Structural Transformation of the Agricultural Sector and Influencing Factors in Sumatra Island

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Abstract: - The objective of this research is to determine whether there has been a transformation in Sumatra Island during the period from 2010 to 2022 and to identify the influencing factors. The data utilized in this study is secondary data obtained from official sources such as the Central Statistics Agency. The collected data includes Gross Regional Domestic Product (GRDP), poverty rate, open unemployment rate, investment data, and average years of schooling. The findings reveal that over the 12-year period, Sumatra Island did not experience a significant transformation, despite the agricultural sector being its primary contributor. The island only underwent a shift of 0.62, a value smaller than that of the mining sector. The factors influencing the shift in the agricultural sector in Sumatra Island include the unemployment rate, poverty rate, investment, and average years of schooling.

Key-Words: - Transformation, Economic Development, Agricultural Sector, Influencing Factors

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1 Introduction

The abundant diversity in Indonesia creates varied potentials in each region. These differences arise due to the distinct characteristics of each region, leading to a possibility of leaning towards a specific aspect with the greatest potential in that area [1]. This results in varying economic conditions in each region. Developing countries like Indonesia typically initiate regional development, beginning with the economic aspect, as it is considered crucial and functions to meet societal needs. Economic development can support goal achievement and drive innovation in other aspects and sectors [2].

One indicator that can illustrate the differences in economic conditions across regions in Indonesia is the Gross Regional Domestic Product (GRDP). Based on the published GRDP data by the Central Statistics Agency (Badan Pusat Statistik), it is known that the largest contribution comes from Java Island at 58.69 percent, followed by Sumatra Island at 21 percent, Kalimantan Island at 8.21 percent, Sulawesi Island at 6.73 percent, Bali Island at 2.75 percent, and lastly, Papua and Maluku Islands at 2.61 percent [3].

Sumatra Island is one of the largest islands in Indonesia, covering approximately 443,065.8 km2, and it is the second-fastest-growing economy after Java Island. Sumatra Island is notable for its agricultural sector. According to the 2021 data from the Central Statistics Agency (BPS), Sumatra Island excels in its plantation sub-sector, making it a dominant force in this sub-sector. The produced plantation commodities include palm oil, rubber, coconut, coffee, and betel nut. The plantation sector, particularly oil palm plantations, remains a key player in Sumatra Island, contributing 53 percent of the national palm oil production, equivalent to 24.4 million tons in 2021. In other words, half of the national palm oil production originates from Sumatra Island. The robust economic activities are supported by the abundant natural resources in the region, particularly in the agricultural sector [4].

The largest contribution to Sumatra Island's GRDP is from the agricultural sector, accounting for 23.35 percent in 2020. This figure represents an increase compared to the previous years, which were 17.80 percent in 2010 and 23.16 percent in 2015. However, there was a significant increase from 2010 to 2015, amounting to 5.36 percent, whereas from 2015 to 2020, within the same time frame of five years, the contribution increased by only 0.19 percent. The comparison of increases within the same time frame differs significantly. Other sectors experiencing growth include the trade sector and the accommodation and food service activities sector. Conversely, the manufacturing industry and mining and quarrying sector experienced a considerable

decline in the last decade. The overall increase in contribution in Sumatra Island suggests that the agricultural sector still holds potential for effective utilization in regional development. However, this increase is not evenly distributed across all provinces in Sumatra Island.

As a sector that tends to have a significant contribution to the primary sector, Sumatra Island serves as a resource-rich hub with the potential to develop value-added products through the enhancement of the secondary sector, especially the manufacturing industry, as part of the transformation and industrialization process. Industrialization is a modernization process that encompasses all economic sectors interconnected with the manufacturing industry, aiming to generate added value. Therefore, with industrial development, it will stimulate and uplift other sectors [5]. Hence, the aim of this research is to determine whether Sumatra Island has undergone transformation with its abundant agricultural resources and identify the factors influencing this transformation.

