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STRATEGI HILIRISASI KOMODITAS PERTANIAN DAN PERIKANAN PRIORITAS UNTUK MENDUKUNG SWASEMBADA PANGAN DAN PENGUATAN AGROINDUSTRI

Andree Breitner M., MHA Ridhwan, Meily Ika Permata, Dina Tania T., Oki Hermansyah, Ilham Farizi Indrayadi, Shelly L. Silahali, Illinia Ayudhia Riyadi, Savira Yulita

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Strategi Hilirisasi Komoditas Pertanian dan Perikanan Prioritas untuk Mendukung Swasembada Pangan dan Penguatan Agroindustri

Andree Breitner M., MHA Ridhwan, Meily Ika Permata, Dina Tania T., Oki Hermansyah, Ilham Farizi Indrayadi, Shelly L. Silahali, Illinia Ayudhia Riyadi, Savira Yulita

Abstract

Downstreaming has become one of Indonesia's most strategic avenues for lifting the value of its agricultural sector, yet evidence on its real impacts and constraints remains limited. This study evaluates the downstreaming performance of key commodity sectors, measures its effects on economic outcomes, identifies binding constraints, and formulates policy strategies to accelerate downstream development. Using a mixed-method approach, the analysis integrates quantitative techniques based on BPS, UN Comtrade, and IBS data with qualitative insights from focus group discussions and field surveys conducted in major production centers. The quantitative component includes RSCA&TBI analysis, trade trend analysis, spatial productivity assessments, panel regressions to estimate the impacts of downstreaming on exports, revenues, productivity, and input imports, and a Computable General Equilibrium (CGE) model to capture macroeconomic and regional effects. The CGE simulations show that productivity gains in fisheries, maize, and salt increase real GDP, real wages, investment, and export competitiveness, with stronger impacts in core producing provinces. The qualitative findings reveal persistent bottlenecks in production factors, institutional coordination, infrastructure, financing access, and market linkage. Based on this diagnosis, the study develops commodity-specific business model recommendations to strengthen downstreaming pathways. Overall, the results provide a comprehensive foundation for designing more effective downstreaming strategies that enhance competitiveness, improve food security, and promote more inclusive regional economic growth in Indonesia.

Keywords: Agricultural Downstreaming, Fisheries, Maize, Salt, Productivity, Food Security, Downstreaming Policy

JEL Classifications:

Acknowledgement:

Disclaimer:

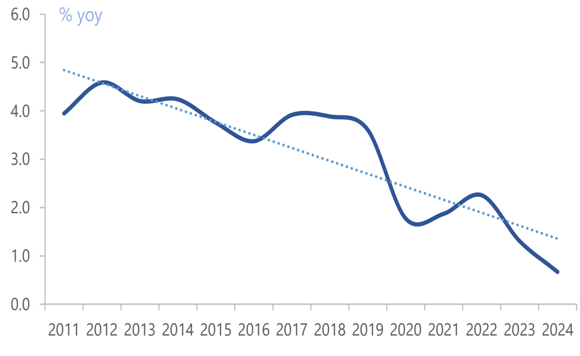
1. Introduction

1.1 Background

The agricultural sector is integral to Indonesia’s economy. In 2024, it contributed 11% to the national GDP and served as a primary driver of socio-economic development through employment generation and export performance (Lintang, 2023; Triandarto et al., 2024; Hasan et al., 2022). Approximately 41.61 million Indonesians, representing 28.54% of the total workforce, are employed in agriculture, forestry, and fisheries (BPS, 2025). Additionally, agricultural sectors influence inflation dynamics, as major food commodities such as rice, chillies, shallots, and fish have substantial weight in the volatile food component. These factors highlight the strategic importance of agriculture in maintaining price stability by ensuring a reliable food supply.

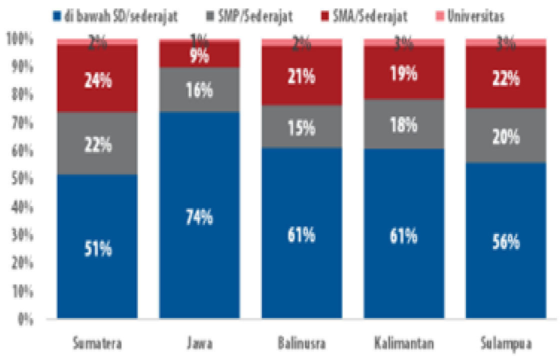
Although Indonesia’s agricultural sector remains a vital contributor to the national economy, it is exhibiting clear signs of deceleration (Figure 1.1). Productivity has declined due to ongoing land conversion (Irawan, 2005; Susilowati, 2016) and the slow adoption of modern infrastructure and technology (Ikhsani et al., 2020). The sector is further challenged by demographic pressures, including an aging workforce, limited participation of younger farmers (Susilowati, 2016; Ngadi et al., 2023), and generally low educational attainment among agricultural workers (Figure 1.2). Climate change exacerbates these issues by increasing the frequency of extreme weather events, accelerating land degradation, and intensifying water scarcity (IPCC, 2017). These challenges are particularly significant given that 66.49 percent of Indonesia's agricultural land is classified as unsustainable based on output per hectare (BPS, 2025). Collectively, these factors highlight the urgent need to accelerate agricultural transformation to sustain growth and ensure long-term food security.

Figure 1. 1 Development of Agricultural Sector Performance



Source: Sakernas BPS, Feb 2024

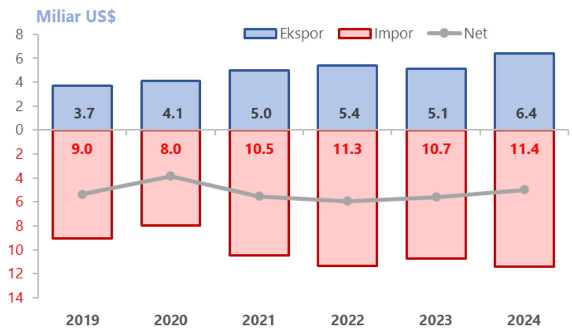
Figure 1. 2 Agricultural Workers by Education Level



Source: Sakernas BPS, Feb 2024

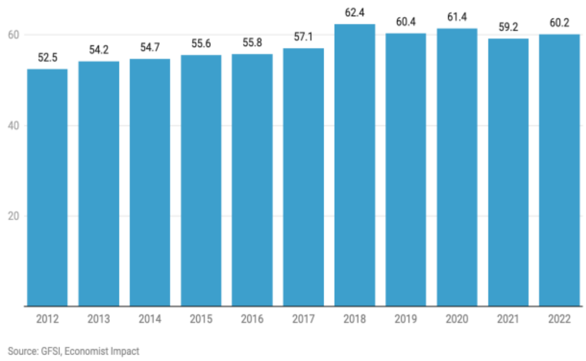
Strengthening Indonesia’s agricultural sector is not just about boosting numbers on a balance sheet; it is about securing livelihoods, nourishing communities, and shaping the country’s future. Yet, the sector faces persistent challenges, productivity remains stubbornly low, and advances in infrastructure and technology have been slow to reach the people who need them most. As a result, most agricultural exports are still raw materials with little added value, which means farmers often struggle to get ahead, and Indonesia's place in global markets remains vulnerable. The effects ripple inward, too: weak productivity leaves domestic markets exposed, fueling trade deficits in vital commodities like maize and fisheries (Figure 1.3), and putting food security and price stability at risk. The urgency becomes clear when we see Indonesia ranked 63rd out of 113 countries in the 2022 Global Food Security Index (Figure 1.4), well behind many regional neighbors. Addressing these realities requires more than policy; it demands a renewed commitment to innovation, value creation, and sustainable practices so that agriculture can truly fulfill its role as a cornerstone of Indonesia's resilience and growth.

Figure 1. 3 Indonesia's Agricultural Commodity Trade Balance



Sumber: Bea Cukai (diolah)

Figure 1. 4 Indonesia's Food Security Index



Sumber: GFSI, Economist Impact

Agricultural downstreaming is more than a policy buzzword; it is a practical pathway that can help Indonesia overcome some of its most pressing agricultural challenges. When farmers and businesses move beyond simply producing raw goods and start processing, transforming, and distributing their products, they create higher value for communities and the economy (Zhong et al., 2017). This approach can speed up the industrialization of agriculture and open doors to a wider range of high-value products (World Bank, 2019; Bruegel, 2020). Building a stronger agro-industry means that food supplies become more secure, with more reliable access to key raw materials and more efficient supply chains. At the same time, this reduces dependence on imports and helps strengthen Indonesia's trade position (Suryani, 2006; Abbas and Suhaeti, 2016; Aldillah, 2017). Downstreaming also brings tangible benefits to people by creating new jobs and stimulating local economies in ways that primary production alone cannot match. As domestic agro-industries grow stronger, communities are better equipped to handle swings in food prices. For these reasons, downstreaming is not just a sectoral priority. It stands out as a national strategy that can bring inclusive and lasting growth to Indonesia.

The Government's focus on downstreaming, especially as outlined in Asta Cita 5, is more than just a policy direction, it is a practical step towards creating better opportunities for people and building a stronger, more resilient economy. By prioritizing which downstream commodities to develop, Indonesia can make the most of its rich natural resources and help ensure that investments, technology, and policies reach the areas where they can make the biggest impact (Yu et al., 2014; Saediman, 2015). The emphasis on value addition, competitiveness, and job creation means that the agro-industry is recognized for its potential to provide meaningful work for many Indonesians. When these priorities are aligned with Asta Cita 2, which is dedicated to achieving national food self-sufficiency, the benefits multiply. For example, the Government's 2025 agenda includes plans to lower import quotas for staple foods like rice, maize, sugar, and salt so that more of what the country needs is produced at home (Bank Indonesia, 2025). However, because local supplies of these commodities are still often insufficient, downstreaming is increasingly essential for making sure there is enough raw material and for building a food system that can withstand shocks. Prioritizing and developing leading commodities is not just about numbers. It means more jobs, better livelihoods, and a greater capacity for Indonesia to stand on its own while growing in a way that includes everyone.

This study builds upon the Government's Asta Cita priorities and the broader three-pronged downstream approach by focusing on three strategic commodities: fisheries, maize, and salt. Consistent with Asta Cita's objectives of stabilizing inflation, supporting economic growth, and advancing food self-sufficiency, downstream development in the fishery sector is prioritized due to its dual function in price stabilization and economic expansion, supported by Indonesia's abundant marine resources and robust production base. Downstreaming in fisheries primarily aims to strengthen agro-industrial processing and increase value added. The selection of maize and salt is informed by the national goal of achieving food self-sufficiency, as both commodities remain heavily dependent on imports to satisfy domestic demand. Enhancing downstreaming in maize and salt provides substantial benefits for feed industries, food processing, and household consumption. The strategic framework for developing these three commodities, which integrates both price stability and long-term growth objectives, is illustrated in Appendix 1.

1.2 Research Objectives

Drawing from the preceding background, this study aims to achieve the following objectives:

1. Assess the current state of downstream development within Indonesia's fisheries, maize, and salt sectors.
2. Evaluate the impact of downstreaming on the economic performance of these commodities, with particular attention to productivity and trade outcomes.
3. Identify key constraints that impede downstream development in each sector.
4. Develop policy recommendations to enhance downstreaming in the TCT fisheries, maize, and salt sectors.

2. Literature Review

2.1. Conceptual Framework

The conceptual framework positions downstreaming as a strategy to enhance Indonesia's agro-industry by increasing the value of fisheries, salt, and maize (See Appendix 2). Each commodity contributes distinctly to national objectives. In the case of fisheries, downstreaming enables Indonesian fishers and exporters to compete internationally and improve the national trade balance by leveraging abundant marine resources (Irawan et al., 2015). For salt and maize, the emphasis is on increasing domestic production to reduce import dependence and strengthen food security (Hermawan et al., 2022; Ratya et al., 2013). Achieving these objectives requires a combination of investment-friendly policies, targeted subsidies or tax incentives for producers, and strategies that enable companies to align with consumer preferences. By fostering innovation, promoting efficient production, and addressing the rising demand for high-quality, nutritious food, the agro-industry can assume a more significant and inclusive role in Indonesia's development.

Technological advancement and infrastructure development are also critical components of this strategy. In fisheries, the adoption of sustainable fishing practices and efficient processing can reduce production costs and provide consumers with higher-quality products (Neilson et al., 2020). For salt and maize, improved processing extends shelf life and ensures consistent quality, benefiting both commercial enterprises and households. Realizing these advancements requires robust port facilities, reliable transportation networks, and a workforce skilled in new technologies and supply chain management (Triandarto et al., 2024; Zulfiandri, 2023). When these elements are integrated, Indonesia's agro-industry can generate employment, decrease reliance on imports, and enhance the global competitiveness of local producers. Emphasizing product innovation and expanding market access allows downstream agriculture to deliver greater benefits to communities and contribute to Indonesia's economic growth (Sasongko et al., 2022; Penggalih et al., 2023; Yasa et al., 2022; Fahmid et al., 2022; Fikri et al., 2023).

2.2. Agricultural Downstreaming Policies

Downstreaming encompasses the processing, transformation, and distribution stages that follow primary agricultural production (Zhong et al., 2017). In Indonesia, downstreaming serves as a strategy to strengthen the national industrial base, promote spatial industrial development, and transition the economy from raw material exports to higher value-added production (Kementerian Perindustrian, 2016). This analysis links downstreaming with Global Value Chains (GVCs), emphasizing that domestic value addition is intrinsically connected to imported inputs and international production networks. Enhanced GVC integration enables technology transfer and efficiency improvements, whereas a solely inward-focused approach to downstreaming may result in isolated and uncompetitive industries (Patunru and Rahardja, 2015). Concurrently, Indonesia pursues food self-sufficiency, defined as the capacity to meet domestic demand for key commodities through stable and affordable domestic production. These dual objectives position downstreaming, GVC integration, and self-sufficiency as central elements of Indonesia's agricultural transformation agenda.

Downstreaming strategies in Indonesia have become increasingly tailored to specific sectors. In fisheries, these strategies prioritize sustainability, export competitiveness, and industrial upgrading. Key regulations, including the measured fishing policy and zoning system established through PP No. 11/2023 and Ministerial Regulations No. 28 and 11 of 2023, are designed to ensure resource sustainability, enhance product quality, and strengthen digitalized fisheries value chains. For maize, policy priorities focus on food security, quality improvement, and market stabilization, achieved through import regulations, export facilitation, and price-setting instruments issued by the Ministry of Trade and the National Food Agency. The Ministry of Agriculture's designation of maize as a national priority commodity further supports downstream industrial development, with the forthcoming Regulation No. 02/2025 anticipated to reinforce organizational and trade structures. In the salt sector, downstreaming efforts aim to increase domestic production and upgrade processing capacity. Regulations such as Ministerial Regulation No. 7/2023 and Perpres No. 126/2022 promote productivity enhancements in major salt-producing regions, integration of production areas, and technological advancement to facilitate the transition to industrial-grade salt and achieve national self-sufficiency by 2027.

Taken together, these policies show how committed Indonesia is to using downstreaming to build a stronger agro-industry, rely less on imports, and be more competitive in exporting fisheries, maize, and salt. However, putting downstreaming into practice isn't without its hurdles. There are still big challenges, like limited investment, complicated regulations, weak infrastructure, supply chain problems, and gaps in technology. These issues vary from one sector to another and affect how quickly and effectively downstreaming can move forward. Appendix 3 lays out these obstacles in detail, mapping out the policy and institutional barriers faced by fisheries, maize, and salt. This overview helps shape the next part of the analysis and guides how targeted downstreaming strategies are developed.

3. Methodology

This study employs a mixed-methods approach, integrating quantitative data and qualitative perspectives to address the research questions (see Appendix 4). Quantitative analysis utilizes data from BPS, UN Comtrade, WITS, the Ministry of Industry, and the Ministry of Marine Affairs and Fisheries. The descriptive analysis examines changes in sectoral GDP over the past decade, tracks net-export trends across production stages, and assesses competitiveness and trade specialization using RSCA and TBI scatter plots from WITS and UN Comtrade. The study also maps the concentration of production and labor, analyzes productivity patterns, and constructs industry trees for each commodity. These industry trees illustrate product flows from upstream to downstream, highlight value-added at each stage, and classify products based on local production and import dependence (see Appendix 5). To evaluate the impact of downstreaming on fisheries, maize, and salt, panel regressions with Fixed Effects are conducted. This approach assesses how value addition influences exports, revenue, productivity, and raw material imports. Driscoll and Kraay standard errors are applied to ensure the robustness of results in the presence of data irregularities. The majority of quantitative analysis is based on industrial statistics from the Large and Medium Manufacturing Survey (IBS).

In addition to regression analysis, a Computable General Equilibrium (CGE) model is employed to provide a comprehensive economic perspective. This model evaluates the effects of productivity gains on output, consumption, investment, trade balances, and regional economic growth. For maize and salt, scenario analyses incorporate self-sufficiency objectives to assess the potential impact of import reduction. Qualitative methods include Focus Group Discussions (FGDs) and field surveys to gather direct input from stakeholders, facilitating an understanding of their perspectives, challenges, and support needs. The integration of qualitative insights with quantitative findings informs the development of policy recommendations. Utilizing the 3P framework, which encompasses Production Factors, Policy and Institutions, and Promotion and Market Access, the study also develops business models and financing schemes tailored to each commodity.

3.1. Descriptive Analysis (RSCA&TBI, Spatial Analisis, and Industry Tree)

This study draws on data from UN Comtrade, WITS, and HS codes provided by the Ministry of Industry to take a closer look at the Revealed Symmetric Comparative Advantage (RSCA) and Trade Balance Index (TBI). By examining these indices, we can better understand where fisheries, maize, and salt stand in terms of supply strength and market demand. The HS codes help us pull detailed export and import data for each sector, making it possible to calculate both RSCA and TBI for a clearer picture of each commodity's position. The formulas used for these calculations are shown below.

a. The Revealed Comparative Advantage (RCA)

$$RCA_{it} = \frac{X_i / \sum_{i=1}^{N} X_i}{X_{iw} / \sum_{i=1}^{N} X_{iw}} \ , \quad i = 1 \ldots . N; \text{dan}$$

$$RSCA_{it} = \frac{RCA_{it} - 1}{RCA_{it} + 1} \qquad (1)$$

b. Trade Balance Index (TBI)

$$TBI_i = \frac{X_i - M_i}{X_i + M_i}, \quad i = 1 \ldots . N \qquad (2)$$

Once we have calculated RSCA and TBI for each commodity, we use a four-quadrant scatter plot to show how they compare. This chart makes it easier to see the supply strengths and the areas with the most demand, helping us understand both global market trends and how resilient each sector is at home. By visualizing the results this way, we can analyze the current situation more clearly and spot strategic opportunities for fisheries, maize, and salt.

This study also collects secondary data from sources such as BPS and the Ministry of Marine Affairs and Fisheries to conduct a spatial analysis. Mapping the distribution of production and labor in the fisheries, maize, and salt sectors identifies areas of activity concentration and regions that may require additional support. Distribution maps at the provincial level illustrate geographic patterns, highlight major production centers, and identify regions with lower productivity that could benefit from further development. This spatial approach enhances the quantitative results and provides a clearer understanding of regional differences and sectoral strengths.

Building on this, industry tree data from the Ministry of Industry is used to construct value chain maps for each of the three commodities. These trees represent the entire flow, from upstream raw materials to intermediate and downstream products. Integrating this overview with data on domestic production, import volumes for non-locally produced items, HS codes, and value addition at each stage provides a comprehensive understanding of each commodity's production structure. This approach clarifies product movement along the supply chain and identifies potential opportunities for value creation.

3.2. Panel Data Regression

Variable selection for this study is based on the specific characteristics of downstreaming in the fisheries, maize, and salt sectors, alongside theoretical and empirical determinants of value added and firm performance in agro-industry (see Appendix 6). The primary variables are value added, exports, raw material imports, and firm revenue. Value added is utilized as the principal indicator of downstreaming success, representing a firm's capacity to transform raw inputs into higher-value products. Exports and revenue measure market orientation and commercial performance, while raw material imports are included due to the continued reliance of downstreaming processes in Indonesia on imported inputs for processing technology, auxiliary materials, or raw materials that must satisfy particular standards.

