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Reduction of Economic Disparities in Regions with Different Population Densities through the Agricultural Sector

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Keywords:	Abstract
Agricultural sector; Economic inequality; Population density; Region; Theil index	Regions in Indonesia have relatively high economic growth, but are also accompanied with high economic inequality. In addition, population density tends to vary, so the opportunities to utilize resources by each population differ between regions. The objectives of this research are (1) to determine economic inequality in regions with high population density (Java-Bali), medium (Sumatra), and low (Maluku); and (2) to analyze the contribution of the agricultural sector in reducing this inequality. The Theil index analysis method is used to address the first objective, while the Theil index values with and without the agricultural sector are compared to address the second objective. The research results indicate that economic inequality in regions with high population density is higher than in regions with medium population density, and in regions with medium population density is higher than in regions with low population density. The research also confirms that the agricultural sector is able to reduce economic inequality in the research regions. The research findings are important as a basis for the development of the agricultural sector in order to reduce economic inequality.

How To Cite (APA 6th Style):

INTRODUCTION

Economic inequality in developing countries, particularly in Indonesia, has been rapidly increasing over the past two decades (Makhlouf, 2023). The rise in inequality poses a serious challenge to development because the goal of development is not only to increase economic growth, but also to ensure a reduction in economic inequality (Seidman, 2005). Reducing economic inequality is the tenth goal in the SDGs (Cuong, 2010) and has been a focus of policy makers for the past few decades (Yuldashev *et al.*, 2023). Furthermore, Indonesia's Medium-Term Development Plan (RPJMN) for the years 2020-2024 states that economic growth in each region of Indonesia is expected to progress in tandem with national economic growth and economic inequality should be minimized. However, high economic growth does not necessarily guarantee equal distribution (Yan & Mohd, 2023).

As it happens in Indonesia, despite relatively high economic growth, in the short term it is accompanied by relatively high economic disparities between regions (Salim *et al.*, 2020). Significant differences in the contribution by each region to the Gross Domestic Product (GDP) can indicate rough economic disparities. For example, the Java-Bali Island contributes more than 50% to Indonesia's GDP, while the total contribution of Kalimantan, Sulawesi, Maluku, and Papua Islands does not reach 10% (Central Bureau of Statistics, 2023). Economic disparities between regions are caused by several factors such as differences in geographical conditions and natural resource content in each region (Akita & Kataoka, 2022).

Based on the above facts, research related to efforts to reduce economic inequality becomes important to ensure that the goals of regional development can be achieved optimally. Previous research has focused more on national economic inequality (Akita, 2003; Akita & Alisjahbana, 2002; Alisjahbana & Akita, 2020; Amri & Nazamuddin, 2018; Hakim & Rosini, 2022; Novianti & Panjaitan, 2022; Walujadi *et al.*, 2022) or inter-district within a province (Andiny & Mandasari, 2017; Aprelia & Arif, 2023; Artaningtyas & Sriwinarti, 2020; Destiningsih *et al.*, 2019; Khaerunnisa & Puspitasari, 2024; Suryani & Woyanti, 2021). Previous studies tend to not consider population density and the agricultural sector. Meanwhile, the growth of the agricultural sector has a significant impact on reducing the level of economic inequality in various regions as seen in Pakistan, Thailand, India, and Papua (Ali *et al.*, 2013; Cuong, 2010; Gordón & Resosudarmo, 2019; Sa'diyah & Irham, 2016). Additionally, regions with high population density have higher economic inequality in other countries, such as in India, Thailand, and the US (Milanovic, 2018) as well as in China (Yan & Mohd, 2023).

