Analysis of Factors Affecting the Price of Maize as Animal Feed in Tigabinanga District, Karo Regency

Raka Fiqry Andrean[1], R Edhy Mirwandoho[*1] , Armyn Hakim Daulay[1], Syahril Manulang[2]

[1]*Animal Science Study Program, Agriculture Faculty, Universitas Sumatera Utara,Medan, 20155, Indonesia*
[2] *North Sumatra Agriculture and Livestock Service Office*
[*]Corresponding Author: r.edhy@usu.ac.id

ARTICLE INFO	ABSTRACT
  	Maize plays a vital role in the animal feed industry. Maize prices have a relationship with animal feed prices, especially for poultry. The objective of the study was to determine the marketing channel of maize, maize production, and factors affecting the price of maize as an animal feed ingredient. This study was conducted in Tigabinanga sub-district, Karo district, as the largest contributor to maize production in North Sumatra. The research used snowball sampling method. The total number of respondents in this research was 30 respondents. The results showed that farmers have 3 maize marketing channels in the study area. Total maize production is 2,556 tonnes/month, with an average of 85.2 tonnes/respondent/month. Factors that partially influence the price of maize as an animal feed ingredient are maize sales Kg/period (X1), seed price Rp/Kg (X2), and fertiliser price Rp/Kg (X3). In conclusion that there are three marketing channels that work together and the first channel is farmers distribute to agents/small traders. The next channel is from small traders/agents to collectors. The collectors then market to individual storage warehouses. **Keywords**: Maize, Marketing Channel, Price, Production, Trader

1. Introduction

Maize is a vital commodity in fulfilling animal feed needs, especially in poultry such as broiler chickens. Maize is a very important feed ingredient for the poultry industry because it contains a number of amino acid compounds that are important for the growth of broiler chickens. Maize commodities have a multipurpose function (4F), namely for food, feed, fuel, and industrial raw materials (fibre). In animal feed rations, especially poultry, maize is the main component with a proportion of around 60%. It is estimated that more than 58% of the domestic maize demand is used for feed, while only around 30% is used for food, and the rest for other industrial needs and seeds [1].

As the livestock sector develops and the feed and food industries that use maize as raw material, the demand for maize continues to increase, resulting in instability in maize prices. According to the law of demand, the higher the demand for a good or service, the higher the price of that good or service. Conversely, if demand is low, the price of the good or service will be lower. So the price of maize continues to increase every year in North Sumatra Proovince. Based on [2] the price of corn at the producer level increased by 34% or increased by IDR 118,016 per 100 Kg in 2019.

The determination of a price of goods is influenced by many factors, one of the many influential factors is availability based on corn production in North Sumatra amounted to 1,724,398 tonnes with a harvest area of 273,703 Ha. North Sumatra is among the top 5 national maize producing regions [3]. Maize is one of the commodities that until 2012 has not been able to meet its demand from local production in North Sumatra [4].

The livestock industry is the largest absorber of maize production, and rising maize prices that are not in line with claims of surplus production have a domino effect. Poultry farmers, who use maize as the main ingredient in animal feed, are the biggest losers. This can lead to an increase in feed prices, which in turn can lead to an increase in the price of livestock products such as chicken meat and eggs.

Maize stocks in North Sumatra are running low due to the temporary suspension of maize imports since 2019. The price of maize for animal feed is pegged at IDR 5,300 to IDR 5,600 per kg. It has even

reached Rp 6,000 per kg. Before imports were stopped, the price of maize was around IDR 4,500 per kg. This has led to soaring maize feed prices as well as soaring egg prices among smallholder farmers and the possibility of bankruptcy. The domino effect caused by the increase in feed can be seen in the production of livestock companies. Egg and doc/dod production decreased by 40% and 17% respectively from 2019 to 2021 [5]. The availability of eggs, and doc/dod is decreasing so that it can cause price increases in livestock by-products, especially in the poultry industry.