Annual panel data from 2017 to 2021 are utilized, encompassing 3,450 firms in fisheries, 3,515 in maize, and 4,294 in salt. This panel structure facilitates the analysis of downstreaming dynamics over time while accounting for firm-level heterogeneity. Estimation is conducted using a Fixed Effects Model, selected based on the Hausman test to address unobserved heterogeneity. To mitigate issues of cross-sectional dependence, serial correlation, and heteroskedasticity, Driscoll–Kraay standard errors are employed to ensure robust inference. Model validity is supported by correlation matrices for each estimated equation, provided in Appendix 7, which document relationships among key variables and controls and assist in assessing potential multicollinearity. The econometric specification applied in this study is as follows:

$$Y_{it} = a_i + \beta_1 VA_{it} + \beta_2 Z_{it} + u_i + \varepsilon_{it} \quad (3)$$

Where:

- Y_{it}: Dependent variable, consisting of sector performance indicators such as exports, raw material imports, total revenue, and labor productivity.
- VA_{it}: Main independent variable representing value added generated through downstreaming.
- Z_{it}: Control variables, including FDI, capital intensity, firm size, energy use, worker incentives, wages, domestic raw material usage, and the industry concentration index (Herfindahl–Hirschman Index/HHI).
- α_i: Fixed effect specific to each unit (e.g., firm or sector), capturing unobserved heterogeneity that is constant over time.
- ε_{it}: Error term, which varies across units and over time.

3.3. Computable General Equilibrium Model

The economic effects of downstreaming are assessed using a Computable General Equilibrium (CGE) model. This model evaluates downstream policy impacts in the fisheries, maize, and salt sectors. For analytical clarity, the fisheries sector covers all commercial fishing operations, maize refers to the maize production and processing sector, and salt is defined as the 'Garam Kasar' extraction and production sector. The methodology builds on previous CGE applications in Indonesia (Widyastutik et al., 2025; Sahara et al., 2022; Malahayati and Masui, 2018). Unlike panel regressions, the CGE model integrates 185 economic sectors using the national Input–Output table and the Interregional Input–Output (IRIO) framework. This integrated structure allows a comprehensive assessment of sectoral shocks on macroeconomic indicators and provincial GRDP. The model includes spatial detail across all 34 provinces to analyse interregional transmission of policy effects.

The Indonesian computable general equilibrium model is based on ORANI (Horridge et al., 1999) and its Indonesian adaptation, WAYANG (Wittwer, 1999), which extends ORANI by adding regional disaggregation. Together, they form an integrated model that captures linkages among industries, households, investors, government, and foreign sectors and is organised into 18 functional blocks, including production, intermediate demand, institutions, and trade. This cohesive structure enables analysis of both national and regional impacts of downstreaming policies.

Sector-specific shocks are applied using empirical estimates and national policy targets. In this analysis, the fisheries sector refers to all activities related to the harvesting and production of fish and seafood products. For fisheries, two productivity scenarios are simulated: a 5 per cent increase ("Big Push") and a 2.5 per cent increase ("Moderate Push"). Both are calibrated from fixed-effects regression results linking value-added growth to productivity improvements. The maize sector comprises cultivation, harvesting, and primary processing. In the maize sector, the simulation includes a 5 per cent productivity increase from econometric estimation and an 8 per cent reduction in raw material imports, based on secondary data, to align with the national maize self-sufficiency agenda (see Appendix 8). The salt sector here encompasses the extraction and production of salt for domestic use. For salt, productivity is increased by 52.36 per cent, calculated from secondary data to meet national demand without imports (see Appendix 9). These shocks allow the model to capture how downstreaming and self-sufficiency policies propagate throughout the economy at both macroeconomic and regional levels.

3.4. three-pronged approach downstream strategy

The three-pronged downstream strategy serves as an analytical framework for prioritizing downstream commodities according to three objectives: maintaining inflation stability, enhancing competitiveness, and fostering more inclusive economic growth. This approach evaluates commodities using indicators such as commodity inflation, industrial competitiveness, and labor absorption. By integrating these dimensions, the framework enables prioritization that extends beyond value addition to encompass macroeconomic stability and social impact. The framework has been implemented in ISEI (2024) and Bank Indonesia (2024) to identify priority food downstreaming opportunities in Indonesia.

The three-pronged approach is implemented through three pillars: improving production factors, strengthening regulation and institutions, and expanding market access (see Appendix 10). The first pillar aims to enhance domestic capacity by investing in infrastructure, developing human capital, and increasing output per worker to address productivity gaps. The second pillar focuses on regulatory and institutional reform to reduce structural barriers, improve industrial incentives, and facilitate exports, thereby addressing regulatory shortcomings. The third pillar seeks to broaden market access through trade cooperation and export promotion by increasing the number of destination countries and diversifying export products. Collectively, these pillars constitute a comprehensive downstreaming strategy that integrates production upgrading, governance reform, and market expansion.

The application of this framework in the study is supported by qualitative evidence from Focus Group Discussions with KKP, BAPANAS, KEMENTAN, PT Garam, and ASTUIN, as well as field surveys in major production centers, including South Sulawesi for maize and Cirebon for salt. These qualitative insights provide direct understanding of upstream–downstream conditions, supply chain challenges, and local industrialization opportunities. Combining the three-pronged analytical framework with field-based evidence allows this study to more accurately determine downstreaming priorities for fisheries, maize, and salt in line with Indonesia's industrial dynamics.

4. Results / Analysis

4.1. Fisheries Sector

4.1.1 Descriptive Analysis

Indonesia's fisheries sector has experienced growth that is both uneven and, more recently, subdued. For example, after a strong 9.9 percent year-on-year expansion in the second quarter of 2023, the growth rate dropped dramatically to just 0.95 percent by the end of 2024 (See Appendix 11). While the ups and downs are partly due to seasonal catch cycles, the persistent slowdown points to more fundamental challenges, such as rising fuel prices and weaker demand in global fish markets. These factors reveal ongoing vulnerabilities at the production stage, which in turn limit the potential gains from downstream development in fisheries.

Indonesia's trade performance in fisheries remains on solid ground, with the country consistently achieving a surplus across all product segments (See Appendix 12). That said, recent years have seen this surplus shrink, especially for processed downstream products. The main drivers of surplus are still high-value products like canned tuna (HS 160414) and tuna fillet/loin (HS 030487), which each contribute annual surpluses of over USD 300 million. However, export destinations are heavily concentrated in a handful of countries, including the United States, China, ASEAN, and Japan. This pattern highlights the importance of diversifying both the range of products and export markets to ensure the sector's long-term stability.

Competitiveness indicators further support this assessment. Mapping with RSCA and TBI shows that Indonesia maintains a solid comparative advantage in several processed fish products, such as fillets, loins, canned tuna, and tilapia (See Appendix 13). Maintaining this edge will depend on ongoing efforts to improve production capacity, strengthen quality assurance systems, and expand market access, particularly as international competition grows.

Looking at regional patterns, the need for targeted downstream investment becomes even clearer. Eastern Indonesia alone contributes 37.2 percent of all capture fisheries output, with Sumatra and Java following behind (See Appendix 14). This concentration mirrors the distribution of fishing communities and points to specific regions where investments in processing plants, cold-chain logistics, and transportation infrastructure could have the most significant impact on added value and job creation.

Financial conditions add another layer of complexity to the sector's development. Most fisheries credit is still directed toward working capital, mirroring the dominance of small- and medium-sized, labor-intensive enterprises. Investment credit has grown only modestly, even though credit risk has remained relatively stable. Non-performing loans for working capital improved slightly from 5.7 percent in 2023 to 5.4 percent in 2024 (See Appendix 15). This limited access to investment finance continues to slow industrial upgrades and downstream growth, underscoring the need for more targeted financial instruments.

Looking at the fisheries value chain, it becomes clear that these constraints also point to significant untapped potential for value addition.

While upstream products like fresh and frozen fish tend to yield lower profit margins, intermediate goods such as surimi, albumin, fish meal, and dried fins command much higher value (See Appendix 16). Some of the most valuable intermediates, including collagen, fish oil, and gelatin, are still largely imported. Downstream products display the widest range of value, from lower-value items like fish feed and handicrafts to premium products such as dim sum, canned fish, fillets, loins, cosmetics, and pharmaceuticals. Indonesia currently lacks capacity in several high-value downstream categories, such as health supplements, which offer the greatest potential for value-added. These gaps reveal significant opportunities to expand downstream processing, cut import dependence, and boost the overall performance of the fisheries sector.

4.1.2 Panel Data Regression

Estimation results for the fisheries sector reveal strong and statistically significant effects of value added on key performance indicators. Industrial survey data from 3,450 fisheries-processing firms were analyzed using a fixed-effects panel regression with Driscoll–Kraay standard errors, with all variables in logarithmic form to facilitate interpretation as elasticities. The results (see Appendix 17) indicate that a 1 percent increase in value added corresponds to a 0.78 percent increase in exports, a 0.36 percent rise in labor productivity, and a 0.86 percent increase in firm revenues, all significant at the 1 percent level. These effects remain robust under Driscoll–Kraay corrections, supporting the reliability of the estimates.

These findings underscore the critical role of downstreaming in enhancing the fisheries sector. The strong export elasticity demonstrates that upgrading and value addition facilitate Indonesia's access to international markets and improve competitiveness. The positive productivity effect indicates advancements associated with technological adoption and operational efficiencies, while the substantial revenue effect shows that downstreaming bolsters firm-level financial performance and long-term viability.

In summary, the empirical evidence demonstrates that downstreaming offers substantial potential to elevate Indonesia's fisheries sector in the global market. Enhancing export capacity, productivity, and firm revenues through value-added activities supports broader economic growth objectives and strengthens Indonesia's position in international seafood value chains.

4.1.3 Computable General Equilibrium

The CGE simulation highlights how a 5 percent boost in productivity within the fisheries sector can positively influence Indonesia's economy as a whole (See Appendix 18, Figure 1). With this increase, real GDP moves up by 0.0884 percent, showing that efficiency gains in fisheries drive overall economic growth. Real wages also climb by 0.1714 percent, reflecting better earnings for workers as production becomes more robust. The aggregate investment index grows by 0.1011 percent, pointing to greater investor confidence in fisheries and related sectors. Export prices see a 0.0484 percent increase, a sign that Indonesian fisheries are becoming more competitive internationally. Meanwhile, the consumer price index drops by 0.098 percent, indicating that these productivity gains help lower domestic price pressures and make goods more affordable.

Looking at the regional impact, the increase in productivity brings positive results to every province, though the size of these gains depends on each region's economic structure (See Appendix 18, Figure 2). Provinces with a strong focus on fisheries, like Maluku and Southeast Sulawesi, experience the biggest improvements, with Maluku's GRDP rising by 0.7279 percent and Southeast Sulawesi's by 0.4256 percent. Most other provinces see GRDP grow by between 0.08 and 0.13 percent, which shows that the benefits reach across the country. The fact that eastern Indonesia experiences the largest effects reflects its central role in national fisheries and underscores the importance of investing in downstream processing, cold-chain logistics, and improved infrastructure in these regions.

Taken together, the CGE results make it clear that boosting productivity through downstreaming policy in fisheries leads to steady gains both nationally and regionally. Increases in growth, wages, investment, and export competitiveness show that downstreaming and productivity upgrades in the fisheries sector can deliver real value to Indonesia's economy and strengthen key regional growth centers. These findings underscore the importance of continuing to invest in value-added activities and essential infrastructure so that the benefits of productivity gains can be maintained and shared more widely across the country.

4.1.4 Challenges Based on the Result of FGD and Field Surveys (Tuna Fisheries)

This analysis of downstreaming challenges in the tuna fisheries sector uses the 3P framework to provide a comprehensive view. The first pillar, Production Factors (P1), highlights several key hurdles: access to financing, the condition of fishing vessels and gear, infrastructure, logistics, and workforce skills. Many fishers still depend on middlemen through advance purchase agreements, which restrict their ability to grow their operations. The challenge is compounded by high fuel costs, which push up production expenses and squeeze profit margins, leaving little room for investment in better vessels or equipment. Infrastructural gaps persist as well. The fleet mostly consists of small vessels with limited range, and there are not enough landing sites, collector boats, or transport links to processing plants. These shortfalls create supply chain bottlenecks. Additionally, gaps in skills and postharvest practices can lead to a loss of quality, making it even harder for Indonesia's tuna products to compete.

The second pillar, Regulation and Institutions (P2), highlights the ongoing uncertainty caused by regulations that change frequently. The Measured Fishing (PIT) policy, which is based on quotas, still lacks predictable implementation. On top of that, inconsistencies between national and regional tax and levy structures add to the administrative burden and can deter new investment. Another challenge is the uneven access to quality and safety certifications, which makes it harder for producers to enter premium export markets.

The third pillar, Promotion and Market Access (P3), focuses on the lack of diverse export channels and the relatively weak branding of Indonesian processed tuna. Most export flows are still centered in Java, which means tuna from eastern Indonesia often has to be routed through Jakarta or Surabaya. This detour adds to logistics costs and increases the risk of quality loss. The distribution of cold chain infrastructure is also uneven, with many facilities located far from landing sites, leading to low usage and less efficient networks. On the international front, tariff barriers, including reciprocal tariffs introduced in 2025 on certain tuna products, have made it even harder for Indonesian tuna to compete in major export markets. Altogether, these issues show that to unlock the full value of downstreaming in the tuna fisheries sector, there needs to be a coordinated push to improve production efficiency, clarify regulations, and develop stronger market access strategies.

4.2. Corn/Maize Sector

4.2.1 Descriptive Analysis

Over the past five years, Indonesia's agricultural GDP and the food crop subsector have steadily declined, despite some year-to-year ups and downs. For example, after a positive result in 2020, the food crop subsector saw a sharp drop of 3.86 per cent in 2023 and then levelled off at a slight decline of 0.21 per cent in 2024 (See Appendix 19). This kind of volatility highlights just how exposed the sector is to climate shifts, supply shortages, and swings in commodity prices. Maize, as a key part of this subsector, is especially sensitive to these pressures. When production falters upstream, it disrupts the steady flow of raw materials that intermediate and downstream industries rely on. That is why keeping production and supply stable is so important for supporting downstream development.

Indonesia's maize trade has been in deficit at every stage of the value chain, upstream, intermediate, and downstream, over the past five years, with downstream products showing the largest gap (See Appendix 20). The biggest shortfall comes from maize kernels used in the feed and food industries, a sign that imports remain crucial to meeting local demand. On a more positive note, a handful of downstream products, such as ethanol and sorbitol, do generate trade surpluses. This points to real opportunities for Indonesia to expand its competitive maize-based industries, provided it can address production costs and improve supply chains.

Competitiveness mapping shows that Indonesia has a limited comparative advantage in maize products. Downstream items like sorbitol and some chemical derivatives fall into the competitive quadrant, whereas most upstream products, including maize kernels, are positioned in deficit quadrants, reflecting strong import dependence (See Appendix 21). This pattern indicates that Indonesia's maize industry is not yet fully integrated from upstream to downstream, with limited domestic supply constraining downstream growth.

In 2024, maize production is heavily centered in Java, which makes up 51.4 percent of the country's total output, with East Java and Central Java leading the way. Sumatra adds another 22.9 percent, while Sulawesi, Bali–Nusa, and NTB are also important production hubs (See Appendix 22). About

60 percent of maize farmers live in Java. This concentration can make supply chain management easier, but it also means the entire system is more exposed to climate risks in these core regions. By raising productivity in the main producing provinces and building up capacity in secondary areas such as NTB, South Sulawesi, and Gorontalo, Indonesia could better manage risks and build a more resilient supply system.

Most financing for maize farming comes from working capital loans, making up 86 percent of the total, while investment credit only accounts for 14 percent. Both types of credit have declined since 2022, reflecting lower production and more price volatility (See Appendix 23). On the upside, credit risk is still under control, with non-performing loans on working capital decreasing. The reliance on short-term financing shows that there is not much long-term investment going into productivity upgrades. Shifting more resources toward investment credit is key for modernizing farming practices, adopting new technology, and making supply chains run more smoothly.

Looking at the maize value chain, it is clear how value is added as products move from upstream kernels to more processed intermediate and downstream goods. Maize kernels at the upstream end are low in value and their prices are highly sensitive to farm-level changes (See Appendix 24). Intermediate products such as corn grits, starch, corn gluten meal, DDGS, and corn germ can provide up to five times more value and are widely used for feed, snack, and bioethanol industries. Downstream items, including ethanol, animal feed, snacks, maltodextrin, fructose, glucose, and sorbitol, are worth three to eleven times more than the raw kernels. However, some products, like dextrose and maltose as well as premium goods such as corn oil, bioplastics, xanthan gum, and amino acids, are still entirely imported. Patterns in consumer prices reinforce these gaps (See Appendix 25). These missing downstream segments stand out as promising areas for import substitution and high-value industry growth.

4.2.2 Panel Data Regression

Estimation results for the maize sector demonstrate that downstreaming significantly enhances sector performance. Analysis of panel data from 3,515 firms, employing a fixed-effects model with Driscoll–Kraay standard errors (see Appendix 26), reveals that a 1 percent increase in value added correlates with a 1.1 percent increase in exports. However, this effect is not statistically significant when applying the Driscoll–Kraay correction. In contrast, the effect on imported raw materials is both negative and robust: a 1 percent increase in value added leads to a 0.14 percent reduction in raw material imports, significant at the 1 percent level. These findings underscore the potential of downstreaming to reduce import dependence.

Downstreaming further enhances internal firm performance. Specifically, a 1 percent increase in value added is associated with a 0.55 percent increase in labor productivity and a 0.78 percent increase in firm revenues, both statistically significant at the 1 percent level. These results indicate that downstreaming improves production efficiency, strengthens technological capacity, and supports improved financial outcomes for maize-processing firms.

In summary, empirical evidence demonstrates that downstreaming reduces the maize sector's reliance on imported inputs while simultaneously increasing productivity and firm income. By decreasing import dependence, the sector can contribute to narrowing the current account deficit and advancing Indonesia's maize self-sufficiency objectives. These findings reinforce the role of downstreaming as a structural mechanism that enhances competitiveness and supports national food security goals.

4.2.3 Computable General Equilibrium

The CGE simulation for the maize sector highlights how increasing productivity by 6 percent and reducing imports by 8 percent can benefit Indonesia's economy (See Appendix 27, Figure 1). With these changes, real GDP rises by 0.0254 percent, showing that a stronger domestic production base and lower reliance on imports help boost national output. However, the consumer price index goes up by 0.3725 percent, which suggests that domestic supply is still not enough to fully meet demand, so prices remain sensitive to changes in import levels. Export prices increase by 0.339 percent, pointing to improved competitiveness for maize-based products, and real wages rise by 0.0253 percent, reflecting gains from higher productivity. The aggregate investment index is up by 0.3753 percent, indicating that improvements in productivity and the push for self-sufficiency are encouraging new investment in maize processing and related industries.

Taken together, these results show that boosting productivity while reducing imports helps strengthen domestic output and lays a solid foundation for food security, stable costs, and a more resilient supply system. The findings also shed light on how these combined changes affect different regions, depending on their production structure and capacity.

At the regional level, most provinces see a positive impact on GRDP, though the size of these gains varies (See Appendix 27, Figure 2). Major maize-producing areas like West Nusa Tenggara, Lampung, and South Sulawesi enjoy the biggest increases, with GRDP rising between 0.039 and 0.047 percent. Provinces with smaller maize sectors, such as Central Java and North Sumatra, also benefit, but to a lesser extent. The strongest effects are seen in the Java–Bali corridor and in parts of Sumatra and Sulawesi, highlighting their importance as production centers and showing that downstreaming and import-reduction policies provide real economic benefits to these regions. To make sure that the gains from maize self-sufficiency last and reach more areas, it will be important to keep building up production capacity, improve logistics, and better connect each part of the value chain.

4.2.4 Challenges Based on the Result of FGD and Field Surveys (Maize/Cornfeed)

This part explores the main downstreaming challenges in Indonesia's maize sector through the lens of the 3P framework. The first pillar, Production Factors (P1), reveals that productivity remains low, largely due to limited adoption of high-quality seeds, unbalanced fertilizer use, minimal mechanization, and underdeveloped postharvest infrastructure like dryers and silos. The lack of consistent crop calendars leads to harvest gluts, which can lower grain quality and push prices down. Turning to Regulation and Institutions (P2), the sector faces hurdles such as fragmented farmer organizations, small average farm sizes, and weak buffer capacity, all of which make it difficult to absorb surplus maize and maintain quality standards. The third pillar, Promotion and Market Access (P3), spotlights the high cost of moving maize from surplus areas outside Java to major feed centers, which erodes the competitiveness of local maize compared to imports.

