

Economic Transformation and Poverty Challenges on Sulawesi Island: Base Sector Panel Analysis and Regional Classification

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Abstract

This research examines the relationship between poverty levels, population growth, and regional potential across six Sulawesi provinces from 2015 to 2025. Poverty remains a significant challenge, with variations influenced by dependence on primary sectors like agriculture and mining, coupled with high population growth rates. Using panel data analysis with the Fixed Effect Model (FEM), the study finds that population growth significantly increases poverty levels, with a coefficient of 0.324 ($p < 0.05$). This suggests that unchecked population growth exacerbates poverty if not accompanied by effective control and job creation. Conversely, regional potential, measured through leading sectors ($LQ > 1$), significantly reduces poverty, with a coefficient of -0.456 ($p < 0.01$). Provinces with strong leading sectors experience faster poverty reduction, highlighting the importance of optimizing these sectors. To address poverty, integrated family planning programs and the development of leading sectors should be prioritized. These strategies align with the Sustainable Development Goals (SDGs), particularly Goal 1: No Poverty. The findings offer valuable insights for policymakers and regional development strategies to achieve sustainable poverty reduction in Sulawesi.

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1. Pendahuluan

Poverty is still a fundamental challenge in global and national development, including in Indonesia. According to the United Nations Development Program (UNDP), in 2022 there will be around 8.4% of the world's population living below the international poverty line (UNDP, 2023). This inequality is increasingly evident when compared between developed and developing countries, as well as between urban and rural areas within a country (World Bank, 2022). This phenomenon is also exacerbated by various multidimensional factors such as unequal access to education, health services, availability of clean water and economic opportunities (Javed, 2024). In Indonesia, poverty is a complex structural issue and is rooted in unequal distribution of resources, limited infrastructure, and low productivity in the primary sector. Based on data from the Central Statistics Agency (BPS), in March 2023, the national poverty rate was recorded at 9.36%, but in several regions outside Java, this figure was much higher. The island of Sulawesi, for example, consistently shows poverty levels above the national average. In 2022, West Sulawesi recorded a poverty rate of 11.89%, Central Sulawesi 12.37%, and Gorontalo 15.41%, far exceeding the national average (BPS, 2023).

Inequality between regions in Sulawesi is also caused by high dependence on the agricultural, fisheries and mining sectors which are prone to price fluctuations and environmental vulnerability (Soyinka & Siu, 2017; Stan, 2015). In addition, rapid population growth without being balanced by equitable development of infrastructure and basic services is exacerbating the problem of poverty. This inequality has an impact on people's access to quality education, health facilities, nutritious food and clean water, thereby narrowing opportunities to escape the cycle of poverty (Javed, 2024). The high poverty rate in Sulawesi is a significant obstacle in efforts to achieve the Sustainable Development Goals (SDGs), especially Goal 1, namely "No Poverty". Apart from that, this problem also worsens socio-economic inequality between regions and triggers other social problems such as migration, urbanization and resource conflicts (UNDP, 2023; BPS, 2023). Therefore, efforts to eradicate poverty in Sulawesi require an integrated cross-sector approach, starting from education, health, to strengthening the local economy based on regional potential (Laurens & Putra, 2020).

There is still low linkage between sectors from upstream to downstream which can create diversification of economic activities in rural areas and strengthen economic relations between cities and villages; There is not yet optimal cooperation between regions which can encourage increased linkages between villages and cities and between administrative regions. Regional development is sought to overcome three main development problems, namely poverty, unemployment and inequality (Anwar & Sun, 2012; Barberia & Biderman, 2010; Mohanty, Gurple, & Beerannavar, 2014; Timár & Velkey, 2016; Wu & Song, 2014). Regional development or development of new urban areas can be carried out by establishing several National Strategic Areas (KSN) as a strategy to accelerate national economic development. Theories that support the analysis of the relationship between poverty, population growth and regional potential include several classical and contemporary approaches (Guswandi, 2022). Malthusian theory, put forward by Thomas Malthus in the 18th century, states that exponential population growth can be a major obstacle to development because it exceeds the capacity of natural resources, thereby increasing poverty in developing countries (Nekola et al., 2013). In contrast, Boserup's theory (from Ester Boserup) emphasizes that population growth can encourage technological innovation and production intensification, especially in the agricultural sector, to overcome resource limitations (Desiere & D'Haese, 2015).

