

Regional Economic Transformation Based on Superior Commodities: A Study of Klassen Typology and Land Use Patterns of Nutmeg Farming in Fakfak District

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Abstract—This study examines regional economic transformation based on superior commodities through Klassen Typology analysis and nutmeg agricultural land use patterns in Fakfak Regency, West Papua (2014-2023). This research uses the Klassen Typology methodology and systematic GRDP assessment to analyze sectoral economic dynamics and nutmeg agricultural land use patterns. The results showed Fakfak's economic transformation excelled with a growth rate of 4.05% compared to West Papua Province (3.30%), characterized by a diversified economic structure dominated by construction (25.26%) and agriculture (17.91%). The Klassen Typology classification reveals six key sectors driving regional transformation, while identifying structural challenges in the manufacturing and mining sectors. Analysis of nutmeg's agricultural land use pattern reveals a paradoxical relationship where the expansion of plantation area is negatively correlated with agricultural GRDP contribution (coefficient -343.66, $p = 0.0142$), indicating complex structural inefficiencies in the development of the leading commodity. These findings reveal that successful regional economic transformation requires an integrated approach beyond traditional land expansion, emphasizing value chain optimization, technological innovation, and improved market connectivity. This study contributes to the regional development literature by providing empirical evidence on the dynamics of superior commodity-based transformation and agricultural land use optimization strategies in peripheral regions.

Keywords— Regional Development, Klassen Typology, Nutmeg Plantation, GRDP Analysis, Economic Structure, West Papua.

I. INTRODUCTION

Indonesia as an agricultural country has unique geographical and structural characteristics, with the complexity of the archipelago and the dominance of the population who depend on the agricultural sector for their livelihoods. Demographically and geoecologically, agriculture is not just an economic activity, but fundamental to national survival and development [1,2]. Indonesia's plantation sector is projected to continue to strengthen its position as the main pillar of the national economy. This great potential is clearly reflected in the spice sector, where Indonesia maintains its position as a leading producer and exporter with a market share of 75 percent, making Indonesia one of the largest spice-producing countries

in the world [3]. One of the leading commodities in the spice trade in Indonesia is Nutmeg, which contributes around 31 percent of the total world production. Data from the Ministry of Agriculture shows that Indonesia's nutmeg exports in 2021 reached a volume of 26,461 tons with a value of around USD 198 million. Indonesia's dominance in the global nutmeg trade reflects not only increased productivity but also the ability to meet international quality standards, while providing strategic opportunities for the development of downstream industries and strengthening positions in pricing in the global market.

Fakfak Regency, located in West Papua Province, is one of the nutmeg production centers in eastern Indonesia. Fakfak Regency, known as the Nutmeg City, has a comparative advantage through the endemic Tomandin Nutmeg variety. Despite having great potential in the agricultural sector, especially nutmeg commodities, Fakfak Regency faces various challenges in an effort to increase nutmeg productivity which affects Gross Regional Domestic Product (GRDP). Fakfak District manages 4,046 nutmeg farming units in 14 out of 17 districts, covering approximately 80% of the regional farmland. Despite comparable land potential, there are significant productivity gaps between districts, indicating suboptimal resource utilization and uneven economic development. This spatial heterogeneity in agricultural productivity, combined with the region's high dependence on nutmeg cultivation, requires a comprehensive analysis to understand the factors contributing to this gap and its impact on regional economic transformation. Nutmeg is the region's leading commodity with exports reaching 120 tons (60% of total national exports) with a value of US\$1,440 [4]. In addition, the average income of nutmeg farmers shows promising profit potential [5]. The total annual income of nutmeg farmers in Fakfak is around IDR 14,445,000 per hectare, indicating significant economic potential [6].

Nutmeg cultivation has been the main source of livelihood for local communities for generations, with unique environmental conditions contributing to the quality of nutmeg produced. However, economic vulnerability is exacerbated by the seasonal nature of the nutmeg harvest and fluctuating market prices. Based on these conditions, this study aims to analyze the regional economic transformation of Fakfak Regency through the Klassen typology approach integrated with the evaluation of the nutmeg agricultural sector. This research identifies the regional economic structure by mapping growth quadrants and sectoral contributions, analyzing the strategic role of the nutmeg agricultural sector in regional economic dynamics, and formulating a sustainable economic transformation framework

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based on superior commodities. The significance of the research lies in contributing to the development of a conceptual framework for regional economic transformation and providing empirical evidence-based development policy analysis instruments that can be replicated in agricultural areas with similar characteristics.