Data shows that the agricultural sector contributes to the GDP ranging from 12.30% to 13.70% from 2011 to 2022 (Central Bureau of Statistics, 2023). The agricultural sector can also serve as a provider of employment opportunities without requiring special skills or specific qualifications (Muta'ali, 2019). Previous research has confirmed that the living standards of low-income population groups can improve as a result of labor absorption in the agricultural sector in developing countries (Gordón & Resosudarmo, 2019). Equally important, the agricultural sector is able to sustain economic growth (Akita & Alisjahbana, 2023) and its growth remains positive even in crisis situations such as the Covid-19 pandemic (Central Bureau of Statistics, 2023) while also being an irreplaceable food provider to date (Songsermsawas *et al.*, 2023). Based on this, it can be assumed that the agricultural sector is capable of reducing economic inequality levels in regions.

Meanwhile, different population densities also imply differences in the proportion and opportunities for the management of natural resources between regions (Bouincha & Karim, 2018; Breau, 2015; Chen & Zhang, 2023; Milanovic, 2018). The higher the population density in a region, the lower the proportion and opportunities of natural resources that can be utilized by the population in that region (Yan & Mohd, 2023). Referring to the previous research, regions with high population density are suspected to have higher levels of economic inequality compared to regions with low population density.

However, there is no research on the contribution of the agricultural sector in reducing economic inequality associated with population density in Indonesia, making this research important. The agricultural sector is more often studied in relation to efforts to combat hunger and reduce poverty (Francks *et al.*, 2002). Previous research tends to discuss the connection between economic inequality and population in a region without considering the area or population density.

Java-Bali Island is representative in representing regions with high population density, even the highest population density in Indonesia where there are 500 to 1,000 people per km2. The population density in Sumatra Island is classified as medium with 60 to 499 people per km2, while in Maluku Island it is considered low because there are only 30 to 59 people per km2 in that area. This research on economic inequality is conducted in the regions of Java-Bali, Sumatra, and Maluku for the aforementioned reasons.

Research related to the contribution of the agricultural sector in reducing economic inequality in various regions is interesting. Unlike previous researches that only examined the level of economic inequality (Sutomo *et al.*, 2024), the novelty in this

research is analyzing economic inequality within and between regions with different population densities using the decomposed Theil index and linking the agricultural sector, which plays a crucial role in SDGs, to efforts to reduce economic inequality over the past 12 years (2011-2022). Although the analysis of economic inequality within and between regions has been done before (Cao & Tao, 2024; Widyastaman & Hartono, 2022), it has not been linked to the important role of the agricultural sector. The research objectives are 1) to determine economic inequality in regions with high, medium, and low population densities in Indonesia and 2) to analyze the contribution of the agricultural sector in reducing economic inequality in the research area.

RESEARCH METHODS

The research location is based on differences in population density and economic contribution, namely Java-Bali Island, Sumatra, and Maluku. The considerations for determining the location are that Java-Bali Island has high economic contribution and population density, Sumatra Island has medium economic contribution in line with the population density in that region, while Maluku Island has low economic contribution and population density in line with the research objectives. In addition, the agricultural sector has a high contribution to the Gross Regional Domestic Product (PDRB) of each region. Secondary data in the form of panels covering both total PDRB and agricultural sector PDRB, as well as the population numbers in 303 districts within the research area from 2011 to 2022, are used for analysis. The total number of observations in this research is 3,636 data points. The research data is obtained from the official websites of the Indonesian Central Bureau of Statistics and the Central Bureau of Statistics of each district and province, with literature review as the data collection method. Economic disparity variables, agricultural sector contributions, and population density are measured in ratios. Meanwhile, the analysis method used is based on the research objectives.

