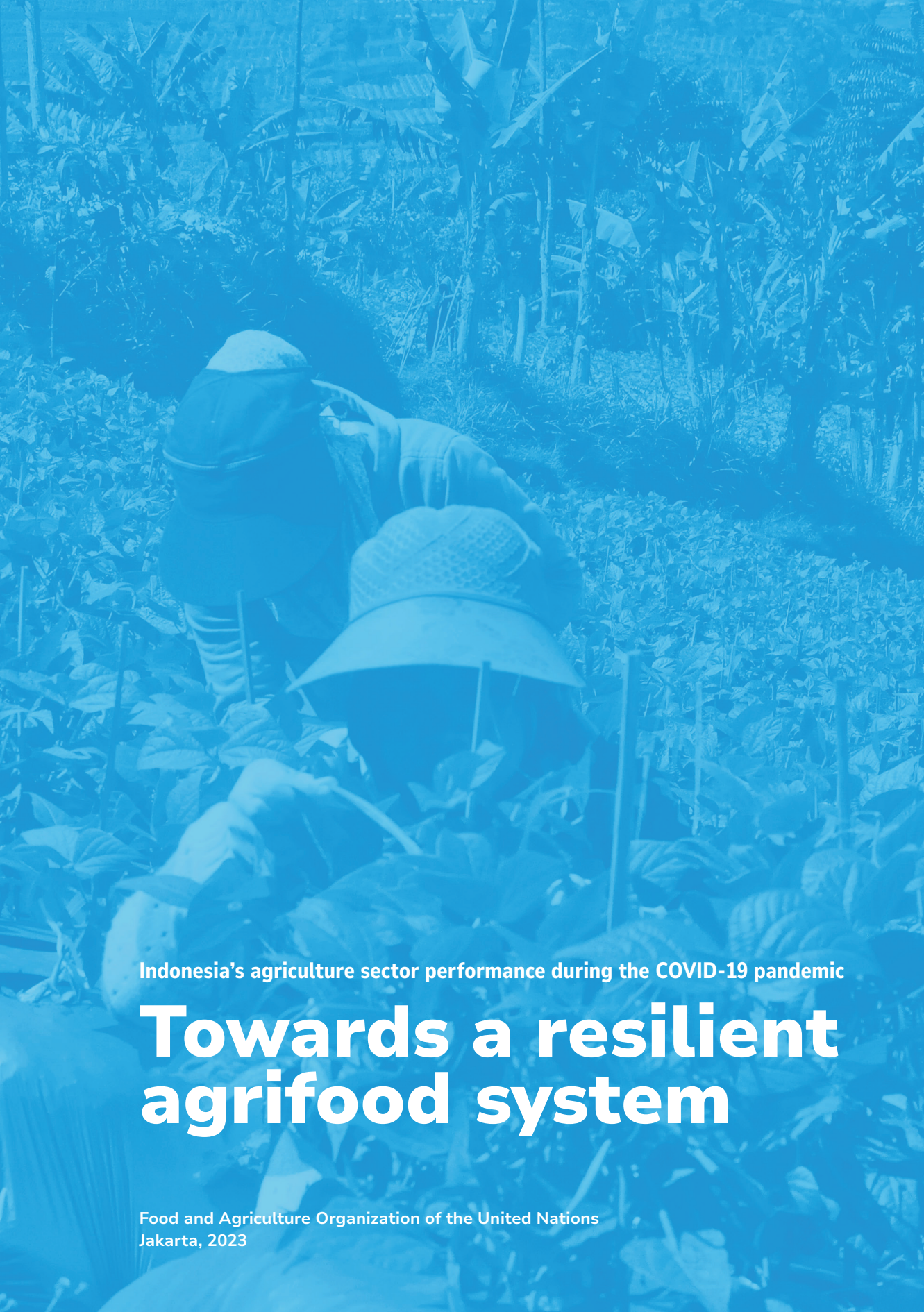
Food and Agriculture Organization of the United Nations

Indonesia's agriculture sector performance during the COVID-19 pandemic

Towards a resilient agrifood system



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Acknowledgements

This report analyses the performance of Indonesia's agricultural sector especially during the Covid-19 pandemic. The study was carried out by the Faculty of Economics and Management, IPB University with the cooperation with Ministry of Agriculture and the guidance of the Food and Agriculture of the United Nations (FAO).

The report was written by Muhammad Firdaus (lead), Amzul Rifin, Feryanto W Karo-Karo and Fahmi Salam Ahmad. The report drafts were reviewed by Aziz Elbehri, Andrea Cattaneo (Senior economists, FAO), Peter Timmer (external expert), and Achmad Suryana (Indonesia). In addition, the report benefited from valuable inputs during a Focus Group Discussion (FGD) meeting with multi-stakeholders.. More critically, the timely completion of this report owes greatly to the support of officers from the Ministry of Agriculture and National Food Agency (Bapangnas) who provided the necessary data.

Acronyms and Abbreviations

ASEAN	Association of Southeast Asian Nations
BLT-DD	*Bantuan Langsung Tunai Dana Desa* (Village Fund Direct Cash Assistance)
Botabek	Bogor, Tangerang and Bekasi
BPNT	*Bantuan Pangan Non Tunai* (Non-Cash Food Assistance)
BPS	*Badan Pusat Statistik* (Statistics Indonesia)
BST	*Bantuan Sosial Tunai* (Cash Social Assistance)
CPI	Consumer Price Index
CV	Coefficient of Variance
FAO	Food and Agriculture Organization of the United Nations
FSVA	Food Security and Vulnerability Atlas
GDP	gross domestic product
GKG	*Gabah Kering Panen* (Milled Dry Grain)
ha	Hectare
ICASEPS	Indonesian Centre for Agricultural Socioeconomic and Policy Studies
JPS	*Jaring Pengaman Sosial* (Social Safety Net)
kg	Kilogram
KUR	*Kredit Usaha Rakyat* (People's Business Credit)
MSME	micro, small and medium-sized enterprise
Mt	Metric tonnes
NPK	Nitrogen, Phosphorous, Potassium
NTP	*Nilai Tukar Petani* (Farmers' Terms Of Trade)
NTUP	*Nilai Tukar Usaha Pertanian* (Agricultural Business Terms of Trade)
OECD	Organisation for Economic Co-operation and Development
PEN	*Pemulihan Ekonomi Nasional* (National Economic Recovery)
PKH	*Program Keluarga Harapan* (Family Hope Programme)
PoU	Prevalence of Undernourishment
PP	*Peraturan Pemerintah* (Government Regulation)
PPI	Producer Price Index
Rastra	*Beras untuk Rakyat Sejahtera* (Rice for a Prosperous Population)
Sembako	*Sembilan Bahan Pokok* (Nine Basic Necessities)
SP	Superphosphate
TNP2K	*Tim Nasional Percepatan Penanggulangan Kemiskinan* (National Team for the Acceleration of Poverty Reduction)
va	Volt Ampere
WFP	World Food Programme
ZA	Zwavelzure Ammoniak (Ammonium Sulphate)

1 Introduction

The COVID-19 pandemic has had a huge impact on food security in Indonesia. Reductions in production were reported (Hirawan and Verselita, 2020; Warsito *et al.*, 2021). At the beginning of the pandemic, there were restrictions on the movement of people and agricultural goods (Empatika, 2021; HLPE, 2020; Kim, Kim and Park, 2020). In addition, agricultural inputs such as seed and fertilizer were not evenly distributed to the regions. This disrupted the planting season and thus led to setbacks (OECD, 2020).

Ensuring food production and availability is a major concern for policymakers (Russell *et al.*, 2011). The Indonesian Government has historically made various efforts in this regard (Ika, *et al.*, 2017), encouraging and providing facilitation to farmers as the main producers of food, such as through the supply of agricultural inputs. Meanwhile, on the supply side, producers themselves have an important role to play. Farmers in the upstream food sector had to continue production under COVID-19 in order to guarantee sustainable food security (Darma, *et al.*, 2020). Domestic production is the main focus today for every country, including Indonesia. In this pursuit, production facilities, such as agricultural machinery and equipment and subsidized fertilizers and seeds, are a priority (Hirawan and Verselita, 2020). Such facilities and assistance are particularly urgent considering that 93 percent of farmers in Indonesia are smallholder farmers (Hirawan and Verselita, 2020).

In responding to the pandemic, the Indonesian Government designed several programmes to protect farmers as food producers. These included social security programmes (social assistance, the Family Hope Programme (*Program Keluarga Harapan* – PKH), basic food packages, electricity subsidies, Village Fund Direct Cash Assistance [*Bantuan Langsung Tunai Dana Desa* – BLT-DD]); financing programmes (interest subsidies, easy access to the People's Business Credit (*Kredit Usaha Rakyat* – KUR) programme; and facilitating the availability of fertilizers (Darma, *et al.*, 2020; FAO, 2019; HLPE, 2020; Kim, *et al.*, 2020). The government was already carrying out these programmes before COVID-19 broke out but it increased their number and frequency during the pandemic (Empatika, 2021).

The government also issued government regulation (*Peraturan Pemerintah* – PP) No. 23 of 2020 concerning the National Economic Recovery (Pemulihan Ekonomi Nasional – PEN) programme (Government of Indonesia, 2020). The PEN programme aims to protect, maintain and improve the economic capacity of business actors, thus helping the business world deal with COVID-19. It is aimed at micro, small and medium-size enterprises (MSMEs), corporations and state-owned enterprises. For MSMEs, assistance is provided in the form of interest subsidies of IDR 34.15 trillion (USD 2.44 billion), tax incentives of IDR 28.06 trillion (USD 2 billion) and guarantees for new working capital loans. The government has also provided a credit stimulus for MSMEs amounting to IDR 34.15 trillion (USD 2.44 billion). IDR 27.26 trillion (USD 1.95 billion) of this goes through the Rural Bank, banks and finance companies. IDR 6.40 trillion (USD 456.7 million) is channelled through the KUR programme and ultra micro, mekaar and *pegadaian* microfinance institutions. Finally, IDR 0.49 trillion (USD 35.0 million) is distributed through cooperatives, farmers, revolving fund management institutions, marine and fisheries business capital management institutions, and MSMEs of regional governments.


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The PEN programme aims to protect, maintain and improve the economic capacity of business actors, thus helping the business world deal with COVID-19. It is aimed at micro, small and medium-sized enterprise (MSMEs), corporations and state-owned enterprises.

The functioning of Indonesia's agrifood system depends on the commodity. For estate crops, most production takes place off the main island of Java. Some processing occurs close to the production area (e.g. palm oil, rubber) but some takes place in Java (e.g. cocoa). Horticultural production takes place all over Indonesia, with outputs sent on to be sold in traditional or modern markets. Staple crops such as rice are also produced all over the country, and sold to the cities close to the production area. During the harvest period, rice is also sold to other islands or even to other countries.

Indonesia's agrifood system has transformed over the years, shifting from traditional to modern approaches. Reardon *et al.* (2015) and Vetter, Larsen and Bruun (2019) have emphasized the increasing importance of new market channels mediating Indonesia's rural–urban value chains. These channels have mostly entailed the positioning of modern supermarkets at the end of the value chain. COVID-19 has disrupted the flow of goods along this value chain.

This paper examines the situation for several agricultural commodities as a result of the travel restrictions implemented under COVID-19. These restrictions affected the flow of goods, including of agricultural inputs and outputs. In addition, the paper compares conditions before and during the pandemic, assessing this within the broader context of government actions to address the challenges posed by COVID-19. It employs descriptive analysis, trend analysis and comparative analysis. The paper ends with an analysis of the adequacy of food consumption and food security in Indonesia and of the Social Safety Net (*Jaring Pengaman Sosial* – JPS) programme.

2 Methodology

The data collected for this study relate to six of the most important staple food commodities in Indonesia: rice, corn, chicken meat, chicken eggs, shallots and bananas. Rice, corn, chicken meat, chicken eggs and shallots are strategic commodities according to the Ministry of Agriculture, and also have an influence on inflation. The six commodities represent sources of major nutrients, including carbohydrates (rice and corn), protein (chicken meat and chicken eggs) and vitamins (shallots and bananas).

The study compares the performance of Indonesian agriculture during the COVID-19 pandemic (2020–2021) with that in the period just before its onset (2018–2019). The data were obtained from the monthly reports of Statistics Indonesia (BPS, 2020a). The data used are mostly monthly data covering the period between January 2018 and December 2021.

Performance is analysed on five aspects: production, productivity (measured as the ratio of production to harvest area), producer and consumer price, export and import. Descriptive analysis in the form of graphs is complemented by trend analysis that shows whether there is a statistically significant trend of value movement during the (relatively short) four-year period of analysis. Trend analysis was carried out on monthly data as well as on yearly aggregate data.

Another type of analysis conducted to compare agricultural performance before and during the pandemic involved measuring mean value and its fluctuation. The level of fluctuation can be calculated using the coefficient of variance (CV), which is the standard deviation value of a piece of data divided by its mean value. This analysis uses statistical tests in the form of mean comparison tests and variance comparison tests. As for the trend analysis, the scope of performance comparison in this research is the four-year period of analysis and does not take into account pre-existing characteristics (from before 2018).

Information on the provision of agricultural inputs, government pandemic policies and prevalence of undernourishment is presented to support the data analysis.

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3 Results and discussion

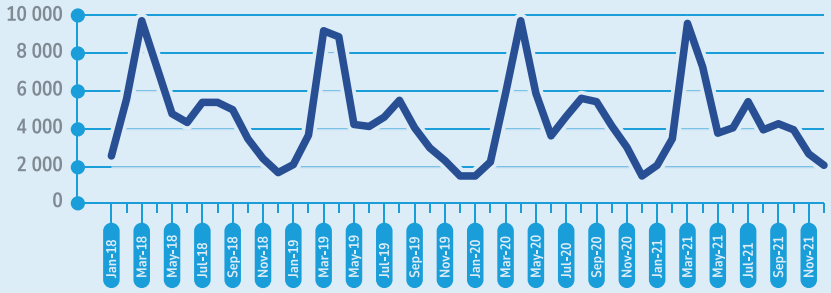
This section compares performance before and during the COVID-19 pandemic on the five indicators for the six selected agricultural commodities listed in Section 2.

