



US–China Trade War and Indonesia’s Food Security: Evidence from Household Microsimulation

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Abstract. This study investigates the impact of the US–China trade war on Indonesia’s trade dynamics and food security using a microsimulation approach. By modeling 500 simulated households and projecting outcomes from 2020 to 2045, the research analyzes how tariff-induced shocks to staple commodities affect household welfare, food affordability, and trade flows. Results reveal that tariff shocks consistently increase food insecurity, particularly for rice, vegetable oil, wheat, and horticultural products. Notably, food security outcomes converge across optimistic, moderate, and pessimistic scenarios, underscoring the structural nature of global trade disruptions. Quintile-based analysis shows that while the poorest households remain persistently vulnerable, the most pronounced increases in food insecurity occur among middle and upper-middle-income groups, challenging conventional assumptions about vulnerability being concentrated only among the poor. At the commodity level, impacts are heterogeneous: sugar and chicken benefit from export gains in some simulations, whereas wheat, milk, and rice demonstrate heightened volatility and dependency on imports. These findings highlight the broad-based and long-term consequences of global trade conflicts for Indonesia’s food system. Policy recommendations include diversifying import sources, strengthening domestic agricultural productivity, expanding social protection to middle-income groups, and enhancing regional cooperation. The study underscores the importance of forward-looking, inclusive, and adaptive strategies to safeguard Indonesia’s food security in the context of global uncertainties and in pursuit of Indonesia Emas 2045.

Keywords: Trade War, Food Security, Microsimulation

1 Introduction

The global economy has become increasingly interconnected, with trade relations shaping the dynamics of growth, development, and food security. In recent decades, international trade has played a pivotal role in improving resource allocation, fostering innovation, and enhancing the efficiency of food distribution across countries [1], [2]. However, trade disputes and disruptions among major global economies pose significant challenges to the stability of international markets, particularly in developing countries that remain vulnerable to external shocks [3]. One of the most critical contemporary issues is the United States–China trade war, which has introduced uncertainties into the global trading system.

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The US–China trade war, which escalated in 2018, is widely recognized as one of the most significant geopolitical and economic conflicts in the 21st century [4]. Characterized by reciprocal tariffs, trade restrictions, and retaliatory measures, this conflict has disrupted global supply chains and affected global commodity markets [5]. Given that the United States and China are the world’s two largest economies and trade partners, their disputes have reverberated worldwide, influencing not only advanced economies but also emerging markets that rely heavily on trade for economic stability and food supply security.

Food security, defined by the Food and Agriculture Organization (FAO) as the availability, accessibility, utilization, and stability of food, has emerged as a major concern in the context of the US–China trade conflict [6]. Tariff escalation and non-tariff barriers have contributed to price volatility in global agricultural commodities, including rice, wheat, soybeans, and edible oils, which form the backbone of staple food consumption worldwide [7]. For countries like Indonesia, where dependence on food imports remains significant, external shocks from trade disputes can create vulnerabilities in domestic supply and threaten long-term food security [8].

Indonesia represents a critical case in understanding the nexus between global trade disputes and domestic food systems [9]. With a population of more than 270 million people, Indonesia is one of the largest consumers of staple food commodities in the world. Although domestic agricultural production has grown, Indonesia continues to import strategic commodities such as wheat, soybeans, and sugar to meet domestic demand. Consequently, disruptions in international trade flows, whether due to tariff escalation or supply chain instability, could significantly influence Indonesia’s ability to maintain food security and protect vulnerable households [10].

The dynamics of staple food consumption in Indonesia, commonly referred to as “Sembako” (Nine basic necessities), further underscore the sensitivity of the country’s food security to global market fluctuations. These commodities, such as rice, sugar, cooking oil, and soybeans, are essential to Indonesian households, especially for low-income populations. Increases in global prices or disruptions in import channels can translate into higher domestic prices, thereby reducing affordability and increasing the risk of malnutrition and food insecurity [11]. The vulnerability of poor households highlights the importance of assessing the broader impacts of international trade disputes on the national food system [12].

In addition to immediate effects on food prices and availability, the US–China trade war raises broader concerns about Indonesia’s long-term food security strategy. While short-term shocks may result in price volatility, prolonged disputes between major economies could reconfigure global trade flows and alter Indonesia’s access to affordable imports. These structural shifts necessitate forward-looking approaches to anticipate and mitigate potential risks, especially as Indonesia prepares for its demographic and economic transformation toward the vision of Indonesia Emas 2045.

Microsimulation methods provide a powerful analytical tool to examine the complex and heterogeneous effects of trade disruptions on household welfare and national food security [13]. By capturing variations across income groups, regions, and consumption patterns, microsimulation allows researchers to model both the immediate and long-term implications of external shocks. This approach is particularly valuable in the

Indonesian context, where disparities in income and access to food remain pronounced, and where policy responses must be tailored to diverse socioeconomic conditions.

The literature on the economic consequences of the US–China trade war has primarily focused on macroeconomic indicators, such as GDP growth, trade balance, and industrial performance. However, relatively few studies have examined its implications for food security in developing countries, particularly Indonesia. Furthermore, most existing research has not integrated microsimulation techniques to assess household-level impacts and long-term scenarios. This creates a knowledge gap in understanding how global trade conflicts intersect with domestic vulnerabilities and food security objectives.

Against this backdrop, this study seeks to investigate the impact of the US–China trade war on trade and food security in Indonesia through a microsimulation approach. By modeling household consumption of staple commodities and projecting food security scenarios until 2045, this research aims to provide nuanced insights into the potential risks and policy options available to safeguard Indonesia’s food system. The findings are expected to contribute to the broader discourse on trade, development, and sustainability while offering practical recommendations for policymakers navigating the dual challenges of global uncertainty and domestic food security.

The primary objective of this study is to examine the impact of the US–China trade war on Indonesia’s trade dynamics and food security, with a particular emphasis on staple food commodities that form the foundation of household consumption. Using a microsimulation approach, this research seeks to analyze both short-term and long-term effects of global trade disruptions on household welfare, food affordability, and the stability of essential commodities. Furthermore, the study aims to project scenarios of Indonesia’s food security until 2045, thereby providing insights for designing sustainable and adaptive policy interventions.

