Policy Paper No. 59

Future Food Demand in Poor Indonesian Districts

by Ahmad Heri Firdaus & Ely Nurhayati

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GLOSSARY

ASF:
Area Sampling Frame

BULOG:
The National Logistics Agency

CIPS:
Center for Indonesian Policy Studies

GRDP:
Gross Regional Domestic Product

HDI:
Human Development Index

MAD:
Mean Absolute Deviation

MAPE:
Mean Absolute Percentage Error

MSD:
Mean Squared Deviation

NK:
Neraca Komoditas

PPH:
Pola Pangan Harapan/Desirable Dietary Pattern

RAN-PASTI:
The National Action Plan for the Acceleration of Stunting Reduction in Indonesia 2021–2024

RAN-PG:
The National Action Plan for Food and Nutrition 2020–2024

EXECUTIVE SUMMARY

Indonesia faces a challenge: its projected food demand cannot be met by domestic food production. From 2018 to 2021, the national demand for rice, maize, wheat flour, and soybeans gradually increased in Indonesia, with an estimated annual average growth of nearly 300,000 tonnes for rice, 16,000 tonnes for maize, 26,000 tonnes for wheat flour, and about 144 tonnes for soybeans.

Domestic food production is unlikely to keep up with increasing consumption trends, and imports of these food items remain restricted, making it more difficult for international trade to help supply meet demand. Economic growth and declining poverty will not be enough to address food insecurity if the food is simply not available. The looming lack of supply may adversely affect the calorie intake of around 26 million low-income people, leading to food insecurity, malnutrition, and poverty.

This paper highlights the issue of food demand, using projections for 2025–2045 in 20 districts with poverty rates among the highest in Indonesia, where the population struggles to meet even the standard daily calorie intake. The quantity demanded for rice, maize, and wheat flour in these 20 districts is projected to increase annually by 1.20% (rice), 1.27% (maize), and 6.24% (wheat flour).[1] If the food supply in these districts failed to keep up, the government will fail to achieve its Indonesian Vision 2045 targets in creating high-quality human resources in poor regions in Indonesia through healthier consumption.

These projections suggest that there could be grave repercussions if the Indonesian government fails to address the increasing quantity demanded of rice, maize, and wheat flour in the poorest populations. A holistic approach should be taken with four policy changes: The government should improve the investment climate to increase access to better farm technology; improve provision of free technology and streamline the transfer of farm technology by the private sector; liberalize trade in order to allow international supply to help meet domestic demand; and work with the private sector, and all stakeholders, to ensure that these reforms are implemented, and to take on roles in actually conducting importing activities.

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[1] The quantity demanded for soybeans is projected to fall, but overall demand is very low.

PURPOSE OF THE STUDY

The purpose of this paper is to highlight the projected increasing quantity demanded for rice, maize, wheat flour, and soybeans among low-income people in Indonesia from 2025 to 2045. While similar research on future food demand has been conducted by Arifin et al (2018), this paper takes a different approach, focusing on the food demand in several regions with higher levels of poverty. This paper provides policymakers with four recommendations for a holistic approach to answer the challenge of food security in Indonesia.

CURRENT SITUATION

Food demand in Indonesia (2018–2021)

Rice, maize, wheat flour, and soybeans are among the most widely consumed food items in Indonesia, and experienced gradually increasing demand from 2018 to 2021. Most notably, the national consumption of rice in 2021 reached around 21.9 million tonnes, a 4.68% increase compared to 2020 (Statistics Indonesia, 2022b). Rice is the staple food of most Indonesians and soybeans provide an important source of protein.

> On average, from 2018 to 2021, the quantity demanded for rice increased by around 297,700 tonnes every year, while the quantity demanded for maize, wheat flour, and soybeans increased every year by 16,280 tonnes, 26,079 tonnes, and 144.02 tonnes, respectively.

National consumption of soybeans in 2021 increased by 0.79% compared to 2020, but due to data limitations, calculations involving soybeans in this study refer to raw soybeans only, which is not how soybeans are usually consumed.[2] Although our analysis cannot speak as directly to the relevance of soybeans for the analyzed populations, the overall availability of soybeans in Indonesia remains important to the nutrition needs of poor Indonesians.

On average, from 2018 to 2021, the quantity demanded for rice increased by around 297,700 tonnes every year, while the quantity demanded for maize, wheat flour, and soybeans increased every year by 16,280 tonnes, 26,079 tonnes, and 144.02 tonnes, respectively (Table 1).

Table 1.
National Consumption of Rice, Maize, Wheat Flour, and Soybeans, 2018–2021

Food Items	Consumption (000 tonnes)				Avg. increase per year (1000 tonnes)
	2018	2019	2020	2021	
Rice	21,067.5	20,726.3	20,979.5	21,960.8	**297.7**
Maize	653.6	771.7	906.1	702.5	**16.3**
Wheat flour	694.5	675.2	655.2	772.8	**26.1**
Soybeans	13.6	13.8	13.9	14.05	**0.144**

The table is drawn from Statistics Indonesia (2022)

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[2] Most soybeans are consumed as processed products such as tofu and tempeh, which provide an important protein source. Unfortunately, this nutritional input is not captured by the data available in our analysis. In contrast, raw soybeans are typically an input into food production, rather than a food consumed by poor Indonesians.

Domestic production

While the demand for food is increasing, the domestic production is declining. Domestic soybeans production decreased every year from 2018 to 2021, with an annual average reduction of 28,728 tonnes. Production in 2021 was 18.27% lower than in 2018 (Table 2).

> While the demand for food is increasing, the domestic production is declining.

Table 2.
Domestic Production of Soybeans, 2018–2021

Food Items	Domestic Production (000 tonnes)				Comparison 2018 v. 2021 (%)	Avg. decrease per year (1000 tonnes)
Soybeans	2018/2019	2019/2020	2020/2021	2021/2022		
	471.74	435.45	430.91	385.55	-18.27%	-28.73

The table is drawn from USDA (2019–2022)

Domestic rice production in 2021 only reached 31.4 million tonnes, falling by 7.62% from 2018 production levels despite increasing production between 2019 and 2021 (Table 3).