At the heart of production, several challenges persist: inconsistent postharvest quality, high grain moisture, risks of aflatoxin contamination, and not enough storage space. Many farmers struggle to access affordable finance and frequently rely on traders, which drives up their working capital costs. Institutionally, the fragmentation of farmer groups and a shortage of proper drying and storage facilities make it hard for buffer agencies to stabilize the maize supply. Together, these barriers make it difficult for downstream industries to secure a steady and reliable source of maize.

At the market end, poor connectivity and high transport costs from regions such as NTB or Gorontalo to Java decrease competitiveness and, in some cases, incentivise exports to nearby countries. Without more efficient logistics, downstream industries continue to face high input costs. Overall, maize downstreaming is constrained by systemic issues across production, institutions, and market access. Strengthening productivity, farmer aggregation, postharvest capacity, and financing mechanisms is essential for building a reliable supply base that supports industrial processing and national self-sufficiency.

4.3. Salt Sector

4.3.1 Descriptive Analysis

Indonesia's salt sector continues to grapple with deep-rooted structural challenges, particularly its heavy reliance on imports, low productivity, and limited impact on the broader economy. Over the past five years, the portion of fisheries GDP that includes salt has hovered at about 3 percent of the national total, showing little sign of growth (See Appendix 28). This stagnation is tied to fluctuating weather, inconsistent production, and a slow pace of technological adoption. These patterns signal that the sector has not reached its full potential. Addressing these issues calls for a stronger industrial structure, better product quality, more efficient distribution, and increased investment in modern production systems. Only then can the salt sector achieve more stable and sustainable growth in the years ahead.

Despite growing demand, domestic salt production still falls well short of what the country needs, which keeps import volumes consistently high (See Appendix 29). Between 2019 and 2022, production dropped, and by 2024, Indonesia was importing 2.7 million tons of salt worth 125 million USD. This gap exists because much of the domestic supply cannot meet the industrial quality standards required by local industries, fueling ongoing trade deficits across both upstream and intermediate salt products. As a result, Indonesia remains highly dependent on countries like Australia, India, and New Zealand for industrial-grade salt, with annual imports averaging over 123 million USD between 2021 and 2024 (See Appendix 30). Competitiveness mapping using RSCA and TBI reveals that almost all salt-related commodities are at a disadvantage globally, with only inorganic acids (HS 281119) showing a positive trade balance. These findings point to persistent structural barriers that prevent Indonesia from moving into higher-value areas of the salt industry.

Much of these difficulties can be traced back to low productivity and a production system that is still dominated by traditional salt farming. An estimated 90 percent of the nation's salt comes from small-scale farmers, while state-owned and private companies make up less than 10 percent of output (See Appendix 31). Both productivity and the number of farmers have dropped sharply in recent years, mainly due to slow adoption of technology and limited access to financing. Traditional harvesting methods result in substantial losses—over 30 percent—and often lead to inconsistent product quality. In contrast, small and medium processors who use modern technology have reduced these losses to about 15 percent (See Appendix 32). With national demand ranging from 4.5 to 5.2 million tons annually and domestic production stuck at just 2.7 million tons, this gap continues to block Indonesia's path to self-sufficiency (See Appendix 33).

Salt production and the concentration of salt farmers are heavily centered in Java, which is responsible for 77.36 percent of the country's total output and 71.24 percent of the salt farming population, especially in East and Central Java. Bali and Nusa Tenggara add nearly 20 percent more to national output and around 14 percent to the farmer population (See Appendix 34). This geographic concentration makes the industry more vulnerable to climate-related risks and limits opportunities for other regions to take part in the salt supply chain. These factors make it even harder to achieve a stable national supply and move closer to self-sufficiency.

The salt value chain in Indonesia supports many downstream industries, from textiles and food processing to pharmaceuticals. As salt moves from raw material to finished product, its value can increase up to ten times (See Appendix 35). However, most intermediate products, such as sodium carbonate and sodium borate, are still imported in large quantities—281 million USD and 58 million USD, respectively. This reliance on imports is due to the generally low quality of locally produced raw salt, limited processing capacity, and slow technological upgrades among farmers and small processors. Because of these barriers, the sector cannot maximize the high-value opportunities available and continues to depend on imported intermediate products, which holds back the broader economic potential of Indonesia's salt industry.

4.3.2 Panel Data Regression

The analysis of the salt sector, based on data from 4,294 firms and a fixed-effects model with Driscoll and Kraay standard errors, reveals important connections between value addition and sector performance. The results show that every 1 percent increase in value added leads to a 0.61 percent rise in exports and a 0.31 percent decrease in imported raw materials, both highly statistically significant (See Appendix 36). Growth in value added is also linked with a 0.41 percent improvement in labor productivity and a 0.87

percent boost in firm revenue. Robustness checks confirm that these findings are stable and reliable.

These results highlight how crucial downstreaming is for improving the performance of Indonesia's salt sector. The increase in exports points to stronger competitiveness, while the drop in imported raw materials suggests the sector is gradually becoming less dependent on foreign inputs. Together, these trends support Indonesia's aim to achieve self-sufficiency in salt and improve the country's trade balance.

At the firm level, gains in productivity and higher revenues show that downstreaming helps companies operate more efficiently, adopt new technologies, and build financial strength for future investment. Taken together, the evidence points to downstreaming as a key strategy for tackling the main structural challenges in the salt sector. By boosting competitiveness, lowering import dependence, and encouraging more resilient and sustainable growth, downstreaming can help move Indonesia's salt sector forward.

4.3.3 Computable General Equilibrium

The CGE simulation for the salt sector demonstrates that increasing productivity by 53 percent, the estimated level needed for Indonesia to fully substitute salt imports, can deliver a range of positive macroeconomic results (See Appendix 37, Figure 1). With this boost, real GDP rises by 0.0679 percent, showing that stronger domestic production moves the country closer to self-sufficiency. The consumer price index drops by 0.0289 percent, suggesting lower production costs and greater stability in domestic supply. Export prices go up by 0.0232 percent, indicating that Indonesian salt is becoming more competitive internationally. Meanwhile, real wages increase by 0.0202 percent as higher productivity leads to better earnings for workers. The aggregate investment index also rises by 0.0289 percent, reflecting greater incentives for investment in salt processing and related industries.

Taken together, these macroeconomic results suggest that reaching self-sufficiency in salt goes beyond just improving domestic supply. It also helps stabilize prices, boosts efficiency, and makes downstream manufacturing sectors that depend on salt more resilient. These nationwide benefits set the stage for looking more closely at the regional impacts, which are shaped by differences in production structure and industrial capacity.

At the regional level, the biggest GRDP gains from higher productivity occur in the main salt-producing provinces: West Java, Central Java, East Java, Bali, and Nusa Tenggara (See Appendix 37, Figure 2). These areas benefit most because their production and processing activities are highly concentrated. Provinces outside of Java also see positive effects, though on a smaller scale, which reflects how the salt value chain links different regions through logistics, distribution, and processing. This pattern shows that boosting productivity in the salt sector creates direct improvements in key producing areas and indirect benefits that reach other provinces. By raising productivity, Indonesia can reduce its reliance on imports, build a stronger industrial base, and promote economic growth across the regions.

4.3.4 Challenges Based on the Result of FGD and Field Surveys (Industrial Salt)

The challenges facing Indonesia's salt sector, as revealed through Focus Group Discussions and field surveys, can be understood by applying the 3P framework. Looking first at Production Factors (P1), the sector's heavy reliance on imports stems from low domestic capacity, unpredictable productivity, and inconsistent quality. Many local producers struggle to meet the high NaCl purity standards required by industrial and pharmaceutical buyers. Extreme weather adds to these difficulties, with traditional farmers often achieving yields of only about 60 tons per hectare, while the optimal target is closer to 100. This forty per cent gap highlights the productivity issues that persist. Technology adoption is slow, standard operating procedures for producing high-quality salt are not widely implemented, and high processing costs, along with limited access to capital, continue to hold back both smallholders and local SMEs. The situation is further complicated by low levels of education and welfare among salt farmers, which make it harder to upgrade production methods and consistently achieve the quality required by industry.

Turning to Regulation and Institutional Arrangements (P2), the sector faces a number of organizational and policy-related obstacles. Farmer organizations are often weak and operations are generally small in scale. Institutional initiatives, such as the Sentra Garam Rakyat (SEGAR) program, have not yet led to meaningful improvements. Investment in the sector is still limited, which slows down technology adoption and limits the spread of productivity gains. Strict SNI standards for contamination and purity pose additional challenges, especially for small and medium enterprises that may lack the resources to achieve certification. Navigating complex permitting requirements and dealing with inconsistent regulations further undermines competitiveness. Government assistance programs, which are sometimes provided without sufficient training or follow-up, often fail to deliver the intended results. There have even been cases where equipment meant for farmers is resold, which reflects a disconnect between support initiatives and the real needs or capabilities of farmers. Finally, while local SMEs are subject to import restrictions designed to protect domestic supply, larger industries continue to import, which exacerbates market imbalances and limits opportunities for domestic value chain development.

Looking at Promotion and Market Access (P3), the salt sector faces fragmented market connections and small-scale farmers often have limited bargaining power. Large industrial buyers tend to prefer imported salt because of its consistent quality and reliable supply. Producers and SMEs outside Java face particularly high logistics and transportation costs, which makes it even harder to compete and connect with bigger markets. With most production and farming still concentrated on Java, other regions like Bali and Nusa Tenggara struggle to access the main industrial markets. When you add in inconsistent quality from local sources and the availability of cheaper, higher-grade imports, it becomes clear why local SMEs find it difficult to participate fully in the salt supply chain.

Taken together, these findings show that Indonesia's salt sector is held back by a range of interconnected structural issues: low and unpredictable productivity, weak farmer organisations, limited access to finance and technology, strict quality demands, and uneven access to markets. These obstacles reinforce the country's reliance on imports and keep local producers from moving up the value chain. This study aims to provide a comprehensive set of policy recommendations, review the existing value chain and business models, and identify practical financing solutions to support lasting improvements in the national salt sector.

5. Implication / Policy Recommendation

5.1. Policy Recommendation for Tuna Fisheries Sector

In the short term (1–2 years), policy should focus on reducing production costs, improving product quality, and making sure fishers have reliable buyers for their catch. Access to working capital can be expanded by directing KUR loans through cooperatives, backed by credit guarantees, so small-scale fishers can invest in better gear and onboard handling equipment. Distributing subsidized fuel in a more targeted way—using cards or QR codes—alongside incentives for fishers who join formal partnerships, will help make operations more efficient. At landing sites, authorities should provide temporary cold chain solutions, like refrigerated containers or flake ice, to keep fish fresh before processing. Providing practical training on standard onboard handling procedures, along with incentives for adopting these practices, will also help fishers improve the quality of their catch.

For regulation and institutional strengthening, the main priorities are to make levies easier to navigate and widen access to quality certification. Clear and straightforward fee structures can help lower compliance costs and give businesses more certainty. Strengthening fisher organizations throughout the country will make it easier for members to get certified, especially when backed by community-led mentoring programs that have already shown good results. At the same time, getting ready for the Measured Fishing (PIT) policy will require stronger institutional capacity, including better port facilities and monitoring technology for consistent implementation. These efforts should be matched by measures to improve market access, like offering incentives to reduce logistics costs from eastern Indonesia and encouraging investment in key downstreaming regions. Developing an export branding strategy based on quality and certification, with support from market analysis, can also help raise Indonesia's profile in important export markets.

Looking further ahead, in the medium term (2–5 years), policy should aim to build a modern, sustainable production system. Creating scheduled transport networks using a hub-and-spoke model, along with integrated port and cold chain operations, can help reduce travel time to processing plants and reduce quality losses. Upgrading small vessels and gear should be supported through investment loans with interest subsidies, provided recipients meet clear reporting and quality standards. Fisheries ports should develop into fully integrated processing hubs, complete with ice facilities, clean water, grading, and cold storage, managed by BLUD, BUMD, or public-private partnerships with clear service standards. Accelerating digitalisation, such as fisher identification, e-logbooks, and digital payments, will make it easier to trace products and boost creditworthiness. On the marketing side, incentives for export promotion should shift from isolated programs toward a joint export promotion fund, and new integrated processing clusters should be established to lower distribution costs. The government could also launch national branding for Indonesian fishery products based on quality and digital traceability, supported by coordinated market intelligence with industry associations and trade attachés.

Together, these short- and medium-term measures are meant to deliver quick results and also set the stage for stronger supply chain competitiveness in the long run. The main goal is to build cooperative or cluster-based business models that can pool supply, maintain quality, and secure stable buying agreements with processors. With a steadier cash flow, cooperatives will be able to access financing for working capital, post-harvest facilities, and investments in downstream activities, all while reducing risk. The following section discusses the proposed business model and financing structure to support downstream growth in the tuna fisheries sector.

Beyond policy recommendations, this study also looks closely at the current business model, drawing on findings from fieldwork (See Appendix 38, Figure 1). The model maps out the entire tuna supply chain and shows how different stakeholders interact. Fishers typically sell their catch to collectors, who often provide informal financing for fishing trips. The tuna is then sold by collectors to the next stage in the supply chain. Processors work with collectors to offer training that helps maximize value addition. While processors buy fish from both fishers and collectors and supply both local and export markets, these transactions usually take place without formal contracts. At the final stage, processors sign demand contracts with buyers and supply tuna based on specific quality grades.

Financing in the tuna sector is still quite fragmented. While processors and exporters usually have access to bank loans or use their own funds, this support rarely makes its way upstream. Most fishers and collectors rely on personal savings, informal advances, or small-scale KUR loans. Although some new fisher cooperatives are starting to tap into KUR Mikro or KUR Nelayan (KUSUKA), uptake remains limited due to paperwork challenges and low financial literacy. There are some encouraging examples, like direct sourcing models and quality-focused training programs. Processors have also put in place in-house grading systems and can access export finance. Still, most transactions are spot-market deals without off-take contracts, and the ongoing dependence on informal lending means there is little motivation to improve quality.

Experiences from successful cooperative–industry partnerships, such as KUD Mino Saroyo in Cilacap and the tuna hub in Bitung, show that strong aggregation capacity, consistent quality control, reliable cold chain management, and lasting partnerships with industry players are all critical for success. Both of these ecosystems have thrived thanks to their location near fishing grounds and strong government support for downstream development.

Looking at value-chain finance (VCF), the strongest financing structures are built around formal trading relationships, such as off-take contracts or purchase orders. Pre-export working capital (PEWC) can give processors contract-based credit, while supplier financing lets cooperatives provide working capital directly to fishers in a transparent way. The suggested approach is a cluster-based system where cooperatives act as aggregators and quality managers, supplying processors or exporters under off-take contracts with flexible volumes and grade-based pricing. This structure is supported by PEWC for processors and supplier financing through cooperatives to fund fishing trips (See Appendix 38, Figure 2).

5.2. Policy Recommendation for Maize/Corn Feed Sector

In the short term, policy efforts in the maize sector should focus on stabilising supply and improving grain quality to ensure domestic production consistently meets the needs of the feed industry. Productivity gains can be achieved by providing better seeds, subsidising fertilisers, and introducing basic mechanisation in key regions, especially those outside Java. Cooperatives and farmer groups will benefit from financing to invest in dryers and silos, ensuring that moisture levels and aflatoxin levels meet industry requirements. Technical training, clear post-harvest procedures, and better planning of planting calendars will help avoid harvest gluts and reduce waste. It is also important to build stronger farmer institutions through cooperatives, clusters, or village-owned businesses so they can act as trustworthy aggregators with access to working capital. When the government helps brokers off-take agreements between these groups and feed mills, it gives both price and market certainty, making it easier for cooperatives to secure financing. Improvements in rural road logistics, port schedules for bulk shipping, and lower distribution costs will further boost the sector's competitiveness.

Looking ahead to the medium term, the focus should shift to building a well-integrated and competitive value chain. This involves encouraging the growth of small and medium-sized feed mills in production centers so that surplus maize can be processed close to where it is grown. Fiscal incentives and targeted financing should encourage investment outside Java, and ongoing improvements in transport and logistics will help cut distribution costs and make supply chains more dependable. As downstream capacity grows, medium-term contracts between cooperatives and feed mills will give farmers the confidence to invest, while also ensuring steady quality and supply.

Recent field observations suggest that business practices in the maize sector are gradually improving (See Appendix 39, Figure 1). Some feed mills are now investing in advanced drying, sorting, and grading technologies to boost efficiency and increase transparency in the process. Integrated feed and poultry operations have also provided a stable demand for maize. However, many upstream transactions remain spot-market-based, making it hard for farmers to plan ahead or invest in better post-harvest facilities. High logistics costs, challenging road conditions, and limited transport links between islands continue to hurt the sector's competitiveness, which is why some downstream companies are choosing to build processing plants closer to maize production areas. Examples from Grobogan, Bandung, and NTB show that a strong maize value chain relies on robust aggregation, skilled cooperative management, reliable post-harvest quality, and formal market relationships.

Drawing on these insights, the recommended approach centres on cooperatives or MSME clusters as integrated aggregators. They handle the consolidation of harvests, manage drying, storage, and grading, and ensure that grain meets industry standards. Once quality is assured, cooperatives can enter into flexible off-take contracts with feed mills or livestock associations, providing a steady supply and stable cash flow. Sharing logistics using bulk shipping or multimodal transport helps cut distribution costs for everyone involved. Financing should be coordinated across the ecosystem: farmers can access input financing through individual KUR or seasonal advances from their cooperatives; cooperatives can obtain working capital based on contracts and invest in dryers, silos, and grading equipment; and warehouse receipt systems can offer short-term liquidity, giving cooperatives the flexibility to sell when market conditions are best. On the downstream side, feed mills depend on their own funds or working capital loans to keep operations running smoothly (See Appendix 39, Figure 2).

This integrated approach brings together improvements in production, stronger farmer organisations, and structured market access to build a resilient, commercially sustainable maize ecosystem. When cooperatives act as reliable aggregators, offering steady supply, consistent quality, and formal off-take agreements, they lay the groundwork for contract-based financing models. This kind of system encourages investment, helps manage risk, and can speed up Indonesia’s journey toward self-sufficiency in feed-grade maize.

5.3. Policy Recommendation for Industrial Salt Sector

After carefully reviewing the challenges facing Indonesia’s salt sector, this study puts forward a set of policy recommendations designed to strengthen the sector’s overall performance. These recommendations focus on improving production, refining regulatory and institutional frameworks, and expanding market access. They are organized into short- and medium-term actions to support both immediate improvements and longer-term progress.

In the short term, targeted steps are needed to strengthen the fundamentals of salt production and reduce reliance on imports. It is especially important to expand access to microfinance for salt farmers, since the current financing system is often informal and does not fully meet their working capital needs. The new mandate under Law No. 4/2023 on Financial Sector Development and Strengthening (P2SK) offers a valuable opportunity to broaden financial inclusion, but real-world implementation still lags behind policy ambitions. Bringing this law to life will require concrete measures such as scaling up ultra-micro credit, creating financial products tailored for farmers affected by weather risks, and integrating financing with technical support. Alongside better financing, farmers need more training on standard operating procedures and quality benchmarks, because raising the quality of domestic salt is key to lessening the industry’s dependence on imports. In practice, short-term priorities should blend improved financial access with capacity-building programs to help stabilize both production levels and product quality.

Looking to the medium term, empowering farmers through business training, hands-on technical mentoring, and wider adoption of modern technologies will be critical for boosting productivity. Expanding technology-based subsidies and upgrading infrastructure can help farmers move away from traditional practices and toward more consistent, industrial-grade salt production. While these changes will require time and investment, they are expected to have a strong and lasting impact on productivity, quality, and competitiveness.

Improvements in regulation and institutions are just as vital. Streamlining licensing for small and medium salt processors can lower barriers and make it easier for new players to enter the market, which in turn boosts domestic demand and gives investors more confidence. Over time, government assistance programs should be refined to ensure they are well-targeted and effective, accompanied by strong oversight to prevent misuse. Another helpful step would be to require large industrial buyers to source a portion of their raw salt from local processors, which would strengthen domestic supply chains and further cut down on imports.

Addressing market access is also a priority, especially given the high logistics costs faced by farmers outside Java. Providing short-term transport subsidies can help salt producers in places like East Nusa Tenggara compete more effectively in domestic markets. Government stockpiling of salt from these regions can also help stabilize demand and limit price swings. In the medium term, building long-term partnerships between local processors and large industrial users will help create more reliable supply chains. Setting quotas for local salt absorption would further strengthen small and medium processors, leading to technology transfer and higher quality standards across the sector.