The first objective is analyzed using the Two-stage Nested Theil Decomposition Analysis method so that economic inequality within regions and between regions can be identified. The formula used is as follows (Akita & Kataoka, 2022):

$$T = \sum_i \sum_j \sum_k (\frac{Y_{ijk}}{Y}) ln\left[(\frac{Y_{ijk}}{Y})/(\frac{N_{ijk}}{N})\right], \ 0 < T_i < 1$$

$$T = \sum_i \sum_j \sum_k (\frac{Y_{ijk}}{Y}) ln\left[(\frac{Y_{ijk}}{Y})/(\frac{N_{ijk}}{N})\right] = \sum_i \left(\frac{Y_i}{Y}\right) T_{di} + TBR$$

$$TBR = \sum_i \left(\frac{Y_i}{Y}\right) ln[(\frac{Y_i}{Y})/(\frac{N_i}{N})]$$

$$T_{di} = \sum_j \sum_k \left(\frac{Y_{ijk}}{Y_i}\right) ln\left[(\frac{Y_{ijk}}{Y_i})/(\frac{N_{ijk}}{N_i})\right]$$

$$Tdi = \sum_j \sum_k \left(\frac{Yijk}{Yi}\right) ln \left[\left(\frac{Yijk}{Yi}\right)/\left(\frac{Nijk}{Ni}\right)\right] = \sum_j \left(\frac{Yij}{Yi}\right) Tij + Tpi$$

$$Tij = \sum_k \left(\frac{Yijk}{Yij}\right) ln \left[\left(\frac{Yijk}{Yij}\right)/\left(\frac{Nijk}{Nij}\right)\right]$$

$$Tpi = \sum_i \left(\frac{Yij}{Yi}\right) ln \left[\left(\frac{Yij}{Yi}\right)/\left(\frac{Nij}{Ni}\right)\right]$$

$$TWP = \sum_i \sum_j \left(\frac{Yij}{Y}\right) Tij$$

$$TBP = \sum_i \left(\frac{Yi}{Y}\right) Tpi$$

$$T = TWP + TBP + TBR$$

Legend:

T   = Theil Index (total inequality)

Tdi   = Economic inequality in Island i

TBR   = Economic inequality between islands

TWP   = Component of inequality within the province (average Tij)

TBP   = Inter-provincial inequality component (average Tpi)

Tij   = Disparity in Province j on Island i

Tpi   = Disparity between provinces on Island i

Yijk   = Gross Regional Domestic Product (GRDP) of District k in Province j on Island i

Nijk   = Population of District k in Province j on Island i

Yi   = Total Gross Regional Domestic Product (GRDP) in Island i

Ni   = Population of Island i

Y   = Gross Regional Domestic Product (GRDP) in the research location

N   = Population size in the research location

When the Theil index value approaches one, it indicates a higher economic inequality, while when the Theil index value approaches zero, the economic inequality is lower (Qin *et al.*, 2021).

       The second objective is also analyzed using the Theil index decomposition method, but the data used is GDP that has been adjusted by subtracting the agricultural sector GDP. The results of the Two-stage Nested Theil Decomposition Analysis without the agricultural sector are compared with the results of the first objective analysis.

$$TP = \sum_i \sum_j \sum_k \left(\frac{YPijk}{YP}\right) ln \left[\left(\frac{YPijk}{YP}\right)/\left(\frac{Nijk}{N}\right)\right], \ 0 < TPi < 1$$

$$TP = \sum_i \sum_j \sum_k \left(\frac{YPijk}{YP}\right) ln \left[\left(\frac{YPijk}{YP}\right)/\left(\frac{Nijk}{N}\right)\right] = \sum_i \left(\frac{YPi}{YP}\right) TdPi + TBRP$$

$$TBRP = \sum_i \left(\frac{YPi}{YP}\right) \ln\left[\left(\frac{YPi}{YP}\right)/\left(\frac{Ni}{N}\right)\right]$$

$$TdPi = \sum_j \sum_k \left(\frac{YPijk}{YPi}\right) \ln\left[\left(\frac{YPijk}{YPi}\right)/\left(\frac{Nijk}{Ni}\right)\right]$$

$$TdPi = \sum_j \sum_k \left(\frac{YPijk}{YPi}\right) \ln\left[\left(\frac{YPijk}{YPi}\right)/\left(\frac{Nijk}{Ni}\right)\right] = \sum_j \left(\frac{YPij}{YPi}\right) TPij + TpPi$$

