International Journal on Advanced Science Engineering Information Technology

Vol.12 (2022) No. 3
ISSN: 2088-5334

Analysis of the Risk of Rubber Prices Using the ARCH-GARCH and VaR Methods on Farm Income in West Aceh District

Mustafa Usman [a,*], M. Yuzan Wardhana [a], Mauwaddah Istiqamah [a]

[a] *Faculty of Agriculture, Department of Agribusiness, Universitas Syiah Kuala, Aceh, 23111, Indonesia*
Corresponding author: [*]musthafa_usman@unsyiah.ac.id

***Abstract*—The fluctuating price of rubber is often detrimental to farmers because farmers generally cannot manage the timing of the sale to get a profitable selling price. High price fluctuations provide opportunities for traders to manipulate price information on farmers and cause farmers not to enjoy the higher true price. This research aims to see how risky the price is received by rubber farmers and its effect on farm income in West Aceh District. This study uses the ARCH-GARCH method and VaR calculations for price risk analysis and Simple Linear Analysis to analyze the effect of price on farm income. The results showed that the price risk received by rubber farmers was high, namely 41.699% during the one-year sales period. The regression results show that the price significantly affects the income of rubber farming in West Aceh Regency with a probability of 0.000. The value of R2 is 0.935, which means that rubber prices influence 93% of rubber farming income, and variables outside the model influence 7%. The selling price of rubber influences the income of rubber farming. If the price of rubber is low, the farmers cannot afford to pay for rubber maintenance, thus disrupting rubber productivity. Decreased productivity will reduce farm income in the West Aceh Regency, which means that the price of rubber influences 93% of rubber farming income, and 7% is influenced by variables outside the model.**

***Keywords*— Price risk; rubber; farm income; ARCH-GARCH; VaR.**

Manuscript received 3 Nov. 2020; revised 4 Apr. 2021; accepted 7 May 2021. Date of publication 30 Jun. 2022.

I. INTRODUCTION

Most of Indonesia's rubber production is exported to various countries in the world [1]. A small portion is marketed in the local market. Indonesian natural rubber reaches five continents, Asia, Australia, Europe [2], Africa, and America, with the main market share of the Asian continent. In 2018, the top five importing countries for Indonesian natural rubber were the USA (United States of America), Japan, China, India, and Korea [3]. The export value of the USA reached 605.97 tons, which is 21.54% of Indonesia's total natural rubber exports. Next to Japan at 17.2%. Then India 10.77% and China 8.96%. Meanwhile, Korea with an export weight of 189.54 tons or 6.74%. Since 2013, the price of rubber has continued to decline.

Many factors keep the price of rubber from rising [4]. One of the reasons is the increased supply of rubber. Rubber supply increased due to the emergence of several new producers, such as Myanmar, Laos, and Cambodia. Apart from that, the conditions of the trade war between China and the United States also contributed to the decline in world rubber prices [5]. In addition, the global economic downturn has also reduced demand for vehicles, both motorbikes and cars. Meanwhile, 70% of natural rubber is consumed by the world tire industry. World rubber prices, Indonesia (national) and Aceh for 2011 to 2019 can be seen in Figure 1 below:

Fig. 1 World, Indonesia, and Aceh Rubber Prices, 2011 – 2019

The fluctuation of the price of rubber often disadvantages farmers rather than traders. This is because farmers generally cannot manage their sales time to get a more profitable selling price. In other words, high price fluctuations also provide opportunities for traders to manipulate price information on

farmers [6]. This causes the price transmission from the consumer market to farmers tends to be asymmetrical. This means that if there is an increase in prices at the consumer level, the price increase is not passed on to farmers quickly and perfectly, and vice versa if there is a price decline [7]. Farmers cannot enjoy the true price. This affects farmers' income.

Aceh Barat is a district in Aceh Province with the largest land area with an area of 25,329 hectares and a total production of 15,071 tons/year. Rubber production in West Aceh District continues to decline. Based on data for the last five years, rubber production has continued to decline. Decreased rubber production is due to a lack of maintenance. Farmers cannot take care of their plants regularly because the price of rubber continues to decline. So far, there is no model for managing rubber plantations in Aceh in an environmentally friendly and sustainable way to utilize the needs of the tire industry, such as in Sumatra, such as Jambi and Kalimantan [8]. The decline in rubber prices had an impact on crop cultivation which was no longer intensive. Natural conditions are also a determining factor in rubber production. Natural factors such as weather and climate are very important factors affecting rubber production. In running a plantation business, some obstacles pose a risk to the business. One of them is price risk.