To support these policy ideas, the study also presents an end-to-end business model for Indonesia's salt sector, drawing from fieldwork observations (See Appendix 40, Figure 1). This model traces how value moves along the supply chain, starting with farmer associations or clusters that work with traditional producers. Raw salt is sold to these groups and then passed on to small and medium processors (IKM) for sorting and refinement. IKM serve two markets: they supply refined industrial salt to large manufacturers and also distribute consumer-grade salt to retailers. Success in this system relies on several factors, including APGRI's role in upholding production standards, the grading and quality control managed by IKM, and the use of long-term contracts that give processors and buyers more certainty.

Nevertheless, the sector still faces significant challenges. Raw salt quality is often inconsistent, largely because of traditional production methods, limited access to finance, and inconsistent application of standard operating procedures. Economic pressures sometimes force farmers to shorten production cycles, which results in lower quality salt that does not meet the needs of industrial users. Other issues, such as slow adoption of technology, unpredictable weather, and regulations that do not always align with industry needs, add further complexity. Small and medium processors often cannot import better quality raw materials and are required to absorb all locally produced salt, regardless of its quality, making it hard to compete with imported industrial salt.

To overcome these barriers, the business model should develop into a more fully integrated system that brings together farmer clusters, associations, processors, and industrial users through well-structured commercial and financial arrangements. Some practical steps include establishing formal off-take agreements backed by regulatory quotas for processors, promoting contract farming between processors and farmer groups to maintain quality and consistency, and encouraging the government to play a more active role in standardizing production processes. These actions would not only strengthen the reliability of the supply chain but also boost farmer incomes and the competitiveness of small and medium processors.

The study also puts forward a financing model to support these recommendations (See Appendix 40, Figure 2). For farmers, microfinance and KUR loans tailored specifically for salt production can help meet working capital needs and reduce dependence on informal lenders. Introducing a warehouse receipt system would let farmers store their salt and wait for better prices, while also ensuring a steady supply for processors. Between associations and processors, invoice financing can speed up cash flow and allow for ongoing support to farmers even before full payment is settled. For processors themselves, access to short-term working capital loans is essential for upgrading technology, improving logistics, and meeting certification standards. By putting these financing tools in place, the sector can build a stronger, more flexible, and quality-focused value chain that drives comprehensive salt sector development.

6. Conclusion and Further Research

This study finds that Indonesia's efforts to advance downstreaming in fisheries, corn, and salt are making progress and opening up significant opportunities for greater value creation. Drawing on value chain mapping, trade analysis, and a range of secondary data, several key insights stand out.

First, downstreaming progress varies across the three commodities. In fisheries, the sector has advanced due to increased production of intermediate and finished products like canned fish and fillets, which have boosted exports. However, continued reliance on imported intermediates means some value is still lost, highlighting the need to expand production of higher-value goods such as collagen, gelatin, and nutraceuticals. In corn, downstreaming has also progressed, with domestic producers now making intermediates like fructose, glucose, sorbitol, and ethanol. Still, the sector's trade balance remains in deficit because imports of shelled corn are high for feed and food industries. There is room for more value addition, especially through products like corn oil, bioplastics, and amino acids. In contrast, the salt sector lags, with limited domestic output of key intermediates such as sodium carbonate and sodium borate. Strengthening the salt industry's value chain is critical to reducing import dependence and supporting industries like textiles, food processing, and pharmaceuticals.

Second, the econometric analysis confirms that increasing value added through downstreaming has clear, positive effects on how these commodities perform. In the Tuna fisheries sector, for example, a 1 percent rise in value added leads to a 0.78 percent increase in exports, a 0.36 percent boost in productivity, and a 0.86 percent increase in firm revenues, all statistically significant and robust results. In the maize sector, a 1 percent increase in value added lifts exports by 1.1 percent (though this result is not robust in sensitivity checks), reduces raw material imports by 0.14 percent, and improves productivity and firm revenues by 0.55 percent and 0.78 percent respectively, with most results holding up to further scrutiny. For industrial salt, a similar 1 percent increase in value added is linked to higher exports (0.61 percent), lower imports of raw materials (0.31 percent), increased productivity (0.41 percent), and higher firm revenues (0.87 percent), all of which are robust to the statistical tests applied.

Third, the simulation results show that increasing productivity and reducing import dependence through downstreaming bring clear national and regional benefits. In fisheries, for example, a 5 percent productivity boost increases real GDP, wages, investment, and export prices, while easing inflation. Every province sees GDP gains, with the largest increases in places like Maluku and Southeast Sulawesi. In corn, higher productivity and reduced imports also lift real GDP, export prices, wages, and investment, though consumer prices rise as domestic supply still lags demand. Major corn-growing regions such as NTB, Lampung, and South Sulawesi see the strongest benefits. For salt, a 53 percent productivity increase is enough to reach self-sufficiency, raise GDP, lower inflation, and boost export prices, wages, and investment, especially in key production hubs like West Java, Central Java, East Java, Bali, and Nusa Tenggara.

Fourth, fieldwork and focus group discussions reveal ongoing challenges in production, institutions, and market access. Many farmers and fishers still use traditional techniques, have limited access to finance, and face workforce skill gaps. Institutional barriers include weak upstream organizations and inconsistent regulatory enforcement. For market access, limited promotion and high logistics costs continue to undermine competitiveness, making it harder for domestic players to thrive.

Taken together, these findings show that downstreaming can boost exports, productivity, and firm revenues, while also driving broader economic growth. To unlock these benefits, it is crucial to strengthen the enabling environment across production, institutional, and market dimensions, ensuring that downstreaming reaches its full potential in Indonesia's agricultural and maritime sectors.

Looking forward, further research should explore ways to improve and expand business models along each commodity's value chain, focusing on better aligning incentives between upstream producers and downstream industries. There is also a need to develop investment strategies that guide public and private capital into fisheries, corn, and salt, especially targeting technologies, logistics, and processing facilities that deliver higher value added. More detailed analysis of trade strategies for each commodity will also be key to making Indonesian exports more competitive, cutting import dependence, and strengthening the country's position in regional and global markets.

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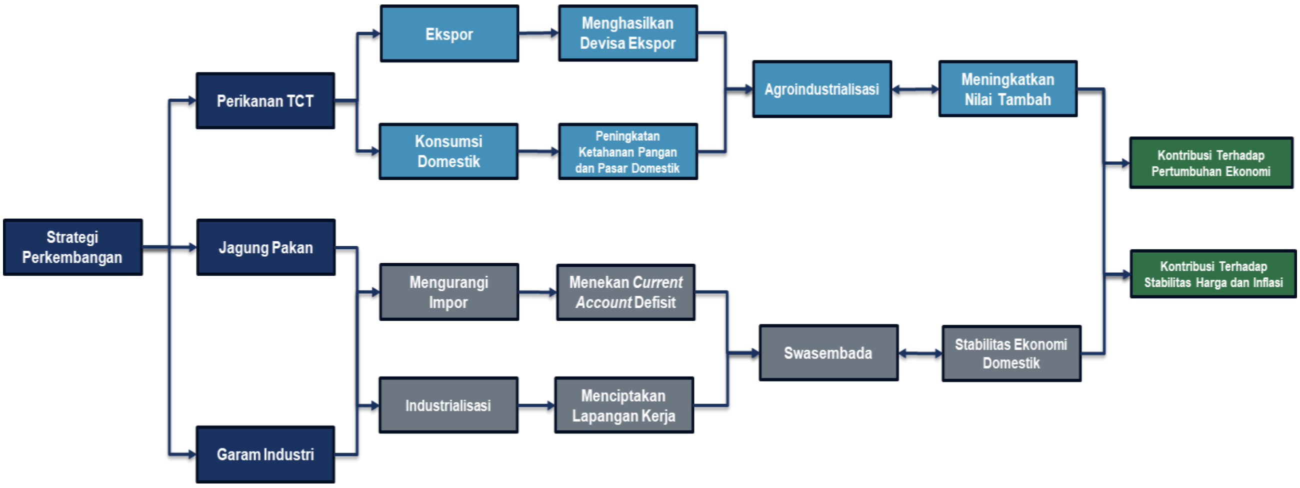
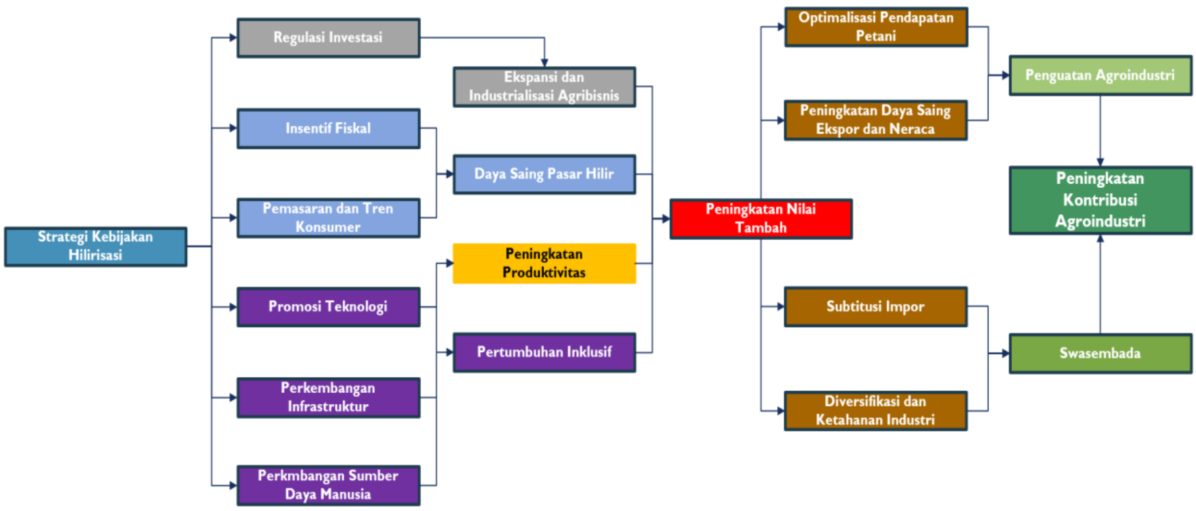
Appendix

Appendix 1 Framework of Thinking



Appendix 2 Conceptual Framework

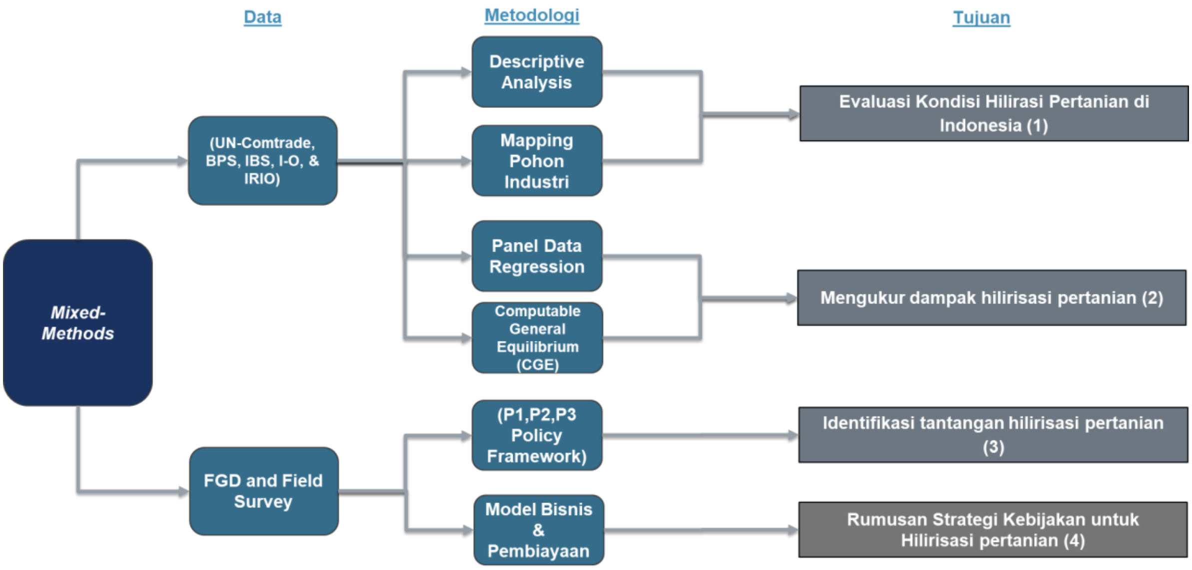


Appendix 3 Summary of Issues in Indonesian Agricultural Downstream Policy

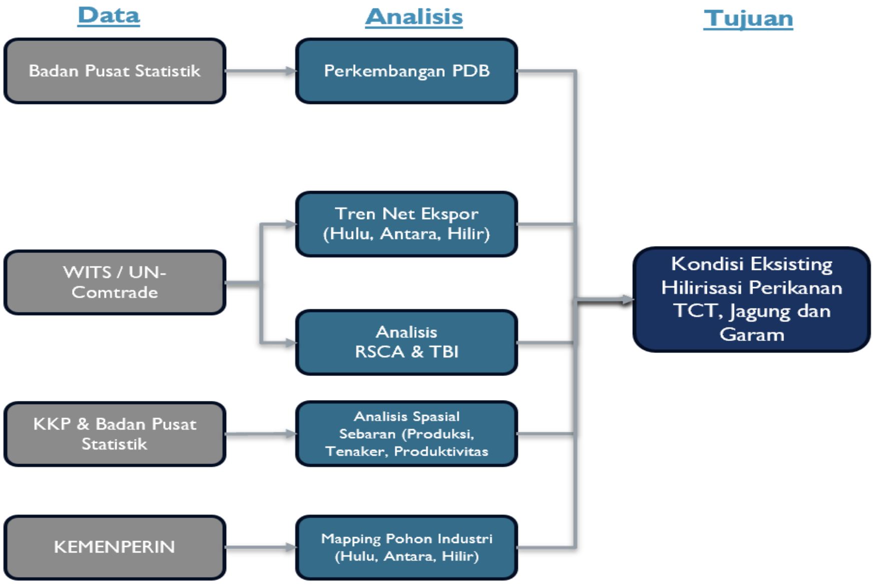
Bidang Isu	Permasalahan Utama	Sumber / Referensi
Kerangka Regulasi & Kelembagaan	Fragmentasi lintas sektor dan pusat daerah, mandat industrialisasi belum terselaraskan, ketidakpastian usaha	Pemerintah RI (2020; 2022), KKP (2017), World Bank (2020), OECD (2021)
Perdagangan & Harga	Trade off antara stabilisasi harga vs insentif investasi hilir; penetapan HPP/HET dan impor tidak sinkron dengan panen	World Bank (2020), OECD (2021), Kemendag (2023)
Standar & Sertifikasi	Biaya dan durasi pemenuhan standar (SNI, halal, BPOM) tinggi, khususnya bagi UMKM	BSN (2020), BPJPH (2021)

Data & Informasi Pasar	Lemahnya integrasi data rantai pasok, sinyal pasar tidak kredibel bagi investor	Bappenas (2020)
Insentif & Investasi	Akses insentif (tax holiday, kemudahan izin, dsb.) tidak merata, terutama di luar Jawa	Kemenkeu (2021), Bappenas (2022)
Infrastruktur Hulu–Hilir	Infrastruktur irigasi, jalan produksi, pelabuhan, rantai dingin, dan pergudangan kurang memadai; biaya logistik tinggi	FAO (2019), World Bank (2018)
Produktivitas Hulu	Keterbatasan benih unggul, pakan, teknologi pascapanen, produktivitas rendah	Kementan (2020)
Keberlanjutan & ESG	Tuntutan kelestarian lahan, overfishing, efisiensi energi, dan pengelolaan limbah sebagai syarat akses pasar global	UNCTAD (2021)
Kesenjangan Wilayah	Konsentrasi industri di Jawa, disparitas kapasitas antar daerah	BPS (2023)
Sektoral: Tuna	Pengelolaan stok lemah, IUU fishing, rantai dingin terbatas, ekspor bahan mentah masih dominan	DJPT (2022), ITC (2022)
Sektoral: Jagung	Kualitas tidak konsisten (kadar air), fasilitas pascapanen kurang, kebijakan impor dan harga tidak selaras	Kementan (2020), Kemendag (2023)
Sektoral: Garam	Kualitas NaCl rendah, kapasitas pemurnian minim, risiko cuaca, adopsi teknologi lambat, izin impor tidak selaras dengan produksi	KKP (2023)
Rekomendasi Kebijakan	Penyelarasan regulasi harga dan perdagangan, penguatan infrastruktur, reformasi sertifikasi, kemitraan industri–petani, pembiayaan berbagi risiko, integrasi data	Bappenas (2022), Kemenperin (2015)

Appendix 4 Research Framework



Appendix 5 Descriptive Analysis Framework



Appendix 6 Summary of Variables (Industry Data Survey 2017-2021)

Variabel	**Definisi**
Nilai tambah	Nilai Tambah per Perusahaan sektor (perikanan TCT, jagung, dan garam), mengukur kontribusi setiap perusahaan dalam meningkatkan nilai dari bahan baku menjadi produk jadi
Ekspor	Total Ekspor per Perusahaan di sektor perikanan TCT, Jagung dan Garam
Impor Bahan Baku	Total Impor bahan baku per Perusahaan di sektor perikanan TCT, jagung dan garam
Pendapatan	Total pendapatan per Perusahaan di sektor perikanan TCT, jagung dan garam
Produktiitas Tenaga Kerja	Produktivitas Tenaga Kerja diaproksimasi dengan membagi total output dengan total tenaga kerja yang dimiliki, untuk setiap perusahaan di sektor perikanan TCT, jagung, dan garam.
Intensitas Modal	Intensitas modal diaproksimasi dengan membagi modal dengan total tenaga kerja yang dimiliki, untuk setiap Perusahaan di sektor perikanan TCT, jagung dan garam
Energi	Energi diaproksimasikan dengan membagi jumlah biaya bahan bakar dan tenaga Listrik dengan total output untuk setiap Perusahaan di sektor perikanan tct, jagun dan garam
Insentif Pekerja	Total insentif pekerja produksi dan lainnya per Perusahaan di sektor perikanan TCT, jagung dan garam
Upah Pekerja	Total upah pekerja produksi dan lainnya per Perusahaan di sektor perikanan TCT, jagung dan garam
FDI	Presentase penanaman modal atau investasi luar negeri per Perusahaan di sektor perikanan TCT, jagung dan garam
Bahan Baku Domestik	Dummy variable ketersediaan bahan baku domestic per Perusahaan di sektor perikanan TCT, jagung dan garam. (0= <25% bahan baku domestik yang digunakan & 1=>25% bahan baku domestik yang digunakan)
Herfindahl-Hirschman Index (HHI)	Index variable konsentrasi pasar dan Tingkat kekuatan pasar per Perusahaan di sektor perikanan TCT, jagung dan garam
Firm Size	Dummy variable ukuran Perusahaan berdasarkan total tenaga kerja per Perusahaan di sektor perikanan TCT, jagung dan garam. (0= <100 Total Pekerja, & 1=>100 Total Pekerja)

Appendix 7 Correlation Matrix

Variables	(1)	(2)	(3)	(4)	(5)	(6)
(1) ln_ekspor	1.000					
(2) ln_nilai_tambah	0.542	1.000				
	(0.000)					
(3) fdi	0.189	0.090	1.000			
	(0.000)	(0.000)				
(4) ln_capitalinte~e	0.479	0.065	0.231	1.000		
	(0.000)	(0.000)	(0.000)			
(5) fsize	0.013	-0.386	0.084	0.285	1.000	
	(0.653)	(0.000)	(0.000)	(0.000)		
(6) HHI	-0.245	-0.662	0.006	0.107	0.434	1.000
	(0.000)	(0.000)	(0.530)	(0.000)	(0.000)	