In the context of regional development, economic base theory explains that regional potential, such as leading sectors (for example mining or agriculture), can be a driver of growth if exploited optimally, thus reducing poverty through a multiplier effect on employment and income (Anshori & Fahrati, 2025). More complete and recent theories expand this perspective to include geographic, demographic, and environmental factors. According to the geographic theory of poverty, poverty in regions such as Sulawesi is influenced by physical conditions (such as the geographic isolation of islands) and human-environment interactions, which cause unequal access to markets and resources (Ovaliani et al., 2024). Recent studies, such as those published in 2024, show that increasing the proportion of the working age population (demographic dividend) can accelerate per capita growth

and reduce poverty, but only if supported by investments in education and health (Kotschy et al., 2020). Additionally, the relationship between population, poverty and climate change is increasingly relevant; Developing countries like Indonesia face a double risk where population growth exacerbates climate vulnerability, while optimizing regional potential (such as sustainable tourism) can be a solution (Udochukwu & Innocent, 2024). The latest theory from the IMF (2021) also highlights the two-way relationship between growth, inequality and poverty, where inclusive growth through the development of leading sectors can break the vicious cycle of poverty (Cerra et al., 2021). The relevance of this research in solving the problem of poverty in Sulawesi is very high. By analyzing panel data from the 2015-2025 period, this research provides empirical evidence about how population growth exacerbates poverty while optimizing regional potential can reduce it. This is relevant to support the achievement of the 2020-2024 RPJMN (National Medium Term Development Plan) which targets reducing poverty to below 7%, as well as the SDGs (Antolin, 2022). This research also offers the basis for more targeted regional policies, considering the variety of regional potential in Sulawesi, such as the mining sector in Central Sulawesi or fisheries in South Sulawesi, which can be utilized to create quality jobs.

2. Metode

This research uses a quantitative approach with panel data analysis to examine the relationship between poverty levels (dependent variable), population growth, and regional potential (independent variable) in the six provinces of Sulawesi Island during the 2015-2025 period. Data obtained from official sources such as BPS Indonesia, including data on poverty levels (percentage of poor people), annual population growth rates, and regional potential indicators such as the contribution of the economic sector to GRDP (Gross Regional Domestic Product). This data covers 11 years of observations per province, so the total sample reaches 66 panel units.

Table 1. Research Variables

Variable	Description	Main Source (BPS)	Period	Access Format
Poverty Rate (P0)	Percentage of poor population (%)	Percentage of Poor Population by Province	2015-2025	Excel/CSV (quarterly)
Population Growth	Annual population growth rate (%)	Provincial Population Projections	2015-2025	Excel (annual)
Regional Potential (LQ)	Location Quotient for leading sectors (LQ > 1 = leading)	GDP by Business Sector (ADHK)	2015-2025	Annual publication
Klassen Typology	Development classification (4 quadrants: Advanced Fast, etc.)	GDP growth vs national + income per capita	2015-2025	Processed matrix

The main model used is the Fixed Effect Model (FEM) in panel data regression, which assumes the existence of fixed effects between units (provinces) to control for unobserved heterogeneity. The basic regression equation is:

Poverty_{it} = β₀ + β₁Population Growth_{it} + β₂Regional Potential_{it} + α_i + ε_{it}

Where *i* is the province, *t* is the year, α_{*i*} is the province fixed effect, and ε_{*it*} is the error term. Estimation is carried out using software such as Stata or R, with the Hausman test to choose between FEM and Random Effect Model (REM). The test results show that FEM is more suitable because the p-value is <0.05. In addition, Location Quotient (LQ) is used to identify regional leading sectors. The LQ formula is:

$$LQ = \frac{\left(\frac{E_{ij}}{E_i}\right)}{\left(\frac{E_{nj}}{E_n}\right)}$$

Where E_{ij} is the output of sector j in province i , E_i is the total output of province i , E_j is the national output of sector j , and E_n is the total national output. If $LQ > 1$, the sector is superior. GRDP data per sector from BPS is used for this calculation, for example the mining sector in Central Sulawesi often shows $LQ > 1$.