The model used to predict the risk of rubber prices is carried out using the ARCH-GARCH model. ARCH-GARCH model (Autoregressive Conditional Heteroskedasticity - Generalized Autoregressive Conditional Heteroskedasticity) is an econometric model introduced [9] and [10]. VaR (Value at Risk) is a method of calculating price risk to determine the maximum risk of loss in normal market conditions. VaR (Value at Risk) is a risk measurement method that can estimate the maximum possible loss at a certain confidence level. The VaR calculation value is always accompanied by a probability value indicating how likely it is that an adverse event will occur, less than the VaR value [11].

Research on price risk for rubber farmers is important to do to see the real conditions of rubber farmers in West Aceh District so that farmers can make the right decisions in running a business in the rubber plantation sector especially Indonesia [12]. Farmers will also be able to minimize the price risk that will occur to increase their income. In addition, it can provide useful input and suggestions in the future. This research aims to analyze the risk of rubber prices and their impact on farm income in West Aceh District for 12 years (2008-2019).

II. Material and Methods

A. Samples

This research was conducted in West Aceh District. The research location is determined intentionally (purposive) considering West Aceh Regency is one of the natural rubber-producing areas in Aceh Province [13]. This research was conducted from January to March 2020.

B. Method of collecting data

The data used in this research is secondary data in the form of data time series (time series) years [14]. Research time span 2008-2019. The data are rubber land area data, rubber production data, rubber commodity price data, rubber farming income data obtained from the Aceh Central Statistics Agency, Aceh Agriculture and Plantation Service, and West Aceh Plantation Service.

C. Method of Analysis

The analytical method used in this research is quantitative analysis. Quantitative data analysis was conducted using the ARCH. The ARCH model was then refined by Tim Bolerslev by including not only past error terms but also past error terms variants [15] and GARCH model provides a parsimonious parameterization for the conditional variance [16]. VaR [17] calculations to determine the price risk for rubber commodities using the application E-Views 7 [18]. Meanwhile, a Simple Regression Analysis was conducted to determine the effect of rubber prices on rubber farming income by using the SPPS application Statistics 25 [19].

III. Result and Discussion

A. Rubber Price Development

To be aware of the selling price data of rubber in the West Aceh Regency, we can use E-Views 7. The graph of rubber price data can be seen in Figure 2.

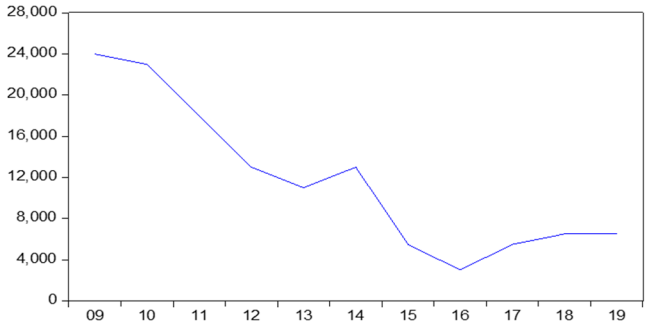

Fig. 2 Rubber prices fluctuation in Aceh Barat Regency 2009-2019

The graph above shows fluctuations in the selling price of rubber at the farmer level in West Aceh District. From 2009 the price continued to decline until 2013. The lowest selling price at the farm level occurred in 2016, amounting to IDR 3000 / kg. The drop in the selling price of rubber in West Aceh Regency was due to the drop in international rubber prices. So, this causes the selling price at the farm level to drop dramatically [20]. After declining in 2016, the price of rubber began to climb again in the following years until 2019. The average rubber price growth rate in West Aceh District was -0.26%. This means that the price of rubber each year tends to decrease by 0.26%.

The fact is that today the price of rubber in the international market fluctuates every year. These conditions indicate the magnitude of the risks faced by rubber farmers [21].

TABLE I
SUMMARY STATISTICS OF THE RUBBER PRICE EQUATION MODEL IN ACEH DISTRICT WEST

Summary Statistics	Rubber
Skewness	0.512599
Kurtosis	3.390173

The elongation coefficient (Skewness), a measure of the slope, is greater than 0 indicating the rubber price equation

model has a sloping distribution to the right, meaning that the data tends to accumulate at a low level of fluctuation. Kurtosis values greater than three are an early symptom of heteroscedasticity.