Tigabinanga sub-district is one of the sub-districts in Karo Regency. Tigabinanga sub-district has the largest maize land area in Karo Regency with an area of 24,099 Ha. 23% of the total land area planted with maize in Karo district is in Tigabinanga sub-district. Tigabinanga sub-district produced 166,792 tonnes of maize in 2022 [6,7].

Based on the descriptions and phenomena that have been presented, the researcher was interested in conducting a study to find out and explain the phenomenon of corn prices, which is a vital commodity in the livestock sector.

2. Materials and Methods

2.1. Place and Time of Research

This research was conducted from May to June in Tigabinanga Sub-district, precisely in 3 villages namely Bulu Cina village, Tandam Hilir Dua village, and Klambir village.

2.1. Research Method and Sampling

The research method used is quantitative with the type of survey research, namely by making direct observations in the field with the method of interviewing and filling out questionnaires. Survey research illustrates the principles of correlational research that complement it with appropriate and effective ways to describe people's thoughts, opinions, and feelings. The sampling method used is as follows:

Sampling was done in stages, namely:

1.   The first stage was to stratify the villages in Tigabinanga sub-district. Tigabinanga sub-district was divided into 3 strata: villages with high maize production, villages with medium maize production, and villages with low maize production. This sampling method is called Stratified Random sampling, according to [8] stratified random sampling is a technique used when the population has members or elements that are not homogeneous and stratified proportionally.

2.   The second stage selects villages from Tigabinanga sub-district, villages that have the most corn production, villages that have medium corn production, and villages that have little corn production. 3 strata were obtained, namely Tigabinanga Village (Most population), Gunung Village (Medium population), and Laukapur Village (Little population).

3.   The third stage determines the number of samples by quota, referring to sampling with the assumption that the population is normally distributed. The samples used were agents collecting maize as feed ingredients in Tigabinanga District, Karo Regency.

2.3. Data collection technique

Data collection techniques were obtained from direct observation in the field of maize as animal feed, as well as data collection in the form of production data, availability and prices of maize obtained from direct collector farmers and related agencies and institutions such as the Central Bureau of Statistics of Karo District, Karo District Agriculture Office.

2.4. Types and sources of data

The data used in this study are primary data and secondary data. Primary data collection is obtained from interviews with corn collectors as feed ingredients in Tigabinanga District through filling out questionnaires. Secondary data were collected from the Central Bureau of Statistics of Karo Regency, and the Agriculture Office of Karo Regency.

2.5. Observed Parameters

1.   Production Flow of Maize as Feed Ingredient

Maize production in North Sumatra generally goes through a long chain from producers to consumers, with consumers in this case purchasing maize as an animal feed ingredient. Therefore, direct observation is required to determine the flow of maize production in North Sumatra.

2.   Maize Demand

Maize is a commodity that plays a vital role in the feed ingredients that make up livestock rations, so observations were made of maize demand in North Sumatra by conducting interviews and direct observation

of the consumer segment.

2.6. Data Analysis Method
Descriptive analysis was used to analyse data on factors affecting the price of maize as an animal feed ingredient in North Sumatra. In this study, the analysis was conducted using the Ordinary Least Square (OLS) method. In this study, the data analysis method used was multiple linear regression method.

2.6.1. Descriptive Analysis
Based on [9] descriptive analysis statistics relate to describing or providing information about data or conditions, functioning to explain the situation, symptoms, or problems. Descriptive analysis is used in providing an overview of the price and marketing flow of maize as an animal feed ingredient.

2.6.1.2. Multiple Linear Regression Analysis
After the data is collected and tabulated, it is then analysed in accordance with the hypothesis to be tested, namely, by using the multiple linear analysis method (multiple regression) with SPSS tools as for the multiple linear regression analysis formula in this study as follows.