$$TPij = \sum_k \left(\frac{YPijk}{YPij}\right) \ln\left[\left(\frac{YPijk}{YPij}\right)/\left(\frac{Nijk}{Nij}\right)\right]$$

$$TpPi = \sum_i \left(\frac{YPij}{YPi}\right) \ln\left[\left(\frac{YPij}{YPi}\right)/\left(\frac{Nij}{Ni}\right)\right]$$

$$TWPP = \sum_i \sum_j \left(\frac{YPij}{YP}\right) TPij$$

$$TBPP = \sum_i \left(\frac{YPi}{YP}\right) TpPi$$

$$T = TWPP + TBPP + TBRP$$

Legend:

TP = Theil Index (total inequality) without the agricultural sector

TdPi = Economic inequality in Island i without the agricultural sector

TBRP = Economic inequality between islands without the agricultural sector

TWPP = Component of inequality within provinces ($\bar{x}$ Tij) without the agricultural sector

TBPP = Interprovincial inequality component ($\bar{x}$ Tpi) without the agricultural sector

TPij = Disparity in Province j on Island I without the agricultural sector

TpPi = Interprovincial inequality in Island i without the agricultural sector

YPijk = GDP without the agricultural sector of District k in Province j on Island i

Nijk = Population of District k in Province j on Island I

YPi = Gross Regional Domestic Product (GRDP) without the agricultural sector in Island i

Ni = Population of Island i

YP = Gross Regional Domestic Product (GRDP) without the agricultural sector in the research location

N = Population size in the research location

When the Theil index value without the agricultural sector in the calculation is higher than the Theil index value with all economic sectors, it can be interpreted that the agricultural sector plays a role in reducing the level of economic inequality in Java-Bali, Sumatra, and Maluku Islands.

RESULTS AND DISCUSSION

Economic Disparities in Areas with High, Medium, and Low Population Density

The results of Theil index decomposition indicate that the inequality between provinces and districts contributed more to the total inequality increase than the inequality between islands from 2011 to 2022 (Figure 1). Akita (2003) also found that the inter-provincial inequality contributed more to the total economic inequality in Indonesia in 1996. Economic inequality has been increasing since 2020. According to Novianti & Panjaitan (2022), economic inequality has been higher due to the impact of the Covid-19 pandemic.

Figure 1. Results of Two-stage Nested Theil Decomposition Analysis
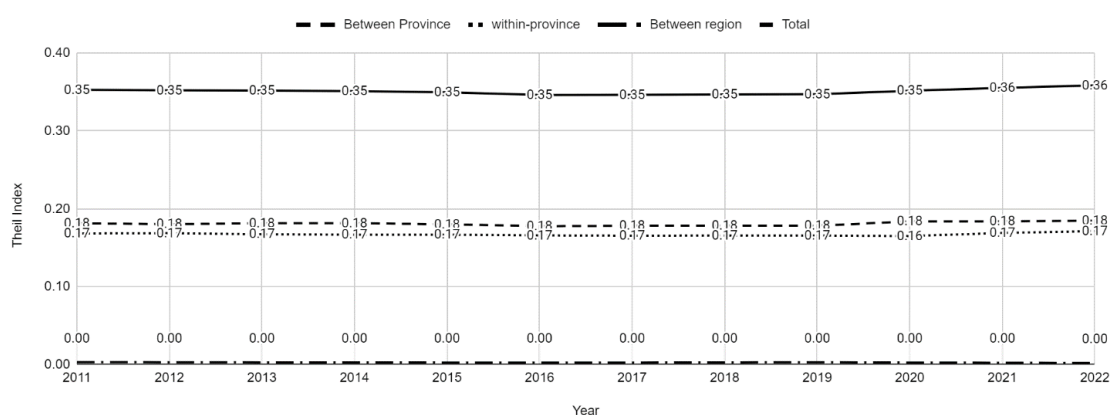
Source: Processed Secondary Data, 2023