3.1 Production

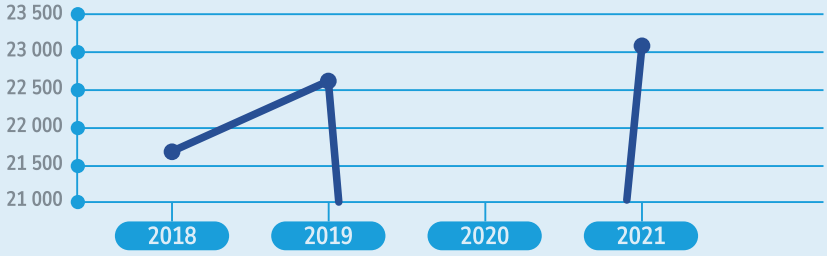
Based on Figure 1, the production information of the six commodities is as follows:

- Rice production calculated from milled dry grain (*gabah kering panen* – GKG) production has a seasonal pattern, with a peak in March–April. In general, there is no noticeable difference between the production performance of GKG before the pandemic (2018–2019) and during the pandemic (2020–2021).
- Prior to 2020, corn production data were not available on a monthly basis, so data are presented by year. There is a measurable increase in yearly corn production up to 2020; corn production stabilized but did not decrease between 2020 and 2021.
- Chicken meat production does not have a seasonal pattern: the numbers are relatively stable and do not change much between months. Fluctuations in the pandemic period are greater.
- Chicken egg production also does not have a seasonal pattern. There was a fairly high increase in production between December 2018 and January 2019 (before the pandemic) and monthly production figures remained relatively stable during the pandemic.
- Shallot production has a seasonal pattern, with the highest production in January and August and the lowest in December. In general, there is no significant difference between shallot production before and during the pandemic.
- Banana production data are available by quarter. Banana production also has a seasonal pattern, with the highest production in the first and fourth quarters of the year. There was a consistent increase in banana production every year between 2018 and 2021.

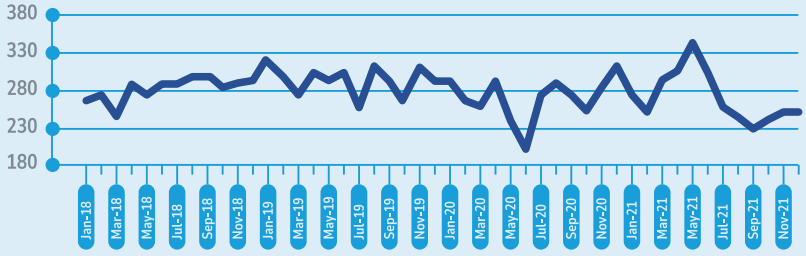
GKG production



Corn production



Chicken meat production



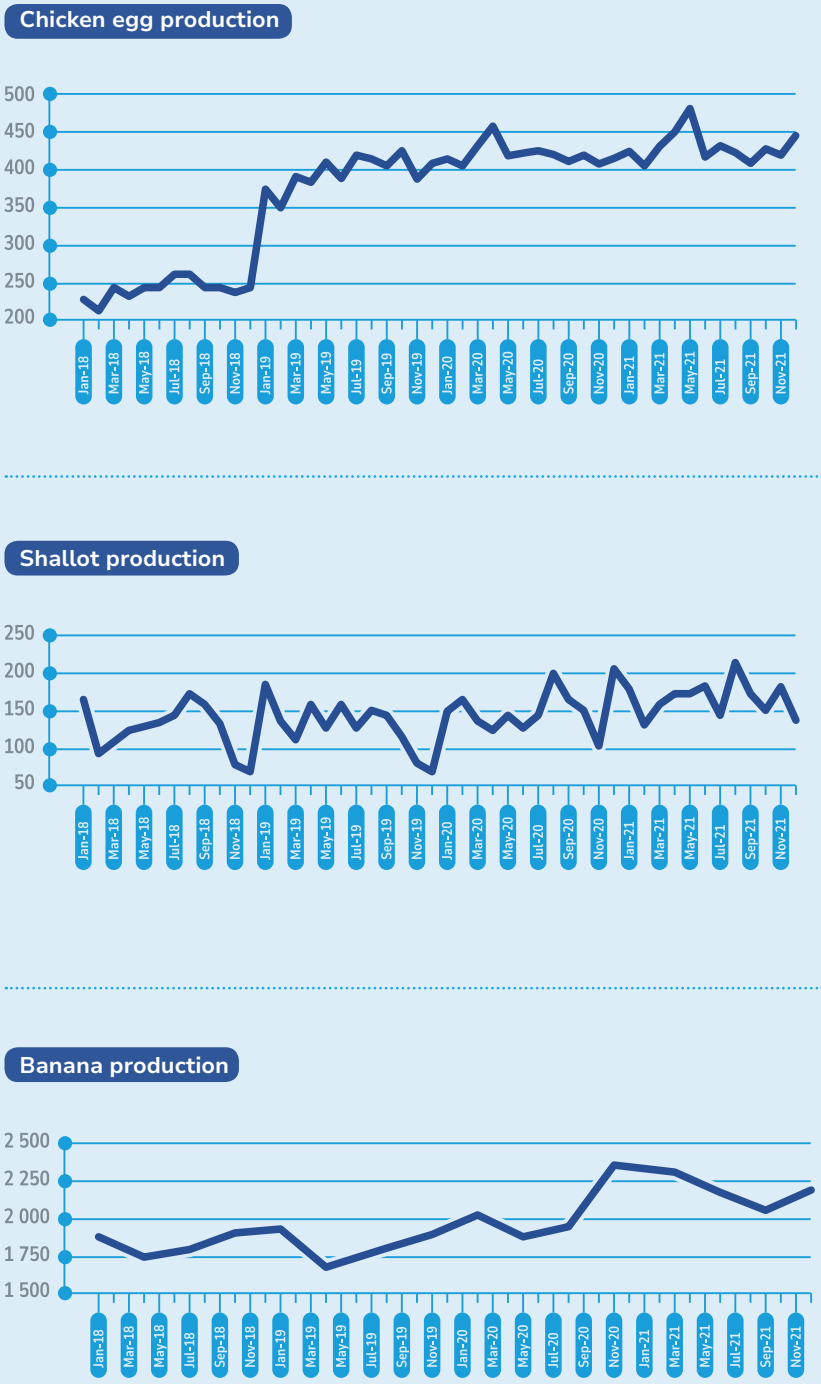


FIGURE 1 Production of six commodities (000 tonnes), 2018–2021

To test whether the production value movement trend was statistically significant, trend analysis was conducted. This was done by regressing the production of each commodity as the dependent variable and the time period (t) as the independent variable. Regression was carried out on monthly and yearly production data. For monthly data, the analysis was carried out for three different time periods – namely, for the entire period (January 2018–December 2021), in the period before the pandemic (January 2018–December 2019) and in the period during the pandemic (January 2020–December 2021). As well as revealing patterns during the observed data periods, trend analysis can suggest future trends for the food commodities being examined.

Meanwhile, the study included seasonal elements. Analysis of the total study period by year, covering the years before the pandemic (2018–2019) and during the pandemic (2020–2021), was unable to capture seasonal elements. To capture the seasonal factor in the trend analysis, then, the study looked at the data on a monthly basis.

The results of the analysis of the production trends of the six commodities (detailed in **Appendix 1.1**) are as follows:

- There was no significant change in rice production. In other words, rice production was stable before and during COVID-19.
- Over the whole period, the production of corn, chicken eggs, shallots and bananas saw a significant upward trend.
- Chicken meat production showed a statistically significant production decrease (at 10 percent significance level) but the magnitude of the average decrease was small.

A comparative analysis of production before and during the pandemic was carried out on all commodities except corn. This is because corn production data on a monthly basis were available only from January 2020. The indicators compared before and during the pandemic were production mean and variance.

The results of the mean comparison test of the five commodities (detailed in **Appendix 1.2**) show statistically significant differences in the commodities of chicken meat, chicken eggs, shallots and bananas. There is no significant difference in rice production. Production of chicken meat was lower during the pandemic than before the pandemic. Production of chicken eggs, shallots and bananas was higher during the pandemic.

The results of the variance comparison test of production (detailed in **Appendix 1.3**) show significant CV differences for chicken meat, chicken eggs and bananas. There is no significant CV difference for rice and shallots. Compared with before the pandemic, during the pandemic the fluctuations in chicken meat and banana production were high. Fluctuations in chicken egg production decreased, on the other hand.

To understand the stable or upward trending production levels for the analysed commodities, we looked at a key production input: **fertilizer**. This section presents the distribution of fertilizer subsidies to farmers by type of fertilizer. Data on the use of fertilizers based on the types of commodities studied are not available. The discussion focuses on the monthly subsidized fertilizer amount distributed to farmers before and during the pandemic.

The production performance of these commodities (especially that of food crops) cannot be separated from the subsidized fertilizer programme. The data on the subsidized fertilizer distributed to farmers shows changes between the 2018–2019 period and the 2020–2021 period. Four types of subsidized fertilizers are discussed here: *urea*, superphosphate (SP-36), ammonium sulphate (zwavelzure ammoniak – ZA) and nitrogen, phosphorous, potassium (NPK); moreover, to understand the use of non-chemical fertilizers, the use of organic fertilizers is also considered.

Subsidized fertilizer is regulated in Decree of the Minister of Trade No. 70/MPP/Kep/2/2003, dated 11 February 2003, concerning the Procurement and Distribution of Subsidized Fertilizers for the Agricultural Sector. Meanwhile, the government's budget policy shows the difference before and during the COVID-19 pandemic. In the period before the pandemic, the government budget for fertilizer subsidies was IDR 33.6 trillion (USD 2.40 billion) in 2018 and increasing to IDR 34.3 trillion (USD 2.45 billion) in 2019. During the pandemic, the budget allocation for subsidized fertilizers decreased to IDR 31.09 trillion (USD 2.22 billion) in 2020 and again to IDR. 29.1 trillion (USD 2.08 billion) in 2021. This budget reduction was the result of the impacts of COVID-19 in terms of a weaker economy and the need to divert part of the budget to handle the pandemic.

Looking at the amount of subsidized fertilizer distributed to farmers, it can be seen that urea, SP-36 and ZA fertilizers experienced a decline during the period. Figure 2 shows the distribution of fertilizers before and during the pandemic. It can be seen that the biggest decrease was for SP-36, from an average of 67.94 tonnes per month before the pandemic down to only 39.39 tonnes per month during the pandemic (a decrease of 28.55 tonnes). ZA distribution before the pandemic on average was 82.16 tonnes per month, going down to 61.84 tonnes per month during the pandemic (a decrease of 20.32 tonnes). Urea, the main fertilizer, experienced the same situation: during the pandemic, distribution of urea fertilizer was on average 326.28 tonnes per month; this dropped to 320.37 tonnes per month during the pandemic, a decrease of 6.01 tonnes.

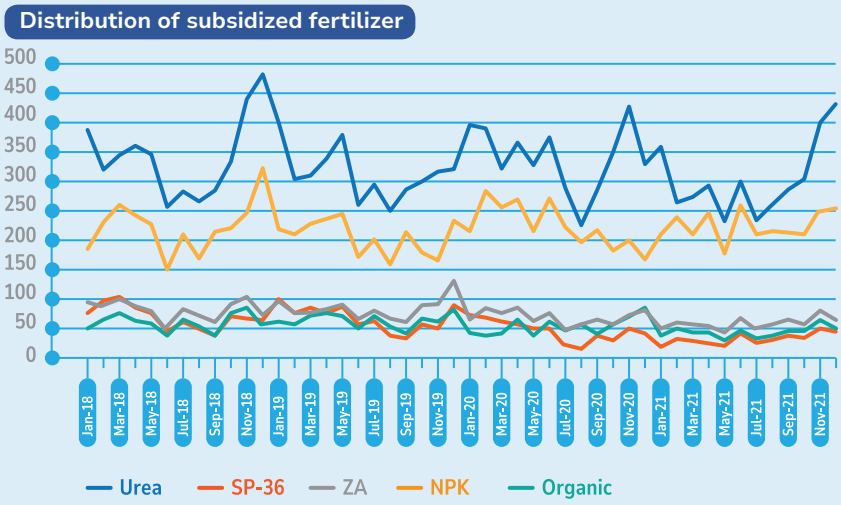


FIGURE 2 Subsidized fertilizer distributed (tonnes), 2018–2021

Meanwhile, for NPK compound fertilizer, average fertilizer use during the pandemic shows an increase. Distribution of the NPK fertilizer subsidy before the pandemic was 214.22 tonnes; this increased during the pandemic to 223.72 tonnes, or an increase of 9.5 tonnes. This shows that during the pandemic the distribution of NPK fertilizer was more optimized than the distribution of other subsidized fertilizers. Among other types of fertilizer, NPK is the only type whose use increased during the pandemic. A strong reason why farmers increased their use of NPK fertilizer during the pandemic was that the price of NPK fertilizer set by the government did not increase. The government through PP No. 49 of 2020 of the Ministry of Agriculture raised the highest retail price of subsidized fertilizers. The largest increase was for SP-36, which led farmers to significantly reduce their use of this type during the pandemic.

The government also provides assistance with organic fertilizers but the momentum of the pandemic was not capitalized on to optimize the use of these fertilizers. During the pandemic, the distribution of organic fertilizer decreased by 12.52 tonnes from the pre-pandemic situation, when average monthly distribution was 60.55 tonnes (Table 1). The use of organic fertilizers is something the government needs to encourage in the future, in anticipation of the high cost of chemical fertilizers and issues regarding their availability (ICASEPS, 2022).

