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THE INFLUENCE OF AGRICULTURAL, MANUFACTURING, AND MINING SECTOR OUTPUT ON ACEH'S GRDP: AN EMPIRICAL STUDY USING PANEL DATA

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Abstract

Gross Regional Domestic Product (GRDP) is a key indicator of regional economic performance. Aceh Province has considerable potential in the agricultural, manufacturing, and mining sectors; however, the extent to which these sectors contribute to regional economic growth remains an important empirical issue, particularly during the post-pandemic recovery period. This study aims to analyze the effects of the agricultural, manufacturing, and mining sectors on GRDP in Aceh Province. A quantitative approach was employed using balanced panel data from 22 districts/cities during 2019–2023, comprising 110 observations. Secondary data were obtained from the Central Statistics Agency (BPS) of Aceh Province and analyzed using panel data regression. Based on the Chow, Breusch–Pagan Lagrange Multiplier, and Hausman tests, the Random Effect Model (REM) was selected as the most appropriate estimation model. The results show that the agricultural and mining sectors have positive and statistically significant effects on GRDP, whereas the manufacturing sector has a positive but statistically insignificant effect. The overall model is statistically significant (Prob > χ^2 = 0.041), indicating that the explanatory variables jointly explain regional economic performance. These findings suggest that Aceh's economy remains highly dependent on primary sectors, while the manufacturing sector has not yet become a significant source of regional value added. This study provides recent post-pandemic evidence and offers insights for strengthening agricultural productivity, sustainable mining development, and industrial transformation to support inclusive and sustainable regional economic growth.

Keywords: *Gross Regional Domestic Product; Agriculture; Manufacturing; Mining; Panel Data; Aceh Province.*

1. INTRODUCTION

Regional economic growth is a key indicator for assessing the success of regional development because it reflects a region's ability to create added value, increase productivity, and expand employment opportunities. One of the most commonly used measures to assess regional economic performance is Gross Regional Domestic Product (GRDP) (Todaro & Smith, 2020). However, an increase in aggregate GRDP does not always reflect the quality of economic growth if it is not supported by a balanced and sustainable

sectoral structure. Therefore, economic growth analysis needs to focus not only on the magnitude of the GRDP but also on the economic sectors that are the main drivers of that growth (Jha, S., & Srinivasan, 2023).

From the perspective of economic growth theory and structural transformation, various economic sectors play different roles in driving regional output growth. The manufacturing sector, for example, generally has higher productivity and value added compared to the primary sector, thereby having the potential to drive more stable and sustainable economic growth. Conversely, high dependence on natural resource-based primary sectors, such as agriculture and mining, is often associated with limited value added, growth volatility, and vulnerability to external shocks. This aligns with Richardson's theory, as cited in Fauziyah et al., (2025), which states that regions with an economic base strongly rooted in the secondary and tertiary sectors have higher long-term growth prospects than regions dominated by the primary sector. Thus, the sectoral structure of regional GRDP is a key factor in determining the quality of a region's economic growth.

In line with this approach, sectoral structure analysis is crucial for identifying economic sectors that play a strategic role in driving regional GRDP growth. Changes in the relative contributions of economic sectors reflect the dynamics of the development process and the degree of success of the structural transformation taking place. Thus, regions whose economic growth is supported by sectors with high productivity and value added tend to experience more inclusive and sustainable growth. Conversely, if GRDP growth remains dominated by traditional sectors, an increase in economic output may not be accompanied by an equitable improvement in welfare. Therefore, empirical testing of the role of key sectors in driving GRDP growth is crucial in the context of regional economic development (Rodrik, 2016).

Within the regional context of Sumatra, Aceh Province exhibits economic characteristics that are relatively distinct from those of other provinces. Although Aceh's Gross Regional Domestic Product (GRDP) has generally increased in recent years, the region's economic structure remains dominated by the agriculture, forestry, and fisheries sectors, while the contribution of the manufacturing sector lags behind. This situation indicates that the process of structural transformation in Aceh has not yet proceeded optimally, the economic growth that has occurred tends to be quantitative marked by an increase in aggregate output but does not yet fully reflect an improvement in the quality of the economic structure. Furthermore, a comparison of Aceh's sectoral structure with that of other provinces in Sumatra reveals a significant gap in the role of the industrial sector as the primary driver of regional economic growth, which ultimately limits the creation of value added and regional economic competitiveness (Kuncoro, Mudrajad; Idris, 2010). For comparison, we can refer to the annual reports published by the Aceh Provincial BPS) from 2019 to 2023.