2 Research Method

2.1 Data Collection

The data utilized in this research consists of secondary data on the GRDP at constant prices (ADHK) of Sumatra Island from the years 2010 to 2022. Secondary data refers to information that is not directly provided to the data collector but is obtained through intermediaries or documents [6]. The method for collecting secondary data involves gathering information from available sources such as documents, publications, databases, archives, and other officially published or publicized sources [7]. The research method applied in this study is the case study method [8]. In addition to the GRDP data for the years 2010-2022 [9], other data used include the Human Development Index, the number of people living in poverty, the unemployment rate, and the economic growth rate sourced from the Badan Pusat Statistik (BPS).

2.2 Data Analysis

2.2.1 Metode Analisis Deskriptif

This analysis is used to examine the transformation of the economic structure in Sumatra Island [10]. Microsoft Excel is employed for this analysis. The discussed outcomes of this analysis include the economic sector conditions in Sumatra Island, showcasing the fluctuations in GRDP contributions with a research sample from the years 2010 to 2022.

2.2.2 Analisis Data Panel

This analysis is utilized to examine the influence of the tested variables on the transformation of the agricultural structure in Sumatra Island. The research data is in the form of panel data, combining time series data (temporal sequence) with cross-sectional data (cross-sectional data) [11], assisted by Microsoft Excel and E-views software. The equation employed in this study is:

$$Y_{it} = \beta 0 + \beta_1 X_{1\,it} + \beta_2 X_{2\,it} + \beta_3 X_{3\,it} + \beta_4 X_{4\,it} + \beta_5 X_{5\,it} + \beta_6 X_{6\,it} + e_{it}$$

Keterangan:

Y = Economic Agriculture Shift
B0 = Constanta
B1,2,3 = Regression coefficient
X1 = Unemployment
X2 = Poverty
X3 = Pulation Density
X4 = Investment
X5 = Expections School
i = *Cross section*
t = *Time series*
e = *Error*

In panel data analysis, several steps are undertaken:

1. Model Estimation This involves determining the model estimation based on various models such as the Common Effect Model (CEM), Fixed Effect Model (FEM), and Random Effect Model (REM) [12].
2. Model Selection The selection of the best model is determined through various tests, including the Chow Test [13], Hausman Test, and Breusch-Pagan Test.
3. Once the model is chosen, it is then examined for potential issues such as multicollinearity [14] and Heteroskedasticity [15].
4. Regression testing using the selected model.

3 General Description

Sumatra Island is the fourth-largest island in the world, situated in Indonesia, featuring diverse geography encompassing mountains, lowlands, and beautiful coastlines. In Indonesia, Sumatra Island holds several advantages that make it exceptional, including vast tropical rainforests and rare wildlife such as tigers, elephants, and Sumatran orangutans. The island plays a crucial role in the national economy as a significant center for large-scale production of palm oil and rubber. The rich cultural diversity, with ethnic groups like the Minangkabau,

Batak, Aceh, and Melayu, contributes significantly to Indonesia's cultural diversity. Furthermore, Sumatra offers various stunning tourist destinations with natural beauty that remains relatively untouched. Despite its numerous advantages, the island faces challenges such as deforestation and environmental issues. Therefore, maintaining a balance between natural resource utilization and environmental protection is crucial for Sumatra's future.

Sumatra Island comprises 10 provinces, covering an area of 473,481 km2, and has a substantial population of 61,617,515 people as of 2022 [16]. The Sumatra region holds a strategic location within the national, ASEAN regional, and global frameworks. Nationally, Sumatra is a hub for the production and processing of various agricultural products such as rubber and palm oil, as well as being a significant contributor to the mining sector [17].

Figure 1. Sumatera Island Map

4 Result and Discussion

4.1 Shift in Agricultural Sector

Economic development is often associated with an increase in economic growth supported by changes in more modern sectors. A region undergoing economic development always faces issues related to income distribution. However, successful economic development in a region is typically accompanied by increased economic growth [18]. The economic growth in Sumatra Island can be observed in Figure 2.