The novelty of this research lies in its application of microsimulation modeling to assess the intersection between international trade conflicts and domestic food security. While previous studies have largely concentrated on the macroeconomic consequences of the US–China trade war, this study advances the discourse by focusing on household-level impacts and the consumption of *sembako*. In addition, the integration of long-term projections until 2045 offers a forward-looking perspective that bridges the gap between short-run economic shocks and strategic planning for Indonesia’s food security resilience in the context of Indonesia Emas 2045.

This study addresses a critical research gap in the literature, as the majority of existing works have either overlooked food security implications of trade disputes or treated them from a purely macroeconomic lens. Few studies have systematically explored how tariff wars and global trade disruptions cascade into household consumption and food affordability in Indonesia. By combining microsimulation with a policy-oriented framework, this study provides a comprehensive and empirically grounded contribution to understanding the vulnerabilities and adaptive strategies of Indonesia’s food system under the shadow of global trade conflicts.

2 Literature Review

International trade has long been recognized as a central driver of global economic growth, resource allocation, and welfare distribution. Classical trade theories, such as Ricardo's comparative advantage and Heckscher–Ohlin's factor endowment models, highlight the efficiency gains that countries achieve through specialization and trade [14]. More recent perspectives emphasize the importance of global value chains and interdependence among economies, illustrating how disruptions in one part of the system can generate ripple effects across the globe [15]. In this context, trade disputes between major economies have significant implications for both developed and developing nations, especially in terms of price volatility and access to essential goods.

The escalation of the US–China trade war since 2018 has attracted considerable scholarly attention, with a focus on its implications for global markets [5]. Several studies highlight how tariff increases and retaliatory measures disrupted global supply chains, raised production costs, and created uncertainty in international trade flows. For instance, Zhen et al. [16] found that bilateral tariffs substantially reduced trade volumes between the United States and China, leading to trade diversion toward other markets. Similarly, Ledyeva [17] argued that the burden of tariffs largely fell on US consumers and importers, while exporters sought alternative destinations. These findings underscore the far-reaching nature of the conflict and its capacity to reshape global economic relations.

In the agricultural sector, the trade war's impact has been particularly pronounced. Soybeans, wheat, rice, and edible oils became focal points of tariff escalation, altering global trade patterns. Research by Martignone et al. [18] demonstrated how Chinese tariffs on US soybeans redirected trade flows toward Brazil and Argentina, raising prices and affecting global supply dynamics. Other scholars have shown that tariff-induced volatility in agricultural commodities has implications for food-importing countries, particularly in Asia and Africa, where dependence on imports is high [19]. Such disruptions raise concerns not only about price stability but also about food availability and access.

Food security, as conceptualized by the FAO, encompasses four dimensions: availability, accessibility, utilization, and stability [20]. Scholars such as Manikas et al. [21] emphasize that food security is not only a question of production but also of distribution, affordability, and resilience to shocks. Studies in the context of global crises—such as the 2007–2008 food price crisis and the COVID-19 pandemic—demonstrate how external shocks can rapidly undermine food security, particularly in developing economies. In this light, trade disputes between major economies may have effects comparable to global crises, as they can constrain access to affordable staple commodities and exacerbate vulnerabilities among low-income households [22].

In Indonesia, food security has been a persistent policy concern due to the combination of high population growth, changing consumption patterns, and reliance on food imports. Several studies have explored the dynamics of staple food consumption and the role of imports in ensuring supply adequacy. For example, Kang [23] argued that rice remains central not only to food consumption but also to political stability in Indonesia, while Yudhatama et al. [24] noted that soybean and wheat imports are

increasingly vital in meeting urban consumption demands. These findings highlight the sensitivity of Indonesia’s food system to global price fluctuations and import availability, making it highly relevant to analyze the potential effects of international trade disputes.

Empirical studies on Indonesia’s food security also emphasize the vulnerability of low-income households to price shocks. Research by Ruddin and Hidayana [25] revealed that food price increases disproportionately affect poor households, as food constitutes the largest share of their expenditure. Similarly, studies employing household-level data, such as those by Theresia et al. [26], found that food price inflation directly contributes to rising poverty and malnutrition risks. These insights underscore the importance of analyzing food security at the household level, particularly in the face of external shocks such as the US–China trade war.

Despite the growing literature on trade wars and food security, most studies have primarily focused on macroeconomic indicators such as trade balances, GDP, and sectoral output. While these studies provide valuable insights into the overall economic consequences, they often overlook the micro-level implications for household welfare and food consumption. For example, Sun and Zhang [27] explored the macroeconomic spillovers of the trade war in Asia but did not extend the analysis to food affordability at the household level. This gap indicates the need for methodological approaches that can bridge the macro–micro divide in analyzing trade-related shocks.

Microsimulation methods have been increasingly adopted in policy-oriented research to examine the distributional effects of economic shocks. As highlighted by Adu-Ababio [28], microsimulation allows researchers to simulate household-level outcomes under alternative scenarios, capturing heterogeneity in consumption, income, and welfare. Applications in food security research have demonstrated the method’s capacity to assess how price changes in staple commodities affect different income groups. For instance, Akter and Basher [29] used microsimulation to analyze the poverty impacts of rising food prices in developing countries, showing that poor households are disproportionately affected.

In the Indonesian context, research employing microsimulation remains relatively limited. While this approach has been widely applied in other countries to examine the welfare implications of food price changes, subsidy reforms, and agricultural shocks, studies in Indonesia have not yet adopted microsimulation to assess the broader economic and food security consequences of international trade conflicts. To date, no empirical work has specifically investigated the potential impacts of global trade disputes—such as the US–China trade war—on Indonesia’s long-term food security using a microsimulation framework.

