INDONESIA'S POSITION AND PARTICIPATION IN THE GLOBAL VALUE CHAIN OF THE AGRICULTURE SECTOR

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Abstract

Background: The agricultural sector in Indonesia, contributing 13.7% to GDP and employing 30% of the workforce, is critical to the nation's economy. Despite its importance, the country's participation in the agricultural global value chain (GVC) faces persistent challenges, particularly in advancing agro-processing and integrating into high-value production.
Purpose: This study analyzes Indonesia's GVC position and participation from 2007 to 2021, using the UIBE GVC Index and ADB ICIO data.
Design/Methodology/Approach: Descriptive statistics and linear regression methods are used to assess Indonesia's forward and backward GVC participation compared to that of 62 other countries worldwide.
Findings/Result: Findings reveal significant declines in Indonesia's backward participation, reflecting progress toward self-sufficiency, yet limited participation in complex forward and backward linkages underscores deficiencies in technological infrastructure and value-added exports. Moderate engagement in simple forward linkages highlights the need for targeted investments to boost competitiveness. Strategic interventions in infrastructure, advanced inputs, capacity-building, and global collaborations are essential for strengthening Indonesia's agricultural GVC role.
Conclusion: To enhance GVC participation, Indonesia must address technological, infrastructure, and policy gaps. Strategic investments in agro-processing, advanced inputs, supply chain modernization, and international partnerships are critical to boosting competitiveness and export performance.
Originality/Value (State of the Art): This study provides comprehensive insights for policymakers and stakeholders, emphasizing innovative strategies to enhance Indonesia's global agricultural presence and achieve sustainable growth.

Keywords: Agriculture, GVC Position, GVC Participation, Global Value Chain (GVC), UIBE GVC Index.

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INTRODUCTION

Indonesia's agricultural sector serves as a crucial pillar of the national economy, contributing 13.7% to the Gross Domestic Product (GDP) and providing employment for 30% of the workforce (Firda & Estiningtyas, 2021). As one of the largest agricultural economies in Southeast Asia, Indonesia has a diverse range of agricultural commodities, including palm oil, fisheries, rice, rubber, pulp and paper, and coffee, which are significant contributors to both domestic consumption and international trade (Marissa et al. 2020; Prakarsa, 2022; Yunita, 2021). However, despite its strong agricultural production base, Indonesia has yet to fully integrate into the Global Value Chain (GVC) in a way that maximizes economic benefits and strengthens long-term sustainability.

Participation in the GVC is critical for enhancing economic competitiveness, fostering innovation, and creating more efficient production linkages. In the case of Indonesia, many of its key agricultural commodities are exported as raw materials with minimal value addition, resulting in lost economic opportunities. The lack of advanced processing capabilities, weak market linkages, and limited adoption of modern agricultural technologies have prevented Indonesia from capturing higher-value segments within the GVC. Additionally, unequal value distribution in the supply chain has led to a scenario where smallholder farmers who produce a significant portion of the country's agricultural output receive disproportionately low profits compared to large agribusiness firms and downstream processors (Guritno, 2018; Alkayyis et al. 2021).

Given these challenges, understanding Indonesia's position and participation in the GVC is essential for formulating strategies to enhance its global trade competitiveness. A comprehensive assessment of historical trends, structural barriers, and potential policy interventions can provide valuable insights into how Indonesia can strengthen its role in the global agricultural economy while ensuring more equitable economic gains for all stakeholders.

Over the past decade, extensive research has been conducted on global agricultural value chains, with a focus on trade integration, market efficiency, and the role of technology in enhancing productivity. Existing literature highlights Indonesia's strong position as a major global supplier of agricultural commodities but also reveals persistent disparities in economic benefits across different actors in the supply chain (Nabhani et al. 2015; Rum & Rijoly, 2020). Previous studies have shown that smallholder farmers are often marginalized in the value chain, with limited access to modern technologies, financial resources, and global markets, making it difficult for them to benefit from international trade (Nuryanah et al. 2021).

Additionally, Indonesia's GVC participation exhibits weaknesses in backward and forward linkages. While the country has made progress in reducing reliance on imported agricultural inputs, its domestic agro-processing industry remains underdeveloped, leading to an overreliance on exporting raw commodities rather than processed goods with higher value-added (Nugraha et al. 2024b). As a result, Indonesia struggles to compete with nations that have strong agro-industrial bases and advanced supply chain networks.

Despite the growing body of research on GVC integration and agricultural trade, studies focusing on Indonesia's specific positioning within the agricultural GVC remain limited. There is a need for a more comprehensive, data-driven analysis that not only maps Indonesia's GVC participation but also examines historical trends, structural weaknesses, and potential policy interventions to enhance competitiveness. This study seeks to address this research gap by providing a detailed evaluation of Indonesia's GVC engagement from 2007 to 2021, using a combination of quantitative and qualitative analytical techniques.

This study adopts a quantitative and qualitative approach to assess Indonesia's participation in the agricultural Global Value Chain (GVC). Utilizing secondary data from the UIBE GVC Index and the ADB ICIO database (2007–2021), the research examines Indonesia's forward (export) and backward (import) linkages to identify trends, structural challenges, and comparative performance relative to other economies.

Based on these findings, the study develops targeted policy recommendations to strengthen Indonesia's agricultural competitiveness and value chain integration. The research emphasizes strategies such as enhancing agro-processing capabilities, expanding access to advanced agricultural inputs, improving trade partnerships, and modernizing supply chain infrastructure. By linking empirical analysis with strategic policymaking, this study aims to provide

actionable insights for policymakers, industry stakeholders, and researchers to optimize Indonesia's role in global agricultural trade and promote sustainable economic growth.

This study aims to comprehensively analyze Indonesia's position and participation in the agricultural Global Value Chain (GVC), focusing on its forward and backward linkages within global trade networks. By examining historical trends from 2007 to 2021, this research seeks to identify key structural changes, barriers, and comparative performance relative to other economies. Understanding these dynamics is essential for enhancing Indonesia's agricultural competitiveness, strengthening its global trade integration, and ensuring equitable value distribution within the supply chain.

Furthermore, the study intends to develop strategic policy recommendations to address Indonesia's limited engagement in high-value segments of the GVC. This includes enhancing agro-processing capabilities, improving access to advanced agricultural inputs, and fostering stronger global trade partnerships. By providing a data-driven assessment of Indonesia's agricultural trade performance, the findings will serve as a foundation for policy formulation and industry decision-making, helping stakeholders navigate the challenges of global market integration and sustainable economic growth.