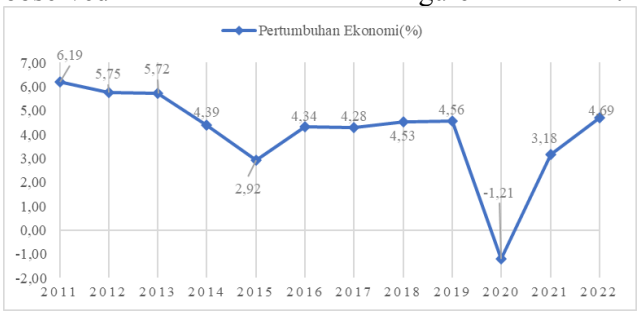

Figure 2. Economic growth of Sumatera Island

Based on Figure 2, it can be observed that economic growth in Sumatra Island fluctuates during the period of 2011-2022. Declines occur in every 5-year period, marked by a decrease in economic growth in 2015 and 2022. In 2015, there was a decrease in economic growth from 4.39 percent, dropping to 2.92 percent. However, this decline in growth then rose to 4.34 percent, similar to the rate in 2014, and later fell to a negative value of -1.21 in 2020. This was due to the COVID-19 pandemic, causing significant impacts on economic growth, with reduced economic activities, losses in the tourism and travel sector, disruptions in the supply chain, decreased investment, job losses, and high uncertainty. Many countries responded to the pandemic with economic stimulus measures, but economic recovery takes time. Changes in consumption patterns and business sector adaptations have occurred in response to the evolving pandemic situation. The impacts of the pandemic will continue to be felt for a longer period [19].

Industrialization in Sumatra Island is still in a balanced condition as the primary sector (agriculture and mining) continues to contribute more compared to the secondary or tertiary sectors. This is because if the tertiary sector surpasses the industrial sector, it may lead to an imbalance in economic growth, dependence on the service sector, potential imports due to inadequate raw materials within the region, changes in job availability, and more. However, a balanced increase in the tertiary sector alongside the primary and secondary sectors is more advantageous as it provides more diverse employment opportunities in this sector [20]. This contrasts with the findings of another study [21], where the secondary sector becomes the largest contributor, followed by the tertiary sector, and the rest is the primary sector [21]. The agricultural sector remains a primary focus in Sumatra Island as it contributes the most to economic growth, albeit with fluctuating values.

Sumatra Island continues to be the backbone of agriculture in Indonesia [22]. Sumatra and Kalimantan are islands that play a significant role in fulfilling food needs and agricultural exports in Indonesia. This underscores Sumatra Island's crucial role in supporting agriculture, and any shift or slight decrease in its contribution will impact agriculture nationally. The average contribution of the agricultural sector in Sumatra Island can be seen in Figure 3

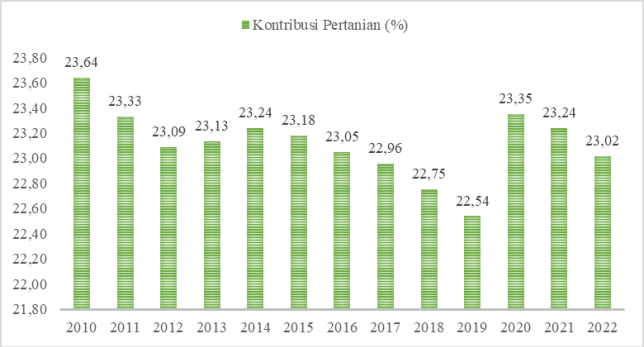

Figure 3. Agricultural Contribution Sector in Sumatera Island.

Based on Figure 3, it can be seen that the contribution of the agricultural sector undergoes significant fluctuations during the period of 2010-2022, with the lowest contribution in 2019, where it dropped to only 22.54 percent. Leading sectors that contribute the most in Sumatra Island are often hindered by factors impeding economic growth, such as electricity, illegal levies, road quality, and a lack of supporting market facilities.