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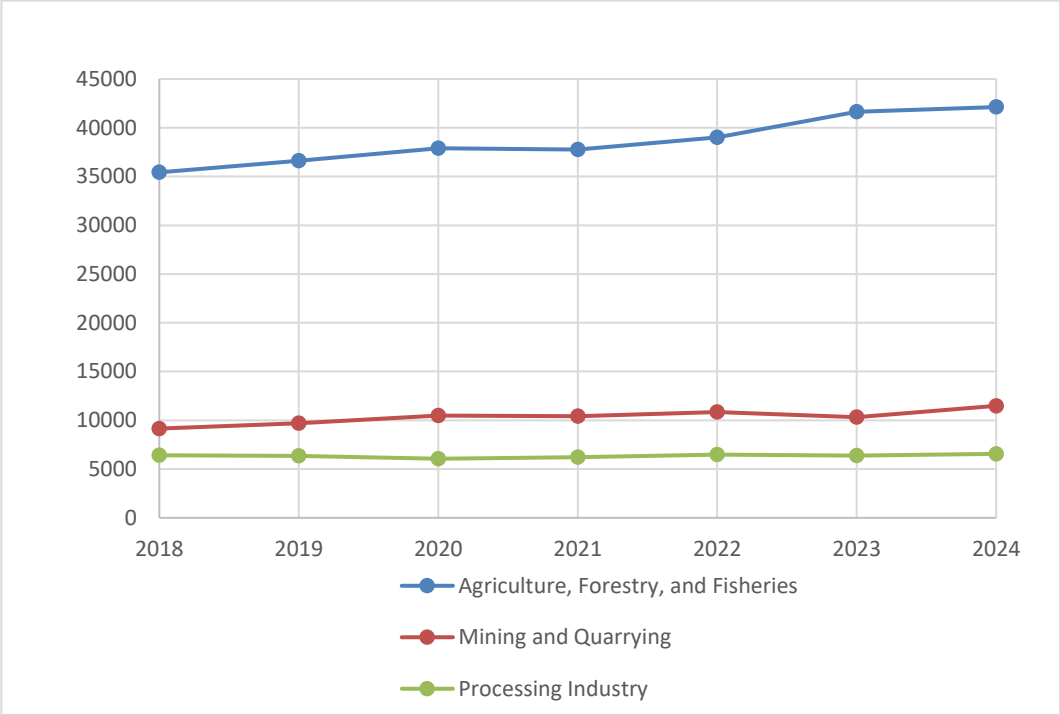

Figure 1. GRDP at Constant Prices by Three Economic Sectors in Aceh Province, 2018–2024

Based on Figure 1, which shows Aceh Province's GRDP (at constant 2018 prices) for 2018–2024, the agriculture, forestry, and fisheries sector is the largest contributor to Aceh's GRDP and shows an upward trend from approximately 35 thousand in 2018 to more than 42 thousand in 2024, despite a slight decline in 2021. The mining and quarrying sector also experienced a gradual increase from around 9 thousand to more than 11 thousand by 2024, although it declined briefly in 2023. Meanwhile, the manufacturing sector had the lowest contribution, with a relatively stagnant value ranging from 6 to 6.5 thousand throughout the observation period. This phenomenon indicates that the process of economic structural transformation in Aceh has not yet proceeded optimally, resulting in economic growth that tends to be more quantitative than qualitative. Thus, the low contribution of the manufacturing sector serves as a key indicator that the region's economic competitiveness and value-added creation still face various limitations.

The agricultural sector plays a vital role, given that Aceh is an agrarian region with agricultural potential that includes the production of rice, coffee, and other plantation commodities. In addition, the industrial sector is also beginning to develop, particularly in the processing of agricultural products and small-scale manufacturing. Meanwhile, the mining sector contributes through the management of natural resources including oil, gas,

and minerals which serve as one of the main pillars of the regional economy. However, although these three sectors play strategic roles, their respective contributions to GRDP growth have not yet been fully optimized. Commodity price fluctuations, technological limitations, and infrastructure issues are among the factors affecting the productivity of these sectors.