TABLE 1 Average monthly subsidized fertilizer distribution before and during the pandemic (tonnes)

Fertilizer	January 2018–December 2019	January 2020–December 2021
Urea	326.38	320.37
SP-36	67.94	39.39
ZA	82.16	61.84
NPK	214.22	223.72
Organic	60.55	48.03

Did the decrease in the distribution of subsidized fertilizers have an impact on food production during the pandemic? To answer this question, it is necessary to look again at the situation of food production, in this case of rice and corn, which are priority commodities in terms of the distribution of fertilizer subsidies. Based on our calculations, it can be seen that average rice production per month before the pandemic was 4 741.9 tonnes, and during the pandemic it was 4 544.4 tonnes per month, showing a decrease of 197.5 tonnes. The temporary assumption is that the decline in rice production was caused not only by a drop in the use of fertilizers but also by a decline in harvested area: before the pandemic the harvested area was 919 000 ha but during the pandemic it decreased to an average of 877 900 ha. One implication of the decline in rice production is that rice reserves have also declined (Figure 3). The situation of rice reserves during the pandemic was different to that in the 2018–2019 period, when there was an increase in stock.

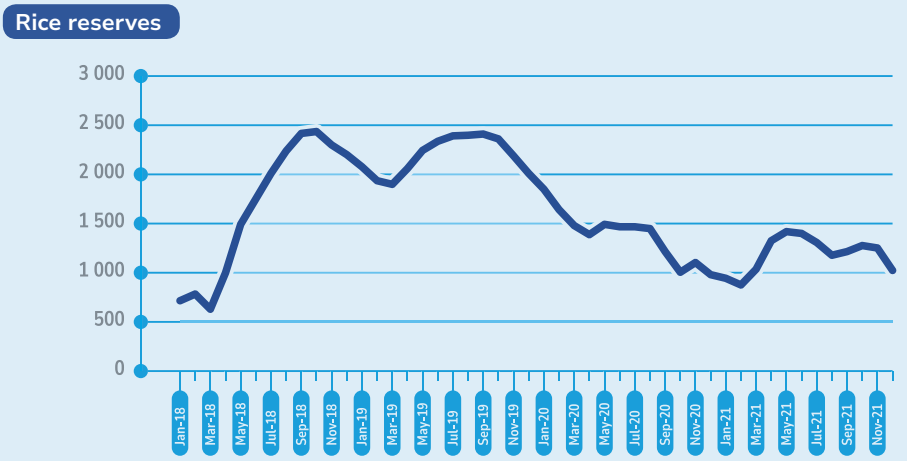


FIGURE 3 Rice reserves (tonnes), 2018–2021

The results of the analysis show the resilience of agriculture as reflected in the stability of production levels during the pandemic. Actions by the government, both longstanding measures and emergency measures under COVID-19, may have contributed to this outcome. Among the government programmes and policies aimed at minimizing the impacts of the pandemic with a particular impact on agriculture and food production (Purba *et al.*, 2020) were the following:

- refocusing activities and the state budget in order to minimize the impact of the pandemic;
- accelerating the labour-intensive programme in rural areas;[1] and
- maintaining the availability of staple foods, through supporting agricultural inputs (i.e. fertilizers, seeds, etc.) and through the labour-intensive programme.

These policies were accompanied by strategic steps to prevent the spread of COVID-19 and protect from its impacts:

- provision of staple foods, mainly rice and corn, for 267 million people, with accelerated exports of strategic commodities to support economic sustainability;[2]
- sensitization of farmers, agricultural extension officers and pest management officers to prevent the spread of COVID-19 according to World Health Organization and government standards; and
- creation/development of farmers' markets in each province, optimization of local food production and coordination of logistics infrastructure and e-marketing.

Prior to the pandemic, the government implemented agricultural financing policies through the KUR programme. The agriculture sector, especially small farmers, most of whom are food crop farmers, need working capital to carry out their farming activities. The government put in place various measures and policies during the pandemic so that farmers could access low-interest financing (interest subsidies), one of them through the KUR programme, distributed by banks appointed by the government. In addition to simplifying the financing scheme, the government allowed for the relaxation and restructuring of financing that was already running at the beginning of the pandemic, giving farmers a grace period to repay their loans while protecting them from the shock of the beginning of the pandemic.

Figure 4 shows that distribution of the KUR showed an increasing trend from year to year. It also has a seasonal pattern, with the lowest value usually arising in December. Distribution of the KUR during the period before the pandemic was on average IDR 2 751.4 billion (USD 196.3 million) per month; during the pandemic it more than doubled, to IDR 5 873.77 billion (USD 419.1 million) per month, and to a total of 2 616 444 customer farmers.

[1] This programme aims to provide employment opportunities for farmers, farm workers and people in rural areas; provide an additional income to farmers, farm workers and households (the general public); improve agricultural development performance and support increased production, value added and agricultural competitiveness; and empower the economy and increase the purchasing power of people in rural areas. Activities include increasing the capacity of agricultural infrastructure and increasing production in various commodities. The target is 1.5 million farmers, farm workers and affected communities with a budget allocation of IDR 2.5 trillion (USD 178.4 million).

[2] The government has taken several steps to increase agricultural exports, including easing quarantine checks, introducing commodity clusters all over Indonesia and developing high-yielding varieties that meet the international demand and compete with other countries.

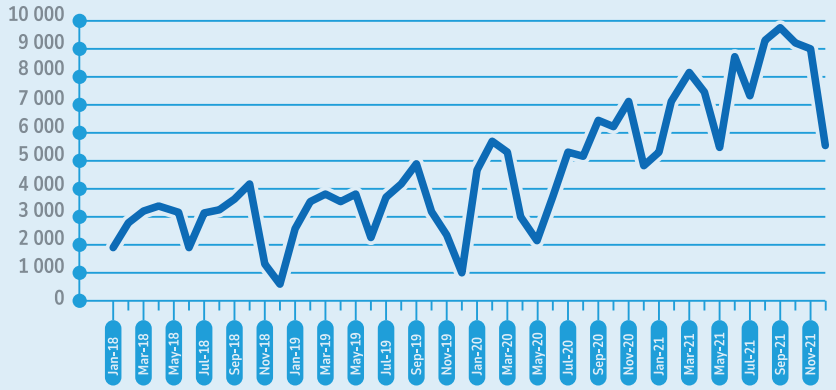


FIGURE 4 Distribution of the KUR (IDR billion), 2018–2021

3.2 Productivity

Analysis on productivity indicators was carried out on four of the six commodities, excluding chicken meat and eggs. Productivity is calculated as production value divided by harvested area and no data were available on harvested area for chicken meat and chicken eggs. Based on Figure 5, productivity information on the four commodities is as follows:

- Rice productivity has a seasonal pattern. Interestingly, the peak of production occurs in March–April but the highest productivity is consistently in November. The pattern of highest rice yields in November is common for rice-producing countries with significant wet and dry seasons such as Indonesia. Rice plants receive more solar energy during the dry season (harvested in November) than during the cloudy wet season, and fields also usually have better water control because only irrigated fields can be planted to rice in the dry season.
- Corn productivity (analysed by year) shows an increasing pattern over the years although it was relatively stagnant in the year of the pandemic (2020 and 2021).
- Shallot productivity has a seasonal pattern, with the highest productivity in August, which also sees the peak of its production. Between 2018 and 2021, productivity showed an increasing pattern.
- Banana productivity does not have a seasonal pattern. Like shallots, though, there was an increase in productivity between 2018 and 2021.

FIGURE 5 Productivity of four commodities (kg/ha), 2018–2021

A trend analysis of productivity indicators was also carried out. The results of this (details in **Appendix 2.1**) for four commodities are as follows:

- There was a trend of increased rice productivity at a 10 percent significance level in the pandemic period (January 2020–December 2021). This is an indicator of agriculture's good performance during the pandemic, especially in rice farming.
- Corn productivity did not show a significant increase over the years.
- Shallots and bananas showed significantly increasing trends in productivity over the entire analysis period (2018–2021). Furthermore, the positive trend in shallot productivity was supported significantly by shallot performance during the pandemic.

Comparative analysis of the mean and variance of productivity before and during the pandemic was carried out on rice, shallots and bananas. Corn was not analysed because monthly data were available only starting in January 2020. Chicken meat and chicken eggs were not analysed because there were no data on harvested area.

The results of the mean comparison test on three commodities (details in **Appendix 2.2**) show a statistically significant difference in productivity only for bananas. Banana productivity was higher during the pandemic compared with before the pandemic. Meanwhile, the results of the variance comparison test (details in **Appendix 2.3**) show no significant CV differences in the productivity of rice, shallots and bananas.

The results for productivity are relatively similar to the results for production. The increasing trend in rice productivity can be explained by the government's efforts in the supply of inputs, such as fertilizers, high-yield varieties and targeted financial support to farmers.

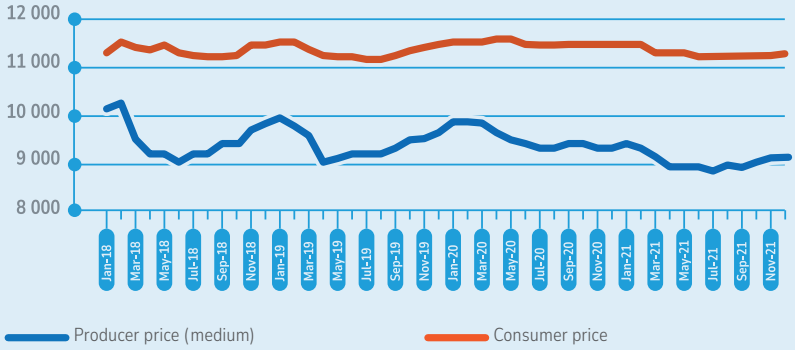
3.3 Producer prices and consumer prices

Based on Figure 6, information on the prices of the six commodities at the producer and consumer levels is as follows:

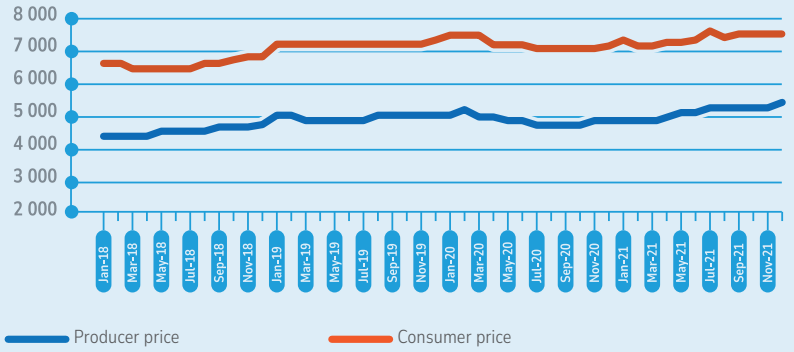
- In rice, consumer prices are more stable than producer prices. The seasonal pattern is more visible in producer price movements and this is in line with production levels, whereby the lowest producer price levels generally occur in April when there is high rice production. The price pattern of rice as the main food was thus relatively stable at the consumer level both before and during the pandemic. At the producer (farmer) level, prices also tended to be stable over the whole period, even though at the beginning of the pandemic in 2020 the price of rice increased, was relatively low and was fluctuating as a result of the number of harvests. The price increase at the beginning of the pandemic was very possibly a result of restrictions on mobility. In 2021, the price of rice at the producer level saw a decreasing trend, albeit still within reasonable limits, because harvests at rice centres had begun to be distributed to the market. In the beginning, the impact of price fluctuations at the producer level was reflected in a decrease in the level of welfare as indicated by the farmer terms of trade indicator but since mid-2020 the trend in farmer terms of trade has been positive. Conditions indicate that farmers' welfare has been relatively well maintained (Figure 15). The government made several efforts in this regard, including guaranteeing the distribution of rice from central areas to markets, financial assistance for farmers and farmhands, and assistance from the input side (seeds and fertilizers).

- Corn prices at the producer and consumer levels showed a stable and increasing trend from year to year, except for in 2020 at the beginning of the pandemic, when the price was lower than in the same month in 2019.
- Similar to the situation for corn, the producer and consumer prices for chicken meat showed a stable and increasing trend from year to year. There was a decrease in the gap between the two prices, with the difference in 2021 lower than in 2018.
- For chicken eggs, producer and consumer prices tended to fluctuate, and there is a seasonal pattern, with prices higher in July and December. In contrast to the situation for chicken meat, the gap between the two prices for chicken eggs increased.
- Producer prices and consumer prices for shallots also have a seasonal pattern. The highest prices occur in May–June and the lowest in September–October. The price of shallots in 2020, at the beginning of the pandemic, was higher than in other years.
- Both producer and consumer prices of bananas show different movements from those of other commodities, with a trend of increasing prices before COVID-19 that then stabilized.