II. LITERATURE REVIEW

A. Klassen Typology

Klassen typology is an analytical method to classify economic sectors based on growth rate and contribution to GRDP [7]. This classification divides regions into four categories: developed and fast-growing, developed but depressed, fast-growing, and lagging, based on average economic growth and per capita income [8]. The application of this typology can be done through sectoral and regional approaches, with the two main indicators being economic growth and per capita income [9,10].

B. Land Use Theory

Land use in agricultural production systems involves space allocation, utilization patterns, and land transformations that have not only physical but also social, economic, and ecological dimensions [11]. The theory of [10] emphasizes that the efficiency of land use is determined by the location and intensity of use, where on narrow land farmers face the challenge of increasing productivity or expanding the area. The application of modern technology such as mechanization and irrigation systems is a determining factor for agricultural

productivity [11].

C. Nutmeg Value Chain in Agribusiness

The nutmeg value chain involves multiple stakeholders from seed providers to traders, with significant value-added potential but challenges in post-harvest management [12,13]. The high economic value of nutmeg can be optimized through comprehensive utilization of all plant parts and an effective market information system [14]. Institutional factors and business capital financing play a crucial role in optimizing the value chain, especially for smallholders [15]

III. METHOD

A. Biodiesel production with KOH catalyst

This research was conducted in Fakfak Regency, an administrative region located in West Papua Province, Indonesia. The selection of the research location in Fakfak Regency was based on strategic considerations to produce findings that can make a significant contribution to regional development planning. The data used in this study are secondary data in the form of Gross Regional Domestic Product (GRDP) at constant prices for Fakfak Regency and West Papua Province for the period 2014-2023. Regression analysis was conducted to see the effect of the superior nutmeg commodity as measured by land area and nutmeg production on the contribution of increasing Fakfak Regency's Agricultural GRDP.

$$\text{Agriculture GRDP}_{it} = \beta_0 + \beta_1 \text{Nutmeg Land Area}_{it} + \beta_2 \text{Nutmeg Production}_{it} + \varepsilon_{it}$$

Epistemologically, Klassen Typology Analysis integrates two fundamental variables in evaluating economic performance: growth rate and sector contribution (share contribution). These two parameters are analyzed comparatively using a reference area as a baseline, which

allows for identification of the relative position of economic sectors in a regional and national context. The methodological complexity lies in the classification mechanism that can measure and interpret economic conditions. The Klassen typology classification is as follows.

TABEL I: CLASSIFICATION OF THE KLASSEN TYPOLOGY APPROACH

Quadrant I $r_i \geq r$ and $y_i \geq y$ Advanced and rapidly growing sectors	Quadrant II $r_i < r$ and $y_i \geq y$ Sectors with suppressed growth
Quadrant III $r_i \geq r$ and $y_i < y$ Potential or still developing sectors	Quadrant IV $r_i < r$ and $y_i < y$ Sectors that are relatively underdeveloped

Where r_i = regional sector growth rate, r = provincial average growth rate, y_i = sector contribution to regional GRDP, y = sector contribution to provincial GRDP.

A. Classification of Economic Structure Growth in Fakfak Regency and West Papua Province

The Klassen Typology analysis method is an analysis tool used to identify the grouping of economic sectors in Fakfak Regency based on the growth rate and contribution of the sector to the regional economy. Through the quadrant approach in the

Klassen Typology analysis, economic sectors can be grouped into four main categories by considering the rate of economic growth and the value of their contribution to the gross regional domestic product (GRDP). This approach allows for a comprehensive assessment to determine leading sectors and sectors that still have development potential.