Economic inequality in the Java-Bali Island is higher than in Sumatra Island, while inequality in Sumatra Island is higher than in Maluku Island. The calculation results indicate that economic inequality in regions with high population density is higher than in regions with medium and low population density, in line with the research hypothesis. Economic inequality in Java-Bali and Maluku Islands tends to increase, while in Sumatra Island it tends to decrease (Figure 2). Consistent with the research findings, (Soejoto *et al.*, 2022) stated that population density tends to be concentrated in Java-Bali Island and high population density can cause natural resources to be insufficient to meet the population's needs. This is consistent with the research findings of Peterson (2017) which indicate that high population growth can reduce family welfare in the short term and slow down development in low-income countries. On the other hand, Milanovic (2018) found that low population density can increase relative wages to land rent, thus reducing economic inequality. Boschken (2023) also stated that economic inequality can decrease when high population density is dominated by people who are workers.

Figure 2. Interprovincial Disparities in Indonesia
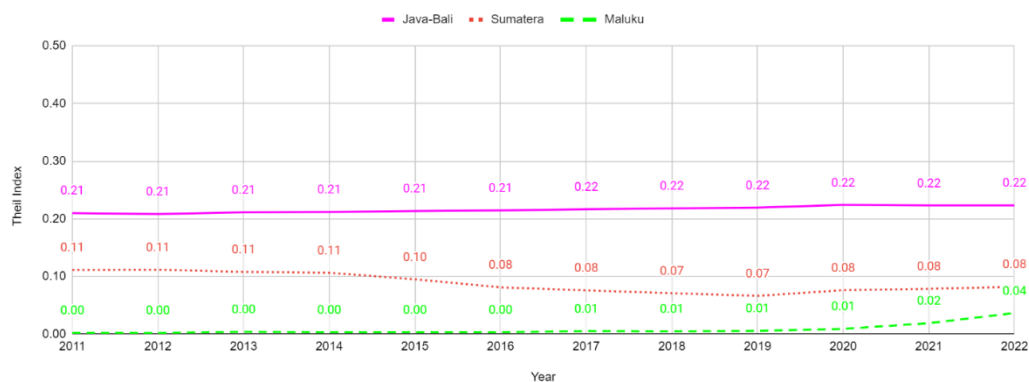
Source: Processed Secondary Data, 2023.