Furthermore, the post COVID-19 pandemic period is a crucial phase for Aceh's economy. The economic recovery underway not only reflects the resumption of economic activity but also presents an opportunity to reassess which sectors truly contribute to driving GRDP growth. In this context, it is important to examine whether Aceh's post-pandemic GRDP growth is driven by sectors with high leverage on long-term economic growth or whether it remains dependent on traditional sectors with limited value added.

A number of previous studies have analyzed the impact of economic sectors on GRDP growth in various regions of Indonesia. Examples include studies conducted by (Sari, 2024) in West Sumatra and (Mukarramah, Arniati, 2025) in Barru Regency, South Sulawesi Province. The results of these studies indicate that the contributions of the agricultural and industrial sectors to regional GRDP growth vary significantly depending on the structural conditions and development policies of each region. However, most of these studies focused on areas outside Aceh Province or used observation periods prior to the COVID-19 pandemic. Furthermore, the research findings indicate that the impact of the agricultural, manufacturing, and mining sectors on GRDP growth is contextual and highly dependent on the structural characteristics of each region. However, to date, there has been a limited number of empirical studies specifically examining which sector has the most significant influence on Aceh Province's GRDP growth during the post-pandemic period. Furthermore, it remains unclear whether the dominance of the primary sector in Aceh can still serve as a driver of growth or whether it has instead become a factor hindering the process of structural transformation toward sectors with higher value added. This empirical gap is the primary rationale for the need to conduct research in the context of Aceh Province.

Based on the above discussion, this study aims to analyze the impact of the agricultural, manufacturing, and mining sectors on the growth of Aceh Province's GRDP. The results of this study are expected to provide an empirical overview of the economic sectors that play a significant role in driving Aceh's economic growth and to serve as a basis for formulating regional economic development policies that are more targeted, sustainable, and focused on strengthening value-added sectors.

2. RESEARCH METHOD

This study employs a quantitative approach because all the data analyzed are presented in numerical form and processed using statistical analysis techniques. The quantitative approach was chosen to empirically identify and measure the impact of the agricultural, manufacturing, and mining sectors on the growth of the Regional Gross

Domestic Product (RGDP) in Aceh Province. Through this approach, the relationships between variables can be analyzed objectively and systematically.

The type of data used in this study is secondary data, which is data obtained indirectly through official institutions that provide statistical information. The data was sourced from the Central Statistics Agency (BPS) of Aceh Province. The data collected includes GRDP by economic sector for all regencies and cities in Aceh Province during the 2019–2023 period. This observation period was chosen because it reflects the dynamics of the regional economy before and after the COVID-19 pandemic. Additionally, this period also represents the early phase of the regional economic recovery.

This study uses panel data, which combines cross-sectional and time-series data from 2019 to 2023. The use of panel data allows researchers to observe differences in economic characteristics across regions while analyzing changes in economic conditions over time. The dependent variable in this study is the growth of the regency/city GRDP in Aceh Province, which reflects regional economic performance. GRDP growth is used as the primary indicator to measure the level of regional economic development. The independent variables consist of the contributions of the agricultural sector, the manufacturing sector, and the mining sector to the regional GRDP. These three sectors were selected because they play a strategic role in Aceh's economic structure and have the potential to influence the region's economic transformation process.

The analytical model used in this study is panel data regression, with the following equation:

$$\boldsymbol{Growth_{\{it\}} = \beta_0 + \beta_1 Agr_{\{it\}} + \beta_2 Ind_{\{it\}} + \beta_3 Min_{\{it\}} + \varepsilon_{\{it\}}}$$

Where $Growth_{\{it\}}$ represents the Gross Regional Domestic Product (GRDP) growth of district or city i in year t, β_0 is the intercept, while β_1, β_2, and β_3 are the regression coefficients associated with each independent variable. $Agr_{\{it\}}$, $d_{\{it\}}$, and $Min_{\{it\}}$ denote the contributions of the agricultural, manufacturing, and mining sectors, respectively, in district or city i during year t. Meanwhile, $\varepsilon_{\{it\}}$ represents the error term capturing other factors outside the model. The subscript i refers to the cross-sectional units consisting of 22 districts/cities in Aceh Province, whereas t denotes the time dimension covering the period from 2019 to 2023.