Table 3.
Domestic Production of Rice, 2018–2021

Food Items	Domestic Production (000 tonnes)			
Rice	2018	2019	2020	2021
	33,942.8	31,313.1	31,334.5	31,356.1

The table is drawn from Statistics Indonesia (2018–2022)

Although 2019 also saw a prolonged dry season, the sharp decrease in rice production compared to 2018 was the result of a change to Statistics Indonesia's methodology. The Area Sampling Frame (ASF) survey is meant to more accurately estimate paddy harvested area (Alika, 2020; Nasution, 2020; Statistics Indonesia, 2019, p. 247) compared to the previous method, which used manual Agriculture Statistics reports collected by statistic officers. These officers used eye-estimates that over-estimated harvested area and therefore overall domestic rice production (Statistics Indonesia, 2020b). Even the new methodology suffers from concern among analysts that the official statistics for domestic production are not entirely reliable and may still constitute an overestimate (Herdiyan, 2022; Silaban, 2016).

Import restrictions

As the Center for Indonesian Policy Studies (CIPS) has demonstrated in previous studies quoted below, imports of rice and maize remain restricted despite potential supply shortfalls. The National Logistics Agency (Bulog) has a government-sanctioned monopoly as the sole entity authorized to import rice, and Bulog can only import with formal instruction from an inter-ministerial meeting spearheaded by the Coordinating Ministry of Economic Affairs (Ministry of Trade, 2022, pp. 34–38; Respatiadi & Nabila, 2017). Maize imports are restricted by cumbersome procedures to acquire import licenses as stipulated by several ministerial regulations (Freddy et al., 2018; Ministry of Agriculture, 2015; Ministry of Trade, 2022, pp. 43–46).

The government rightly acknowledges the multidimensional nature of food and nutrition issues and has responded by conducting inter-ministerial programs such as the National Action Plan for the Acceleration of Stunting Reduction in Indonesia 2021–2024 (RAN-PASTI) and the National Action Plan for Food and Nutrition 2020–2024 (RAN-PG). The government falls short by failing to follow up with a systematic review and impact assessment of trade policies in the food and agricultural sector (Alta et al., 2023, p. 10). As of January 2021, there were 466 coded non-tariff measures, such as import quotas and the government's non-automatic import licensing system, that serve as trade barriers on imported food and agricultural products (Amanta, 2021, p. 7; Amanta & Wibisono, 2021, pp. 14–15). These barriers contribute significantly to high food prices in Indonesia. In particular, rice prices in Indonesia were 67.2% higher than the international price due to non-tariff measures (Amanta & Wibisono, 2021, p. 18).

To address the costs of importing in Indonesia, in early 2022 the government introduced *Neraca Komoditas* (NK) as a system intended to expedite import licensing processes and set more accurate import quotas using economic modeling. This system faces continuing challenges—it is difficult to collect consumption and production data at the firm, consumer, producer, industry, and national levels, and its models use an unrealistic assumption of static food prices, which can actually be quite volatile (Gupta, 2022, p. 4; Gupta et al., 2022, p. 9). Unless these challenges can be addressed, it is unlikely that Neraca Komoditas can ameliorate the costs associated with importing.

Although there is no import recommendation requirement for soybeans and wheat flour, the government intends to expand the Neraca Komoditas to cover more food items in the future. Policy changes that would restrict importing wheat flour and soybeans in the same way as rice and maize (Coordinating Ministry of Economic Affairs, 2022) should be avoided.

> " Poverty is Indonesia's main challenge to food security, but insufficient food supply, which contributes to rising food prices, exacerbates the inability of poor Indonesians to afford adequate, nutritious food. "

Issues with food consumption in Indonesia

Food availability and access have become a concern in Indonesia, particularly among low-income people, who spend most of their income on food (Amanta & Wibisono, 2021, p. 10; The World Bank, 2023). Poverty is Indonesia's main challenge to food security, but insufficient food supply, which contributes to rising food prices, exacerbates the inability of

poor Indonesians to afford adequate, nutritious food (Arif et al., 2020). Among 113 countries, the 2022 Global Food Security Index ranked Indonesia 84th for food availability and 44th for affordability, lower than the neighboring countries such as Thailand (77th and 39th), Vietnam (49th and 38th), and Malaysia (56th and 30th) (The Economist, 2022).

Recent statistics indicate that millions of Indonesians suffer from malnutrition. Approximately 21 million people (around 7% of the population) are undernourished with a daily per capita calorie intake below the Ministry of Health's standard of 2,100 kcal (Arif et al., 2020; Ministry of Health, 2019, Article 3 (2)). Around 24.4% of under-five-year-old Indonesian children experience stunting (low height-for-age ratio), and 4.9% suffer from wasting (low weight-for-height ratio) (Ministry of Health, 2022a, pp. 160–161, 2022b). Malnourished children tend to have lower cognitive intelligence, and in the long term, insufficient nutrition as children will negatively affect adult worker productivity (Hadidjaja et al., 1998; Webb et al., 2005). Poor nutrition for children stacks the deck against them, making it more difficult to escape poverty as they reach adulthood (Dasgupta, 1997; Kraay & McKenzie, 2014). This also sets the stage for a vicious cycle of poverty, as these low-income adults will also be less able to afford nutritious food their children.

> " Approximately 21 million people (around 7% of the population) are undernourished with a daily per capita calorie intake below the Ministry of Health's standard of 2,100 kcal. "

ANALYSIS

Although food production in Indonesia is falling, food consumption is expected to increase through 2045. Meeting the demand for food over this time horizon is a challenge for the Indonesian government.

Rice, maize, wheat flour, soybeans as the selected food items

This analysis focuses on rice, maize, wheat flour, and soybeans. These commodities are both widely consumed and among those that contribute to inflation in Indonesia (Caisar Darma et al., 2019; Marpaung et al., 2019; Ramakrishnan & Vamvakidis, 2002).[3] These items are also important commodities in the food basket used to establish the Indonesian poverty line. Of the March 2022 poverty line of IDR 505,469/capita/month, spending on rice accounts for 23.04% of the total, instant noodles 2.63%, bread 1.82%, tempeh 1.65%, and tofu 1.61% (Statistics Indonesia, 2022e, p. 6). Rice makes up the largest proportion (23.04%) of monthly expenditure on any category of food and non-food items, including cigarettes (11.63%), housing (8.41%), eggs (3.49%), and fuel (3.26%).

Twenty districts with high poverty rates

To provide a representative projection of the food demand among low income Indonesians within our chosen period, this paper focuses on 20 districts (*kabupaten*) with poverty rates among the highest in Indonesia. These districts are spread between six provinces: Papua, Central Papua, West Papua, Southwest Papua, Highland Papua, and East Nusa Tenggara, all in the eastern part of Indonesia (Table 4). In 2021, around one-third of the people residing in these districts lived below the poverty line, much higher than the national poverty rate of 9.71% (Statistics Indonesia, 2023b, 2023a, p. 272).