Figure 3 shows that the economic inequality in each province in the Java-Bali Island tends to increase. East Java province has the highest economic inequality, while Bali province has the lowest inequality in line with its population density. East Java has a high population compared to other regions and is accompanied by high population density. High population density impacts the limited opportunities for each individual in utilizing resources in a certain area, so some population groups have better economic opportunities, while others are marginalized, in accordance with previous studies (Aprelia & Arif, 2023; Chen & Zhang, 2023; Milanovic, 2018; Yan & Mohd, 2023). Since 2020, economic inequality in East Java, West Java, Banten, Central Java, and Bali provinces tends to increase, while in DKI Jakarta and Yogyakarta Special Region tends to decrease. The increase in economic inequality can occur due to policies restricting movement and activities during the Covid-19 pandemic as explained in the study by Akita & Alisjahbana (2023). Job losses causing some people to not earn income (Antara, 2022), while certain groups can still work or even increase their income, thus widening economic inequality, consistent with previous research (Novianti & Panjaitan, 2022).
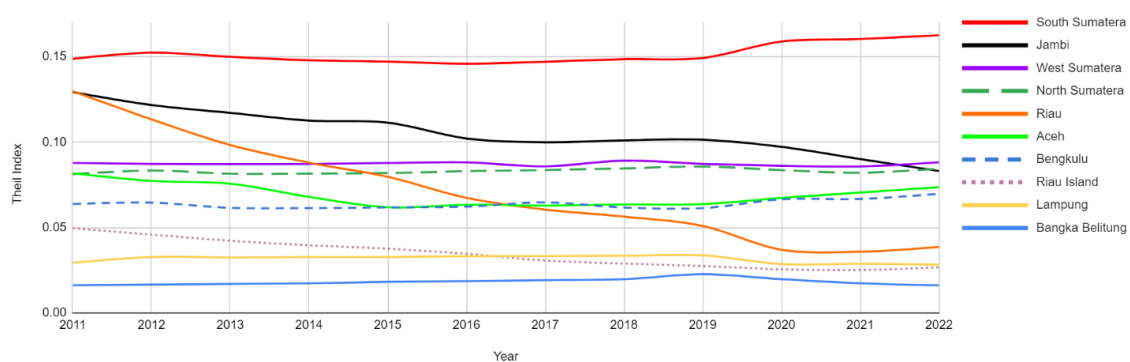
Figure 3. Economic inequality in Java-Bali Island
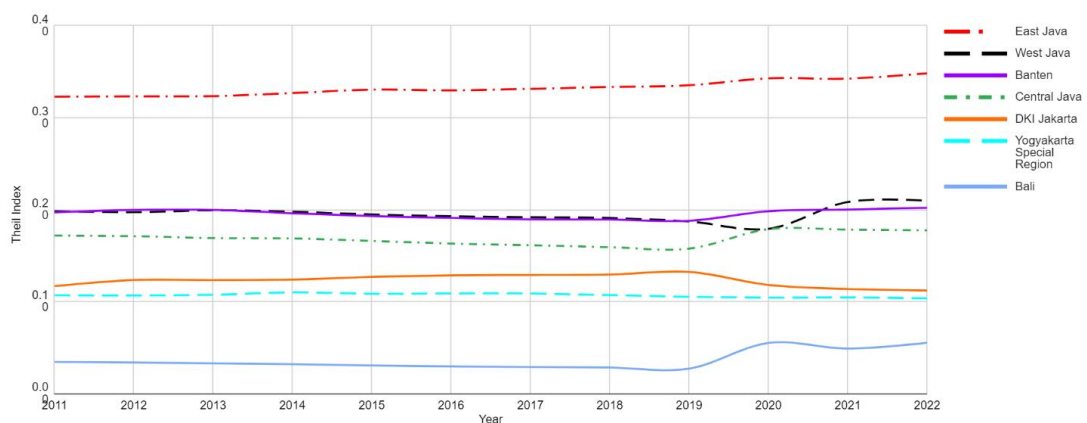
Source: Processed Secondary Data, 2023.

Unlike the economic inequality in the Java-Bali Island, economic inequality in each province in Sumatra tends to decrease, such as in the provinces of Jambi, Riau, Riau Islands, Lampung, Bangka Belitung, and Aceh. Economic inequality in West Sumatra and North Sumatra provinces tends to remain stable, while in South Sumatra and Bengkulu provinces it tends to increase (Figure 4). The decrease in economic inequality in Sumatra is attributed to the success in maintaining population density stability and improving human development supported by the strategic location of the region in the economy. The research findings are consistent with previous studies (Hidayat, 2023; Hidayat *et al.*, 2022).

Figure 4. Economic inequality in Sumatra Island

Source: Processed Secondary Data, 2023.

Economic inequality in the Maluku Islands tends to increase (Figure 5). The increase in economic inequality in North Maluku Province has been very significant since 2020 and has risen rapidly in 2022. In addition to the Covid-19 pandemic, the rapid growth of the mining sector's economy is due to the policy of not selling raw mining products in that region, leading to the construction of various facilities and supporting infrastructure that attract investments into the area (Central Bureau of Statistics North Maluku Province, 2023). However, only a certain group with large capital tends to enjoy the rapid growth of the mining sector's economy, resulting in a drastic increase in economic inequality. In line with what is happening in North Maluku Province, economic inequality in Maluku Province is also increasing, but not as high as in North Maluku Province.