Taken together, the existing literature provides valuable insights into trade wars, food security, and microsimulation applications, but it reveals a clear gap in connecting these three strands of research. While macroeconomic analyses have documented the global consequences of the US–China trade war, and microsimulation studies have explored food security in other contexts, there has been limited integration of these approaches to assess the household-level and long-term implications of trade conflicts in Indonesia. This study seeks to fill this gap by applying microsimulation techniques to evaluate how the US–China trade war affects staple food consumption and projecting

Indonesia's food security scenarios until 2045. By bridging macroeconomic disruptions with micro-level outcomes, this research contributes to a more comprehensive understanding of the nexus between trade, food security, and household welfare in developing economies.

3 Data and Methodology

3.1 Data

This study employs simulated datasets to investigate the impact of the US–China trade war on household food consumption and national food security in Indonesia. The datasets are structured to capture both microeconomic and macroeconomic dimensions, allowing for an integrated microsimulation analysis. Four main groups of data are utilized: household microdata, trade shocks, commodity prices, and macroeconomic indicators.

The household dataset consists of 500 simulated household observations containing demographic and expenditure information. Variables include household identifiers, household size, urban or rural classification, total expenditure, food expenditure, and calorie intake per capita. Additionally, detailed expenditure categories are provided for key staple commodities that form Indonesia's basic needs (*sembako*), such as rice, oil, wheat, sugar, beef, chicken, eggs, milk, shallots, and chili. These variables enable the modeling of food security outcomes across different income and demographic groups.

The shock dataset represents simulated disturbances to staple food commodities arising from the US–China trade war. Each commodity is assigned a shock magnitude and a pass-through rate, which reflect how external price changes are transmitted to domestic markets. This dataset is essential to model the vulnerability of different commodities to international trade disruptions.

The price dataset provides baseline information on staple food commodities. It serves as the reference level against which shocks are applied in the simulation. By combining household expenditure data with price information, the analysis estimates how shifts in international markets alter household food affordability and nutritional access.

The macroeconomic dataset is a simulated time series covering historical trends and structural indicators of Indonesia's food economy. It includes variables such as global demand, Indonesian exports, imports, and the consumer price index for food. This dataset provides the broader context for linking household-level impacts with global and national trade dynamics, ensuring that microsimulation results incorporate both micro and macro perspectives.

All datasets are simulated rather than drawn from official statistics. This design allows for controlled experimentation, ensuring internal consistency across household, commodity, and macroeconomic dimensions. Although not representing real-world data, the simulations are calibrated to approximate realistic economic structures and consumption behaviors, making them suitable for scenario analysis and long-term projections.

Table 1. Operational Definitions of Variables.

Variable Group	Variable	Definition	Measurement
Households	Weight	Sampling weight applied in simulations	Ratio
	hh-size	Number of individuals in the household	Ratio
	Urban	Household location	Dummy (0 = rural, 1 = urban)
	Total expenditure	Total household expenditure across all goods	Ratio
	Food expenditure	Expenditure devoted to food consumption	Ratio
	Calorie per capita	Average daily calorie intake per person in household	Ratio
	Spend all commodity	Household expenditure for each staple commodity	Ratio
Shocks	Shock_pct	Magnitude of external trade shock applied to a commodity	Ratio (Percentage)
	pass_through	Proportion of shock transmitted to domestic markets	Ratio (0-1)
Prices	Price Commodity	Baseline unit price of each staple commodity	IDR Rupiah /Unit
	World Demand	Simulated indicator of global demand for food commodities	Ratio Index
Macro	Idn_exports	Simulated value of Indonesia’s exports	Ratio
	Idn_imports	Simulated value of Indonesia’s imports	Ratio
	Idn CPI Food	Consumer price index for food in Indonesia	Index

3.2 Methodology

This study employs a microsimulation approach to evaluate the impact of trade-war-induced price shocks on household food security in Indonesia over the period 2020–2045. Household-level data were constructed to represent 500 simulated households, containing information on demographic characteristics, total and food expenditure, caloric intake, and disaggregated spending on the ten essential commodities commonly classified as sembako (rice, vegetable oil, wheat, sugar, beef, chicken, eggs, milk, shallots, and chili). Macroeconomic variables, including growth in per capita expenditure (PCE) under different baseline scenarios, were also integrated to capture the long-term evolution of food security.

The core of the analysis lies in modeling price shocks as a function of tariff increases and pass-through rates to consumers. For each commodity c in year t , the new price is defined as

$$P_{c,t}^{new} = P_{c,t} \times (1 + \theta_{c,t} \times \pi_c) \quad (1)$$

Where $\theta_{c,t}$ represents the imposed tariff shock and π_c denotes the pass-through parameter. Household expenditures on each commodity adjust to these shocks according to their own-price elasticities, expressed as

$$E_{c,t}^{new} = E_{c,t} \times (1 + \theta_{c,t}) (1 + \varepsilon_c \cdot \theta_{c,t}) \quad (2)$$

Where E_c is the original expenditure and ε_c is the price elasticity of demand.

Changes in food expenditure are subsequently linked to caloric intake. Assuming constant caloric conversion, household caloric intake per capita after the shock is computed as

$$Cal_i^{new} = Cal_i \times \frac{Food(Exp)_i}{Food(Exp)_i^{new}} \quad (3)$$

Where Cal_i is the initial caloric intake and $Food(Exp)_i^{new}$ is the post-shock food expenditure. A household is classified as food insecure if its per capita intake falls below the minimum threshold of 2100 kilocalories.

To summarize the outcomes, the food insecurity headcount index is calculated as a weighted proportion of food-insecure households:

$$H = \frac{\sum_{i=1}^N \omega_i \cdot FoodInsecure_i}{\sum_{i=1}^N \omega_i} \quad (4)$$

Where ω_i denotes household survey weights. Projections are then generated from 2020 to 2045 under three baseline growth scenarios (optimistic, moderate, and pessimistic). The baseline headcount is allowed to evolve with economic growth according to the equation.

$$H_t^{baseline} = H_{t-1} + \beta \cdot g_t \quad (5)$$

Where g_t is the growth rate of PCE and β captures the sensitivity of food insecurity to income growth.