These districts also have below-average gross regional domestic product (GRDP). In 2021, Indonesia's total gross domestic product reached IDR 16,976.69 trillion (Statistics Indonesia, 2023b, p. 690), with an average GRDP of IDR 33 trillion per district/municipality (Statistics Indonesia, 2023b, pp. 50–51). In the 20 districts selected for this analysis, 2021 GRDP ranged between IDR 243 billion to IDR 4,44 trillion, far below the national average (Statistics Indonesia, 2022a, pp. 21, 36, 2023b, pp. 50–51, 690).

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[3] In 2021, these food items and their derivative products contributed 1.1 percentage points of the annual inflation. Rice: 0.05%; tofu and tempeh: 0.04%, and instant noodles: 0.02% (Statistics Indonesia, 2022d, p. 12).

Table 4.
Poverty Rate and Gross Regional Domestic Products (GRDPs) of the Selected Districts, 2021

No.	District	Province	District's Poverty Rate (%)	District's GRDP (billion IDR)
1	Paniai	Papua	36.59	4,447
2	Supiori	Papua	37.91	1,087
3	Deiyai	Central Papua	40.59	1,493
4	Intan Jaya	Central Papua	41.66	1,304
5	Puncak	Central Papua	36.26	1,513
6	Puncak Jaya	Central Papua	36.00	1,407
7	Pegunungan Arfak	West Papua	34.70	243
8	Tambrauw	West Papua	33.86	244
9	Teluk Wondama	West Papua	31.61	1,559
10	Maybrat	Southwest Papua	31.39	751
11	Jayawijaya	Highland Papua	37.09	8,455
12	Lanny Jaya	Highland Papua	38.73	2,020
13	Mamberamo Tengah	Highland Papua	36.76	1,262
14	Nduga	Highland Papua	37.18	1,346
15	Pegunungan Bintang	Highland Papua	30.46	2,080
16	Tolikara	Highland Papua	32.60	1,721
17	Yahukimo	Highland Papua	37.64	2,626
18	Yalimo	Highland Papua	33.25	1,354
19	Sabu Raijua	East Nusa Tenggara	30.13	1,449
20	Sumba Tengah	East Nusa Tenggara	34.27	1,230

The table is drawn from Statistics Indonesia (2022 and 2023)

Food demand projections in the selected twenty districts (2025-2045)

> *Food demand projections for 2025–2045 are made in five-year intervals and used variables such as poverty rate, GRDP, and average per capita expenditure on each food item.*

Food demand projections for 2025–2045 are made in five-year intervals, for 2025, 2030, 2040, and 2045. Some of the variables used for the projection are poverty rate, GRDP, and average per capita expenditure on each food item. Complete information about the methodology and variables is available in the Appendix.

Rice

By 2045, total per capita weekly quantity of rice demanded in the selected 20 districts is projected to reach 26.62 kg with a per district average of 1.33 kg. These numbers are more than 20% higher than in 2021, when total weekly per capita quantity demanded was 21.96 kg with a per district average of 1.09 kg. From 2025 to 2045, the quantity demanded for rice in the selected 20 districts is projected to increase every year by an average of 1.20%, slightly higher than the annual average for 2018–2021 of 1.17% (Table 5 and Table 6).

Previous research (Arifin et al., 2018, pp. 55, 64) estimated that by 2045, average annual per capita rice quantity demanded would reach 99.55 kg. In contrast, this paper estimates that by 2045 annual per capita rice demand reach 69.16 kg, only around two-thirds of the previous estimate.

> *Although quantity demanded of rice in these districts is projected to grow, it is expected to grow more slowly over time, by 1.28% per year from 2025–2030, but just 1.10% per year in 2040–2045.*

Although quantity demanded of rice in these districts is projected to grow, it is expected to grow more slowly over time, by 1.28% per year from 2025–2030, but just 1.10% per year in 2040–2045. This finding broadly agrees with Arifin et al. (2018, p. 55), which estimates that national per capita rice quantity demanded in Indonesia will grow by 1.5% between 2017–2025, but slow to grow by only another 0.5 percentage point, for cumulative growth over 28 years of a mere 2% by 2045.

Table 5.
Quanity Demanded of Rice in the Selected Districts ((kg/capita/week), 2018–2021

District	2018	2019	2020	2021
Deiyai	0.9980	0.9770	0.9040	0.9710
Jayawijaya	1.1520	0.9550	0.8070	1.1590
Lanny Jaya	0.8450	1.0120	1.0200	1.2270
Mamberamo Tengah	0.4290	0.5460	0.5820	0.4410
Puncak Jaya	1.1630	0.5740	1.1320	0.8990
Sumba Tengah	1.7230	1.8540	2.0170	1.7990
Tambrauw	1.4700	1.5940	1.4640	1.4540
Teluk Wondama	1.2940	1.2930	1.4190	1.2960
Maybrat	1.4240	1.3660	1.6590	1.5060
Intan Jaya	0.6150	0.9790	1.1000	0.9660
Nduga	0.5180	0.3750	0.4820	0.7200
Paniai	1.0150	1.0120	1.0210	0.9520
Pegunungan Arfak	1.6580	1.3560	1.1870	1.6160
Pegunungan Bintang	0.8450	0.7280	0.7110	0.3590
Puncak	0.0970	0.2780	0.0840	0.1320
Sabu Raijua	2.1320	2.2240	2.1180	2.2720
Supiori	1.7180	1.7260	2.0910	2.0310
Tolikara	1.0520	0.9240	1.0770	0.9190
Yahukimo	0.4970	0.2790	0.3010	0.2430
Yalimo	0.5020	0.8180	1.3510	0.9970
Average of All Districts	1.0574	1.0435	1.1264	**1.0980**
Total of All Districts	21.1470	20.8700	22.5270	**21.9590**
Increase/decrease per year (%)		–1.33%	7.36%	–2.52%
Avg. increase/decrease 2018-2021 (%)			**1.17%**	

The table is drawn from Statistics Indonesia (2022) and the authors' calculation

Table 6.
Projected Quantity Demanded of Rice, 2025–2045 in the Selected Districts (kg/capita/week)