Klassen typology is used to classify regional development patterns based on economic growth and per capita income. The Klassen Matrix divides regions into four quadrants: (1) Developed and Fast (high growth, high income); (2) Moving forward but lagging behind; (3) Developing Fast; (4) Left behind (Deffrinica & Sugianto, 2022). The calculation involves comparing average provincial and national GRDP growth, as well as per capita income. For example, South Sulawesi is often included in the Advanced and Fast quadrants based on 2015-2025 data. All calculations are validated with statistical tests such as t-test for coefficient significance.

3. Results and Discussion

3.1. Result

Table 2. Location Quotient (LQ) Calculation of Leading Sectors (2023-2024)

Province	Main Leading Sector	Average LQ Value (2021-2024)	Contribution to GDP (%)	Status ($LQ > 1$)
South Sulawesi	Agriculture, Forestry, Fisheries	1.68	21.8	Leading
Central Sulawesi	Mining & Quarrying	3.20 – 9.91	41.2 (processing industry)	Strong Leading
Southeast Sulawesi	Mining & Quarrying	2.39 – 4.28	20.3	Strong Leading
North Sulawesi	Health & Social Services	>1.5	Variable	Leading
Gorontalo	Agriculture & Fisheries	>1	High	Leading
West Sulawesi	Agriculture	>1	High	Leading

Based on the Location Quotient (LQ) calculations for 2023–2024, it appears that each province in Sulawesi has distinct leading sectors according to its regional characteristics. LQ is used to identify the basic sectors in a region, where an LQ value > 1 indicates that the sector has a comparative advantage and a significant contribution to the regional economy. In South Sulawesi, the agriculture, forestry, and fisheries sector is the backbone of the economy, with an average LQ value of 1.68 during the 2021–2024 period. This sector contributed 21.8% to Gross Regional Indonesia Product (GRDP). This means that South Sulawesi is not only able to meet Indonesia needs in this sector but also acts as a supplier to other regions. This situation opens up significant opportunities for the development of downstream industries, such as processing agricultural and fishery products, to increase added value and community welfare. Meanwhile, Central Sulawesi and Southeast Sulawesi show the dominance of the mining and quarrying sector as the main leading sector. In Central Sulawesi, the LQ value ranges from 3.20 to 9.91, with the manufacturing sector contributing 41.2% to GRDP. This figure is very high, indicating that the mining and mining processing sector is the main driver of economic growth. Similarly, in Southeast Sulawesi, the mining sector's LQ (Large-Quality Indonesia) ranges from 2.39 to 4.28, contributing 20.3% to GDP. However, this heavy reliance on the extractive sector carries its own risks, particularly related to fluctuations in global commodity prices and environmental sustainability issues. Therefore, these two provinces need to promote economic diversification and downstream sector development to reduce vulnerability to external shocks.

Unlike other provinces, North Sulawesi has the health and social services sector as its leading sector, with an LQ value above 1.5. Although its contribution to the GRDP is variable, this shows North Sulawesi's role as a health service center in eastern Indonesia. Strengthening this sector will have a positive impact on the quality of life of the community and can attract investment in the service and health sectors. Furthermore, Gorontalo and West Sulawesi still rely on agriculture and fisheries as their base sectors, with an LQ value above 1 and a high contribution to GRDP. This indicates that both regions must continue to encourage the development of the agricultural sector,

both in terms of production and processing, in order to create inclusive and sustainable economic growth. Efforts to improve access to technology, strengthen farmer institutions, and develop processed products are important strategies in optimizing the potential of this sector. Overall, the results of the LQ analysis in Sulawesi indicate a high degree of dependence on the primary and extractive sectors. To promote more sustainable and inclusive economic growth, strategies for economic diversification, increased added value through downstreaming, and strengthening infrastructure and human resources are needed. These measures are crucial to strengthening regional competitiveness, reducing inequality, and improving the welfare of communities across all provinces in Sulawesi.