METHODS

The research assesses Indonesia's participation in the global agricultural value chain by utilizing the UIBE GVC Index developed by the University of International Business and Economics in China (Mouanda-Mouanda, 2019). The UIBE GVC Index offers a holistic assessment of a country's participation in global value chains, considering both upstream and downstream linkages (Dutta, 2021).

The research collects data through secondary data extraction sourced from the UIBE GVC Index from 2007 to 2021. To provide a thorough assessment of the country's involvement in global value chains, data are retrieved and structured systematically to facilitate comparative and trend analysis.

Descriptive statistics and exploratory analysis are applied to gain insights into Indonesia's position in GVC participation in the agricultural sector. To address the second objective, the study utilizes linear regression analysis to identify changes in Indonesia's GVC participation in the agriculture sector over time, as well as the factors driving these trends (Lim & Kim, 2022; Zhang, 2023). The analysis leverages the available data from the UIBE GVC Index for Indonesia and 62 other countries, with additional analysis grouping the data by income level and economic regions. Simple linear regression is employed to detect any significant trends across the year (James et al. 2021; Zdaniuk, 2014). At the last stage, based on the findings from the UIBE GVC Index analysis, the study proposes policy recommendations to strengthen Indonesia's position and participation in the global agricultural value chain. A linear regression defines the relationship between a dependent variable and one or more independent variables in the following form:

$$Y = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + ... + \beta_n X_n + \varepsilon$$

Where Y is the dependent variable, X_1, X_2, ..., X_n are the independent variables, β_0 is the constant term, β_1, β_2, ..., β_n are the regression coefficient for each independent variable, and ε is the error term (James et al. 2013). In this study, the dependent variable is the year range from 2007 to 2021, and the independent or predictor variables will be the participation index as shown in Table 1.

Analyzing a country's position and participation in global value chains can be done by examining its forward and backward linkages in global trade data (Dutta, 2021). This approach uses input-output tables to track the flow of goods and services across countries (OECD, 2013). The participation index value reflects a country's involvement in the global agricultural value chain. This index can be broken down into two components: The forward linkage-based participation index measures the extent to which a country's domestic value-added is used in other countries' exports, indicating its position in the downstream stages of the value chain. The backward linkage-based participation index measures the extent to which a country relies on foreign value-added in its exports, indicating its position in the upstream stages of the value chain (García-Ramos & Gambero, 2018).

Table 1. Predictor variables for regression analysis

Variable	Description
Xpfs	Simple forward GVC participation
Xpfc	Complex forward GVC participation
Xpbs	Simple backward GVC participation
Xpbc	Complex backward GVC participation

GVC participation can be divided into simple and complex forms, based on the number of countries involved. Simple GVC participation reflects the share of a country's gross exports that are part of a vertical trading relationship, regardless of whether the country is in the upstream or downstream segment. In contrast, complex GVC participation focuses on the domestic value-added that is part of intricate value chains, where a country's exports contain foreign value-added, and its own value-added is also embodied in other countries' exports (Wang et al. 2017).

A model created by Koopman et al. (2010) has been modified to examine the correlation between a nation's GVC and its trading partners, as articulated in the position and participation index. The GVC Position Index assesses whether a specific country sector, indexed by sector i in country r, is upstream or downstream in the global value chain. It is calculated as the logarithm of the ratio between IV_{ir}, the sector's indirect value-added exports (intermediates used by other countries for exports), and FV_{ir}, the foreign value-added in imports used by that sector. A higher $GVC\_Position_{ir}$ suggests an upstream role, providing inputs for other countries' exports, while a lower value indicates a downstream role, using foreign intermediates primarily for final goods production.

$$GVC\_Position_{\mathrm{ir}} = Ln\left(1 + \frac{IV_{\mathrm{ir}}}{E_{ir}}\right) - Ln\left(1 + \frac{FV_{ir}}{E_{ir}}\right)$$

The GVC Participation Index measures the level of involvement of sector i in country r within the global supply chain by summing IV_{ir} (indirect value-added exports) and FV_{ir} (foreign value-added in imports). A higher GVC_Participation signals deeper integration, reflecting both the sector's role as a supplier to other countries' exports and its reliance on foreign inputs for production, highlighting the sector's interconnectedness and economic reach within global trade. For this purpose, the use of the formula described by (Koopman et al. 2010) will result in the following changes:

$$GVC\_Partisipation_{\mathrm{ir}} = \frac{IV_{ir}}{E_{ir}} + \frac{FV_{ir}}{E_{ir}}$$

These countries were selected based on the UIBE GVC Index. Additional regional analysis was conducted using classifications defined by the World Bank (2024) as outlined in Table 2.

The categorization is updated each year on July 1, based on the 2021 GNI per capita. This GNI is measured in United States dollars (USD) and determined using the Atlas method's conversion factor. The classification of countries by income levels in Table 3. follows the World Bank (2024) framework, which divides the global economy into four categories: lower-middle-income (below USD 4,255 per capita) with 12 countries, upper-middle-income (USD 4,256 to USD 13,205 per capita) with 13 countries, and high-income (above USD 13,206 per capita) with 37 countries. This classification will function as a standard to evaluate whether Indonesia's participation status exceeds or falls short of the average within its economic region or income level category.

As described in Figure 1, the study employs descriptive statistical analysis to map Indonesia's engagement in the GVC and linear regression modeling to analyze factors influencing participation. This method allows for a data-driven assessment of Indonesia's agricultural trade dynamics while providing insights into key barriers such as infrastructure limitations, trade policies, and technological gaps.

This study hypothesizes that Indonesia's position in the Global Value Chain (GVC) is relatively weak compared to high-income countries but remains above that of lower-middle-income countries. This positioning is influenced by factors such as limited technological infrastructure, underdeveloped agro-processing industries, and weaker trade integration. Furthermore, the trend of Indonesia's GVC participation from 2007 to 2021 is expected to show a decline in backward participation, reflecting progress toward self-sufficiency, while forward participation remains stagnant or grows at a slower rate compared to peer countries. These hypotheses will be tested using linear regression analysis with the UIBE GVC Index to assess Indonesia's relative standing and trends over time.