These factors, if addressed, could actually support commercial agriculture. Differences in contributions each year lead to a shift in percentage contributions, resulting in significant numerical differences. A large contribution does not guarantee continuous positive growth for agriculture. Based on contributions from 2010-2022, there is a decrease of 0.624 percent in the agricultural sector's contribution, placing it among the sectors experiencing a decreased contribution shift. Together with the mining sector, which decreased by 6.11 percent, and mandatory government administration, defense, and social security, which decreased by 0.060 percent.

The calculated shift using the initial year (2010) and the final year (2022) results in a mostly negative shift value in the agricultural sector. This indicates a tendency in Sumatra Island for the agricultural sector to shift towards other sectors. [23] [24] state that within a period of five to ten years, the agricultural sector decreases very little, and its contribution shifts to the secondary and tertiary sectors, such as accommodation and food services, trade in services, and service sectors. It is evident that the decrease in the agricultural sector's shift is followed by a positive shift in the wholesale and retail trade sector; Repair of motor vehicles and motorcycles by 1.826 percent, the information and communication sector by 1.347 percent, and the construction sector with a positive shift of 1.335 percent.

However, as a primary sector, agriculture has not undergone significant changes, as shown in Table 1.

Table 1. Economic Contribution in Sumatera Island

Sector	contribution shift
	Sumatera
A. Agriculture, Forestry, and Fisheries	-0.62
B. Mining and Quarrying	-6.11
Primary Sector	-6.73
C. Mmanufacturing Industry	0.41
D. Electricity and Gas Supply	0.04
E. Water Supply, Waste Management, and Recycling	0.00
F. construction	1.33
Secondary Sector	1.79
G. Wholesale and Retail Trade; Repair of Motor Vehicles and Motorcycles	1.83
H. Transportation and Storage	0.26
I. Accommodation and Food and Beverage Service Activities	0.26
J. Information and Communication	1.35
K. Financial and Insurance Activities	0.18
L. Real Estate	0.40
M,N. Professional, Scientific, and Technical Activities	0.05
O. Public Administration, Defense, and Mandatory Social Security	-0.06
P. Education Services	0.31
Q. Health and Social Work Activities	0.27
R,S,T,U. Other Services	0.09
Tertiary Sector	4.94

Sumatra Island positions agriculture as the most contributing sector, but it appears that this sector has not transformed significantly over the 12-year period (2010-2022). During this time, transformation is essential for the primary sector to support income by adding value to primary products through the tertiary and secondary sectors.

4.2 Factors Influencing the Agricultural Sector

Factors influencing the shift in the economic agricultural sector were analyzed using panel data regression analysis with the assistance of Eviews 12 software. The aim was to analyze the factors influencing the economic shift, particularly in the agricultural sector in Sumatra Island during the period 2010-2022. The dependent variable used in this study is the transformation depicted by the value of the Gross Regional Domestic Product at constant prices for the agricultural sector (Y). The independent variables suspected to affect the economic shift in the agricultural sector are the Open Unemployment Rate (X1), Population Density

(X2), Number of Poor People (X3), Investment (X4), and Years of Schooling Expectancy (X5).

4.2.1 Determining the best model

1. Chow Test

The Chow Test is a test aimed at selecting the best estimation model that can be used for panel data research. The hypotheses used in this test are: H0: Common Effect Model (CEM) H1: Fixed Effect Model (FEM). The detailed results of the analysis using the Chow test estimation method can be seen in the table.

Table 2. *Chow Test* Result

Effects Test	Statistic	d.f.	Prob.
Cross-section F	321.779524	(9,105)	0.0000
Cross-section Chi-square	402.329488	9	0.0000

It can be seen in Table that the results of the Chow Test indicate that the obtained probability is 0.0001, and this value is less than the significance level (0.005). Therefore, the best estimation model used is the Fixed Effect Model (FEM).