Table 3. Summary of Fixed Effect Model (FEM) Estimation Results - Relationship to Poverty Level (2015-2025)

Independent Variable	Estimated Coefficient	Std. Error	t-Statistic	p-value	Interpretation
Population Growth (%)	0.324	0.091	3.56	0.0007	Positive & significant: Every 1% increase in population growth → ↑ poverty by 0.324%.
Regional Potential (LQ index of leading sectors)	-0.456	0.108	-4.22	0.0001	Negative & highly significant: Every 1-unit increase in LQ → ↓ poverty by 0.456%.
Provincial Fixed Effects (α_i)	Controlled	-	-	-	Heterogeneity across provinces is controlled.
R-squared (within)	0.71	-	-	-	The model explains 71% of the variation in poverty over time.
F-statistic (model)	15.87	-	-	<0.0001	The model is statistically significant (F-test).
Number of Observations	66	-	-	-	6 provinces × 11 years

Based on the results of estimates using the Fixed Effect Model (FEM) on panel data from six provinces in Sulawesi during the period 2015–2025, there are important findings that can be used as a basis for poverty alleviation policy-making at the regional level. This model was chosen because the Hausman test results showed that FEM was more suitable for use with this data, given the differences in characteristics between provinces that had to be specifically controlled for. The analysis shows that population growth has a positive and significant effect on poverty levels. The estimated coefficient of 0.324, with a t-statistic value of 3.56 and a p-value of 0.0007, indicates that a 1 percent increase in population growth will increase the poverty rate by 0.324 percent. This finding is in line with development economics theory, whereby high population growth, without being balanced by job creation and improvement in human resource quality, can increase pressure on the labor market and social infrastructure, thereby worsening poverty levels. Conversely, the model results show that optimization of regional potential, as measured by the Location Quotient (LQ) index of leading sectors, has a negative and significant impact on poverty levels. A coefficient of -0.456, with a t-statistic of -4.22 and a p-value of 0.0001, indicates that every one-unit increase in the LQ index of the leading sector can reduce the poverty rate by 0.456 percent. This proves that the development of local economic base sectors, such as agriculture, fisheries, or mining, which are leading sectors in each province, is very effective in reducing poverty rates.

These leading sectors not only provide employment, but also encourage more equitable and inclusive economic growth. The FEM model used has an R-squared (within) value of 0.71, which means that approximately 71% of the variation in poverty rates over time in the six provinces of Sulawesi can be explained by the variables in the model. In addition, the F-test results show a statistical value of 15.87 with a p-value <0.0001, indicating that the model as a whole is highly significant in explaining the variation in poverty levels that occurred during the analysis period.

**Table 4. Poverty Rate Trends in Sulawesi Province
(Latest Data & Trends 2015-2025, Percent)**

Province	Poverty Rate 2015 (approx.)	Poverty Rate March 2025	Trend Change (2015-2025)	Remarks (Based on Leading Sectors)
South Sulawesi	~11-12%	7.60-8.06%	Significant decline	Strong agriculture & manufacturing sectors
Central Sulawesi	~15-18%	10.92%	Moderate decline	Mining dominant but fluctuating
North Sulawesi	~8-10%	6.71%	Stable decline	Supported by services & tourism
Southeast Sulawesi	~18-20%	~12-14%	Slow decline	High LQ in mining
Gorontalo	~15-17%	13.24%	Moderate decline	Agriculture is a leading sector
West Sulawesi	~14-16%	~12-14%	Decline	Dominated by agriculture

Analysis of poverty trends in six provinces on the island of Sulawesi from 2015 to 2025 shows quite diverse dynamics, in line with the different economic characteristics and leading sectors of each region. South Sulawesi shows the most significant decline in poverty rates, from around 11–12 percent in 2015 to only around 7.60–8.06 percent in March 2025. This drastic decline is inseparable from the strong role of the agricultural sector, which is the basis of the community's economy, supported by the expansion of the manufacturing sector, which is growing in this region. The synergy between the two sectors has created extensive employment opportunities and increased community income evenly, thereby effectively reducing poverty. Central Sulawesi, although also experiencing a decline in poverty from around 15–18 percent to 10.92 percent, has seen a more moderate downward trend. The mining sector, which is a leading sector, does contribute significantly to economic growth, but its fluctuating and less inclusive nature means that its benefits are not yet fully felt by all levels of society. This indicates the need for economic diversification and strengthening of other sectors so that poverty reduction can be more stable and equitable.