TABEL II: GROWTH RATE AND CONTRIBUTION OF GRDP SECTORS FAKFAK REGENCY AND WEST PAPUA PROVINCE 2014-2023

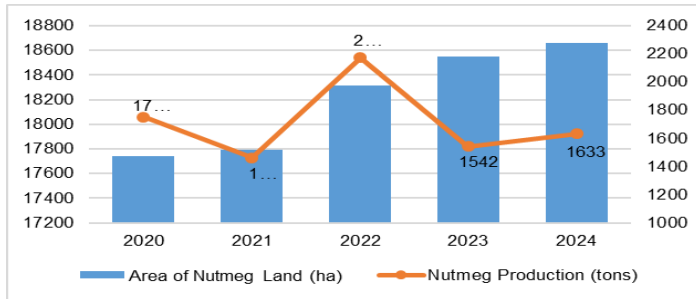
Sector	Fakfak Regency		West Papua Province	
	Economic Growth (ri)	Kontribusi PDRB (yi)	Economic Growth (r)	GRDP Contribution (y)
Agriculture, Forestry, and Fisheries	2.45	17.91	1.81	9.98
Mining and Quarrying	1.10	1.48	1.55	20.02
Processing Industry	2.75	3.88	3.15	32.10
Electricity and Gas Supply	3.96	0.05	5.59	0.04
Water Supply, Waste Management, Waste and Recycling	2.54	0.22	4.04	0.11
Construction	3.75	25.26	3.00	11.75
Wholesale and Retail Trade; Car and Motorcycle Repair	5.20	12.47	6.90	6.41
Transportation and Warehousing	4.79	5.17	4.28	2.34
Provision of Accommodation and Food and Beverages	6.41	1.09	5.87	0.55
Financial and Insurance Services	7.01	3.37	7.25	1.93
Information and Communication	4.77	1.46	6.14	1.43
Real Estate	4.46	2.27	6.17	1.19
Company Services	4.42	0.19	4.88	0.11
Government Administration, Defense and Compulsory Social Security	4.77	18.09	4.66	8.56
Education Services	4.72	5.34	4.44	2.44
Health Services and Social Activities	3.90	1.42	5.55	0.80
Other Services	5.49	0.33	5.52	0.27
GROSS REGIONAL DOMESTIC PRODUCT	4.05	100.00	3.30	100.00

Fakfak Regency showed superior economic growth (4.05%) compared to West Papua Province (3.30%), with different sectoral composition. Fakfak's economy is dominated by Construction (25.26%) and Agriculture, Forestry, and Fisheries (17.91%), emphasizing infrastructure development and primary sector activities. In contrast, West Papua relies heavily on Mining and Quarrying (20.02%) and Manufacturing (32.10%), reflecting a natural resource-based economic structure. This comparison reveals opportunities for economic diversification, where Fakfak needs strengthening of the industrial and technology sectors for value addition, while West Papua needs enhancement of the services sector and infrastructure for inclusive growth. The Klassen Typology classification reveals complex regional economic dynamics in four different quadrants. Quadrant I identifies leading sectors with superior performance, including Agriculture, Forestry, and Fisheries; Construction; Transportation and Warehousing; Accommodation and Food Services; Government Administration; and Education Services, showing substantial GRDP contributions and significant growth rates. Quadrants I and II present paradoxical sectors with high GRDP contributions but sluggish growth, including Electricity and Gas, Wholesale and Retail Trade, Financial Services, and Health Services, indicating economic stagnation that requires strategic intervention. Quadrant III represents potential

development areas with structural complexities that demand innovative approaches, while Quadrant IV includes sectors with minimal performance, particularly Mining and Quarrying and Manufacturing, reflecting structural challenges that require transformative interventions for regional economic optimization.

A. Use of Nutmeg Plantation Land in Increasing Nutmeg Production in Fakfak Regency

The use of nutmeg agricultural land in Fakfak Regency shows an important role in the local economy, especially in the agricultural sector. Nutmeg, as a superior commodity, has long been an integral part of agricultural activities in Fakfak Regency, which is located in the West Papua region. The following is the area and production of nutmeg plants in Fakfak Regency. The use of nutmeg agricultural land in Fakfak Regency in the 2020-2024 period displays significant spatial and structural complexity in the context of developing nutmeg agricultural commodities.



