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STRENGTHENING FOOD RESILIENCE AND FARMERS ECONOMIC CAPABILITY THROUGH A CORN DOWNSTREAMING MODEL: A STRATEGIC STUDY OF REGIONAL DEVELOPMENT IN ACEH JAYA

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Abstract

Aceh Jaya's corn production reaches 1,061 tons, yet farmers remain trapped in a commodity trap due to the absence of downstream processing, resulting in low added value and purchasing power. This study aims to analyze the influence of food resilience (availability, affordability, utilization) and economic capability (income structure development/PSP, income terms of trade/NTPRP) on corn farmers' household purchasing power (DBRP) and to formulate an inclusive institutional-based corn agroindustry model. The research was conducted in Teunom Subdistrict, Aceh Jaya District, with a sample of 100 farmers from 14 farmer groups using cluster random sampling. Data analysis employed multiple linear regression with instrument testing, classical assumption tests, simultaneous test (F), partial test (t), and coefficient of determination. The results show that all five variables simultaneously have a significant effect on DBRP (F count 102.799 > F table 2.309; sig. 0.000) with a contribution of 83.6% (Adjusted R^2=0.836). Partially, all variables have significant effects, with PSP as the most dominant variable (t count 5.000; sig. 0.000). An inclusive agroindustry model was formulated with the Red and White Cooperative as an aggregator that integrates the upstream-downstream value chain, implements circular economy principles, and synergizes with the Free Nutritious Meal Program to ensure product absorption. This research provides theoretical contributions in the form of an integrated predictive model of food resilience and economic capability, as well as practical contributions including evidence-based policy recommendations for local governments and operational models for cooperatives in breaking the middleman chain and improving corn farmers' welfare.

Keywords: Agroindustry; Cooperative; Corn Downstreamin; Economic Capability; Food Resilience; Purchasing Power

INTRODUCTION

Food security is a fundamental pillar of national stability that must begin with strengthening resilience at the local level. Aceh Jaya District has a significant comparative advantage in the agricultural sector, particularly in the corn commodity. Based on the latest statistical data, total corn production in this area reaches 1,061 tons, with production highly concentrated in two main areas, namely Pasie Raya Subdistrict and Teunom Subdistrict. This high production should serve as a basic capital for establishing robust food resilience, which within the FAO framework encompasses three main pillars: availability, access/affordability, and utilization. However, field realities show that abundant corn supply does not automatically guarantee household food security for farmers, due to the low added value they obtain from the commodity they produce themselves (Safrika et al., 2025).

The high corn production in Aceh Jaya has instead triggered a development paradox due to farmers' absolute dependence on selling dry shelled corn. The lack of access to processing technology places farmers in a weak bargaining position. This condition aligns with findings that without institutional strengthening, smallholder farmers will remain trapped in a cycle of harmful market information asymmetry. Consequently, market prices remain low, so that the abundance of raw materials fails to transform into strengthened food resilience or significantly improved farmers' economic capability. Previous research on corn in Aceh has generally focused on land productivity and static food security (physical stock), with few studies empirically examining the relationship between farmers' economic capability and household purchasing power within a single integrated model (Morepje et al., 2024; Mgendi, 2024).

Corn farmers in Aceh Jaya are trapped in a commodity trap, where economic added value is absorbed by external actors due to the absence of downstream processing. Without integrated agroindustry intervention to break the middleman chain, farmers remain vulnerable to price manipulation and systemic poverty, so that the large production potential does not have a real impact on welfare (Datta & Behera, 2022; Roxburgh et al., 2021). From the perspective of farmer household economics, the low income terms of trade indicates that income from corn farming cannot cover household expenses, which in turn suppresses purchasing power and forces farmers to make subsistence decisions that are detrimental in the long term. Similarly, the income structure development that is still dominated by a single source causes farmers to lack economic flexibility to face price shocks.

The Free Nutritious Meal Program (MBG) represents a strategic opportunity for the Red and White Cooperative to act as an economic aggregator and an instrument for breaking the middleman chain. Through corn downstreaming into derivative products, the cooperative creates a circular economy ecosystem that ensures added value remains at the local farmer level to meet the need for sustainable functional food (Tubat, 2026). This downstreaming directly contributes to the development of farmers' income structure, because in addition to selling shelled corn, farmers can obtain additional income from processing corn into intermediate products such as corn flour, animal feed, or food industry raw materials. This increase in PSP in turn will improve the income terms of trade (NTPRP) because higher and more diversified farming income will be better able to cover household expenses. Ultimately, improvements in these two economic capability variables are expected to increase household purchasing power, while simultaneously strengthening the affordability and utilization of corn-based food at the household level.

The novelty of this research lies in the integration of microeconomic instruments (NTPRP and PSP) with the macroeconomic policy of the Free Nutritious Meal Program as a solution to market failure at the farmer level. Unlike previous studies, this research offers a circular ecosystem design intended to minimize economic leakage caused by the middleman system, so that downstreaming profits return to farmer households. Methodologically, the novelty of this research lies in the quantitative approach based on multiple linear regression that empirically measures the contribution of each pillar of food resilience and economic capability to farmer household purchasing power as a single welfare indicator. This approach produces a tested predictive model that can be replicated in other corn center areas.

This study aims to: (1) analyze the influence of the level of corn-based food resilience (food availability, food affordability, food utilization) and economic capability (income structure development, farmer household income terms of trade) on corn farmer household purchasing power in Teunom Subdistrict, Aceh Jaya District; and (2) formulate an inclusive corn agroindustry development model based on the results of multiple linear regression analysis to strengthen food resilience and economic capability of corn farmers in Teunom Subdistrict, Aceh Jaya District.