B. Rubber Price Risk Forecasting

1) ARCH-GARCH Model for Rubber Price Risk:

The ARCH-GARCH model can be done by analyzing regression with the OLS technique (Ordinary Least Square) [22]. This is done to see whether the residual has been free from autocorrelation or not. Apart from autocorrelation, the often-used assumptions are confounding variables or residuals that are fixed from time to time. If the residuals are not fixed, then the equation model still contains elements of heteroscedasticity.

The autocorrelation of the rubber price equation can be done by testing the residual square autocorrelation value [23]. The residual quadratic autocorrelation function is to detect the presence of the ARCH effect. If there is autocorrelation in the residual square, it is identified that there is an ARCH element error. Autocorrelation testing on the rubber equation model shows that the value probability of the first 11 lags was significant. This identifies the ARCH error effect on the rubber price equation model. Then, to find out whether the residuals in the rubber price equation model contain heteroscedasticity, it can be proven by doing a test White Heteroskedasticity. Test White Heteroskedasticity based on the null hypothesis, namely the absence of ARCH error. Test results White Heteroskedasticity.

TABLE II
SUMMARY OF WHITE HETEROSKEDASTICITY

Summary	Rubber
*Obs*R-Squared*	8.759141
Probability	0.0305

Based on the table, the statistical probability value Obs * R-Squared for the rubber price equation model can be said to be high with a value of 0.0305. The probability of the rubber price equation is smaller than α, which is usually used, namely 5%. With this, it can be concluded that the residual of the rubber price equation model contains heteroscedasticity.

OLS Technique (Ordinary Least Square) [24], For the rubber price equation model, it turns out that there is still an ARCH effect and contains heteroscedasticity. Therefore, it is suggested to overcome the problem using the ARCH-GARCH analysis model. To get the best ARCH-GARCH model, the first step is to simulate several variance models with the obtained average model specifications. Then do the estimation of model parameters using the quasi-maximum likelihood method (maximum likelihood). Try out the best model estimation for rubber commodity, GARCH (1,1) is chosen, the standard model [25], namely to predict the price risk. The estimation of this parameter can be seen in Table 3 below.

TABLE III
THE BEST ARCH-GARCH MODEL FOR THE RUBBER PRICE EQUATION MODEL IN WEST ACEH DISTRICT

Variable	Rubber
	GARCH (1,1)
Equation of Mean	
	Coefficient	**Probability**
C	1109.986	0.5646
P_{t-1}	0.911500	0.0000
Q	0.027728	0.5261

The estimation model in the table above shows that the constant (C) and the previous price coefficient (Pt-1) are positive. This shows that the price of rubber in the previous year affected the price of rubber in the current year. For production (Q) is also marked positive, which means that production does not affect prices. Based on the results of this equation, it can be seen that the coefficient value of Q is 0.027728, which indicates that rubber production has no effect and depends on the price of rubber.

In the table above, it can also be seen that the amount of risk in rubber prices is influenced by volatility and previous price variants. The relatively high price of rubber this year will indicate a high risk for the coming year. The adequacy of the model can be determined by conducting an error check against the blackout error. This method can be done by observing the value of the Jarque-Bera test statistic in checking the normality assumption.

TABLE IV
STANDARDIZED ERROR NORMALITY TEST

Score	Rubber
Jarque-Bera	0.652172
Probability	0.000000

In the provisional prediction model, the risk of rubber price from the Jarque-Bera test results in a probability of 0.000000, which means rejecting the null hypothesis of standardized errors or not spreading normally. The parameter estimates will remain consistent if the mean and variance equations are specified correctly even though they do not spread normally. This is because data processing has included the Heteroscedasticity Consistent Covariance Boolerslev-Wooldridge method so that the error assumption is maintained and spreads normally [26]. Thus, the standard error of parameter estimates remains consistent.

2) Rubber Price Risk Level with VaR (Value at Risk) Calculation:

The amount of risk in rubber prices is calculated using the VaR calculation (Value at Risk). Using the GARCH (1,1) approach obtained in this study, the estimation of the risk of rubber prices has the results shown in Table 5.

TABLE V
ESTIMATION RESULT OF RUBBER PRICE VARIANCE.