Finally, the distributional effects are examined by disaggregating households into quintiles of per capita consumption. This enables a comparative analysis of food insecurity before and after shocks across different socioeconomic strata and over the projection horizon 2025–2045.

4 Results

4.1 Tariff Shocks on Essential Commodities

This subsection presents the projected tariff shocks imposed on Indonesia’s essential food commodities over the period 2020–2045. Table 2 summarizes the simulated changes in tariffs for ten staple commodities, namely rice, vegetable oil, wheat, sugar, beef, chicken, eggs, milk, shallots, and chili. These commodities represent the backbone of household consumption in Indonesia and are therefore highly sensitive to trade-related disruptions. The tariff shocks are designed to reflect the potential long-term consequences of the US–China trade war, particularly through price volatility transmitted via international trade channels. By tracking the changes across different time points, the table provides a basis for analyzing the extent of pressure on household purchasing power and the broader implications for national food security.

Table 2. Tariff Shocks for Indonesia (2020–2045).

Year	Rice	OilVe g	Whea t	Suga r	Beef	Chicke n	Egg	Mil k	Shallo t	Chil i
2020	0.0 %	1.0%	0.0%	0.0%	0.0 %	0.0%	0.0 %	0.0 %	0.0%	0.0 %
2025	2.0 %	3.0%	1.5%	1.0%	0.5 %	1.0%	0.8 %	1.0 %	2.0%	2.5 %
2030	3.0 %	5.0%	2.5%	1.5%	1.0 %	2.0%	1.2 %	1.5 %	3.0%	3.5 %
2035	4.0 %	7.0%	3.5%	2.0%	1.5 %	3.0%	1.8 %	2.0 %	4.0%	4.5 %
2040	5.0 %	8.0%	4.5%	2.5%	2.0 %	4.0%	2.5 %	3.0 %	5.0%	5.5 %
2045	6.0 %	10.0%	5.5%	3.0%	2.5 %	5.0%	3.0 %	4.0 %	6.0%	6.5 %

Source: Data Processed by Author, 2025

In 2020, tariffs on most commodities remained unchanged, with the exception of vegetable oil, which recorded a 1.0 percent increase. This indicates the early stage of shock transmission, in which the global trade conflict had not yet exerted widespread effects on domestic food markets. Key commodities such as rice, wheat, sugar, animal protein sources, and horticultural products maintained zero tariff shocks, implying that households experienced relatively limited exposure to international trade disruptions during this initial period.

By 2025, tariff shocks became more evident across a wider range of commodities. Vegetable oil experienced a sharp increase of 3.0 percent, followed by rice (2.0 percent), wheat (1.5 percent), and sugar (1.0 percent). Animal-based commodities such as beef, chicken, eggs, and milk also registered moderate increases, reflecting the gradual diffusion of international price pressures into the domestic market. Furthermore, shallots and chili were affected with tariff shocks of 2.0 and 2.5 percent, respectively,

suggesting that horticultural products had begun to absorb the impact of global trade disturbances. This stage marks the onset of more broad-based transmission of tariff shocks to Indonesia's essential commodities.

The period from 2030 to 2035 reveals a more pronounced escalation in tariff shocks. Vegetable oil recorded the steepest rise, increasing from 5.0 percent in 2030 to 7.0 percent in 2035, consolidating its position as the most vulnerable commodity to trade-induced disturbances. Rice tariffs rose steadily from 3.0 to 4.0 percent over the same interval, raising concerns about the affordability of Indonesia's staple food. Meanwhile, animal protein sources and horticultural products continued to face gradual increases, though at a slower pace compared to vegetable oil. This trend demonstrates the cumulative effect of persistent trade shocks, which may increasingly challenge the food security of low-income households.

In the subsequent period of 2040 and 2045, tariff shocks intensified across almost all commodities. Vegetable oil reached the highest tariff increase of 10.0 percent in 2045, followed by chili (6.5 percent) and shallots (6.0 percent). Rice and wheat also recorded significant increases, with tariffs rising to 6.0 and 5.5 percent, respectively. The consistent upward trajectory highlights the structural nature of trade-related pressures on Indonesia's food system. Without adequate policy interventions, these shocks could undermine food affordability, accessibility, and nutritional adequacy. Thus, while the table provides a quantitative projection of tariff dynamics, it also illustrates the long-term risks to household welfare and the stability of Indonesia's food economy.

4.2 National Food Security Headcount

This subsection presents the national food security headcount over the period 2020–2045 under three simulated scenarios: moderate, optimistic, and pessimistic. The food security headcount is expressed as a percentage, representing the proportion of households that achieve the minimum threshold of food security based on expenditure and caloric intake. The figures are provided in two dimensions—before and after the application of tariff-induced shocks—allowing for a direct comparison of how trade disruptions influence national food security outcomes across different future scenarios. Table 3 and Figure 1 summarizes the projected results.

Table 3. Food Security Headcount by Year and Scenario (%)

Scenario	Year	Headcount Before	Headcount After
Moderate	2020	28.74	30.80
	2025	28.98	33.27
	2030	29.14	34.28
	2035	29.30	35.01
	2040	29.38	36.24
	2045	29.46	37.97
Optimistic	2020	27.94	30.80
	2025	28.34	33.27
	2030	28.50	34.28

	2035	28.58	35.01
	2040	28.66	36.24
	2045	28.74	37.97
	2020	29.54	30.80
	2025	29.70	33.27
Pessimistic	2030	29.78	34.28
	2035	29.86	35.01
	2040	29.94	36.24
	2045	30.02	37.97

Source: Data Processed by Author, 2025

In the moderate scenario, the headcount before shocks remains relatively stable across the time horizon, beginning at 28.74 percent in 2020 and gradually rising to 29.46 percent in 2045. However, once tariff shocks are introduced, the food security headcount increases more sharply, reaching 30.80 percent in 2020 and escalating to 37.97 percent in 2045. This widening gap between the “before” and “after” values reflects the significant role of trade-related disturbances in shaping household food security levels.