District	2025	2030	2035	2040	2045
Deiyai	0.9327	0.9177	0.9027	0.8877	0.8727
Intan Jaya	1.2419	1.3672	1.4925	1.6178	1.7431
Jayawijaya	1.3941	1.4356	1.4771	1.5186	1.5601
Lanny Jaya	1.1675	1.4049	1.6423	1.8796	2.1170
Mamberamo Tengah	0.9119	0.9173	0.9228	0.9282	0.9336
Maybrat	1.0821	1.1379	1.1936	1.2494	1.3052
Nduga	0.4330	0.7372	1.0414	1.3456	1.6498
Paniai	1.0340	1.0490	1.0640	1.0790	1.0940
Pegunungan Arfak	1.3016	1.3107	1.3199	1.3290	1.3381
Pegunungan Bintang	0.3265	0.2714	0.2516	0.2361	0.2206
Puncak	0.4127	0.4106	0.4085	0.4064	0.4044
Puncak Jaya	1.1895	1.3754	1.5613	1.7472	1.9331
Sabu Raijua	2.1693	2.2258	2.2824	2.3390	2.3956
Sumba Tengah	1.6645	1.6762	1.6880	1.6997	1.7114
Supiori	1.0442	1.1438	1.2435	1.3431	1.4428
Tambrauw	1.0259	1.0584	1.0908	1.1232	1.1556
Teluk Wondama	1.0652	1.1004	1.1357	1.1709	1.2062
Tolikara	1.0865	1.1526	1.2186	1.2846	1.3506
Yahukimo	0.6025	0.5783	0.5541	0.5299	0.5057
Yalimo	1.0097	1.1787	1.3478	1.5168	1.6858
Avg. of All Districts	1.0548	1.1225	1.1919	1.2616	1.3313
Total of All Districts	21.0953	22.4491	23.8386	25.2318	26.6254
Increase/decrease per 5-year (%)		6.42%	6.19%	5.84%	5.52%
Avg. increase/decrease per year (%)		**1.28%**	**1.24%**	**1.17%**	**1.10%**
Avg. increase/decrease 2025-2045 (%)		**1.20%**			

The table is drawn from Statistics Indonesia (2022) and the authors' calculation

Maize

Total per capita weekly quantity demanded of maize in 2045 in these 20 districts is projected to reach 1.96 kg with a per district average of 0.098 kg. These numbers are 2.89% higher than in 2021 (1.91 kg and 0.095 kg). From 2025 to 2045, the quantity demanded for maize in these districts is projected to increase every year by an average of 1.27%, much lower than the 7.70% annual growth achieved between 2018 and 2021 (Table 7 and Table 8). The projected slowdown in the growth of quantity demanded is primarily caused by the average expenditure on maize, which tends to flatten over as long a period as 25 years.[4]

The average per capita annual quantity demanded of maize in 2045 from the 20 districts is estimated to reach 5.10 kg, which is 71.14% higher than the estimate arrived at by Arifin et al. of 2.98 kg (Arifin et al., 2018). Arifin et al. argue that maize consumption tends to decrease as income increases, and Indonesia is expected to experience steady economic growth (Arifin et al., 2018, pp. 28, 52).

> " maize consumption tends to decrease as income increases, and Indonesia is expected to experience steady economic growth. "

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[4] More details in the Appendix.

Table 7.
Quantity Demanded of Maize in the Selected Districts (kg/capita/week), 2018–2021

District	2018	2019	2020	2021
Deiyai	0.0570	0.0000	0.0000	0.0180
Intan Jaya	0.0350	0.0000	0.0130	0.0000
Jayawijaya	0.0500	0.0420	0.0830	0.0370
Lanny Jaya	0.0220	0.1630	0.2030	0.2020
Mamberamo Tengah	0.1600	0.1440	0.1720	0.1040
Maybrat	0.0600	0.0270	0.0210	0.0060
Nduga	0.0000	0.0000	0.0240	0.0450
Paniai	0.0060	0.0000	0.0000	0.0320
Pegunungan Arfak	0.0100	0.0060	0.0190	0.0440
Pegunungan Bintang	0.0180	0.0110	0.0130	0.0070
Puncak	0.0000	0.0000	0.0000	0.0000
Puncak Jaya	0.1270	0.0350	0.0310	0.0000
Sabu Raijua	0.2930	0.0700	0.1320	0.2870
Sumba Tengah	0.6240	0.7510	0.6150	0.6160
Supiori	0.0020	0.0010	0.0030	0.0050
Tambrauw	0.0070	0.0090	0.0210	0.0030
Teluk Wondama	0.0130	0.0180	0.0380	0.0070
Tolikara	0.0160	0.0610	0.1000	0.1620
Yahukimo	0.0350	0.0430	0.0650	0.0440
Yalimo	0.0300	0.0330	0.2040	0.2870
Average of All Districts	0.0783	0.0707	0.0879	**0.0953**
Total of All Districts	1.5650	1.4140	1.7570	**1.9060**
Increase/decrease per year (%)		-9.65%	24.26%	8.48%
Avg. increase/decrease 2018–2021 (%)			**7.70%**	

The table is drawn from Statistics Indonesia (2022) and the authors' calculation

Table 8.
Projected Quantity Demanded of Maize, 2025–2045 in the Selected Districts (kg/capita/week)

District	2025	2030	2035	2040	2045
Deiyai	0.0001	0.0001	0.0001	0.0001	0.0001
Intan Jaya	0.0326	0.0475	0.0624	0.0773	0.0922
Jayawijaya	0.0326	0.0474	0.0623	0.0772	0.0920
Lanny Jaya	0.2042	0.2297	0.2630	0.2716	0.2986
Mamberamo Tengah	0.0646	0.0606	0.0565	0.0525	0.0484
Maybrat	0.0767	0.0600	0.0433	0.0266	0.0199
Nduga	0.0038	0.0057	0.0076	0.0096	0.0115
Paniai	0.0116	0.0160	0.0205	0.0249	0.0294
Pegunungan Arfak	0.0009	0.0011	0.0013	0.0014	0.0016
Pegunungan Bintang	0.0000	0.0000	0.0000	0.0000	0.0000
Puncak	0.0000	0.0000	0.0000	0.0000	0.0000
Puncak Jaya	0.0105	0.0181	0.0257	0.0333	0.0409
Sabu Raijua	0.0564	0.0736	0.0908	0.1080	0.1253
Sumba Tengah	0.5767	0.5600	0.5032	0.4465	0.4098
Supiori	0.0003	0.0005	0.0007	0.0009	0.0011
Tambrauw	0.0426	0.0512	0.0598	0.0684	0.0771
Teluk Wondama	0.0026	0.0043	0.0060	0.0076	0.0093
Tolikara	0.1043	0.1761	0.2479	0.3196	0.3914
Yahukimo	0.0224	0.0165	0.0106	0.0048	0.0000
Yalimo	0.2896	0.2943	0.2997	0.3064	0.3124
Avg. of All Districts	0.0766	0.0831	0.0881	0.0918	0.0981
Total of All Districts	1.5325	1.6627	1.7614	1.8367	1.9610
Increase/decrease per 5-year (%)		8.50%	5.94%	4.28%	6.77%
Avg. increase/decrease per year (%)		**1.70%**	**1.19%**	**0.86%**	**1.35%**
Avg. increase/decrease 2025-2045 (%)			**1.27%**		