Table 2. Country groups by economic region

Region	Number	Country
Europe & Central Asia	34	Austria, Belgium, Bulgaria, Switzerland, Cyprus, Czech Republic, Germany, Denmark, Spain, Estonia, Finland, France, United Kingdom, Greece, Croatia, Hungary, Ireland, Italy, Lithuania, Luxembourg, Latvia, Malta, Netherlands, Norway, Poland, Portugal, Romania, Russia, Slovak Republic, Slovenia, Sweden, Turkey, Kazakhstan, Kyrgyz Republic
East Asia & Pasific	17	Australia, People's Republic of China, Indonesia, Japan, Republic of Korea, Taipei China, Malaysia, Philippines, Thailand, Viet Nam, Mongolia, Fiji, Laos, Brunei Darussalam, Cambodia, Singapore, Hong Kong China
South Asia	7	India, Bangladesh, Sri Lanka, Pakistan, Bhutan, Maldives, Nepal
North America	2	Canada, United States
Latin America & Caribbean	2	Brazil, Mexico

Table 3. Country groups by income level

Region	Number	Country
High	37	Australia, Austria, Belgium, Canada, Switzerland, Cyprus, Czech Republic, Germany, Denmark, Spain, Estonia, Finland, France, United Kingdom, Greece, Croatia, Hungary, Ireland, Italy, Japan, Republic of Korea, Lithuania, Luxembourg, Latvia, Malta, Netherlands, Norway, Poland, Portugal, Slovak Republic, Slovenia, Sweden, Taipei China, United States, Brunei Darussalam, Singapore, Hong Kong China
Upper Middle	13	Bulgaria, Brazil, People's Republic of China, Indonesia, Mexico, Romania, Russia, Turkey, Malaysia, Thailand, Kazakhstan, Fiji, Maldives
Lower Middle	12	India, Bangladesh, Philippines, Viet Nam, Mongolia, Sri Lanka, Pakistan, Laos, Bhutan, Kyrgyz Republic, Cambodia, Nepal

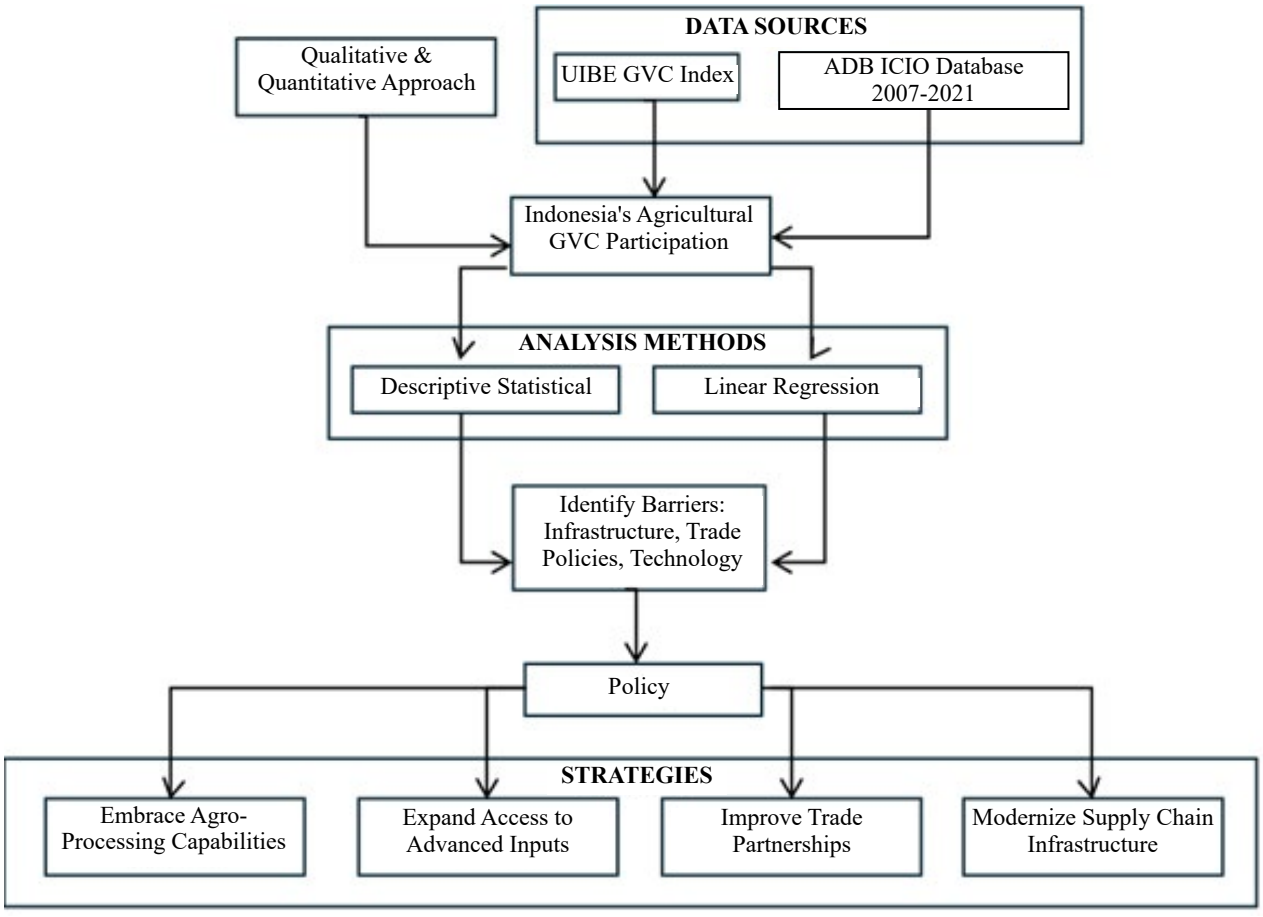

Figure 1. Framework of Indonesia GVC Participation Analysis

RESULTS

The UIBE GVC Index is used to calculate the forward and backward linkage-based participation indices for Indonesia's agricultural sector, enabling an assessment of the country's overall GVC participation and its positioning within the global agricultural value chain (Mouanda-Mouanda, 2019). For these GVC participation indices, values close to 1.0 or 100% would suggest extremely high participation relative to the scale of Indonesia's economy, with major portions of economic output tied to these GVC activities. Conversely, values near zero would indicate low or minimal participation in that specific GVC role, signaling limited engagement (Wang et al. 2017).

Indonesia's Position in the GVC Agriculture Sector

Referring to Table 4, Indonesia's position within the GVC for agriculture reflects both its strengths and limitations across different participation types. The analysis of Indonesia's GVC participation indices for 2021 provides insights into the extent of its involvement in exporting raw and processed agricultural products, as well as its reliance on imported agricultural inputs. Each participation type is examined in relation to Indonesia's relative standing among other countries, allowing for a deeper understanding of its comparative advantages and areas for improvement. This perspective can help inform targeted strategies to enhance Indonesia's role in the agricultural GVC, maximizing both its economic potential and resilience in global markets.