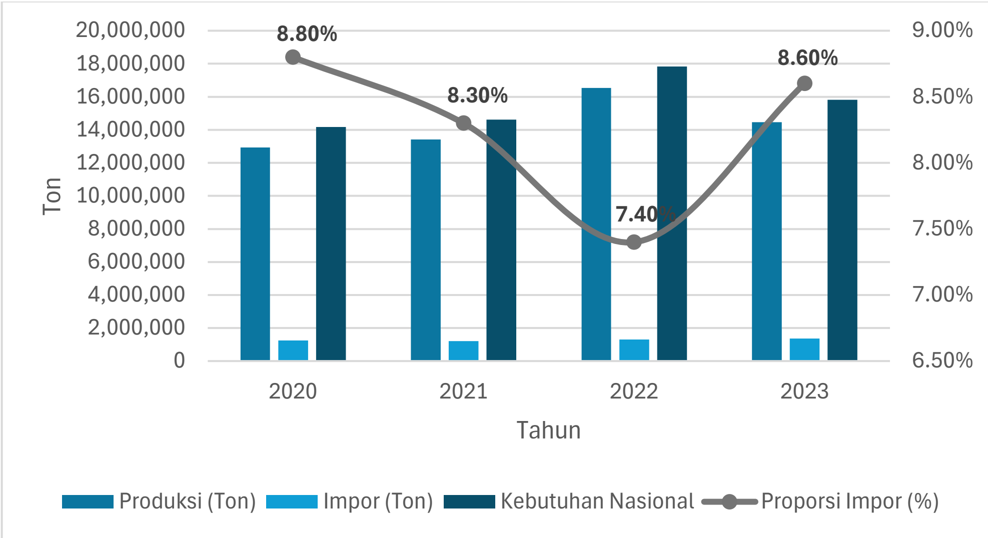
Variables	(1)	(2)	(3)	(4)	(5)	(6)
(1) ln_impor	1.000					
(2) ln_nilai_tambah	-0.291	1.000				
	(0.000)					
(3) fdi	0.178	0.090	1.000			
	(0.000)	(0.000)				
(4) ln_capitalinte~e	0.649	0.065	0.231	1.000		
	(0.000)	(0.000)	(0.000)			
(5) fsize	0.496	-0.386	0.084	0.285	1.000	
	(0.000)	(0.000)	(0.000)	(0.000)		
(6) drawmaterial	-0.291	-0.137	-0.084	-0.383	-0.128	1.000
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	

Variables	(1)	(2)	(3)	(4)	(5)	(6)
(1) ln_laborprod	1.000					
(2) ln_nilai_tambah	0.910	1.000				
	(0.000)					
(3) ln_wage	0.958	0.954	1.000			
	(0.000)	(0.000)				
(4) ln_incentive	0.686	0.760	0.843	1.000		
	(0.000)	(0.000)	(0.000)			
(5) fdi	0.068	0.090	0.036	0.121	1.000	
	(0.000)	(0.000)	(0.002)	(0.000)		
(6) ln_capitalinte~e	-0.173	0.065	-0.144	0.123	0.231	1.000
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	

Variables	(1)	(2)	(3)	(4)	(5)	(6)
(1) ln_pendapatan	1.000					
(2) ln_nilai_tambah	0.926	1.000				
	(0.000)					
(3) ln_energy	-0.334	-0.194	1.000			
	(0.000)	(0.000)				
(4) ln_capitalinte~e	0.306	0.065	0.123	1.000		
	(0.000)	(0.000)	(0.000)			
(5) fsize	-0.005	-0.386	-0.033	0.285	1.000	
	(0.621)	(0.000)	(0.001)	(0.000)		
(6) HHI	-0.384	-0.662	0.095	0.107	0.434	1.000
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	

Appendix 8 Corn Policy (Shock) Simulation

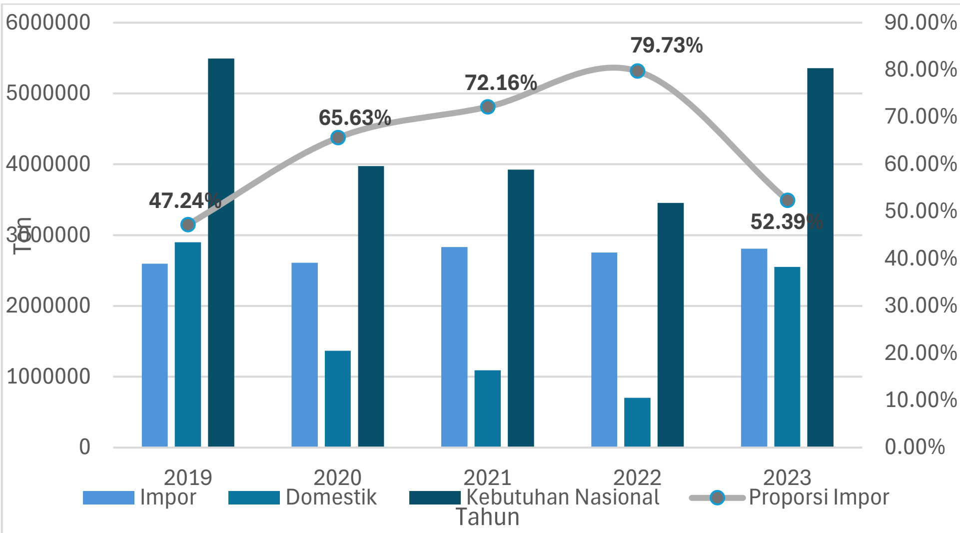
Produksi, Impor & Kebutuhan Nasional Jagung



(Ministry of Agriculture & BAPANAS, 2020-2023)

Appendix 9 Salt Policy (Shock) Simulation

Produksi Domestik, Impor dan Kebutuhan Nasional Garam

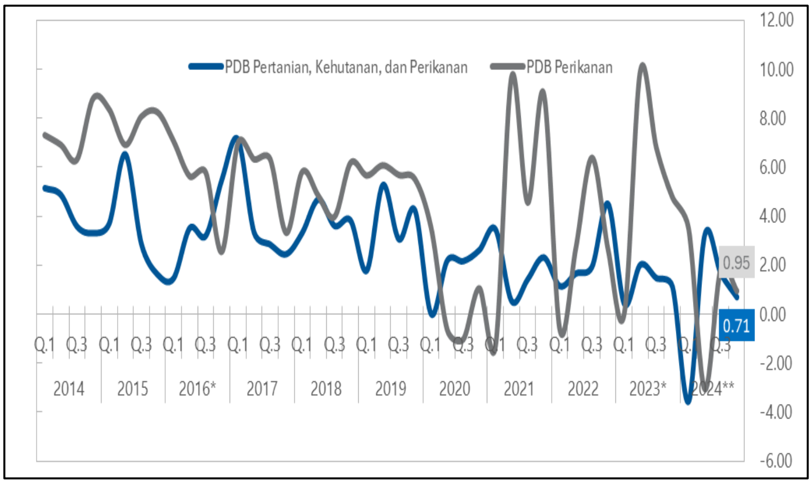


(Ministry of Maritime Affairs and Fisheries, 2019-2023)

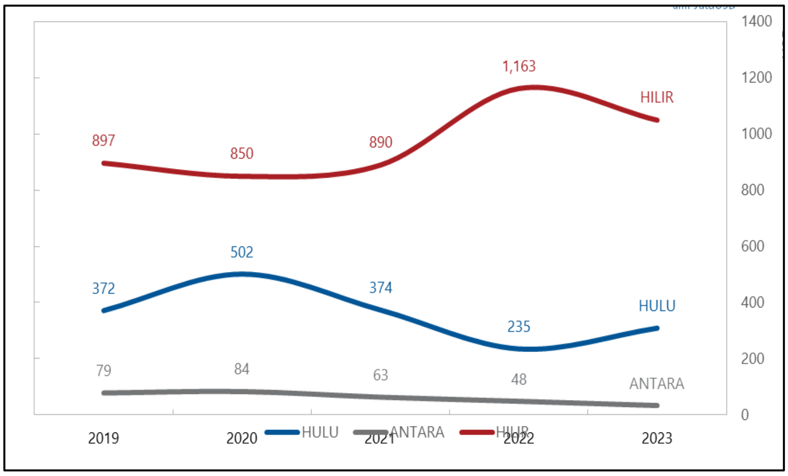
Appendix 10 Three-pronged Approach Downstream Strategy

Strategi *End-to-End* Penguatan Industri Manufaktur (Bank Indonesia, 2019)

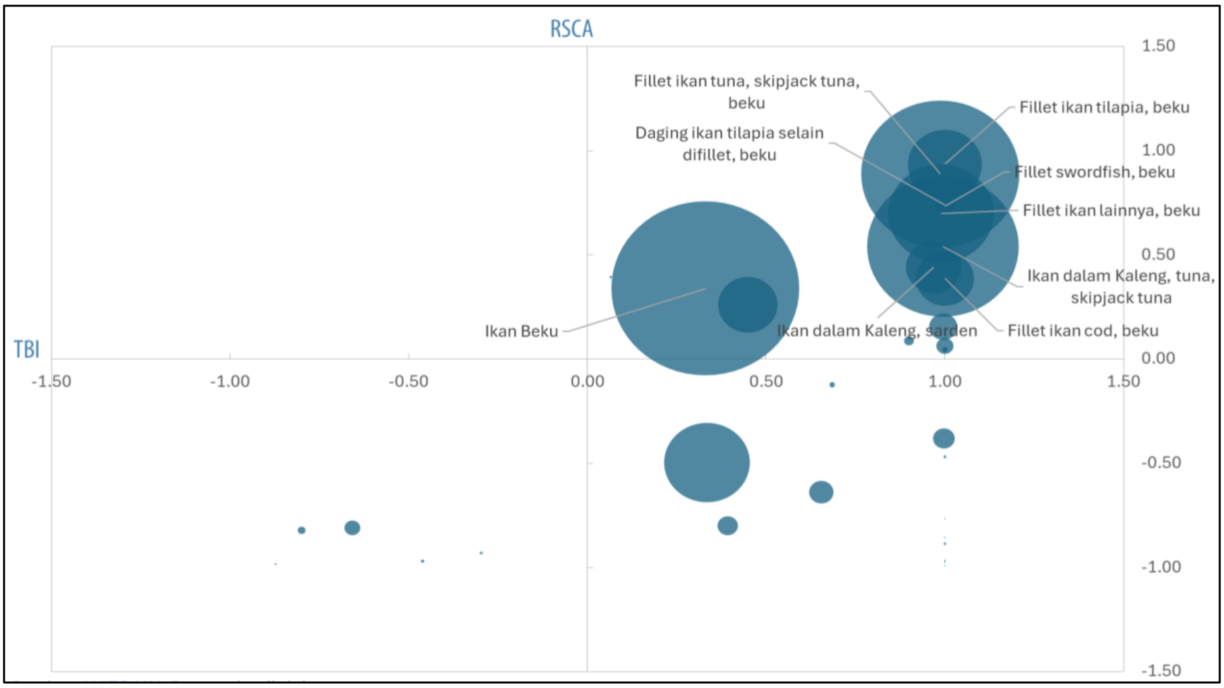
Appendix 11 Development of Fisheries GDP, (BPS, 2014-2024)



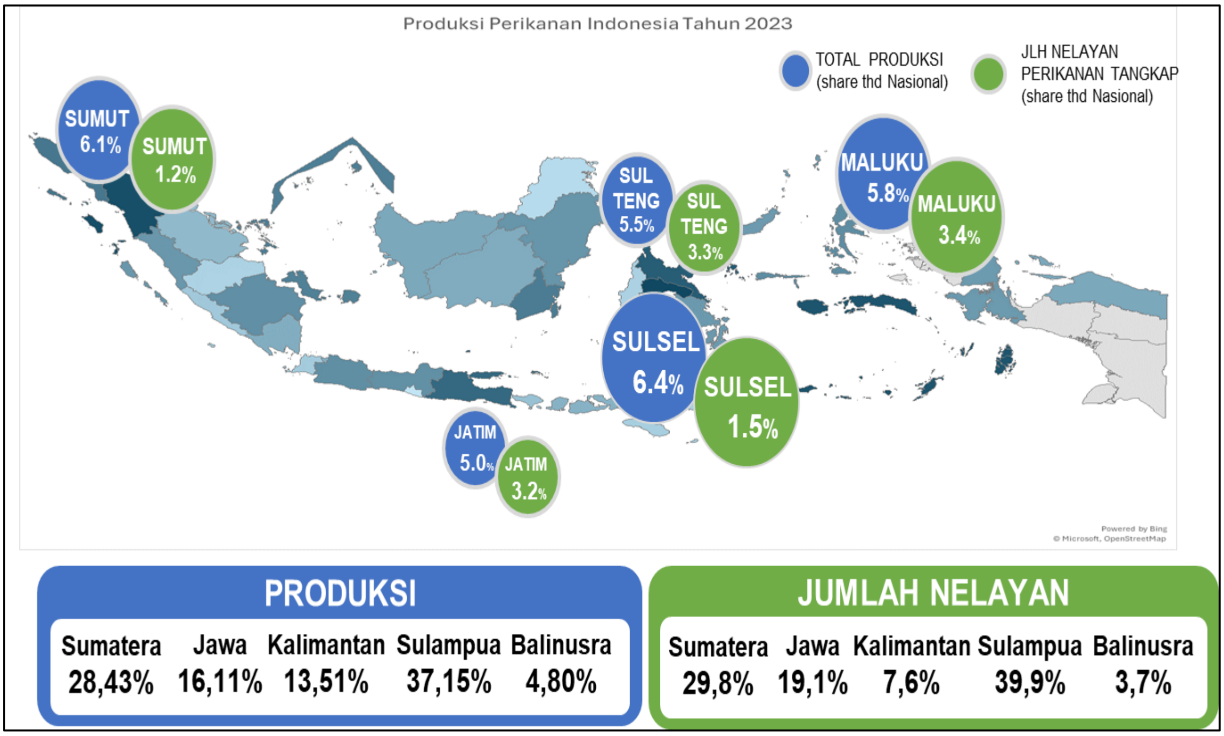
Appendix 12 Net Export of Fishery Commodities (Upstream, Intermediate, Downstream), (UN-ComTrade, 2019-2023)



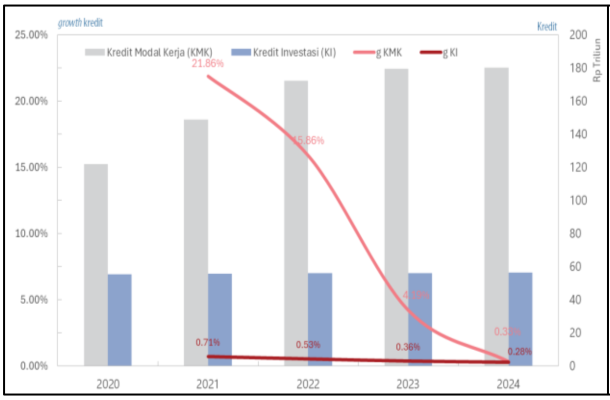
Appendix 13 Scatter Plot RSCA & TBI Tuna Fishery Commodity, (UN-ComTrade, 2024)

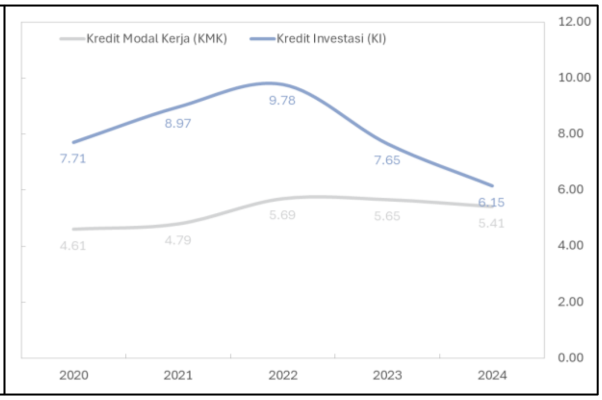


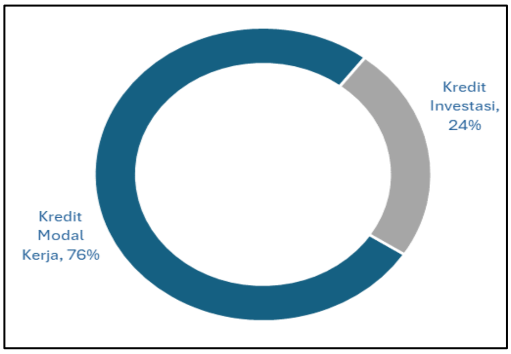
Appendix 14 Distribution of Fisheries Production and Number of Fishermen per Province (BPS, 2023)



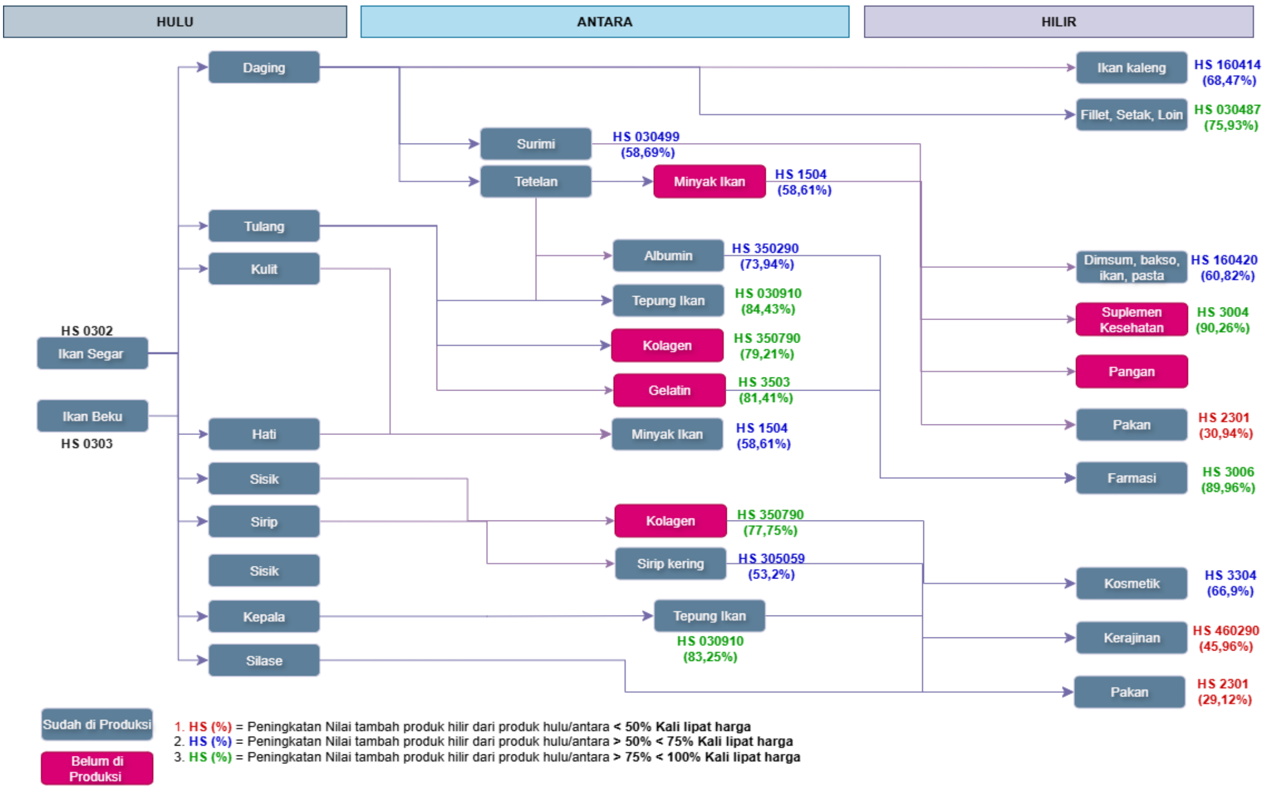
Appendix 15 Fisheries Commodity Financing and Credit Profile, (Bank Indonesia, 2021-2024)







Appendix 16 Tuna Fisheries Industry Tree, (Ministry of Industry, 2025)



Appendix 17 Panel Data Regression (Tuna Fisheries), (Industry Survey, 2017-2021)

	(FE) ekspor	(FE-DK) ekspor	(FE) productivity	(FE-DK) productivity	(FE) pendapatan	(FE-DK) pendapatan
Nilai Tambah	0.779***	0.258**	0.360***	0.494**	0.861***	0.749***
	(0.000)	(0.007)	(0.000)	(0.003)	(0.000)	(0.000)
fdi	0.00452**	0.00690*	-0.00205	0.00514*		
	(0.003)	(0.036)	(0.129)	(0.020)		
Capital_I	0.0794*	0.352*	0.0562**	0.252*	0.0440***	0.118**
	(0.021)	(0.021)	(0.005)	(0.018)	(0.000)	(0.009)
fsize	0.699***	0.661			0.261***	0.213
	(0.001)	(0.310)			(0.000)	(0.142)
HHI	-2.495	5.854			7.762***	1.537
	(0.205)	(0.353)			(0.000)	(0.451)
Upah_pekerja			0.397***	1.307***		
			(0.000)	(0.000)		
Insentif			0.110***	-0.0389		
			(0.000)	(0.538)		
Energi					-0.0398**	-0.0337
					(0.002)	(0.081)
N	3450	3450	3450	3450	3450	3450
R-sq	0.601	0.477	0.941	0.906	0.870	0.859
adj. R-sq	0.596		0.941		0.869	

p-values in parentheses
* p<0.05, ** p<0.01, *** p<0.001

Appendix 18 Computable General Equilibrium (Tuna Fisheries), (IO, 2020 and IRIO, 2016)