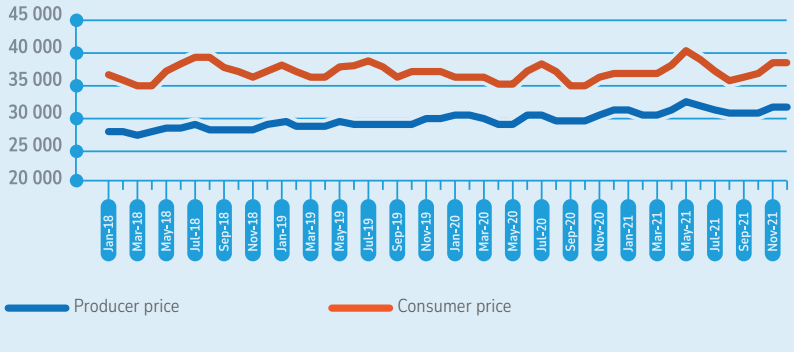
Rice prices



Corn prices



Chicken meat prices



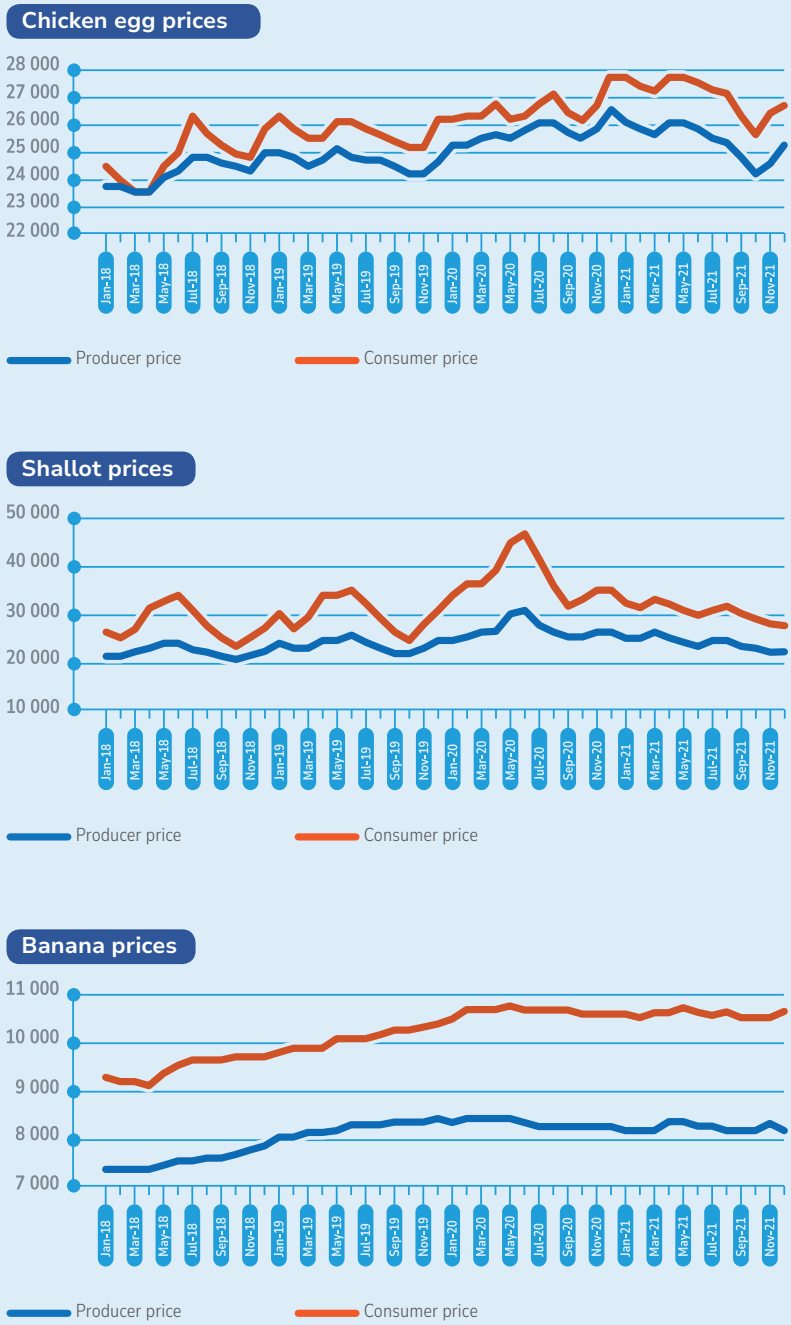


Figure 6 Prices of six commodities at the producer and consumer levels (IDR/kg), 2018–2021

Trend analysis of producer price indicators (detailed in **Appendix 3.1**) reveals the following. Of the six commodities analysed, all of them show statistically significant trends in price movements. All except rice show positive trends. Rice prices at the producer level tended to fall, and even more so during the COVID-19 period.

A trend analysis was also carried out on consumer price indicators (details in **Appendix 4.1**). Of the six commodities, four show an upward trend in consumer prices – namely, corn, chicken eggs, shallots and bananas. On the other hand, consumer prices of rice show a decreasing trend. Chicken meat shows an increasing trend albeit one that is not statistically significant.

Mean and variance comparison tests of producer prices before and during the pandemic were carried out on all commodities. The results of the mean comparison test of producer prices (details in **Appendix 3.2**) show statistically significant differences in all commodities. For almost all commodities, producer prices increased during the pandemic compared with before; the outlier is rice, for which prices at the producer level actually decreased during the pandemic.

The results of the variance comparison test of producer prices (details in **Appendix 3.3**) show significant CV differences for chicken meat, shallots and bananas and no significant CV differences for rice, corn and chicken eggs. Compared with before the pandemic, during the pandemic fluctuations in producer prices increased for chicken meat and shallots; on the other hand, fluctuations in producer prices for chicken eggs decreased.

Mean and variance comparison tests of consumer prices before and during the pandemic were conducted on all commodities. The results of the mean comparison test of consumer prices (details in **Appendix 4.2**) show statistically significant differences in all commodities except chicken meat. In all commodities where the difference is statistically significant, consumer prices increased during the pandemic compared with before the pandemic.

The results of the variance comparison test of consumer prices (details in **Appendix 4.3**) show significant CV differences for corn, shallots and bananas and no significant CV differences in rice, chicken meat and chicken eggs. Compared with before the pandemic, during the pandemic consumer price fluctuations increased for shallots; on the contrary, fluctuations in consumer prices for corn and bananas decreased.

Specifically for rice commodities, the decline in rice prices during the pandemic is thought to have little to do with fluctuations in production, because rice production movements show a stable trend before and during the pandemic. Rather, the decline is thought to be related to the increase in supply after the decline in rice reserves during the pandemic (Figure 3). The reduction of rice reserves during the early stages of the pandemic was an important part of the government response to avoid a rice price increase, given the importance of rice as a staple.

As for international rice prices, early in the pandemic (throughout 2020 until early 2021) there was an increase in the price of Thai rice, which was then followed by a decrease in prices until the end of 2021 back to the level before the pandemic. The Indonesian domestic rice price did not exhibit the same pattern. This shows that international rice prices did not greatly influence rice price movements in Indonesia.

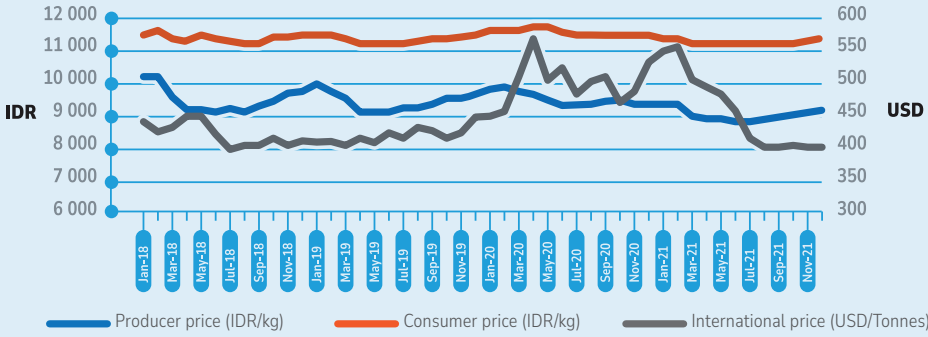


FIGURE 7 Domestic and international rice prices, 2018–2021

As for the comparison of rice prices with general inflation and volatile food inflation throughout 2018–2021, the decline in producer prices is relatively in line with the decline in general inflation and volatile food inflation. Annual inflation in Indonesia was recorded at 3.13 percent in 2018, falling to 2.72 percent in 2019, 1.68 percent in 2020 and 1.87 percent in 2021. Meanwhile, volatile food inflation was relatively higher than general inflation, at 3.39 percent in 2018 , 4.30 percent in 2019, 3.62 percent in 2020 and 3.20 percent in 2021. When both types of inflation are reviewed on a monthly basis, volatile food inflation has larger fluctuations. Figure 8 shows a drop in the fluctuation of volatile food inflation during the pandemic compared with before it.

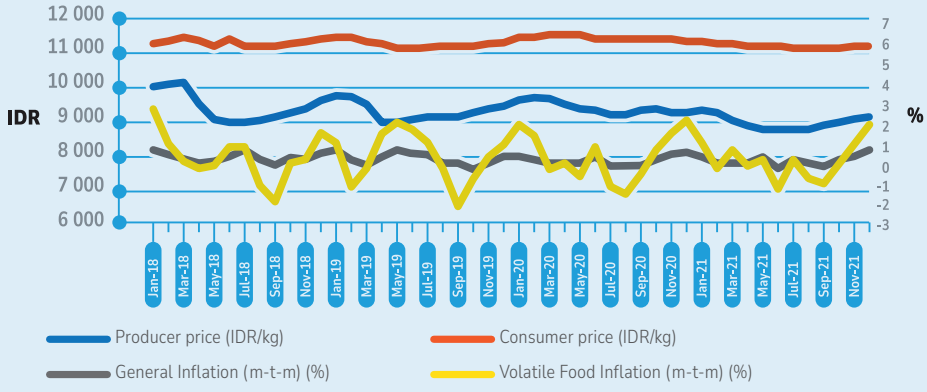


FIGURE 8 Fluctuation of Indonesia's domestic rice price and inflation, 2018–2021

A comparison of the consumer price index (CPI) and the producer price index (PPI) in Indonesia shows a pattern of convergence, with the difference between the two getting smaller. However, in the trend analysis of producer and consumer prices (details in **Appendix 3.1** and **Appendix 4.1**), producer rice prices show a decline during the pandemic whereas consumer prices are relatively stable (statistically increasing but small). This is thought to indicate a decline in the contribution of rice prices to the agriculture PPI as well as the PPI in general.

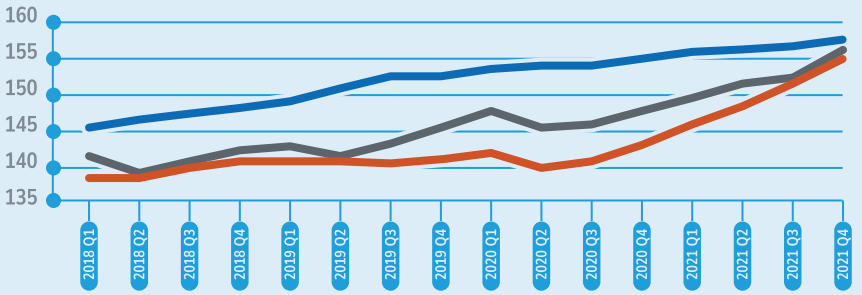


FIGURE 9 Consumer price and producer price indices in Indonesia, 2018–2021 (2010=100)

The stability of commodity prices at the consumer level demonstrates the success of the government in maintaining the availability of staple foods.

The government response also covered the logistics sector, especially related to the supply of agricultural products, as a sector affected by COVID-19. Government policies through the Ministry of Agriculture were supported by other ministries, such as the Ministry of Trade and the Ministry of Transportation. To ensure the availability of food for the people of Indonesia, the government through the Ministry of Trade issued Regulation No. 317/M-DAG/4/2020, covering, among other things:

- measures supporting food access by consumers by regulating working hours for people's markets and supermarkets that sell daily necessities in the form of minimarkets, supermarkets and hypermarkets;
- measures supporting food access by consumers by calling on retailers and market traders, in addition to serving consumers directly by implementing social distancing as a safety protocol to anticipate the spread of COVID-19, to implement delivery services so that people's needs could still be met.

This Ministry of Trade regulation was supported by Ministry of Transportation Regulation No. 18 of 2020, which regulated the distribution of important commodities such as staples and medical, health and sanitation materials in spite of the government lockdown.

3.4 Exports

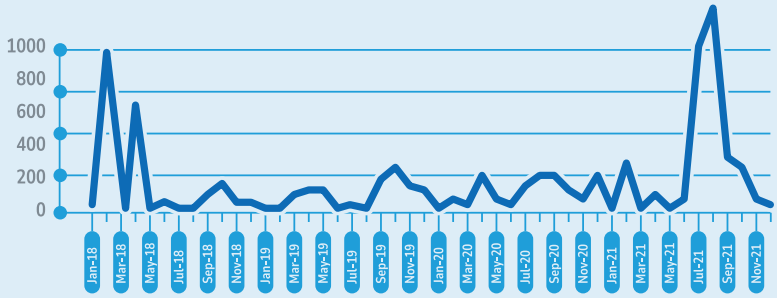
The commodities analysed in this study represent sources of carbohydrate (rice and corn), protein (chicken meat and eggs) and vitamins (shallots and bananas) that are commonly consumed by Indonesians. However, they are not the main commodities exported or imported. Given the scope of work and the limited timeframe for this study, this study cannot present data on other commodities (the main exportables and importables).

Based on Figure 10, information on the export performance of the six commodities is as follows:

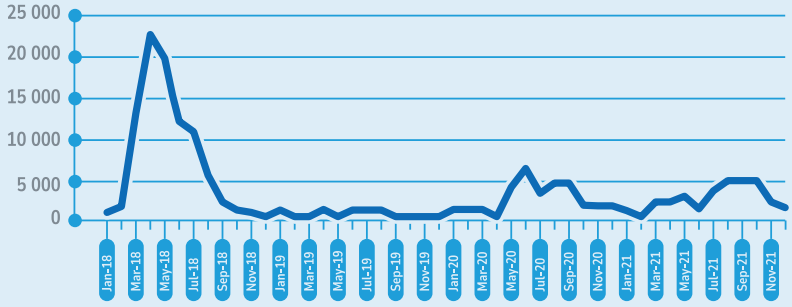
- Rice exports tended to be stable and low, with a few exceptions in February 2018, April 2018, July 2021 and August 2021.
- Corn and banana exports declined during the pandemic compared with before the pandemic. Banana exports before the pandemic showed a peak in March or April, or after the peak of banana production in the first quarter of that year or the fourth quarter of the previous one.

- Exports of chicken meat and eggs per year are relatively stable but there were fluctuations between months.
- Shallot exports show a seasonal pattern with a peak in September, or one month after the peak of production.