Table 4. Indonesia's Position Ranking of GVC Participation in Agriculture Sector by 2021

Country	Simple Forward Index (SF)	Rank SF	Complex Forward Index (CF)	Rank CF	Simple Backward Index (SB)	Rank SB	Complex Backward Index (CB)	Rank CB
Ireland	61.9	1	30.0	5	39.2	1	8.3	34
Latvia	40.8	2	34.5	2	9.1	35	24.3	7
Bulgaria	37.8	3	24.3	7	12.0	21	9.2	32
Canada	36.3	4	9.6	29	8.6	38	12.3	18
Lithuania	35.8	5	29.6	6	17.5	7	24.6	6
Laos	34.8	6	23.7	8	1.6	61	3.4	47
Estonia	34.5	7	22.9	9	23.1	3	19.9	9
Singapore	27.3	8	10.6	26	17.3	8	12.3	17
Hungary	26.3	9	22.3	10	10.8	26	11.5	23
Brazil	26.2	10	10.7	25	11.0	24	4.0	45
Croatia	25.3	11	16.0	16	9.3	33	9.5	31
Malaysia	24.8	12	10.3	27	8.8	37	4.3	44
Luxembourg	24.4	13	35.7	1	5.4	50	52.2	1
Belgium	22.7	14	33.6	3	3.7	56	36.3	3
Sweden	22.6	15	16.3	15	4.2	54	13.9	15
Thailand	22.4	16	10.0	28	5.5	48	8.0	35
Netherlands	22.4	17	21.8	11	1.4	62	36.6	2
Denmark	19.9	18	19.6	12	3.9	55	31.2	5
Slovenia	19.7	19	15.5	17	13.0	16	17.5	11
Maldives	19.1	20	12.0	23	10.2	30	14.0	14
Finland	18.8	21	12.9	21	8.9	36	3.7	46
Germany	18.4	22	17.2	13	9.8	31	11.5	22
Mongolia	17.8	23	4.9	38	12.7	19	2.8	54
Romania	16.1	24	13.4	20	11.1	23	5.1	41
Viet Nam	15.6	25	5.4	37	16.6	9	23.4	8
Czech	15.5	26	15.3	18	18.5	6	12.2	20
Australia	15.0	27	7.1	32	5.9	45	5.2	40
Slovakia	13.9	28	17.1	14	21.8	4	12.2	19
Austria	13.9	29	13.6	19	10.4	29	11.1	26

Table 4. Indonesia's Position Ranking of GVC Participation in Agriculture Sector by 2021 (continue)

Country	Simple Forward Index (SF)	Rank SF	Complex Forward Index (CF)	Rank CF	Simple Backward Index (SB)	Rank SB	Complex Backward Index (CB)	Rank CB
United States	13.6	30	5.7	35	6.3	43	3.3	49
Poland	11.8	31	11.8	24	14.5	12	11.3	24
Portugal	11.3	32	7.9	30	10.5	28	12.1	21
France	11.2	33	12.1	22	10.8	25	9.7	30
Kazakhstan	10.9	34	5.8	34	5.6	47	2.4	55
****Indonesia**	**10.4**	**35**	**3.8**	**44**	**1.9**	**60**	**0.7**	**62**
Russia	9.8	36	4.4	40	9.3	32	3.2	51
Hong Kong	9.1	37	3.6	46	13.1	15	12.8	16
Switzerland	9.1	38	5.4	36	19.5	5	11.2	25
Cambodia	8.4	39	30.1	4	6.6	41	9.8	29
Greece	8.0	40	3.9	43	16.1	10	11.0	27
Rest of the World	7.8	41	4.3	42	6.8	40	2.8	53
Fiji	7.7	42	1.9	52	10.7	27	5.2	39
Taipei	6.3	43	3.6	45	14.7	11	4.5	43
Spain	5.6	44	4.4	41	4.9	52	10.5	28
Cyprus	5.2	45	6.2	33	12.9	17	15.0	13
Italy	5.0	46	4.5	39	9.2	34	7.9	36
Brunei	4.8	47	1.1	58	34.6	2	16.2	12
Turkey	4.6	48	2.3	49	6.5	42	4.5	42
United Kingdom	4.5	49	7.5	31	12.7	18	8.8	33
Sri Lanka	4.1	50	2.2	50	6.3	44	2.9	52
PR of China	4.0	51	2.6	48	4.5	53	1.4	59
Mexico	3.6	52	1.0	60	5.8	46	6.6	37
Korea	3.5	53	2.0	51	12.6	20	3.3	48
Norway	3.1	54	3.1	47	2.9	58	19.8	10
Kyrgyz Republic	3.1	55	1.0	59	13.7	14	6.5	38
Philippines	2.9	56	1.5	53	5.1	51	2.0	57
India	2.7	57	1.2	57	2.5	59	0.8	61
Japan	2.4	58	1.4	55	11.8	22	3.2	50
Malta	2.1	59	1.4	56	13.8	13	32.8	4
Pakistan	2.0	60	1.4	54	3.6	57	1.0	60
Nepal	1.6	61	0.3	62	5.4	49	1.8	58
Bangladesh	0.7	62	0.3	61	7.9	39	2.3	56
Bhutan	0.7	63	0.2	63	1.3	63	0.4	63

Position in Simple Forward Participation

Indonesia ranks 35th in Simple Forward Participation, with an index value of 10.4%. This ranking indicates that a portion of Indonesia's agricultural output is tied to the export of primary agricultural commodities, such as unprocessed crops and raw materials. Compared to countries like Ireland (61.9%), Latvia (40.8%), and Bulgaria (37.8%), which lead in this category, Indonesia's participation level is relatively modest. The higher participation indices of these leading countries suggest a strong orientation towards exporting raw agricultural goods and deeper integration into the global market for unprocessed agricultural products. In contrast, Indonesia's lower position implies that while the country plays a role in primary exports, there is potential for increased engagement in this area.

Position in Complex Forward Participation

In terms of Complex Forward Participation, which involves the export of processed agricultural products, Indonesia ranks 44th with an index of 3.8%. This position highlights Indonesia's relatively limited engagement in value-added agricultural exports. Countries such as Luxembourg (35.7%) and Latvia (34.5%) rank significantly higher in this category, demonstrating well-developed agro-processing sectors that allow them to export processed goods with added value. Indonesia's current position suggests a gap in its agro-processing capabilities, which limits its ability to participate fully in more lucrative segments of the agricultural GVC. Bridging this gap could involve investments in technology, infrastructure, and capacity-building to enhance the domestic processing of agricultural goods before export, thereby capturing greater economic value within the country.