Figure 1 The Impact of Increased Productivity in the Fisheries Sector (5%) due to the Increase in Value Added from Downstream

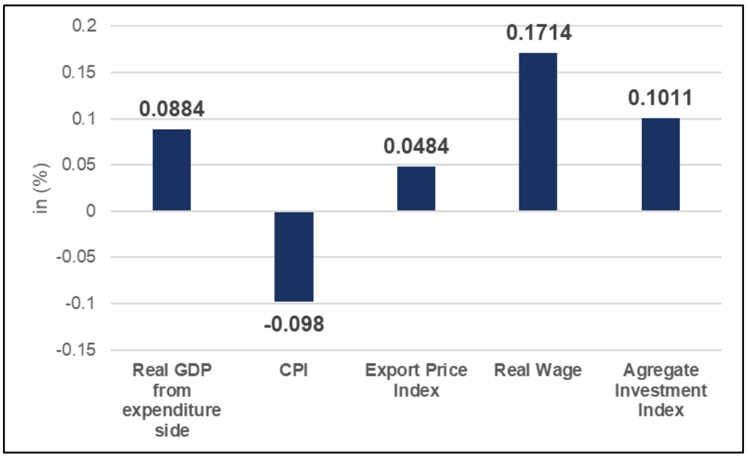
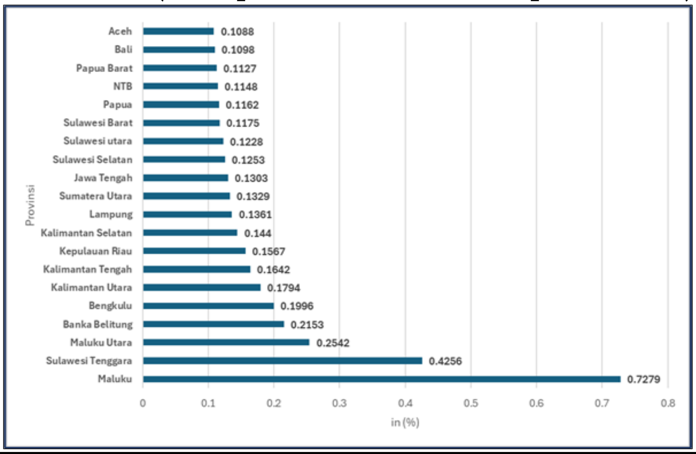
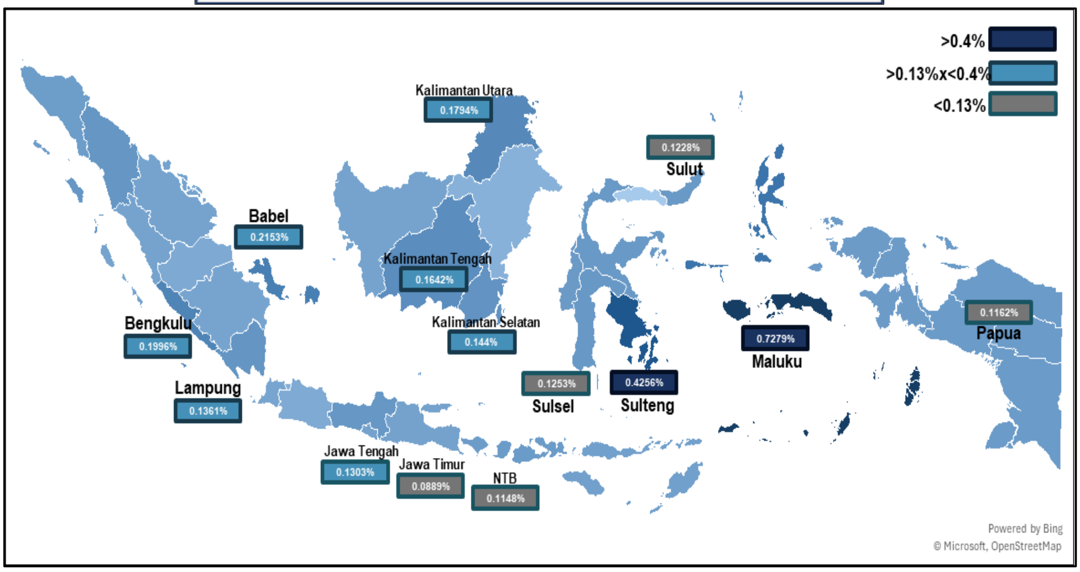
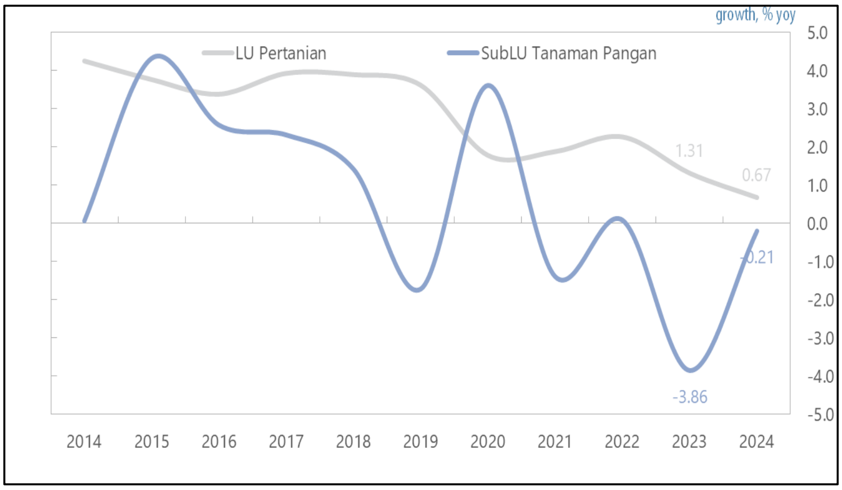


Figure 2 The Impact of Increasing Productivity in the Fisheries Sector (5%) on GDRP (Computable General Equilibrium)

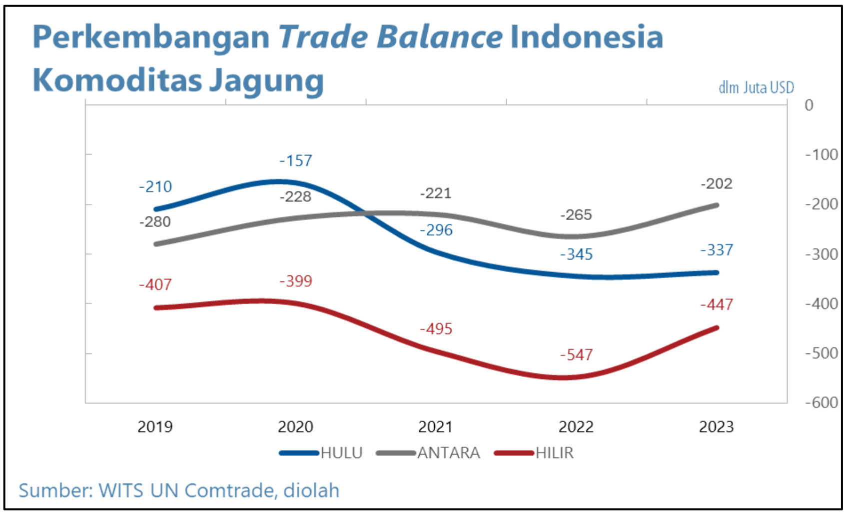




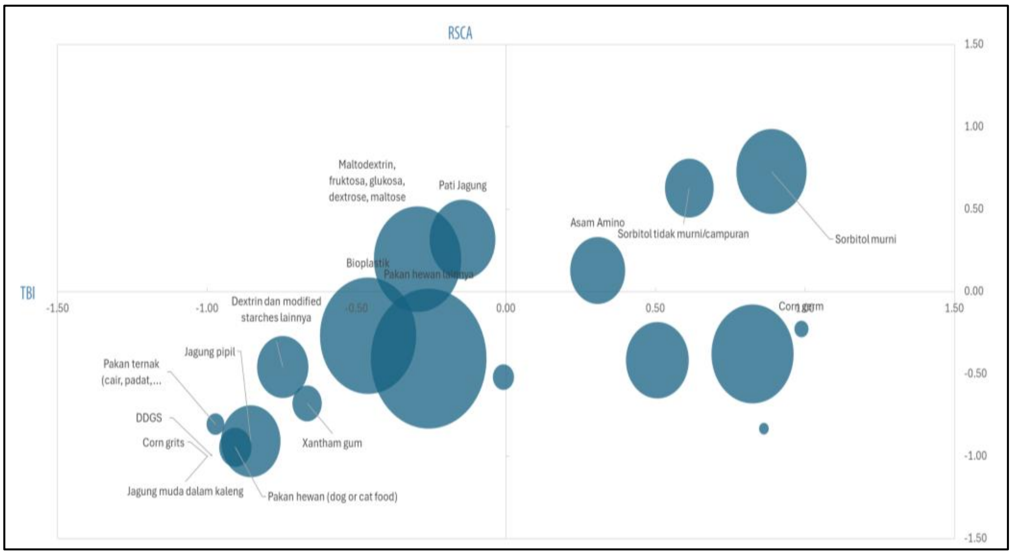
Appendix 19 Agricultural GDP Development, (BPS, 2014-2024)



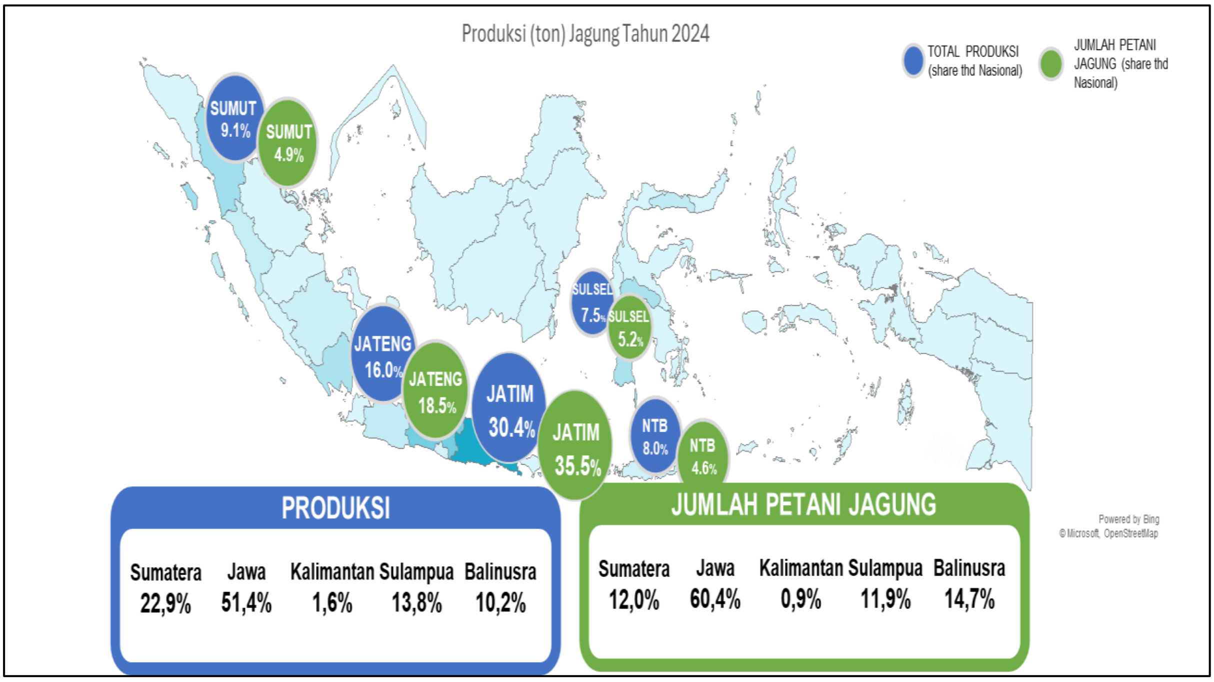
Appendix 20 Net Exports of Corn Commodity (Upstream, Intermediate, Downstream), (UN-ComTrade, 2019-2023)



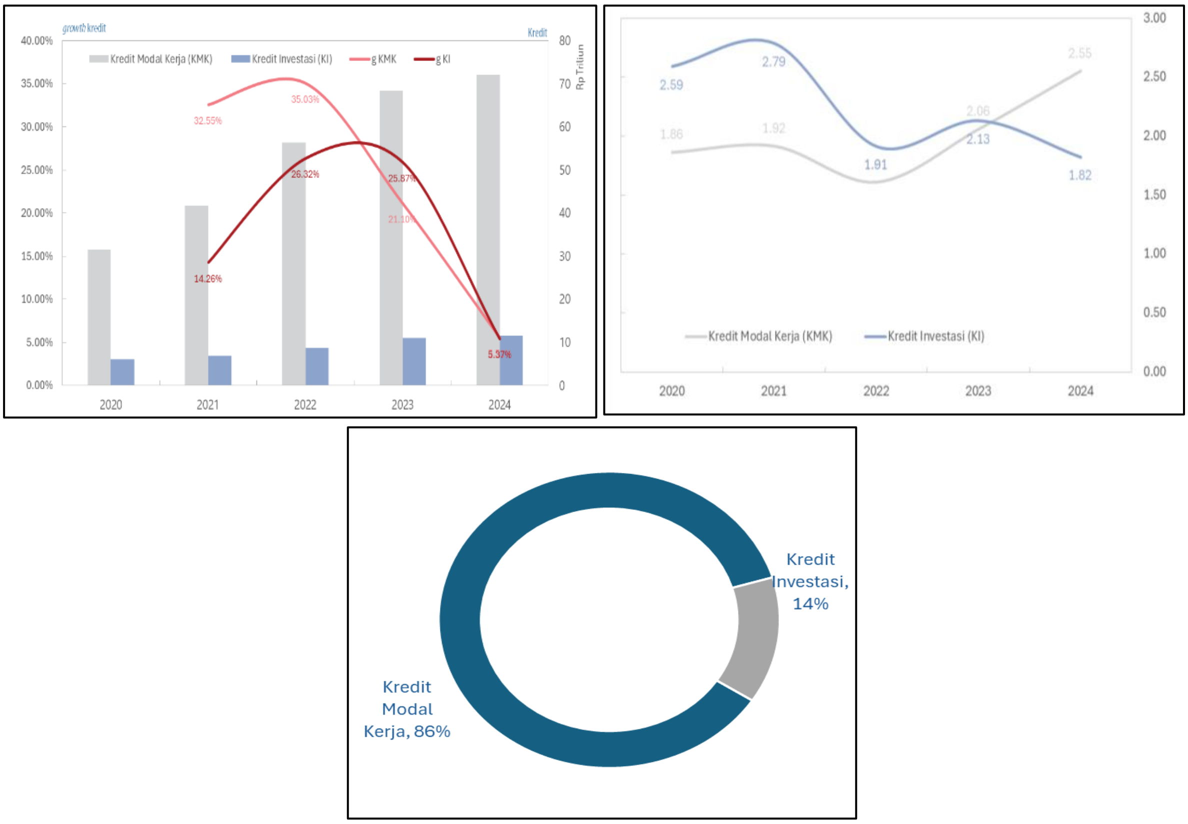
Appendix 21 Scatter Plots RSCA & TBI Corn Commodity, (UN-ComTrade, 2024)



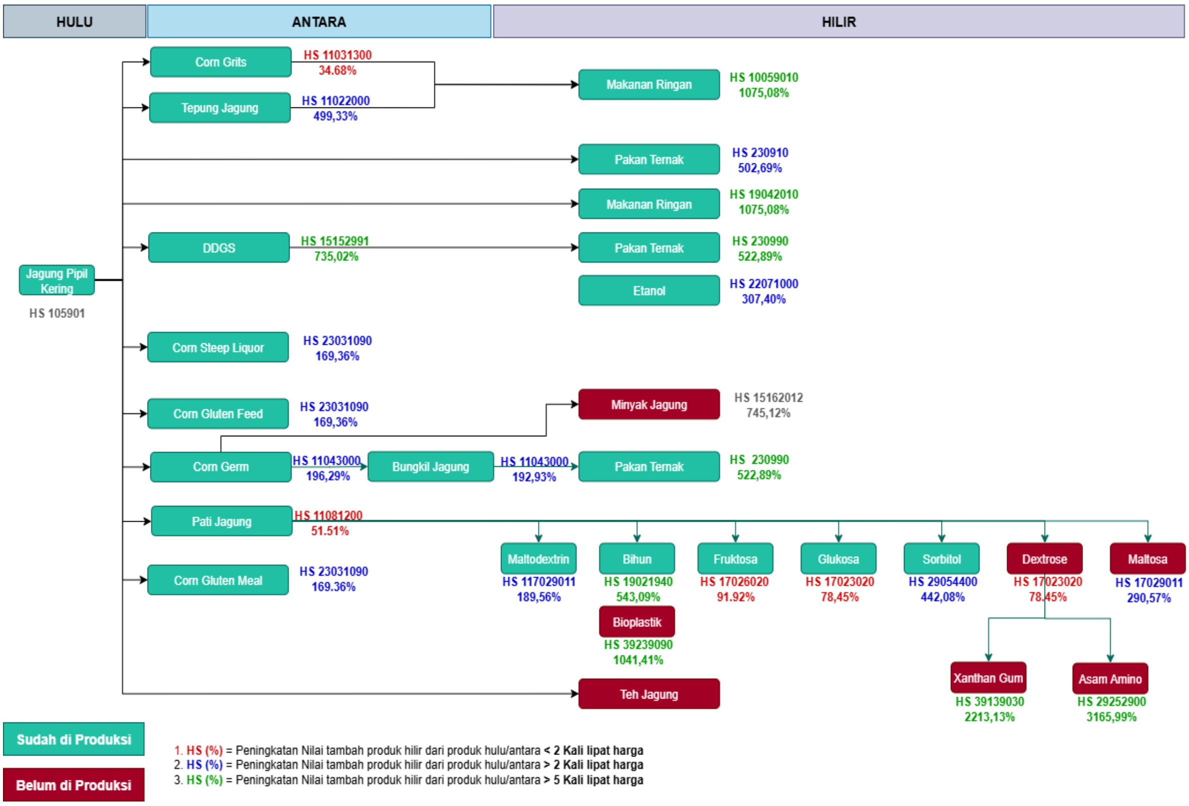
Appendix 22 Production Distribution and Number of Corn Farmers by Province



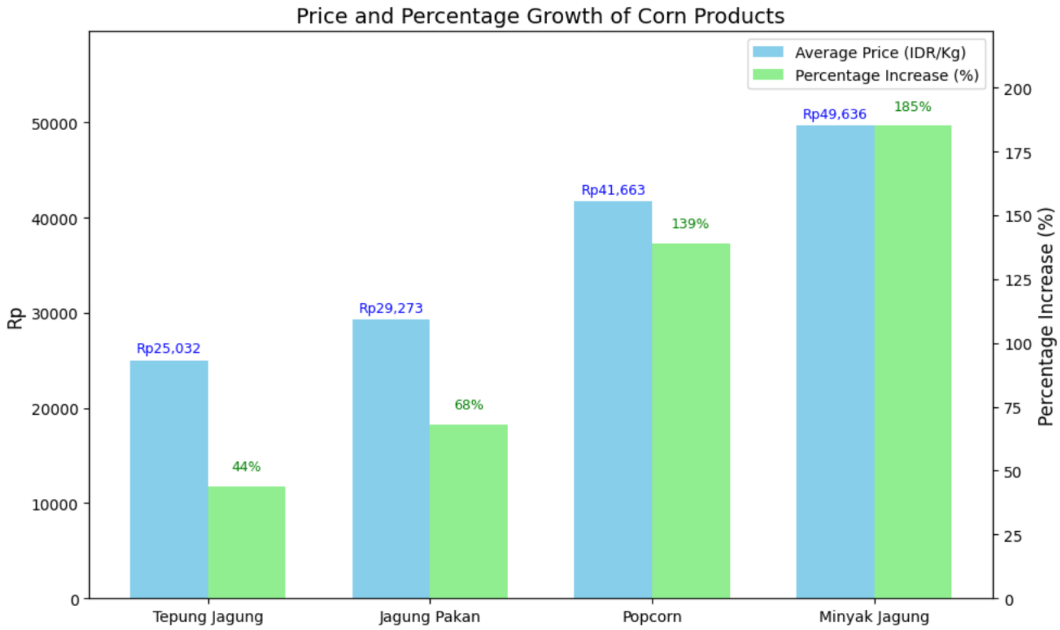
Appendix 23 Corn Commodity Financing and Credit Profile