The table is drawn from Statistics Indonesia (2022) and the authors' calculation

Wheat flour

Of the food items considered in this paper, wheat flour is projected to experience the strongest increase in demand in the selected 20 districts. Weekly per capita quantity demanded for wheat flour in 2045 in these 20 districts is projected to reach 0.56 kg with a per district average of 0.028 kg, around four times higher than in 2021 (0.14 kg and 0.0072 kg, respectively). The quantity of wheat flour demanded is projected to increase by 6.24% every year from 2025–2045, a complete reversal of the trend from 2018–2021, when quantity demanded fell, with average annual growth of -7.11% (Table 9 and Table 10).

> **Of the food items considered in this paper, wheat flour is projected to experience the strongest increase in demand in the selected 20 districts.**

The contrasting trends between 2018–2021 and 2025–2045 can be explained by an assumption about the average expenditure on wheat flour, which is increasing over time. As a result, while in the short term (2018–2021) the quantity of wheat flour demanded may have declined due to other factors, over the long term (2025–2045) increasing expenditure is expected to predominate, driving up demand.

Table 9.
Quantity Demanded of Wheat Flour in the Selected Districts (kg/capita/week), 2018–2021

District	2018	2019	2020	2021
Teluk Wondama	0.1170	0.0590	0.0630	0.0680
Supiori	0.0220	0.0370	0.0140	0.0180
Maybrat	0.0120	0.0150	0.0120	0.0170
Sabu Raijua	0.0050	0.0070	0.0080	0.0100
Tambrauw	0.0100	0.0500	0.0270	0.0090
Sumba Tengah	0.0030	0.0100	0.0060	0.0080
Jayawijaya	0.0040	0.0060	0.0240	0.0050
Pegunungan Arfak	0.0020	0.0000	0.0070	0.0040
Yalimo	0.0000	0.0000	0.0130	0.0040
Deiyai	0.0000	0.0000	0.0000	0.0000
Lanny Jaya	0.0000	0.0000	0.0000	0.0000
Mamberamo Tengah	0.0000	0.0020	0.0010	0.0000
Puncak Jaya	0.0000	0.0030	0.0310	0.0000
Intan Jaya	0.0080	0.0000	0.0020	0.0000
Nduga	0.0000	0.0000	0.0000	0.0000
Paniai	0.0000	0.0370	0.0000	0.0000
Pegunungan Bintang	0.0070	0.0100	0.0040	0.0000
Puncak	0.0000	0.0000	0.0000	0.0000
Tolikara	0.0000	0.0000	0.0000	0.0000
Yahukimo	0.0050	0.0020	0.0010	0.0000
Average of All Districts	0.0098	0.0119	0.0107	**0.0072**
Total of All Districts	0.1950	0.2380	0.2130	**0.1430**
Increase/decrease per year (%)		22.05%	-10.50%	-32.86%
Avg. increase/decrease 2018-2021 (%)			**-7.11%**	

The table is drawn from Statistics Indonesia (2022) and the authors' calculation

Table 10.
Projected Quantity Demanded of Wheat Flour, 2025–2045
in the Selected Districts (kg/capita/week)

District	2025	2030	2035	2040	2045
Teluk Wondama	0.0589	0.0843	0.1097	0.1351	0.1605
Puncak Jaya	0.0374	0.0595	0.0815	0.1035	0.1256
Jayawijaya	0.0272	0.0424	0.0576	0.0728	0.0880
Sabu Raijua	0.0138	0.0246	0.0355	0.0464	0.0572
Maybrat	0.0173	0.0258	0.0342	0.0427	0.0511
Supiori	0.0071	0.0109	0.0146	0.0184	0.0221
Pegunungan Bintang	0.0108	0.0130	0.0153	0.0175	0.0197
Tambrauw	0.0111	0.0120	0.0129	0.0138	0.0147
Sumba Tengah	0.0049	0.0071	0.0093	0.0115	0.0137
Yalimo	0.0021	0.0033	0.0044	0.0055	0.0067
Mamberamo Tengah	0.0009	0.0011	0.0013	0.0014	0.0016
Pegunungan Arfak	0.0009	0.0011	0.0013	0.0014	0.0016
Deiyai	0.0000	0.0000	0.0000	0.0000	0.0000
Intan Jaya	0.0000	0.0000	0.0000	0.0000	0.0000
Lanny Jaya	0.0000	0.0000	0.0000	0.0000	0.0000
Nduga	0.0000	0.0000	0.0000	0.0000	0.0000
Paniai	0.0000	0.0000	0.0000	0.0000	0.0000
Puncak	0.0000	0.0000	0.0000	0.0000	0.0000
Tolikara	0.0000	0.0000	0.0000	0.0000	0.0000
Yahukimo	0.0000	0.0000	0.0000	0.0000	0.0000
Avg. of All Districts	0.0096	0.0143	0.0189	0.0235	0.0281
Total of All Districts	0.1924	0.2851	0.3776	0.4700	0.5625
Increase/decrease per 5-year (%)		48.18%	32.44%	24.47%	19.68%
Avg. increase/decrease per year (%)		**9.64%**	**6.49%**	**4.89%**	**3.94%**
Avg. increase/decrease 2025-2045 (%)		**6.24%**			

The table is drawn from Statistics Indonesia (2022) and the authors' calculation

Soybeans

Because of data limitations, "soybeans" here refers to raw soybeans and does not include derivative products such as tofu and tempeh. Raw soybeans are primarily a productive input rather than a consumption good, and so quantity demanded is lower in these exceptionally poor districts that lack food production facilities.