Position in Simple Backward Participation

With an index of 1.9%, Indonesia ranks 60th in Simple Backward Participation, indicating a very low dependence on imported basic agricultural inputs, such as seeds, fertilizers, and machinery. In contrast, countries such as Ireland (39.2%) and Slovakia (21.8%) exhibit high levels of backward participation, reflecting substantial reliance on foreign inputs to support domestic agricultural productivity. Indonesia's low index in this category may suggest a degree of self-sufficiency in basic inputs or, alternatively, limited access to or utilization of imported agricultural inputs. Expanding access to and use of high-quality agricultural inputs from international sources could be a strategic approach to boosting productivity in Indonesia's agricultural sector, potentially strengthening its position within the GVC.

Position in Complex Backward Participation

In Complex Backward Participation, Indonesia ranks 46th with a minimal index value of 0.7%, the lowest among all countries analyzed. This metric reflects Indonesia's minimal engagement in importing intermediate goods for further processing within the agricultural sector. Leading countries in this category, such as the Netherlands (36.6%) and Belgium (36.3%), exhibit strong reliance on imported complex inputs, which often support sophisticated agro-processing industries. Indonesia's position suggests a substantial gap in its agricultural value chain infrastructure, particularly in the ability to handle advanced inputs and process them into higher-value products. Increasing imports of complex intermediate goods, such as specialized machinery and processed feed, could enable Indonesia to enhance the productivity and value-added capacity of its agricultural sector.

Changes in Indonesia's GVC Participation relative to other Economic Region and Income Level Group

The analysis of Indonesia's participation in the GVC for agriculture from 2007 to 2021, reveals varied trends in comparison to other countries based on economic region and income level. In this study, the coefficient from the linear regression analysis represents the trend over time, with a positive coefficient indicating an upward trend and a negative coefficient suggesting a downward trend in GVC participation. The model's goodness of fit, represented by the R-squared value, indicates how well the data fits the trend line, while the p-value assesses the statistical significance of these trends. Together, these metrics provide a comprehensive view of Indonesia's GVC position relative to other regions and income groups.

Changes in Simple Forward Participation

From 2007 to 2021, Indonesia's simple forward GVC participation (Xpfs) showed some progress as shown in Figure 2, as indicated by a positive coefficient of 140.5. However, the trend lacks statistical significance (p-value 0.447) and explains only a small portion of variability (R-squared 0.045), suggesting limited consistency or meaningful progress over time. Indonesia's performance aligns more closely with regions like East Asia & Pacific, which also shows a non-significant trend (coefficient 1.06, p-value 0.744), rather than with regions such as Europe & Central Asia, which demonstrate significant upward trends.

Based on the significance test summarized in Table 5, relative to income levels, Indonesia's Xpfs performance mirrors lower-middle-income countries (coefficient -3.32, p-value 0.486) rather than upper-middle-income peers, despite being classified in this income group. High-income countries exhibit the strongest growth in Xpfs (coefficient 4.00, p-value 0.026), reflecting their dominance in agricultural value chains and effective integration into global markets. In contrast, Indonesia's non-significant trends highlight barriers such as weak infrastructure, limited market access, and insufficient forward linkages in agricultural exports.

Indonesia's simple forward participation does not show a downward trend as previously noted but instead reflects a lack of statistically significant growth over the study period. Compared to other countries in the East Asia & Pacific region, which also demonstrate non-significant trends, Indonesia's performance reinforces the challenges of limited or inconsistent growth in exporting unprocessed agricultural commodities.

In contrast, countries in Europe & Central Asia exhibit a significant upward trend in simple forward participation, supported by a coefficient of 5.10, R-squared of 0.015, and p-value of 0.006. This trend reflects strong integration into the agricultural GVC due to robust infrastructure and supportive policies. Latin America & the Caribbean and North America show positive coefficients (13.96 and 8.66, respectively), but these trends are not statistically significant due to high p-values, indicating inconsistent growth compared to Europe & Central Asia.

By income level, high-income countries demonstrate consistent upward trends, leveraging advanced infrastructure and trade policies to enhance exports of unprocessed goods. However, upper-middle-income countries, including Indonesia (coefficient 3.88, p-value 0.245), show non-significant trends, suggesting barriers such as weaker processing industries or policy constraints. These findings emphasize the need for strategic interventions to improve Indonesia's GVC participation and competitiveness in the global supply chain.

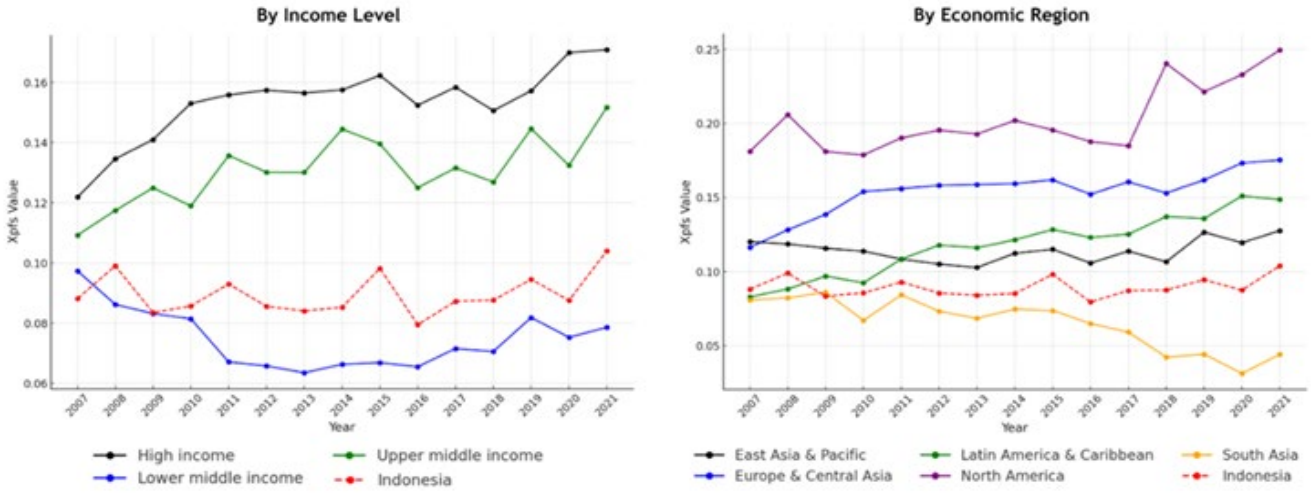

Figure 2. Simple forward GVC participation trend 2007-2021

Table 5. Simple forward participation changes 2007-2021

	Coef	R-sq	p-value	Sig
Indonesia	140.5	0.045	0.447	ns
by Economic Region				
East Asia & Pacific	1.06	0.000	0.744	ns
Europe & Central Asia	5.10	0.015	0.006	***
Latin America & Caribbean	13.96	0.064	0.178	ns
North America	8.66	0.033	0.338	ns
South Asia	(9.84)	0.034	0.061	ns
by Income Level				
High income	4.00	0.009	0.026	**
Upper middle income	3.88	0.007	0.245	ns
Lower middle income	(3.32)	0.003	0.486	ns