Appendix 24 Corn/Maize Industry Tree, (Ministry of Industry, 2025)



Appendix 25 Increase in Corn Prices at the Consumer Level, (Web-Scrapping E-commerce, 2025)



Appendix 26 Panel Data Regression (Corn/Maize), (Industry Survey, 2017-2021)

	(FE) ekspor	(FE-DK) ekspor	(FE) impor	(FE-DK) impor	(FE) productivity	(FE-DK) productivity	(FE) pendapatan	(FE-DK) pendapatan
Nilai_tambah	1.139**	0.464	-0.149***	-0.0674*	0.552***	0.559***	0.781***	0.695***
	(0.002)	(0.328)	(0.000)	(0.018)	(0.000)	(0.000)	(0.000)	(0.000)
FDI	-0.00335	-0.0109	-0.00330	-0.00145	0.00493**	0.00543**		
	(0.750)	(0.308)	(0.677)	(0.588)	(0.003)	(0.003)		
Capital_I	-0.438	0.247	0.127	0.781***	-0.0873***	-0.190***	0.124***	0.194**
	(0.373)	(0.286)	(0.156)	(0.000)	(0.000)	(0.000)	(0.000)	(0.007)
fsize	-1.764	-1.597	-0.359	-0.322			0.206**	0.137
	(0.199)	(0.152)	(0.121)	(0.497)			(0.005)	(0.174)
HHI	-1.225	70.78					-43.68***	0.154
	(0.976)	(0.302)					(0.000)	(0.971)
drawmaterial			-1.322*	-1.394*				
			(0.025)	(0.022)				
Upah_pekerja					0.161*	0.823***		
					(0.018)	(0.001)		
Insentif					-0.0482	-0.0483		
					(0.095)	(0.095)		
Energy							-0.205***	-0.195***
							(0.000)	(0.000)
N	3515	3515	3515	3515	3515	3515	3515	3515
R-sq	0.659	0.388	0.354	0.581	0.880	0.850	0.902	0.886
adj. R-sq	0.412		-1.482		0.879		0.901	

p-values in parentheses
* p<0.05, ** p<0.01, *** p<0.001

Appendix 27 Computable General Equilibrium (Corn/Maize), (IO, 2020 and IRIO, 2016)

Figure 1 Impact of Downstream through Increased Productivity (6%) and Decreased Corn Imports (8%)

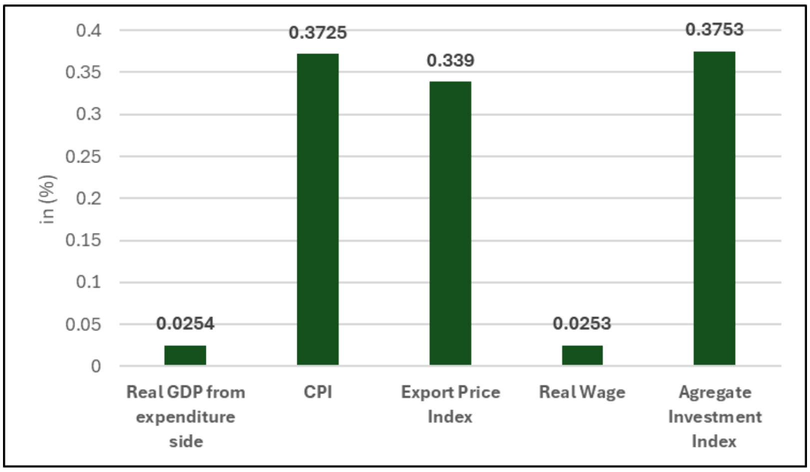
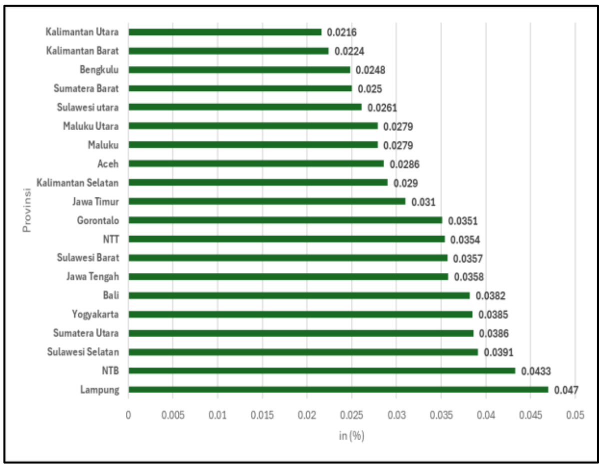
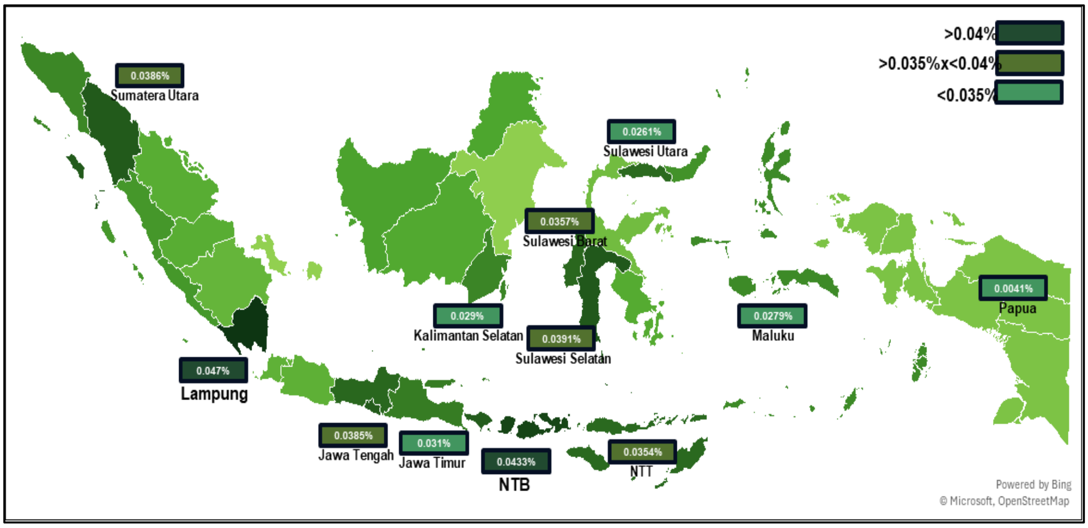
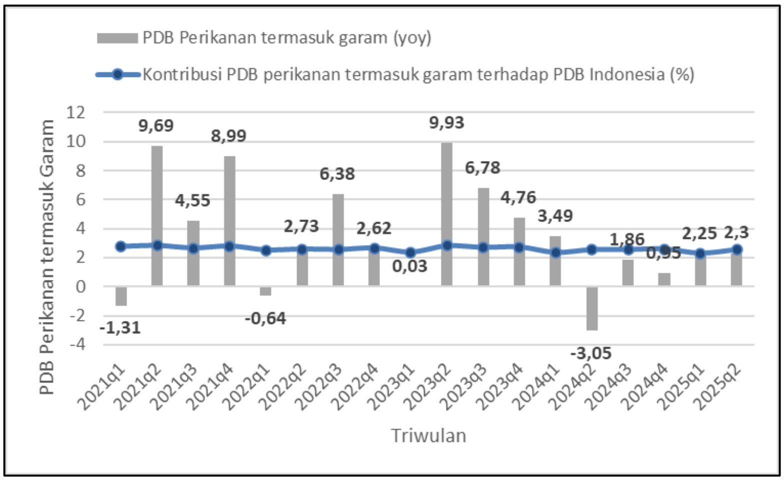


Figure 2 The Impact of Increased Productivity (5%) and Decrease in Imports for Self-Sufficiency (8%) in the Corn Sector on GDRP

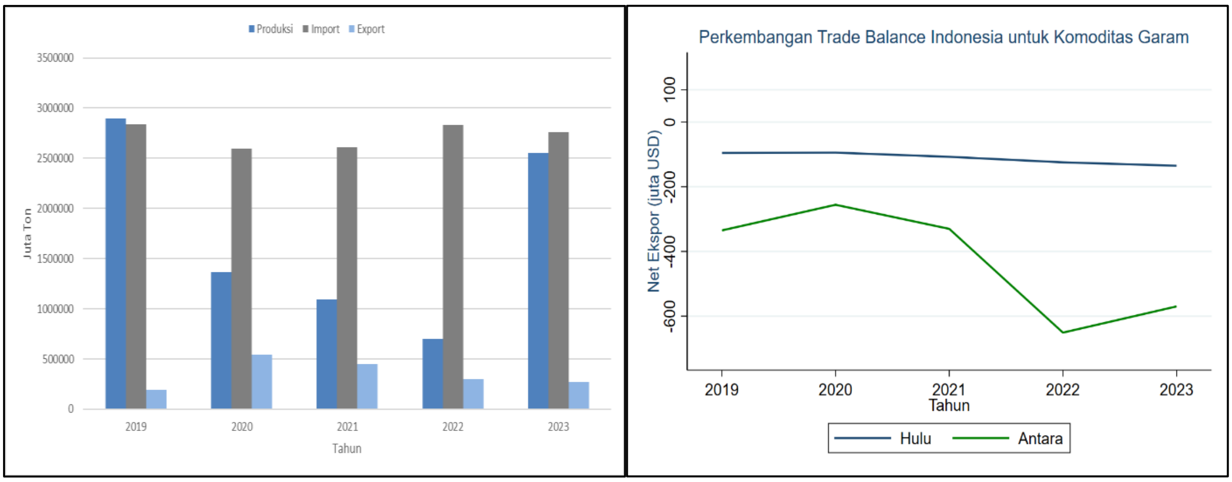




Appendix 28 Development of Salt GDP, (BPS, 2021-2024)



Appendix 29 Production, Net Export and Trade Balance, (UN-ComTrade, 2019-2023)

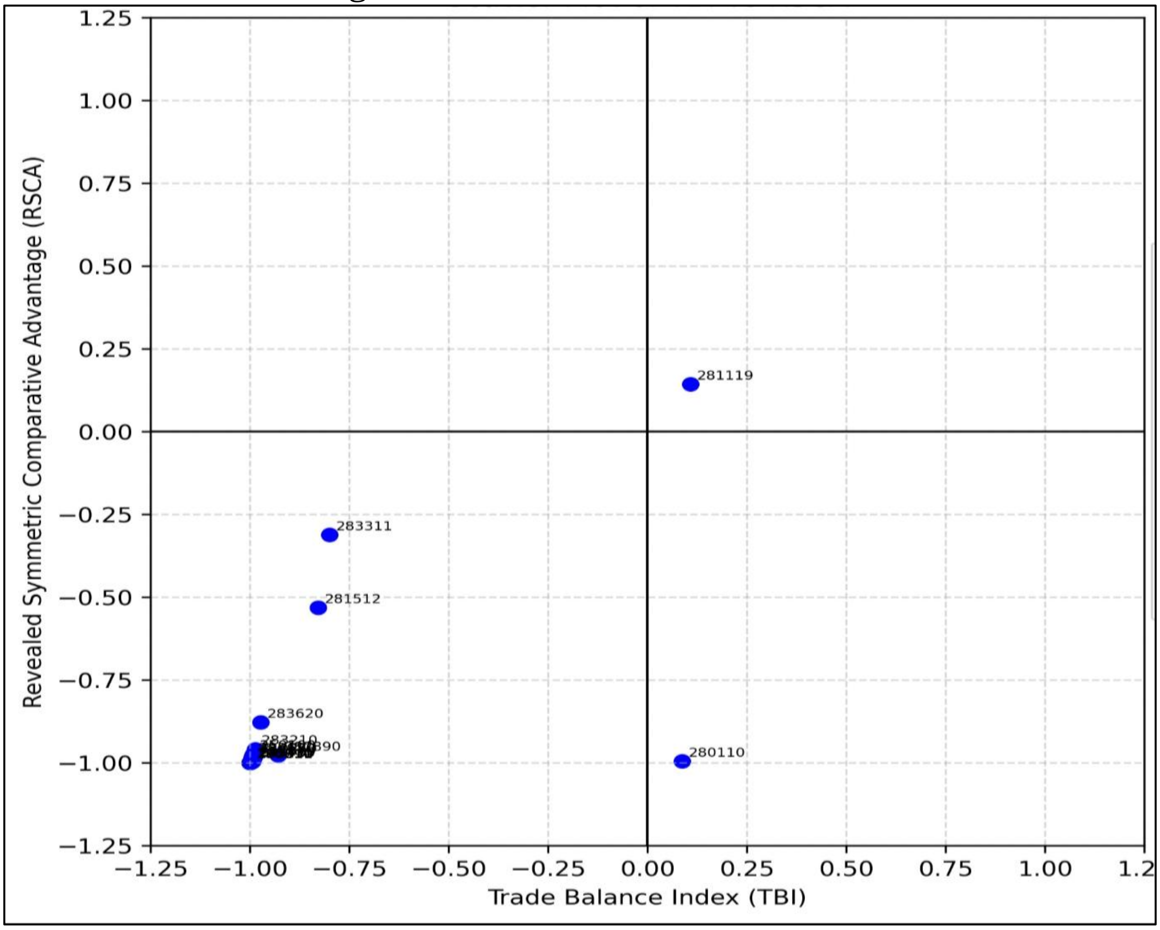


Appendix 30 Scatter Plots RSCA & TBI Salt Commodities, (UN-ComTrade, 2024)

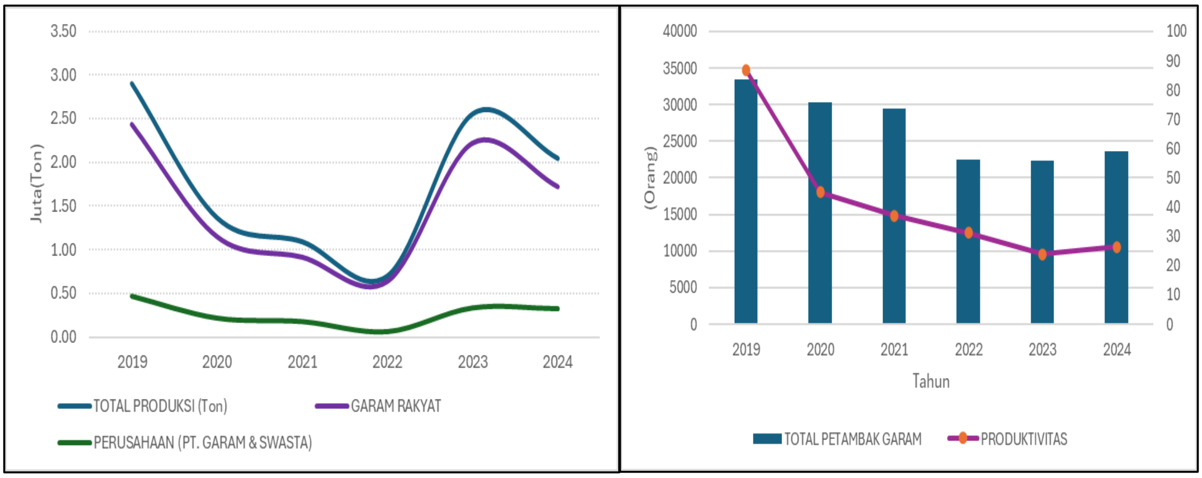
HS Legend

- 281119: Inorganic acids; other than hydrogen fluoride
- 283311: Sodium sulphates; disodium sulphate
- 281512: Sodium hydroxide (caustic soda); in aqueous solution (soda lye or liquid soda)
- 283620: Carbonates; disodium carbonate
- 283210: Sulphites; of sodium
- 250100: Salt (including table salt and denatured salt); pure sodium chloride whether or not in aqueous solution; sea water
- 282890: Hypochlorites; n.e.c. in heading no. 2828
- 283630: Carbonates; sodium hydrogen carbonate (sodium bicarbonate)
- 310250: Fertilizers, mineral or chemical; nitrogenous, sodium nitrate
- 2501: Salt
- 282619: Fluorides; other than of aluminium
- 280110: Khlor
- 2834: nitrate
- 282739: Chlorides; other than of ammonium, calcium, magnesium, aluminium and nickel
- 283230: Thiosulphates
- 282810: Hypochlorites; commercial calcium hypochlorite and other calcium hypochlorites
- 284019: Borates; disodium tetraborate (refined borax), other than anhydrous
- 280610: Asam Klorida
- 290391: Kloborenze

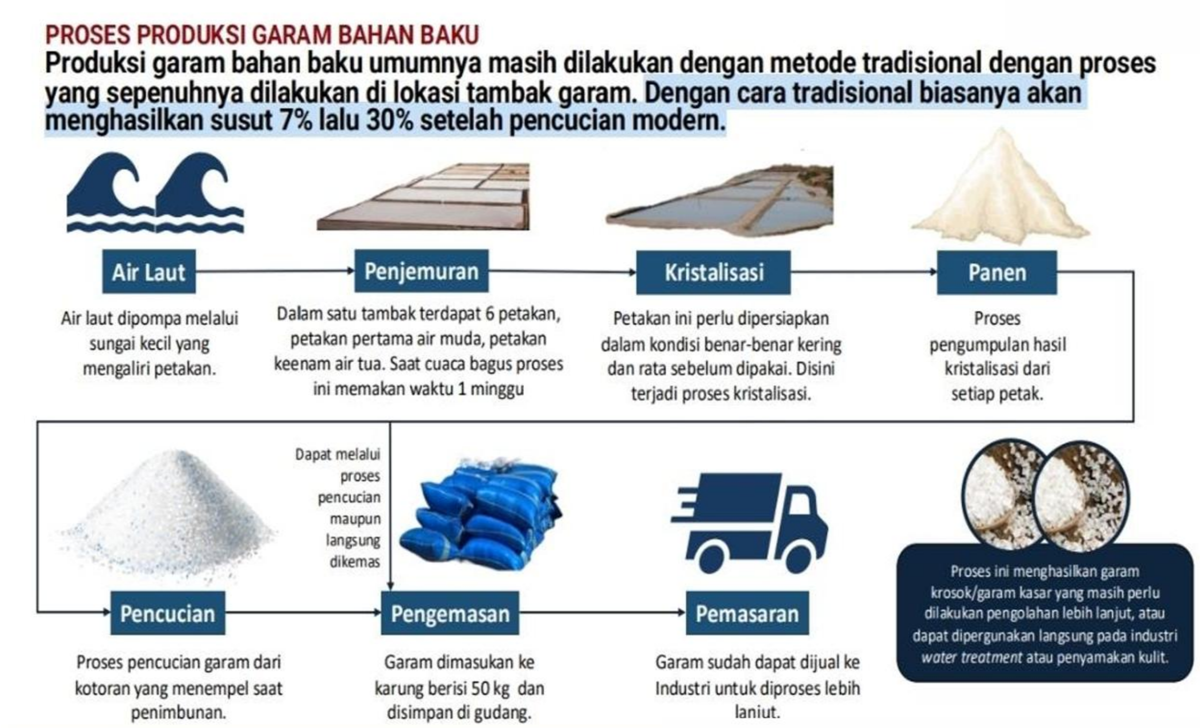
Figure 1 RSCA & TBI Scatter Plot

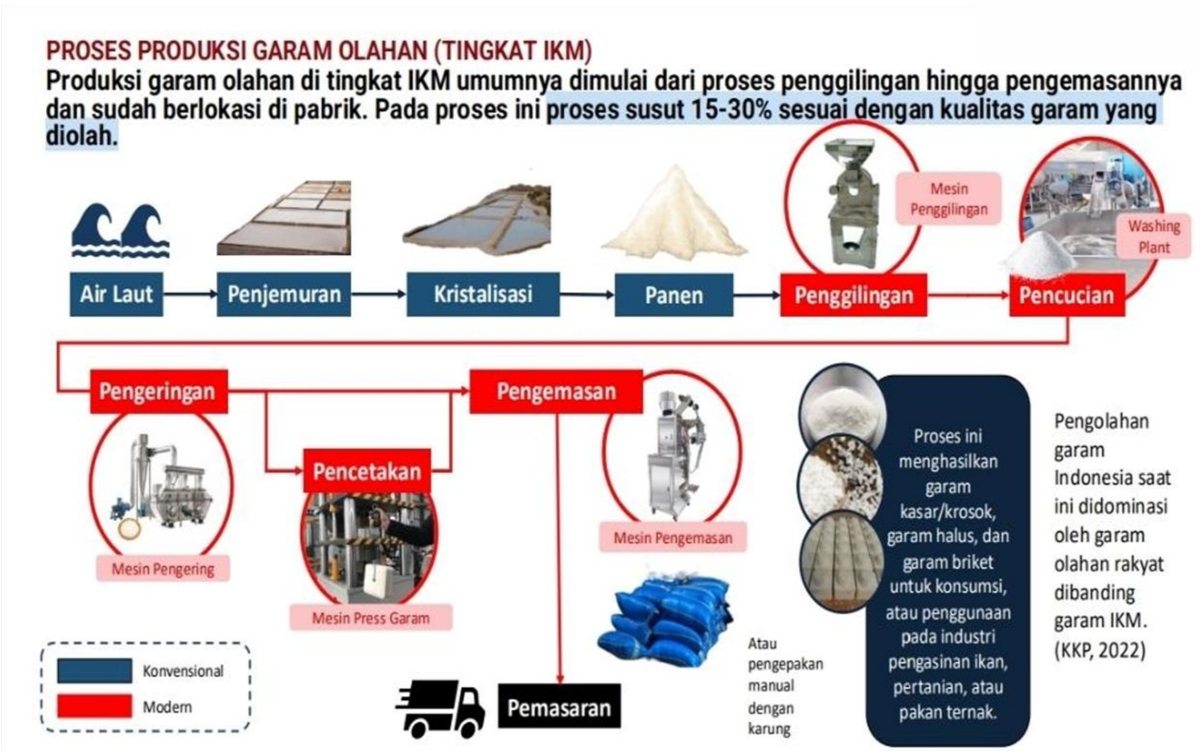


Appendix 31 Production Distribution, Total Farmers and Productivity, (Ministry of Maritime Affairs and Fisheries, 2019-2024)



