 90 days. The data used in this study covers the period from January 1, 2021, to September 25, 2024. By integrating data from various sources, namely Bapanas and official reports, this research aims to develop a comprehensive and accurate corn price prediction model. This integration of data from multiple aspects is expected to provide a more complete picture of the factors influencing corn price fluctuations, thereby supporting the development of more effective policies.

c) Simulation with LSTM – SVR Algorithm

In this study, the LSTM, SVR, and hybrid LSTM-SVR algorithms are used to process a dataset consisting of the national average corn price and the average corn price in production centers obtained from various official sources. The LSTM model is employed to capture temporal patterns in historical corn price and weather data, while SVR is utilized to process this data to predict corn prices. The integration of these two algorithms allows the model to combine information from various aspects, including weather and economic factors, to generate more accurate corn price predictions. By leveraging information from multiple data sources, this model is expected to provide a more comprehensive understanding of the factors influencing corn price fluctuations.

d) Results Analysis

In this stage, an analysis will be conducted on the prediction results from LSTM, SVR, and the Hybrid LSTM-SVR, ultimately producing data such as price forecasting and trends of corn prices. This stage will provide an overview of the performance of the methods used. Additionally, it will offer insights into the weaknesses of the LSTM-SVR method in its application for determining corn

prices.Evaluation metrics such as MAE, MAPE, RMSE, and others will be used at this stage to assess the effectiveness of the developed program. Subsequently, the results of these trend predictions will serve as a basis for policy making, which will later be presented in the form of a policy brief.

1.7 Time Schedule

This section explains the estimated time for completing this project:

No	Activity	Month									
		MRT	APR	MAY	JUNE	JULY	AUG	SEP	OCT	NOV	DES
1	Literature Study										
2	Collecting Data										
3	Build System										
4	Performance Analysis of LSTM-SVR										
5	Economic Analysis										
6	Regulatory Analysis										
7	Conclusion										
8	Final Thesis Trial										