Note: **: Very significant (p-value < 0.01); *: Significant (p-value < 0.05); Not significant (p-value≥ 0.05)

Changes in Complex Forward Participation

Indonesia's complex forward GVC participation (Xpfc) shows a significant decline, with a coefficient of -627.4, an R-squared of 0.578, and a p-value of 0.001. This sharp negative trend underscores Indonesia's minimal engagement in high-value intermediate exports, reflecting critical gaps in technological advancement, supply chain sophistication, and agro-processing capabilities. Unlike other regions, Indonesia's Xpfc performance does not align with consistent upward trends observed elsewhere as described in Figure 3.

From the perspective of income levels, Indonesia's Xpfc performance is significantly weaker compared to high-income countries (coefficient 14.27, p-value 0.000) and upper-middle-income countries (coefficient 12.42, p-value 0.050) as summarized in Table 6. Despite being classified as an upper-middle-income nation, Indonesia's Xpfc trend aligns more closely with lower-middle-income countries, which show a non-significant coefficient of 10.12 (p-value 0.150). This suggests persistent structural limitations, including limited capacity for advanced intermediates and value-added exports.

Indonesia's negative trend in complex forward participation highlights the critical need for targeted investments in research and development, technological upgrades, and policy reforms to facilitate integration into global agricultural value chains. Without such measures, Indonesia risks falling further behind in contributing to the high-value segments of the GVC.

In contrast, regions such as Europe, Central Asia, and North America exhibit significant growth in complex forward participation. Europe and Central Asia show a coefficient of 17.03, with an R-squared of 0.090 and a p-value of 0.000, driven by strong agro-processing industries and favorable policies. North America leads with a coefficient of 104.10, an R-squared of 0.229, and a p-value of 0.008, reflecting its advanced agro-processing capabilities and dominance in processed agricultural exports. Meanwhile, East Asia & Pacific (coefficient 5.49, p-value 0.350) and Latin America & Caribbean (coefficient 28.48, p-value 0.243) show positive but statistically insignificant trends, indicating inconsistent progress.

By income level, high-income countries demonstrate a significant positive trend in forward complex participation, reflecting their advanced infrastructure and technological capabilities for value-added exports. Upper-middle-income countries, including Indonesia, show only modest growth with limited significance, while lower-middle-income countries exhibit non-significant trends. These findings highlight the urgency for Indonesia to address challenges in infrastructure, technology, and policy to improve its competitiveness in the GVC for processed agricultural goods.

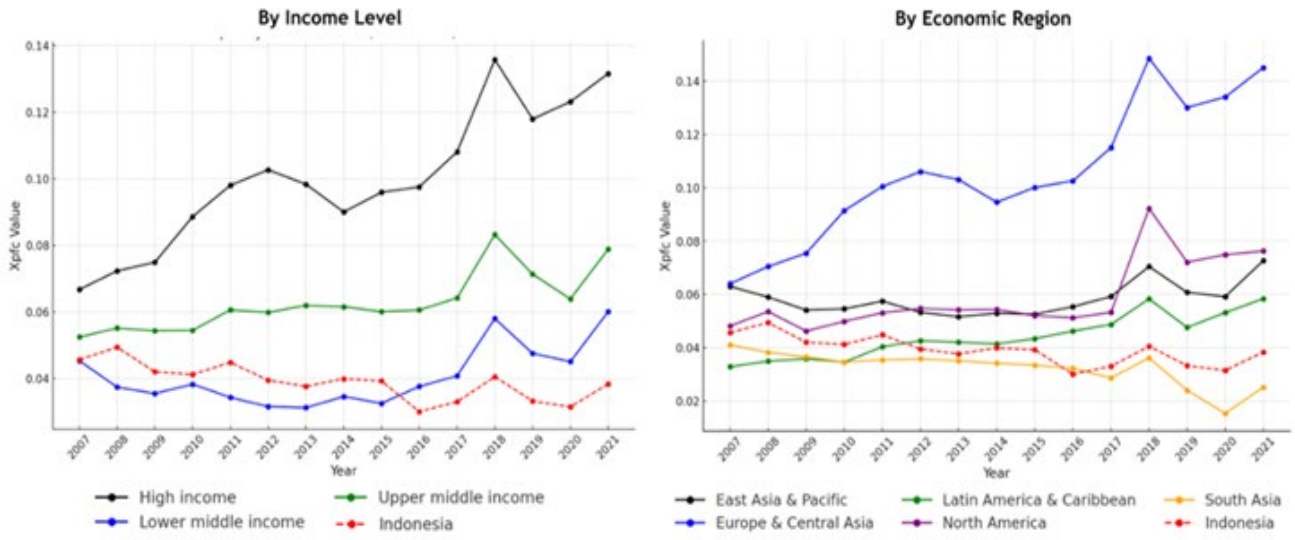

Figure 3. Complex forward GVC participation trend 2007-2021

Table 6. Forward complex participation changes 2007-2021

	Coef	R-sq	p-value	Sig
Indonesia	(627.4)	0.578	0.001	**
by Economic Region				
East Asia & Pacific	5.49	0.003	0.350	ns
Europe & Central Asia	17.03	0.090	0.000	**
Latin America & Caribbean	28.48	0.048	0.243	ns
North America	104.10	0.229	0.008	**
South Asia	(13.27)	0.016	0.201	ns
by Income Level				
High income	14.27	0.060	0.000	**
Upper middle income	12.42	0.020	0.050	*
Lower middle income	10.12	0.012	0.150	ns

Note: **: Very significant (p-value < 0.01); *: Significant (p-value < 0.05); Not significant (p-value≥ 0.05)

Changes in Simple Backward Participation

In terms of simple backward GVC participation (Xpbs), Indonesia exhibits a significant downward trend shown in Figure 4, with a coefficient of -542.33, an R-squared of 0.714, and a p-value of 0.000. This reflects a notable reduction in reliance on imported primary agricultural inputs, signaling progress toward self-sufficiency in agricultural production. However, this shift may pose challenges for Indonesia's integration into the global value chain (GVC) as the reduced reliance on foreign inputs limits access to advanced intermediates for domestic supply chains.

