

CHAPTER I. INTRODUCTION

A. Background

Maize is one of Indonesia's strategic agricultural commodities and plays a crucial role in supporting food security and the sustainability of the national livestock sector. As the second most important source of carbohydrates after rice, maize is not only consumed directly by population but also serves as a primary raw material for the food processing industry, animal feed production, and bioenergy. Domestic maize demand is primarily for animal feed, with the remainder for food consumption, other industrial needs, and seeds (Center for Agricultural Data and Information Systems, 2024). The demand for maize for animal feed, particularly poultry feed, is the largest, accounting for more than 50-60% of total feed formulations. In layer chicken feed formulations, maize constitutes approximately 52.10% of total raw materials (Tangendjaja, 2007), highlighting its dominant role in the feed industry. This conditions positions maize as a fundamental component in sustaining the poultry industry, especially the layer chicken sub-sector, which plays a vital role in providing animal protein for the population. Along with population growth and the increasing demand for eggs for consumption, the need for high quality feed, which is largely composed of maize, also continues to rise annually.

However, this growing demand has not been fully met by domestic maize production. Data from the Statistic Indonesia (BPS, 2025), as shown in Appendix 1, indicates that Maize production in Indonesia remains volatile from year. Total maize production increased from 13.41 million tons in 2021 to 16.53 million tons in 2022, then declined to 14.77 million tons in 2023 before rising again to 15.14 million tons in 2024. Monthly production patterns also fluctuated significantly, with sharp increases and declines occurring in several periods. This instability reflects the strong influence of agroclimatic conditions, planting and harvesting seasons, land availability, cultivation technology, and distribution efficiency on national maize production (Erviyana, 2014).

The imbalance between production and consumption compels Indonesia to source maize from domestic producing regions or even rarely on imports. According to Statistics Indonesia (BPS, 2025), the increase in national production in recent years has not been sufficient to keep pace with the continuously expanding demand from the poultry feed industry. This reliance on external supply makes domestic maize prices more vulnerable to climate change, global price fluctuations, and instability in domestic supply. Ultimately, fluctuations in maize prices directly affect production costs in layer chicken farming, as feed accounts for approximately 76.73% of total production costs (Nikhila et al., 2025). When maize prices increase, feed prices also increase, which in turn affects egg prices, as emphasized by Sartina et al. (2024), who that fluctuations in feed prices significantly reduce farmers' profit margins.

West Sumatra is one of the provinces that has experienced significant development in the poultry sub-sector, particularly layer chicken farming. According to Statistics Indonesia (BPS, 2025), The population of layer chickens in West Sumatra during 2020–2025 showed fluctuating growth. The population increased significantly in 2022 by 16.59%, indicating rapid expansion of the poultry industry, but declined in 2023 and 2024 due to possible increases in feed costs and market instability. In 2025, the population rebounded by 4.82%, showing signs of recovery (Appendix 2). However, West Sumatra is not a major national maize-producing region; therefore, the province's demand for maize as poultry feed remains highly depend on supplies from the other regions, such as North Sumatra, Bengkulu, West Java, and East Java (BPS, 2025). This dependence causes maize prices in West Sumatra to be relatively higher and more volatile compared to price in major production centers.

The length of the distribution chain, which involves farmers, villages collectors, wholesalers, interprovincial distributors, and feed mills, creates opportunities for high marketing margins and imperfect price transmission. Imperfect price transmission across different market levels indicates weak market integration in the context of agricultural commodities such as maize, price changes at the consumer level are often transmitted more quickly to producers when prices decline, but not when prices increase (Ashari & Syamsir, 2021). This

asymmetric price transmission disadvantages farmers and further undermines market efficiency.

Such phenomena are highly likely to occur within the maize supply chain in West Sumatra, given the uneven market structure, disparities in bargaining power among market participants, and unequal access to price information. Maize farmers, as primary producers, occupy a weaker position compared to wholesalers to interprovincial distributors (Aqil et al., 2022). As a result, the prices received by farmers tend to be lower than those determined at the wholesaler or feed mill level (Lestari et al., 2024). This lack of price integration not only affects farmer's welfare but also has implications for layer chicken farmers as the final users of maize in the form of feed. When maize prices increase abruptly without a balanced adjustment at the production level, feed costs rise sharply, which can ultimately reduce the profitability of layer chicken farming operations.

Several previous studies on maize market integration in Indonesia have been conducted; however, their scope has largely been limited to integration among maize markets themselves. Ekaputri et al., (2022) identified co-integration among imported maize prices, maize prices in North Sumatra, and those in Karo Regency using the Johansen and ECM approaches, indicating strong linkages across maize market levels. Maghfiroh (2014), in a study of maize market integration in East Java employing the Engle-Granger and ECM methods, highlighted weak short term integration due to limited market information, despite the presence of long term integration along the marketing chain. Xu et al., (2011) analyzed the integration of analyzed vertical price transmission in the laying industry chain in China using the Johansen co-integration test, the Error Correction Model (ECM), Granger causality, and the Finite Distributed Lag (FDL) model to examine the relationships between the prices of maize, feed, laying hens, and eggs. Sari (2025) identified price integration among vegetable oil commodities at the international level using VECM with IRF and VD. Meanwhile, Gobel et al. (2024) in their study in Gorontalo, found that the maize Index of Market Connection (IMC) was categorized as high, yet structural barriers in distribution remained evident. These three studies share a common focus on analyzing price integration within the maize commodity chain, without linking its

effects to downstream commodities such as feed or eggs.