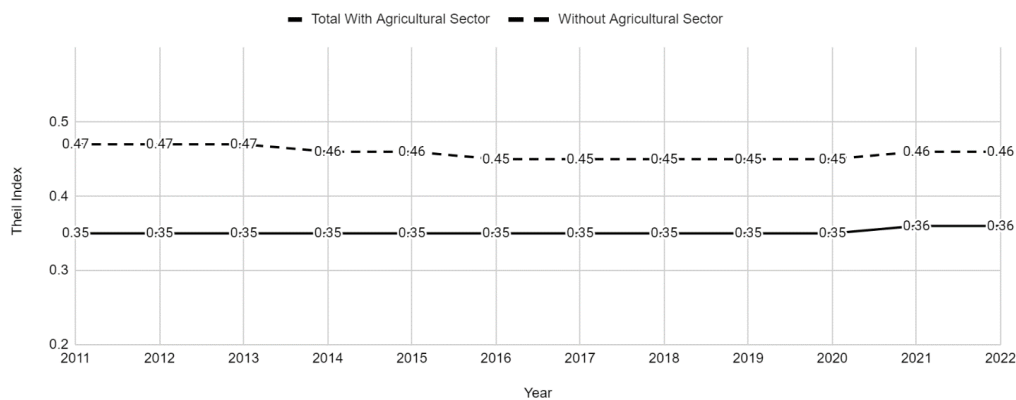**Figure 5. Economic inequality in the Maluku Islands**
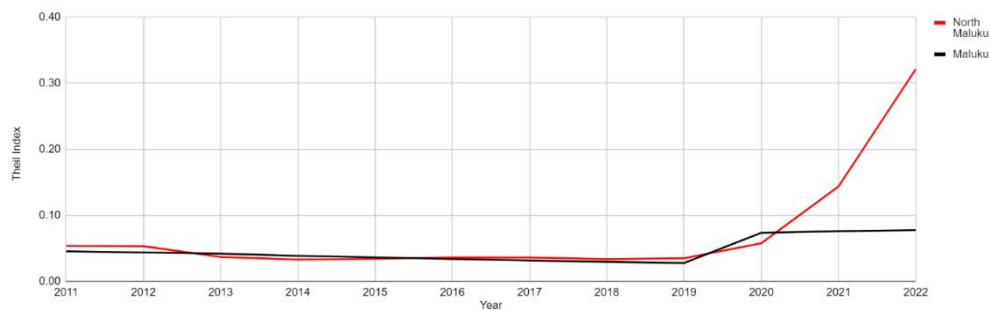
Source: Processed Secondary Data, 2023.

Contribution of the Agricultural Sector in Reducing Economic Inequality

Without the agricultural sector, economic inequality in Indonesia becomes higher. This is indicated by a higher Theil index value without including the agricultural sector compared to including the agricultural sector (Figure 6). The agricultural sector has been proven to be able to reduce the level of economic inequality in line with the research hypothesis.

Figure 6. Theil Index Values With and Without the Agricultural Sector

Source: Processed Secondary Data, 2023.

The calculation results indicate that the agricultural sector contributes to reducing economic inequality in the research area. This is consistent with several previous studies (Cuong, 2010; Sa'diyah & Irham, 2016). In developing countries, including Indonesia, the agricultural sector serves as a source of income for a majority of the population (Ali *et al.*, 2013). In line with this, the agricultural sector will simultaneously improve the living standards of the lowest 20% income group, where an increase in the sector's ratio to GDP can enhance the relative expenditure of the 20% of households with the lowest expenditure in Indonesia and reduce economic inequality (Gordón & Resosudarmo, 2019).