When assessed against income levels, Indonesia's Xpbs performance contrasts sharply with high-income countries, which also exhibit a significant downward trend (coefficient -8.03, p-value 0.008 in Table 7) driven by robust domestic input industries and technological advancements. Upper-middle-income countries show a similar trend with a coefficient of -15.18 (p-value 0.011), indicating efforts to reduce dependency on global inputs while advancing production capabilities. In contrast, Indonesia's significant reduction in Xpbs highlights a gap in aligning its backward linkages with its upper-middle-income classification, reflecting challenges in accessing and integrating high-quality foreign inputs.

Regionally, East Asia and the Pacific demonstrate a non-significant downward trend in backward simple participation (coefficient -2.94, p-value 0.440), suggesting limited progress in reducing input reliance. Europe and Central Asia exhibit a significant reduction in input dependency, with a coefficient of -9.70 and a p-value of 0.006, reflecting strong domestic capacity and input industries. North America shows a similarly significant downward trend (coefficient -54.02, p-value 0.034), underpinned by highly developed domestic input systems. Conversely, Latin America and the Caribbean record a positive but statistically non-significant trend, with a coefficient of 20.74 (p-value 0.703), indicating inconsistent patterns in input reliance.

By income level, Indonesia's significant downward trend in Xpbs deviates from the broader trends of lower-middle-income countries, which show a non-significant positive coefficient of 3.18 (p-value 0.619). This suggests that Indonesia is shifting toward localized input sourcing more rapidly than expected for its income group, albeit with potential trade-offs in technological advancement and GVC integration. These findings underscore the need for Indonesia to balance its efforts toward self-sufficiency with policies that enhance access to high-quality global inputs to support sustainable agricultural production and competitiveness in the GVC.

Changes in Complex Backward Participation

Indonesia's complex backward GVC participation (Xpbc) demonstrates a significant decline, with a coefficient of -1,154, an R-squared of 0.692, and a p-value of 0.000. As shown in Figure 5, the downward trend indicates a substantial reduction in reliance on advanced imported intermediates, reflecting efforts toward self-sufficiency. However, this decline may also highlight structural barriers, such as limited access

to high-value inputs and insufficient technological advancement, which constrain Indonesia's ability to integrate into complex global agricultural supply chains.

From an income-level perspective, Indonesia's Xpbc performance aligns more closely with lower-middle-income countries, which show a non-significant positive coefficient of 2.93 (p-value 0.683) as summarized in Table 8. In contrast, high-income countries display a significant upward trend in backward complex participation, with a coefficient of 5.76 (p-value 0.002), reflecting their ability to leverage advanced global inputs for domestic production. Upper-middle-income countries, including Indonesia, exhibit non-significant trends (coefficient -4.96, p-value 0.570), further underscoring gaps in technological capacity and policy support to advance their agricultural production systems.

Regionally, East Asia and Pacific, North America, and South Asia show non-significant trends in backward complex participation. East Asia & Pacific records a coefficient of -1.16 (p-value 0.796), indicating minimal changes in reliance on foreign advanced inputs. Similarly, North America and South Asia show non-significant coefficients of 9.62 and -10.45, respectively, reflecting stable but unchanging patterns of input dependency. Conversely, Europe and Central Asia exhibit a significant upward trend, with a coefficient of 6.28 (p-value 0.001), driven by strong processing industries and effective integration into the GVC for processed agricultural goods.

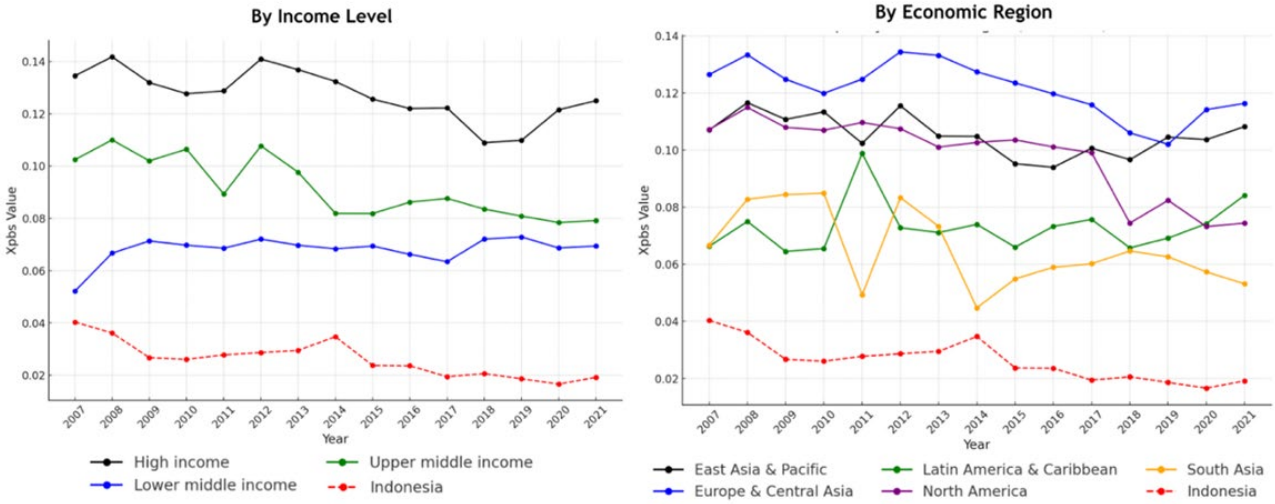

Figure 4. Simple backward GVC participation trend 2007-2021

Table 7. Backward simple participation changes 2007-2021

	Coef	R-sq	p-value	Sig
Indonesia	(542.33)	0.714	0.000	**
by Economic Region				
East Asia & Pacific	(2.94)	0.002	0.440	ns
Europe & Central Asia	(9.70)	0.015	0.006	**
Latin America & Caribbean	20.74	0.005	0.703	ns
North America	(54.02)	0.150	0.034	*
South Asia	(7.66)	0.013	0.249	ns
by Income Level				
High income	(8.03)	0.013	0.008	**
Upper middle income	(15.18)	0.033	0.011	*
Lower middle income	3.18	0.001	0.619	ns

Note: **: Very significant (p-value < 0.01); *: Significant (p-value < 0.05); Not significant (p-value≥ 0.05)

Income-level analysis highlights the disparity between high-income and lower-income groups in leveraging advanced inputs. High-income countries lead with significant positive trends, showcasing their capability to integrate complex global inputs into high-value production processes. By comparison, Indonesia's significant downward trend indicates a constrained ability to maintain or expand reliance on advanced inputs, emphasizing the need for targeted investments in technology, infrastructure, and policy frameworks. These measures are critical to improving Indonesia's participation in complex backward linkages and enhancing competitiveness within the GVC.