The optimistic scenario shows a slightly lower baseline level of food security compared to the moderate case, beginning at 27.94 percent in 2020. The headcount increases steadily to 28.74 percent by 2045 before tariff shocks are introduced. After shocks, however, the pattern mirrors that of the moderate scenario, with the headcount starting at 30.80 percent in 2020 and reaching 37.97 percent by 2045. Although the pre-shock values remain somewhat lower, the post-shock results converge with those of the moderate scenario, suggesting that tariff shocks exert a dominant influence regardless of baseline expectations.

By contrast, the pessimistic scenario presents a higher pre-shock headcount compared to the other scenarios, beginning at 29.54 percent in 2020 and increasing to 30.02 percent by 2045. This indicates a more favorable baseline for food security before the application of shocks. Nonetheless, after shocks are accounted for, the headcount values align exactly with those in the moderate and optimistic scenarios—rising from 30.80 percent in 2020 to 37.97 percent in 2045. This convergence suggests that the impact of tariff shocks overrides differences in initial conditions, leading to uniform outcomes in the long term.

The comparison across scenarios highlights an important pattern: while the pre-shock trajectories differ slightly among moderate, optimistic, and pessimistic assumptions, the post-shock values converge into a common trajectory. This implies that tariff-induced shocks impose a systematic upward adjustment in food security headcount regardless of the underlying scenario. The results also indicate that the effect of shocks amplifies over time, as the difference between pre- and post-shock values grows larger from 2020 through 2045.

Over the entire projection horizon, the most pronounced increases occur after 2030, with all three scenarios showing accelerated growth in the headcount following the application of shocks. For example, in the moderate case, the post-shock headcount rises from 34.28 percent in 2030 to 37.97 percent in 2045. A similar trajectory is observed

in the optimistic and pessimistic scenarios, reinforcing the finding that long-term trade disruptions exert cumulative effects on household food security outcomes.

Taken together, the results from Table 3 suggest that the imposition of tariff shocks consistently raises the national food security headcount across all scenarios. While baseline values differ slightly depending on assumptions of optimism or pessimism, the convergence of post-shock outcomes illustrates the dominant and structural role of global trade disruptions in shaping Indonesia’s long-term food security landscape.

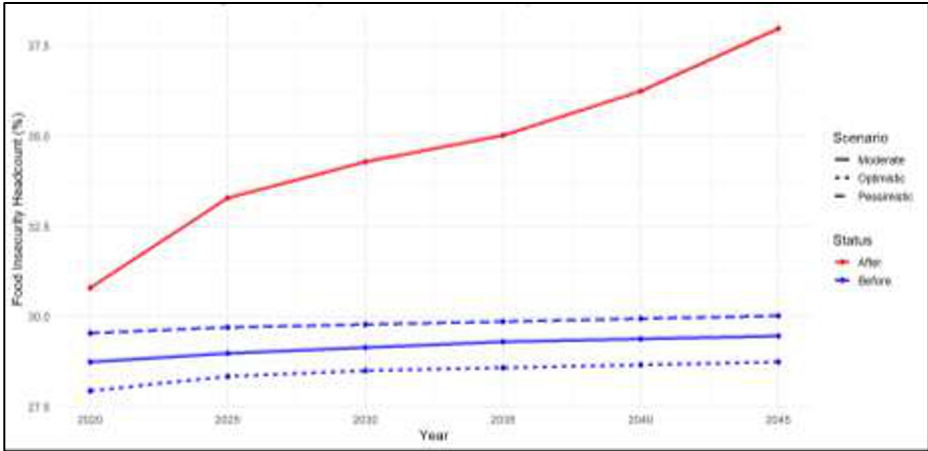


Fig. 1. Illustrates the Trend in Food Insecurity Before and After Tariff Shocks Across Scenarios. Source: Data Processed by Author, 2025

4.3 Food Insecurity by Household Quintile

The analysis of food insecurity across household expenditure quintiles provides a more nuanced understanding of the heterogeneity of vulnerability within the population. By disaggregating households into five quintiles—ranging from the very poor (Quintile 1) to the very rich (Quintile 5)—the dynamics of food insecurity reveal differentiated impacts of tariff shocks across socioeconomic groups. Table 4 presents the headcount ratios of food insecurity before and after shocks from 2030 to 2045.

Table 4. Food Insecurity by Household Quintile

Year	Pce Quint	Head before	Head after
2030	1	28.66	34.98
	2	31.45	33.25
	3	30.96	38.80
	4	36.27	39.74
	5	26.36	24.69
2035	1	28.66	34.98
	2	31.45	33.25
	3	30.96	39.73

	4	36.27	41.61
	5	26.36	25.52
	1	28.66	34.98
2040	2	31.45	38.25
	3	30.96	40.86
	4	36.27	41.61
	5	26.36	25.52
	1	28.66	34.98
2045	2	31.45	39.29
	3	30.96	42.66
	5	36.27	43.69
	5	26.36	29.28

Source: Data Processed by Author, 2025

The results in Table 4 indicate that the very poor households in the first quintile experience a consistent increase in food insecurity, rising from 28.66 percent before shocks to 34.98 percent after shocks. This trend remains stable over the projection horizon, suggesting that the poorest segment of the population is structurally the most vulnerable to price fluctuations and trade disruptions. Although the year-to-year changes are not dramatic, Quintile 1 persistently reflects the highest degree of exposure among the low-income population.

Households in the second quintile, representing the poor but not the very poorest, also face rising food insecurity but with a more moderate pace in the early years. For instance, the headcount increases from 31.45 percent to 33.25 percent in 2030, but by 2045 it rises sharply to 39.29 percent. This escalation highlights the mounting pressure on lower-middle households, whose resilience weakens over time as tariff shocks continue to affect food prices.