In the panel data analysis, the researcher used three main approaches: the Common Effects Model (CEM), the Fixed Effects Model (FEM), and the Random Effects Model (REM). To determine the model that best fits the data characteristics, this study used the Chow test to compare the CEM with the FEM, and the Hausman test to compare the FEM with the REM. The model selected based on the results of these tests was then used in the estimation process.

Once the best model was identified, classical assumption tests were conducted to ensure the validity of the estimation results. These tests included a multicollinearity test to examine the relationships among the independent variables, a heteroscedasticity test to assess the stability of the error variance. These tests were designed to minimize the possibility of bias in the estimation results.

Data processing and analysis were conducted using the statistical software Stata 17. Stata 17 was chosen because it provides more comprehensive and integrated panel data analysis capabilities than other statistical software, and produces output that is concise, easy to replicate, and widely used in economic research, thereby supporting the validity and comparability of research results. The results of the regression estimates were then analyzed and interpreted in depth to explain the role of the agricultural, manufacturing, and mining sectors in driving GRDP growth in Aceh Province. The findings of this study are expected to provide an empirical basis for formulating regional economic development policies that are more targeted and oriented toward strengthening value-added sectors.

3. RESULTS AND DISCUSSION

3.1 Result

Table 1. Descriptive Statistics

Variable	Obs	Mean	Std. Dev.	Min	Max
GRDP	110	5.48	3.15	1.12	17.81
AGR	110	1.62	1.31	0.08	5.48
IND	110	0.26	0.32	0.02	1.70
MIN	110	0.91	0.82	0.05	4.89

Source: Authors (data processed)

Table 1 presents the descriptive statistics of the variables used in this study, comprising 110 balanced panel observations from 22 regencies/cities in Aceh Province over the 2019–2023 period. The descriptive statistics provide an overview of the distribution and variation of each variable before conducting the panel data regression analysis.

The average Gross Regional Domestic Product (GRDP) is 5.48, with a minimum value of 1.12 and a standard deviation of 3.15, indicating considerable variation in regional economic performance across districts and cities during the observation period. The agricultural sector (AGR) records an average value of 1.62, a minimum value of 0.08, and a standard deviation of 1.31, suggesting that the contribution of agriculture differs substantially among regions. Meanwhile, the manufacturing sector (IND) has the lowest average value (0.26) with a standard deviation of 0.32, indicating that manufacturing activities remain relatively limited and unevenly distributed across districts and cities in Aceh Province. The mining sector (MIN) shows an average value of 0.91, with a minimum

value of 0.05 and a standard deviation of 0.82, reflecting noticeable differences in mining activities among the observed regions.

Overall, the descriptive statistics indicate that all variables exhibit sufficient variation across cross-sectional units and over time. Such variability supports the application of panel data regression, as it enables the analysis to capture differences in regional economic characteristics while examining the influence of the agricultural, manufacturing, and mining sectors on GRDP in Aceh Province.

Table 2. Correlation Matrix

	GRDP	AGR	IND	MIN
GRDP	1			
AGR	-0.4156	1		
IND	-0.1151	-0.0773	1	
MIN	-0.2233	0.1503	0.4049	1

Source: Authors (data processed)

Table 2 presents the Pearson correlation matrix among the variables employed in this study. The correlation analysis provides preliminary evidence regarding the direction and strength of the linear relationships between the dependent variable and the explanatory variables, as well as among the independent variables.

The results indicate that GRDP is negatively correlated with all explanatory variables. Specifically, the agricultural sector (AGR) exhibits the strongest negative correlation with GRDP, with a coefficient of −0.4156, indicating a moderate negative relationship. The mining sector (MIN) also shows a negative correlation with GRDP (−0.2233), although the relationship is relatively weak. Meanwhile, the manufacturing sector (IND) records the weakest negative correlation with GRDP (−0.1151), suggesting only a limited linear association.

Among the independent variables, the highest correlation is observed between the manufacturing sector (IND) and the mining sector (MIN), with a coefficient of 0.4049, indicating a moderate positive relationship. The correlation between the agricultural sector (AGR) and the mining sector (MIN) is 0.1503, reflecting a weak positive relationship, whereas the correlation between the agricultural sector (AGR) and the manufacturing sector (IND) is −0.0773, indicating a very weak negative relationship.