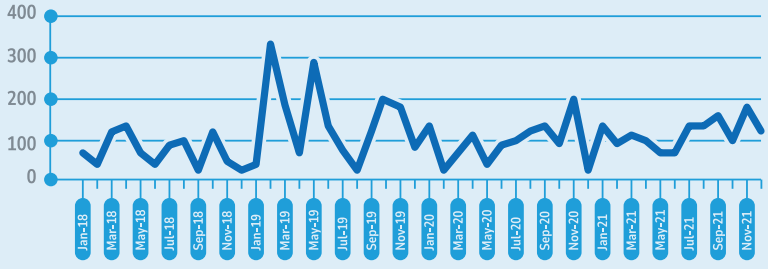
Rice exports



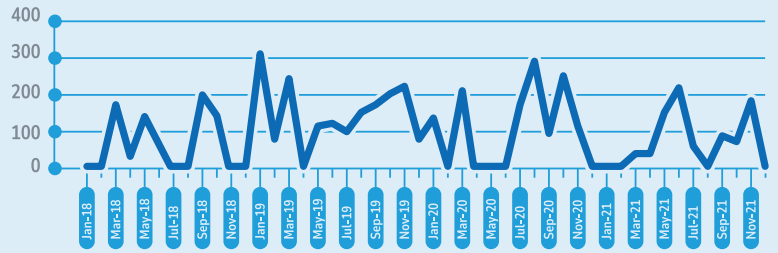
Corn exports



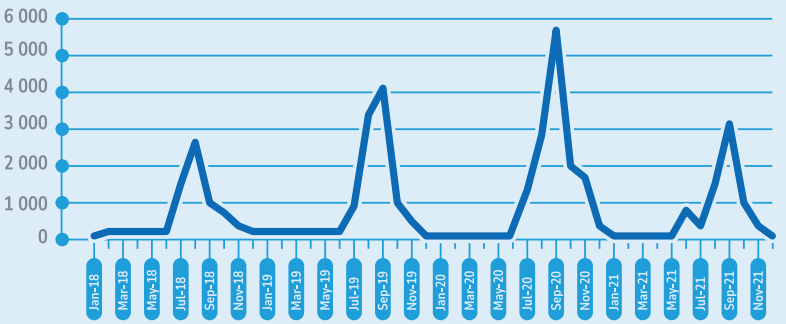
Chicken meat exports



Chicken egg exports



Shallot exports



Banana exports

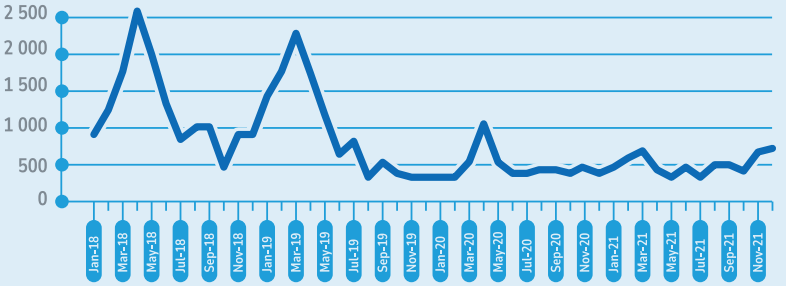


FIGURE 10 Exports of six commodities (USD 000), 2018–2021

Trend analysis of export indicators for the six commodities (details in **Appendix 5.1**) was carried out, with the following results:

- Export trends for corn and bananas show a statistically significant decrease. This started in the pre-pandemic period, as indicated by a negative and significant coefficient in the period January 2018–December 2019. The decline in corn exports owed to a high corn export anomaly in 2018. As such, a trend analysis covering the four-year period (2018–2021) shows a downward trend. Banana exports decreased noticeably during the pandemic. Export restrictions, lockdowns and social distancing (limiting the number of workers) led to a decline in exports and so production was absorbed more into the domestic market.
- Exports of rice, chicken meat, chicken eggs and shallots fluctuated around their mean.

Mean and variance comparison tests of exports before and during the pandemic were carried out on all commodities. The results of the mean comparison test of exports of six commodities (details in **Appendix 5.2**) show a statistically significant difference in exports only for bananas. The export value of bananas decreased during the pandemic compared with before it.

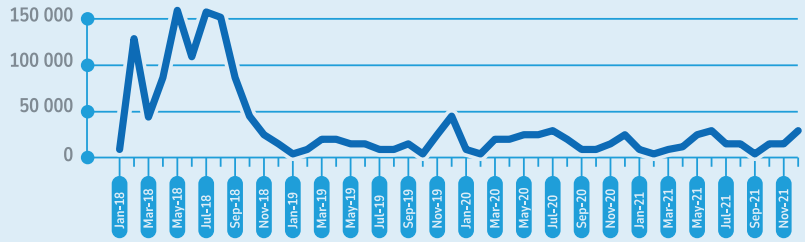
The results of the variance comparison test of exports (details in **Appendix 5.3**) show significant CV differences for corn, chicken meat and bananas and no significant CV differences for rice, chicken eggs and shallots. Compared with before the pandemic, during the pandemic fluctuations in exports of corn, chicken meat and bananas were less evident. The unchanged means of exports (except in the case of bananas) against a decreased CV (for some commodities) may indicate that export movements tended to be more stable and lower as a result of export restrictions, lockdowns and social distancing affecting export performance.

3.5 Imports

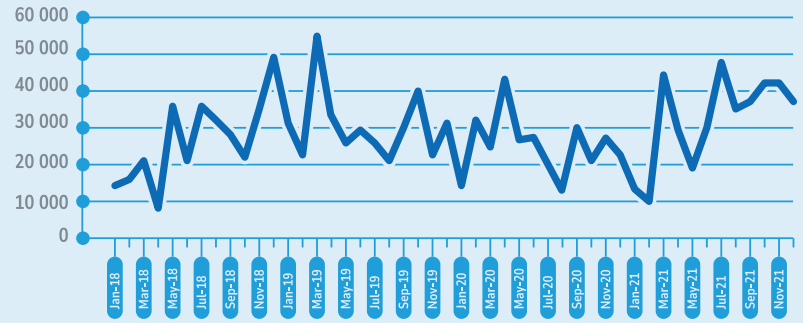
Based on Figure 11, the import information for six commodities is as follows:

- A comparison of the value of exports and imports of the six commodities analysed shows that Indonesia is a net importer of rice, corn and chicken eggs. The country is a net exporter of shallots and bananas. Rice imports come mostly in the form of premium rice.
- Rice imports were quite high in February–September 2018 but after that they declined and tended to be stable, including during the pandemic.
- Imports of corn, chicken meat and chicken eggs per year were relatively stable but there were fluctuations between months.
- Shallot imports tended to be stable at low levels except in July–August 2020, which were the early months of the pandemic and near the peak of the shallot harvest.
- Banana imports were low – at almost zero – every month from May 2020.

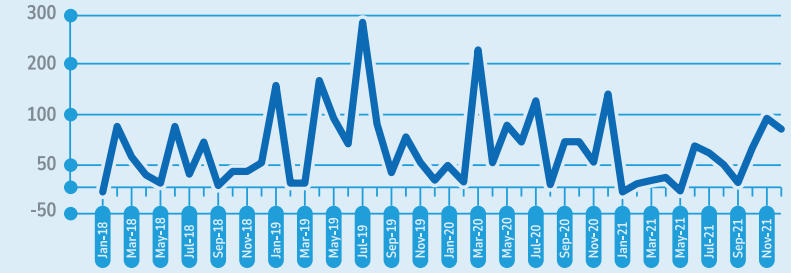
Rice imports



Corn imports



Chicken meat imports



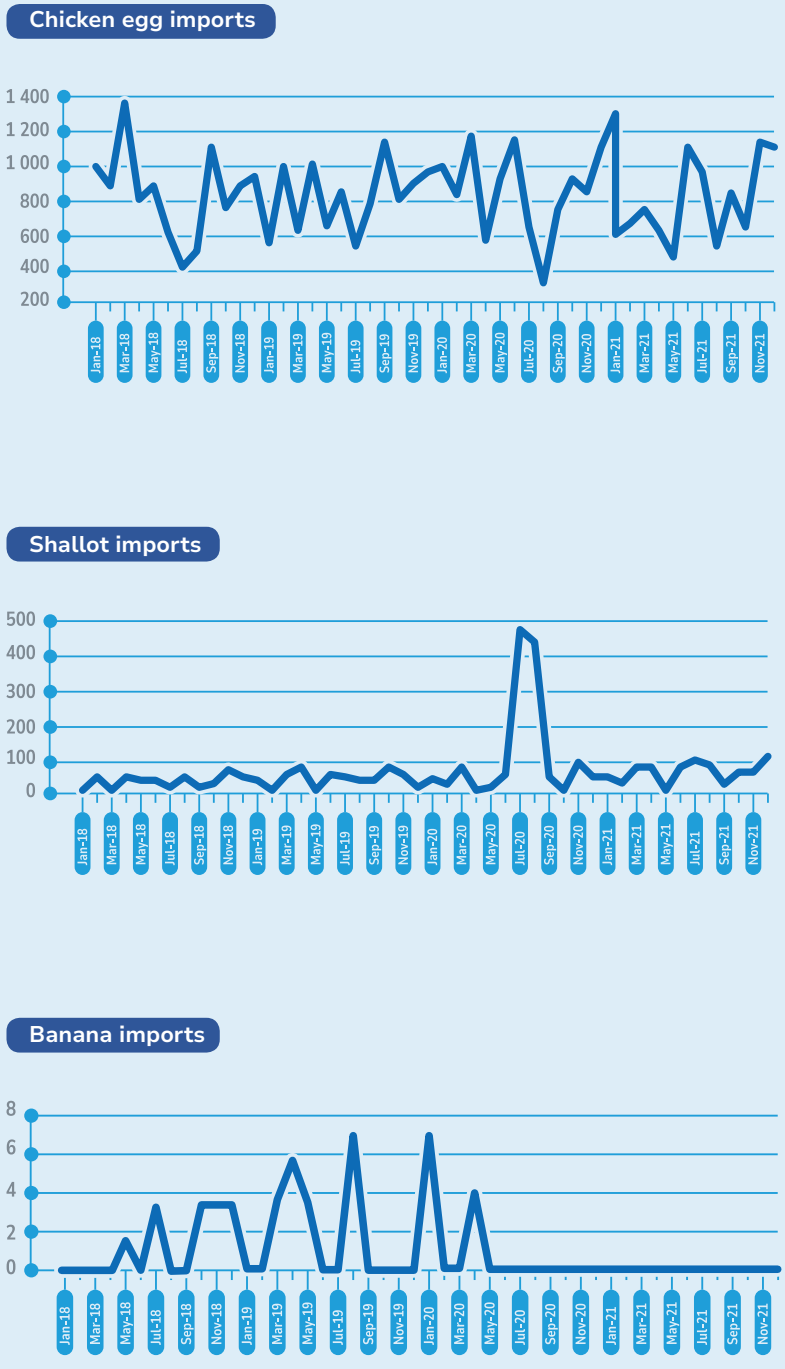


FIGURE 11 Imports of six commodities (USD 000), 2018–2021

In Figure 11, one of the anomalies that can be observed is the high value of rice imports in 2018. This makes it necessary to look at the trend of rice imports for several years before the pandemic. Table 2 presents data on production of rice and its equivalent, consumption, exports and imports for the five years before the pandemic (2015–2019). In 2018, there was a big adjustment to the rice production data. Starting in 2018, rice production is calculated using the Area Sampling Frame method employing satellite imagery, whereas previously it used the yield per hectare method by multiplying the harvested area and productivity. Meanwhile, the rice import data for 2018 show an anomaly compared with the previous years (as well as with the following years, as seen in our data). Since this study covers the analysis period of 2018–2021, the result is a large downward trend in rice imports.

TABLE 2 Rice production, exports and imports in Indonesia, 2015–2019

Year	Production (tonnes)	Rice equivalent (tonnes)	Household consumption (tonnes)	Exports		Imports	
				Volume (tonnes)	Value (USD 000)	Volume (tonnes)	Value (USD 000)
2015	75 397 841	45 239 705	21 676 921	152	265	861 601	351 842
2016	79 354 767	47 612 860	22 420 952	84	149	1 283 178	531 842
2017	81 148 594	48 689 156	21 269 111	3 457	3 098	305 274	143 642
2018	59 200 534	35 520 320	21 305 161	3 113	1 336	2 253 824	1 037 128
2019	54 604 033	32 762 420	20 874 645	180	367	444 508	184 254

SOURCE: Badan Pusat Statistik – Statistics Indonesia (2021).

Trend analysis was carried out on the import indicators (details in **Appendix 6.1**). Significant import movement trends were found only in rice, corn and bananas. Downward trends in imports were found in rice and bananas whereas an increasing trend in imports was found in corn.

Mean and variance comparison tests of imports before and during the pandemic were carried out on all commodities. The results of the mean comparison test of imports on six commodities (details in **Appendix 6.2**) show statistically significant differences in imports of rice, shallots and bananas. The import values of rice and bananas decreased during the pandemic compared with before it whereas those of shallots increased.

The results of the variance comparison test of imports (details in **Appendix 6.3**) show significant CV differences for rice and shallots and no significant CV differences for corn, chicken meat, chicken eggs and bananas. Compared with before the pandemic, during the pandemic rice import fluctuations decreased whereas shallot import fluctuations increased.

3.6 Adequacy of food consumption, food security and the role of social safety nets

3.6.1 Adequacy of consumption and food security

The COVID-19 pandemic had impacts in terms of changes in people's behaviour and reduced economic activity, leading to a rise in poverty rates (BPS, 2020a). The impacts were felt especially in households whose income comes from informal sector workers on a daily income without much by way of savings, which makes them very vulnerable to shocks to economic activity (Barany *et al.*, 2020; BPS, 2020a). Access to food became more difficult for poor families, resulting in decreased consumption and threatening food security (TNP2K, 2020).

The prevalence of undernourishment (PoU) indicator describes the proportion of a population for which daily energy consumption from food is not sufficient to meet the energy level required for a normal, active and healthy life (FAO, 2022). The PoU figure is expressed as a percentage. PoU indicators can describe changes in food availability and households' ability to access that food, at different socioeconomic levels as well as at national and subnational levels.