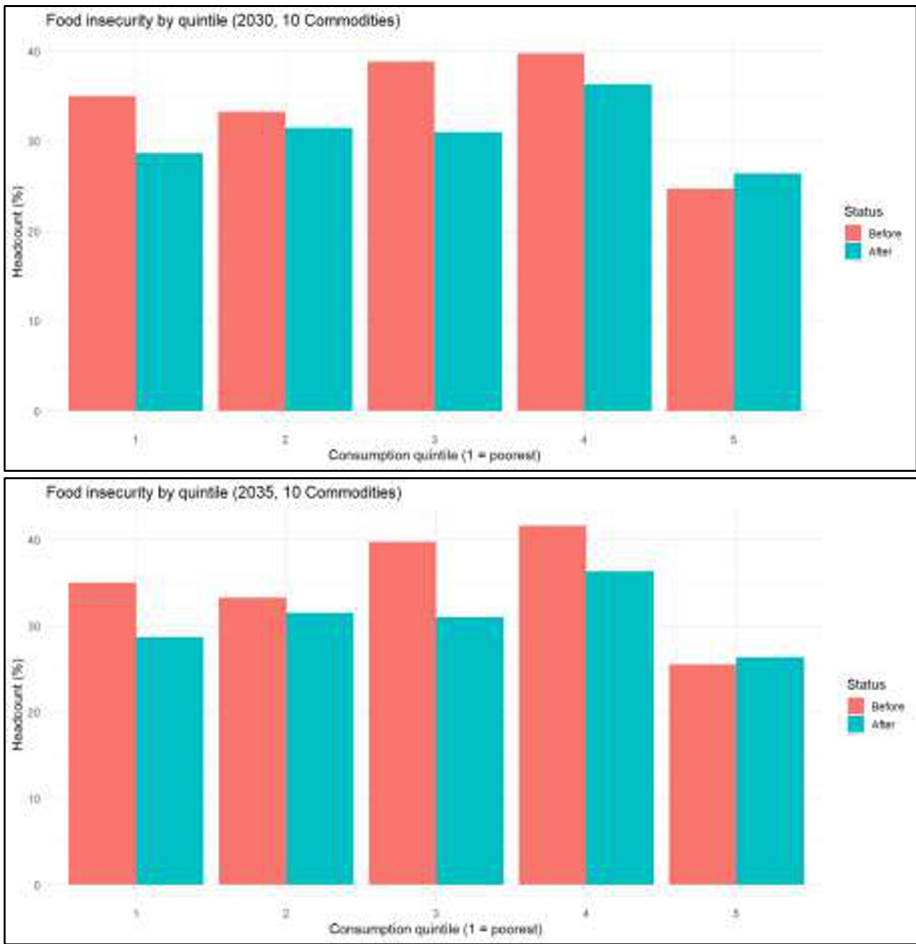
A striking pattern is observed in the third quintile, which represents the middle-income households. Food insecurity in this group jumps from 30.96 percent before shocks to 38.80 percent in 2030, and further escalates to 42.66 percent by 2045. This pronounced increase underscores that middle-class households, while not the poorest, are particularly susceptible to the cumulative effects of trade shocks. Such vulnerability challenges the common perception that food insecurity is concentrated only among the poorest households.

The fourth quintile, corresponding to the upper-middle households, records the highest overall levels of food insecurity among all quintiles. In 2030, the headcount rises from 36.27 percent to 39.74 percent, reaching 43.69 percent by 2045. This indicates that households just below the wealthiest group are disproportionately affected by tariff-induced disturbances. Their food insecurity levels exceed those of both the very poor and the rich, suggesting that structural factors beyond poverty contribute to heightened vulnerability in this group.

In contrast, the wealthiest households in the fifth quintile exhibit a different trajectory. Rather than worsening, their food insecurity headcount initially decreases—from 26.36 percent before shocks to 24.69 percent after shocks in 2030. Nonetheless, this advantage does not hold in the long run, as the figure rises to 29.28 percent by 2045.

These results demonstrate that although rich households are better equipped to absorb shocks, they are not completely immune to long-term trade-related disturbances.

Taken together, these findings emphasize the unequal distribution of food insecurity across socioeconomic groups. The middle and upper-middle quintiles (Quintile 3 and 4) face the most significant increases, whereas the wealthiest are comparatively more resilient, and the very poorest remain persistently exposed. This underlines the need for policy interventions that go beyond targeting only the poorest, addressing also the vulnerabilities of non-poor but fragile groups. Visualizing this data would provide clearer insights, the curves for Quintile 3 and 4 would appear steeper compared to other groups, the line for Quintile 5 would initially dip before rising again, and the line for Quintile 1 would remain relatively flat but consistently above the poverty threshold, like in Figure 2.