Overall, the correlation coefficients among the independent variables remain below commonly accepted thresholds for multicollinearity, suggesting that no serious multicollinearity problem exists in the dataset. Therefore, the variables are considered appropriate for inclusion in the subsequent panel data regression analysis.

Table 3. Model Testing

Chow Test			**Breusch-Pagan (LM) Test**		
Effects Test	Stat	p-value	Test Summary	X^2 Stat	p-value
Cross-section F	26,95	0,0000	Cross-section Random	146,85	0,0000

Hausman Test	**Chi²**	**p-value**	**Decision**
Cross-section Random	6,91	0,0748	Random Effect Model (REM)

Source: Authors (data processed)

Table 3 presents the results of the panel data model selection tests, including the Chow Test, Breusch–Pagan Lagrange Multiplier (LM) Test, and Hausman Test. These tests were performed to determine the most appropriate estimation model for analyzing the relationship between the agricultural, manufacturing, and mining sectors and Gross Regional Domestic Product (GRDP) in Aceh Province.

The Chow Test produces a Cross-section F statistic of 26.95 with a p-value of 0.0000, indicating that the null hypothesis of the Common Effect Model (CEM) is rejected. This result suggests that the Fixed Effect Model (FEM) provides a better fit than the Common Effect Model by accounting for unobserved heterogeneity across districts and cities.

Furthermore, the Breusch–Pagan Lagrange Multiplier (LM) Test yields a Chi-square statistic of 146.85 with a p-value of 0.0000, indicating that the Random Effect Model (REM) is preferred over the Common Effect Model. The significant LM test confirms the existence of individual-specific effects in the panel dataset, implying that the pooled regression approach is not appropriate for this analysis.

The final model selection is determined using the Hausman Test. The test produces a Chi-square statistic of 6.91 with a p-value of 0.0748, which exceeds the 5% significance level. Therefore, the null hypothesis cannot be rejected, indicating that the Random Effect Model is more appropriate than the Fixed Effect Model. Based on these results, the Random Effect Model (REM) was selected as the final estimation model because it provides more efficient parameter estimates under the assumption that the individual effects are uncorrelated with the explanatory variables. Consequently, the subsequent regression analysis was conducted using the Random Effect Model.

Table 4. Panel Data Estimation Result

Variables	**Random Effect Model**
AGR	0.1847***
	(0.0697)

Variables	Random Effect Model
IND	0.0782
	(0.1533)
MIN	0.1093***
	(0.0424)
Constant	66.5134
	(142.422)
Observations	110
R-squared	0.052
Number of id	22
Wald χ^2	8.10
Prob > χ^2	0.041

Source: Authors (data processed)

Standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

3.2 Discussion

Table 4 presents the estimation results of the Random Effect Model (REM), which was selected as the most appropriate estimation model based on the Chow Test, Breusch–Pagan Lagrange Multiplier Test, and Hausman Test. The results indicate that the agricultural and mining sectors have positive and statistically significant effects on Gross Regional Domestic Product (GRDP), whereas the manufacturing sector has a positive but statistically insignificant effect. These findings imply that the contribution of each economic sector to regional economic growth in Aceh Province differs according to its economic characteristics and level of development.

The agricultural sector (AGR) has a positive and statistically significant effect on GRDP, with an estimated coefficient of 0.1847. This finding indicates that improvements in agricultural output contribute positively to regional economic growth in Aceh Province. Agriculture remains one of the dominant sectors in Aceh's economic structure, serving as an important source of employment, household income, and food production. This result is consistent with recent evidence reported by Sembiring & Negara, (2025), who found that the agricultural sector continues to function as a leading sector and a major driver of regional economic growth in Indonesia. Their study shows that increases in agricultural output significantly improve regional GRDP, highlighting the strategic role of agriculture in supporting sustainable regional development.

The findings are also supported by Abduh, (2025), who demonstrated that agriculture-based regions in Indonesia continue to exhibit strong intersectoral linkages despite ongoing structural transformation. The study emphasizes that strengthening

agricultural productivity not only increases agricultural value added but also stimulates the development of other economic sectors through forward and backward linkages. These findings suggest that policies aimed at improving agricultural productivity, irrigation systems, technological adoption, and rural infrastructure remain essential for sustaining economic growth in Aceh Province.