Source: Fakfak District Plantation Office, 2025

Fig.2: Development of Nutmeg Land Area and Production in Fakfak Regency 2020-2024

Fig.2 The Development of Land Area and Nutmeg Production in Fakfak Regency 2020-2024 shows the complex dynamics of the plantation sector. This production variability illustrates the complexity of factors affecting agricultural output, which are not always linear with land expansion, such as climatic conditions [16,17], efficient cultivation techniques

through the use of modern technology [18], and market dynamics based on commodity price fluctuations [19]. This indicates that there are other factors besides land availability that affect nutmeg productivity. The analysis shows a complex relationship between the expansion of nutmeg plantation area and the GRDP contribution of the agricultural sector, where an increase in plantation area is not directly correlated with proportional GRDP growth. This phenomenon points to structural challenges in value chain integration and productivity optimization that require strategic interventions beyond the traditional area expansion approach. The spatial and productive complexity of nutmeg farming in Fakfak Regency requires a geographically insightful and technically enhanced strategy to optimize the potential of nutmeg as an instrument of sustainable regional economic development, emphasizing increased efficiency and added value over extensive cultivation expansion.

TABEL III: ANALYSIS OF THE IMPACT OF NUTMEG LAND AREA ON THE PDRB OF THE AGRICULTURAL SECTOR

Variable	Coefficient	P-value
const	7,117,630.91	0.0142
Nutmeg Land Area	-343.66	0.0142
Nutmeg Production	-395.96	0.1950

This comprehensive study reveals the multifaceted regional economic structure of Fakfak Regency through the Klassen Typology methodology and systematic GRDP analysis. The study identifies agriculture, forestry, fisheries, construction and education services as the fundamental pillars of the region's economic architecture, while uncovering structural disparities in the manufacturing and mining industries that show stagnant performance. Despite nutmeg's high economic potential, the analysis reveals a counterintuitive relationship where an increase in plantation area is negatively correlated with agricultural GRDP contribution (coefficient -343.66), indicating underlying structural inefficiencies including infrastructure limitations, reduced market accessibility, and minimal adoption of modern agricultural technologies. The paradoxical economic impact reflects the complex challenges of nutmeg agricultural land use, where declining productivity is occurring despite the commodity serving as the backbone of the local economy with stable farmer income contribution and export potential. Spatial polarization in land use creates economic vulnerability through over-reliance on single-commodity agriculture, which requires strategic interventions for sustainable and diversified development approaches.

access and distribution networks; (3) Regional Economic Diversification to reduce commodity dependency; (4) Institutional Strengthening and Regional Governance for effective policy implementation; and (5) Technology Investment and Improved Market Access including product certification systems. These strategic interventions aim to transform Fakfak Regency's economic potential into a sustainable, inclusive, and equitable competitive advantage, which serves as an empirical foundation for evidence-based regional development policies while requiring further research to evaluate the effectiveness of interventions and develop adaptive strategies that are responsive to global economic changes.

IV. CONCLUSION

This study reveals the complexity of regional economic transformation based on superior commodities in Fakfak Regency through Klassen Typology and nutmeg agricultural land use analysis. Findings show a successful transformation with a growth rate of 4.05% driven by sectoral diversification, identifying agriculture, construction, and education as pillars of transformation while uncovering structural challenges in the manufacturing and mining sectors. Important findings show a paradoxical negative correlation between nutmeg land expansion and agricultural GRDP (coefficient -343.66, $p=0.0142$), indicating that transformation based on superior commodities requires an integrated approach beyond area expansion, emphasizing value chain optimization and technological innovation. This study contributes empirical evidence on the dynamics of transformation in peripheral areas,

A. Strategic Policy Framework for Sustainable Transformation

This study provides comprehensive policy recommendations for inclusive and sustainable economic transformation: (1) Optimization of Superior Commodity Management to increase productivity and added value; (2) Improved Infrastructure and Market Connectivity to improve

proposing a strategic framework for sustainable development through superior commodity optimization, infrastructure improvement, and economic diversification.

V.ACKNOWLEDGEMENTS

The author would like to express their gratitude to the Indonesia Endowment Fund for Education (LPDP), Ministry of

Finance of the Republic of Indonesia, for funding this research through the LPDP scholarship. This financial support has significantly contributed to the completion of the study and research presented in this paper

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