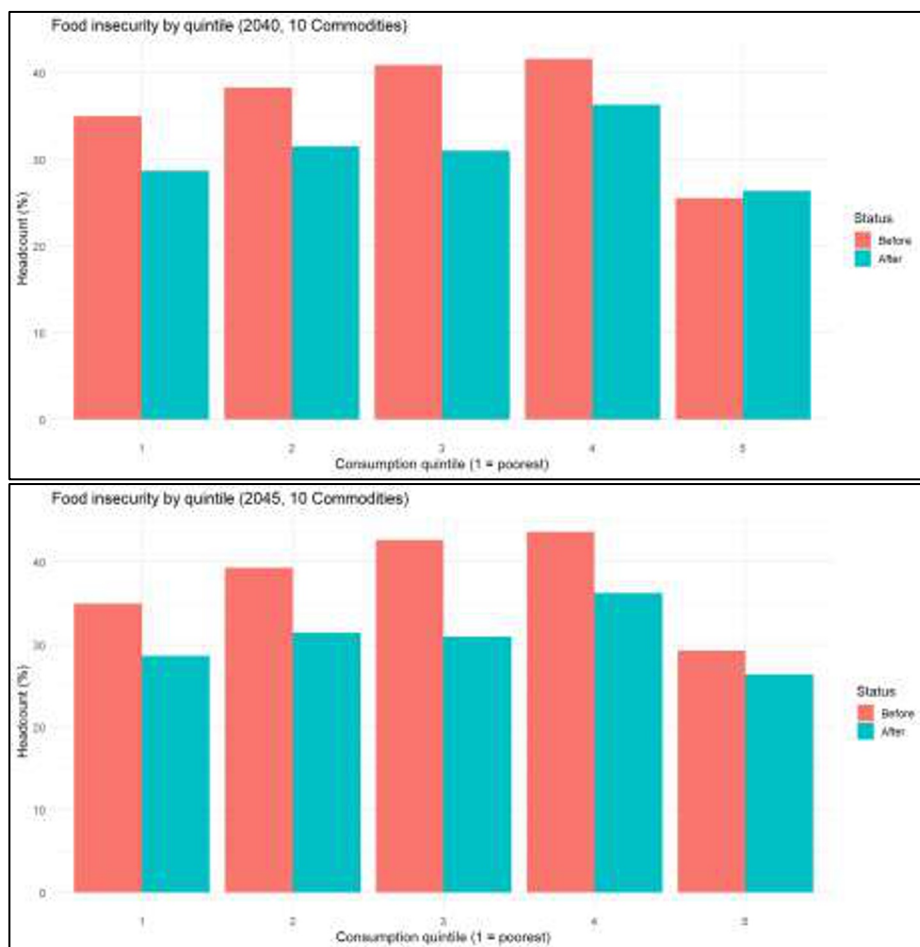


Fig. 2. The Quintile-Level Comparison Across Years for Food Insecurity (2030 – 2045)

Source: Data Processed by Author, 2025

4.4 Impact on Selected Commodities

Table 5 presents the simulated effects of trade war–induced tariff shocks on selected essential food commodities in Indonesia for the year 2045, measured in terms of the Food Security Index (FSI), exports, and imports under four different simulation settings. The results highlight the heterogeneous impacts across commodities, reflecting the complex interplay between global trade dynamics and domestic food systems. For instance, staple foods such as rice and wheat demonstrate notable fluctuations in both food insecurity and trade flows, with rice showing alternating increases and decreases in food insecurity and wheat exhibiting sharp declines in exports and imports in certain simulations. In contrast, protein-based commodities such as chicken, beef, and eggs reveal mixed trajectories, where some scenarios indicate temporary gains in exports

while others reflect significant contractions. Similarly, horticultural products such as shallots and chili display considerable volatility, with chili imports in particular surging sharply under one simulation setting.

The simulated outcomes suggest that tariff shocks arising from global trade disputes produce uneven consequences across Indonesia’s food commodity sectors. While some commodities benefit from increased export demand, others experience heightened vulnerability through greater import dependence or declining export competitiveness. This underscores the importance of understanding the differentiated effects of international trade disruptions on food security and trade balances at the commodity level.

Table 5. Effect on Selected Commodities in 2045 (Percentage Change)

Com-mod-ities	Food Insecurity				Export				Import			
	Sim .1	Sim .2	Sim .3	Si m. 4	Sim .1	Sim .2	Sim .3	Si m. 4	Sim .1	Sim .2	Sim .3	Si m. 4
Rice	-0.28	0.61	-0.53	0.21	-0.69	-0.25	-0.99	0.53	0.01	0.99	0.38	0.58
Oil	0.12	0.18	-0.11	0.15	0.21	0.03	0.55	0.11	0.39	0.55	-0.50	0.61
Whea t	0.78	0.20	-0.51	0.45	1.27	0.04	0.24	0.51	0.37	0.24	0.33	1.62
Sugar	0.04	0.06	-0.36	0.44	2.17	1.37	-0.63	0.36	0.64	-0.63	1.02	0.06
Beef	0.06	-0.28	-0.31	0.41	1.21	-0.23	1.36	0.31	-0.22	1.36	-1.07	0.52
Chick en	0.86	0.89	-0.84	0.34	-1.12	1.52	-0.60	0.84	0.33	-0.60	0.30	0.30
Egg	0.23	0.25	0.42	0.28	0.40	1.55	2.19	0.42	1.10	2.19	0.45	0.11
Milk	-0.63	-0.98	0.08	0.03	-0.47	0.58	1.53	0.08	0.44	1.53	0.05	0.64
Shall ot	-0.34	0.35	-0.57	0.15	0.78	0.12	-0.24	0.57	0.33	-0.24	0.92	0.85
Chili	-0.22	-0.24	0.63	0.19	-0.08	0.22	-1.03	0.63	1.15	-1.03	2.05	1.02

Source: Data Processed by Author, 2025

At the level of food commodities, the impact of the trade war between the United States and China is highly varied, particularly because both countries are among Indonesia’s major trading partners. As shown in Table 1, shifts in trade patterns resulting from excess supply and demand in international markets affect food insecurity, exports, and imports of Indonesian commodities. For instance, rice experienced a decline in food insecurity by -0.28% under Simulation 1, but increased by 0.61% in Simulation 2, indicating that Indonesia’s food vulnerability is sensitive to global market dynamics. A similar trend is observed for wheat, where dependence on imports results in fluctuating outcomes, with food insecurity rising by as much as 0.78% under Simulation 1.

Excess supply from the United States and China due to the trade conflict has driven an increase in the imports of several key commodities. Rice imports rose by 0.99% in Simulation 2, while chili recorded a significant surge of 2.05% in Simulation 3. Conversely, some commodities experienced a substantial decline in imports, such as wheat, which dropped sharply by -1.62% under Simulation 4. This pattern suggests that global trade disputes can create imbalances in domestic supply, particularly for commodities that are strongly influenced by international price fluctuations.

From the export perspective, excess demand from U.S. and Chinese importers who struggle to find alternative suppliers has provided positive momentum for several Indonesian commodities. For example, sugar exports recorded considerable increases of 2.17% and 1.37% in Simulations 1 and 2, respectively. Animal protein products, such as chicken, also saw a temporary rise of 1.52% in Simulation 2. However, negative effects remain evident for other commodities, including eggs, which fell dramatically by -2.19% in Simulation 3, and milk, which declined by -1.53% under the same scenario.