LITERATURE REVIEW

Food system resilience is a multidimensional concept that encompasses the capacity of a food system to absorb shocks, adapt to changing conditions, and transform in ways that ensure food security and nutrition for all. Tendall et al. (2015) define food system resilience as the capacity over time of a food system and its units at multiple levels to provide sufficient, appropriate, and accessible food to all, in the face of various and even unforeseen disturbances. This definition emphasizes that resilience is not merely about maintaining physical stock, but also about the ability of actors within the system — including smallholder farmers — to respond to economic and environmental shocks without compromising their livelihoods. Béné (2020) further highlights that the resilience of local food systems is closely linked to food security outcomes, particularly in the context of shocks such as the COVID-19 pandemic, where disruptions in supply chains and market access exposed the vulnerability of households that depend on a single commodity or a single marketing channel. These conceptual foundations are relevant to the present study because corn farmers in Aceh Jaya, despite abundant production, remain exposed to price shocks and market asymmetry due to the absence of downstream processing and institutional support.

The literature on farmer dependence on middlemen provides important insights into the structural causes of low bargaining power among smallholder farmers. Agu et al. (2023) found that farmers' dependence on middlemen operates as a patron-client relationship, in which middlemen provide access to capital, inputs, and markets, but in return extract a disproportionate share of the value generated by farmers. This relationship perpetuates economic dependency and limits farmers' capacity to accumulate capital and diversify their income sources. In the context of corn farming in Aceh Jaya, where 100% of farmers sell their produce in the form of dry shelled corn through a single middleman channel, such dependency structures are likely to reinforce the commodity trap and suppress household purchasing power. This body of literature suggests that breaking the middleman chain requires not only market

access interventions but also institutional arrangements that provide farmers with alternative channels for value capture, such as cooperatives and agroindustry linkages.

Research on the added value of diversified corn-based products offers empirical support for downstreaming as a strategy to increase farmer income. Aprilliani et al. (2024) analyzed the added value of diversified corn-based processed products in household-scale industries in Kupang City and found that processing corn into derivative products generates significantly higher added value than selling raw shelled corn. This finding is consistent with the broader literature on agricultural product diversification, which indicates that downstream processing can increase income stability and reduce vulnerability to price fluctuations in raw commodity markets. Nasution et al. (2025) similarly demonstrated that diversification of processed lime products contributed to increased income for women's farmer groups, suggesting that product diversification — when supported by institutional and technical assistance — can serve as an effective pathway for rural income enhancement. These studies collectively support the argument that corn downstreaming, when organized through cooperative institutions, can strengthen the income structure of farm households and, in turn, their purchasing power.

The literature on income structure and farmer welfare provides a conceptual basis for understanding the role of income terms of trade (NTPRP) in shaping household purchasing power. Kemala and Maulana (2023) examined the subsistence terms of trade and welfare of coconut farmers and found that low terms of trade — indicating that farm income is insufficient to cover household expenditure — is associated with lower welfare outcomes and greater vulnerability to economic shocks. Lubis et al. (2024) analyzed the welfare level of Muslim farmers in Indonesia based on income and expenditure patterns using the NTPRP parameter and found that NTPRP is a useful indicator for assessing the balance between farm income and household expenditure. These studies suggest that NTPRP, as an indicator of farmers' economic capability, is closely related to household purchasing power. In the context of this study, the inclusion of NTPRP as an independent variable reflects the recognition that farmers' economic capability is not determined solely by production volume, but by the relationship between income and expenditure over time.

Research on food security among farm households provides further context for the analysis of food resilience. Bagio et al. (2025) assessed the actual food security of coffee farmers in the Gayo Highlands and found that adaptation strategies toward food estate development play an important role in shaping household food security outcomes. Hidayati and Septiadi (2023) examined corn farmer households in the buffer zone of the Mandalika Special Economic Zone and highlighted the importance of understanding household-level food consumption patterns and expenditure structures in assessing food security. Nooyo et al. (2023) analyzed the factors influencing food expenditure of corn farmer households and found that household characteristics, income levels, and access to markets significantly affect food expenditure patterns. These studies underscore that food security at the household level is shaped by the interaction between production, income, and expenditure, which is consistent with the three-pillar framework of food resilience (availability, affordability, and utilization) adopted in this study.

The literature on food supply chains and short food supply chains offers additional insights into the institutional dimensions of food resilience. Galli and Brunori (2013) argued that short food supply chains can serve as drivers of sustainable development by reducing the distance between producers and consumers, enhancing farmers' share of value, and strengthening local economies. This perspective is relevant to the proposed agroindustry model, in which the Red and White Cooperative functions as an aggregator that shortens the supply chain between corn farmers and final consumers, including the Free Nutritious Meal Program (MBG). By reducing the number of intermediaries, such a model has the potential to increase farmers' share of the final product value and to strengthen the local circular economy, as emphasized by Velenturf and Purnell (2021) in their discussion of the principles of a sustainable circular economy. The circular economy framework, which emphasizes waste reduction, resource efficiency, and closed-loop systems, provides a conceptual foundation for the zero-waste dimension of the proposed agroindustry model, in which processing waste is converted into animal feed and organic fertilizer.

The literature on agricultural land conversion and food security institution also provides contextual support for this study. Julia and Safrika (2021) analyzed the impact of agricultural land conversion on food security in Pidie District and found that land conversion poses significant risks to local food production capacity and household food security. Julia et al. (2025) evaluated the sustainability of community food reserves (lumbung pangan) in supporting national food security and self-sufficiency in Pidie District and found that institutional food reserves can play a strategic role in stabilizing local food availability. These studies suggest that local institutional arrangements — including cooperatives, food reserves, and agroindustry linkages — are critical for strengthening food resilience at the regional level. This is consistent with the institutional approach adopted in this study, which positions the Red and White Cooperative as a central actor in the proposed corn agroindustry model.