Because of the resulting low demand for soybeans in the selected 20 districts, figures for this food are given in grams rather than kilograms. Additionally, most districts have zero quantity demanded for soybeans over both time horizons (2018–2021 and projected for 2025–2045), so tables in this section do not break down numbers by district.

Although soybeans are the only food item considered in this paper projected to experience declining quantity demanded, the quantities in question are extremely small . Total per capita weekly quantity demanded for soybeans in 2045 in these 20 districts is projected to reach only 5.30 grams with a per district average of 0.26 grams (Table 12). This represents a decline from 2021 (11 grams and 0.55 grams, respectively) (Table 11). These numbers are so low that they indicate insignificant quantity demanded for soybeans in these poor districts. Despite the importance of soybean-derived foods as a protein source for Indonesians, data limitations limiting estimates to raw soybeans mean that estimates will not be used to inform discussion.

> "Soybeans are the only food item considered in this paper projected to experience declining quantity demanded, and the quantities in question are extremely small."

Table 11.
Quantity Demanded of Soybeans in the Selected Districts (gram/capita/week), 2018–2021

District	2018	2019	2020	2021
Average of All Districts	17.1000	5.0000	2.0500	**0.5500**
Total of All Districts	342.0000	100.0000	41.0000	**11.0000**
Increase/decrease per year (%)		-70.76%	-59.00%	-73.17%
Avg. increase/decrease 2018-2021 (%)		**-67.64%**		

The table is drawn from Statistics Indonesia (2022) and the authors' calculation

Table 12.
Projected Quantity Demanded of Soybeans, 2025–2045 in the Selected Districts (gram/capita/week)

District	2025	2030	2035	2040	2045
Avg. of All Districts	0.8854	0.7194	0.4618	0.3236	0.2652
Total of All Districts	17.7082	14.3882	9.2355	6.4722	5.3034
Increase/decrease per 5-year (%)		-18.75%	-35.81%	-29.92%	-18.06%
Avg. increase/decrease per year (%)		**-3.75%**	**-7.16%**	**-5.98%**	**-3.61%**
Avg. increase/decrease 2025-2045 (%)		**-5.13%**			

The table is drawn from Statistics Indonesia (2022) and the authors' calculation

Potential impact on calorie intake in the twenty districts

Even if the inability of domestic production to meet demand is set aside, the level of quantity demanded—as indicated by the level of consumption—of rice, maize, and wheat flour in the selected

> The level of quantity demanded of rice, maize, and wheat flour in the selected 20 districts suggests grim prospects for the nutritional intake of these districts' residents.

20 districts suggests grim prospects for the nutritional intake of these districts' residents . The Ministry of Agriculture's Desirable Dietary Pattern (*Pola Pangan Harapan* or PPH) suggests an ideal daily calorie intake per person from grains is 1,050 kcal (Table 13) (Ministry of Agriculture, 2021a, p. 31), but for residents of these districts this figure was only 590 kcal in 2021 and is expected to reach only 727 kcal by 2045.

Table 13.
Quantity Demanded of Analyzed Foods and Calorie Intake per Person in the Selected Districts, 2018–2045

Year	Description	Food Items				Total of Calorie Intake
		Rice (1 kg = 3,622 kcal)	Maize (1 kg = 1,780 kcal)	Wheat Flour (1 kg = 3,330 kcal)	Soybeans (1 kg = 3,810 kcal)	
2018	Avg. Consumption (kg/week)	1.0574	0.0783	0.0098	0.0171	
	Calorie (kcal/week)	3,829.9028	139.3740	32.6340	65.1510	4,067.0618
	Calorie (kcal/day)	547.1290	19.9106	4.6620	9.3073	581.0088
2019	Avg. Consumption (kg/week)	1.0435	0.0707	0.0119	0.0050	
	Calorie (kcal/week)	3,779.5570	125.8460	39.6270	19.0500	3,964.0800
	Calorie (kcal/day)	539.9367	17.9780	5.6610	2.7214	566.2971
2020	Avg. Consumption (kg/week)	1.1264	0.0879	0.0107	0.0021	
	Calorie (kcal/week)	4,079.8208	156.4620	35.6310	8.0010	4,279.9148
	Calorie (kcal/day)	582.8315	22.3517	5.0901	1.1430	611.4164
2021	Avg. Consumption (kg/week)	1.0980	0.0953	0.0072	0.0006	
	Calorie (kcal/week)	3,976.9560	169.6340	23.9760	2.2860	4,172.8520
	Calorie (kcal/day)	568.1366	24.2334	3.4251	0.3266	596.1217
2025	Projected Avg. Consumption (kg/week)	1.0548	0.0766	0.0096	0.0009	
	Calorie (kcal/week)	3,820.4856	136.3480	31.9680	3.4290	3,992.2306
	Calorie (kcal/day)	545.7837	19.4783	4.5669	0.4899	570.3187
2030	Projected Avg. Consumption (kg/week)	1.1225	0.0831	0.0143	0.0007	
	Calorie (kcal/week)	4,065.6950	147.9180	47.6190	2.6670	4,263.8990
	Calorie (kcal/day)	580.8136	21.1311	6.8027	0.3810	609.1284
2035	Projected Avg. Consumption (kg/week)	1.1919	0.0881	0.0189	0.0005	
	Calorie (kcal/week)	4,317.0618	156.8180	62.9370	1.9050	4,538.7218
	Calorie (kcal/day)	616.7231	22.4026	8.9910	0.2721	648.3888
2040	Projected Avg. Consumption (kg/week)	1.2616	0.0918	0.0235	0.0003	
	Calorie (kcal/week)	4,569.5152	163.4040	78.2550	1.1430	4,812.3172
	Calorie (kcal/day)	652.7879	23.3434	11.1793	0.1633	687.4739
2045	Projected Avg. Consumption (kg/week)	1.3313	0.0980	0.0281	0.0003	
	Calorie (kcal/week)	4,821.9686	174.4400	93.5730	1.1430	5,091.1246
	Calorie (kcal/day)	688.8527	24.9200	13.3676	0.1633	727.3035

The table is drawn from Statistics Indonesia (2022 and 2023c) and the authors' calculation

Significant reforms are needed to help the Indonesian government achieve its development targets for the improvement of health and quality of life in its Vision 2045 document. This goal includes a targets for reducing the stunting rate by improving nutrition access (BAPPENAS, 2019, pp. 4, 10). With healthy populations free from stunting, the government aims to develop high-quality, well-educated human resources that would lead to much higher employment rate at the formal sector to reduce the poverty rate (BAPPENAS, 2019, pp. 10–12). To achieve these ambitious targets, the government must address the issue of poor nutrition in these 20 districts.