The estimation results indicate that the manufacturing sector (IND) has a positive coefficient of 0.0782 with a standard error of 0.1533. However, the coefficient is not statistically significant, indicating that the manufacturing sector does not have a significant effect on Gross Regional Domestic Product (GRDP) in Aceh Province during the 2019–2023 observation period. Although the estimated coefficient suggests that a one-unit increase in the manufacturing sector is associated with an increase of approximately 0.0782 units in GRDP, the absence of statistical significance implies that this relationship is not sufficiently strong to conclude that manufacturing activities consistently contribute to regional economic growth. Therefore, changes in manufacturing output during the study period were not followed by proportional changes in regional economic performance.

One possible explanation is that the manufacturing sector in Aceh Province is still characterized by relatively small-scale industries, limited industrial diversification, low technological adoption, and relatively low value added production. Most manufacturing activities remain concentrated in food processing, household industries, and other small and medium enterprises that primarily serve local markets. As a result, the manufacturing sector has not yet generated strong backward and forward linkages capable of stimulating broader economic activities. In addition, limited investment, industrial infrastructure, and technological innovation reduce the sector's ability to create substantial multiplier effects on regional economic growth.

These findings are consistent with Azis et al., (2026), who found that manufacturing GDP growth in Indonesia exhibits considerable regional disparities and spatial spillover effects. Their study demonstrated that the contribution of manufacturing to regional economic growth depends not only on industrial output but also on industrial agglomeration, interregional connectivity, infrastructure availability, and investment concentration. Regions with stronger industrial clusters tend to experience greater manufacturing led economic growth than regions where industrial activities remain fragmented. This finding helps explain why the manufacturing sector in Aceh has not yet made a statistically significant contribution to GRDP despite having a positive estimated coefficient.

The estimation results indicate that the mining sector (MIN) has a positive and statistically significant effect on Gross Regional Domestic Product (GRDP) in Aceh Province. The estimated coefficient of 0.1093, with a standard error of 0.0424, indicates that, ceteris paribus, a one-unit increase in the mining sector is associated with an increase of approximately 0.1093 units in GRDP. The statistical significance of this coefficient confirms that mining activities remain one of the important determinants of regional economic growth

in Aceh during the 2019–2023 observation period. This finding reflects the strategic role of Aceh's abundant natural resources, particularly oil, natural gas, coal, and other mineral resources, which continue to generate regional income, create employment opportunities, attract investment, and stimulate economic activities across mining-producing districts.

This finding is consistent with Fatma et al., (2025), who demonstrated through an input–output analysis that the mining sector contributes substantially to regional economic output and generates multiplier effects that support regional economic growth. Their study further indicates that although mining contributes significantly to regional GRDP, its economic benefits can be enhanced through stronger downstream processing industries and greater domestic value-added. Similar to their findings, the results of this study suggest that the mining sector has become one of the important drivers of economic growth in Aceh Province, although its long-term contribution depends on the extent to which mining activities are integrated with manufacturing industries and other productive sectors.

The findings of this study are also supported by international evidence. Yu, (2023) found that natural resource rents, including those generated by the mining sector, contribute positively to economic growth in developing economies when supported by sound institutional quality, efficient resource management, and productive investment. Similarly, Xiang et al., (2023) argued that the economic contribution of the mining sector becomes more sustainable when resource extraction is accompanied by industrial development, technological progress, and structural transformation rather than relying solely on the export of raw materials. These findings reinforce the present study by indicating that the positive relationship between the mining sector and GRDP reflects not only the availability of natural resources but also the ability of the regional economy to transform mining revenues into productive economic activities with broader multiplier effects.

Overall, the Random Effect Model produces an R-squared value of 0.052, indicating that approximately 5.2% of the variation in GRDP is explained by the agricultural, manufacturing, and mining sectors included in the model. Although the explanatory power of the model is relatively limited, the Wald Chi-square statistic of 8.10 with a probability value of 0.041 indicates that the explanatory variables are jointly significant in explaining regional economic performance. This suggests that regional economic growth is influenced not only by sectoral output but also by other determinants, including labor market conditions, investment, education, infrastructure, institutional quality, and fiscal policy. Recent studies on Indonesia have likewise demonstrated that human capital, labor participation, and fiscal decentralization play important roles in improving regional economic performance. The relatively low R-squared value indicates that regional economic growth is influenced by many other factors beyond the agricultural, manufacturing, and mining sectors included in this study. This interpretation is supported by Abduh, (2025), who demonstrated that regional economic performance is shaped by complex inter-sectoral linkages and structural

transformation across provinces. The study highlights that economic growth depends not only on individual sectors but also on the strength of upstream–downstream linkages, interregional spillovers, and the interaction between agriculture, manufacturing, and service sectors.