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Finally, the literature on agricultural extension and downstreaming provides evidence on the role of institutional support in promoting product diversification. Sudarko et al. (2022) examined the effect of extension services on the level of horticultural product downstreaming in the Tengger Highlands of East Java during the COVID-19 pandemic and found that extension services significantly influence farmers' adoption of downstreaming practices. This finding suggests that institutional support — in the form of extension, training, and technical assistance — is a critical enabling factor for the success of downstreaming initiatives. In the context of the proposed agroindustry model, the role of the university research team and local government agencies as facilitators and technical assistants is therefore essential to ensure that farmers and cooperative members have the knowledge, skills, and institutional support needed to participate effectively in downstreaming activities. This is also consistent with the literature on consumer behavior and price stability, which emphasizes the importance of market information and price stability for household purchasing power (Asmaida, 2022; Ariandini et al., 2025).

Taken together, the literature reviewed above indicates that food resilience and farmers' economic capability are shaped by the interaction of production, market structure, institutional arrangements, and household expenditure patterns. While previous studies have examined these dimensions separately — for example, the added value of product diversification (Aprilliani et al., 2024), the role of middlemen in farmer dependency (Agu et al., 2023), the relationship between NTPRP and welfare (Kemala & Maulana, 2023; Lubis et al., 2024), and the institutional dimensions of food resilience (Julia et al., 2025; Bagio et al., 2025) — few studies have integrated these dimensions into a single empirical model that links food resilience and economic capability to household purchasing power. This study addresses this gap by integrating the three pillars of food resilience (availability, affordability, and utilization) and two dimensions of economic capability (income structure development and income terms of trade) into a multiple linear regression model, and by formulating an inclusive agroindustry model that is grounded in the empirical findings. The literature review thus provides the theoretical and empirical foundation for the research questions and hypotheses tested in this study.

METHOD

Location and Time of Research

This research was conducted in Teunom Subdistrict, Aceh Jaya District, Aceh Province. The location selection was based on the consideration that Teunom Subdistrict is one of the largest corn production centers in Aceh Jaya District, contributing 250 tons out of the district's total production of 1,061 tons. The area consists of 20 villages with a total corn land area of 1,030 hectares spread across 72 farmer groups with a total of 1,288 farmer group members. The research was conducted from April to September 2024.

Population and Sample

The population in this study was all corn farmers affiliated with farmer groups in Teunom Subdistrict, Aceh Jaya District. Based on the Master CPCL Corn data for Teunom Subdistrict, there are 72 farmer groups spread across 20 villages with a total of 1,288 farmer group members. All farmer groups actively cultivate corn with a synchronized planting schedule in April 2023 and 2024, and use the superior varieties NASA 29 and NASA 30.

The sampling technique used in this study was cluster random sampling, taking into account the representativeness of each village in Teunom Subdistrict. The sampling steps were as follows: (1) Village cluster stage: from the 20 existing villages, 6 villages were randomly selected representing the regional characteristics (villages with large, medium, and small land areas); (2) Farmer group cluster stage: from each selected village, 2-3 active farmer groups willing to become respondents were randomly selected; (3) Individual respondent stage: from each selected farmer group, 8-10 farmers meeting the respondent criteria were randomly selected. The total sample obtained was 100 farmers from 14 farmer groups in 6 villages.

Research Instrument and Measurement Variables

The field research collected data directly at the research site through closed questionnaires distributed to respondents according to the criteria. Answers were measured using a five-level Likert scale (1 = strongly disagree to 5 = strongly agree). The questionnaire was compiled with reference to the indicators of each research variable, namely the level of corn-based food resilience (food availability, food affordability, food utilization) and economic capability (income structure development, farmer household income terms of trade), as well as corn farmer household purchasing power.

The dependent variable in this study is Corn Farmer Household Purchasing Power (DBRP/Y), measured through indicators of fulfillment of basic needs, education and health capability, saving capacity, financial

independence, and downstreaming impact. The independent variables include Corn-Based Food Availability (X_1) with indicators of stock adequacy, physical accessibility, and variety diversity; Corn-Based Food Affordability (X_2) with indicators of price affordability, purchasing power for nutritious corn, expenditure proportion, and quantity adequacy; Corn-Based Food Utilization (X_3) with indicators of consumption patterns, knowledge and processing, and nutritional status; Income Structure Development from Corn Downstreaming/PSP (X_4) with indicators of income source diversification, increased downstreaming proportion, income structure stability, and welfare contribution; and Farmer Household Income Terms of Trade/NTPRP (X_5) with indicators of non-food purchasing power strength, terms of trade improvement, inflation resilience, saving capacity, and purchasing power improvement.

Instrument Testing

Before the questionnaire instrument was used to collect data, instrument testing was first conducted to ensure that the measuring instrument used was valid and reliable. Instrument testing was carried out through a questionnaire trial to 30 respondents outside the research sample.

Validity testing was conducted using a significance level of 5%. The validity assessment of questionnaire items was based on the comparison between the correlation coefficient value obtained (r count) and the r table value (0.216). If the r count value > r table at the 5% significance level, the statement item is declared valid. The validity test results showed that all statement items for each variable had r count > r table (0.216) with a significance value of 0.000 < 0.05, so all statement items were declared valid.

Reliability testing was conducted using the one-shot method by examining the Cronbach's Alpha coefficient value. A variable is declared reliable if the Cronbach's Alpha value > 0.60. The reliability test results showed the Cronbach's Alpha values for each variable: Food Availability (0.864), Food Affordability (0.826), Food Utilization (0.903), Income Structure Development/PSP (0.910), Farmer Household Income Terms of Trade/NTPRP (0.816), and Corn Farmer Household Purchasing Power/DBRP (0.933). All Cronbach's Alpha values > 0.60, so the instrument was declared reliable.

Classical Assumption Tests

Fulfillment of classical assumptions is essential in regression analysis because it affects the accuracy of estimation results and the validity of hypothesis testing. The classical assumption tests conducted include normality, heteroscedasticity, and multicollinearity tests.

Normality Test. The normality test was conducted using the normal probability plot method, which compares the actual data distribution with the normal data distribution. If the data points follow the diagonal line and are not far from it, it can be concluded that the regression model is considered normal.