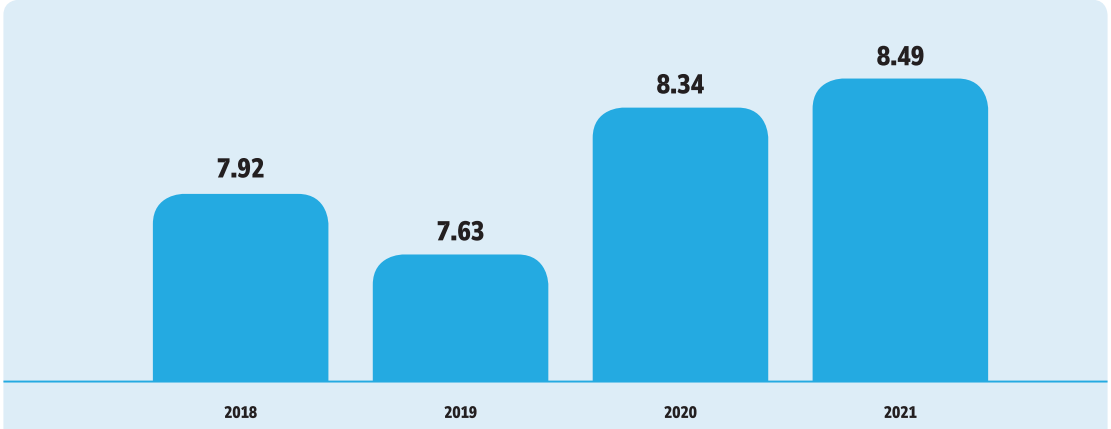


FIGURE 12 Prevalence of undernourishment in Indonesia (%), 2018–2021

SOURCE: Badan Pusat Statistik – Statistics Indonesia (2020a).

Based on data for Indonesia for 2018–2021 obtained from the 2020 Statistics Indonesia (Badan Pusat Statistik – BPS) National Socioeconomic Survey (BPS, 2020b), PoU in Indonesia trended downward between 2018 and 2020, from 7.92 percent to 7.63 percent. After the outbreak of COVID-19, the PoU rate increased to 8.34 percent in 2020 and 8.49 percent in 2021. The increase in PoU during the pandemic is in line with the increase in the percentage of poverty and the decline in economic growth. At the provincial level, there is a variation in the PoU rate, from a low of 1–2 percent to a high of more than 30 percent. Between 2018 and 2021, the five provinces with the highest rates were Papua, West Papua, Maluku, North Maluku and West Kalimantan. The lowest rates were in DKI Jakarta, Banten, South Kalimantan and West Nusa Tenggara.

Figure 13 gives an overview of the PoU in 34 provinces for 4 years (2018–2021). It shows a decrease in the PoU gap between provinces with low and high percentages during the pandemic (2020–2021) compared with before the pandemic. This decrease in the gap owes more to an increase in PoU in provinces with originally low rates, while provinces with high rates did not change much and some even experiencing a decline. The increase in PoU in most provinces contributed to an increase in PoU nationally.

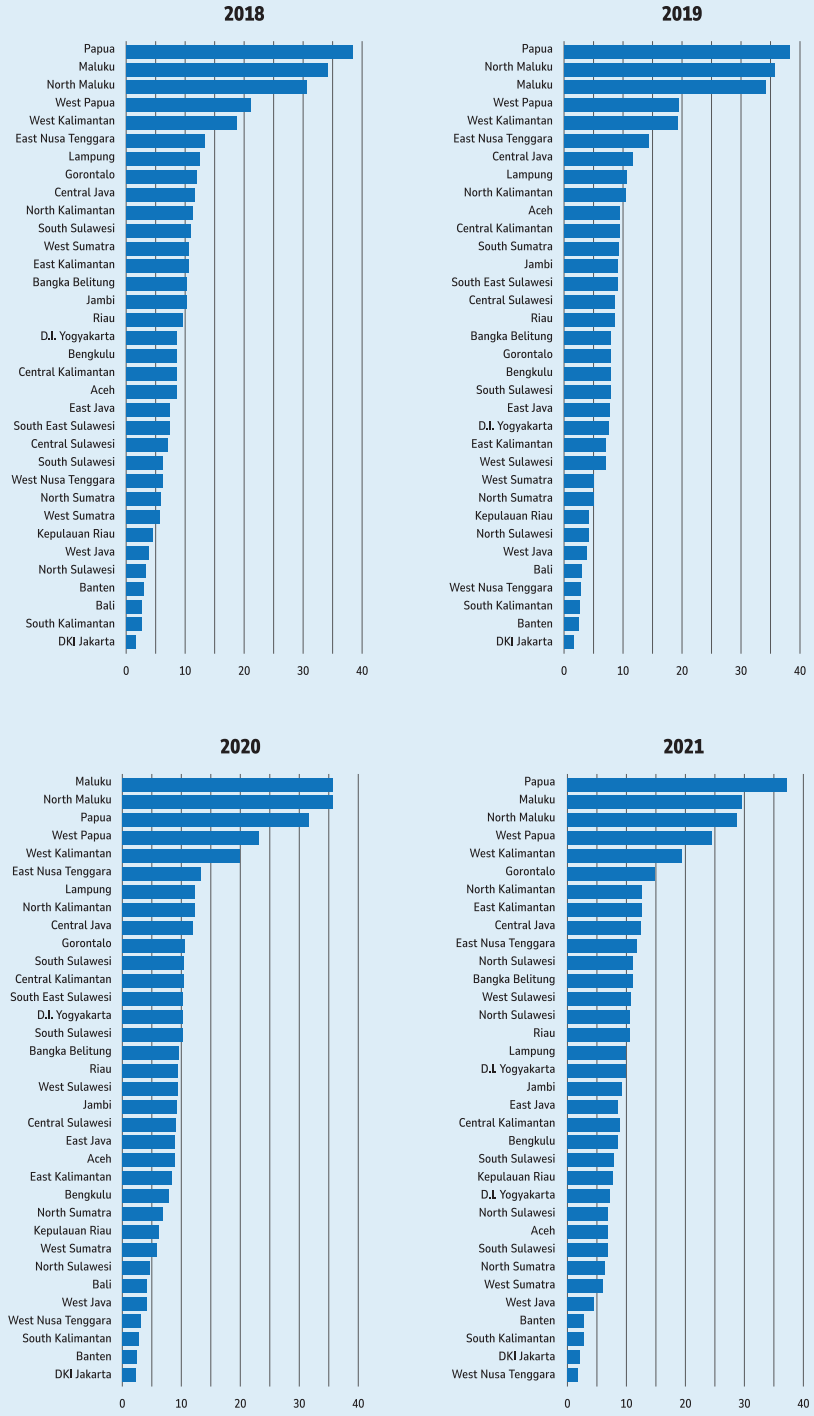


FIGURE 13 Prevalence of undernourishment at the provincial level (%), 2018–2021

The next analysis entails a comparison of Indonesia's PoU rate with that of other developing regions or countries. Based on data sourced from FAO, Indonesia's PoU percentage is lower than the average PoU rate on the African continent and in India. But it is higher than that of China and Brazil. Within the Association of Southeast Asian Nations (ASEAN), Indonesia's PoU is higher than that of Malaysia and the Philippines, more or less on par with that of Viet Nam and lower than that of Thailand. Table 3 present the complete data. As a historical trend covering a longer period, Indonesia has achieved a large reduction in PoU, from 19.2 percent in 2001 to 6.2 percent before the pandemic in 2019. Other countries also achieved a large reduction in PoU during this 20-yearsperiod, with the exception of the African continent and India.

TABLE 3 Comparison of prevalence of undernourishment for Indonesia and some other developing countries (%)

Country/region	2001	2005	2010	2015	2018	2019	2020
Africa (continent)	23.4	20.7	16.5	15.8	17.0	17.4	19.6
Brazil	10.7	6.5	3.7	< 2.5	< 2.5	2.6	4.1
China	10.0	7.0	< 2.5	< 2.5	< 2.5	< 2.5	< 2.5
India	18.4	21.6	15.9	14.5	13.3	14.6	16.3
Indonesia	19.2	19.2	13.0	7.2	5.9	6.2	6.5
Malaysia	2.5	3.2	3.4	3.8	2.7	2.6	< 2.5
Philippines	18.7	14.4	12.2	10.2	6.2	5.5	5.2
Thailand	17.3	11.9	9.9	7.3	7.8	8.0	8.8
Viet Nam	19.7	15.5	10.9	8.1	6.8	6.2	5.7

SOURCE: FAO (2022).

If an individual or family is unable to meet their food needs, this will disrupt the nutritional status of the family. Low nutritional status can affect the immune system, causing the body to become susceptible to various diseases, which in turn can reduce health status. This nutritional status is closely related to food security (Russell *et al.*, 2011).

The Food Security and Vulnerability Atlas (FSVA) is an indicator in the form of a thematic map that offers a geographic visualization of the results of data analysis on indicators of vulnerability to food insecurity (WFP, 2015). FSVA is generated by calculating the percentage of districts/cities that are vulnerable to food insecurity against all districts/cities. FSVA is composed of nine indicators based on aspects of **food availability** (one indicator: ratio of consumption per capita to net food production), **food access** (three indicators: percentage of poor people, percentage of households with a food expenditure proportion above 65 percent, percentage of households without access to electricity) and **food utilization** (five indicators: average length of schooling for girls, percentage of households without access to clean water, ratio of population to health worker, prevalence of stunting under five years old, life expectancy). The data used in the creation of FSVA are the previous year's data (t-1).

Table 4 shows that FSVA in Indonesia was decreasing but then increased during the COVID-19 pandemic. In the 2020 figures (using 2019 data), FSVA in Indonesia was 13.62 percent, or 70 districts/cities in Indonesia identified as vulnerable to food insecurity. It increased to 14.40 percent or 74 districts/cities in the 2021 publication (using 2020 data).

TABLE 4 Food Security and Vulnerability Atlas in Indonesia, 2018–2021

Year	Total districts/cities vulnerable to food insecurity	Total districts/cities	%
2018	88	514	17.12
2019	76	514	14.79
2020	70	514	13.62
2021	74	514	14.40

SOURCE: Ministry of Agriculture (2022).

3.6.2 Social safety net (*Jaring Pengaman Sosial*)

To counter the increase in the PoU and FSVA indicators in Indonesia during the pandemic, the government issued policies to reduce the impact of COVID-19 on the population (FAO, 2019). One of the most important programmes is the Social Safety Net (*Jaring Pengaman Sosial* – JPS), implemented nationally since April 2020. The policy consists of seven programmes:

- The **Pre-Employment Card Programme** is a work and entrepreneurship competency development programme in the form of financial assistance aimed at job-seekers, laid-off workers and workers who need competency improvement, including MSME actors. Recipients receive IDR 1 million for training and an incentive payment of IDR 600 000 per month. As of February 2022, the number of beneficiaries was 11.4 million, from 22 batches of registration.
- **Presidential assistance for nine basic necessities for Jakarta, Bogor, Depok, Tangerang and Bekasi** was intended for as many as 1.3 families from the overall Special Capital Region of Jakarta including as many as 600 000 families from the Botabek (Bogor, Tangerang and Bekasi) area. The assistance was in the form of food packages worth IDR 600 000 per package in April to June 2020 and IDR 300 000 per package in July to December 2020.
- **Cash Social Assistance** (*Bantuan Sosial Tunai* – BST) came in the form of money given to poor, underprivileged and vulnerable families affected by the pandemic. It was worth IDR 600 000 per family per month. In 2021, the government distributed overall BST of IDR 17.24 trillion to 9.99 million beneficiary families. In 2022, the BST was not allocated.
- **Village Fund Direct Cash Assistance** (BLT-DD) was provided to underprivileged persons and those affected by COVID-19 who did not receive assistance from the centre through village funds. The amount was IDR 600 000 per month per beneficiary. As of May 2022, BLT-DD had been distributed in the amount of IDR 3.84 trillion to 406 788 families in 44 681 villages throughout Indonesia.

- The **Nine Basic Necessities Programme** (*Program Sembilan Bahan Pokok* – Sembako) is an updated version of Non-Cash Food Assistance (Bantuan Pangan Non Tunai – BPNT). The assistance provided can be spent on rice and eggs but also on other sources of carbohydrate, protein and vitamins, such as corn, chicken meat, beef, nuts, vegetables or fruit, which can be obtained in local markets. The target is 20 million families with a benefit value of IDR 200 000 per month.
- The **Family Hope Programme** (*Program Keluarga Harapan* – PKH) is a social assistance programme for poor families. It is implemented by the Ministry of Social Affairs to help overcome poverty with the main objective of improving the quality of human resources, especially in the fields of education and health, for poor family groups. It has been implemented since 2007. Under PKH, poor families fitting within predetermined criteria receive financial assistance for a certain period, to help them access and utilize basic social services, health, education, food and nutrition, care and other assistance. As many as 10 million families are to be targeted with this assistance.
- **Electricity assistance** entails free electricity to customers in the 450 va power category and a 50 percent discount to customers in the subsidized 900 va power category.

Specifically in agriculture, the Ministry of Agriculture continues to spend its COVID-19 handling budget in the sector, especially on the labour-intensive JPS programme. JPS is expected to accelerate economic recovery, especially in rural areas, which are also agricultural areas.

Prior to the JPS policy, put in place as the government's response to the pandemic, the government implemented a social assistance programme known as Rastra (*Beras untuk Rakyat Sejahtera*, or Rice for a Prosperous Population) for low-income communities. Rastra was introduced after the Asian financial crisis in 1997–1998. Even before that, Indonesia had historically placed a heavy emphasis on price stability, food sufficiency and other food-based social safety nets (Timmer, *et al.*, 2016).

Previous government policy and emergency policies such as JPS during COVID-19 have helped ensure agricultural production's relative performance and resilience, although our analysis did not permit a precise quantification of the impacts of these policies on indicators of resilience such as PoU and FSVA. On a macro level, agricultural performance and resilience can be seen from the quarterly (year-on-year) agricultural sector Gross Domestic Product (GDP) growth rate, which was consistently positive for eight quarters from the start of the pandemic (first quarter of 2020–fourth quarter of 2021). Figure 14 shows that, while national economic growth was negative in 2020, the agriculture sector was still growing positively, and contributed greatly to supporting national economic growth. In 2021, national economic growth began to recover and grow positively; the agriculture sector also continued to grow positively, in a consistent manner. National economic growth in 2021 is higher than that of the agriculture sector because of Indonesia's declining GDP in 2020 (low baseline effect).