Variable	Parameter	Probability
Constant	5410504	0.8799
Previous year's volatility (ε^2_{t-1})	0.130000	0.8575
The previous year's variant (h_{t-1})	0.500000	0.7934

Based on the results of the estimation of the rubber price variant equation, the volatility parameters and the variance of the rubber price in the previous year showed positive and significant results at the 5% real level. These results show that the variance and volatility of rubber prices in the previous year are factors that affect the risk of rubber prices in the following year. This means that the increase in rubber prices in the previous year will impact increasing-price risk in the

coming year. One of the factors that become the consideration of farmers in farming is the product's price. An indicator that is very important to pay attention to is the previous price, which becomes a benchmark in decision-making. If the previous price was relatively high and provided benefits for farmers, the farmers would increase their business scale.

Increasing the business scale by farmers can be done in various ways, either by renting land, increasing the area of the land or by increasing the population, or increasing the frequency of harvest. However, not all farmers can do this. This is due to certain limitations such as limited land, capital, skills, and others. After estimating the variance equation on the price of rubber, then the calculation of the price risk received by rubber farmers is carried out. The amount of price risk to be measured is in one year of sales.

The amount of price risk is measured by calculating VaR (Value at Risk). The following is the VaR calculation with the capital issued by the farmer per land area of IDR 78,075,000. The amount of costs incurred by farmers used in this study is not an absolute cash cost for each rubber farmer in West Aceh District. The following equation can calculate the amount of risk borne by rubber farmers:

$$\begin{aligned} \text{VaR} &= (\sigma t + 1 \times \sqrt{b}) \times Z\alpha \times W \\ &= (0.9x \sqrt{365}) \times 1{,}645 \times \text{IDR } 78{,}075{,}000 \\ &= \text{IDR } 22{,}083{,}466 \end{aligned}$$

Thus, VaR in the form of a percentage (%) can be expressed as follows:

$$\text{VaR} = \frac{IDR\ 22{,}083{,}466}{IDR\ 78{,}075{,}000} x100\% = 28.3\%$$

The price risk received by farmers in West Aceh District is Rp 28.3% over the one-year sales period. The price risk obtained is 28.3% of the total investment costs incurred by rubber farmers. The risk value of 28.3% if converted into rupiah is IDR 22,083,446. According to the Journal of Business and Management, the price risk is high if the risk value is greater than 1%. The price risk is low if the risk is lower than one [27], [28]. The amount of risk obtained from this study was 28.3%, where the figure is greater than 1%, which means that the price received by farmers in West Aceh Regency is high.

C. Simple Regression Analysis

Analysis of the effect of price on rubber farming income was carried out using simple regression analysis. This simple regression analysis uses one variable each. The dependent variable is income (Y) and the independent variable is the price (X). Based on these two variables, a simple regression analysis was carried out using the application SPSS Statistics 25 and obtained the following results:

TABLE VI
T-TEST RESULT

Model	B	Std. Error	Beta	T	Sig.
Constant	475593.483	1252835.814	-	0.380	0.712
Price	895.622	75.944	0.996	11.793	0.000

Based on the simple regression equation, it can be seen that the constant value is 475593.48. This constant value means that if the price of rubber (X) is fixed, then the income of rubber farming is IDR 475,593.48 -. While the value of the income coefficient (X) is 895.62, so if the price of rubber (X) increases by 1 rupiah, it will tend to increase the income of rubber farming (Y) by IDR 895.62. Table 6 above also shows that rubber farming income (Y) is the dependent variable, and rubber price (X) is the independent variable. The significance value of X is equal to 0.000; that is, this value is smaller than 5% ($p > 0.05$). Thus, it can be concluded that the independent variable price of rubber (X) has a significant effect on the dependent variable of rubber farming income (Y). The t table value is 2,22814. Because the t value is greater than the t table value (11.793 > 2,22814), therefore the independent variable price of rubber (X) has a significant effect on the dependent variable of rubber farming income (Y).

TABLE VII
RESULT COEFFICIENT

Model	R	R Square	Adjusted R Square	Std. Error of Estimate
1	0.966	0.933	0.926	2129226.459

Based on the following table, the value for the coefficient of determination is 0.933. This value means that the dependent variable rubber farming income (Y) is influenced by the independent variable rubber price (X) by 93%. Meanwhile, 7% is influenced by variables outside the model. This indicates that the price of rubber and the income of rubber farming have a reciprocal relationship, where the income of rubber farming is the product of the price of rubber and the production of rubber minus the cost of producing rubber.

The amount of risk generated in the VaR calculation is 28.3%, which means that the risk is high. The resulting price risk affects the decline of farm income in the West Aceh Regency. This is under previous research conducted by Rasmikayati *et al.* [29] that price risk significantly affects farm income. Thus, the risk of high rubber prices in West Aceh District has a significant effect on the income of rubber farming in the West Aceh District. In this case, a price support policy model for plantation resource resilience is needed, as is done in China, which makes price support policies even though they are used for food security [30].