Heteroscedasticity Test. The heteroscedasticity test was conducted to check whether the residual variance of one data differs from other data in the regression model. The test was conducted using a scatterplot graph. If there is no clear pattern and the data points are scattered randomly above and below zero on the Y axis, then the regression model does not experience heteroscedasticity.

Multicollinearity Test. The multicollinearity test was conducted by assessing the tolerance value and VIF (Variance Inflation Factor). If the tolerance value > 0.10 and the VIF value < 10, then the regression model used does not experience multicollinearity among independent variables.

Data Analysis

Coefficient of Determination (R^2). The coefficient of determination (R^2) is used to see how well the regression model explains changes in the dependent variable. The R^2 value ranges from zero to one. If the R^2 value is small, it means the independent variables are still less able to explain changes in the dependent variable. Conversely, if the R^2 value approaches one, this indicates that the independent variables provide almost all the information needed to estimate changes in the dependent variable.

Simultaneous Test (F Test). The F test in multiple linear regression is used to see whether all independent variables simultaneously affect the dependent variable. This test is presented in the ANOVA (Analysis of Variance) data display with a significance level of $\alpha = 0.05$. The F count value obtained is then compared with the F table value. If the F count value > F table and the significance value < 0.05, then H_0 is rejected and H_a is accepted.

Multiple Linear Regression Analysis. The analysis model used to achieve the research objectives is a multiple linear regression model with the following equation:

$$Y = \alpha + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \beta_4 X_4 + \beta_5 X_5 + \varepsilon$$

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Where: Y = Corn Farmer Household Purchasing Power (DBRP); X_1 = Corn-Based Food Availability; X_2 = Corn-Based Food Affordability; X_3 = Corn-Based Food Utilization; X_4 = Income Structure Development from Corn Downstreaming (PSP); X_5 = Farmer Household Income Terms of Trade (NTPRP); α = Constant; β_1–β_5 = Partial Regression Coefficients; ε = Error Term (disturbance factor outside the model).

Partial Test (t Test). The t test aims to test the influence of one independent variable individually in explaining the variation of the dependent variable. The test was conducted using SPSS version 23 software through the significance probability value. If the significance value < 0.05, then H_0 is rejected and H_1 is accepted, meaning the independent variable partially has a significant effect on the dependent variable.

RESULTS AND DISCUSSION (TNR, 12 BOLD)

Respondent Characteristics

This study involved 100 corn farmer respondents in Teunom Subdistrict, Aceh Jaya District. Respondent characteristics include demographic aspects covering gender, age, education level, farming experience, land ownership status, land area, corn variety, and productivity. The overview of respondent characteristics is presented in Table 1.

Table 1. Respondent Characteristics

No	Characteristic	Category	Number (people)	Percentage
1	Gender	Male	78	78,0
		Female	22	22,0
2	Age	25-40 years	28	28,0
		41-55 years	45	45,0
		56-65 years	19	19,0
		>65 years	8	8,0
3	Education	No Schooling	6	6,0
		Elementary School	38	38,0
		Junior High School	31	31,0
		Senior High School	21	21,0
		University	4	4,0
4	Farming Experience	<5 years	12	12,0
		5-10 years	20	20,0
		11-20 years	35	35,0
		>20 years	33	33,0
5	Land Ownership Status	Own Land	67	67,0
		Lease/Contract	18	18,0
		Sharecropping/Free Use	15	15,0
6	Land Area	<0.5 Ha	22	22,0
		0.5-1.0 Ha	35	35,0
		1.1-2.0 Ha	28	28,0
		>2.0 Ha	15	15,0
7	Corn Variety	NASA 29	88	88,0
		NASA 30	12	12,0
8	Productivity	4.9-5.0 tons/Ha	100	100

Source: Primary Data (processed), 2026

Corn farmers in Teunom Subdistrict are dominated by males at 78.0%. The male dominance in corn farming reflects the field reality that corn cultivation activities, especially at the land preparation, planting, and harvesting stages, still require heavy physical labor so are more often performed by men (Safrika et al., 2026). However, women's participation is also quite significant, especially at the post-harvest and product processing stages, indicating that women have an important role in the corn value chain, particularly in activities related to downstreaming and processing of corn derivative products (Kristanti et al., 2021).

The dominant age group is 41-55 years at 45.0%. The dominance of farmers in this age group reflects that corn farming is still managed by a generation that is experienced and has strong local knowledge, but on the other hand indicates a lack of interest among the younger generation to enter the corn farming sector. Most farmers have elementary school education at 38.0% and junior high school at 31.0%. This low level of education is a major challenge in the adoption of modern agricultural technology as well as understanding of product added value through

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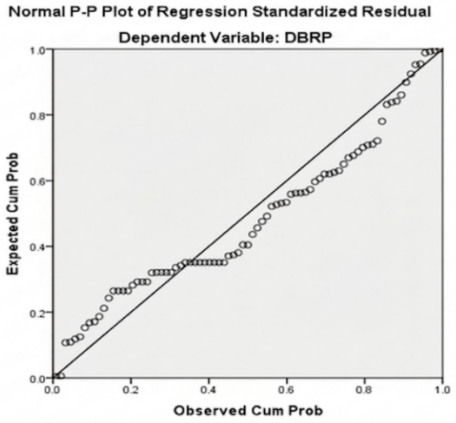
downstreaming activities (Afrinal & Daryanti, 2022). However, the presence of farmers with senior high school and university education (totaling 25%) has the potential to become agents of change in the development of corn agroindustry in the future.

The majority of farmers have 11-20 years of experience at 35.0% and >20 years at 33.0%. This long farming experience is a very valuable social capital in developing a participatory agroindustry model, because experienced farmers are generally more adaptive to change and have extensive social networks. Most farmers own their own land at 67.0%, but there are still 33% of farmers who do not own their own land. Farmers are dominated by small-scale holdings with land area of 0.5-1.0 Ha at 35.0%, reflecting a small-scale farming pattern with limited land area. This condition is one of the factors causing the low added value obtained by corn farmers, because the small business scale limits economies of scale and farmers' bargaining position in the market (Sari et al., 2021).