Appendix 32 Traditional Salt Production Process and SME Level, (FGD: Ministry of Maritime Affairs and Fisheries, 2025)

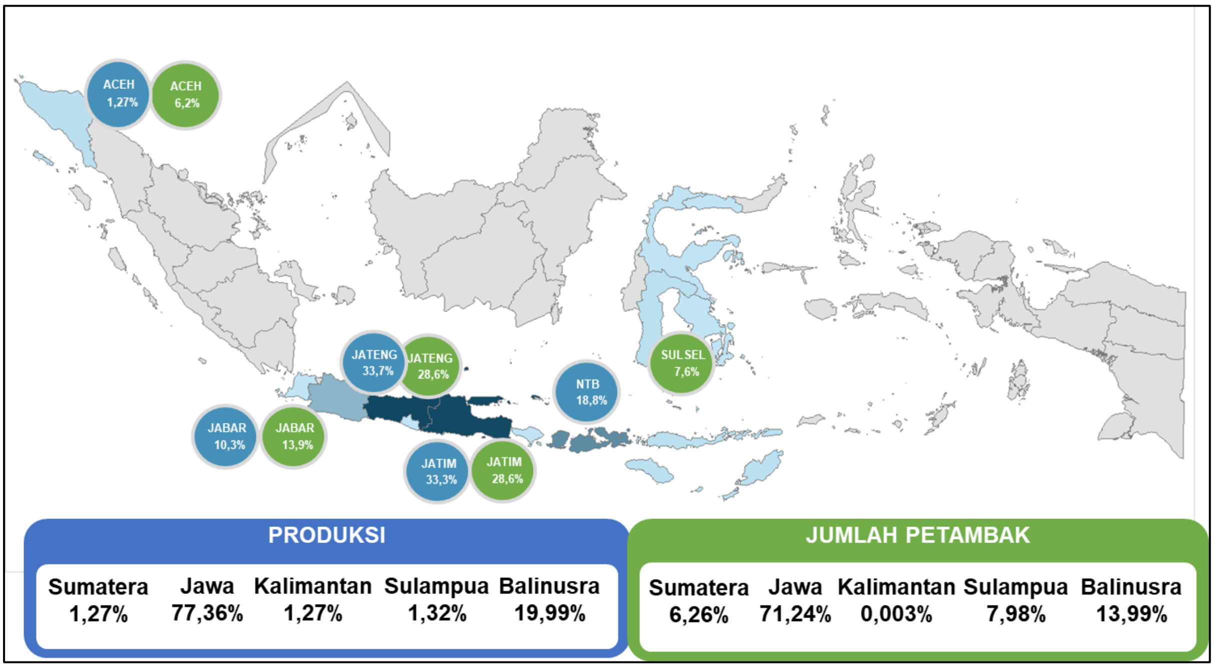




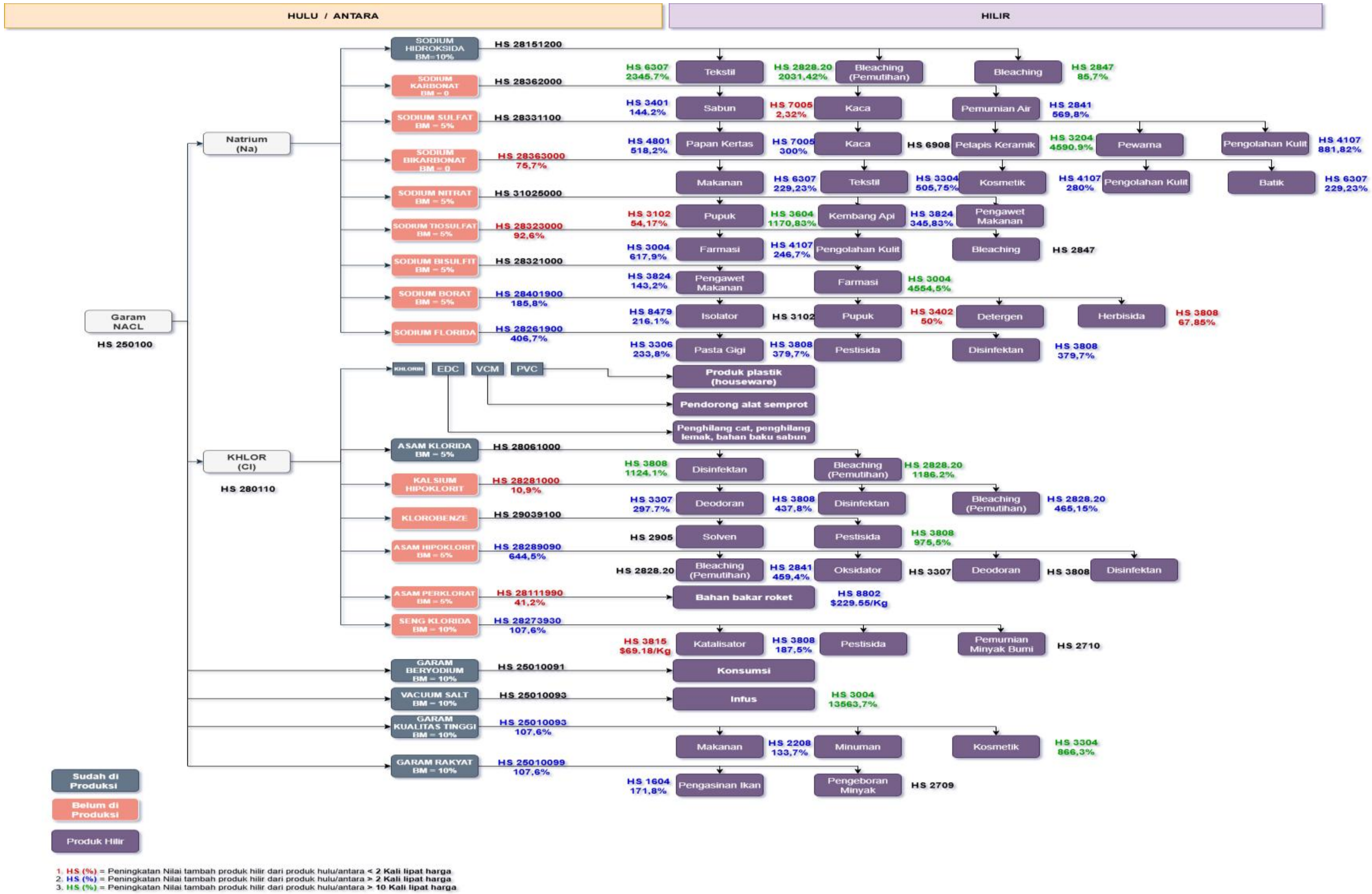
Appendix 33 National Needs (Salt), (Ministry of Maritime Affairs and Fisheries, 2025)

POTENSI PEMASARAN		
Jenis Kebutuhan Garam Industri	**Volume Kebutuhan (juta ton/tahun)**	**Keterangan**
Industri Makanan dan Minuman	0,6 – 0,8	SNI Butuh NaCl ≥ 94%
Industri Farmasi dan Kosmetik	0,1 – 0,15	Butuh NaCl ≥ 99% (pharmaceutical grade)
Industri Kimia dan Tekstil	1,5 – 1,8	Butuh NaCl ≥ 97%
Industri Chlor Alkali (CAI)	1,0 – 1,2	Digunakan untuk soda api, pemutih, dll
Lain-lain (pengeboran, pengasinan)	0,1 – 0,2	Termasuk sektor UMKM
Total Garam Industri	3,3 – 4 juta ton/tahun	Sekitar 65–70% dari total kebutuhan SNI konsumsi, kemasan kecil
Garam Konsumsi Rumah Tangga	1,2 – 1,5 juta ton/tahun	SNI konsumsi, kemasan kecil
Total Nasional	4,5 – 5,2 juta ton/tahun	

Appendix 34 Production Distribution and Number of Salt Farmers, (Ministry of Maritime Affairs and Fisheries, 2024)



Appendix 35 Salt Industry Tree, (Ministry of Industry, 2025)



Appendix 36 Panel Data Regression (Salt), (Industry Survey, 2017-2021)

	(FE) ekspor	(FE-DK) ekspor	(FE) impor	(FE-DK) impor	(FE) productivity	(FE-DK) productivity	(FE) pendapatan	(FE-DK) pendapatan
Nilai_tambah	0.612***	0.369*	-0.312***	-0.211**	0.418***	0.437***	0.875***	0.854***
	(0.000)	(0.046)	(0.000)	(0.002)	(0.000)	(0.000)	(0.000)	(0.000)
FDI	0.00474	0.00705*	0.0177	0.00923	0.00134	-0.000620		
	(0.083)	(0.011)	(0.060)	(0.287)	(0.304)	(0.779)		
Capital_I	0.158**	0.363*	0.151	0.722***	0.0819***	0.163*	0.0427***	0.0710**
	(0.004)	(0.026)	(0.065)	(0.000)	(0.000)	(0.022)	(0.000)	(0.003)
fsize	0.244	-0.103	-0.146	0.509			0.263***	-0.0338
	(0.450)	(0.611)	(0.514)	(0.328)			(0.000)	(0.793)
HHI	-3.790	16.46					7.537***	7.906*
	(0.482)	(0.230)					(0.000)	(0.034)
drawmaterial			-1.289***	-1.256**				
			(0.000)	(0.007)				
Upah_pekerja					0.385***	0.994**		
					(0.000)	(0.005)		
Insentif					0.0112	-0.0173		
					(0.636)	(0.828)		
Energy							-0.0996***	-0.0988*
							(0.000)	(0.015)
N	4294	4294	4294	4294	4294	4294	4294	4294
R-sq	0.580	0.539	0.672	0.668	0.880	0.842	0.917	0.913
adj. R-sq	0.570		-0.139		0.879		0.916	

p-values in parentheses
* p<0.05, ** p<0.01, *** p<0.001

Appendix 37 Computable General Equilibrium (Salt), (IO, 2020 and IRIO, 2016)

Figure 1 Downstream Impact through Increased Productivity (53%) to achieve salt self-sufficiency

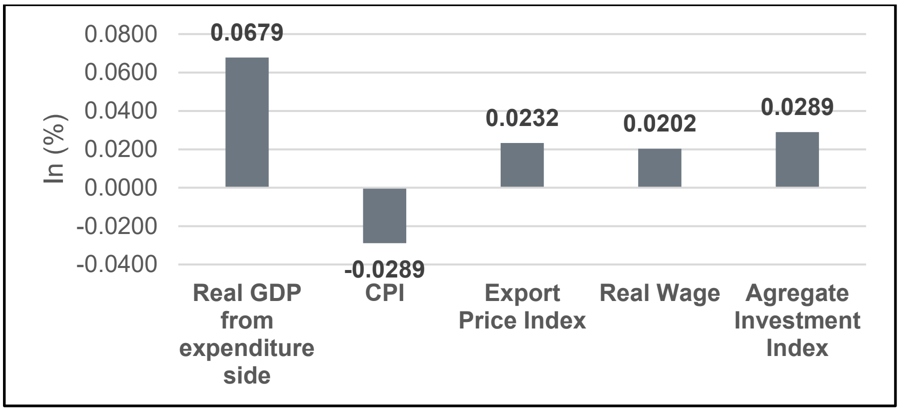
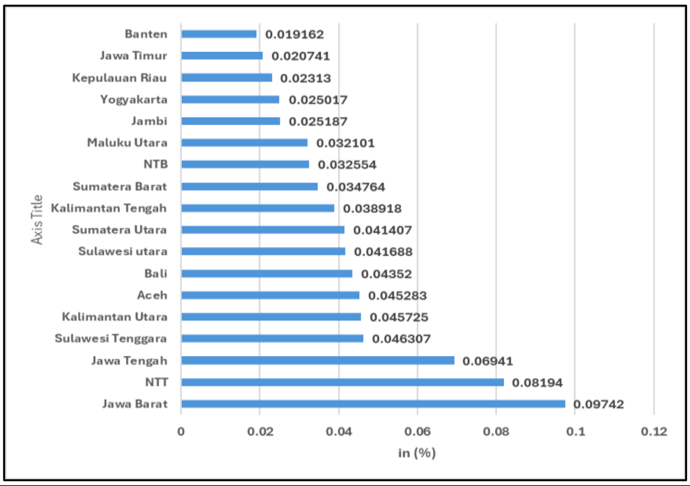
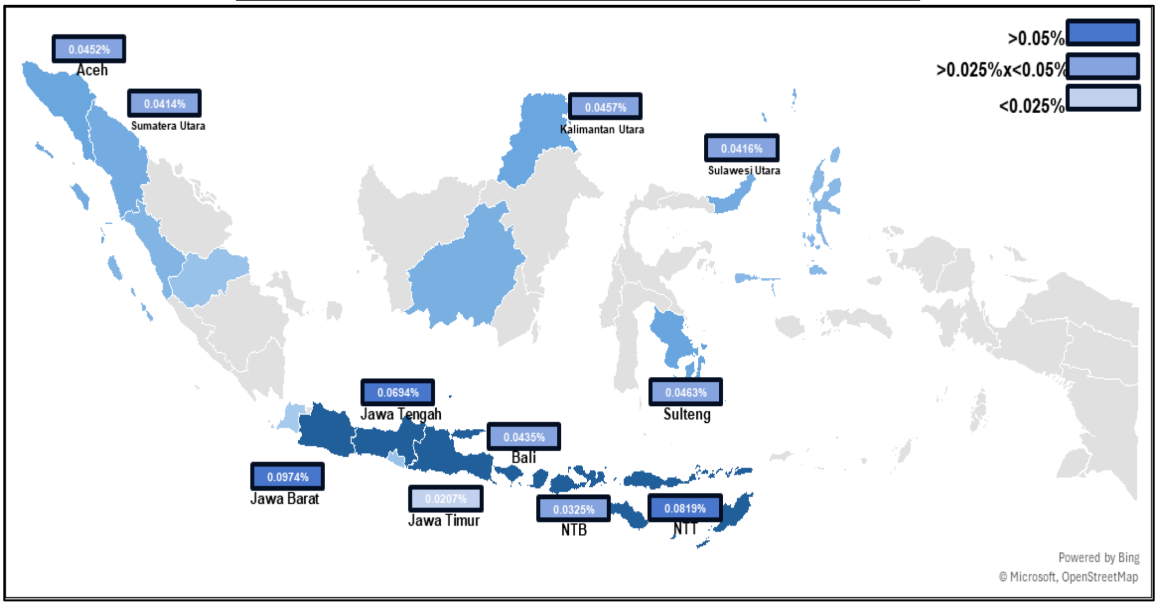


Figure 2 The Impact of Increased Productivity (53%) in the Salt Sector on GDRP





Appendix 38 Business Model (Tuna Fisheries), (FGD and Field Surveys)

Figure 1 Business Model of Field Study Findings (Tuna Fisheries)

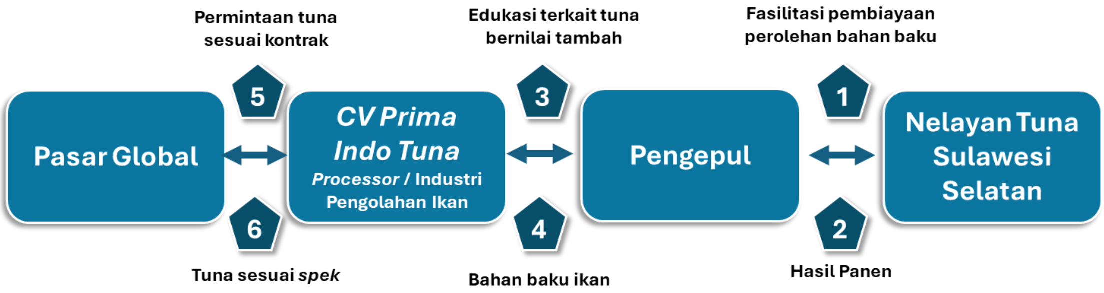


Figure 2 Recommendations for Business Models and Fishermen's Financing

Tingkat	Industri	Klaster/Koperasi	Nelayan
Pembiayaan	*Pre-export working capital*	KUR berbasis klaster, *suppy chain financing*	KUR nelayan, *supplier financing via koperasi*

Appendix 39 Business Model (Corn/Maize), (FGD and Field Surveys)

Figure 1 Business Model of Field Study Findings (Corn/Maize)

Figure 2 Business Model and Financing Recommendations for Corn/Maize Sector

Tingkat	Industri	Klaster/Koperasi	Nelayan
Pembiayaan	Kredit perbankan, modal sendiri	KUR berbasis klaster, *PO/contract financing*	KUR mikro, talangan modal dari koperasi

Appendix 40 Business Model (Salt), (FGD and Field Surveys)

Figure 1 Business Model of Field Study Findings (Salt)

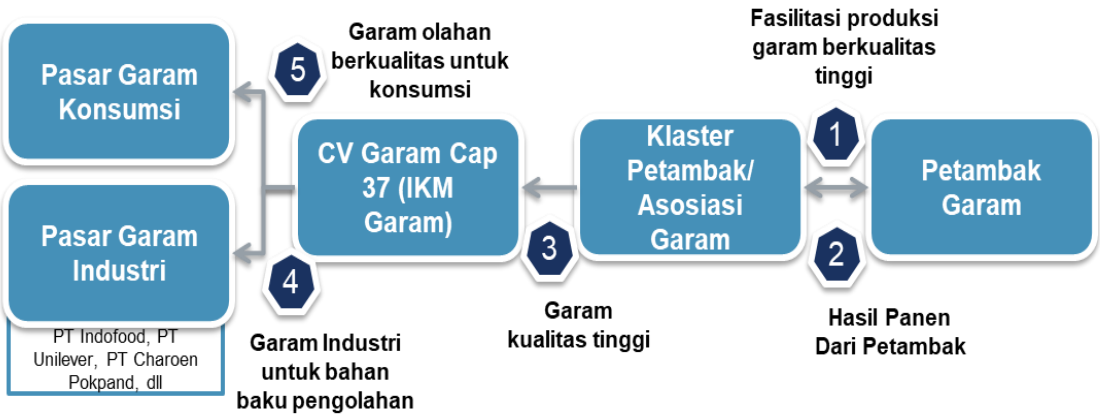


Figure 2 Business Model and Financing Recommendations for Salt Sector

Tingkat	IKM Garam	Klaster/Koperasi	Petambak
Pembiayaan	Kredit perbankan, modal sendiri	KUR berbasis klaster, *PO/contract financing*	KUR mikro, talangan modal dari koperasi, sistem resi gudang