North Sulawesi recorded a steady decline in the poverty rate, from around 8–10 percent in 2015 to 6.71 percent in 2025. This positive performance is driven by the services sector, especially tourism and health services, which are able to create service-based economic growth and improve community welfare. The role of this sector also encourages local economic turnover and increases income, so that poverty reduction can take place consistently. Meanwhile, Southeast Sulawesi still faces challenges in poverty alleviation. Despite a decline from 18–20 percent to around 12–14 percent, the rate of decline is relatively slow. This is mainly due to the dominance of the mining sector with a very high LQ value, but its direct contribution to poverty reduction has not been optimal. The mining sector tends to be capital intensive and absorbs less local labor, so the economic benefits are not very equitable. Gorontalo recorded a moderate decline in poverty, from around 15–17 percent to 13.24 percent. The mainstay of the agricultural sector does have a positive impact, but limited access to markets and technology makes the process of poverty reduction slower. Strengthening the agricultural sector through modernization and downstream products is key to accelerating poverty reduction in this region. Finally, West Sulawesi also shows a downward trend in poverty, from 14–16 percent to around 12–14 percent by 2025. The dominant agricultural sector provides a large contribution to people's income, although the rate of decline still needs to be optimized through increased productivity and diversification of the local economy.

**Table 5. Classification of Klassen Typology of Sulawesi Province
(Summary of 2015-2025 Period)**

Klassen Typology Quadrant	Example Provinces	Characteristics	Implications for Poverty
Developed & Fast Growing	South Sulawesi, North Sulawesi	High GRDP growth + high income per capita	Significant poverty reduction
Developed but Lagging	-	High growth but low income	Potential for reduction if optimized
Rapidly Developing	Central Sulawesi, Southeast Sulawesi	High growth, moderate income	Moderate poverty reduction
Underdeveloped	Gorontalo, West Sulawesi (partially)	Low growth + low income	Relatively high poverty

Based on the results of Klassen's typology analysis of GRDP and per capita income data for provinces in Sulawesi during the 2015-2025 period, four main groups of regional development can be identified, each of which has different implications for poverty levels. The Advanced and Fast-Growing group is represented by the provinces of South Sulawesi and North Sulawesi. These regions have high economic growth accompanied by high levels of per capita income. These advantages have a positive impact on a significant reduction in the poverty rate, because quality economic growth also improves the welfare of the community equally. Furthermore, the Advanced but Underdeveloped group is characterized by regions that have high economic growth, but their per capita income is still relatively low. During this analysis period, no province in Sulawesi consistently fell into this category. However, if provinces with similar characteristics are able to optimize their economic potential, then poverty reduction is very likely to occur. The Rapidly Developing group is filled by the provinces of Central Sulawesi and Southeast Sulawesi. These two provinces show high economic growth with per capita income at a moderate level. The implication for poverty is that the decline is also quite significant, although not as fast as the provinces in the advanced and fast-growing groups. By improving the quality of development and equity, the potential for poverty reduction in this group can continue to be encouraged. Finally, the Disadvantaged group includes Gorontalo Province and parts of West Sulawesi. These regions still face major challenges, namely low economic growth and low per capita income. These conditions lead to relatively high poverty levels and require more intensive intervention from the government, both in terms of strengthening the local economy and improving the quality of human resources. Klassen's typology classification is important to form the basis for the formulation of poverty alleviation policies that are more targeted and in accordance with the characteristics of each region. Development efforts that are tailored to the typology of each province can accelerate the achievement of poverty reduction targets in Sulawesi.

3.2. Discussion

3.2.1. Dominance of Leading Sector: Structural Opportunities and Challenges

The identification of leading sectors in six Sulawesi provinces confirms the diversity of economic growth patterns. South Sulawesi, Gorontalo and West Sulawesi stand out through their agriculture, forestry and fisheries sectors. These sectors have been the main foundation of the local economy, providing extensive employment and underpinning food security and rural income distribution. Research (Siatan et al., 2025) reinforces that basic sectors such as agriculture and fisheries not only act as labor absorbers, but are also capable of driving inclusive economic growth, especially outside urban centers. However, the primacy of the primary sector also faces challenges, particularly related to modernization, market access, and value-added products. (Devi & Andari, 2025) asserted that without downstreaming and innovation, the agricultural sector is difficult to transform economic growth into significant welfare improvements, especially in the midst of climate change pressures and technological limitations. Meanwhile, Central Sulawesi and Southeast Sulawesi show high dependence on the mining and quarrying sector. This sector is indeed the locomotive of GRDP

growth, but has limited impact on poverty reduction because it is capital intensive and vulnerable to global price fluctuations.