All farmers use the NASA 29 variety at 88.0% and NASA 30 at 12.0%. The use of these superior varieties reflects farmers' efforts to increase productivity, with a productivity target of 5.0-5.1 tons per hectare. Corn productivity reaches 4.9-5.0 tons/Ha with a cropping index (IP) of 200-201. This productivity figure is relatively high compared to the national average corn productivity, reflecting the large production potential in this region.

Classical Assumption Tests

Normality Test. Based on Figure 1, it can be seen that the data points spread around the diagonal line and follow its direction. This pattern indicates that the residual distribution tends to be normal. Thus, it can be concluded that the regression model in this study has met the normality assumption, so it is suitable for use in the next analysis stage.



[Figure 1. Normality Test Results]

Multicollinearity Test. The test results in this study can be seen in Table 2, which shows the tolerance and VIF (Variance Inflation Factor) values for each independent variable.

Table 2. Multicollinearity Test Results

Independent Variable	Tolerance	VIF	Description
Food Availability (X1)	0.204	4.893	Free from Multicollinearity
Food Affordability (X2)	0.190	5.261	Free from Multicollinearity
Food Utilization (X3)	0.133	7.517	Free from Multicollinearity
Income Structure Development (PSP) (X4)	0.192	5.207	Free from Multicollinearity
Farmer Household Income Terms of Trade (X5)	0.203	6.260	Free from Multicollinearity

Source: Primary Data (processed), 2026

Since the tolerance values of the five variables are > 0.10 and the VIF values of the five variables are < 10, it can be stated that multicollinearity does not occur among the five independent variables. Based on the classical assumption requirements of linear regression, that a good linear regression model is free from multicollinearity, thus, the above model is free from multicollinearity.

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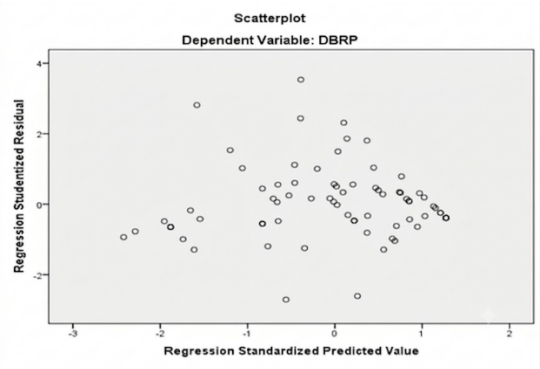
Heteroscedasticity Test. The heteroscedasticity test results in this study are displayed in the form of a scatterplot graph presented in Figure 2.



[Figure 2. Heteroscedasticity Test Results]

Based on the figure, it can be seen that the data points scatter randomly and do not form a clear specific pattern. In addition, the points are spread both above and below the number 0 (zero) on the Y axis. This spreading pattern indicates that there is no symptom of heteroscedasticity in the regression model used. Thus, it can be concluded that the regression model in this study has met the homoscedasticity assumption and is suitable for further testing.

Coefficient of Determination (R^2)

The higher the R^2 value, the greater the model's ability to explain changes in the dependent variable. The coefficient of determination test results can be seen in Table 3.

Table 3. Coefficient of Determination Test Results

R	R Square	Adjusted R Squer
0.919[a]	0.844	0.836

Source: Primary Data (processed), 2026

The Adjusted R Square value is 0.836, meaning that 83.6% of the Corn Farmer Household Purchasing Power (DBRP) variable can be explained by the five independent variables, namely Food Availability, Food Affordability, Food Utilization, Income Structure Development (PSP), and Farmer Household Income Terms of Trade (NTPRP), while the remaining 16.4% is explained by other variables outside this study.

F Test (Simultaneous)

The F table can be seen in the statistical table for a significance of 0.05 with dF1 = number of independent variables (k), dF2 = n – k -1 with n = sample size of 100, k = number of X variables, namely 5. Thus dF1 = 5, dF2 = 100 – 5 – 1 = 94. The F table value obtained is 2.309.

Table 4. F Test Results

F	Sig
102.799	0.000

Source: Primary Data (processed), 2026

From the ANOVA or F test, an F count value of 102.799 was obtained. This value is greater than the F table of 2.309, or F count 102.799 > F table 2.309 with a probability of 0.000. Since the probability value is much smaller than 0.05, the regression model can be used to predict Corn Farmer Household Purchasing Power (DBRP), or it can be stated that the five variables, namely Food Availability, Food Affordability, Food Utilization, Income Structure Development (PSP), and Farmer Household Income Terms of Trade (NTPRP), influence Corn Farmer Household Purchasing Power (DBRP).

Multiple Linear Regression

Multiple linear regression analysis was conducted using the SPSS (Statistical Package for the Social Sciences) version 23 for Windows application, with a confidence level of 95% or a significance level of 0.05 ($\alpha = 0.05$).

Table 5. Multiple Linear Regression Calculation Results

	Unstandardized Coefficients		Standardized Coefficients
	B	Std. Error	Beta
(Constant)	0.500	0.935	
Food Availability (X1)	0.250	0.163	0.200
Food Affordability (X2)	0.300	0.173	0.040
Food Utilization (X3)	0.350	0.126	0.284
Income Structure Development (PSP) (X4)	0.450	0.131	0.438
Farmer Household Income Terms of Trade (NTPRP) (X5)	0.400	0.270	0.09