In the layer poultry industry, maize, feed, and eggs form an interconnected price transmission chain that cannot be analyzed separately. Maize serves as the primary raw material for feed production, while feed represents the largest production input in layer chicken farming. Consequently, fluctuations in maize prices are expected to influence feed prices, which may subsequently affect egg prices. Despite the importance of these linkages, empirical studies examining the price integration among maize, feed, and layer chicken eggs in West Sumatra remain limited, representing an important research gap. Therefore, this study, entitled “Price Integration Analysis of Maize, Feed, and Layer Chicken Egg Prices in West Sumatra,” aims to analyze the dynamic relationship and price integration among these three commodities. Specifically, the study investigates how changes in maize prices are transmitted to feed prices, how feed price movements affect egg prices, and the extent to which these markets are integrated. The findings are expected to provide a better understanding of price transmission along the poultry supply chain and to serve as a basis for formulating policies that strengthen market efficiency, stabilize feed and egg prices, and support the sustainability of the layer poultry industry in West Sumatra.

B. Problem Statement

Fluctuation in maize prices observed in West Sumatra over the period of 2024 indicate instability in a commodity that serves as the primary raw material for layer chicken feed (Table 1). Maize, feed, and egg prices exhibited different patterns of movement throughout 2024, but generally reflected an interconnected relationship. Maize prices declined substantially from IDR 5.627,86/kg in January to IDR 4.548,15 /kg in December, indicating lower raw material costs for the feed industry. Feed prices also showed a downward trend, although the adjustment occurred with a time lag, suggesting that changes in maize prices were not transmitted immediately due to production and inventory processes. Egg prices experienced relatively smaller fluctuations compared to maize and feed prices, reflecting the influence of additional factors such as market demand and supply conditions. Overall, the patterns in Table 1 provide preliminary indications that

there is a vertical price linkage between maize, feed, and layer chicken egg prices in West Sumatra. Maize prices, as an upstream commodity, tend to influence feed prices as an intermediate commodity, while changes in feed prices subsequently affect egg prices as a downstream commodity. However, this relationship does not occur simultaneously but rather through a price transmission mechanism that involves a time lag.

This price instability has direct implication for changes in feed costs, which constitute the largest component of total production costs for layer chicken farmers. Given that maize accounts for a dominant proportion of feed formulation, price changes in this commodity lead to significant increases or decreases in production costs. This condition is further reinforced by limited maize production capacity within the province and the high dependence on supplies from outside regions. The average demand for maize as poultry feed in West Sumatra reaches approximately 2.4 million tons per year. Meanwhile, local production is only around 742,492 tons per year, resulting in an annual supply deficit of about 1.6 million tons (Hendra, 2025). At the same time, the layer chicken population increased by 4.82% over the past five years (Appendix 2), which directly contributes to rising demand for maize as primary feed ingredient. This imbalance between demand and supply makes local maize prices highly sensitive to price fluctuations in major producing regions as well as to interregional distribution dynamics.