Figure 7. Theil Index Value Decomposition Results without the Agricultural Sector
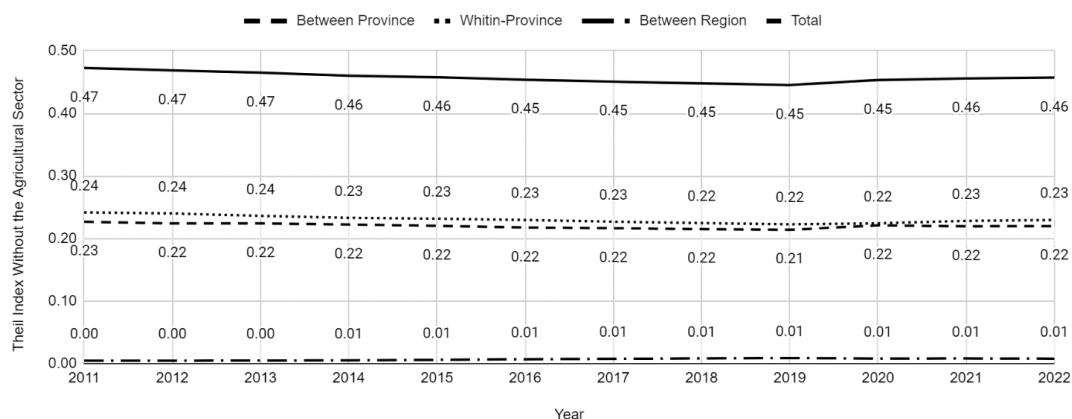
Source: Processed Secondary Data, 2023.

Without the agricultural sector, economic inequality between districts is higher than between provinces (Figure 7). This result can be interpreted as the contribution of the agricultural sector in reducing inter-district inequality is relatively higher than inter-provincial inequality. The development of the agricultural sector at the district level should receive support to promote the reduction of economic inequality. District areas are more dominated by rural areas. The agricultural sector can become the main source of income in rural areas, which are home to the majority of the poor population (Sassi, 2023).

Although small in scale, the agricultural sector is pursued by a relatively large number of people in Indonesia, so that cumulatively it can become a source of income and reduce economic inequality. In line with this, (Akpa *et al.*, 2024) stated that the agricultural sector is able to absorb labor and provide opportunities for women to earn income. Increasing subsidies and investments in the agricultural sector can reduce poverty and gender inequality, in addition to reducing economic inequality (Maisonnave & Mamboundou, 2022). Afandi *et al.* (2017) also emphasized that one way to reduce economic inequality in Indonesia is by increasing the share of the agricultural sector in GDP and labor absorption.

Research results (El Benni & Finger, 2013) indicate that the agricultural sector plays a role in reducing inequality in various regions through increasing income both on farm and off-farm. In contrast to previous studies, the regions referred to are not between regions with varying population densities but between mountainous and valley regions. Additionally, Tang & Sun (2022) explain that the agricultural sector can reduce inequality through mechanisms providing access to credit and financial services in rural areas and increasing investment in education, training, and skill

development for the workforce in that sector. Research by Siami-Namini & Hudson (2019) with data from various developing countries further strengthens the research findings that economic growth in the agricultural sector can reduce economic inequality.

CONCLUSION

Based on the research results, it can be concluded that areas with high population density have higher economic inequality compared to areas with medium population density, while economic inequality in areas with medium population density is higher than in areas with low population density. Population density has a positive contribution to increasing economic inequality. Based on time series data analysis, economic inequality in Java-Bali and Maluku tends to increase, while in Sumatra it tends to decrease. Furthermore, this research confirms that the agricultural sector is able to reduce the level of economic inequality in Indonesia. Therefore, the objective of this research can be considered achieved.

RECOMMENDATION

This research has limitations in the data used. The research reveals economic disparities only on three islands with different population densities in Indonesia, thus suggesting the need for further comprehensive research covering all regions and deepening to the level of agricultural subsectors. The government is advised to make efforts to reduce population density disparities and increase the Gross Regional Domestic Product (GRDP) in the agricultural sector in each region by continuing the transmigration program from densely populated areas to areas with low population numbers and determining leading agricultural commodities. Research analyzing leading agricultural commodities in each region is highly recommended. Furthermore, further research using more variables is recommended to understand the factors influencing economic disparities and to develop more effective strategies to reduce economic disparities more accurately.

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