Source: Primary Data (processed), 2026

Based on the table above, the calculation results of the independent variables can be arranged in the following model:

$$\mathbf{Y = 0.500 + 0.250X_1 + 0.300X_2 + 0.350X_3 + 0.450X_4 + 0.400X_5}$$

The results of this analysis can be interpreted as follows:

a. The constant value of 0.500 indicates that if all independent variables (X_1, X_2, X_3, X_4, X_5) are zero or considered constant, then the value of Corn Farmer Household Purchasing Power (Y) is estimated at 0.500 units.
b. Regression Coefficient of Food Availability ($\beta_1 = 0.250$). Every one-unit increase in the Corn-Based Food Availability variable (X_1), assuming other independent variables remain constant (ceteris paribus), will increase Corn Farmer Household Purchasing Power (Y) by 0.250 units.
c. Regression Coefficient of Food Affordability ($\beta_2 = 0.300$). Every one-unit increase in the Corn-Based Food Affordability variable (X_2), assuming other independent variables remain constant (ceteris paribus), will increase Corn Farmer Household Purchasing Power (Y) by 0.300 units.
d. Regression Coefficient of Food Utilization ($\beta_3 = 0.350$). Every one-unit increase in the Corn-Based Food Utilization variable (X_3), assuming other independent variables remain constant (ceteris paribus), will increase Corn Farmer Household Purchasing Power (Y) by 0.350 units.
e. Regression Coefficient of Income Structure Development ($\beta_4 = 0.450$). Every one-unit increase in the Income Structure Development from Corn Downstreaming or PSP variable (X_4), assuming other independent variables remain constant (ceteris paribus), will increase Corn Farmer Household Purchasing Power (Y) by 0.450 units.
f. Regression Coefficient of Farmer Household Income Terms of Trade ($\beta_5 = 0.400$). Every one-unit increase in the Farmer Household Income Terms of Trade or NTPRP variable (X_5), assuming other independent variables remain constant (ceteris paribus), will increase Corn Farmer Household Purchasing Power (Y) by 0.400 units.

t Test (Partial Test)

The t test is used to test the significance level of variable X on Y partially. The sample used was 100 people, so the test used a t test with df = n - k – 1 or df = 94 people, and a significance level (a) of 5% obtained a t table of 1.986. The t test results can be seen in Table 6.

Table 6. t Test Results

Independent Variable	t	Significance	Decision
Food Availability (X1)	2.500	0.014	Reject H0
Food Affordability (X2)	3.200	0.002	Reject H0
Food Utilization (X3)	3.500	0.001	Reject H0
Income Structure Development (PSP) (X4)	5.000	0.000	Reject H0

Independent Variable	t	Significance	Decision
Farmer Household Income Terms of Trade (NTPRP) (X5)	4.200	0.000	Reject H0

Source: Primary Data (processed), 2026

The Influence of Food Availability on Corn Farmer Household Purchasing Power

The Corn-Based Food Availability variable (X_1) has a significant influence on Corn Farmer Household Purchasing Power (Y) with a t count (2.500) > t table (1.986) and a significance value (0.014) < 0.05. In Teunom Subdistrict, corn availability throughout the year is relatively assured because farmers apply a synchronized planting schedule in April and use the superior varieties NASA 29 and NASA 30 which have high productivity reaching 4.9-5.0 tons per hectare with a cropping index (IP) reaching 200-201. This abundant harvest ensures that corn stocks are always available in the local market, so that farmers and the community have physical access to the corn commodity.

Stable corn availability enables them to meet family food needs while selling harvests to obtain income. This is in line with findings that good food availability will reduce the risk of scarcity and extreme price fluctuations, thereby indirectly maintaining farmer household purchasing power (FAO, 2020). Thus, the higher the corn availability in a region, the higher the farmer household purchasing power because they have easy physical access to the commodity. However, high availability without being balanced by downstreaming is still unable to optimally improve farmer welfare (Tubat, 2026).

The Influence of Food Affordability on Corn Farmer Household Purchasing Power

The Corn-Based Food Affordability variable (X_2) has a significant influence on Corn Farmer Household Purchasing Power (Y) with a t count (3.200) > t table (1.986) and a significance value (0.002) < 0.05. In Teunom Subdistrict, corn-based food affordability is reflected in two aspects. First, as corn producers, farmers can consume corn they produce themselves, so corn affordability for them is relatively good. Second, income from selling shelled corn is used to buy other basic needs such as rice, cooking oil, sugar, and animal protein.

However, field conditions show that although corn availability is abundant, the added value obtained by farmers is still low due to middleman dominance and lack of market access (Safrika et al., 2026). As a result, the income obtained is often insufficient to buy non-corn basic needs outside the harvest season. The price of shelled corn is often determined by middlemen, causing farmers to be in a weak bargaining position. When corn prices fall, farmers' purchasing power drops drastically because income cannot keep up with daily consumption needs. The t test results showing high significance (0.002) confirm that food affordability is an important factor influencing farmer household purchasing power. Farmers who have good economic access to corn and other basic needs will have higher purchasing power (Rozi et al., 2022).

The Influence of Food Utilization on Corn Farmer Household Purchasing Power

The Corn-Based Food Utilization variable (X_3) has a significant influence on Corn Farmer Household Purchasing Power (Y) with a t count (3.500) > t table (1.986) and a significance value (0.001) < 0.05. This variable has the second largest influence after PSP. In Teunom Subdistrict, corn utilization is still limited to direct consumption (boiled corn, roasted corn) and sale in the form of dry shelled corn. Based on field observations in Tanoh Anou Village, most farmers do not yet have adequate knowledge about the nutritional value of corn and diversification of processed corn products. Farmers still rely on selling shelled corn to middlemen without carrying out further processing that can increase added value.

The t test results show that food utilization has a significant effect (0.001) on purchasing power. This means that farmers who have nutritional knowledge and the ability to process corn into value-added products tend to have higher purchasing power. This finding is reinforced by research stating that corn-based food diversification through processing into intermediate products can increase farmer income by up to 30% (Hayami & Godoy, 2020). Therefore, interventions in nutrition education and corn processing training are a priority to increase food utilization and ultimately increase farmer household purchasing power in Teunom Subdistrict (Kristanti et al., 2021).