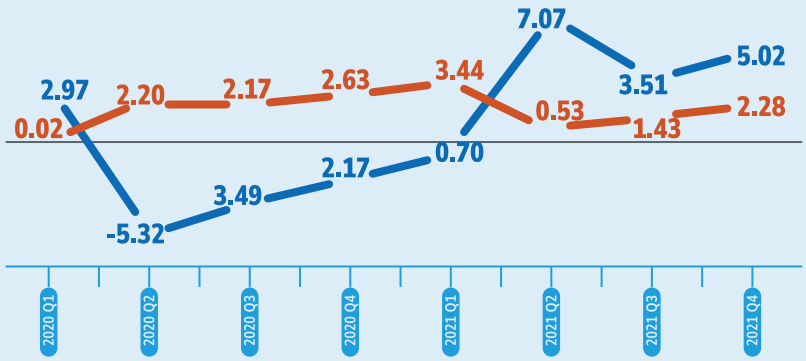


FIGURE 14 Growth in GDP and agricultural GDP in Indonesia, year on year, 2020–2021 (%)

SOURCE: Badan Pusat Statistik - Statistics Indonesia (2022a).

Agricultural conditions can also be understood by looking at the indicators of farmers' terms of trade (*nilai tukar petani* – NTP) and agricultural business terms of trade (*nilai tukar usaha pertanian* – NTUP). Both NTP and NTUP are measures of the price relationship. NTP provides a general indication of the purchasing power of agricultural commodities/products for the goods and services currently purchased by farmers, both for their daily needs as well as for production costs and additional capital goods. NTUP has the same meaning but does not take into account consumption costs in the price components paid by farmers.

The COVID-19 pandemic had an impact on NTP and NTUP through declining prices of agricultural products owing to oversupply and declining demand in response to distribution barriers triggered by social restrictions (Suryana *et al*., 2020). The pandemic reduced incentives for farming, as indicated by the decline in NTUP until mid-2020, as rice prices declined during the main harvest period. On the other hand, the prices of production factors increased as a result of distribution barriers and labour mobility issues. The easing of restrictions stimulated the recovery of economic activity, reflected in part in the increase in NTP and NTUP from mid-2020.

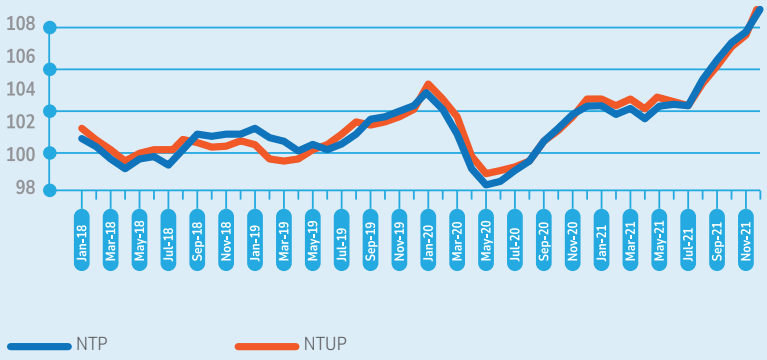


FIGURE 15 NTP and NTUP in Indonesia, 2018–2021 (2018=200)

SOURCE: Badan Pusat Statistik - Statistics Indonesia (2022b).

4 Conclusions

1. The agriculture sector in Indonesia has withstood the shocks of the COVID-19 pandemic and its early restrictions relatively well. This can be seen in the economic growth (year on year) of the Indonesian agriculture sector, which was consistently positive for eight quarters (from the first quarter of 2020 to the fourth quarter of 2021) while at the same time total GDP growth in 2020 was negative. Specifically, the performance and relative resilience of the agriculture sector during the pandemic can be observed on several indicators, such as production, productivity, prices and trade in a number of main commodities, described below.

2. Based on trend analysis and statistical tests on the six commodities using data from before and during the pandemic, it can be concluded that:

   - Production, productivity and exports of rice did not experience significant changes between the periods before and during the COVID-19 pandemic. The producer price of rice tended to be lower during the pandemic than before. The consumer price saw no significant change.
   - Maize production increased during the pandemic while productivity did not change significantly. The producer price and the consumer price of maize also increased during the pandemic. There was no significant change in the export and import of maize. The pandemic did not affect the production cycle for maize or access to inputs. Prices were moderate, at least in 2020; they increased more in 2021. This can be attributed in part to government measures that protected agricultural production from isolation measures except during severe temporary lockdown periods.
   - Chicken meat production decreased during the pandemic. The producer price increased while the consumer price did not change significantly, so the gap between the two decreased. There was no significant change in the export and import of chicken meat.
   - Chicken egg production was relatively stable during the pandemic after increasing significantly before it. The producer price and the consumer price for chicken eggs increased significantly. There were no significant changes in the export and import of chicken eggs. As for chicken meat, production is sensitive to demand, which was more affected during the pandemic than cereals or grains.
   - Shallot production increased during the pandemic, with productivity not changing significantly. The producer price and the consumer price of shallot increased significantly. There was no significant change in shallot exports. As for imports, there was a significant increase, generated through high shallot imports in the early months of the pandemic.
   - Banana production and productivity increased during the pandemic. Likewise, producer prices and consumer prices also increased. The trade balance also improved, as indicated by the increase in banana exports, while imports tended to decline and were close to zero from the beginning of the pandemic.

3. On the input side – that is, with regard to the use of fertilizer and microcredit – it can be concluded that:
    - The distribution of subsidized fertilizers (*Urea*, SP-36 and ZA) during the pandemic showed a decline; the same thing was observed for organic fertilizers – optimization of the use of organic fertilizers to increase agricultural production has not been achieved. Meanwhile, use of NPK compound fertilizer increased compared with in the period before the pandemic. Differences in farmers' behaviour in using subsidized fertilizers before and during the pandemic emerged, owing to a reduction in the fertilizer subsidy budget and an increase in the retail price of subsidized fertilizer during the pandemic period.
    - Efforts to maintain food production were encouraged through financial assistance programmes for farmers. The distribution of the KUR increased, from IDR 2 751.4 billion (USD 196.3 million) before the pandemic to IDR 5 873.77 billion (USD 419.1 million) during the pandemic, to a total of 2 616 444 debtor beneficiary farmers.
4. The Indonesian government set up several policies to minimize the impact of the COVID-19 pandemic. These can be divided into two: policies for the poor, through the JPS programme, and assistance for the business world. In the agriculture sector, the government re-allocated the budget to help farmers reduce the impact of COVID-19 and focused on implementing labour-intensive policies, especially in rural areas, to increase farmers' income.
5. The impacts of COVID-19 on consumption and food security were as follows:
    - In terms of the PoU indicator, calculating food consumption in terms of dietary energy, the rate in Indonesia increased in 2020 and 2021. The increase in the national PoU rate was contributed to by an increase in most provinces. Compared with other developing countries, Indonesia's PoU was lower than the average on the African continent and that in India, but higher than that of China and Brazil. Within ASEAN, Indonesia's PoU was higher than that of Malaysia and the Philippines, on a par with that of Viet Nam and lower than that of Thailand.
    - The FSVA indicator showed an increase in the number of districts/cities in Indonesia assessed as vulnerable to food insecurity during the COVID-19 pandemic.
    - Social safety net programmes taken together helped contain the rise of both PoU and FSVA and avoid higher increases. Apart from the positive GDP growth of the agriculture sector during the pandemic, another indicator of the relative resilience of agriculture is farmers' terms of trade, which increased steadily after having fallen in the early months of the pandemic.

5 Recommendations

During the COVID-19 pandemic, for all six commodities studied, no major shocks were observed on several indicators, including production, productivity, prices and trade. There were also no major shocks to food resilience. Responsive policies and assured provision of inputs were very important in facing the threat of food stock uncertainty.

Indonesia's Government implemented several social safety net programmes, which suppressed the negative impacts of the COVID-19 pandemic on food security. Policy recommendations for the government, to ensure the continued stability and resilience of agriculture and the food system, include the following:

1. Strengthen the upstream by providing support to production activities. The government is pushing for the facilitation of financing and the provision of inputs (fertilizers and seeds) with a subsidy scheme.
2. Ensure market access, especially by facilitating and improving value chain performance from central regions to local and export markets. This should entail improvements to transportation systems and technology to maintain the quality of agricultural products produced.
3. Strengthen the national food reserve system for main foodstuffs, especially the main contributors to inflation.

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Appendix 1 Production data

Appendix 1.1 Production trend analysis of six commodities (monthly and yearly)

Trend analysis was carried out by means of simple linear regression, with commodity production as the response variable and time (period) as predictor.

Commodity	Monthly (Jan 2018–Dec 2021)	Monthly (Jan 2018–Dec 2019)	Monthly (Jan 2020–Dec 2021)	Yearly (2018– 2021)
	Coefficient (p-value)			
Rice	-23.30 (0.318)	-95.04 (0.154)	-42.14 (0.534)	-1 431.3 (0.205)
Corn				449.8* (0.075)
Chicken Meat	-0.52* (0.052)	0.92* (0.078)	-0.42 (0.638)	-79.8 (0.261)
Chicken Eggs	4.70*** (0.000)	10.43*** (0.000)	0.49 (0.363)	710.4 (0.137)
Shallots	1.02*** (0.003)	-0.70 (0.496)	1.20 (0.143)	174.1** (0.017)
Bananas	32.40*** (0.001)	2.86 (0.851)	33.06 (0.246)	533.3** (0.049)

Note: ***, ** and * show significance at the significance levels of 1 percent, 5 percent and 10 percent, respectively.

Appendix 1.2 Summary of results of mean comparison test of commodity production before and during the pandemic

H0 : production mean before COVID-19 = production mean during COVID-19

H1 : production mean before COVID-19 ≠ production mean during COVID-19

Commodity	Period	n	Mean (Tonnes)	p-value
Rice	Before COVID-19	24	4 741.92	0.7608
	During COVID-19	24	4 544.29	
Chicken meat	Before COVID-19	24	285.50	0.0108**
	During COVID-19	24	266.87	
Chicken eggs	Before COVID-19	24	318.33	0.0000***
	During COVID-19	24	425.00	
Shallots	Before COVID-19	24	128.54	0.0012***
	During COVID-19	24	159.21	

Commodity	Period	n	Mean (Tonnes)	p-value
Bananas	Before COVID-19	8	1 818.25	0.0007***
	During COVID-19	8	2 115.37	

Note: ***, ** and * show significance at the significance levels of 1 percent, 5 percent and 10 percent, respectively.

Appendix 1.3 Summary of results of variance comparison test of commodity production before and during the pandemic

H0 : standard deviation of production before COVID-19 / standard deviation of production during COVID-19 = 1

H1 : standard deviation of production before COVID-19 / standard deviation of production during COVID-19 ≠ 1

Commodity	Period	n	Standard deviation	CV	p-value
Rice	Before COVID-19	24	2 237.64	0.4719	0.9927
	During COVID-19	24	2 233.30	0.4915	
Chicken meat	Before COVID-19	24	17.82	0.0624	0.0204**
	During COVID-19	24	29.34	0.1099	
Chicken eggs	Before COVID-19	24	81.16	0.2549	0.0000***
	During COVID-19	24	17.90	0.0421	
Shallots	Before COVID-19	24	33.84	0.2633	0.3289
	During COVID-19	24	27.53	0.1729	
Bananas	Before COVID-19	8	87.87	0.0483	0.0913*
	During COVID-19	8	174.24	0.0824	

Note: ***, ** and * show significance at the significance levels of 1 percent, 5 percent and 10 percent, respectively.

Appendix 2 Productivity data

Appendix 2.1 Productivity trend analysis of four commodities (monthly and yearly)

Trend analysis was carried out by means of simple linear regression, with commodity productivity as the response variable and time (period) as predictor.

Commodity	Monthly (Jan 2018–Dec 2021)	Monthly (Jan 2018–Dec 2019)	Monthly (Jan 2020–Dec 2021)	Yearly (2018–2021)
	Coefficient (p-value)			
Rice	2.43	0.39	12.65*	8.38
	(0.346)	(0.958)	(0.087)	(0.805)
Corn				74.01
				(0.170)
Shallots	23.82***	39.03	71.18***	192.60
	(0.010)	(0.127)	(0.007)	(0.204)
Bananas	311.13***	88.26	92.93	1 229.13
	(0.000)	(0.626)	(0.573)	(0.117)

Note: ***, ** and * show significance at the significance levels of 1 percent, 5 percent and 10 percent, respectively.

Appendix 2.2 Summary of results of mean comparison test of commodity productivity before and during the pandemic

H0 : productivity mean before COVID-19 = productivity mean during COVID-19

H1 : productivity mean before COVID-19 ≠ productivity mean during COVID-19

Commodity	Period	n	Mean (kg/ha)	p-value
Rice	Before COVID-19	24	5 155.34	0.7198
	During COVID-19	24	5 181.09	
Shallots	Before COVID-19	24	9 714.67	0.2208
	During COVID-19	24	10 036.54	
Bananas	Before COVID-19	8	23 195.23	0.0000***
	During COVID-19	8	26 263.17	

Note: ***, ** and * show significance at the significance levels of 1 percent, 5 percent and 10 percent, respectively.

Appendix 2.3 Summary of results of variance comparison test of commodity productivity before and during the pandemic

H0 : standard deviation of productivity before COVID-19 / standard deviation of productivity during COVID-19 = 1

H1 : standard deviation of productivity before COVID-19 / standard deviation of productivity during COVID-19 ≠ 1

Commodity	Period	n	Standard deviation	CV	p-value
Rice	Before COVID-19	24	243.84	0.0473	0.9007
	During COVID-19	24	250.34	0.0483	
Shallots	Before COVID-19	24	861.82	0.0887	0.7052
	During COVID-19	24	933.41	0.0930	
Bananas	Before COVID-19	8	1 053.98	0.0454	0.8167
	During COVID-19	8	962.47	0.0366	

Note: ***, ** and * show significance at the significance levels of 1 percent, 5 percent and 10 percent, respectively.

Appendix 3 Producer price data

Appendix 3.1 **Price trend analysis of six commodities at producer level (monthly and yearly)**

Trend analysis was carried out by means of simple linear regression, with commodity prices as the response variable and time (period) as predictor.