> "Significant reforms are needed to help the Indonesian government achieve its development targets for the improvement of health and quality of life in its Vision 2045 document."

THE WAY FORWARD

Meeting food demand is a massive challenge that requires a holistic policy approach, which are covered in detail in other CIPS publications as quoted in the discussion below. This analysis

suggests that domestic food demand will continue to increase even as food production has been falling in Indonesia in recent years. There are four steps the government should take to help address the shortfall. Performing these actions will improve food affordability for low-income people such as those who live in the 20 districts analyzed, giving them a greater chance to meet the minimum standards of nutrition intake and break the vicious cycle of poverty that malnutrition can perpetuate.

Improve investment climate to increase access to better farm technology

To help ensure demand is met, food crop productivity must be increased through the use of better farm technology. In order to improve access to farm technology, the government improve opportunities for businesses in areas currently dominated by state-owned enterprises and improve regulatory predictability in rules and regulations to create an environment that should attract more investors, both local and international (Pasaribu et al., 2021, pp. 6–7).

Streamline transfer of technology and knowledge programs

To further improve the productivity in Indonesian agriculture, the government should streamline its transfer of technology and knowledge programs to avoid overlap with similar programs offered by private sector (Budiman & Alta, 2022, p. 9). The government should improve the targeting of its free technology programs and monitor and evaluate the results of its technology provision to avoid sub-optimal adoption that does not improve long-run productivity. The government should also facilitate private sector transfer of technology, which uses a market-based approach to reward farmers for quality harvests.

Allow international trade to help meet unmet food demand

To complement domestic food production, the government should maximize the ability of international trade to ensure the food supply can keep up with the increasing demand. The government should conduct a comprehensive review of the cost and benefits of non-tariff measures that affect imports and remove those with large net costs. In addition, the government should introduce an automatic import licensing system that facilitates transparency and ease of trade in accordance with the food market situation (Amanta, 2021, p. 7).

Work with the private sector when implementing reforms

Finally, the government should work closely with the private sector to implement these reforms. Food and agriculture is a complicated sector and holistic approaches to improvement requires cooperation from all stakeholders, both public and private institutions, to ensure reform programs meet their intended objectives. Rather than the driving force in reform, the government should act as enabler by providing a conducive legal framework and ensuring fairness, transparency, and compliance among all involved parties.

Private institutions with grassroots networks should conduct outreach to the people who require their technical assistance, and those with expertise in trading in the international food market should be given ample opportunity to import food.

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APPENDIX

This paper takes a quantitative approach to analyzing food demand among low-income Indonesians. The independent variables used are:

- average expenditure per capita for each commodity (Sengul and Tuncer, 2005);
- unemployment rate (Baland, 1991; Etana and Tolossa, 2017);
- poverty rate (Baland, 1991; Cirera and Masset, 2010; Etana and Tolossa, 2017);
- gross regional domestic product (GRDP) (Cirera and Masset, 2010); and
- human development index (HDI) (Hiç *et al.*, 2016; Ferretti and Mariani, 2017; Bao *et al.*, 2021).

Food demand is the dependent variable. The quantity of food demanded is measured by the average weekly per capita consumption of commodities by weight in each district.

Average expenditure per capita for each commodity helps determine how much of a commodity is consumed. However, consumption may be higher than zero even when expenditure is zero—when the consumer is a farmer consuming their own crops, for example, as is common in the districts analyzed.[5] Consumption can also be funded by social assistance rather than private expenditure, and this is especially true in poor districts like those being analyzed here.

Unemployment rate, poverty rate, and gross regional domestic product are variables that describe the aggregate welfare of the district. Communities with a good level of welfare have relatively better access to food (Riches, 1997; Pinstrup-Andersen, 2009). The hypothesis is the better the welfare of the people of an area, the higher the quantity of food demanded.

The Human Development Index is used as a proxy for the quality of human resources in the analyzed district (Ferretti and Mariani, 2017). The better the HDI of an area, the more food will be demanded in that district.

This study therefore hypothesizes the following relationships between food demand and its independent variables, to be tested by regression analysis:

- An inverse relationship between unemployment and food demand. When unemployment increases, the quantity of food demanded will decrease.
- An inverse relationship poverty and food demand. When poverty increases, the quantity of food demanded will decrease.
- A positive relationship between GRDP and food demand. When GRDP increases, the quantity of food demanded will increase.
- A positive relationship between average expenditure per capita for each commodity and the quantity of food demanded. When average expenditure increases, the quantity of food demanded will increase.
- A positive relationship between HDI and food demand. When HDI improves, the quantity of food demanded will increase.

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[5] The Ministry of Agriculture (2021b) using Statistics Indonesia data gives the following as the proportion of all workers in the agricultural sector in 2021: East Nusa Tenggara—50.37%, Papua—68.13%, and West Papua—32.69%.

Econometric model

$$\ln FD_{it} = \alpha + \beta_1 Pov_{it} + \beta_2 \ln GRDP_{it} + \beta_3 \ln Exp_{it} + \beta_4 Unemp_{it} + \beta_5 HDI_{it} + U_{it}$$

FD   = Poor Food Demand, Average Consumption per Capita per Commodity per Week (Kilogram)
Pov   = Poverty rate (%)
GRDP   = Gross Regional Domestic Products (Million IDR)
Exp   = Average per capita expenditure per commodity (IDR)
Unemp = Unemployment rate (%)
HDI   = Human Development Index (%)

The determinant factor was analyzed by estimating the consumption function using panel data regression. The cross-section data used is the data of 20 districts with a poverty rate above 30%, which at the same time are the 20 provinces with the highest percentage of poverty. The time series data used in this analysis is data from 2018 to 2021.

The data used in this study were taken from the publications of the Badan Pusat Statistik, both BPS at the national, provincial and district levels.

Rice

Our analysis found that the only independent variable with a significant relationship to the demand for rice was average expenditure per capita. However, the districts analyzed include rice producing regions,[6] which gives us good reason to believe that consumption will exceed what is purchased in these regions.