Managerial Implication

The research findings indicate that Indonesia's agricultural Global Value Chain (GVC) participation remains concentrated in simple forward linkages, with limited integration into high-value processing and advanced supply chain networks. From a managerial perspective, this underscores the urgent need for industry stakeholders to enhance the competitiveness of domestic agro-processing industries. Agribusiness firms and cooperatives must adopt modern processing technologies, improve quality control, and strengthen supply chain management to meet international standards and capture greater value from exports. Additionally, business associations and policymakers should facilitate access to global markets through improved trade agreements, certifications, and branding strategies. Strengthening farmer organizations can also enhance collective bargaining power, ensuring that smallholder farmers benefit from higher-value market opportunities rather than being confined to low-margin raw commodity production.

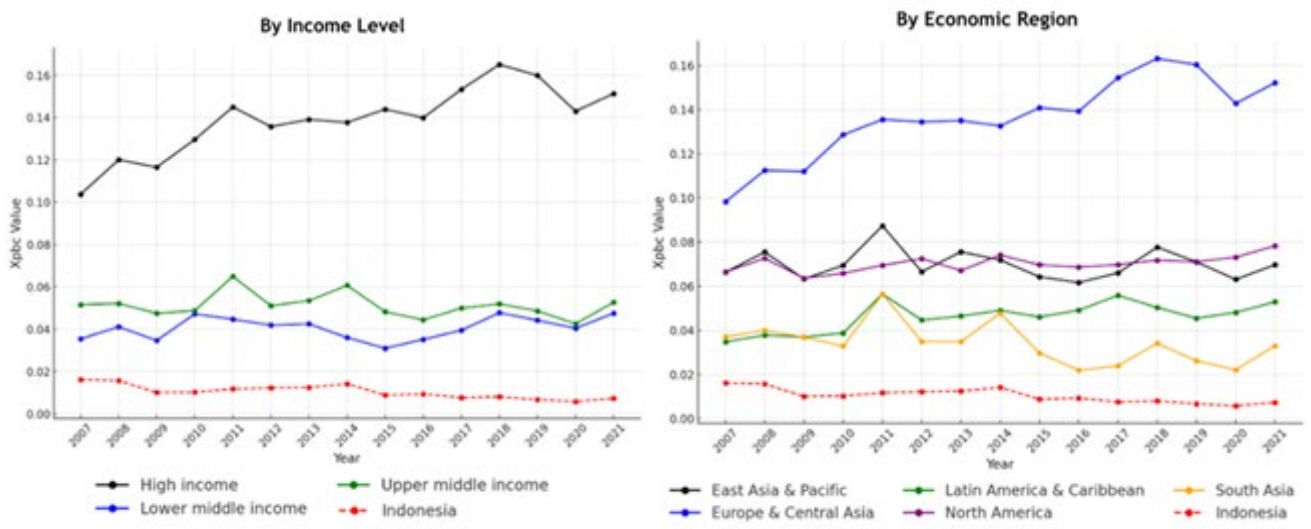

Figure 5. Complex backward GVC participation trend 2007-2021

Table 8. Backward complex participation changes 2007-2021

	Coef	R-sq	p-value	Sig
Indonesia	(1,154)	0.692	0.000	**
by Economic Region				
East Asia & Pacific	(1.16)	0.000	0.796	ns
Europe & Central Asia	6.28	0.023	0.001	**
Latin America & Caribbean	59.52	0.060	0.191	ns
North America	9.62	0.005	0.714	ns
South Asia	(10.45)	0.012	0.273	ns
by Income Level				
High income	5.76	0.018	0.002	**
Upper middle income	(4.96)	0.002	0.570	ns
Lower middle income	2.93	0.001	0.683	ns

Note: **: Very significant (p-value < 0.01); *: Significant (p-value < 0.05); Not significant (p-value≥ 0.05)

Another critical managerial implication is Indonesia's declining backward participation, which reflects reduced reliance on imported agricultural inputs. While this may indicate progress toward self-sufficiency, it also highlights potential gaps in access to high-quality seeds, fertilizers, and agro-industrial machinery. Industry leaders must focus on developing domestic input production capabilities while maintaining selective global integration for advanced agricultural technologies. Public-private partnerships can play a crucial role in expanding investment in agricultural research, innovation, and supply chain modernization to ensure that Indonesia remains competitive. Additionally, agribusiness firms should prioritize digitalization, logistics improvements, and market intelligence systems to optimize distribution networks and reduce inefficiencies in the agricultural supply chain. These managerial strategies will enable Indonesia to transition toward a more resilient and competitive position in the global agricultural economy.

CONCLUSIONS AND RECOMMENDATIONS

Conclusions

The study concludes that Indonesia has achieved significant progress in reducing reliance on imported inputs, as evidenced by its substantial decline in backward participation. However, forward participation, particularly in complex linkages, remains underwhelming and highlights critical structural challenges in agro-processing and value-added production. These challenges limit Indonesia's ability to compete globally and fully leverage its agricultural potential. The findings underscore key gaps in infrastructure, technological capacity, and policy frameworks that hinder Indonesia's integration into high-value agricultural exports and the global value chain (GVC). Addressing these gaps through targeted investments and strategic interventions is essential to unlocking Indonesia's agricultural potential and enhancing its role in the GVC.

Recommendations

Based on the findings, Indonesia should focus on strengthening agro-processing infrastructure and facilitating access to advanced agricultural inputs to overcome stagnation in forward participation. Investments in precision agriculture technologies, specialized machinery, and modernized supply chains are vital for improving productivity and competitiveness in value-added agricultural exports. Policies should incentivize innovation and foster public-private partnerships to address technological and infrastructural limitations in agro-processing capabilities. These measures are critical for transitioning Indonesia away from reliance on raw commodity exports toward a more prominent role in the global agricultural GVC.

Capacity-building programs are also essential to equip farmers and agribusiness stakeholders with the skills required for effective participation in value-added production. Collaborative efforts at regional and global levels can provide access to advanced technologies, best practices, and opportunities for integration into sophisticated value chains. Additionally, these efforts must align with sustainable agricultural practices to ensure environmental responsibility, resilience, and long-term growth. By addressing these strategic priorities, Indonesia can strengthen its global competitiveness, unlock higher economic value, and achieve sustainable growth in its agricultural sector.

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