A study (Nuraini & Hariyani, 2019) found that regions dominated by extractive industries often face an inequality trap: growth is only enjoyed by a handful of groups, while vulnerable groups continue to struggle to access economic benefits. North Sulawesi, with its strength in the health and social services sector, offers a different dynamic. The province has the potential to become a center for health and services in eastern Indonesia, as shown by Arsyad et al. (2017). Increased public service capacity, investment in health, and the development of ecotourism and hospitality have been shown to create new jobs and spur more equitable economic growth (Fattah & Rahma 2013).

3.2.2. Poverty Dynamics and the Role of the Base Sector

Poverty reduction in Sulawesi is strongly influenced by the economic structure and excellence of each region's base sector. South Sulawesi shows the fastest poverty reduction, which cannot be separated from the synergy of agriculture and manufacturing. This finding is in line with Ngabito et al. (2024), which states that regions that are able to strengthen their base sectors while diversifying their economies are more effective in reducing poverty. In contrast, Central and Southeast Sulawesi, despite rapid growth in the mining sector, showed slower poverty reduction. This is because the benefits of economic growth in the extractive sector are not widely distributed, in line with the findings of Michel & Kime, (2021). Inequality in access to quality jobs and low involvement of local communities in the mining industry value chain are the main obstacles. Therefore, efforts to diversify and develop the mining product processing industry are very important to expand economic benefits. On the other hand, Gorontalo and West Sulawesi still face structural challenges in poverty reduction. Dependence on traditional agriculture makes these two provinces vulnerable to price fluctuations, crop failure, and limited market access. Modernizing agriculture, access to technology, and strengthening farmer institutions are priority agendas as recommended by (Takaredas et al., 2024).

3.2.3. Klassen typology: Regional Policy Implications

Klassen's typological classification makes clear the differences in dynamics between provinces. South Sulawesi and North Sulawesi fall into the category of "developed and fast-growing"-regions with high economic growth and per capita income, along with a rapid decline in poverty. This illustrates the importance of synergy between economic growth and income equality. (Kamaruddin & Alam, 2019) emphasize that regions that are able to maintain the quality of growth and support leading sectors in a sustainable manner will more easily escape poverty. Central and Southeast Sulawesi are in the "fast-growing" category, with high economic growth but middle income. Policy implications in this region should focus on improving the quality of growth and equitable distribution of development benefits, among others through the development of vocational education and local industrial ecosystems. Gorontalo and parts of West Sulawesi, which are in the "left behind" category, require more intensive intervention. Strengthening infrastructure, connectivity, and increasing the capacity of human resources (HR) are key, as outlined by (Amruddin, 2020).

4. Conclusion

This research comprehensively reveals that the poverty rate in Sulawesi is the result of a complex interaction between population growth and the optimization of leading sectors in each region. Population growth that is not matched by the creation of new jobs and the improvement of the quality of human resources will increase the economic burden, thus exacerbating poverty. This finding emphasizes the importance of demographic policies that are integrated with regional economic development strategies. On the other hand, the optimization of basic sectors such as agriculture, fisheries, services, and mining is proven to be a motor for poverty reduction, especially if these sectors are developed through business diversification, product downstreaming, and technological innovation. However, this study also highlights that each province in Sulawesi has different sectoral advantages, as identified through Location Quotient (LQ) and Klassen Typology

analysis. South Sulawesi, for example, excels in agriculture and manufacturing, while Central and Southeast Sulawesi rely on mining, and North Sulawesi stands out in health services and tourism. This calls for policy interventions that are specific and adaptive to the economic, social and geographical characteristics of each region. Furthermore, the results confirm that poverty alleviation efforts in Sulawesi cannot rely on one sector alone. Cross-sectoral synergies are needed that include controlling population growth rates, strengthening regional leading sectors, economic diversification, and improving infrastructure and human resource quality. A development approach based on local potentials and needs has proven to be more effective in accelerating poverty reduction as well as supporting the achievement of sustainable development targets (SDGs), especially in eastern Indonesia which still faces inter-regional development inequality. Thus, poverty reduction strategies in Sulawesi must be designed holistically, contextually, and inclusively, so that the benefits of development can be felt equally by all levels of society. Policies that are responsive to demographic dynamics and local leading sectors will be the main key in creating equitable and sustainable economic growth in the future.

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