IV. CONCLUSION

The magnitude of the price risk received by rubber farmers is high in Aceh Barat District. The price risk received by farmers in West Aceh District is 28.3%. The magnitude of the risk of rubber prices received by rubber farmers indicates the number of losses received by rubber farmers during the one-year sales period. If converted into rupiah, the price risk of 28.3% is IDR 22,083,455,7 - per 365 days (one year) of the sales period. This is related to the selling time of the harvest, so rubber farmers must sell their rubber harvest as soon as possible to reduce depreciation. The high price risk affects the income of rubber farming in West Aceh Regency. The price of rubber has a significant effect on the income of rubber farming in the West Aceh Regency.

In this study, the t value is greater than the t table value (11.793 > 2.22814) at α 5%, thus the independent variable price of rubber (X) has a significant effect on the dependent variable of rubber farming income (Y). The price of rubber

(X) and farm income (Y) have a reciprocal relationship, where the income of rubber farming is the product of the price of rubber and the production of rubber minus the cost of producing rubber. This indicates that the amount of income from rubber farming depends on the price of rubber in West Aceh Regency.

NOMENCLATURE

previous price coefficient	P_{t-1}
previous year's volatility	ε^2_{t-1}
previous year's variant	h_{t-1}
C	constant
Q	production

REFERENCES

[1] M. Mulyani, K. Kusnandar, and E. Antriyandarti, "Analysis of Indonesian Rubber Export Supply for 1995-2015," *J. Asian Financ. Econ. Bus.*, vol. 8, no. 1, pp. 093–102, 2021, doi: 10.13106/jafeb.2021.vol8.no1.093.

[2] A. D. Nugroho, I. Y. Prasada, and Z. Lakner, "Performance and Forecast of Indonesian Rubber Exports To the Central European Countries," *OISAA J. Indones. Emas*, vol. 5, no. 1, pp. 66–81, 2022, doi: 10.52162/jie.2022.005.01.8.

[3] Ngatindriatun, A. Pujiati, and E. Soesilowati, "The Contribution of Rubber Commodity Toward Indonesian Export and Indonesian Rubber Export Prospect," *Int. Semin. FEUM*, no. July, 2015.

[4] Arifin B, "3345-19433-1-PB.pdf," *Manaj. Agribisnis*, vol. 2, pp. 1–16, 2005.

[5] U. Kashyap and N. Bothra, "Sino-US Trade and Trade War," *Manag. Econ. Res. J.*, vol. 5, p. 1, 2019, doi: 10.18639/merj.2019.879180.

[6] P. Courtois and J. Subervie, "Farmer bargaining power and market information services," *Am. J. Agric. Econ.*, vol. 97, no. 3, pp. 953–977, 2014, doi: 10.1093/ajae/aau051.

[7] M. D. . Simatupang, *Pengantar Teori Terjemahan*. Jakarta: Departemen Pendidikan Nasional, 2000.

[8] F. Otten, J. Hein, H. Bondy, and H. Faust, "Deconstructing sustainable rubber production: contesting narratives in rural Sumatra," *J. Land Use Sci.*, vol. 15, no. 2–3, pp. 306–326, 2020, doi: 10.1080/1747423X.2019.1709225.

[9] R. F. Engle, "Autoregressive Conditional Heteroscedacity with Estimates of variance of United Kingdom Inflation,journal of Econometrica, Volume 50, Issue 4 (Jul., 1982),987-1008.," *Econometrica*. 1982.

[10] V. O. Nur Laily, B. Warsito, and D. A. I Maruddani, "Comparison of ARCH / GARCH model and Elman Recurrent Neural Network on data return of closing price stock," 2018, doi: 10.1088/1742-6596/1025/1/012103.

[11] D. Wen, G. J. Wang, C. Ma, and Y. Wang, "Risk spillovers between oil and stock markets: A VAR for VaR analysis," *Energy Econ.*, 2019, doi: 10.1016/j.eneco.2019.02.005.

[12] I. Lisdiani, S. I. Nikensari, and D. Irianto, "The effect of exchange rate, consumption, and GDP on Indonesian Rubber Export by main destination country," *J. Pendidik. Ekon. Perkantoran dan Akunt.*, vol. 7, no. 2, pp. 101–111, 2019.