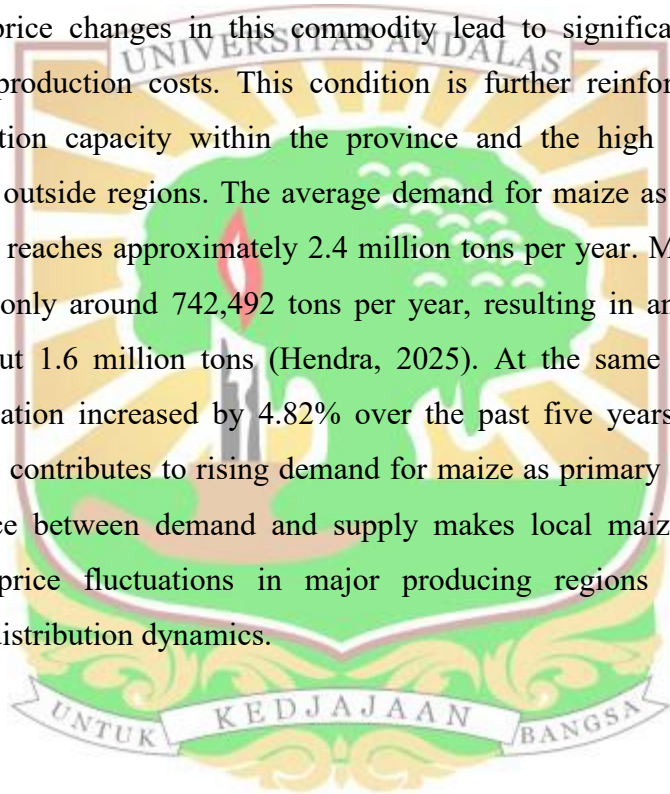


Table 1. Maize, feed, and egg price trends in West Sumatra Province in 2024

Month	Maize (IDR)	Growth (%)	Feed (IDR)	Growth (%)	Egg (IDR)	Growth (%)
January	5.627,86	-	7.762,00	-	22.976,00	-
February	6.145,81	9%	8.205,00	6%	23.726,00	3%
March	5.336,66	-13%	7.874,00	-4%	25.533,00	8%
April	5.233,78	-2%	7.947,00	1%	24.909,00	-2%
May	4.869,75	-7%	7.425,00	-7%	25.062,00	1%
June	4.709,95	-3%	7.050,00	-5%	24.718,00	-1%
July	4.441,89	-6%	7.474,00	6%	24.130,00	-2%
August	4.512,30	2%	6.675,00	-11%	23.320,00	-3%
September	4.687,62	4%	6.675,00	0%	23.200,00	-1%
October	4.598,67	-2%	6.675,00	0%	22.663,00	-2%
November	4.440,75	-3%	6.675,00	0%	22.560,00	-0,5%
December	4.548,15	2%	6.400,00	-4%	23.174,60	3%

Source: BPS And Directorate General of Livestock an Animal Health through SPORA, and SIMPONI *Ternak* After Processing (2025).

Within the poultry agribusiness system, feed functions as the crucial intermediary linking maize prices as the primary production input to egg prices as the final output. Consequently, understanding the interaction among these three commodities requires not only examining the direct relationship between maize and feed prices but also investigating how changes in feed prices are transmitted to egg prices. Efficient vertical market integration implies that price changes occurring at the upstream market are transmitted to downstream markets in both the short run and the long run. However, in practice, price transmission is often imperfect due to production lags, market structure, transaction costs, and information asymmetry.

To date there has been no empirical study that comprehensively analyzes integration patterns and price transmission mechanisms along the maize –feed-egg supply chain in West Sumatra. The lack of understanding regarding long-run relationships and short-run price adjustment mechanisms limits insights into market efficiency and complicates the formulation of effective price stabilization policies. Unclear information on price movement patterns also constrains the

ability to measure market efficiency and to assess output price responsiveness to changes in input prices.

In addition to the absence of identified relationships between maize prices and egg prices, the magnitude of the impact of maize price changes on egg prices and the adjustment mechanisms between these two commodities have not yet been systematically examined. In fact, fluctuations in feed prices resulting from changes in maize prices are a major determinant of profitability and sustainability in layer chicken farming. Without clear information on the extent to which maize price changes affect production costs, farmers face difficulties in formulating feed procurement strategies, managing production planning, and anticipating price risks that may change unpredictably.

Based on the issues outlined above, the research questions addressed in this study are as follows:

1. Is there a long-run and short-run price integration between maize, feed, and layer chicken egg prices in West Sumatra in 2020-2024?
2. How do shocks in maize prices affect feed prices in West Sumatra in 2020-2024?
3. How do shocks in feed prices affect layer chicken egg prices in West Sumatra in 2020-2024?

C. Research Objective

Based on the research problems formulated above, the objectives of this study are as follows:

1. To analyze long-run and short-run price integration between maize, feed, and layer chicken egg prices in West Sumatra in 2020-2024.
2. To analyze the impact of shocks in maize price on feed prices in West Sumatra in 2020-2024.
3. To analyze the impact of shocks in feed price on layer chicken egg prices in West Sumatra in 2020-2024.

D. Research Benefit

1. Theoretically, this study is expected to contribute to the development of agricultural economics and agribusiness literature, particularly with regard to price integration and price transmission in strategic food commodities. The examination of co-integration between maize prices and layer chicken egg prices enriches the empirical literature, which has previously focused predominantly on price linkages among maize markets alone. Furthermore, this study extends the application of econometric methods, such as co-integration tests and the Vector Error Correction Model (VECM), in analyzing both long-run and short-run relationships within the poultry agribusiness supply chain. As such, it may serve as a reference for future studies investigating market efficiency in agricultural commodities.
2. Practically, this study provides benefits for relevant stakeholders as follows:
 - a. For layer chicken farmers, the finding offer insights into how changes in maize prices affect production costs and egg prices, thereby supporting feed procurement planning, price risk management, and improvements in operational efficiency.
 - b. For maize farmers, an understanding of price transmission between the producer lever and the final consumer level can strengthen farmers' bargaining positions, enhance awareness of price formulation mechanisms in the market, and encourage improvements in production and distribution efficiency.
 - c. For the feed industry and supply chain actors, the results can support greater transparency of price information and more efficient management of raw materials.
 - d. For local governments, this study may serve as a basis for formulating policies on maize and egg price stabilization, improving the distribution of feed raw materials, and protecting farmers' income.