Commodity	Monthly (Jan 2018– Dec 2021)	Monthly (Jan 2018– Dec 2019)	Monthly (Jan 2020– Dec 2021)	Yearly (2018–2021)
	Coefficient (p-value)			
Rice	-11.65*** (0.000)	-13.50 (0.166)	-38.52*** (0.000)	-122.7 (0.277)
Corn	14.28*** (0.000)	30.93*** (0.000)	17.92*** (0.000)	172.3 (0.120)
Chicken Meat	83.68*** (0.000)	63.74*** (0.000)	87.49*** (0.000)	1 029.5*** (0.004)
Chicken Eggs	36.72*** (0.000)	34.00*** (0.007)	-23.56 (0.133)	467.8 (0.117)
Shallots	72.60*** (0.001)	93.44** (0.012)	-214.87*** (0.000)	1009.7 (0.375)
Bananas	19.28*** (0.000)	55.60*** (0.000)	-7.41*** (0.000)	234.9 (0.221)

Note: ***, ** and * show significance at the significance levels of 1 percent, 5 percent and 10 percent, respectively.

Appendix 3.2 Summary of results of mean comparison test of commodity prices at producer level before and during the pandemic

H0 : producer price mean before COVID-19 = producer price mean during COVID-19

H1 : producer price mean before COVID-19 ≠ producer price mean during COVID-19

Commodity	Period	n	Mean (IDR/kg)	p-value
Rice	Before COVID-19	24	9 461.75	0.0771*
	During COVID-19	24	9 296.79	
Corn	Before COVID-19	24	4 747.33	0.0001***
	During COVID-19	24	5 008.92	
Chicken meat	Before COVID-19	24	28 671.13	0.0000***
	During COVID-19	24	30 743.88	
Chicken eggs	Before COVID-19	24	24 501.33	0.0000***
	During COVID-19	24	25 634.17	

Commodity	Period	n	Mean (IDR/kg)	p-value
Shallots	Before COVID-19	24	22 491.46	0.0000***
	During COVID-19	24	25 298.54	
Bananas	Before COVID-19	24	7 841.96	0.0000***
	During COVID-19	24	8 266.08	

Note: ***, ** and * show significance at the significance levels of 1 percent, 5 percent and 10 percent, respectively.

Appendix 3.3 Summary of results of variance comparison test of commodity prices at producer level before and during the pandemic

H0 : standard deviation of producer prices before COVID-19 / standard deviation of producer prices during COVID-19 = 1

H1 : standard deviation of producer prices before COVID-19 / standard deviation of producer prices during COVID-19 ≠ 1

Commodity	Period	n	Standard deviation	CV	p-value
Rice	Before COVID-19	24	326.78	0.0345	0.7427
	During COVID-19	24	304.92	0.0328	
Corn	Before COVID-19	24	235.66	0.0496	0.3031
	During COVID-19	24	189.52	0.0378	
Chicken meat	Before COVID-19	24	537.27	0.0187	0.0754*
	During COVID-19	24	785.01	0.0255	
Chicken eggs	Before COVID-19	24	451.79	0.0184	0.4577
	During COVID-19	24	528.52	0.0206	
Shallots	Before COVID-19	24	1 306.65	0.0581	0.0265**
	During COVID-19	24	2 103.77	0.0832	
Bananas	Before COVID-19	24	401.76	0.0512	0.0000***
	During COVID-19	24	70.62	0.0085	

Note: ***, ** and * show significance at the significance levels of 1 percent, 5 percent and 10 percent, respectively.

Appendix 4 Consumer price data

Appendix 4.1 Price trend analysis of six commodities at the consumer level (monthly and yearly)

Trend analysis was carried out by means of simple linear regression, with commodity prices as the response variable and time (period) as predictor.

Commodity	Monthly (Jan 2018–Dec 2021)	Monthly (Jan 2018–Dec 2019)	Monthly (Jan 2020–Dec 2021)	Yearly (2018– 2021)
	Coefficient (p-value)			
Rice	-0.29	-4.70*	-14.51***	4.3
	(0.793)	(0.081)	(0.000)	(0.937)
Corn	19.64***	44.58***	11.89**	243.3
	(0.000)	(0.000)	(0.013)	(0.119)
Chicken meat	10.28	23.69	91.55**	99.7
	(0.413)	(0.489)	(0.011)	(0.776)
Chicken eggs	62.61***	76.82***	27.37	790.1***
	(0.000)	(0.001)	(0.150)	(0.007)
Shallots	107.23**	95.46	-535.42***	1 629.5
	(0.040)	(0.358)	(0.000)	(0.501)
Bananas	33.47***	54.78***	-5.17**	405.7*
	(0.000)	(0.000)	(0.012)	(0.080)

Note: ***, ** and * show significance at the significance levels of 1 percent, 5 percent and 10 percent, respectively.

Appendix 4.2 Summary of results of mean comparison test of commodity prices at consumer level before and during the pandemic

H0 : consumer price mean before COVID-19 = consumer price mean during COVID-19

H1 : consumer price mean before COVID-19 ≠ consumer price mean during COVID-19

Commodity	Period	n	(Mean (IDR/kg	p-value
Rice	Before COVID-19	24	374.75 11	**0.0261
	During COVID-19	24	442.00 11	
Corn	Before COVID-19	24	914.00 6	***0.0000
	During COVID-19	24	316.75 7	

Commodity	Period	n	(Mean (IDR/kg	p-value
Chicken meat	Before COVID-19	24	245.17 37	0.7063
	During COVID-19	24	113.71 37	
Chicken eggs	Before COVID-19	24	324.42 25	***0.0000
	During COVID-19	24	910.96 26	
Shallots	Before COVID-19	24	880.88 28	***0.0002
	During COVID-19	24	067.54 34	
Bananas	Before COVID-19	24	783.00 9	***0.0000
	During COVID-19	24	655.58 10	

Note: ***, ** and * show significance at the significance levels of 1 percent, 5 percent and 10 percent, respectively.

Appendix 4.3 Summary of results of variance comparison test of commodity prices at consumer level before and during the pandemic

H0 : standard deviation of consumer prices before COVID-19 / standard deviation of consumer prices during COVID-19 = 1

H1 : standard deviation of consumer prices before COVID-19 / standard deviation of consumer prices during COVID-19 ≠ 1

Commodity	Period	n	Standard deviation	CV	p-value
Rice	Before COVID-19	24	91.54	0.0080	0.3775
	During COVID-19	24	110.31	0.0096	
Corn	Before COVID-19	24	344.40	0.0498	0.0011***
	During COVID-19	24	168.48	0.0230	
Chicken meat	Before COVID-19	24	1 129.48	0.0303	0.5826
	During COVID-19	24	1 268.37	0.0342	
Chicken eggs	Before COVID-19	24	840.60	0.0332	0.1941
	During COVID-19	24	638.23	0.0237	
Shallots	Before COVID-19	24	3 436.94	0.1190	0.0625*
	During COVID-19	24	5 115.67	0.1502	
Bananas	Before COVID-19	24	394.11	0.0403	0.0000***
	During COVID-19	24	72.74	0.0068	

Note: ***, ** and * show significance at the significance levels of 1 percent, 5 percent and 10 percent, respectively.

Appendix 5 Export data

Appendix 5.1 Export trend analysis of six commodities (monthly and yearly)

Trend analysis was carried out by means of simple linear regression, with commodity export as the response variable and time (period) as predictor.

Commodity	Monthly (Jan 2018– Dec 2021)	Monthly (Jan 2018– Dec 2019)	Monthly (Jan 2020– Dec 2021)	Yearly (2018– 2021)
	Coefficient (p-value)			
Rice	2.46	-5.94	11.75*	351.5
	(0.253)	(0.249)	(0.087)	(0.446)
Corn	-105.46**	-513.26***	45.53	-14 971.5
	(0.024)	(0.003)	(0.300)	(0.425)
Chicken meat	0.68	3.43	2.41*	106.3
	(0.324)	(0.161)	(0.060)	(0.626)
Chicken eggs	0.13	5.25*	0.97	-0.7
	(0.890)	(0.054)	(0.727)	(0.998)
Shallots	11.42	48.53	8.98	346.4
	(0.387)	(0.151)	(0.831)	(0.861)
Bananas	-24.00***	-46.48***	2.48	-3 125.4*
	(0.000)	(0.007)	(0.606)	(0.066)

Note: ***, ** and * show significance at the significance levels of 1 percent, 5 percent and 10 percent, respectively.

Appendix 5.2 Summary of results of mean comparison test of commodity exports before and during the pandemic

H0 : export mean before COVID-19 = export mean during COVID-19

H1 : export mean before COVID-19 ≠ export mean during COVID-19

Commodity	Period	n	Mean (USD 000)	p-value
Rice	Before COVID-19	24	130.62	0.3532
	During COVID-19	24	186.00	
Corn	Before COVID-19	24	4 549.08	0.2556
	During COVID-19	24	3 043.54	

Commodity	Period	n	Mean (USD 000)	p-value
Chicken meat	Before COVID-19	24	105.67	0.9305
	During COVID-19	24	104.00	
Chicken eggs	Before COVID-19	24	108.00	0.6350
	During COVID-19	24	95.25	
Shallots	Before COVID-19	24	732.50	0.7117
	During COVID-19	24	868.25	
Bananas	Before COVID-19	24	1 081.33	0.0000***
	During COVID-19	24	489.21	

Note: ***, ** and * show significance at the significance levels of 1 percent, 5 percent and 10 percent, respectively.

Appendix 5.3 Summary of results of variance comparison test of commodity exports before and during the pandemic

H0 : standard deviation of exports before COVID-19 / standard deviation of exports during COVID-19 = 1

H1 : standard deviation of exports before COVID-19 / standard deviation of exports during COVID-19 ≠ 1

Commodity	Period	n	Standard deviation	CV	p-value
Rice	Before COVID-19	24	171.54	1.3132	0.1501
	During COVID-19	24	232.86	1.2520	
Corn	Before COVID-19	24	239.04 6	1.3715	***0.0000
	During COVID-19	24	458.08 1	0.4791	
Chicken meat	Before COVID-19	24	82.19	0.7779	***0.0038
	During COVID-19	24	43.78	0.4210	
Chicken eggs	Before COVID-19	24	93.07	0.8618	0.9470
	During COVID-19	24	91.78	0.9635	
Shallots	Before COVID-19	24	135.27 1	1.5499	0.3532
	During COVID-19	24	381.51 1	1.5911	
Bananas	Before COVID-19	24	615.11	0.5688	***0.0000
	During COVID-19	24	158.19	0.3234	

Note: ***, ** and * show significance at the significance levels of 1 percent, 5 percent and 10 percent, respectively.

Appendix 6 Import data

Appendix 6.1 Import trend analysis of six commodities (monthly and yearly)

Trend analysis was carried out by means of simple linear regression, with commodity import as the response variable and time (period) as predictor.

Commodity	Monthly (Jan 2018–Dec 2021)	Monthly (Jan 2018–Dec 2019)	Monthly (Jan 2020–Dec 2021)	Yearly (2018– 2021)
	Coefficient (p-value)			
Rice	-1 643.79***	-4 513.18***	174.40	-255 302.3
	(0.000)	(0.002)	(0.455)	(0.223)
Corn	155.20	492.78*	642.99**	15 440.3
	(0.146)	(0.099)	(0.035)	(0.494)
Chicken meat	-0.48	3.05	-1.94	-14.3
	(0.953)	(0.228)	(0.366)	(0.956)
Chicken eggs	0.32	-2.68	0.70	41.5
	(0.899)	(0.701)	(0.929)	(0.782)
Shallots	1.27	0.41	-1.67	166.1
	(0.154)	(0.466)	(0.636)	(0.452)
Bananas	-0.04**	0.038	-0.099**	-5.7
	(0.049)	(0.565)	(0.033)	(0.150)

Note: ***, ** and * show significance at the significance levels of 1 percent, 5 percent and 10 percent, respectively.

Appendix 6.2 Summary of results of mean comparison test of commodity imports before and during the pandemic

H0 : import mean before COVID-19 = import mean during COVID-19

H1 : import mean before COVID-19 ≠ import mean during COVID-19

Commodity	Period	n	Mean (USD 000)	p-value
Rice	Before COVID-19	24	062.42 51	***0.0027
	During COVID-19	24	808.83 15	
Corn	Before COVID-19	24	336.46 28	0.8861
	During COVID-19	24	765.42 28	

Commodity	Period	n	Mean (USD 000)	p-value
Chicken meat	Before COVID-19	24	84.29	0.7924
	During COVID-19	24	78.33	
Chicken eggs	Before COVID-19	24	834.96	0.7957
	During COVID-19	24	853.21	
Shallots	Before COVID-19	24	43.92	*0.0626
	During COVID-19	24	89.67	
Bananas	Before COVID-19	24	1.50	*0.0668
	During COVID-19	24	0.46	

Note: ***, ** and * show significance at the significance levels of 1 percent, 5 percent and 10 percent, respectively.

Appendix 6.3 Summary of results of variance comparison test of commodity imports before and during the pandemic

H0 : standard deviation of imports before COVID-19 / standard deviation of imports during COVID-19 = 1

H1 : standard deviation of imports before COVID-19 / standard deviation of imports during COVID-19 ≠ 1

Commodity	Period	n	Standard deviation	CV	p-value
Rice	Before COVID-19	24	810.16 53	1.0538	***0.0000
	During COVID-19	24	704.43 7	0.4873	
Corn	Before COVID-19	24	099.03 10	0.3564	0.8430
	During COVID-19	24	529.55 10	0.3660	
Chicken meat	Before COVID-19	24	84.36	1.0008	0.4141
	During COVID-19	24	70.99	0.9063	
Chicken eggs	Before COVID-19	24	229.17	0.2745	0.6036
	During COVID-19	24	255.70	0.2997	
Shallots	Before COVID-19	24	18.52	0.4218	***0.0000
	During COVID-19	24	115.96	1.2933	
Bananas	Before COVID-19	24	2.19	1.4579	0.1531
	During COVID-19	24	1.61	3.5227	

Note: ***, ** and * show significance at the significance levels of 1 percent, 5 percent and 10 percent, respectively.

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