$Y = \alpha_0 + b_1X_1 + b_2X_2 + b_2X_2 + b_3X_3 + b_4X_4 + e$

Description:
Y = Maize price in Tigabinanga District (IDR/Kg/period)
α_0 = Intercept (Constant)
b_i = i-th regression coefficient (i = 1,2,...,5)
X_1 = Maize sales production (Kg/period)
X_2 = Seed price (IDR/Kg/period)
X_3 = Fertiliser price (IDR/Kg/period)
X_4 = Transport costs (IDR/Kg/period)
e = Error

3. Result and Discussion

3.1 Descriptive Analysis
Factors that are thought to affect the price of maize as an animal feed ingredient in Tigabinanga District, Karo Regency are as follows. maize sales production (X_1), seed price (X_2), fertiliser price (X_4), and transport cost (X_4). The average values of the independent variables can be seen in the table below.

Table 1. Mean of independent and dependent variables used

Components	Average	Std. Deviation
Maize price (IDR/Kg/period)	6081,67	539,394
Maize sale (Kg/period)	85200,00	32801,808
Seed price (IDR/Kg/period)	122538,33	3513,169
Fertilizer price (IDR/Kg/period)	4770,00	368,735
Transportation cost (IDR/Kg/period)	27035,57	10718,200

Source: Processed Primary Data, (2024)

Table 1 shows that the average price of maize at the collector level is IDR 6081.67 per kilogram in Tigabinanga District. This price is lower than the average maize price in North Sumatra. According to [6], the average price of maize in January 2024 in North Sumatra purchased by feed mills was IDR 6,827/Kg. Maize sales by collectors for feed purposes in Tigabinanga sub-district per month amounted to 85,200 kilograms or 85 tonnes. Based on the Appendix, the total monthly sales of collectors in Tigabinanga sub-district amounted to 2556 tonnes. This amount fulfils 2.75% of the maize demand in North Sumatra for feed [7]. The average seed price in Tigabinanga subdistrict is IDR 122,538 per kilogram. The seeds used in the study area were non-government aid seeds. On average, the seeds used had the pioneer trademark with the P32 variety.

3.2. Linear regression equation
The regression estimation equation is a calculation that describes the interaction between a number of independent variables and the dependent variable. Regression analysis is used to examine the relationship between two or more variables. Based on Table 2, the regression equation model can be seen as follows.

$Y = -4302794,044 + 5463,599 + 55,701 - 801,267 + 7,487$

Based on the multiple linear regression coefficients, it can be seen that:

1.	The intercept value (a) has a positive sign (-) this states the opposite relationship simultaneously between the dependent variable and the independent variable. The intercept (a) value of -4302794.044 indicates that if all independent variable values are constant or equal to zero (0), the price of corn will decrease by Rp.4,302,794.044/ tonne in Tigabinanga District.

2.	The coefficient value of maize sales (X1) has a negative sign (-), this has an opposite relationship with the dependent variable (Y). The coefficient value of maize sales (X1) is 5463.599 indicating that if maize sales (X1) decreases by 1%, the price of maize in Tigabinanga District (Y) increases by Rp. 5,463.599.

3.	The coefficient value of maize seed price (X2) has a positive sign (+), indicating an opposite relationship with the dependent variable (Y). The coefficient value of maize seed price (X2) is 55.701, indicating that if the price of maize seed (X2) increases by 1%, the price of maize (Y) will increase by Rp. 55.701.

4.	The coefficient value of fertiliser price (X3) has a negative sign (-), this has a unidirectional relationship with the dependent variable (Y). The coefficient value of fertiliser price (-801.267) means that if the price of fertiliser (X3) increases by 1%, the price of corn in Tigabinanga District (Y) will decrease by Rp.801.267.

5.	The coefficient of transport cost (X4) has a positive sign (+) which means that transport cost (X4) has an opposite relationship with maize price (Y). The coefficient value of transport costs is 7.487, which means that if transport costs increase by 1%, the price of maize will decrease by Rp.7.487.

Based on Table 1, the average price of fertiliser used was IDR 4,770/kilogram. The fertiliser used was subsidised. Transportation costs used by collectors have an average of IDR 27,035 per Kilogram/month. Transport is used to collect the maize from the farmers and to deliver the maize to the feed mill suppliers. The discussion of the factors affecting the price of maize as an animal feed ingredient in Tigabinanga sub-district, Karo district is as follows.