2. Hausman Test

The Hausman Test is a test used to choose between the Random Effect Model (REM) or the Fixed Effect Model (FEM). After being tested with the Chow Test, and the selected model is FEM, it must then be tested using the Hausman Test to assess whether it is the best estimation model. The hypotheses used are:
H0: Random Effect Model (REM)
H1: Fixed Effect Model (FEM)

The detailed results of the analysis using the Hausman Test can be seen in Table 3

Table 3, *Hausman Test* Result
Correlated Random Effects - Hausman Test
Equation: Untitled
Test cross-section random effects

Test Summary	Chi-Sq. Statistic	Chi-Sq. d.f.	Prob.
Cross-section random	17.673545	5	0.0034

Berdasarkan hasil *Hausman Test* yang dapat dilihat pada diketahui bahwa nilai probabilitas yang dihasilkan adalah 0,0034 yang berarti nilai tersebut kurang dari taraf signifikan (0,005) oleh karena itu, model terbaik yang digunakan adalah *Fixed Effect Model* (FEM).

3. Lagrange Multiplier

The Lagrange Multiplier test is used to choose between the Random Effect Model (REM) and Common Effect Model (CEM). However, since the selected model from the Hausman Test is the Fixed Effect Model (FEM), the Lagrange Multiplier test is not necessary.

4.2.2 Classical Assumption Tests

Panel data allows for a more comprehensive study of behaviors within a model, eliminating the need for classic assumption tests [25]. However, according to [26], classic assumption tests commonly used in linear regression with the Ordinary Least Squared (OLS) approach include Linearity, Autocorrelation, Heteroskedasticity, Multicollinearity, and Normality. Nevertheless, not all classic assumption tests need to be conducted for every linear regression model with the OLS approach; only multicollinearity and heteroskedasticity are essential.

1. Multicollinearity

Multicollinearity occurs when there is a correlation between independent variables in a research dataset, meaning that variables X1, X2, X3, X4, and X5 are correlated and interrelated. The Multicollinearity test can be conducted by examining the Variance Inflation Factor (VIF) values in the data. The criteria for the VIF test are as follows:

1. If the VIF value < 10, there is no multicollinearity.
2. If the VIF value > 10, there is multicollinearity.

The results of the multicollinearity test can be seen in Table 4.

Table 4. Multicollinearity Result

No	Independent Variables	VIF
1	Unemployment	1.415
2	Population Density	1.767
3	Poverty	1.667
4	Investment	1.406
5	Expectations School	2.190

Based on Table 25, the VIF values are less than 10 (VIF < 10), indicating that there is no multicollinearity in the data. Thus, it can be concluded that the data is normally distributed as there is no correlation between independent variables.

2. Heteroskedasticity

The Heteroskedasticity test aims to examine whether there is a variance difference from one observation to another in a regression model. If the variance of residuals from one observation to another remains the same, it is called homoskedasticity; if it differs, it is called heteroskedasticity [25]. In this observation, the test for heteroskedasticity used is the Glejser Test. The criteria for the Glejser Test are as follows:

1. If the sig value < 0.05, there is heteroskedasticity.
2. If the sig value ≥ 0.05, there is no heteroskedasticity.

The results of the heteroskedasticity test using Eviews 12 software can be seen in Table 5.

Table 5. Heteroskedasticity Result

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	17528.78	10359.63	1.692027	0.0936
X1	500.3026	261.4075	1.913880	0.0584
X2	17.44213	441.0979	0.039543	0.9685
X3	-1436.041	766.7479	-1.872898	0.0639
X4	0.136943	0.566012	0.241943	0.8093
X5	-10159.41	12123.73	-0.837978	0.4039

Based on the heteroskedasticity test, it can be determined that all probabilities of the independent variables have values > 0.05, indicating no heteroskedasticity in the research data.

4.2.3 Interpretation of the Best Model

The panel data test in this study resulted in the following equation:

$$Y_{it} = 832.1709 - 111.8234X_{1it} - 2.952834X_{2it} - 29.39625X_{3it} + 0.817769X_{4it} + 735.2492X_{5it} + E$$

After passing the multicollinearity and heteroskedasticity tests, the data output from the FEM estimation can be interpreted. The results of the best model (FEM) output estimation data can be seen in Table 6.