Overall, the net effect of the trade war on Indonesia’s food commodities in 2045 is reflected in the heterogeneous outcomes across different products. Staple commodities such as rice and wheat exhibit high vulnerability with direct implications for food insecurity, while horticultural products such as chili and shallots, along with animal proteins such as chicken and eggs, show significant fluctuations. These results underscore that global trade disputes not only influence the industrial sector but also exert tangible impacts on domestic food security through shifts in export and import dynamics.

5 Discussion

The results of the microsimulation highlight that the US–China trade war has both immediate and structural implications for Indonesia’s food security. Tariff-induced shocks consistently altered the affordability of staple commodities, with vegetable oil, rice, wheat, and horticultural products emerging as the most vulnerable sectors. These findings indicate that Indonesia’s reliance on imports for essential commodities exposes households to significant risks when global trade disputes persist or escalate.

A striking outcome is the convergence of food security headcounts across all scenarios after the application of shocks. Regardless of whether baseline assumptions were optimistic, moderate, or pessimistic, the projected food security outcomes aligned in

the long run. This convergence suggests that external shocks, particularly those stemming from trade disputes, exert a dominant influence that outweighs differences in domestic growth trajectories. In other words, trade disruptions have become a structural determinant of food security in Indonesia.

The quintile-based analysis provides important distributional insights. While the poorest households (Quintile 1) remain consistently vulnerable, middle and upper-middle households (Quintiles 3 and 4) experienced the steepest increases in food insecurity. This challenges the conventional assumption that food insecurity is primarily concentrated among the very poor. Instead, the middle-income group—often considered more resilient—appears disproportionately sensitive to prolonged international shocks, which erode their capacity to maintain stable consumption.

The resilience of the wealthiest households is notable but not absolute. Although initially benefiting from their stronger purchasing power, even the fifth quintile faces rising food insecurity in the long run. This demonstrates that no income group is entirely shielded from structural shocks in global trade, though the magnitude of the impact varies. Such outcomes highlight the broad-based nature of trade conflicts, where vulnerabilities transcend traditional poverty boundaries.

At the commodity level, the heterogeneity of impacts underscores the complexity of Indonesia's trade dependence. While sugar and chicken showed potential export gains in some scenarios, commodities such as wheat and milk revealed sharp contractions in trade performance. Rice, the staple of Indonesian diets, consistently demonstrated volatility, reinforcing its role as both an economic and political commodity. This heterogeneity complicates policy design, as interventions must balance short-term stabilization with long-term resilience strategies.

The findings also resonate with the broader literature emphasizing the link between international trade disruptions and domestic vulnerabilities. Similar to the food price crises of 2007–2008, the simulations suggest that external shocks have the capacity to rapidly undermine food security, even when domestic production remains relatively stable. However, unlike past crises that were temporary, the US–China trade war reveals the potential for long-term structural shifts in trade patterns, which could embed vulnerabilities deeper into Indonesia's food system.

These insights highlight the need for Indonesia to rethink its food security strategy in light of increasing global uncertainties. Reliance on imports without adequate domestic buffering mechanisms will continue to expose households to volatility. Policies must therefore extend beyond price stabilization and subsidies, encompassing diversification of trade partners, investment in domestic agricultural productivity, and development of safety nets that protect not only the poorest but also fragile middle-income groups.

Finally, the microsimulation approach itself demonstrates its value as a tool for policy analysis. By capturing the heterogeneous impacts across households and commodities, this method allows for a nuanced understanding of risks and vulnerabilities that would be overlooked in purely macroeconomic analyses. It enables forward-looking scenario planning, which is essential for anticipating challenges on the path toward Indonesia's long-term vision of food security and economic resilience.

6 Conclusion

This study demonstrates that the US–China trade war significantly shapes Indonesia’s trade dynamics and household food security. Tariff-induced shocks consistently increased food insecurity, particularly for vegetable oil, rice, wheat, and horticultural products. While the poorest households remain structurally vulnerable, the most pronounced increases occurred among middle and upper-middle households, reflecting their exposure to cumulative trade shocks. Importantly, food security outcomes converged across scenarios, underscoring the structural nature of global trade disruptions.

The findings confirm that external shocks can override domestic economic conditions, embedding long-term vulnerabilities into Indonesia’s food system. No income group is fully immune, and commodity-level outcomes reveal both risks and opportunities, depending on global market reconfigurations. These insights highlight the urgent need for Indonesia to adopt comprehensive, forward-looking strategies to safeguard its food security in the era of global trade uncertainty.

Before outlining the policy implications, it is important to emphasize that Indonesia’s food security challenges are not only the result of domestic structural weaknesses but also the consequence of persistent global uncertainties. Addressing these challenges therefore requires comprehensive and adaptive policy strategies that go beyond short-term interventions.

Indonesia should diversify its sources of food imports to reduce dependence on a limited set of global suppliers. Expanding trade relations with emerging agricultural exporters in Asia, Africa, and South America can mitigate the risks of supply disruptions from major economies.

Investments in domestic agricultural productivity are critical. Increasing yields in rice, soybeans, and horticultural products will not only reduce import dependence but also strengthen resilience against international price fluctuations. Modernization of agricultural technology, irrigation infrastructure, and supply chain management should be prioritized.

Policy interventions must address the vulnerabilities of middle-income households. While subsidies and assistance programs often focus on the poorest, the findings suggest that middle-income groups are also at risk of falling into food insecurity under persistent trade shocks. Designing inclusive safety nets that extend beyond poverty-targeting is therefore essential.

Indonesia should enhance its strategic food reserves and develop regional distribution systems that can quickly stabilize supply in times of crisis. A stronger food buffer system will enable the government to intervene effectively when international markets become unstable.

Strengthening regional cooperation, particularly through ASEAN frameworks, offers opportunities for collective resilience. By coordinating import sourcing, stockpiling, and market interventions, Indonesia and its neighbors can collectively reduce exposure to global disruptions. Long-term food security strategies should be integrated into Indonesia’s broader economic planning for Indonesia Emas 2045. This requires not only technical solutions but also institutional reforms that enhance governance,

improve data-driven decision-making, and promote inclusive participation of stakeholders from farmers to consumers.

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