[13] U. Sekaran, "Metodologi Penelitian untuk Bisnis," vol. 5, pp. 147–158, 2006.

[14] Z.-Y. Wang, Y.-C. Lin, S.-J. Lee, and C.-C. Lai, "A Time Series Forecasting Method," *ITM Web Conf.*, 2017, doi: 10.1051/itmconf/20171203008.

[15] A. Widarjono, "Aplikasi model ARCH kasus tingkat inflasi di Indonesia," *J. Ekon. Pembang.*, vol. 7, no. 1, pp. 71–82, 2002.

[16] R. Engle, "GARCH 101: The use of ARCH/GARCH models in applied econometrics," *J. Econ. Perspect.*, vol. 15, no. 4, pp. 157–168, 2001, doi: 10.1257/jep.15.4.157.

[17] A. Khamis, N. A. Abdul Razak, and M. A. A. Abdullah, "A robust vector autoregressive model for forecasting economic growth in Malaysia," *Malaysian J. Fundam. Appl. Sci.*, vol. 14, no. 3, pp. 382–385, 2018, doi: 10.11113/mjfas.v14n3.1021.

[18] D. Rosadi, *Ekonometrika dan Analisis Runtun Waktu Terapan dengan E-Views*. Yogyakarta: Andi Offset, 2012.

[19] D. Stockemer, *Quantitative methods for the social sciences: A practical introduction with examples in SPSS and Stata*. 2019.

[20] I. S. Nugraha, A. Alamsyah, and S. Sahuri, "Effort to increase rubber farmers' income when rubber low prices," *J. Perspekt. Pembiayaan dan Pembang. Drh.*, vol. 6, no. 3, pp. 345–352, 2018, doi: 10.22437/ppd.v6i3.5817.

[21] Y. Erlina, D. Koestiono, N. Hanani, and Syafrial, "The influence of rubber price fluctuation on the performance of smallholder rubber plantation in central kalimantan, indonesia," *WSEAS Trans. Bus. Econ.*, vol. 16, no. 1, pp. 130–137, 2019.

[22] C. W. Senarathne and W. Jianguo, "Testing for heteroskedastic mixture of ordinary least squares errors," *Rom. J. Econ. Forecast.*, vol. 23, no. 2, pp. 73–91, 2020.

[23] Y. Chen, "Spatial autocorrelation approaches to testing residuals from least squares regression," *PLoS One*, vol. 11, no. 1, pp. 1–19, 2016, doi: 10.1371/journal.pone.0146865.

[24] T. B. Fomby, S. R. Johnson, and R. C. Hill, "Review of Ordinary Least Squares and Generalized Least Squares," *Adv. Econom. Methods*, pp. 7–25, 1984, doi: 10.1007/978-1-4419-8746-4_2.

[25] A. Aue, L. Horváth, and D. F. Pellatt, "Functional Generalized Autoregressive Conditional Heteroskedasticity," *J. Time Ser. Anal.*, 2017, doi: 10.1111/jtsa.12192.

[26] T. Bollerslev, "Generalized autoregressive conditional heteroskedasticity," *J. Econom.*, pp. 307–327, 1986, doi: 10.1016/0304-4076(86)90063-1.

[27] Y. Berry, "Perhitungan Value at Risk Dengan Pendekatan Variance-Covariance," *JURISMA J. Ris. Bisnis Manaj.*, vol. 7, no. 2, 2017, doi: 10.34010/jurisma.v7i2.458.

[28] A. Wardhana, Y., Hakim, L., Fitra, K dan Baihaqi, "Risk Analysis of Vannamei Shrimp Commodity Price (Litopenaeus vannamei) in Aceh Besar Regency," *Int. J. Adv. Sci. Technol.*, vol. 29, no. 3, pp. 14606–14612, 2020, [Online]. Available: http://sersc.org/journals/index.php/IJAST/article/view/31948.

[29] E. Rasmikayati, L. Sulistyowati, and B. R. Saefudin, "Risiko Produksi DAN Pemasaran Terhadap Pendapatan Petani Mangga: Kelompok mana yang Paling Berisiko," *Mimb. AGRIBISNIS J. Pemikir. Masy. Ilm. Berwawasan Agribisnis*, vol. 3, no. 2, pp. 105–116, 2017, doi: 10.25157/ma.v3i2.564.

[30] J. Qian, S. Ito, and Z. Zhao, "The effect of price support policies on food security and farmers' income in China," *Aust. J. Agric. Resour. Econ.*, 2020, doi: 10.1111/1467-8489.12398.