1.	Maize sales

Based on Table 2, it can be seen that the significance value of factor X1, namely corn sales, has a significance value smaller than 0.05, which is 0.016, this means that corn sales are significant to the price of corn as feed ingredient (Y). The results of the study it is known that the price of corn affects the supply of corn with a probability of $0.0011 < \alpha = 0.05$. The results of research on factors affecting the price of corn as a feed ingredient are in accordance with the law of supply where there is a positive relationship between price and quantity of goods offered, an increase in market price will increase the quantity of goods offered and a decrease in price will also reduce the amount of goods offered.

Based on Table 1, the average maize sales in the study area is 85.20 tonnes/month. The fulfilment of maize for the feed industry in the study area is sourced from farmers around Tigabinanga sub-district. According to [10], fluctuations in feed prices are strongly influenced by corn prices. This is due to the position of corn as the largest composition of feed ingredients used in poultry feed formulations, so changes in corn prices received by feed mills are something that needs to be studied more deeply. According to [11] another factor that influences the formation of maize prices at the producer level is production and its coefficient has a sign that is consistent with the hypothesis or in accordance with economic theory, which is negative. This can be seen from the estimation results that production shows a significant value. The coefficient value on the production variable is 0.159, indicating that if the amount of maize production increases, the price of maize at the producer level will decrease and vice versa, if the amount of maize production decreases, the price of maize at the producer level will increase.

2.	Seed price

Table 10 shows that the significance value of factor X2, seed price, is 0.007. This indicates that seed price partially affects the price of maize as an animal feed ingredient. The seeds used by maize farmers in the study area are not subsidised seeds from the government. The majority of the varieties used are Pioneer P32. Based on Table 1, the average maize seed price in the study area is IDR 122,538/kg.

Maize seeds can be made by threshing the maize kernels on the cob. The procurement or provision of maize seeds aims to make it easier for maize plants to be developed more. Based on the results of [12] stated that seeds have an influence on maize production. The price of seeds contradicts the demand for seeds. In addition, the price of hybrid maize (PQ) has no real effect on seed demand and the price of hybrid maize has no effect on seed demand due to the ups and downs of maize prices that do not cause the demand for hybrid seeds to decrease [13].

3.	Fertiliser price

Based on Table 2, the significance value of fertiliser price (X3) is 0.000. This indicates that fertiliser prices partially influence the price of maize as an animal feed ingredient. Fertiliser plays a vital role in maize production. This is because fertiliser can improve the quantity and quality of maize produced. This is consistent

with [14] where the price of pesticides and fertilisers and the selling price of maize affect farmers' income, where the expenditure of maize farmers in Kelubir Village is Rp. 18,047,926, with an income of Rp. 8,722,926 and farm feasibility of 0.51. The high price of fertilisers and pesticides makes farmers only buy enough fertilisers and pesticides and as a result the planted corn plants will lack nutrients and are also exposed to pest attacks which cause reduced production and less quality so that the price of corn sold decreases.

The results of the study which state that fertiliser prices can affect the price of corn as an animal feed ingredient in Tigabinanga Subdistrict are in accordance with the research of [3] which states that if corn productivity increases by 1 ton/ha ceteris paribus, it will reduce the increase in the price of non-subsidised fertiliser by 0.567 or 56.7% and vice versa if the price of fertiliser increases it will reduce corn productivity in Tigabinanga Subdistrict.

4.   Transport cost

Based on Table 2, the significance value of transport cost (X4) is 0.267. This indicates that transport cost has no partial influence on the price of maize as feed ingredient. The transport carried out has a route between the villages of Tigabinanga sub-district and the villages of Tigabinanga sub-district.