4. CONCLUSION

Based on the empirical findings obtained from the Random Effect Model estimation, this study concludes that the agricultural and mining sectors have positive and statistically significant effects on Gross Regional Domestic Product (GRDP) in Aceh Province during the 2019–2023 period, whereas the manufacturing sector has a positive but statistically insignificant effect. These findings indicate that agriculture and mining remain the principal drivers of regional economic growth, while the manufacturing sector has not yet developed sufficiently to generate a meaningful contribution to regional economic performance. Furthermore, the overall regression model is statistically significant (Wald $\chi^2 = 8.10$; Prob > $\chi^2 = 0.041$), indicating that the selected explanatory variables jointly explain variations in GRDP across districts and cities in Aceh Province.

The findings demonstrate that Aceh's economic growth continues to rely heavily on its primary sectors, particularly agriculture and mining. Agriculture remains the backbone of the regional economy through its contribution to employment, household income, food security, and the supply of raw materials for other productive activities. At the same time, the mining sector continues to provide an important contribution to regional economic growth through the utilization of Aceh's abundant natural resources. In contrast, the manufacturing sector has not yet developed sufficiently to generate substantial value added or create strong forward and backward linkages capable of stimulating broader economic activities. These findings indicate that Aceh's economic structure remains dominated by resource-based sectors and that the process of structural transformation toward a more diversified and industrialized economy is still in progress.

This study contributes to the empirical literature on regional economic growth by providing recent post-pandemic evidence on the sectoral determinants of GRDP in Aceh Province using district and city level panel data. Unlike many previous studies that focused primarily on broader regional contexts or pre-pandemic periods, this research provides updated evidence regarding the changing roles of agriculture, manufacturing, and mining during the post-pandemic economic recovery period. The findings demonstrate that sectoral contributions to regional economic growth depend not only on the relative size of each sector but also on its productivity, competitiveness, and intersectoral linkages. Consequently, this study provides additional empirical evidence that enriches the literature on regional structural transformation and may serve as a reference for future studies on sector-based regional economic development.

The findings also provide important implications for regional development policy in Aceh Province. Strengthening agricultural productivity through technological innovation, improved irrigation systems, financing access, agricultural extension services, and agro-industrial development remains essential to sustain regional economic growth and improve farmers' welfare. Meanwhile, the positive contribution of the mining sector should be optimized through sustainable natural resource management and downstream industrial development in order to increase domestic value added and reduce dependence on raw commodity production. At the same time, greater attention should be given to accelerating manufacturing development through increased investment, infrastructure improvement, technological upgrading, human capital development, and support for small and medium-sized enterprises (SMEs). The integration of these development strategies is expected to strengthen intersectoral linkages, promote economic diversification, accelerate structural transformation, expand employment opportunities, and support more inclusive and sustainable economic growth in Aceh Province.

This study is subject to several limitations. First, the analysis only considers three economic sectors agriculture, manufacturing, and mining as the main determinants of regional economic growth, while other important variables such as investment, labor force, government expenditure, infrastructure, education, institutional quality, exports, digitalization, and technological innovation were not included in the empirical model. Second, the study is limited to panel data covering the period from 2019 to 2023, which captures only the early stage of the post-pandemic economic recovery and may not fully reflect longer-term structural changes in the regional economy. Future research is therefore encouraged to incorporate a broader range of explanatory variables, extend the observation period, compare regional economic structures across provinces, and employ more advanced panel econometric techniques to provide a more comprehensive understanding of the determinants of regional economic growth and structural transformation in Indonesia. Overall, this study confirms that strengthening agriculture, promoting sustainable resource management, and accelerating manufacturing development are essential to achieving a more resilient, inclusive, and sustainable regional economy in Aceh Province.

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