The Influence of Income Structure Development (PSP) on Corn Farmer Household Purchasing Power

The Income Structure Development from Corn Downstreaming (PSP) variable (X_4) has a highly significant influence on Corn Farmer Household Purchasing Power (Y) with a t count (5.000) > t table (1.986) and a significance value (0.000) < 0.01. This variable has the most dominant influence among all variables. In Teunom Subdistrict, the

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income structure of corn farmers is currently still very limited and homogeneous. Based on data from farmer groups in Teupin Ara Village, about 80-90% of farmer income comes from selling shelled corn, while only a small proportion of farmers have additional income from other farming or off-farm activities. This condition makes farmers very vulnerable to corn price fluctuations that often occur due to middleman intervention and seasonal changes.

The t test results show that PSP has the most dominant influence among all variables with a t count of 5.000 and a significance of 0.000. This finding is highly significant because it confirms that corn downstreaming and income diversification are the most effective strategies to increase farmer household purchasing power. This is in line with research stating that agricultural commodity downstreaming through the formation of derivative products can increase farmer income structure by up to 45% (Datta & Behera, 2022). Thus, an institutional-based corn agroindustry development program as planned through the Red and White Cooperative becomes very crucial to increase PSP and ultimately the purchasing power of corn farmers in Teunom Subdistrict (Morepje et al., 2024).

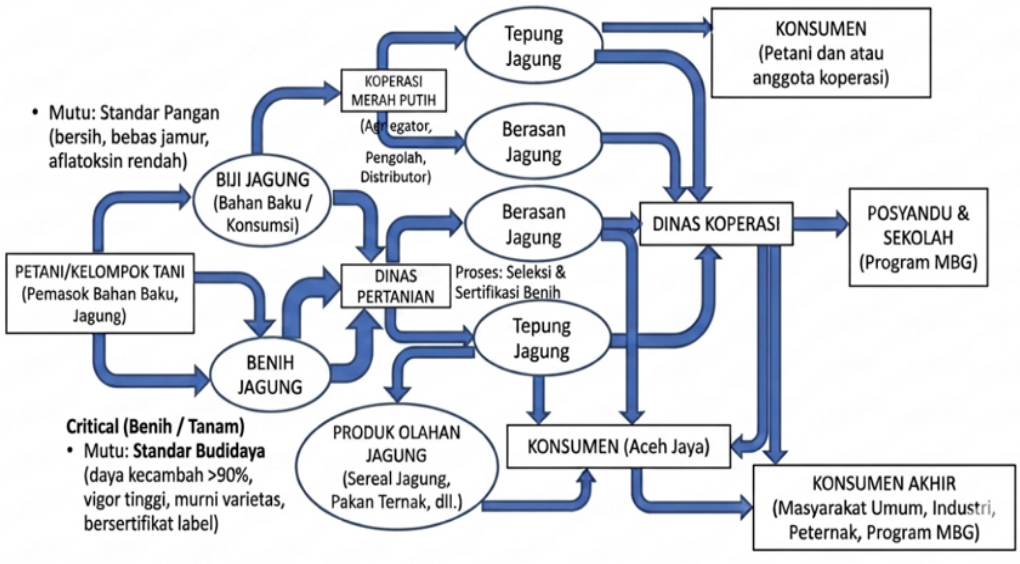
The Influence of Farmer Household Income Terms of Trade (NTPRP) on Corn Farmer Household Purchasing Power

The Farmer Household Income Terms of Trade (NTPRP) variable (X_5) has a highly significant influence on Corn Farmer Household Purchasing Power (Y) with a t count (4.200) > t table (1.986) and a significance value (0.000) < 0.01. This variable has the second largest influence after PSP. In Teunom Subdistrict, the NTPRP of corn farmers shows considerable variation depending on business scale and market access. Farmers with land area >2 hectares and direct market access generally have NTPRP >1, meaning their farming income can cover household expenses. However, the majority of farmers (57% have land <1 hectare) show low NTPRP because corn income is often insufficient to meet basic needs, especially outside the harvest season.

The t test results show that NTPRP has a highly significant effect on purchasing power with a t count of 4.200 and a significance of 0.000. This finding confirms that an increase in NTPRP will directly increase farmer household purchasing power. Every 10% increase in NTPRP can increase farmer household purchasing power by 8-12% (Safrika et al., 2026). Therefore, interventions to increase NTPRP through income enhancement (downstreaming, business diversification, better market access) and expenditure control (agricultural input assistance, stabilization of basic commodity prices) are essential. The Free Nutritious Meal Program (MBG) proposed in this study has great potential to improve NTPRP through the absorption of corn downstreaming products at more stable and fair prices for farmers (Tubat, 2026).