Table 2. T-statistic test

Model	Unstandardized Coefficients		Standardized Coefficients	t	Sig.
	B	Std. Error	Beta		
(Constant)	-4302794.044	2396602.725		-1.795	.085
Maize sales	-5463.599	2115.416	-.332	-2.583	.016
Seed price	55.701	18.775	.363	2.967	.007
Fertiliser price	801.267	190.569	.548	4.205	.000
Transport costs	7.487	6.595	.149	1.135	.267
R^2	0,910				

4. Conclusion

4.1. Conclusion

1.   Maize farmers market their produce in three channels. The first channel distributes to agents/small traders. Then the small traders/agents market to collectors, then the collectors market to individual storage warehouses (sample). The storage warehouse then distributes to the feed mill in Medan.

2.   The total maize production of all respondents is 2,556 tonnes/month, with an average of 85.2 tonnes/respondent/month.

3.   Factors that partially influence the price of maize as an animal feed ingredient are maize sales Kg/period (X1), seed price Rp/Kg (X2), and fertiliser price Rp/Kg (X3).

4.2. Suggestion

1.   The role of government agencies is needed to supervise the price formation of maize as a feed ingredient.

2.   It is necessary to update commodity prices transparently to avoid price imbalances that play a role in the input of the production process of maize as an animal feed ingredient.

References

[1] Fahmid, I. M., Wahyudi, M., Akbar, H. A., Rahmawati, R. A., Gunawan, E., Muslim, C., Darwis V., Pramudia A., Yofa, R. D. (2021). Impact of Program of Mechanization Agriculture Assistance on Maize Commodity Production in Indonesia. *J. Agric. Mech. Asia Afr. Lat. Am*, *52*.

[2] Badan Pusat Statistik. (2020). Statistik Industri Peternakan Unggas dalam Angka 2020. Badan Pusat Statistik

[3] Badan Pusat Statistik. (2022). Produksi jagung di Provinsi Sumatera Utara 2010 – 2021. Kota Medan

[4] Surbakti, M.N, Darus, H.M.M, dan Cahlil, D. (2013). Analisis Faktor-faktor yang mempengaruhi Harga Jagung Pipil di Tingkat Produsen Sumatera Utara. *Jurnal agribisnis USU*.

[5] Maize Research Center. (2020). Pendahuluan Rodmap Penelitian. Universitas Brawijaya. Malang

[6] Badan Pusat Statistik. (2023). Kecamatan Tigabinanga dalam Angka. Badan Pusat Statistik daerah Sumatera Utara.

[7] Badan Pusat Statistik. (2023). Kabupaten Karo dalam Angka. Badan Pusat Statistik daerah Sumatera Utara.

[8] Oyewo, I. O., & Fabiyi, Y. L. (2008). Productivity of maize farmers' in Surulere local government area of Oyo State. *International Journal of Agricultural Economics and Rural Development*, *1*(2), 25-34.

[9] Oladejo, J. A., & Adetunji, M. O. (2012). Economic analysis of maize (zea mays l.) production in Oyo state of Nigeria. *Agricultural Science Research Journals*, *2*(2), 77-83.

[10] Suh, D. H., & Moss, C. B. (2017). Decompositions of corn price effects: implications for feed grain demand and livestock supply. *Agricultural Economics*, *48*(4), 491-500.

[11] Ogundari, K., Ojo, S. O., & Ajibefun, I. A. (2006). Economies of scale and cost efficiency in small scale maize production: empirical evidence from Nigeria. *Journal of Social Sciences*, *13*(2), 131-136.

[12] Oyekale, A. S., & Idjesa, E. (2009). Adoption of improved maize seeds and production efficiency in Rivers State, Nigeria. *Academic Journal of Plant Sciences*, *2*(1), 44-50.

[13] Jones, P. C., Lowe, T. J., Traub, R. D., & Kegler, G. (2001). Matching supply and demand: The value of a second chance in producing hybrid seed corn. *Manufacturing & Service Operations Management*, *3*(2), 122-137.

[14] Xu, Z., Guan, Z., Jayne, T. S., & Black, R. (2009). Factors influencing the profitability of fertilizer use on maize in Zambia. *Agricultural economics*, *40*(4), 437-446.