Table 6. Data Panel Result

Variable	Coefficient	Std. Error	t-statistic	Prob.
C	832.1709	1979.507	0.420393	0.6751
X1	-111.8234	49.36492	-2.265240	0.0256
X2	-2.952834	8.261532	-0.357420	0.7215
X3	-29.39625	14.43857	-2.035952	0.0443
X4	0.817769	0.107402	7.614098	0.0001
X5	735.2492	231.0607	3.182060	0.0019
F-statistic				
Prob(F-statistic)				**0.000000**
R-squared				**0.987662**
Adjusted Rr-Squared				**0.986017**

1. Coefficient of Determination

The coefficient of determination results, as seen in Table 27, is 0.987662. This means that 98.76% of the economic shift in the agricultural sector is influenced by Unemployment Rate (X1), Number of Poor Population (X3), Investment (X4), and Years of Schooling (X5). The remaining 1.24% is explained by other variables not included in the model.

2. Simultant Test (F-Test)

The F-Test is conducted to determine how the independent variables (X) jointly affect the dependent variable (Y). Collectively, the independent variables - Unemployment Rate (X1), Population Density (X2), Number of Poor Population (X3), Investment (X4), and Years of Schooling (X5) - significantly influence the shift in the agricultural sector's economy with a significance level of 0.0001

3. Partial Test (T-Test)

There are four significant factors: Unemployment Rate (X1), Number of Poor Population (X3), Investment (X4), and Years of Schooling (X5).

The variable Unemployment Rate significantly and negatively affects the shift in the economic structure, specifically in the agricultural sector. At a confidence level of 95%, an increase of 1% in the unemployment rate will shift the agricultural sector negatively by 111.8234 billion IDR [27]. This indicates that an increase in unemployment will impact the macroeconomic value, especially in the agricultural sector, in a negative direction. This is consistent with the statements of [28] and [29], which state that the agricultural sector and unemployment have a negative impact.

The variable Number of Poor Population significantly and negatively affects the shift in the economic structure, specifically in the agricultural sector. At a confidence level of 95%, an increase of 1 person in the number of poor population will shift the agricultural sector negatively by 29.39625 billion IDR. This indicates that an increase in the number of poor population will impact the macroeconomic value, especially in the agricultural sector. This is consistent with [30] [31], stating that the agricultural sector has a negative impact on poverty. This is because the agricultural sector, as

the largest contributor, can create job opportunities and reduce poverty [30].

The variable Investment significantly and positively affects the shift in the economic structure, specifically in the agricultural sector. At a confidence level of 99%, an increase of 1% in investment will shift the agricultural sector positively by 0.817769 billion IDR. This is consistent with research [32] stating that investment has a positive impact on the agricultural sector.

The variable Years of Schooling significantly and positively affects the shift in the economic structure, specifically in the agricultural sector. At a confidence level of 99%, an increase of 1 year in schooling will shift the agricultural sector positively by 735.2492 billion IDR. This is consistent with [33] stating that years of schooling will increase the human development index through adequate and sufficient education.

4 Conclusion

Based on Figure 3, it can be seen that the agricultural sector contributes the most to the Gross Regional Domestic Product (GDP) of Sumatra Island. However, this sector has not undergone significant changes, indicating that the agricultural sector has not transformed from a traditional primary sector to a more modern sector with the leading sector being the manufacturing industry, during the 12-year period. As seen in Table 4, the manufacturing industry only experienced a contribution increase of 0.41, a value even smaller than the tertiary sector. The small shift in the contribution of the agricultural sector is influenced by several variables: unemployment rate, poverty rate, investment, and years of schooling. All these variables have a significant impact both simultaneously and partially on the agricultural sector in Sumatra Island.

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Conflict of Interest

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