The relationship between expenditure and quantity demanded is positive, as expected. Every 1% increase in expenditure increases quantity of rice demanded by 0.78%. This finding is in line with the findings of Sengul and Tuncer (2005), where the higher the average expenditure per capita for rice, the quantity demanded for this commodity will also increase. The following is a model of the estimation results.

$$Rice\ Demand = -4.612363 + 0.778355Exp(rice)$$

This analysis found a coefficient of determination (R^2) of 0.709932. This suggests that 70.99% of changes in quantity of rice demanded can be explained by the independent variables, while the remaining 29.01% is explained by other factors not included in the model.

The magnitude of the constant (intercept) was found to be significant and have a value of -4.612363. This suggests that when expenditure 0 (zero), then the quantity of rice demanded is -4.612363. However, this constant value does not make sense because it is impossible for the quantity demanded for rice or the average weekly per capita consumption of rice to be negative. Thus the value of this constant sometimes does not reflect the actual situation. Panel data analysis found the intercept value for each district, given in Table 14.

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[6] Statistics Indonesia (2021a) reported rice production in West Papua of 25 thousand tons of dry milled grain (GKG) rice, in Papua 286 thousand tons of GKG, and in NTT 732 thousand tons of GKG.

Table 14.
Interception Table of Each District

No.	District	Effect
1	Deiyai	0.479886
2	Intan Jaya	-0.309094
3	Jayawijaya	0.111741
4	Lanny Jaya	-0.334967
5	Mamberamo Tengah	-0.537167
6	Maybrat	0.603899
7	Nduga	-0.591507
8	Paniai	0.907052
9	Pegunungan Arfak	0.150200
10	Pegunungan Bintang	-0.574583
11	Puncak	-0.791532
12	Puncak Jaya	-0.428707
13	Sabu Raijua	0.058612
14	Sumba Tengah	0.510210
15	Supiori	0.461521
16	Tambrauw	0.189752
17	Teluk Wondama	0.440417
18	Tolikara	0.046386
19	Yahukimo	-0.060238
20	Yalimo	-0.331882

District Paniai has the district with the highest intercept value. In this district, when rice expenditure is zero, rice demand—that is, average weekly per capita consumption of rice, is 0.91 kg.

Puncak district has the lowest intercept, -0.79.

Maize

Our analysis found that the only independent variable with a significant relationship to the demand for maize was again average expenditure per capita. The relationship is positive. Every 1% increase in expenditure will increase the quantity of maize demanded by 0.23%.

The magnitude of the constant (intercept) and other variables in this commodity model does not significantly affect the quantity of maize demanded. The following is a model of the estimation results.

$$\text{Maize Demand} = 0.235707 \text{Exp(maize)}$$

This analysis found a coefficient of determination (R^2) of 0.603337. This suggests that 60.33% of changes in quantity of maize demanded can be explained by the independent variables, while the remaining 39.67% is explained by other factors not included in the model.

Wheat flour

Our analysis found that the only independent variable with a significant relationship to the demand for wheat flour was again average expenditure per capita. The relationship is positive. Every 1% increase in expenditure will increase the quantity of maize demanded by 0.41%.

The magnitude of the constant (intercept) and other variables in this commodity model does not significantly affect the quantity of wheat flour demanded. The following is a model of the estimation results.

$$\text{Wheat Flour Demand} = 4.71\text{E-}05 \text{Exp(flour)}$$

This analysis found a coefficient of determination (R^2) of 0.363244. This suggests that 36.32% of changes in quantity of maize demanded can be explained by the independent variables, while the remaining 63.68% is explained by other factors not included in the model.

Soybean

Because of data limitations, soybeans here refers to raw soybeans and does not include derivative products such as tofu and tempeh. Raw soybeans are primarily a productive input rather than a consumption good, and so demand is lower in these exceptionally poor districts.

Our analysis found that the independent variables with significant relationships to the demand for raw soybeans were average expenditure per capita and the poverty rate. The relationship is positive for both variables. Every 1% increase in expenditure will increase the quantity of soybeans demanded by 1.02%, and every 1% increase in the poverty rate increased quantity of soybeans demanded by 0.05%.

The magnitude of the constant (intercept) and other variables in this commodity model does not significantly affect the quantity of soybeans demanded. The following is a model of the estimation results.

$$\text{Soybean Demand} = 1.020323\text{Exp(soybeans)} + 0.050022\text{Pov}$$

The estimates for quantity of soybeans demanded found in our analysis were so small that projected demand is not useful for broader analysis and policy recommendations. This analysis found a coefficient of determination (R^2) of 0.952582. This suggests that 95.25% of changes in quantity of maize demanded can be explained by the independent variables, while the remaining 4.75% is explained by other factors not included in the model.

Projection method

The projection of food demand in this study is carried out in three steps, namely (1) forecasting for each predictor variable using linear, quadratic and exponential trend analysis methods, (2) determining the best forecasting results from the three methods based on Mean Absolute Percentage Error (MAPE), Mean Absolute Deviation (MAD) values and the smallest Mean Squared Deviation (MSD), and (3) substituting the independent variable forecasting results in each panel data regression model that has been obtained to get the projected value of food demand (Srihardianti and Prahutama, 2016). In this study, demand projections for rice, maize, wheat flour and soybeans are made every five years, namely in 2025, 2030, 2035, 2040 and 2045. The projection results are assumed to be cateris paribus, which is a condition where other variables outside the model are assumed to be constant and did not change.

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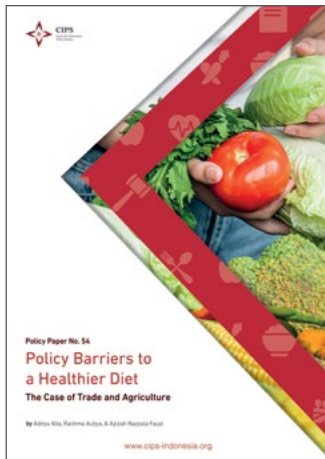
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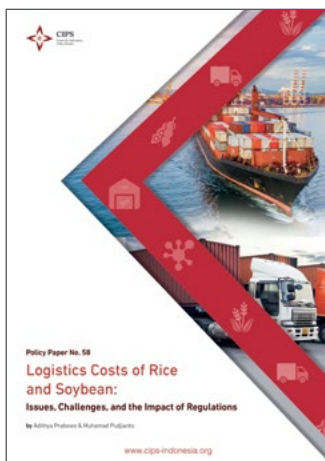
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