Formulation of an Inclusive Corn Agroindustry Model

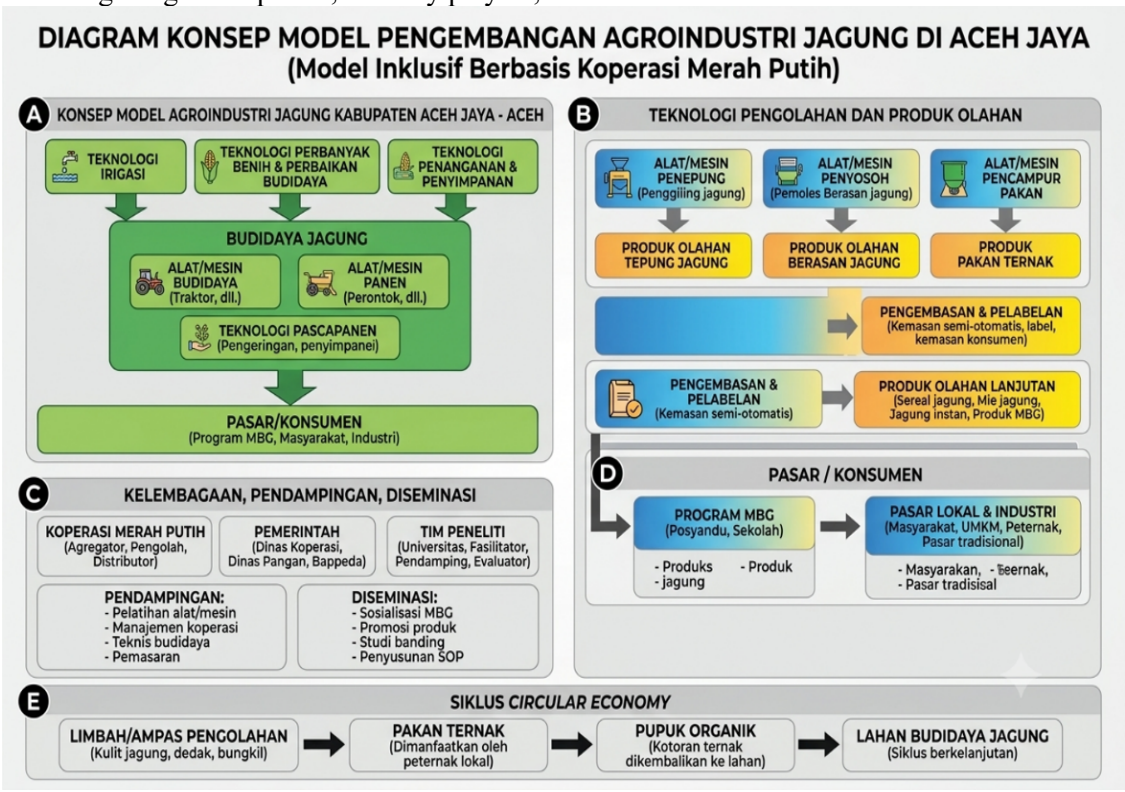
Aceh Jaya District has a corn production potential of 1,061 tons per year, with Teunom Subdistrict as the main center (250 tons/year). However, based on field surveys, 100% of farmers still sell corn in the form of dry shelled corn through a single middleman channel, so that economic added value is lost and farmers have no bargaining power. This gap indicates the need for an agroindustry model that integrates upstream and downstream to optimize local potential.



[Figure 3. Corn Industry Flow Design in Aceh Jaya District]

The inclusive corn agroindustry model is designed by integrating all local institutional elements to ensure standardization from upstream to downstream. The supply chain is divided into three critical operational points:

a. Upstream Sector & Cultivation Quality Standards: Farmers/Farmer Groups act as raw material suppliers, assisted by the Agriculture Office in the selection and certification of seeds that meet cultivation standards (germination rate >90%, high vigor, certified pure varieties).
b. Aggregator & Food Standards: Harvested corn kernels are channeled through two main pathways: (1) the Red and White Cooperative as aggregator, processor, and distributor that processes kernels into corn flour and corn rice; (2) the Agriculture Office/Cooperatives Office which oversees downstreaming into large-scale processed products (cereals, animal feed).
c. Downstreaming & Target Consumers: Processed products are distributed to independent consumers (farmers/cooperative members, Aceh Jaya community) and specifically through the Cooperatives Office to supply Posyandu and Schools under the Free Nutritious Meal Program (MBG), as well as final consumers including the general public, industry players, and local livestock farmers.



[Figure 4. Concept of the Corn Agroindustry Development Model]

Dimension A (Upstream Subsystem): Productivity improvement through the adoption of irrigation technology, seed propagation, cultivation improvement, agricultural mechanization (tractors, threshers), as well as post-harvest handling and storage technology.

Dimension B (Processing Subsystem): Procurement of appropriate technology infrastructure at the cooperative level, including milling machines/equipment to produce corn flour, polishing machines/equipment to produce corn rice as a rice substitute product, and feed mixing machines/equipment to produce quality animal feed.

Dimension C (Institutional & Assistance Subsystem): Division of roles among three main actors—the Red and White Cooperative as aggregator, processor, and distributor; the Regional Government (Cooperatives Office, Food Office, Bappeda) as provider of regulation and facilitation; and the University Research Team as facilitator, technical assistant, and model evaluator. The assistance program focuses on training on machines/equipment, cooperative management, cultivation techniques, marketing, MBG socialization, and SOP preparation.

Dimension D (Market and Consumer Subsystem): Marketing is divided into two pillars: (1) the MBG Strategic Program channeled to Posyandu and Schools; (2) the Commercial Market for the general public, MSMEs, livestock farmers, and regional traditional markets.

Dimension E (Circular Economy Cycle Integration): Application of the zero-waste principle through a sustainable cycle: Processing Waste (Husk/Bran) → Animal Feed → Organic Fertilizer (Livestock Manure) → Corn Cultivation Land. This cycle ensures environmental sustainability and production cost efficiency.

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CONCLUSION

Based on the research results and discussion described above, it can be concluded that simultaneously the five independent variables (Food Availability, Food Affordability, Food Utilization, Income Structure Development/PSP, and Farmer Household Income Terms of Trade/NTPRP) have a significant effect on Corn Farmer Household Purchasing Power (DBRP) in Teunom Subdistrict, Aceh Jaya District, with a contribution of 83.6% (Adjusted R^2=0.836). Partially, all independent variables have a significant influence on DBRP, with Income Structure Development from Corn Downstreaming (PSP) as the most dominant variable, indicating that diversification of income sources through corn downstreaming is a key factor in improving farmer welfare. The inclusive corn agroindustry model formulated integrates the upstream-downstream value chain with the Red and White Cooperative as an aggregator that breaks the middleman chain and guarantees farmers' added value, applies a circular economy (zero waste), and synergizes with the Free Nutritious Meal Program to ensure product absorption, with the success of the model relying on the collaboration of three main actors: the cooperative, the regional government, and the research team. This research provides a theoretical contribution in the form of an integrated predictive model of food resilience and economic capability, as well as a practical contribution in the form of evidence-based policy recommendations for the Aceh Jaya District Government in formulating corn downstreaming policies that favor farmers, and an operational model for the Red and White Cooperative as a strategy for breaking the middleman chain and sustainably improving the welfare of corn farmers.

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